Dancing with Dugongs

Having fun and developing a practical philosophy for environmental teaching and research

PETER OLIVER AND WILLIAM DENNISON

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Dancing with Dugongs is being offered for free through the support of two organizations, the International WaterCentre and the University of Maryland Center for Environmental Science. The International WaterCentre allowed Peter Oliver the time and flexibility to devote to his contribution to this book, as well as hosting Bill Dennison during his sabbatical. The University of Maryland Center for Environmental Science allowed Bill Dennison to conduct a sabbatical which afforded him the time to devote to his contribution. The Integration and Application Network provided the science communication support to assemble this richly illustrated eBook.

How to use this eBook

This book features various 'pop-up' items to obtain additional information or resolution of images. In both the 'Hippies, geeks and concrete' and 'The perfect slime' chapters there are three outlined photographs of key people, and by clicking/tapping on them, transcripts of interviews will appear. Additionally, there are several expanded definitions of various concepts throughout the book, which appear when a symbol with a shadow effect is clicked/tapped. Photographs with a shadow effect can be expanded to full page view by clicking/tapping on them. All of the symbols used as illustrations can be expanded to full page view as well.

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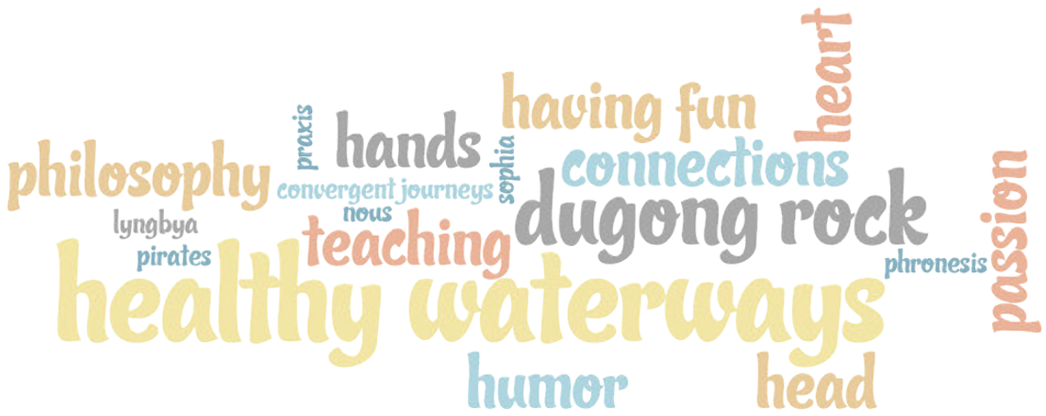
Table of Contents

Forward vii

1. Introduction 1
    1.1 What's this book about? 2
    1.2 It's all Greek to me: The terms 'praxis' and 'phronesis' in environmental philosophy 3
    1.3 People and messy problems 6
    1.4 Our profiles 8
    1.5 How did we do this? 10
    1.6 What's in it for the reader? 11
    1.7 Immersive and popular education 12
    1.8 Why now? 13
    1.9 How this book is structured 14
2. Hippies, geeks and concrete 18
    2.1 Introduction 19
    2.2 What happened 21
    2.3 Lessons 34
3. The Perfect Slime 39
    3.1 Introduction 40
    3.2 What happened 43
    3.3 Lessons 59
4. Converting from passive to active learning 66
    4.1 Converting from passive to active learning 67
5. Popular Education 69
    5.1 Popular Education for Water Sustainability: Three Lessons from Reflective Practice 70
6. Immersive Education 83
    6.1 Studying Nature *In Situ*: Immersive Education for Better Integrated Water Management 84
7. Communicating science 98
    7.1 Recommendations to effectively communicate science 99
    7.2 Communicating science: Storyboarding, teaching philosophy, and self-realization 112
8. Awakening passion 116
    8.1 Awakening environmental passion 117
    8.2 Seven natural wonders of the world 121
9. Having Fun 124
    9.1 Having fun while developing an environmental philosophy 125
    9.2 Having fun: Pirates, dugong rock, humor, and telling stories 129

10. Integrating heart, hands and head 149
10.1 The integration of heart, hands and head 150
10.2 Integrating heart, hands and head: Partnerships, stakeholders, naiveté, and cultural diversity 152
11. Convergent journeys 163
11.1 Hands, head and heart: Aspects of convergent journeys 164
11.2 Convergent journeys: Lyngbya, fishermen, taking risks, and friendship 168
11.3 Peter's top ten books about science 186
11.4 Bill's top ten books about science 190
11.5 Bill's top ten quotes 194
11.6 Top ten principles for environmental actions 198
12. Remembering Peter Oliver 201
12.1 Dugong Rock: Using iconic creatures in conservation 202
12.2 Peter's retirement lecture 204
12.3 Peter's retirement sermon: Greek philosophers, jelly babies, wicked problems, and dugongs 209
12.4 Peter Oliver reflections 212
13. Invitation to dance with dugongs 213
13.1 Dancing with dugongs 214
14. Acknowledgements 218
14.1 Peter Oliver 219
14.2 Bill Dennison 222
15. Bibliography 224
15.1 References 225
15.2 Annotated Bibliography 229
15.3 Photo credits 236
15.4 Graphic credits 243
16. Glossary 252
17. Dynamic Popups from iBooks version 253

Forward



This book is for people who care about the environment. Physically, our environment gives us everything - shelter and clean food, air and water. In that sense, we all manage our surroundings to make certain that, as much as possible, we get the things we need. And then there can be things that we just 'want'- as our wants grow, the demands we place on our environment increase even more rapidly than the steadily increasing needs of our growing human population.

As awareness of these environmental pressures grows, so too does the number of people studying, volunteering, and working in environmental fields. Anyone involved in the management of land, water, energy, or biodiversity is getting busier and busier. People can burn out trying to balance their desire to protect the environment with a wide variety of demands - from those of their family, to the broader community, to their employer.

This book tells the story of Bill Dennison and Peter Oliver, two men who have spent between them sixty years of their lives better understanding catchments, waterways, and people and how they interact. It is the result of them sharing stories about their work with each other. Bill and Peter had fun doing this. They have recognized two important things - that looking after the environment should also be fun, and that there is a real need to reflect individually and with others on the 'how' and 'why' of our work.

Articulating such a practical philosophy can help us to do our work better. Bill and Peter have also recognized key lessons from their work in several areas including science communication, empowering communities, and working in school and university settings.

These lessons are well illustrated in the pages within. As a person who cares about the environment and how we live in it, Bill and Peter invite you to share in their stories and lessons, to feel the joy of 'dancing with dugongs,' and to unearth a practical philosophy to help you in your work.

Dancing with dugongs

This whimsical title has meaning at various levels. Dugong (*Dugong dugon*) are marine mammals in the order Sirenia. Sirenia include dugongs and manatees (*Trichechus* spp.) The order name refers to the sea sirens

described in Homer's epic poem "The Odyssey," as it is thought that sailors mistook manatees and dugong for mermaids, or sea sirens. Dugongs live in Moreton Bay, Australia and feed almost exclusively on seagrasses.

Bill and Peter began working together in response to a bloom of a cyanobacteria (*Lyngbya majuscula*) known as "Mermaid's hair" growing on seagrasses of Deception Bay, in northern Moreton Bay. Australian aborigines described Bribie Island as a dugong, and looking at a map of Southeast Queensland, it is evident that Bribie Island looks remarkably like a dugong. The dugong's mouth at the southern tip of Bribie Island is feeding on Deception Bay seagrasses, where the bloom of "Mermaid's hair" occurred. The dugong's tail to the north has moved around over geologic time as the sand bars migrate and reform.

When Bill and his scientific colleagues hosted an international conference on ecosystem health in Brisbane, Peter came along and performed his song "Dugong Rock" and had the crowd singing and dancing. Bill and dugong share a love of seagrasses, while Peter and sea sirens share a love of singing.

Peter and Bill hope that you will join them in sharing their love for dancing with dugongs.

Bribie Island, separated by Pumicestone Passage in Southeast Queensland, Australia

CHAPTER 1

Introduction

If there's a book that you want to read, but it hasn't been written yet, then you must write it.

TONI MORRISON 1931-

What's this book about?

This book contains stories from and reflections of two people, Peter and Bill. We are both passionate about environmental education, research and management, and are determined to find ways to do it better. We are idealists. We see the world beset with complex, wicked, messy problems. These are not necessarily ‘evil’ or intractable, but the sorts of problems that present unexpected and novel dimensions.

For example, a water problem will have economic, health, ecological, and engineering dimensions and, just when you feel you understand the nature of the problem, you will gain new information about the people involved and their values and new political and governance aspects of the problem will come into focus. Invariably something new will 'pop' up that will make you think again.

We think that good environmental research, management and education based on understanding the people we seek to work with, understanding ourselves and understanding the nature of these problems can make a positive difference to the world around us. We seek to solve such wicked, messy problems. Importantly, we reckon you can have fun and be of service to others while doing this. We have been bold enough to write for similarly-minded people.

This book takes the reader through case studies and articulates a shared, phronetic philosophy that helps one to undertake praxis to solve such problems. Phronesis and praxis are Greek terms that we will use throughout this book, thus we will take some time to explain them.

Bill Dennison and Peter Oliver

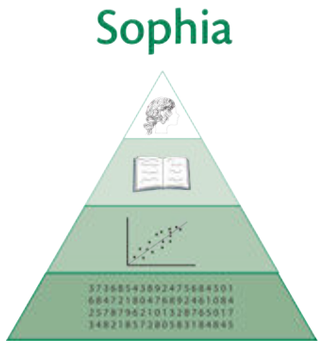
SECTION 2

It's all Greek to me: The terms 'praxis' and 'phronesis' in environmental philosophy

Praxis and phronesis are two of Peter's favorite words, and his enthusiasm about them has infected Bill as well. These Greek terms were part of the vocabulary of the ancient Greek philosophers and were used by Aristotle to describe practical wisdom (phronesis) and thoughtful, practical doing (praxis). They were used within a broader vocabulary to describe various elements of learning and knowledge.

In our attempt to interpret and communicate the meaning of these Greek words and concepts, Peter and Bill collaborated on a series of conceptual symbols to denote a variety of Greek words that are described here.

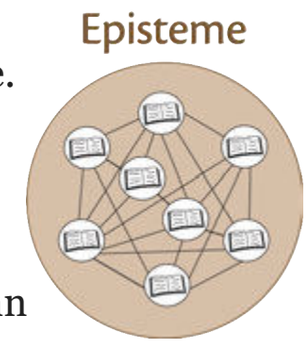
Nous means intellect or understanding and is often interpreted as 'good sense.' Aristotle considered the term nous to be a uniquely human quality. He thought that truth revealed the capacity of the soul and that the attainment of nous was an important goal of an educated person. In Aristotle's view, there was both 'cosmic nous' and 'human nous.' Both Aristotle's teacher Plato and Plato's teacher Socrates used the term nous. The term nous also appears in Homer's "The Iliad" when Agamemnon is talking to Achilles. In order to depict nous, we used four fundamental elements described by Aristotle: earth, water, fire and air/wind. Aristotle's fifth element, aether, a divine substance that comprised the heavenly bodies, was not included.



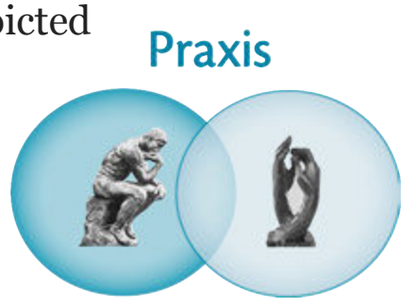
Sophia means wisdom, and Aristotle considered sophia to be theoretical wisdom. This could be interpreted in modern day terms as 'book smart,' which does not necessarily mean 'common sense.' Sophia needs to be coupled with nous to be both 'book smart' and have 'common sense.' The word 'philosophy' is derived from sophia, and the word philosophy can be translated as the love (philo-) of wisdom (sophia). It is interesting that of the various Greek words, sophia is a word that people have chosen as a commonly used name for women. For the depiction of sophia, we chose a four-level learning pyramid. The base of the pyramid is data (depicted as a number series), the second level is information (depicted as a graph), the third level is knowledge (depicted as a book) and the top layer is wisdom (depicted as a human head). We chose a woman's head, given the feminine word sophia.

Techne means craftsmanship or art. The intent of the word techne is the making or doing as opposed to the understanding. It is the root of 'technique,' 'technical,' and various other derivatives. Aristotle viewed techne as an imperfect human representation of nature. Socrates and Plato also used the word, and distinguished craftsmanship (which they viewed in a positive light) from art (which they viewed in a negative light). The depiction of techne that we chose was the hands of a sculptor forming a bowl.

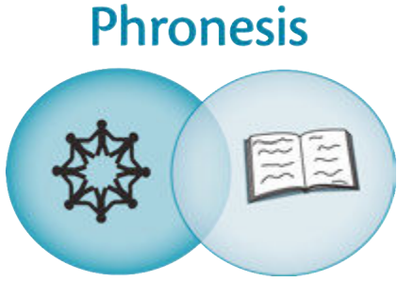
Episteme means knowledge or science. The verb form of this word translates 'to know.' Epistemology, the study of knowledge, is derived from episteme. The Greeks viewed episteme as a partner to techne. Plato used episteme to denote 'justified true belief.' In modern terms, the word 'paradigm' popularized by Thomas Kuhn is often used in a manner similar to how episteme was used by the Greeks. To depict episteme, we chose an interconnected network of books or knowledge to capture this concept of knowledge systems.



Praxis means thoughtful, practical doing. Aristotle, who loved to categorize various concepts, developed a three-tiered scheme of the basic attributes of man. This scheme describes 1) theoria or theoretical with the goal of truth, 2) poiesis or doing with the goal of production and 3) praxis or practical, thoughtful doing with the goal of action. The word praxis promotes practice and reflection, seemingly paradoxical concepts. Combining these two elements is the genius of this word and why we find it so attractive. To depict praxis, we developed two overlapping circles, both containing iconic sculptures by the French sculptor, Auguste Rodin. The thoughtful component of praxis is depicted by Rodin's famous 'The Thinker" sculpture, and the practical doing component of praxis is depicted by Rodin's famous "Two Hands" sculpture.



Phronesis means practical wisdom. Aristotle distinguished between sophia and phronesis in the following manner. Sophia involves reasoning concerning universal truths, while phronesis includes a capability of rational thinking. In order to practice phronesis, Aristotle felt that political abilities were required, as well as thinking abilities. Aristotle categorized three elements of character (ethos) in the following manner: 1) phronesis (how to act in particular situations), 2) arete (virtue) and 3) eunoia (goodwill). He also felt that phronesis was both necessary and sufficient for being virtuous. To depict phronesis, we developed two overlapping circles, not unlike the symbol for praxis. In the case of phronesis, the intersection of values (depicted as human figures holding hands in a circle) and knowledge (depicted as a book) are used.



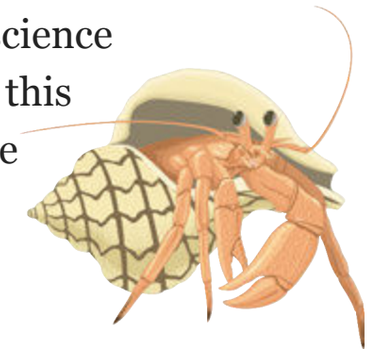
While all of these Greek terms are ancient ways to describe the human condition and help describe the way that we interact with the world around us, they have relevance with important modern concepts. For example, 'adaptive management' is a popular term for "learning by doing," not unlike what the Greek terms phronesis and praxis are promoting.

Developing a practical philosophy for environmental science

Science can be viewed as an attempt to develop nous (intellect) and sophia (wisdom), using the Greek terms promoted by Socrates, Plato and, most importantly, Aristotle. These are classic attributes that we associate with science and learning. The way that Aristotle used the terms are akin to 'common sense' (nous) and 'book smart' (sophia) in modern vernacular. We can view these two terms as complementary skills needed by scientists. Since these terms are rather passive in that they do not involve any action, they can be seen as relatively theoretical and, in a sense, a historical perspective on what is needed for science.

The addition of techne (craftsmanship) and episteme (knowledge) to the repertory of a scientist provides an action-oriented aspect to science. Techne and episteme are also Greek words and were used as complementary terms just as nous and sophia were complementary terms. Modern science needs both sets of terms; nous and sophia combined with techne and episteme.

In this book, Peter and Bill promote two additional Greek terms for the scientific approach; praxis and phronesis. Praxis, defined as practical, thoughtful doing, combined with phronesis, practical wisdom where values intersect with knowledge describe what needs to happen in environmental science. We feel that these two terms are at the core of developing a practical philosophy for environmental science. It is simply not enough to know what should be done, or even recommend what should be done (e.g., science integration). Action is also required and this 'doing' in terms of environmental science can take the form of environmental protection or restoration activities.



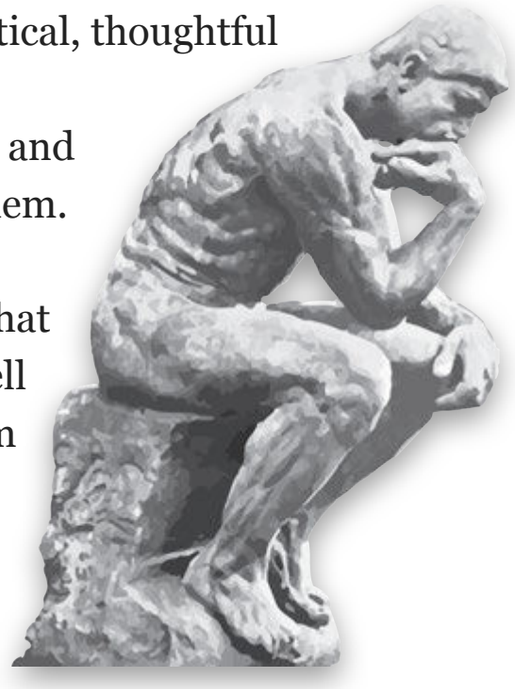
SECTION 3

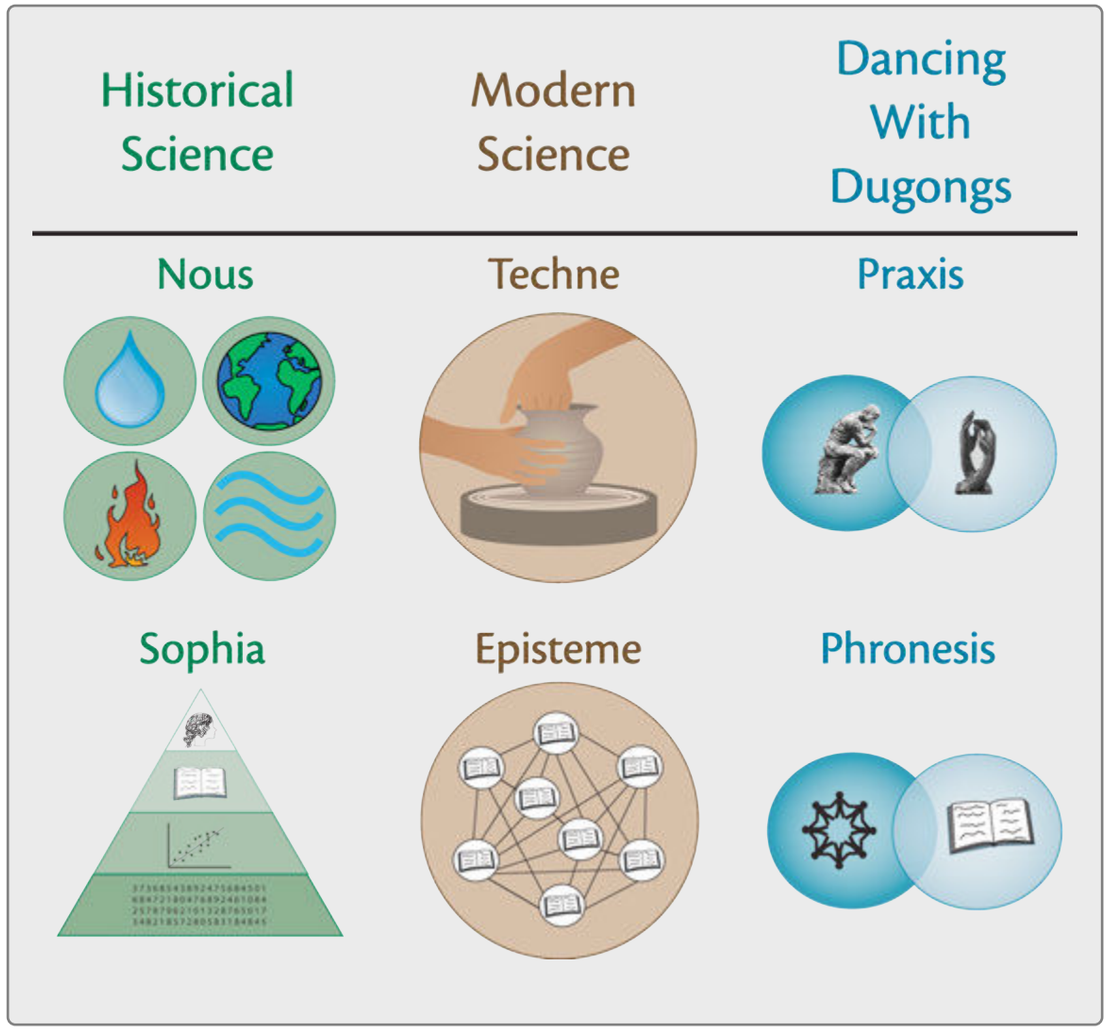
People and messy problems

Why is action required? We believe we face important, messy problems - water, air, biodiversity, energy, climate change, human and ecological 'health,' and other problems, the spatial and temporal scale of which we have not seen before. These problems are more than just complicated. They contain components that interact in new unanticipated ways, because they involve people and what those people believe and value about the problem. We also believe that professionals involved in understanding and managing these problems face a real challenge. We see that it is about much more than just applying the same sorts of epistemologies (knowledge systems) and technologies (ways to apply these epistemologies) that caused the problem or had previously solved them. If what people value changes, then the solutions they value may also change. We need to become what **Donald Schon** called a ‘reflective practitioner.’

Reflective practice on a messy, wicked problem involves much more than just building new epistemologies and technologies - it also involves ways to think about these problems and build new tools to solve them. Messy problems exist at the intersection of what people know about a problem and how they value the problem. Aristotle would say that messy problems are 'phronetic,' that to have a prudent understanding of what should be done to solve the problem, one should have 'phronesis.' That is to say that you will need to know about the people - your values and the values of others in relation to the problem - to have any hopes of solving the problem. In addition , what we would refer to as the 'science’ - Aristotle's episteme and techne, needs to be known as well. Contemporary, positivist scientists might call it understanding both the physical and the social science nature of the problem.

We agree. We would say that before we can engage in what Aristotle called 'praxis,' practical, thoughtful doing, we need to understand the "phronetic" nature of the problem and how we define and value the problem. This will involve understanding ourselves and others better and what we value about the problem, as well as being able to define the problem clearly, not just learn more about the theoretical and technical nature of the problem.





So in many ways, this is a self-help book for environmental practitioners. Over the course of the book we will take you through stories and discussions that help us to know ourselves better, or as Socrates' is reported to have said, 'First Know Thyself.' This concept of walking in the shoes of the 'other' - understanding how others who have something to gain or lose in the resolution of the problem define the problem, and why they might decide to act or not to act - to solve this particular problem is crucial. This is just as Atticus Finch says to Scout in **To Kill a Mockingbird**, "If you just learn a single trick Scout, you'll get along better with all kind of folks. You'll never really understand another person until you consider things from his point of view, until you climb inside of his skin and walk around in it."

To understand the conceptual origins in western thought of living unsustainably - namely, who was it who first said land, water or biodiversity, in fact anything was infinite? We decided to limit ourselves to western thinkers. This still took time!

However, Peter found that one of the ancient Greeks, Pythagoras and his school of early Pythagoreans, had developed what they called '**The Pythagorean Table of Opposites**.' They used a Table of Opposites which had either four or ten opposites to describe the whole world as simply and clearly as they could. The detail does not really matter as much as the fact that Peter remembered that both tables described the World as being described simply as a series of opposites - black/white; male/female; straight/curved; finite/infinite.

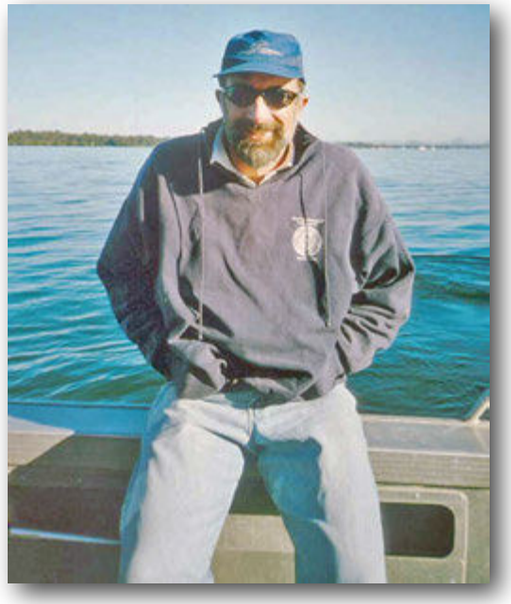
So, when you think about it, around 400BC, the world had no 'edge'. If you ran out of water, wood, or stone, you really just went to 'the edge' and got some more! So for Peter's money, it was Pythagoras who invented the concept of infinity or 'un-sustainability'. Peter is open to debate on the matter, though. It's just good to be able to put a 'name to a face' - so for 'unsustainability' let thy name be 'Pythagoras.'

First then, to know thyself ... Who are we?

Our profiles

Peter

Peter and Bill were raised on different continents and have different educational and professional backgrounds. On occasions we have found ourselves working together, seeking to understand and better manage complex waterway, catchment, and coastal management problems. Usually this has involved us taking quite different approaches to this task. We have recognized that the ways we approach problems are quite complementary and that we have fun on the all too rare occasions when we do work together. This book is about us coming to understand why we have fun in our work and what we might have in common that makes us think in very similar ways about environmental issues and their management.



Bill

Initially, we thought that we had convergent philosophies because we were both blessed with considerable intellects, an incredible sense of humor and a modicum of aging, boyish charm. We were, of course, always fun to be with. This seemed a reasonable conclusion which explained these initial observations quite satisfactorily. However, an element of objectivity was required. We inquired of others to triangulate and confirm our very sensible insights and we were very soon disavowed of these beliefs.

Disappointed, we searched elsewhere. Given our very different backgrounds, why did we think in similar ways about environmental management? Why were we both drawn to water-based ecosystems? What were the key lessons we had gained from our work? What was fun? What wasn't? Did we share a philosophy that guided our work? What was that philosophy? Were there points of difference? What were they? What influence did our academic study, work experience, and philosophy have on each other? How did lessons from our formative years and other life experiences outside of work also impact this philosophy? To what extent would articulating and examining this philosophy ensure we were more effective in our environmental work?

We went back to the Aristotle's word 'praxis' to describe practical, thoughtful, 'doing' - taking on-ground, well-informed action. So our mission became having fun, engaging in environmental praxis and hopefully what would surface would be a practical philosophy to help us meld the two together. We felt all along that such a philosophy existed somewhere below the surface of our conscious thought. There could be much to learn by bringing this potential treasure to the surface and examining its origins and form more closely. We could improve our environmental praxis and fun levels! However, the needs of the proximal and the present can overshadow the wisdom of our intentions. Thanks to the International WaterCentre, where Peter worked and Bill was a Visiting Fellow, time, resources, and intentions were in alignment.

SECTION 5

How did we do this?

We have undertaken this investigation as a series of discussions. We would select a general topic that related to our work in catchment and coastal management and then delve into it, telling relevant stories from our varied experience, asking each other questions and seeking points of commonality and difference as to what we had done, why it was important to us and what we learned from that experience. We did not have an extensive list of topics at the start, rather allowing further topics to surface as the discussions unfolded.

We initially talked using Skype conversations that lasted two to three hours. We then spent several months talking face-to-face, looking and probing more deeply into what we had learned in our working lives to date, seeking key lessons that can guide us into the future and how these lessons might relate to aspects of our more personal philosophies of life. We analyzed texts of our conversations systematically, carefully looking for answers to the above questions and highlighting any other points of interest along the way. We did this individually and then came together to compare the results of this qualitative analysis. Sometimes this comparative analysis gave rise to more discussion and further analysis of the resulting text.

Writing the text for the book itself was inter-woven with these face-to-face conversations and qualitative analytical process. We had fun! You hold the results of this rather organic, iterative, discursive analysis and joint writing process in your hands.

Bill Dennison introducing Dancing with Dugongs at the 14th Annual International Riversymposium in Brisbane, Australia

SECTION 6

What's in it for the reader?

Here's an overview. In this book we focus on our head, heart and hands and how they are interconnected, particularly when we, as environmental managers, look to deal with or improve messy environmental problems - sometimes known as wicked problems. These are problems where knowledge and values intersect. Even communicating these problems, let alone solving them, becomes tricky. Problems in areas such as integrated water management, coastal zone management, human health and sanitation are laden with different values, dependent on the individuals involved and their cultures.

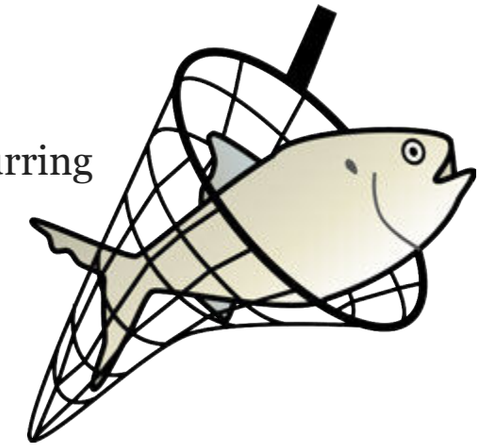
Our conversation took us on many turns - mostly philosophical and practical. We recognized the essence of Aristotlean philosophy was useful. In this introduction then we provide a brief road map about the book. In this book, we:

• articulate a shared philosophy to understand praxis in environmental management

• share stories about what we might have in common that makes us think in similar ways about environmental issues, education, research and management by introducing two case studies: one about a mountain stream, Obi Obi Creek and a town called Maleny and the other about a toxic cyanobacterial marine slime called *Lyngbya majuscula*. We found we were both great believers in stories as ways to help people make sense of what's happened in old situations and apply this learning to new ones, and

• highlight two ways of thinking about environmental education, research and management - namely popular education and 'immersive' education which we see as two ways of engaging in praxis - practical, thoughtful, doing for better environmental management.

We said that having fun is a recurring theme and hope that you enjoy reading this book purely on that level, if not on others as well.

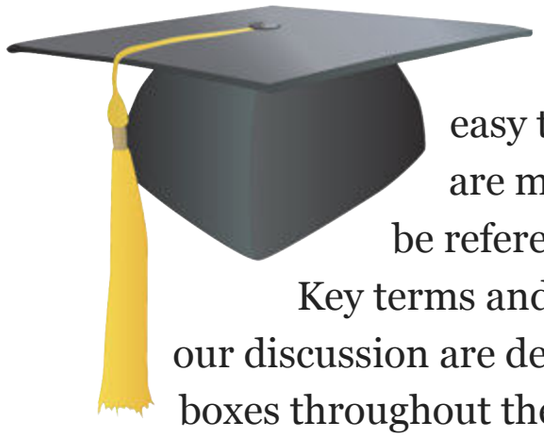


Immersive and popular education

Writing this book has been a process of personal and shared reflection. We hope reading it may be of use to you in two ways.

First, there are many stories relating to our work experiences throughout the book. Real stories can be great teachers. We have both learned a great deal from the stories of others and would hope that some of the stories contained herein resonate with you in a positive way in terms of your own professional environmental praxis. We have endeavored to capture key lessons from these stories. We hope the discussion in the text provides an adequate rationale to justify this synthesis. Of course a reader is always at liberty to find other lessons from a story in ways that are unknown to the writers. We hope our stories are rich enough that this may also occur.

Second, we hope that the process of personal and shared reflection we have documented here inspires further thought in this area. Over time we have become firm advocates of the importance of reflective practice for environmental management professionals. This reflection may be individual or occur more as a deliberative, group-based process. While we would not hold ourselves up as providing perfect examples of reflective and deliberative practice, we do hope that examining our efforts and their outcomes inspires you to work more in this way.



We have avoided Harvard referencing to make the text as easy to read as possible. Where there are major points that we feel need to be referenced, we have used footnotes. Key terms and concepts that are central to our discussion are defined and their use explained in boxes throughout the text. On occasions, stories from others and aspects of theory which we feel enhance the discussion are also presented in boxes. We have also used figures and images as much as possible to illustrate the discussion. Further readings including web sites, textbooks, and journal papers on key lessons/particular topics are also listed in an annotated bibliography at the end of the book. Importantly, we have picked key people, educators, or environmental managers and outlined how we see these people as personifying an important aspect of what we are trying to convey in each chapter. We hope you enjoy meeting these people - our ‘heroes.’

SECTION 8

Why now?

When we started our academic and working lives, environmental science and environmental management were just a glimmer in the night sky. Few telescopes were powerful enough to access the wonders of far-off, trans-disciplinary galaxies. The disciplines and traditional professions shone brightly. Much has changed in thirty years. Programs in environmental management and environmental science at undergraduate and post-graduate levels are now commonplace at universities around the world. The benefits, place and limitations of trans-disciplinary thinking are increasingly well known.

There are now thousands of environmental graduates every year. Life is busy and work demands are often high. The environmental problems that confront them from the local to the global are often complex and wicked. The organizations for which they work can be time, resource and staff poor. The work is challenging. There are also still occasions when environmental graduates can find themselves as a 'round peg in a square hole', carrying out largely uni-disciplinary activities in very narrowly defined employment roles. Whatever the situation, it is difficult to react positively to a complex or constricting external professional environment, unless we understand what we think, the way we think, and why we think the way we think. It is important to 'know thyself'.

Understanding our personal philosophy helps us explain why we do the things we do and importantly what we will do and what we won't do. This process is valuable throughout our professional life, as these complex and constricting situations are unlikely to change for environmental managers. The time for reflective and deliberative practice is now! It is only a short step then to fun. We have used the word 'fun' as a catch-all for everything from that deep sense of personal satisfaction you get from doing something that you know is important and doing it as well as you could; to the feelings of awe, wonder and excitement you get when you swim over vibrant, healthy coral reefs or walk in verdant rain forests; through the sense of camaraderie and shared satisfaction you get when you work with people of like mind on tasks of shared importance.

How this book is structured

This book is divided into three broad themes, namely hands, head and heart - as summarized in Table 1.

We have said that praxis - practical, thoughtful, doing - involves expressing, experiencing and excelling in areas of human endeavor that involve focusing on the hands, head and heart.

Hands refers to action-orientated research (expressing), nature activities (experiencing) and innovative approaches (excelling).

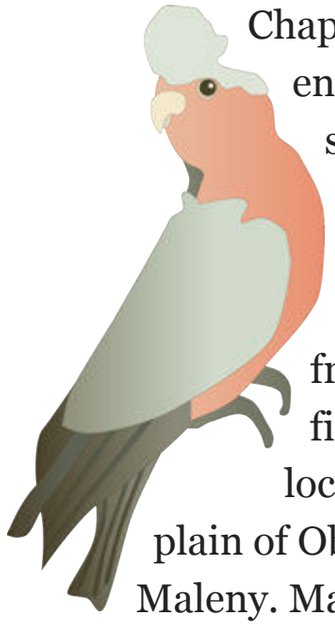
Head refers to teaching (expressing), lifelong learning (experiencing) and deep thinking (excelling).

Heart refers to artistic expression (expressing), sharing (experiencing) and enjoying the journey (excelling).

The first theme of the book is about 'hands,' in which we present two case studies that give personal insight into our lives and some of the work we have done in science, education and management of streams, catchments and associated coastal zones.

Table 1. Summary description of book structure

	Expressing	Experiencing	Excelling
HANDS	Action-oriented research: engaging with stakeholders, communicating results, citizen science	Nature activities: canoeing, boating, diving, swimming, hiking, sailing, climbing	Innovative approaches: Healthy Waterways Campaign, long term consistent efforts, focus on outcomes
HEAD	Teaching: formal classrooms, immersive education experiences, aspire to inspire	Lifelong learning: reading, listening, traveling, meeting new people, open to different perspectives	Deep thinking: writing dissertations, newsletters, press releases, popular science venues, this book
HEART	Artistic expression: songs, poems, drawings, games, humor, playacting, celebrating milestones	Sharing: leading field trips, participating in philosophical discussions, giving away ideas and books, spiritual experiences associated with nature	Enjoying the journey: optimistic outlook, variety of great jobs, wonderful mentors and students, loving families, strive to live in the moment



Chapter 2 is a case study written by Peter. entitled “Hippies, geeks and concrete: Peter’s story of a creek, people, and community empowerment.” This chapter chronicles the story of the Find Another Batching Site (FABS), a community-based group who, from 1990 to 1993, eventually succeeded in fighting a large corporation intent on locating a concrete batching plant on the flood plain of Obi Obi Creek, in Peter’s hometown of Maleny. Maleny is a rapidly growing settlement in the mountain hinterland of the Sunshine Coast, south-east Queensland, Australia. Nearly everything about the proposed location was inappropriate – from the flood plain where it was to be built on the banks of a creek with high ecosystem values, which was also the main water supply for the Sunshine Coast, through to the town planning, traffic, noise and dust problems it would create. Peter was a committee member of FABS for three years.

This case study highlights lessons in community empowerment, a key aspect of environmental praxis, and shows that a mixture of shared knowledge, relationship building and plain stubbornness can prove victorious against a planning and legal system biased in favor of the wealthy and powerful.

Chapter 3 is a case study told by Bill entitled “The Perfect Slime: Bill’s story of a toxic algal bloom and how it transformed a community.” This chapter is the story of blooms of *Lyngbya majuscula*, a toxic marine cyanobacterium (blue-green alga) commonly known as fireweed or mermaid’s hair, occurring in northern Moreton Bay, Queensland, Australia. Starting in 1997, Bill explains what happened when Peter first brought a sample of this toxic slime to The University of Queensland where Bill and his wife Judy were based. It is the story of the people who were involved, what they did, why, and what they learned. Bill highlights the insights he gained in terms of Lyngbya science and management while working with fellow scientists, politicians, citizens, and the fishers forced to work in the bloom that was encroaching on their fishing grounds.

We have gone to some trouble to present these two case studies as real stories using direct speech and the first person where we think it appropriate. We were deeply involved in the events portrayed in these case studies and feel it would be rather disingenuous to present them as something distant from which we are ‘objective’ and emotionally detached. However, we have endeavored as much as possible to triangulate the evidence on which these case studies are based, analyzing relevant documents in the grey and scientific literature and interviewing others who were involved whenever possible. We hope presenting these case studies in this way also makes them more interesting and readable.

The second theme of this book focuses on the ‘head’: Chapters 4 through 7 cover the conversion from passive to active learning, with examples in popular education and immersive education, as well as our thoughts on communicating science.

Chapter 4 contrasts formal education provided through schools and universities, self-guided or 'informal' education provided through visits to parks, museums and aquariums, and public education provided through participatory means like citizen science. The examples of active learning in public education using citizen science (Chapter 5) and in formal education using an immersive approach (Chapter 6) provide case studies for these active learning approaches. Both Chapters 5 and 6 were published in a special issue of the Journal of Contemporary Water Research and Education. Chapter 7 provides ten recommendations to effectively communicate science, based on our collective experience.

The third theme of this book focuses on the 'heart': Chapters 8 and 9 focus on awakening passion and having fun. We use the tables introduced in Chapter 1 where we contrast the hands, head and heart aspects of expressing, experiencing and excelling at awakening passion and having fun to structure a short discussion and then we share transcripts of our discussion of these topics. The stories and conversations presented here provide evidence to support our assertion that a philosophy based on fun is a useful foundation for environmental praxis.

The integration of the hands, head and heart constitute the subject of Chapter 10. The integration of hands, head and heart leads to the group dynamics of "We care," "We know," and "We can" to facilitate social, economic and ecological change. A wide ranging discussion on partnerships, stakeholders, naiveté and cultural diversity is included.

Chapter 11 is on the convergent journeys that Bill and Peter took that brought them together to write this book. This is based on a recognition that, although we have been raised on different continents and come from different academic backgrounds, we had convergent journeys in terms of the philosophies that have guided our work in science and management of waterways, catchments and coastal zones. A discussion on meeting one another, Lyngbya, fishermen, taking risks and friendship is included. In addition, the top ten books about science that influenced each of our careers are presented, as well as Bill's top ten quotes. We also developed our top ten principles for environmental actions.

Chapter 12 is about remembering Peter Oliver, as he succumbed to cancer before this book could be completed. Dugong rock, Peter's signature song, his retirement lecture/ sermon and reflections on his life constitute this chapter.

Chapter 13 is an invitation to the reader to dance with dugongs. Our final recommendations are presented here for our hands (tackle important problems, experience nature and be creative), our head (aspire to inspire, keep learning and stop & reflect) and our heart (awaken passion, have fun and enjoy the journey).

Chapters 14 and 15 are our acknowledgements, bibliography and references.

We hope the reader will find these stories and lessons they raise intuitively compelling. The process we have used to write this book has helped us to surface aspects of our shared philosophy for environmental praxis that underpin these lessons. We have attempted to articulate our shared philosophy for environmental praxis, linking this philosophy back to the case studies presented at the beginning of the book and the stories, conversations, and analysis offered in the middle of the book. In terms of our science, education and environmental management careers, it has indeed been pleasant to stop and reflect with each other as to why we do the things we do and learn that we shared a firm foundation on which to build new endeavors. A journey to a philosophy for environmental praxis awaits . . .

Hippies, geeks and concrete

Peter's story of a creek, people, and community empowerment

From the range to the sea
Let the creeks flow free
Water joins you and me
From the range to the sea

PETER OLIVER 1957-2012

Introduction

"It shouldn't take too long," said our friend Lesley when she rang me one winter Saturday in 1990. "The newspaper wants to run an article on the relocation of the concrete batching plant onto the flood plain behind the old butter factory. They'd like some of us for a photo."

"No worries," I agreed, "See you then."

My wife Ann and I had moved to Maleny, a town of about 3000 people at the time, in the Christmas of 1986. By 1990, we had a small family – two daughters, one three and the other a year old. I taught biology and geography at the local secondary school. Ann worked from home as an artist, running pottery and art classes, supplying local shops with ceramic ware and caring for our growing brood. We had another child, a son, in 1991.

Maleny was growing. People liked the semi-rural lifestyle, the rolling green hills and patches of rainforest and the proximity to the beaches and Brisbane. A small high school, where I worked, opened in January 1987. The high school grounds had once been a farm and adjoined a concrete batching plant, the only one in town.

Maleny, Australia

The secondary school was growing. Because of this and because, from a town planning perspective, concrete batching plants and schools were seen as rather incompatible land uses, the Queensland Education Department was resuming the land on which the batching plant was situated, forcing the owners of the plant to re-locate.

Peter Oliver, teacher in 1987.

Our family was also growing. We were busy with the basics of life, working to pay bills and raising a family. Sellars Holdings, a subsidiary of CSR and the owners of the plant, reckoned they had found a site on the floodplain next to our local creek, Obi Obi Creek, in the center of town. However, it seemed to me that relocating the concrete batching plant from next to the high school, and putting it next to the creek and then funneling a whole lot of large trucks past schools and the center of a growing town was not really a good idea at all. I could understand moving it, but putting it next to the creek?

Sellars Holdings also wanted to make the plant bigger when they re-located. I suppose that made sense from their perspective. You may as well make the plant bigger when you re-locate so you can meet the increasing demand for concrete that was bound to come with growth of the Maleny township. I was sure common sense would prevail. I went along that Saturday morning and then to a couple of public meetings. Little did I know that we would become involved in what became known as the FABS (Find Another Batching Site) Campaign which would dominate three years of our lives and consume hundreds of hours of our time.

This chapter introduces and critically analyzes the FABS case study. Ann and I were active participants in this case study. It focuses on environmental management of creeks, finding suitable locations for heavy industry, the ways people learn and work together, and personal and community empowerment. My purpose has been to share the insights and lessons FABS members gained from their three-year involvement in the FABS campaign in Maleny, and to share the values underpinning the actions of this culture-shaping group. In doing so, I have focused on the group and told their particular story and not the stories of all parties involved.

What happened

Obi Obi Creek

I really didn't think too much more about it at the time. From a town planning perspective, the land they wanted to move to was not appropriately zoned. It often went under water when the creek, which flowed through the treed border of the block, flooded. I was certain there would be considerable opposition to relocation of this site from townsfolk, and that the Caloundra City Council would refuse the town planning special facilities (rezoning) application that Sellars Holdings had made for the site and would be prepared to defend that position strongly in court if needed. A more appropriate site would be found. It seemed simple - you just don't locate heavy industry like a concrete batching plant on a flood plain right next to a creek like Obi Obi Creek. It was a pretty little creek. I enjoyed swimming and kayaking in its waters. The high school students I taught learned about water quality monitoring, catchment management, and stream health by exploring its waters. Obi Obi Creek fed Baroon Pocket Dam, a newly constructed dam that was a major water supply for all of the Sunshine Coast.

Creeks deserve respect.

The proposed batching site of Sellars Holdings concrete batching plant.

Increased traffic

There was also a significant problem with traffic. Depending on their size, concrete batching plants can generate a lot of heavy vehicle traffic. The proposed plant was to be located on 23 Coral Street, Maleny and would generate four large, sand, gravel, cement and fifteen concrete mixing trucks a day. While the trucks supplying the proposed plant would mostly

approach the plant from the east and the west, the concrete mixing trucks would head in all directions when they left the plant. They would all have to travel along Coral Street, a narrow crowded street with limited visibility, which only had two access points, at its eastern and western ends.

Importantly, the proposed batching plant was in the center of town and would increase heavy vehicle traffic through the center of town and past the local pre-school and primary school, regardless of which way the traffic entered and left the plant. It was also significant that the town was growing rapidly, and that any increase of traffic in 1990 would likely compound any future traffic problems the central area of the town may face.

Coral Street - Maple Street intersection photographed in 1990 (left) and 2011 (right).

The image above shows the intersection at the eastern end of Coral Street. The photograph on the left was taken in 1990. The image on the right was taken in 2011. The small white building, below the tree prominent on the right hand side of the 1990 image was the Maleny Post Office in Maple Street, the main street of Maleny. This gives you some idea of proximity of the proposed site to the central business district of the town.

Communities, councils and the courts

"If you are going to get legally involved, you really need to take your case out in the name of someone who can afford to lose everything they own, should things go badly for you," advised the local solicitor at the public meeting on 26 November 1990. "Is there anyone here who would volunteer to take on that role?"

The downstairs room at the Maleny Community Centre where we were meeting was quite full with around forty people attending. Eyes darted nervously around the room. People had been informed that Caloundra City Council, the local government at the time, would very likely refuse the special facilities zoning the concrete company needed to move to the proposed site, but that they may not defend that position very strongly if it came down to a court case. They, and adjoining councils, spent a deal of money on court cases and an adjoining council had recently lost several cases in the Local Government Court, where such a case would be heard. These losses had been expensive. It sounded like council might look after their 'bottom line' rather than the environment.

As a community, we had to be ready to both lobby Council rigorously to defend such a position and to mount our own defense in the event that Council did not allocate sufficient resources and determination to the task.

Alan McClure, a geologist and local resident, knew this question would be asked at the community meeting.

As local resident Danny Rose said, “Alan had approached me before the meeting and asked me if I would become a ‘respondent by election’ to represent the community in the court case should the meeting decide it was necessary. With 433 signatures on a petition and over 30 detailed objections from the community arguing that council should strongly defend their decision, the meeting felt that a separate case should be mounted, especially if the council showed itself to be mounting a weak defense.”

“As a person with limited possessions at the time, I was pleased to volunteer for this role,” commented Danny.

Danny Rose’s impressions

And so it came to be. At the 26 November community meeting in 1990, Danny Rose became a respondent by election in the case of Sellars Holdings against Caloundra City Council regarding their refusal to amend the Town Planning Scheme to rezone the land at 23 Coral Street Maleny from Light Industry to ‘Special Facilities - Concrete Batching Plant.’ He was supported by an unincorporated group, the FABS (Find Another Batching Site) committee of local residents, composed of Alan McClure, geologist; Lesley McClure, writer; Cesca Ennis, laundrette operator and small business woman; Lindsay Kruger, saddler; and me, Peter Oliver, teacher. My wife Ann also supported the group through fundraising - but more of that later.

Danny and FABS tried from the outset to work closely with Council, but found this difficult. We were very unclear on what grounds (e.g. traffic, water quality, noise, town planning) council would defend their decision to refuse the rezoning requested by Sellars Holdings. Many of us on the FABS committee had submitted written objections to the proposed rezoning and were buoyed by the high number of signatures on the petition that Cesca Ennis and others had circulated around town. This was the highest number of signatures ever received by council at the time for any town planning matter. At the time, while FABS committee members knew each other, we did not all know each other and Danny equally well. We were to get to know each other much better over the next three years.

As it turned out Caloundra Council decided to defend their position on only two grounds - that the proposed use of the land in question would create or increase a traffic hazard in the vicinity of the site; and that the amenity of the area would be adversely affected by the volume of vehicular traffic and the noise generated by that traffic.

We did not find these especially strong grounds on which to mount a defense of their decision to disallow the rezoning for the concrete batching plant to go ahead. Council had essentially limited its argument to traffic. If Sellars Holdings could convince the Court that they could manage the traffic issues, then we felt they could win the case. We would then have a large concrete batching plant on the flood plain next to Obi Obi Creek in the center of a rapidly growing town.

We were very pleased by this stage that Danny had decided to be a respondent by election and to fight Sellars Holdings and their desire to build a batching plant on the site in Court. Council was mounting a weak case, probably not wanting to 'waste' money on a Court case they felt they would probably lose.

The Sellars Holding Concrete Batching Plant situated next to Maleny State High School in 1990.

Together Danny Rose and we as FABS came up with ten other points on which we would argue that Council was right to refuse the rezoning to allow construction of the plant.

Namely, that:

1. The proposed plant is incongruous with its surroundings

2. It is contrary to the strategic planning designation

3. The Special Facilities Zoning proposed for the site was being used to circumvent the Town Plan

4. It is against good town planning principles

5. The proposed plant would generate excess noise

6. That the large trucks servicing and being serviced by the plan would generate excess noise

7. Dust would be generated by activities on the site

8. Relocating of pits and ponds on the site to avoid floods would add to noise as these will have to be serviced by pumps to pump waste uphill

9. Pumps will be needed to pump excess waste to sewer and that these will inevitably overflow due to rain and pump failure thereby polluting Obi Obi Creek, and

10. The Appellant has not demonstrated that building earthen 'pads' on which to locate key building and machinery on the site will not displace flood waters so as to exacerbate downstream flooding.

Danny Rose (seated at left) and other members of FABS Alan McGlure (standing): Peter Oliver; Lindsay Kruger (standing); Cesca Ennis and Lesley Synge.

We felt that the Council had given itself a very limited basis on which to defend their decision to allow the rezoning and subsequent development to proceed and that our expanded platform of arguments left us well prepared whatever direction the appellant's arguments should come from.

We were disappointed in Council and entirely uncertain of their motives in mounting such a weak defense, but pleased that we were prepared and able to defend the creek, along with our community. We were not against Maleny having a concrete batching plant - that was implicit in our name, 'Find Another Batching Site.' We all lived in houses with concrete footings. However, we believed that there were other, more suitable sites around the district, for example - two old quarry sites; a vacant area out near the town wastewater treatment plant; or on a macadamia nut farm that at the time was owned by CSR, as was Sellars Holdings at that time. We were simply against them moving the batching plant, a noxious industry, to a site about 200 meters from the town post office, on a flood plain, adjacent to the creek that had flooded the site five times in the last twelve months. We also felt it was significant that the creek, Obi Obi Creek, fed Baroon Pocket Dam one of the major water supply sources for the Sunshine Coast. And so the battle lines were drawn...

Expert witnesses, debt, and fund raising

We engaged two expert witnesses, John Brannock, a planner, and Max Winders, an engineer. Their reports proved expensive, yet useful to our cause. The Local Government Court (now known as the Planning and Environment Court) in which the case was to be heard relied very much on the idea of 'expert witnesses' and even recognized certain persons as such, given their various fields of expertise.

John and Max were recognized as expert witnesses by the Court, so this gave us some measure of credibility. They gave us evidence on which to base arguments arising from our ten assertions and those two of Council as to why the batching plant should not proceed on the proposed site.

However, experts don't come cheaply.

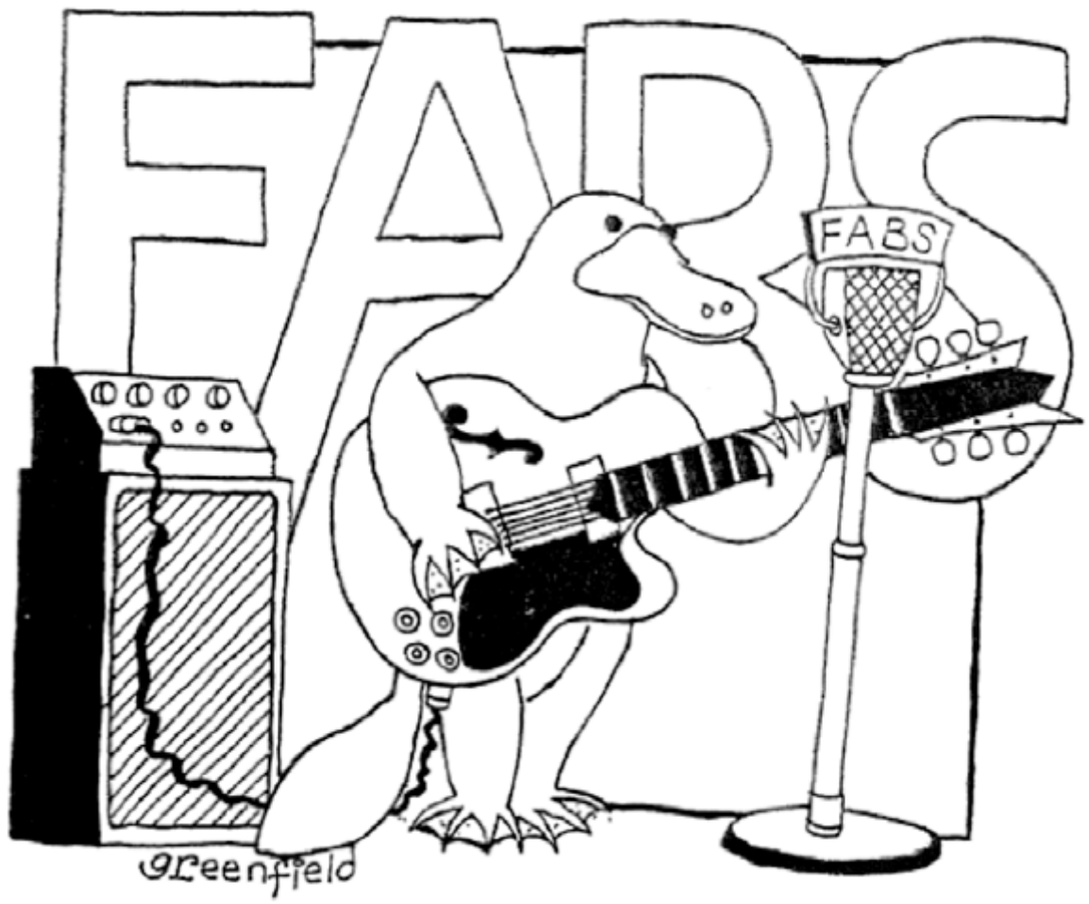
On 14 January 1991 we had $1544.74 in the bank. We knew we would need probably twenty times that amount of money and did as much fundraising as we were able. By the time

Sellars Holdings withdrew their appeal on the 4th of March 1993, we had undertaken myriad fundraising activities. We sold badges and bandanas at three Maleny-Woodford Folk Festivals and innumerable street stalls. We had raffles, rock dances, classical music afternoon teas, writers' morning teas, and auctions.

My wife Ann was an artist and an able screen printer. She screen printed hundreds of platypus t-shirts, and cotton and silk bandanas. Our children colored in hundreds of platypus badges, as did we adults. They sold well.

Lindsay Kruger even made a 'platy-hat,' a type of French foreign legion cap with a platypus bill for a peak and black and white eyes that wandered around in an uncoordinated way when you walked while wearing the hat. We sold fewer of these.

Platypuses are common in Obi Obi Creek and as there was no legal ownership over this monotreme's image, it was quickly co-opted to be our logo. While the platypus in our drawing is playing guitar, he appeared in various poses as our campaign demanded. Donald Greenfield, a local resident and well-known cartoonist, drew our platypus friend wearing boxing gloves when we were in for a fight in court and reclining on bags of cement with a parasol-festooned drink in hand when things were going better for us.



The platypus is endemic to Obi Obi Creek and so is an ideal icon or mascot for a campaign such as FABS which aims to protect its habitat.

Our legal advisor, a local solicitor, had said he would work pro bono for us. None of us were that experienced with the costs associated with taking a case such as ours to court and were suitably chastened when, on 11 June 1991, each FABS member received a legal bill for $18, 502.60 from our solicitor, informing us that the case was now ready for Court. True to his word, he had charged us nothing for his time, but only actual court costs, as well as document lodgment and photocopying costs for disclosure, and of course for hiring the two expert witnesses to produce town planning and engineering reports. This had given us a substantial bill!

What's more, given that we were not an incorporated group, we were all equally liable for its payment. The headline and the story in the article below give some idea of our demeanor as we set about the task of working with the community to pay off the debt and to get ourselves ready for our day in court. More costs were yet to be incurred. Expertise and the Law have their price. We realized wisdom behind the truism - the law is only for the rich.

FABS IS ALIVE AND WELL!
But sobered by legal bills!

THE sobering reality of a community group taking on a big company on an environmental issue came home to FABS (Find Another Batching Site group) last week with the arrival of legal bills.

FABS had commissioned reports by expert witnesses and their fees plus those of solicitors and barrister, have now been received.

FABS case was fully prepared but the court case on May 2 earlier this year adjourned the matter at the Caloundra City Council's request.

FABS spokesperson Alan McClure this week said, "This is an example of how community groups can be scared off from legal action by big business."

"Compare the resources of big business with those of a small community! If we weren't so confident that our cause will win the day in court, we'd have given up long ago."

Fundraising "thousands more dollars", will continue. FABS appealed to community members who wished to contribute their skills and talents to ensure the concrete plant didn't go ahead, to contact Chairperson Lindsay Kruger, phone 94 1068.

Classical FABS, a musical afternoon at Zamaz on Sunday, June 30, from 2 to 4pm, is the first of many planned fundraising events.

Natasha Erdman and students will play Australian composers, Mozart and Chopin, and Tenors and Sopranos will sing arias, English, Italian, French and Gypsy songs as well as favourites from "Showboat" and Desert Song".

Violin compositions by Brahms, Beethoven, Mendelsohnn, and more will be performed by Lisa Plucknett accompanied by Ken Simpson on piano. And a real treat will be a performance of poetry of Roald Dahl! At $10 a ticket it's a lovely way to support a good cause. Bookings and tickets from Cesca Ennis, Maleny Laundrette phone 94 2689. But book soon as places are limited!

An article from the local weekly Maleny paper, The Range News, on 28 June 1991. We had by this stage recovered from the shock of our initial legal bill.

We approached Council about the possibility of sharing some of the legal costs, particularly those relating to having legal representation in court, as there were precedents for this to occur. We would also share our expert reports with them if they were prepared to help to defray our costs. "Could we keep them for the weekend to look over them?" they asked. "No," we replied. Our Council at the time was a pretty conservative lot. Why were they mounting such a weak defense? There was overwhelming community opposition to the relocation of the plant to that site. Wasn't their job to represent the wishes of the community that elected them?

It would be fair to say that by this stage we really didn't trust them and that this was reciprocated in good measure on their part. This was a pity on several fronts:

• First, we felt we were simply doing things that they should have done but had refused to do (i.e. rigorously defending their decision not to allow the batching plant to proceed in this inappropriate location).

• Second, that they had been elected to represent ratepayers of our town, and our petition showed that most ratepayers in the town simply did not want the batching plant in that location.

• Third, this was costing both of us a lot of money and time which could be minimized by working together.

• And, lastly, because this mistrust on both our parts could spill into other aspects of our dealing with each other.

Small communities like ours are usually good places to live. Levels of trust amongst locals were usually high. We were aware that the Councilors who represented us were from some of the older, more established families and were politically conservative.

Danny Rose and FABS members were more recent arrivals in Town and were viewed as somewhat progressive, even alternative. The batching plant was to be the first of several issues (e.g. the Maleny Folk Festival staying or moving from Maleny, the arrival of Woolworths in the main street) which in many ways divided the town into two 'camps', a progressive/ alternative group and a conservative group, who now live in the same geographic location but do not interact as much as they did before these issues came to a head.

We felt that we were now having to play games with Council, rather than being able to deal directly and openly with them. This was a shame. I could hear the words of that old Joe South song rattling around in my head:

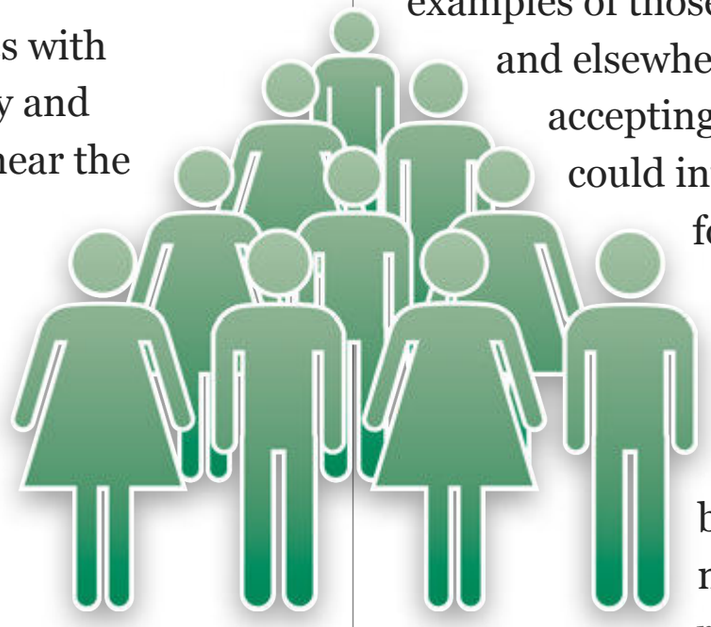
Oh the games people play now

Every night and every day now

Never meaning what they say now

Never saying what they mean

Perhaps I was naive, but I didn't like things being like this. Especially not knowing which things people said that they didn't mean and whether I really meant what I said back. While we all knew that people played games, it was disappointing to play them over things that we all saw as important - our creek and our town. Unfortunately, we saw what we were doing now with Council as game playing - a game that we didn't start but were somehow being cajoled into playing. We were soon to see other examples of games being played.



Media

We felt we had to get the message out to the broader Southeast Queensland community.

This was important for two reasons: first, there may be other examples of those with money using their power in the Courts and elsewhere to foist bad planning decisions on an un-accepting and disempowered public (perhaps we could interact with and gain energy from these folk?); and second, because we thought simply getting the story into the broader State media would show our adversary that their corporate reputation as a responsible environmental citizen could publicly be brought into question. We approached many media outlets early in 1991 and the ABC 7.30 report came and did a feature story which aired on their evening television program across Queensland.

While the piece certainly told an accurate story of the "battle to save the creek," it certainly did present a tongue-in-cheek view of Maleny - a town that was divided between older, conservative folk and lately arrived hippies who were OK, but you wouldn't want to join in with them, as one of the locals who was interviewed commented.

They filmed Danny playing guitar and singing his “Find Another Batching Site” song, the words of which are included below. Danny, bless his heart, looked every inch the hippy, alternate type. We were portrayed in a way which, while accurate to a certain extent, did not make me feel entirely comfortable. I did not see what we were fighting for as alternative, quite the opposite actually. Sensible people protect their creeks - end of story. From the media point of view I realized our story would not be seen as newsworthy, without a bit of parody and being told as us versus them. We had been typecast in concrete. Oh, the games people play. This was a new game - finding the angle that made us newsworthy.

Find Another Batching Site

By Danny Rose

Here on the Obi’s fertile banks, we celebrate and dance
While downstream, just one bend away, its fate is up to chance
A home for platypus and eels, insects, fish and birds
Now if you want to save it, please listen to these words:

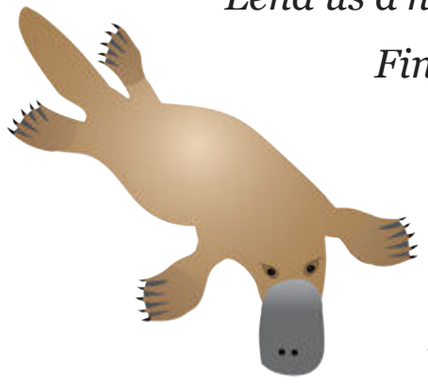
The Kabi Tribe once gathered here, among the bunya pines
Untold ages passed and still culture did survive
Living proof that humankind on nature can depend
Don’t use it all, ‘cause then it’s gone. We need it as a friend.

Now let us see if people’s power can save our river’s plight
Lend us a hand and make a stand -
Find Another Batching Site!

Now tribes of city refugees are seen in Maple Street
They come to view the barren hills, and sniff the air so sweet
With pesticides, insecticides to add to their already wrecked insides
They need a firm foundation, that’s why they use concrete.

Don’t spoil the air and water, don’t spoil the sight and sound
Save it for the platypus, we need some common ground
Don’t let money beat the truth, we’ll win our day in court
So people won’t you stand up, don’t let your soul be bought.

Now let’s see if people power can save our river’s plight
Lend us a hand and make a stand -



Find a another batching
Platypus are hatching
Find another batching
Greedy hands are snatching
Find Another Batching Site!

Getting political yields results

FABS committee member Lindsay Kruger was a saddler. He made beautiful horse saddles, particularly ones for endurance riding which he sold to folk in many different parts of Australia and overseas. His work gave him time to think, which was good as we needed as much intellectual energy as possible if we were to be successful in our cause. Lindsay firmly believed it was time to get political and he had come up with a plan. Caloundra Council elections were to be held on 15 March 1991 and we felt we had not been getting much support from Council.

Lindsay talked with Danny and the FABS Committee and on 8 March FABS placed a full page advertisement in our weekly local paper, The Range News, outlining what Danny Rose, FABS and the Maleny community had done to find another concrete batching site for the town compared to the efforts of Council and our Councilors. The full page table highlighted activity on one side and inactivity on the other. The advertisement finished with the statement “Six months after the flood of objections, years after Council knew Sellars’ needs, why do our local government representatives delay? A solution to all parties is within reach!” (The Range News, 8 March, 1991).

This was very damaging electorally for our incumbent councilors, who subsequently lost the election the following Saturday. We were not popular in some quarters and there were definitely a couple of local government ex-councilors who were not going to be inviting us round for tea for a while. However, the new councilors were much more collaborative and sought to work with Sellars Holdings and the community to find a win-win outcome, if this was possible.

It came as no surprise then that The Range News reported on 23 March 1991 that Sellars Holdings had been given an extension by the Queensland government to stay on their existing site next to the high school until 30 June 1992, and that on 3 May 1991, Sellars Holdings sought and gained an adjournment on their Court appeal, saying they needed to work with the newly elected Council to find another more suitable location for their batching plant. We began to help in the search for a site and even had a site meeting with Council and Sellars Holdings on what quickly became the preferred potential site next to the town wastewater treatment plant.

One or two folk who lived out that way didn’t want the plant going there and told us so. It was, however, the cost of road works for the turning lane that would be required to gain entry to the site that would become the real sticking point. Sellars Holdings didn’t see that they should pay for this and neither did Council. In Queensland industrial estates to service small and regional towns are often built on Crown Land (also known as Unallocated State Land). There was little of this around Maleny, so we were left with some Council-owned land near the wastewater treatment plant and no one wanting to pay for the roadwork upgrades to gain heavy vehicle access to the site.

These discussions dragged on. While the Councilors had changed at the election their planning, administrative and legal staff had not. We found them to be quite conservative folk, who really didn't rate our issues very highly and allocated time and resources for their work accordingly.

The new councilors found it difficult to exert control over the Council CEO and his staff. This alerted us to the need to still be ready to go to Court which would cost more money. There were also other money matters to consider. While our solicitor was being patient, we also still had a substantial debt to pay off.

Legal Aid

It was then Lindsay Kruger had an idea while listening to the radio while doing his saddlery work. Lindsay listened to Paul Friedman, a Legal Aid Lawyer, who was talking about Legal Aid in an interview on ABC Radio. "Why can't we get Legal Aid?" reasoned Lindsay. Within days and with the blessing of the FABS Committee, Lindsay and Danny were on their way to a meeting with Paul to discuss this possibility. Paul Friedman was, at the time, head of the civil law area of Legal Aid for Queensland.

Lindsay Kruger's impressions

Legal Aid is there for people without money so they can be legally represented. Legal matters can cost a lot of money and those with money therefore can have greater power using the law. Legal Aid aims to correct this power imbalance. However, these days, as was the case back then, Legal Aid is only offered only to folk for criminal matters. The money to fund Legal Aid comes from the interest generated from solicitors' trust funds.

As serendipity would have it, in 1991 bank interest rates were at an all time high, so Legal Aid was in a comparatively well-off state financially. I talked with Paul recently and he informed me that FABS securing Legal Aid for the Planning and Environment Court was a first that has not been repeated to this day. One of the main reasons we received Legal Aid was because funds were available. Other reasons included that:

• The case had been taken out in one name - Daniel Rose was the respondent by election defending the decision;

• There was high public interest, as evidenced by the number of petition signatories and the support for Danny through FABS and the community;

• There was real potential for damage if the proposal was not stopped;

• There appeared to be breaches in town planning;

• Other environmental laws may be being broken; and

• A senior legal counsel experienced in Local Government/ Planning and Environment Court matters gave an opinion that there was a good likelihood of winning the case.

From Paul's perspective it proved to be a good partnership. Danny and FABS provided the environmental and town planning argument, while Legal Aid provided the legal argument. We explained to Paul and Legal Aid that, in our view, Council had proven itself not to be a reliable community champion; that there had been a change in Councilors; that they had chosen limited grounds on which to defend their decision; and that there had recently been an apparent change of heart on the part of the staff as to whether they would recommend initiating a defense of their decision or not.

As Paul said to me, in some respects FABS took a punt on Legal Aid, as Legal Aid had never done anything like that before. However he knew we were in a tight spot and, as we both agreed, beggars can't be choosers!

Legal Aid was granted in late October 1991. All our costs were covered from that time. However, we still owed around $7000 in previous bills.

Intimidation

In the meantime, it appeared Sellars Holdings had been doing some strategizing of their own. They gained time from the new Councilors being elected earlier that year, the State government giving them an extension to occupy their old site for longer, and the adjournment they were granted by the Planning and Environment Court. On 22 and 23 April that year, they hired a firm of solicitors to door-knock each and every signatory of Cesca's petition against the relocation of the plant to Council. Four hundred and thirty three objectors take a little time to interview. Many folk reported they felt intimidated when they were greeted at their door by solicitors asking if this was their signature, if they really felt they knew all about the case, and had they been pressured in any way into signing the petition? Some folk reported that they felt intimidated, that it was their right to sign a petition and that these roving solicitors had no right to invade their privacy and question their motives or actions. It appeared that the solicitors were also on the lookout for forged signatures or signatures of non-existent people.

As members of FABS we also sometimes felt a little intimidated and that we were being observed. For example, while working at the FABS stall at the 1990/91 Folk Festival at Maleny we observed that we were being photographed by a policeman who was suspended from duty after being charged with various offenses. He was using what at the time was state-of-the-art photographic equipment - a 35mm SLR camera with a telephoto lens. He ran off when we walked over to talk with him as to why he was photographing us.

Oh, the games people play….

Flood and finalization

The Sellars investigation did not bear much fruit - at least we heard nothing more of it. We saw no photographs of us displayed in embarrassing places. We kept up our fundraising to pay off our remaining debt. On 7 February 1992 the site went under water again. Danny asked that Legal Aid finalize the whole matter in August 1992. On 4 March 1993 the matter went before Judge Row in the Planning and Environment court. Sellars Holdings attended Court and immediately withdrew their appeal.

Our Legal Aid barrister sought for our costs to be awarded against Sellars Holdings. Judge Row, for reasons that I still don't really understand, decided not to do so. It seemed odd. This was something that we were told from the start would very likely happen to us should we lose the case or be forced to withdraw. It did not seem fair at the time and still does not now. However, we were overjoyed that after two and a half years the creek and our community were safe from having a concrete batching plant unnecessarily foisted upon us.

Lesley McClure's impressions

In the end Sellars Holdings chose to continue their operations around Maleny using their existing plants in nearby Beerwah and Caloundra. This was an option that we were told at the time was not financially viable. It's funny how things can change.

We held our last FABS fundraiser at a French restaurant, *La Picardie*, in Maleny in June 1993. It was a time for celebration and we chose a Mardi Gras theme. We auctioned a platypus hat and T-shirt and a Donald Greenfield original of the fighting platypus.

The Queensland government resumed and bought the land on which the old batching plant sat, next to the school for seven hundred thousand dollars, stating that the plant should cease operations by the close of June 1999. What had seemed like a simple thing one Saturday June morning in 1990 - come along for a photo for the paper - this is a silly idea putting heavy industry on a flood plain next to a creek in the middle of a growing town - had taken nine years to play itself out.

We had won, but at a considerable cost to ourselves. Danny Rose had stood to lose everything he owned and those in FABS who had supported him also stood to lose financially. And we had all spent thousands of hours raising funds to fight what we knew environmentally and in terms of town planning to be a stupid idea. Councilors had lost an election. Sellars Holdings had spent many tens of thousands of dollars for no gain.

Creeks deserve respect.

Oh the games people play …

Lessons

Some of the key lessons gleaned from those involved whom I was able to interview are highlighted in the pop-up boxes throughout the previous section. What amazes me is how diverse these lessons are and how folk still find use in these lessons today. Unfortunately I was not able to interview FABS members Cesca Ennis or Alan McGlure. Cesca moved out of the Maleny district some ten years ago and I have lost contact with her. Alan passed away from pancreatic cancer some two years ago. They were both vital members of the group and my story is poorer for not having their input.

So what do I feel I learned in terms of praxis - practical, thoughtful doing, in this case praxis for the environment, by working as a member of FABS? I recounted a range of lessons that I thought were important at a talk I gave at the Greenhouse at the 92 Maleny Folk Festival (now known as the Woodford Folk Festival since it moved to Woodford in 1993). These are outlined below:

Oliver at the Greenhouse at the 92-93 Maleny Folk Festival

Strategies that we have used:

Calling public meetings

Electing a steering committee

Initial petition of objectors to Council

Individual objections

Lobbying local Mayor, Councilors, State member

Letter writing to newspapers

7.30 Report/TV/Radio

Getting good legal advice

Getting good expert witnesses

Regularly communicating to the public on the issue

Using a native animal as a logo/mascot

Using batching site controversy as a election issue to ensure support

Being a diverse group of people with a common purpose

Using diverse methods of fund raising also as venues for publicity (e.g. street stalls, folk festival stalls, dances, raffles, concerts, platypus days)

NOT being incorporated (a dual edged sword)

Having one person willing to go bankrupt as the respondent by election

Seeking and gaining legal aid (as a Queensland First in the Local Government/ Planning and Environment Court)

Seeking Without Prejudice Meetings with Sellars Holdings and Council

Thinking analytically as well as emotionally

Having regular steering committee meetings and seeking feedback from a wide cross-section of the community

Not giving in

Modifying actions on the basis of new information

What of the future?

Negotiate an out of court settlement

Try, if possible to extract FABS/community costs from Sellars/CSR

Putting that money to work in the community

Working for the environment really does take time, passion and commitment

When I became involved in FABS I had no idea that it would be something that would consume almost all my spare time and much of my passion and energy for three years. Was it worth it? Absolutely. Would I do it again? I'm not so sure about the answer to that one - perhaps not in exactly the same way. I suppose I would like to think I've learned some things since 1993 that might help me to do a better job of it. However, I do know that when you see something really stupid occurring, it is your civic duty to do something thoughtful and practical to address what you know to be wrong. Rarely will all stakeholders - people who may have something to gain or lose in relation to the issue - see things exactly as you do. That is why it will take time and you will have to be both passionate and committed to succeed.

Money empowers, but it won't always get you everything you want

Environmental matters and law can be a volatile mix. Folk with money often choose this path, as money empowers them and they can use the law to calm a situation and attempt, often successfully, to bend it to their will. Money can also buy knowledge, expertise and the ear of decision makers. However, for all its uses, money cannot always buy you a healthy ecosystem if what you are proposing is fundamentally ecologically flawed. You will always be playing catch-up, looking for ways to 'manage' the ecosystem in which you are enmeshed as its health invariably declines. In this case the idea of putting heavy industry on a flood plain within the riparian zone of a high value stream system, showed a lack of ecological knowledge about the role of flood plains and riparian zones in maintaining healthy streams. There were other, more suitable places to locate this heavy industry. For some unknown reason the industry group persisted in wanting to use this site and sought to use money to make the site 'suitable.' FABS gaining access to Legal Aid, helped to address this legal power imbalance and allowed us to expose this faulty logic to the daylight of legal and public scrutiny.

A small, diverse group of people with a common purpose can be very powerful

Like many of us, I have been involved in groups where people engaged in shared activities or problem-solving and came from similar backgrounds. For example, this can happen in work settings or when you are studying at TAFE Community College or a university. People may come to workplace or a course of study for a variety of reasons and while they may appear to be diverse, they may all have fairly similar social-economic backgrounds. FABS showed me the power of a common purpose and how it can unite people from different backgrounds (i.e. a launderette operator, a saddler, a writer, a geologist, a hippie and a school teacher) to achieve in ways that would be impossible

to them individually. For example, I observed over three years that each of us brought different skills and knowledge to the achievement of our common purpose. Cesca, for example, as a small business owner running a launderette, kept track of accounts and money. Lesley focused on writing and press releases. Lindsay, by virtue of his work as a saddler and his contemplative nature, often thought 'outside the square.' He gave the group the idea of seeking Legal Aid - something which none of us would have thought of otherwise.

Working on environmental issues involves taking risks

Danny took a risk in becoming the respondent-by-election in a court case against a powerful multi-national company. He knew what he was doing and thought the risk was worth it to protect the creek. Everyone in FABS took a risk in supporting Danny. As I mentioned earlier in this chapter, there's nothing like coming home from work and finding a legal bill in your letter box for which you are individually responsible because the group in which you are a member is not incorporated to jolt you back into the reality of your situation. While we all knew this was a possibility and were prepared to take the risk, this really sharpens your awareness of your situation. You start thinking if things don't work out here, will we sell the house to pay the bill; extend our mortgage; take a second job? Being involved in environmental praxis means taking risks. It's up to you to realize as clearly as possible what these risks actually are and whether or not you feel these risks are actually worth it. In this instance I found the risk to be worth it for two reasons.

Obi Obi Creek in 2012.

First, I believe that creeks deserve respect. This has become apparent to me over many years and sits very comfortably with me as an essential part of my personal philosophy. I recognize the links and interactions between me and the things that make up my surroundings. I see creeks and streams as the arteries of the land on which I live and depend. They are both alive and supporting life. Life is sacred. Things that are sacred deserve respect. I realize other people may not see it like this, but I do. Second, I quickly began to realize at the time that being involved in FABS might interfere with my

ability to protect and nurture other things that I recognized as sacred like our rapidly growing family - my ability to provide financially for them and to spend time with them. I made a judgment call that the risk of hurting my family directly was manageable but that the risk of not being involved in FABS might mean that the creek that flowed through the town in which our family was building its life would inevitably be degraded. It was very hard then not to be involved.

A human interest aspect is needed for a newsworthy story

What I think is newsworthy probably is not. For example, being involved in FABS made me realize that for ABC TV the battle over our Obi Obi Creek in itself was not a story worth sharing on state-wide television, unless it had some other element that would make it interesting to ordinary folk not associated directly involved. Whether it was sex and drugs and rock-n-roll; tales of incompetent politicians or public servants; the innocence of small children or animals; David beating Goliath; or of the extreme eccentricity of others leading to a comedy based on parody; it seems important to find the angle that will help to guarantee an item as being broadly interesting and hence newsworthy. For local media, such as a regional town newspaper, finding the 'angle' many not be so important. The audience can identify as being involved and therefore as, essentially, part of the story. However, the further you travel geographically from the scene of the story, the more likely you will be to need a human interest angle if your story is to become news.

Well-crafted press releases can help you get your story out to the media, as can having suitable images relating to your story. These can be especially important for small local papers which may rely on these resources as the main elements of a news piece. However, larger media outlets get many press releases. You will probably only need to make personal contact by phone or in person and be able to provide personal contacts and have some elements surrounding your story to give it context and 'human interest' angles, as I have mentioned above.

Working together for a common cause helps people to build and share knowledge

Collaboration comes from the Latin and means 'to work together'. Members of FABS collaborated closely for three years. In that time we learned about everything from aquatic ecology, to politics and town planning, through to fund raising and campaigning. We were involved in a process of social learning. We were all students and teachers, learning and teaching ourselves and each other. My presentation at the Greenhouse at the Maleny Folk Festival in 1992 represents an attempt to share what we were learning with others outside our group as does this chapter. However, I

did that only on the invitation of Des Ritchie from the Sunshine Coast Environment Council, who was helping to organize speakers for the Greenhouse. At the time I did not think of myself as being involved in an 'environmental campaign', I really thought that we were simply doing something that any other socially responsible citizen who had the time and energy would do, nor did I think we had learned much that would be of interest to others involved in similar situations. I am still reflecting on this as I write these words. As I look over this chapter, I see we really did learn a lot about ourselves, how we worked together, power, social learning and environmental praxis. Des was right. We did have a story to share.

Always have fun

Everything I have written above sounds like hard work and more than a bit serious. This is not entirely accurate! Every FABS meeting involved sharing food and drink. Whether is was cups of tea and cake, beer or wine, along with music and conversation, our meetings were often broad ranging from events which definitely had a focus, but also strayed onto many other associated and mutually interesting topics. Of course fundraising at folk festivals and going to classical music soirees was not all hard work. We definitely enjoyed being there and taking in the music and the atmosphere even if we also had to organize folk festival parking and camping, manning and stocking the stall or performers of the soiree, and seeing that pink champagne was nicely chilled.

We definitely had our disagreements along the way and although we have all gone our separate ways, we remain friendly towards each other to this day. We have done many things together and have a shared understanding that people working together united by a common cause can achieve what they set out to do and have fun along the way. In coming chapters the necessity of having fun will also be highlighted. In terms of developing a philosophy for environmental praxis, Bill and I both see having fun as a foundation stone on which all other elements depend.

Peter and his guitar

The perfect slime

Bill's story of a toxic algal bloom and how it transformed a community

Somewhere, behind space and time, is wetter water, slimier slime

RUPERT BROOKE 1887-1915

SECTION 1

Introduction

“Is there anyone here who can tell me what this stuff is?" asked a large burly Australian. He had walked into our Marine Botany laboratory on the campus of the University of Queensland and was holding a clear plastic bag with some seawater and some tufts of what looked like algae in it. As he held it up for all to see, we introduced ourselves to each other.

I had been at the University of Queensland with my wife Dr. Judy O'Neil for several years, arriving in 1992. Judy had done her PhD research on a marine Cyanobacteria (= blue-green algae) and was the expert we all turned to when there was a slimy thing to identify or understand. I retrieved Judy from her office and introduced her to Peter Oliver and he began to explain the reason he had driven down the coast to Brisbane to sort out the mystery in the bag. We also had a postdoctoral fellow, Dr. Cindy Heil, in the lab who was an expert on phytoplankton, the single celled algae that can lead to toxic blooms, like red tide. Cindy was intrigued and joined us.

Peter said, "The fishermen's skin is peeling off and they think that it has something to do with this slime that gets on their nets and their crab pots. Can you figure out what it is?" Peter had been approached by Deception Bay fishermen on 23 August 1997 at a public meeting. They told him that these blooms had plagued them the previous Austral summer (1996-1997) and that they estimated the bloom area to be 7 km². The fishermen found enough of the ‘slime’ to put into a bag and this is what Peter approached us with in September 1997.

Microscopic view of Lyngbya filaments (left) and skin rash induced by Lyngbya (right).

Judy removed some of the slime from the bag and placed it in a Petri dish. She then placed the Petri dish under both a low power dissecting microscope and then a high-powered binocular microscope. She quickly realized that there were several different species mixed in the sample, but one was the predominant species. She pored over several identification keys looking for features that would distinguish this cyanobacterium from others. After some time, she started to read aloud the description of *Lyngbya majuscula*, which

included a line about it occasionally causing skin rashes. Peter, Judy, Cindy and I looked at each other and nodded. Now we had a name and could start looking through the scientific literature for information.

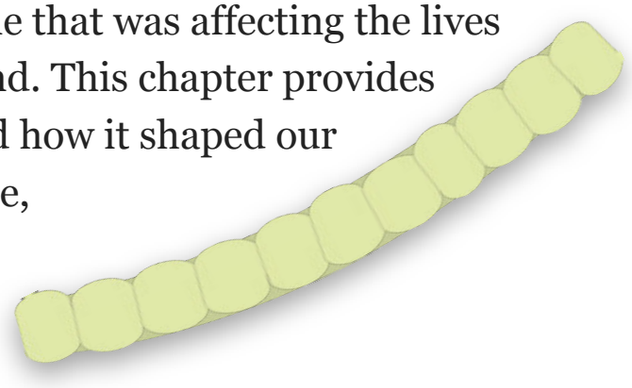
I had visited Australia in 1985-6 to study corals on the Great Barrier Reef as part of my postdoctoral stint at Stony Brook University and had fallen in love with the country and its people. Years later, when I had an opportunity to return to Australia as a Lecturer at the University of Queensland, I readily accepted and even convinced my new wife Judy to finish her PhD research in Australia. We arrived early in Queensland in 2002 and created a Marine Botany group within the Botany Department. Our Marine Botany group became very active in providing science for the Healthy Waterways campaign that was created to address water quality and environmental issues in a Southeast Queensland. It was through our efforts in the Healthy Waterways campaign that I encountered Peter.

Judy and I had our first daughter in 1995, just as Judy finished her PhD through the University of Maryland studying a marine cyanobacteria, Trichodesmium. Following her PhD, she was leading a research effort called Plankton Trophic Dynamics in Moreton Bay. I was supervising a suite of PhD, Honours and undergraduate students in addition to post docs and research assistants in the Marine Botany group. When the Lyngbya bloom came into our life, it was while we had a young daughter and in 1999, a second daughter. This created a personal and professional balancing act throughout our research and management efforts on Lyngbya.

Moreton Bay, Australia

Brisbane during the 1990s was the fourth fastest growing region in the world. The Healthy Waterways campaign was created in 1995 in response to this rapid growth. We had launched a major two year research effort called the Moreton Bay Study in 1996. The Marine Botany group was responsible for several of the scientific tasks, and it was in this context that we began our Lyngbya research.

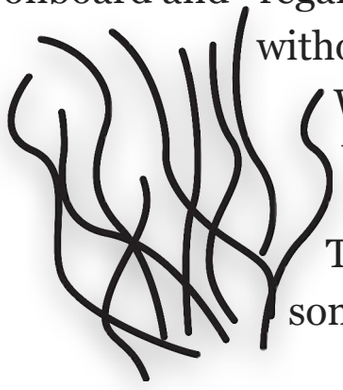
This visit that Peter made to our lab launched us into a journey of scientific discovery and we soon became enmeshed in the saga of this toxic slime that was affecting the lives of fishermen on Bribie Island. This chapter provides the story of this journey and how it shaped our interactions between science, management and policy.



What happened

Lyngbya birthday party

Before Peter left the lab, we arranged to come up to Deception Bay and have a look for ourselves. We had a trip to the research station at Stradbroke Island scheduled and organized to have the university research boat take us up to Deception Bay, where one of the graduate students, Ben Longstaff, was deploying and retrieving underwater light meters. Ben and his field crew had a full day of field work planned, so I had the research boat drive up to a prearranged spot and pick up Peter during our lunch break. Peter came onboard and regaled us with stories and songs, and sang without accompaniment aboard the Sea Wanderer II as the dive team was taking a break from their underwater tasks.



This is when I first knew that Peter was someone special. He spoke about fishermen that he had developed a relationship with and encouraged us to help try to understand what was going on with these mysterious blooms that was causing the fishermen to experience severe skin rashes. After finishing our field work and dropping Peter off, we headed back to the Moreton Bay Research Station at Dunwich, Stradbroke Island.

That night we gathered our scientific team together to discuss this development. We realized that we had contractual obligations to undertake the research scheduled for the Brisbane River and Moreton Bay Wastewater Management Study, Phase Two. Yet, even if we did a superb job on the allocated tasks but ignored the Lyngbya blooms, we would be viewed as failures for not tackling the most pressing issue. So we committed ourselves to reallocating effort to Lyngbya.

A couple of months later, we heard from Peter again and he said that the bloom had returned. We were in the midst of our Marine Botany group annual field trip based at the Moreton Bay Research Station. We had all of the University of Queensland boats assigned to the different research teams, so we had to scramble to find a boat. We were able to get ahold of an inflatable boat that the Zoology Department used as a floating platform to watch dolphins. The boat and its trailer were not very robust, but it was the best we could do, so Judy and I set off to find Lyngbya. It turned out to be Judy's birthday in February 1998. So Judy's birthday party was a sampling trip to Deception Bay, swimming in toxic cyanobacteria blooms. There were stinking, rotting masses of Lyngbya at the boat ramp and it was truly disgusting.

Judy O’Neil’s impressions

"Happy Birthday" did not seem to cut it with Judy. We managed to collect enough Lyngbya and seawater to transport back to the research station to do our experiments, and thanks to our colleagues back at the research station, even come up with a birthday cake.

We had an American exchange student in our lab, Liz Duffy, so Judy assigned her the task of running some bioassays on the samples we collected from Deception Bay. We performed some 'bucket experiments' with Lyngbya. These are experiments where fresh Lyngbya samples are collected from the site and placed into a series of containers with different chemicals added to the seawater.

After an incubation period, we measured the nitrogen fixation rates after adding nitrogen, phosphorus and/or iron. Because of the issue of iron precipitating out in seawater, we also added a chemical compound that is known as a chelator. This is a compound that forms a ring structure with metals which serves to keep the metals form precipitating. The combination of iron and a chelator was the 'winner' - the Lyngbya nitrogen fixation rates took off.

The fishermen’s story

Peter helped organize an introduction to Greg Savige and gave us his address on Bribie Island. Judy and I met Greg and his wife Julie, and they told us the amazing story of how Lyngbya, which they had taken to calling 'Fireweed,' and how it had affected their lives. Greg sheepishly told us that they had been living with this for a couple of summers. Greg told us that he and his fellow fisherman had started noticed the rashes in their private parts, from when they didn’t wash their hands after handling the slime on their gear before relieving themselves. Because of their sensitivity, they didn’t share this news with each other for some time. Greg said "My father was a fisherman and his father was a fisherman and they never spoke of anything like this". He continued, "My catch is down and so is everyone else's. The government closed Pumicestone Passage to commercial fishing and now the only place we can fish is covered with 'fireweed.'"

We told Greg and Julie that we were looking through the scientific literature and found a previous account of Lyngbya up north in Hervey Bay by Dr. Alan Cribb, the University of Queensland Marine Botanist who was my predecessor. In addition, we had found a lot of

Greg Savige’s impressions

papers on secondary compounds extracted from Lyngbya with various potential pharmaceutical attributes. Then Julie piped up and said "I searched on the Internet and found reports of 'stinging limu' in Hawaii that a newspaper reporter wrote about and they identified it as *Lyngbya majuscula*." She gave us some print outs to take with us. We realized that both the scientific approach and the media accounts were going to be useful in tracking this bloom. Because of this visit with Greg and Julie, Judy and I became more committed than ever, realizing that our science could directly affect real people.

We said our goodbyes and headed back to Brisbane, as we had our daughter at Campus Kindy and we needed to pick her up. Raising our small children while working on the same project was the most challenging balancing act that we encountered. But Lyngbya was a project that we both were committed to, and we adapted to the schedule balancing that it required. We started to think a lot about what was causing the blooms. We felt that if we could identify the cause(s), we would have a chance at controlling it, or at least forecasting it and better coping with its impacts.

Bahamas shipwreck

We had a look back in our field notes and we realized that we had encountered something that was in all likelihood a bloom of Lyngbya several years earlier. Judy was conducting her PhD research aboard the R/V Columbus Iselin, the University of Miami research vessel. Doug Capone and Ed Carpenter were the chief scientists on a Trichodesmium project and Judy was a graduate student on the project. Trichodesmium, like Lyngbya, is a cyanobacteria that can convert (or 'fix') nitrogen from the molecule of N_2 into an organic form that can be used to form amino acids and proteins. The N2 molecule has a triple bond which makes it very difficult to break apart, and only bacteria and cyanobacteria can achieve this feat. Because these cyanobacteria can 'fix' nitrogen gas dissolved in seawater, the limiting factors for their growth are typically other nutrients. Thus, the Trichodesmium team had been studying the influence of phosphorus and iron on bloom formation.

In the summer of 1990, I was tagging along on one of the Trichodesmium cruises that transited through the Bahamas in route to the Sargasso Sea. We had heard about a guano shipwreck from Brian Lapointe, a colleague who lived in the Florida Keys. The ship, the Arimoroa, was a 260' Lebonese freighter carrying a load of guano fertilizer when it went aground on a reef in the Bahamas. The hull had cracked open and the guano was leaching into the shallow waters around the ship. Guano is formed from the accumulation of bird excrement in large colonies of seabirds. The fertilizer formed in guano is very rich in phosphorus, both because birds do not digest phosphorus effectively and because microbial transformations within the guano removes nitrogen.

We went scuba diving on the rusty Arimoroa shipwreck and found a waving ‘shag carpet’ of reddish algae blanketing the seafloor, overgrowing the corals and other reef organisms. At first, we thought we were looking at a bloom of red algae, but when the samples were examined under a microscope and we found incredibly high rates of nitrogen fixation, we realized that it was a cyanobacteria. We didn't develop a confirmed identification at the time, and we called it Microcoleus, but in retrospect, it was likely Lyngbya.

Investigating causes of Lyngbya

So when we began investigating the potential causes of Lyngbya, our recent experience had us looking for sources of phosphorus. We measured high rates of nitrogen fixation in Lyngbya, so we knew that sources of other nutrients would be important. We had recently initiated a systematic nutrient sampling program in Moreton Bay in order to develop an Ecosystem Health Monitoring Program. The nutrient maps that were generated showed very clean water in Deception Bay. Clean oceanic water flushed into Deception Bay through the wide opening to Moreton Bay just to the north of Deception Bay. We also collected water samples from directly in and adjacent to the Lyngbya bloom site. We did find small amounts of dissolved phosphorus throughout most of Moreton Bay waters. The concentrations were low, but since the amount of phosphorus needed for growth of marine algae and cyanobacteria was relatively low, there was enough phosphorus in Moreton Bay for Lyngbya. We didn't need a guano shipwreck to supply phosphorus for Lyngbya.

We also looked for any signs that sewage effluent could be implicated in the Lyngbya bloom. As part of our research effort by the Marine Botany group at the University of a Queensland, we had developed a sewage plume mapping technique. This technique used the absorption of nitrogen stable isotopes by macroalgae deployed in Moreton Bay. Repeated measures using this technique showed that the sewage plumes were concentrated in western Moreton Bay, but did not extend to Deception Bay.

We looked for other factors that could account for the Lyngbya blooms in Deception Bay. The next candidate was iron. We found a report of Lyngbya blooming in an aquaculture pond in Egypt which implicated high iron concentrations. The Trichodesmium team had discovered that aerosols of dust from the Sahara desert were deposited in the Atlantic Ocean and the dust contained iron that stimulated blooms of that cyanobacteria. So we set off to find iron sources. On one of our first searches, we went to the mouth of each stream that we found flowing into Deception Bay and nearby Pumicestone Passage to collect water samples. In a small stream on Bribie Island near the bloom site we struck what we thought was gold. The sediments and even the mangrove breathing roots were coated with an orange colored flocculation. When we had the water samples analyzed, we indeed found very high iron concentrations.

Fraser Island bloom

In January 1998, we received a call from Max Haste, the head ranger at Fraser Island. Fraser Island is part of the Great Sandy National Park and administered by the Parks and Wildlife division of the Queensland State Government. Max had been following the media reports about the fishermen's skin rashes in Deception Bay that had been linked to the Lyngbya blooms. He told us that people swimming in the water were reporting skin rashes in the areas covered by their bathing suits, particularly after swimming in a location called the "Champagne Pools.'

Driving on the beach on Fraser Island.

And to cap it off, one of the rangers had driven along the sandy beach and his son rode with his head out the window. The drive along the beach from the southern end of Fraser Island where the ferry from the mainland landed to the northern ranger station was a couple of hours long, and this young boy developed a severe rash on his entire face, even his eyelids were affected. Max also reported an unusual mass mortality of some sea hares that washed up on the beach as well. Clearly, something was out of whack on Fraser Island.

Judy and I had never been to Fraser Island and it was on our 'to do' list, so we jumped at the opportunity to come investigate the bloom. We asked about bringing along our 3 year old daughter, and Max advised against it. He said that the dingos were becoming too aggressive and it would not be safe to bring along young children. Interestingly, it was only a couple of years later when a pack of dingos killed a young boy, and Max was called upon to cull the aggressive alpha male dingos from the island.

With Judy staying home with our daughter, I mobilized a field trip with one of our Marine Botany post-graduate students, Ben Longstaff. We took a four wheel drive vehicle and a small boat with us, as Max advised. They provided us with accommodation at the ranger station. We collected some of the algae that was washed up on the beach and it was primarily a red filamentous algal species, with various strands of green algae and a few fronds of the large brown algae. The red algae was a common species, and it definitely was not a goopy mess of Lyngbya like in Deception Bay. But upon closer

inspection, it was clear that there were filaments of Lyngbya mixed into the red algae.

We surmised that the red algae was only the 'delivery vehicle' for the Lyngbya. The red algae tufts would wash up on the beach at high tide, become dried out in the sun and when the ranger's vehicle's tires crushed the algal tuft, the Lyngbya filaments were aerosolized. The swimmers reported seeing tufts of red algae in the water and presumably the Lyngbya filaments lodged beneath their bathing suits. There is little freshwater on the northern end of Fraser Island, so showering or bathing to remove the seawater was not easy, thus the swimmer's symptoms were likely aggravated.

We then launched the boat into the surf from the beach. It was a bit bouncy but the wind was coming up and our only chance to get offshore to investigate the bloom was to head out with the stiff onshore breezes. We were essentially looking for a needle in a haystack. But we could see some dark patches underwater so we anchored and dove down to the bottom. We found some outcrops of dark, crumbly rock, referred to as 'coffeerock.' This coffeerock was an organic concretion that formed on sand barrier islands and other coastal plant communities. These coastal plant communities are known as 'wallum' vegetation, and it is typified by grass trees, banskia trees, and other plants tolerant of extremely low nutrients.

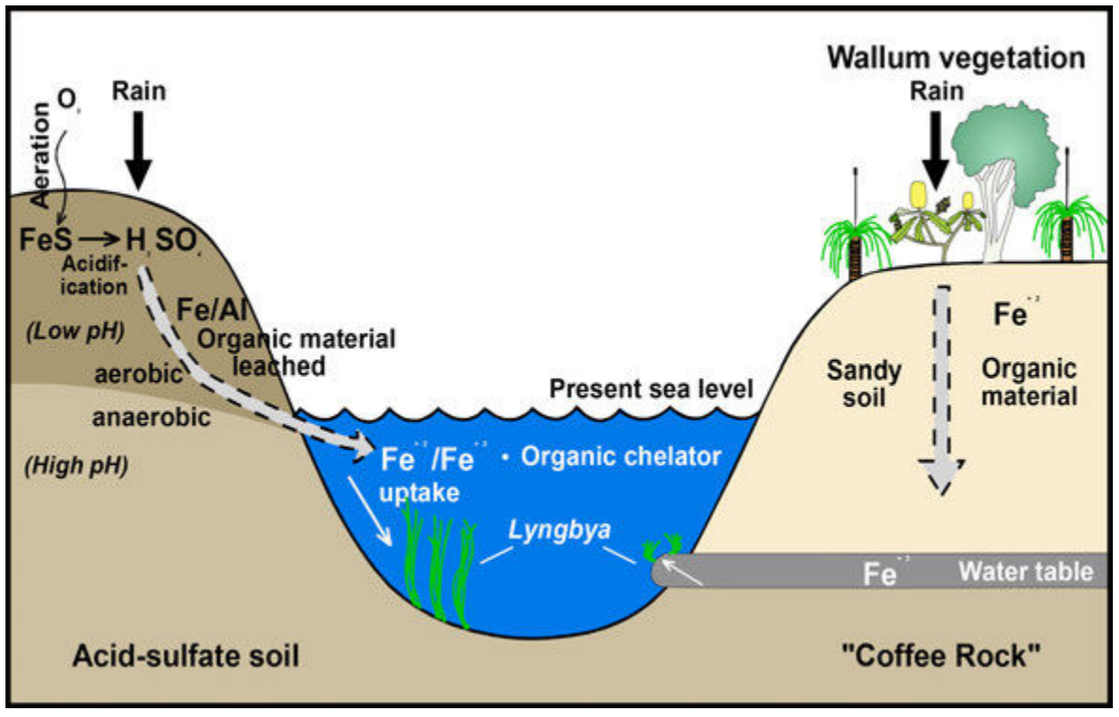
We found tufts of Lyngbya growing on the coffeerock, which helped explain the skin rashes and the sudden appearance of the Lyngbya could be due to the emergence of the coffeerock from the shifting sands offshore Fraser Island. The coffeerock was formed on the island, but as the island's dynamic shoreline moved and shifted, the coffeerock was alternatively buried and exposed. We also had observed coffeerock outcrops along the shores of Pumicestone Passage. Upon investigating coffeerock, it was clear that it contained large amounts of metals that were leached through the sandy soils. We surmised that coffeerock could be a good source of iron to stimulate Lyngbya growth.

Acid sulfate soils

We began to become interested in acid sulfate soils like coffeerock that could be sources of nutrients and iron. Acid sulfate soils (which the Australians abbreviate as ASS, inducing much amusement among the Americans with the multiple double entendres that ensued) were formed when marine sediments were dredged and placed on land to dry out. The drying process oxygenated the soil which leads to a chemical change in which sulfuric acid is produced. The re-wetting of the dried soils then leached the acid out which provided an opportunity to remove metals in the soil (Moreton Bay Study: Scientific basis of the Healthy Waterways campaign 1999).

As a result of our implication that acid sulfate soils could be stimulating Lyngbya blooms, we were contacted by two soil

scientists who worked for the Department of Natural Resources. These scientists, Bernie Powell and Col Ahern, were at first quite skeptical that there was any connection between acid sulfate soil and cyanobacteria, but once I gave them a summary of our observations and the background of the iron/cyanobacteria connection, they invited me to speak at the conference they were organizing. This conference really opened my eyes to the world of acid sulfate soils and the importance of metal leachate making it into rivers and the ocean.



Our initial conceptual diagram of the causes of the Lyngbya blooms.

Bribie Island caravan park laboratory

We prepared for the summer of 1998-1999 by making regular field trips to Deception Bay. The new research station at Stradbroke Island was under construction, so we were unable to use it for the summer of 1998-1999. But we had been going along to various meetings with fishermen and other concerned people in the Deception Bay region and when they learned that we were looking for space to conduct experiments, launch our boats, and house our team, they came up with a generous offer. We were given access to several cabins at the Bribie Island Caravan Park, which we converted into sleeping cabins, a cooking cabin and a laboratory. We used the lawn as our wet lab, and had wet suits, dive gear and life vests strewn around our trailered boats.

It was time to bring in an iron chemist. We asked around and were directed to a fellow named David Waite at the University of New South Wales in Sydney. It turns out that David was in the M.I.T. lab in Boston when I was in Woods Hole, working on my PhD. We had some mutual friends, and we quickly found a lot of common ground and started a productive collaboration. David quickly disavowed us of the notion that the precipitated iron that we found in the stream mouth could have anything to do the Lyngbya bloom. David made us realize that we had found fool's gold. Iron that is dissolved in freshwater immediately precipitates when it meets seawater. Once the iron precipitates, forming the visible flocculate that we saw on Bribie Island, it is no longer biologically available for Lyngbya.

David and his colleagues had been studying iron complexation with humic substances. Humic substances are organic compounds that are formed when plant material breaks

down. David had the theory that these humic compounds could be the vehicle to get the iron from the iron-rich soils on land to the site of the Lyngbya blooms. So we were on the lookout for humic substances which stain the water a tea color. And then we had some good fortune during a sampling trip that followed a rain event. We were in the university research boat and saw a plume of stained water that was flowing over the area where Lyngbya was blooming. We knew that this event was not going to last because the tide was going to turn and it could dissipate quickly. We quickly mobilized an overflight and the aerial photos that we obtained showed that the plume originated from the artificial inlets created for a recently created canal estate, Pacific Harbour.

David showed up at the Bribie Island Caravan Park with his post-graduate student Andrew Rose and his colleague Ron Szymczak from the Australian Nuclear Science and Technology Organization. Judy was there to meet them, while the rest of us were out sampling. She was barefoot and very pregnant with our second daughter and had our three year daughter underfoot. Ron had met Judy before, but thought that this barefoot and pregnant woman was the caravan park manager. After they got settled and the field team returned, Ron was chagrined to recognize Judy as one of the Chief Scientists on the project.

We learned that the Bowls Club adjacent to the caravan park served inexpensive basic meals and we could walk over and eat dinner quickly and come back to the laboratory at the caravan park and continue our experiments. We did have some problems with our students, because there was a dress code which included wearing shoes. We needed to wear shoes, as I broke my toe walking barefoot on a field trip with David looking for iron sources along the shoreline.

The big bloom of 2000

Andrew Watkinson's impressions

Judy and I and encouraged one of the young undergraduate volunteers to study Lyngbya for his Honours thesis. The young man, Andrew Watkinson, started his Honours year mid-year, which was in July 1999. We had begun to allow the students to do their literature searches and develop their proposals in the spring semester, collect the bulk of their data during the summer break and then have the following semester for analysis and writing. Andrew had a mate, Ian Hewson, also starting his Honours at the same time and Ian was keen to study marine bacteria and viruses. Andrew set up several data loggers and started sampling in late 1999, but there wasn't any Lyngbya appearing. We all started to get a bit worried about his thesis and began contemplating alternative thesis topics. Then we received a call from Greg Savige, "It's here!" It was, of course, coincident with Judy's birthday again, and she missed out on her birthday, again. It was difficult to stifle our initial pleasure at receiving such bad news, because as bad as it was for Greg and

the other fishermen, it was our best opportunity to understand what was causing these outbreaks.

Andrew had deployed several environmental sensors in Deception Bay and was able track the conditions before, during and after the bloom. This was a real scientific bonanza, because very often, scientists are running around after a bloom is detected collecting data and trying to infer what had happened prior to the bloom. Not having direct measurements of conditions preceding a bloom makes it difficult to infer casual agents of the bloom. But Andrew had been collecting data well before Christmas and we had arranged various contingencies to mobilize our efforts in case the bloom occurred over the Christmas holidays. Now that the bloom was detected in January, we were able to map it, track its development and begin conducting experiments.

On one memorable sampling trip, Judy was with Andrew Watkinson and Tim Carruthers from our Marine Botany group when the tide dropped quickly and they were caught in the bowl that was formed at low tide in the Amity Banks. I received a frantic call from Judy, as I needed to cut short my trip to the CSIRO laboratory about 45 minutes from campus and return to retrieve our daughter from Campus Kindy. We remember the date well, as it was our eleventh wedding anniversary, 9 September 2000.

Andrew and Greg Savige teamed up to map the extent of the Lyngbya bloom. Their bloom mapping documented the explosive growth of Lyngbya. We calculated this bloom expansion rate as 100 m^2/min. This seemed to be an absolutely unbelievable rate and we checked and rechecked our calculations, because it just seemed too incredible. But on one field trip, we unintentionally learned how insidious this cyanobacteria was. We collected some sediments and seawater in ziplock plastic bags and transported them to the laboratory in Brisbane. In order to preserve them, we placed the sample bags into a walk-in cold room.

Lyngbya fouling the fishermen's nets.

After a long day in the field, everyone is ready to go home, take a shower and eat dinner. In our haste to head home, three of the plastic bags with sediments and seawater were left out on a lab bench at room temperature. When we came into the lab the next morning, we discovered an amazing and scary sight. The bare sediments had sprouted three inches of Lyngbya filaments that were waving in the seawater within

the bags. It was a horror movie! Judy had a terrible allergic reaction to this bloom. This helped explain how quickly the blooms could appear, seemingly out of nowhere. But just as fast as this bloom could appear and expand, we also learned how quickly it could disappear. The bloom would disappear within a few days, and Ian Hewson ended up documenting the viruses that infected the cyanobacteria, inducing a rapid bloom decay.

Canal estates and the Lord Mayor

As a result of the large bloom in early 2000, the press had started reporting the Lyngbya blooms and the Lord Mayor of Brisbane, Jim Soorley, asked for a briefing. We went into the city on 7 April 2000 and I showed a 3 minute video of the bloom that Andrew had pieced together along with some of the early data that implicated dissolved iron runoff as a potential causal agent. I also showed the aerial photos that we had taken of the stained runoff that was apparently coming out of the canal estate inlet.

There was an unfortunate exchange with the lead scientist from the Department of Primary Industries Fisheries Divison which created an uncomfortable working relationship for the next several years. It turns out that the fishermen had reported this bloom to the scientists at this department, as DPI had a lab on the shores of Deception Bay and they were the agency responsible for fisheries research. These scientists did not have the background or expertise to deal with algal blooms. Their initial reaction was to dismiss the fishermen's concerns as hyperbole and they assumed that the bloom was part of a natural cycle.

When I had completed my presentation, the lead scientist from the Department of Primary Industries, Mike Dredge, started to make some assertions about what he thought was happening, and the Lord Mayor, who never suffered fools gladly, launched into him. He said "Do you have any data to add to this conversation? If you don't, perhaps you should keep your mouth shut." I was tainted by this brutal rebuttal, and from this time on, the scientists from the Department of Primary Industries were very cool towards me and my team. They kept looking for alternative explanations for the bloom, which actually turned out to help us build a comprehensive research effort.

I had two quick private conversations with the Lord Mayor that were very consequential. Jim Soorley asked me how much money I needed to properly study this bloom. I indicated that several hundred thousand dollars properly targeted and managed would go a long way. He was willing to have me call for a bigger number, but I sensed that too much money too quickly would be a distraction and would possibly be more headaches than it was worth. It would be better to do a good job with a smaller amount of money than set high expectations and let people down. In addition, after waiting so long for the bloom to initiate, I was somewhat apprehensive that the blooms would not be there to study.

It turned out that a) we eventually did end up with over a million dollars in funding several years later and b) the blooms regularly turned up over the next several years. So the Lord Mayor made some quick calculations in his head and developed a funding strategy which involved him putting up $100,000 of Brisbane City Council money, having it matched by $100,000 by the other local councils in Southeast Queensland, and then this local government money matched by state and federal monies.

Deception Bay shoreline during Lyngbya outbreak, with warning sign and backhoe.

The other conversation was about the role of the canal estates in initiating the bloom. The Lord Mayor asked me if I would be comfortable placing the blame on the canal estate. I declined, as we only had aerial photos of stained water at this stage. We didn't know if the stained water had anything to do with the bloom and we didn't know how the stained water was actually produced. Jim Soorley was gracious in not pushing me, but said "I understand that you cannot say that it is the canal estates, but I can and plan to do just that." He then literally walked out of the building to the press corps that had encamped outside the building and called for a moratorium on canal estates. This call to end canal estates represented a big political shift, as the state of Queensland, and particularly the long serving former Premier, Sir Joh Bjelke-Petersen, had been very supportive of canal estate developments.

The next morning I received an irate call from Dr. Peter Scott, the lead environmental scientist who was contracted by the Pacific Harbour corporate body. Peter assumed that I was involved in the call to end canal estates and threatened to sue me and the university, among other things. I assured Peter that I was solely interested in determining the cause of the bloom and would appreciate any help that he would be willing to provide. Peter calmed down and joined the scientific panel that we assembled to oversee the research.

The bloom resulted in the local council, Caboolture Shire Council, erecting temporary signs along the beaches warning people about coming into contact with Lyngbya that washed up on the beaches. The Council also was hiring small bulldozers and dump trucks to drive onto the beach at low tide and scoop up the rotting Lyngbya and trucking it to the landfill. It was really a mess and the press were reporting on the bloom regularly.

Tracking down the iron

In addition to the Deception Bay bloom in 2000, something happened that changed everything. In March, we started spotting patches of Lyngbya on the Eastern Banks of Moreton Bay that soon expanded to cover much of the seagrass that grew on the shallow sandy sediments. Since these seagrass meadows supported the Moreton Bay dugongs and green sea turtles and Lyngbya posed a threat to these iconic creatures.

We hypothesized that the floating mats of Lyngbya that we observed over the Deception Bay site had rafted over to the Eastern Banks. This provided even more incentive to study and manage these blooms and a Lyngbya Steering Committee and a Lyngbya Scientific Working Groups were formed in 2000.

Rafts of floating Lyngbya in Moreton Bay.

Moreton Bay blooms expand

In the following Australian summer of 2000-2001, we began to look for potential sources for iron that would fuel the Lyngbya blooms. Another student joined in the project, Simon Albert, and he was very resourceful when it came to collecting soil samples that we wanted to test. Simon would launch his kayak in Pumicestone Passage and paddle up the streams to gather soil samples from different land uses, or take a four wheel drive to access remote locations.

Simon performed some simple experiments that were very powerful using his soil samples. It was an interesting contrast between Simon's experiments versus the ultra clean iron chemists. Simon would take buckets of soil samples that he mixed with water to make a soil extract and then he placed large tufts of Lyngbya into replicate jars with different soil extracts. By the time he had his experiment set up, Simon and the wet lab was a total mess. In contrast, the iron chemists were in clean lab coats using glassware, pipettes and lab instruments. But as messy as Simon's experiments appeared, his results were very clean. In fact, we could see the results before analyzing the Lyngbya. Lyngbya in the sample jars with soil samples from the pine forest was visibly darker due to more pigmentation and would float to the water surface, forming bubbles from the oxygen produced by photosynthesis.

In addition to the soil extracts stimulating Lyngbya, David Waite and his team of iron chemists were able to show that

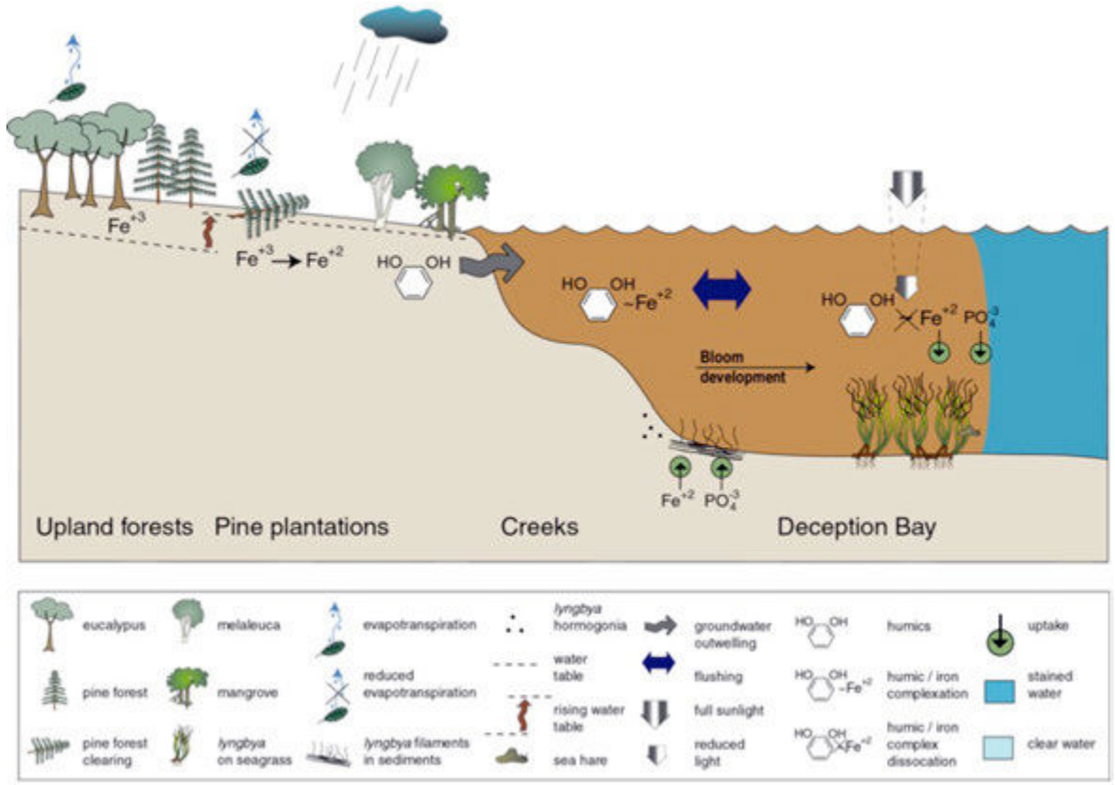
the humics from pine forest runoff could complex with dissolved iron. They also performed experiments that showed that ultraviolet light exposure from sunlight would break the humic-iron complex and release the iron for uptake by Lyngbya. We also conducted an overflight following a rain event and could see vast tracks of Bribie Island that had been recently clearcut and the stained humic water that was clearly coming from these clearcut areas.

Stained water from pine plantation runoff (left) and seawater from Deception Bay (right).

We drove a small research boat up a Bribie Island stream following the stained water, collecting water samples. The smell of pine trees became stronger and stronger as we went upstream. When we arrived at the site of the clearcut trees, the scene was like a moonscape. What was enigmatic about the scene was the presence of standing water in the sandy soil even though it hadn't rained for many days.

Making the forestry connection

These results provided us with enough ammunition to approach the forestry industry, which was regulated by the Queensland Department of Primary Industries. Simon and I went to the forestry offices and presented our results. We were not welcomed with open arms, to say the least. But our results were quite compelling and the foresters eventually opened up and after a few more visits and a tour of their operations we began to piece together what had happened.



Conceptual diagram of Lyngbya blooms of Deception Bay, linking humic runoff to blooms.

It turns out that the pine tree plantations used an imported American species of fast growing pine trees. The standard practice was to have a rotational harvest of different forest tracts. But there had been a series of large bush fires during

the mid 1990s in the region, necessitating a massive clearcut to salvage the remaining timber. In addition, there was a buyout of one of the forestry companies, providing an economic pressure to clearcut various tracts. And then to complete the perfect storm, a prolonged drought was followed by some intense rains so the bare soil that didn't have trees anymore didn't have any evapotranspiration, causing the groundwater levels rise to the soil surface. This explained the standing water that we had observed and the humic runoff following rain events.

The timing of the change in forestry practices, runoff events and weather conditions resulted in the conditions necessary to initiate the Deception Bay Lyngbya blooms, but we were also learning about other outbreaks of Lyngbya in Australia and we set out to investigate these blooms as well.

Great Barrier Reef bloom

There is a small reef formation that is in the shape of a valentine heart within a large reef complex, Hardy Reef, in the central Great Barrier Reef. This 'Heart Reef' is a tourist destination, particularly popular with honeymoon couples who have their picture taken in the reef. In order to take the tourists to 'Heart Reef,' a floating helicopter platform was anchored in the reef lagoon nearby. In fact, it was the helicopter pilot who had been making the trip to 'Heart Reef' for twenty seven years who alerted the Great Barrier Reef Authority about patches of what turned out to be Lyngbya.

After being alerted by the Great Barrier Reef Authority, Judy and Andrew Watkinson traveled twice to Hardy Reef in early 2002 to investigate the bloom. They travelled via a seaplane to Hardy Reef and they found the helicopter platform to be a wonderful seabird roosting site. Bird guano accumulated on the platform and was washed into the reef lagoon when it rained. They brought both Lyngbya and guano samples back to the lab in Brisbane and performed experiments to show that the guano did indeed stimulate Lyngbya.

'Heart reef' formation on Hardy Reef.

Searching for answers

The Lyngbya blooms that began in 2000 continued each summer on the Eastern banks of Moreton Bay. There were higher than usual dugong mortalities and a complete reproductive failure by green sea turtles reported. This led to even more press attention. I soon became beseeched by

reporters, with phone calls to my mobile phone beginning at 6:30 am and continuing throughout the day.

We were searching for an iron source for the Eastern banks Lyngbya blooms when we encountered a tantalizing event late one afternoon at low tide on the banks. We saw some stained water flowing out from a sandbank just before the tide switched and the flood tide rolled in. We were unable to sample the stained water or even photograph it, so we returned at the next low tide which was 5 am the next morning, armed with sampling gear and cameras. But there was no stained water on this tide or any of the subsequent low tides where carefully watched for this event to repeat itself.

We began an investigation to determine if groundwater could travel from the sand barrier islands, North Stradbroke and Moreton Islands, to the Eastern banks. We visited a sand mining location to view the soil profiles that were exposed and learned that these large sand barrier islands were not just big piles of sand. There were layers of coffeerock throughout the soil profiles and these formed impervious layers like swimming pool liners. It was conceivable that groundwater could travel along these impervious layers and find its way to Lyngbya out on the Eastern banks, but we never did find the 'smoking gun' for this transport like we did for the Deception Bay blooms.

Living with blooms

Following our intense Lyngbya research, there has been an ongoing monitoring and research effort, embedded within the Queensland state government. Blooms have occurred every summer with varying intensity and duration. Caboolture City Council regularly cleans the beaches where Lyngbya washes up which has cost them over $750,000.

In 2006, the Altered Oceans series by Ken Weiss was published in the Los Angeles Times, featuring the Queensland Lyngbya blooms. This series netted Ken a Pulitzer Prize. In 2007, a Coastal Algal Blooms Action Plan which includes Lyngbya clean up activities, public signage and web alerts was released. The mapping and prevention of acid sulfate runoff is part of the ongoing effort as well.

Lyngbya clean-up effort on Deception Bay shoreline.

Lyngbya time line

Summer of 1996 - 1997: Large Lyngbya blooms in Deception Bay observed by fishermen; estimated to be 7 km² in area

23 August 1997: Peter Oliver is informed by fisherman of Lyngbya blooms in Deception Bay

September 1997: Peter visits the University of Queensland with Lyngbya sample, Judy O'Neil identifies *Lyngbya majuscula* in sample

December 1997: Onset of Deception Bay Lyngbya bloom; initial bioassay experiments

3 February 1998: Deception Bay field trip - Bill Dennison & Judy O'Neil; initial Lyngbya experiments

March 1998: Fraser Island Lyngbya field trip

Summer of 1998 - 1999: Deception Bay Lyngbya bloom initiated in December; Bribie Island Caravan Park field trip in January 1999

1999: Initial Moreton Bay Lyngbya scientific publication in *Bulletin de I'Institut Oceanographique Monaco*; initial Lyngbya conceptual diagram published in *Moreton Bay Study: A scientific basis for the Healthy Waterways Campaign*

Summer 1999 - 2000: Deception Bay Lyngbya bloom initiated in January 2000; first field trip to new Moreton Bay Research Station, Stradbroke Island; Andrew Watkinson documented rapid bloom expansion to 8 km², rapid bloom collapse observed in March 2000

March 2000: Lyngbya appears in Eastern Moreton Bay

April 2000: Lyngbya Steering Committee (resource managers) and Lyngbya Scientific Working Group (scientists) formed, Lord Mayor Jim Soorley calls for moratorium on canal estates

Summer 2000 - 2001: Deception Bay & Eastern Moreton Bay Lyngbya bloom, 10 km²; Simon Albert's soil extract experiments implicate pine plantations; bloom reported from Hardy Reef, Great Barrier Reef

March 2001: Lyngbya Scientific Workshop, University of Queensland

July 2001: Lyngbya Scientific and Stakeholder Workshop at Moreton Bay Research Station, Stradbroke Island

October 2001: Initial Lyngbya fact sheet/newsletter published with revised Lyngbya conceptual diagram

Summer 2001 - 2002: Deception Bay & Eastern Moreton Bay Lyngbya bloom, 10 km² but not as persistent as previous year; field trip to Hardy Reef, reports of blooms in Peel-Harvey estuary in Western Australia

August 2002: First Lyngbya Management Strategy released

Summer 2002 - present: Deception Bay and Eastern Moreton Bay Lyngbya blooms of varying intensity and duration; regular monitoring by Queensland government

September 2005: Lyngbya synthesis chapter published in *Healthy Waterways Healthy Catchments: Making the connection in Southeast Queensland, Australia*

30 July 2006: Altered Oceans series by Ken Weiss published in Los Angeles Times featuring Moreton Bay Lyngbya story

2007: Coastal Algal Blooms Action Plan for Southeast Queensland released

Lessons

The Lyngbya project provided many important lessons, partly because it was an intense research and management effort embedded within a larger cause (Healthy Waterways Campaign). But it also was very much a hands-on effort with immediate dissemination and feedback, thus the lessons were realized quickly and the learning that was obtained was deep learning. In my long experience doing research, I don't think that I ever learned so many new topics so quickly and so deeply as during the Lyngbya project.

I had crash courses in physiology, life cycles and evolution of cyanobacteria, nitrogen fixation biochemistry, sediment nutrient dynamics, acid sulfate soils, forestry practices, humic acid chemistry, iron biogeochemistry, light interactions, bacteria and virus dynamics, small scale oceanography, food webs, sea hare physiology, fish feeding, toxin production and effects, groundwater movement, coffeerock and other soil formation, science communication, science politics, and media relationships. I am certain that other people learned similar as well as other topics as part of this research and management effort.

In terms of praxis for the environment, I learned similar lessons as part of the Lyngbya team to those that Peter learned with his Find Another Batching plant group. These are outlined below:

Working on environmental issues really does take time, passion and commitment

Bill Dennison on a field trip in Deception Bay with a student.

The Lyngbya project was a major commitment by our research team and we spent a considerable amount of time on the project. We became quite passionate about obtaining answers to the burning question of what triggered the blooms.

Knowing that people's health and livelihoods were dependent on obtaining answers to what caused the blooms and figuring out how to avoid or mitigate the blooms provided incentive and motivation.

One of the things that really took some energy was to maintain a focus on chasing down the causes of the blooms, rather than resorting to documenting the bloom development and impacts. We had to follow scientific leads wherever they took us, which was often into new topics where we did not have proficiency. This extension beyond our scientific comfort zone meant that we were challenged to learn new techniques and develop new collaborations.

As a result of the ongoing communication activities between different sectors during the active research phase, there was a transactional cost of doing business. Results had to be interpreted, synthesized and explained in short order, directly following their creation. Fact sheets, PowerPoint presentations and scientific papers were constantly produced, which all consumed a considerable amount of time.

Money empowers, but it won't always get you everything you want

Money was an interesting aspect of this research and management effort. At first, there was no money available, and everything that we did was either piggybacking on other funded projects, reallocating existing funds or not being compensated at all. Through the leadership of Jim Soorley, Lord Mayor of Brisbane, we did obtain sufficient funding to characterize the bloom and begin discerning causes. We wrote a successful proposal to the Australian Research Council for funding as well, so we developed multiple sources of funding. And then additional money was made available through the Healthy Waterways program, which brought in more scientists to cover more aspects, so we began spending more time managing the project.

Judy O'Neil performing Lyngbya experiments in the laboratory.

I recall a wise senior scientist telling me thirty years ago the following "Give me ten thousand dollars, and I won't have enough money to do much; give me a million dollars, and I'll have too much money to get much done; but give me a

hundred thousand dollars, and I'll give you the world." The dollar amounts need to be adjusted to inflation, but the sentiment still prevails. I sometimes wonder if the Lyngbya dollars didn't start getting reaching the category of too much money to get much done.

Another aspect of money that did not play into the final analysis was the financial interest possessed by the various sectors involved in the Deception Bay blooms, namely, the fishermen, foresters, tourism industry or real estate developers. I think wealthy Pacific Harbour developers may have thought that they could push us around at the beginning, but they quickly became partners in the program. The foresters were initially quite skeptical, but they, too, became partners.

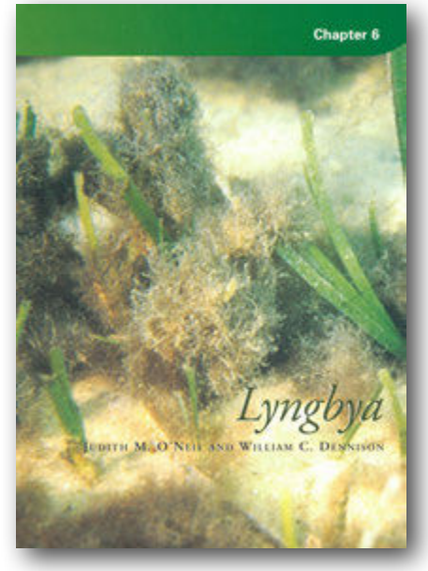
The tourism industry did not want the Lyngbya headlines, and they tried to keep the fishermen from talking about the blooms, but the blooms were soon public knowledge, so there was no stopping the publicity after it started. The fishermen did not have much in the way of financial resources, but they had an active voice as well as a working knowledge of the region that Lyngbya bloomed. In the end, the amount of money that each of these sectors had available did not play into their relative voice in the Lyngbya issue.

A small, diverse group of people with a common purpose can be very powerful

The Lyngbya blooms provided a tangible focus in time and space. We formed a small group of committed people, drew in a much larger group of involved people and focused on the common purpose of understanding these bloom phenomena in Moreton Bay, particularly during summer months. The nucleus of committed people included researchers, resource managers and fisherman. Like the joke about the difference between committed and involved being the difference in a breakfast that includes eggs, where the chicken is involved, and bacon, where the pig is committed, the Lyngbya effort had both committed and involved people.

The common purpose of understanding Lyngbya bloom dynamics provided a thread that ran through the studies that involved physics, chemistry, geology and biology. Diverse scientists came together; terrestrial and marine scientists, ecologists and molecular biologists, chemists and geologists, botanists and zoologists. Lyngbya provided the thread and the diverse group of people that followed their scientific leads produced a powerful body of work.

Judy and I wrote a Lyngbya chapter in our book summarizing the scientific results from Stage 3 of the Moreton Bay Study, Healthy Waterways, Healthy Catchments: Making the connection in Southeast Queensland, Australia. In the process of writing this chapter, it became clear that we had enough material to write an entire book. This is a testament to the scientific productivity that this project



stimulated. Following this book, published in 2005, there has been a steady stream of scientific papers, fact sheets, and management plans published on Lyngbya.

Working on environmental issues involves taking risks

A risk of studying an algal bloom is the lack of predictability of the bloom. It could appear unexpectedly, not appear at all, and disappear almost overnight. We were not able to culture Lyngbya at the outset of the study, so the only way to conduct experiments was to collect fresh material from the field site immediately before the experiment. If there was no fresh Lyngbya to collect, there were no experiments to conduct.

Another risk of studying a toxic bloom was the direct potential impact on the people studying the bloom. A couple of students brought some Lyngbya back to the Hines Building at the University of Queensland and put some of it into the drying oven on the first floor. The drying Lyngbya caused the entire four floors of the building to be evacuated. As a consequence, Judy and the student were sent to the Workplace, Health and Safety officer for lung function tests. Judy experienced breathing difficulties and had swollen and reddened eyes working in the laboratory. I still have a small scar on my arm from an open sore that was exposed to Lyngbya when I was sampling in Deception Bay. It burned intensely at the time, but I was collecting material for experiments for people waiting back in the lab and I didn't want to let them down. One of our colleagues, Ron Johnstone, put some Lyngbya into his wet suit and paid the price. A Lyngbya sample that was mailed from North Queensland to Brisbane leaked out and the Australia Post employee developed a skin rash.

In the early stages of the bloom, there was a risk that the reallocation of resources would compromise the integrity of the carefully crafted suite of research projects for Phase 2 of the Moreton Bay Study. This risk was partially offset by an increased overall effort, but it meant that resources were diverted from other pursuits.

Floating tuft of Lyngbya in Deception Bay.

In the research and environmental management realm, there were risks that the Lyngbya blooms were going to be so elusive we would either not be able to learn enough or be able to use that knowledge to prevent or mitigate the blooms. In the end, we did learn quite a bit and came up with a good

theory as to the factors affecting its origin and affecting its growth, but the ability to manage the blooms remains elusive.

A human interest aspect is needed for a newsworthy story

The media interest in the Lyngbya bloom was intensified because of the human interest aspects. Not only was the bloom affecting people's livelihoods but it also was affecting their health. Ken Weiss who wrote the Pulitzer Prize winning series, Altered Oceans, told me that the reason that the Lyngbya story became his lead was the human interest aspect. He said that once his editors at the Los Angeles Times heard about how the fishermen were affected in their private parts, it became a compelling story. They even sponsored his trip to Australia to talk with the key people involved.

Minister for Environment Dean Wells (left) being briefed by Healthy Waterways Scientific Coordinator Eva Abal (right).

The other human interest aspect to the story was the battle that Jim Soorley initiated with the canal estate developers. It ignited a public debate about whether or not canal estates should be allowed. I met many canal estate homeowners who became quite defensive, asserting that they had seen dolphins swim by, therefore, the canal estate water quality must be all right. Since most people who purchased properties in canal estates did so because of their affinity with the water and the proximity to boating and fishing that a canal afforded them, they did not want to find out that their properties were degrading Moreton Bay.

At one of the press events that was held on the Deception Bay beach where the Lyngbya washed up, a women quietly came up to me holding a silver chalice. She pointed back toward a house that had views of Deception Bay and said, "I live in that house overlooking the Bay and keep my silver in a glass cabinet in my dining room. But look at this chalice, it is tarnished like all of my silver, even though I cleaned it last week. The algae is doing something to my silver. I cannot keep it from tarnishing." As she was telling me this, I could smell the hydrogen sulfide that emanated from the rotting cyanobacteria on the beach. I recalled my Master's thesis advisor wore a silver ring on one of his toes and he would point out when he walked in smelly seagrass mud that it would tarnish. I explained to her that the sea breezes carried the hydrogen sulfide into her house and that was causing the silver to tarnish. After my explanation to the woman about hydrogen sulfide, she plaintively asked, "Please make it stop."

Working together for a common cause helps people to build and share knowledge

One of the things that typified the Lyngbya project was the ongoing communication that occurred between the researchers, fisherman, agency staff and elected officials. There was little that was not shared, rapidly and comprehensively. This ongoing communication served to widen the network of people involved and was one of the reasons that knowledge was shared effectively.

Ian Hewson and Bill Dennison at the Moreton Bay Research Station, Stradbroke Island

Our group of researchers conducted several one and two week research field trips in which the different research teams shared boats, laboratories, dining facilities and accommodations. This promoted interactions and reinforced the concept of working for a common cause. Sharing results from the different measurements and experiments also served to build knowledge with an ongoing effort to synthesize our understanding of the Lyngbya blooms.

One of the things that I began to realize was that the Lyngbya research that we were conducting attracted the best and the brightest students and scientists. We had several different ongoing projects, but it was the Lyngbya project that attracted the graduate students who were very clever and highly motivated. Many students who worked on the project went on to obtain PhD degrees and are active scientists around the world.

For example, Andrew Watkinson who did his Honours thesis on Lyngbya went on to receive his PhD from the National Research Centre for Environmental Toxicology and now works as the Principal Coordinator - Catchment Water Quality at SEQ Water. Simon Albert also did his Honours on Lyngbya, went on to do a PhD and is a researcher based at the University of Queensland. Ian Hewson included Lyngbya in his Honours, went on to finish a PhD at the University of Southern California and is now a professor at Cornell University. Andrew Rose did both his Honours and PhD at the University of New South Wales studying Lyngbya and is now a professor at Southern Cross University. This is just an example of the excellent students that 'cut their teeth' on Lyngbya research, but there were many other students who were involved in the Lyngbya project, including Kath Ahern, Karen Arthur, Angela Capper, Pippi Lawn, and Tim Salmon.

Always have fun

It was fun to be working on a project where the results were so eagerly awaited. Just as soon as we found something out, we were reporting our results to the Lyngbya Scientific Working Group and then shortly after, to the Lyngbya Steering Committee. I recall attending a science panel meeting in a building in downtown Brisbane, and then walking a few city blocks to another building to report a distilled version to the management panel with Eva Abal, the Science Coordinator for the Healthy Waterways program. Eva and I were literally editing the PowerPoint while we walked, balancing the open laptop with one hand and editing with the other.

At one point, we were contacted by one of the television stations to do an interview when we were at the Moreton Bay Research Station on Stradbroke Island. They flew over to the island via helicopter after making some aerial overpasses of the blooms on the Eastern Banks, collecting video footage. They asked us to meet them at the Dunwich rugby field where they could land the helicopter. A reporter and cameraman hopped out of the helicopter and ran over to us and conducted the interview.

Alerted by the noise of the helicopter, townspeople, particularly kids, came out to see what was going on so we gathered an audience. Following the interview late in the afternoon, we asked when this was going to air and they said it would be on that very night. After watching the helicopter head back to the television station on a hill overlooking Brisbane, we went back to the research station and found a television to watch ourselves appearing on the news a short while later, amazed at the quick turnaround.

Because Judy and I worked together on this project, when we had a one or two week long field trip to the Moreton Bay Research Station on Stradbroke Island, we took our girls along with us and organized a babysitter to stay with them during the day. Sometimes David Waite brought his family as well. I taught Lizzie to play cards and she would stay up in the evening and play poker with the graduate students, and she became known as a card shark.

I also remember an exchange with Tim Salmon, a graduate student from the University of New South Wales. He was watching our one year old Laura playing with her dolls and he wistfully said "Laura is really in her own little world. It's a nice world." And then after a pause, he added "I wish I was in that world." I suspect he was having some doubts about graduate school at that stage in his career.

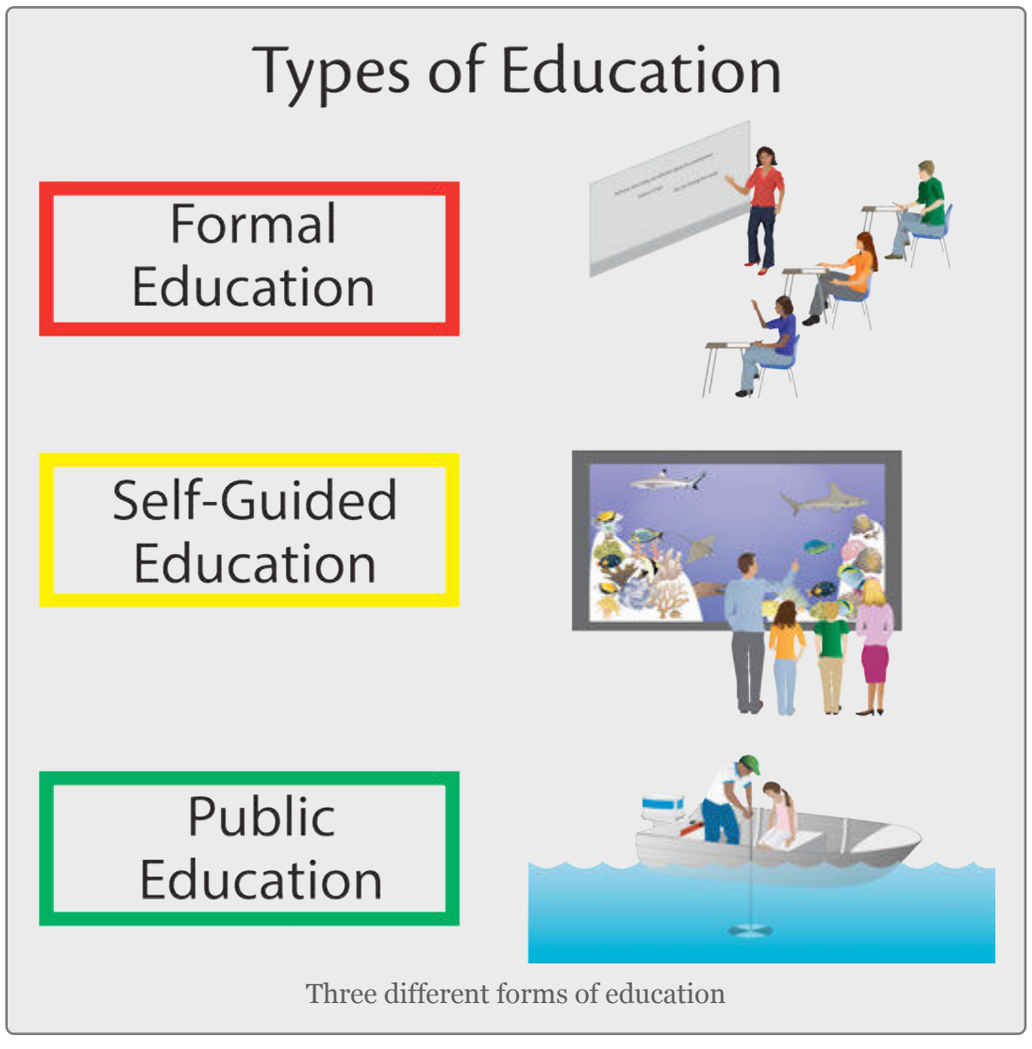
Another fun part of the Lyngbya project was making new scientific discoveries. While the biochemistry and natural product chemistry of Lyngbya was well known, the ecology and ecophysiology of Lyngbya was not well known. We were breaking new ground because we had a ready source of abundant healthy Lyngbya with excellent laboratory facilities and field sampling equipment. It was fun having people care about our results and breaking new ground scientifically.

Converting from passive to active learning

I've never let my school interfere with my education.

MARK TWAIN (1835-1910)

Converting from passive to active learning



Three different forms of education

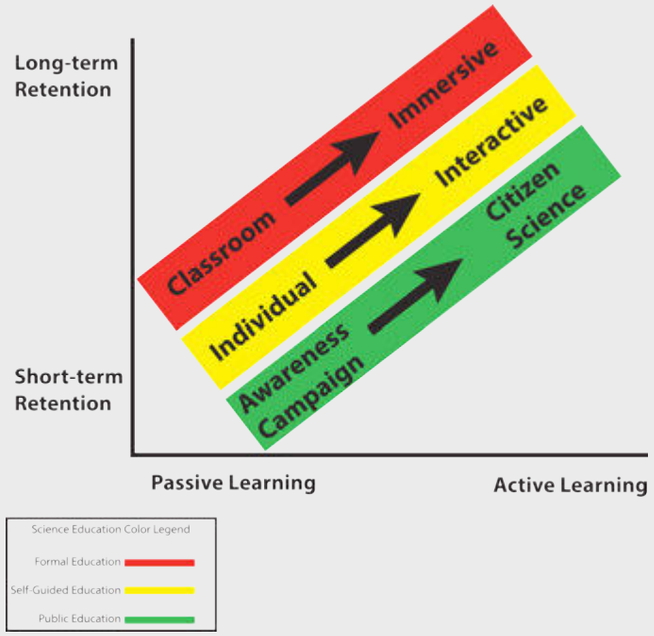
There are many different forms of education and just as many different ways to categorize different forms of education. We have chosen a fairly simplistic three-category scheme: formal education, self-guided education and public education.

What we mean by formal education is the education provided through schools and universities. This form of education has historically been with students and teachers in classrooms.

What we mean by self-guided education is sometimes known as 'informal education' and it is the education that people obtain through visits to parks, museums, aquaria and other means of obtaining information via signage, interpreters, rangers, docents, guides, etc.

What we mean by public education is when the 'student' actively engages in learning through citizen science programs, participatory science and experimentation. In popular education, the lines between the 'teacher' and 'student' blur and learning occurs by both 'teacher' and 'student.'

Passive learning in which the teacher drones on in front of a classroom while students take notes or daydream is not particularly effective, particularly with regard to long-term retention of the material. The adage "see it and forget it," "hear it and remember it," and "do it and learn it" is appropriate regarding passive learning.



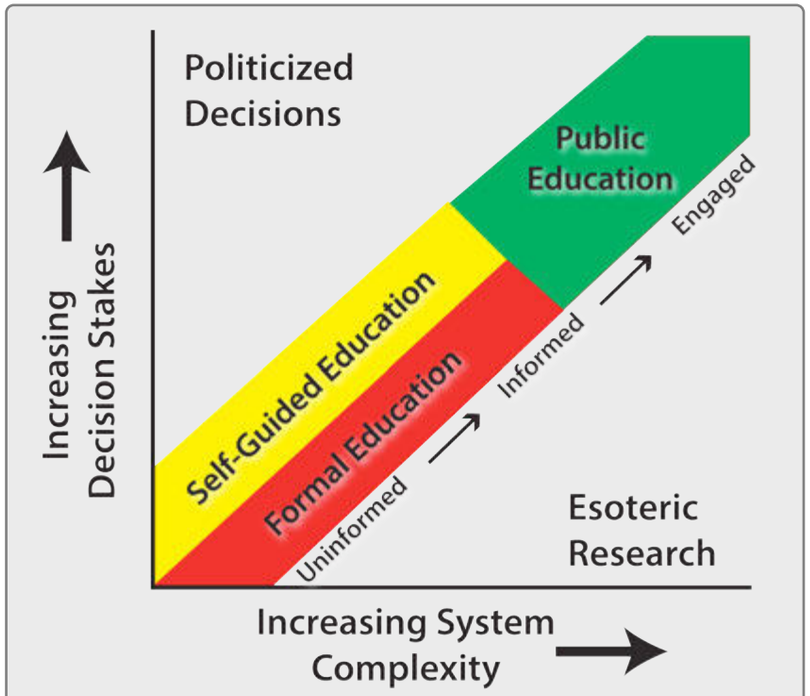
Passive versus active learning approaches for three different forms of education

In formal education, a way to convert passive learning into active learning is to invoke immersive education. In self-guided education, a way to convert passive learning into active learning is to convert individual viewing into an interactive experience, often with groups of people. In public education, a way to convert passive learning through an awareness campaign is to develop citizen scientists. The focus is on getting people to become more engaged in the educational process.

There is a role in society for each of these education modes (formal, self-guided, public). We have established a rough guide as to when these different modes are best utilized by contrasting the system complexity (How complex is the topic? Learning to perform calculations vs. learning to balance multiple goals) with decision stakes (How important is the answer? Does it affect only the student grades or does it affect people's lives?).

With low system complexity and low decision stakes, both formal and self-guided education can be fully adequate in their ability to convert uninformed or untrained people into informed and trained people. With increasing system complexity and increasing decision stakes, converting from passive to active learning becomes increasingly important, thus immersive and interactive education approaches are more relevant.

In addition, public education really is needed to fully engage people in the educational process. In situations that are truly complex, but the decision stakes are not very high, 'esoteric' research can be employed in which basic principles can be derived through research projects but people's lives are not directly or immediately affected. In simple systems with high decision stakes, it is the role of the political leaders to make decisions acceptable to the public.



Guide to using different forms of education based on system complexity and decision stakes

Popular education

Education is not preparation for life, education is life itself.

JOHN DEWEY 1859-1952

Popular Education for Water Sustainability: Three Lessons from Reflective Practice

This chapter is a replication of a journal article titled 'Popular Education for Water Sustainability: Three Lessons from Reflective Practice' written by Peter and Bill, and published in the March 2013 issue #150 of the *Journal of Contemporary Water Research and Education*.

The full publication citation and references are located in section 1 of Chapter 15: Bibliography.

ABSTRACT

Between them, the authors of this paper have over sixty years experience in water education working in primary and secondary schools, universities, field study centres, professional development programs; and with community, industry, and government groups, focusing on coastal zones and catchments. Over the last three years, they have undertaken a systematic process of personal and dialogic reflection and deliberation on this experience, particularly in the area of popular education. This paper presents three key water education lessons gained from this iterative process and provides examples to justify the sagacity of this choice. First and foremost, popular water educators really need to know their participants, what is important to them, why, and what they know already. Second, popular water educators should give their participants an opportunity to share with others what they have learned about water. Lastly, metaphorically speaking, popular educators need to focus their practice on the head, the heart, and the hands. Knowledge, emotion, and action are dialectically interrelated. Integrating them in popular water education is a challenging yet satisfying task that can have significant outcomes.

This paper focuses on the role of popular education in integrated water management. It outlines three lessons gained from practice. Education is one of a range of tools that water resources managers can use to improve the sustainability of ways people interact with water, waterways, catchments and coastal zones. Over the last thirty years, many different tools

have been used in an effort to improve the sustainability of water management, including legislation and regulation, market-based instruments, marketing and communication programs, and improved technology and end-of-pipe solutions. Governments have introduced environmental management legislation (e.g., Queensland Government 1994; Queensland Government 2000). Economists have advocated innovative ways of valuing our ecosystems and the services they provide us (e.g., Costanza et al. 1987). Marketing and communication experts have communicated messages tailored to specific audiences (e.g., Kennedy2010). Researchers have discovered more about the actual nature of water problems and opportunities that confront us and how best to manage them (e.g., eWater Cooperative Research Centre 2012). While each of these groups of tools undoubtedly plays a part in sustainable water management, it has been the experience of the authors and others (e.g., Cosgrove, Evans, and Yancken 1994) that a thoughtfully developed, context-specific mix of tools is necessary, if water management is to be improved in any given situation.

So education, while not the answer, is definitely part of the answer.

An Education Dialogue and Critical Reflections on Practice

Both authors have worked as educators at key times in their careers. Bill was born, raised and educated in the United States and trained in marine science. Peter is Australian; his rather eclectic academic background has spanned land use management, ecology, education, and social science. Bill has worked primarily in research and university teaching. Peter has worked as a researcher, but has spent much of his professional career working as a teacher in field, community, school, and university settings. Peter has also spent some fifteen years working as a volunteer and government-employed extension officer supporting community-based natural resource management groups working in catchment management and Landcare.

They met in 1997 when Peter visited Bill at his laboratories at The University of Queensland seeking causes of a cyanobacterial bloom of *Lyngbya majuscula* that was infesting northern Moreton Bay, south-east Queensland. Peter was working on a state government catchment management initiative with commercial fishers. The commercial fishers had been forced to fish in the Lyngbya bloom area after being excluded by new government regulations from fishing in nearby Pumicestone Passage.

Bill and Peter found they held similar ideas about the importance of involving stakeholders, participants who really

had something to gain or lose, in learning about the cyanobacterial bloom and how best to manage it. Despite their different backgrounds, they both saw education as important, particularly in terms of them learning together with stakeholders.

Further on in their careers, Bill and Peter have had the opportunity to reflect systematically on their practice, including on this case study. The popular education lessons presented in this paper form part of the findings of a larger reflective practice project they have undertaken over the last three years. The methodology used to derive this publication and this paper is presented below, as are two concepts – reflective practice and popular education.

Initially, Bill and Peter had a series of discussions on general topics that related to their work in catchment and coastal management. They told relevant stories from their varied experience, asking each other questions and seeking points of commonality and difference as to what they had done, why it was important to them and what they learned from that experience. They initially talked using Skype, with conversations lasting two to three hours. On several subsequent occasions they talked face-to-face, looking and probing more deeply into what they have learned in their working lives to date and seeking lessons that could guide them into the future.

Peter and Bill analyzed texts of their conversations, following the advice of Schön (1983) reflecting on their practice in the hope that the outputs of this reflection would not only guide their future practice, but that the process and the outcomes may also be of use to others. They coded transcripts systematically, looking for themes and using these outputs to inform further dialogue.

This interactive, dialogic process was punctuated by considerable periods in which the authors were apart, allowing time for both individual reflection and subsequent deliberation and agreement on key lessons when authors came together to discuss their individual analyses (Miles and Huberman 1994).

This paper presents key lessons they have gained in popular education for water sustainability.

Conversation between Bill and Peter.

Reflective Practice

Osterman (1990) sees reflective practice as an individual task of reflecting on one's own work and experiences so that the individual may improve themselves in their area of expertise. Forester (1999) talks of deliberative practice and considers this as an extension of reflective practice in which practitioners work, reflect, and learn collectively with others. In a sense, the work presented here has been both reflective and deliberative in that the authors have reflected individually and then deliberated on what they have learned and how they can further improve their practice as a result of this learning. For brevity, the term reflective practice is used to summarize this process. The authors take solace from the work of Schön (1983), who claims that competent practitioners in any field usually know more than they can say. They recognize that, over time, the origins of this knowledge can be difficult to determine. For example, we may learn things incidentally "on the job," such as how to use PowerPoint or write a consultancy report, and not view acquisition of these skills as "learning." However, these may be just as important as lessons from our academic studies (Schön 1983). The authors both value and enjoy working, deliberating, and learning collaboratively with stakeholders. This collaborative learning becomes a valuable source of knowledge and skill.

For example, in the *Lyngbya majuscula* case study they both learned much from the commercial fishers. These fishers had been disempowered. Their previous fishing grounds in Pumicestone Passage had been closed by the government and they found themselves forced to make a living fishing in an unhealthy and unproductive cyanobacterial (blue green algal) bloom in adjacent Northern Moreton Bay. The work undertaken with these fishers bears many of the hallmarks of popular education, and it is to this topic that the discussion now turns.

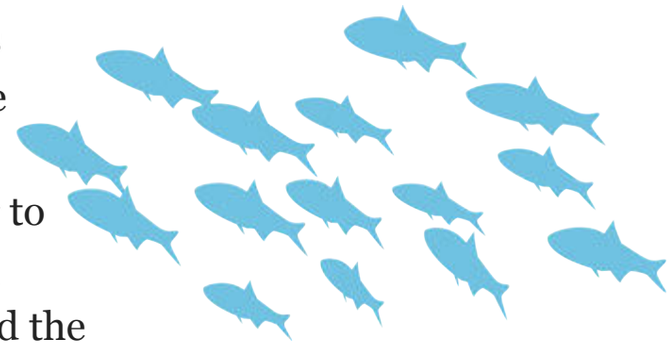
Popular Education

Popular education differs from formal education one finds in institutions such as schools, universities and colleges. It focuses more strongly on the direct needs of the community (Whelan 2005), and seeks to empower those who may be socially, economically, or politically marginalized so that they may take control of their own learning and overcome the aspects of their situation that have caused this marginalization (Hale 2005). It is based on the methodology of education for critical consciousness first described by South American educator, Paulo Freire (1993), and has its origins in Marxist ideology and class analysis. It is conceptually aligned with critical social science which aims to enlighten, empower, and emancipate participants (Fay 1987). Popular education is a collective process in which, unlike formal education, the roles of teacher and learner are not well defined, as all participants at various times will be both a teacher and a student.

These popular education characteristics typify the work undertaken with the fishers. They had been politically marginalized in their dealings with government, and their new fishing grounds were detrimental to them economically, and in terms of their health (Savige 2012). The cyanobacterial blooms that occurred contained carcinogens. The blooms also caused skin rashes, and eye and breathing problems (Osborne, Webb, and Shaw 2001).

Warning sign for Lyngbya bloom in Deception Bay, Queensland, Australia.

Bill's role was initially as a researcher and a teacher as he sought to find out more about the bloom, what caused it to grow and to share this knowledge with fishers and other interested folk. Peter was more the facilitator, focusing people's attention on the issue and bringing different parties together. This changed over time, as Bill and Peter learned much from the fishers who were excellent natural historians.



The commercial fishers were close and accurate observers of nature. They had to be in order to make a living. Working together, Bill, Peter, and the fishers began to use the information they all gained about the bloom to advocate for local fishers. Research funding was gained from all levels of government, and a research team and steering committee were established. Media coverage of the bloom was widespread. Local government took steps to ensure that community health issues were managed by closing and cleaning beaches when blooms were prevalent. What occurred focused strongly on the direct needs of local people.

The process was nonformal and informal, yet educational - all involved acted as both teachers and learners, at various times. The lessons gained were empowering and "of the people." This new knowledge and the support of the researchers empowered the fishers to advocate more strongly for their situation and the resolution of the economic and health problems they faced.

Education may contest or reinforce the status quo (Giroux 2001). Popular education, due to its change-oriented nature, seeks to address inequities and contest the institutions,

cultural norms, or social and political systems that support these inequities, or allow them to exist. The Lyngbya case study is an example of both popular and informal education. Bill and Peter applied the method described above to this case study to reveal three key lessons that may be relevant for other popular educators working in nonformal settings. These are: know your participants; recognize that all involved are both teachers and learners; and focus on topics and activities that involve the head (thinking), the heart (emotions - music, art, dance), and the hands (practical activities) as means for participants to learn and use knowledge gained to address power inequities, or other problems that face them. These lessons are discussed below, using examples from the Lyngbya case study.

Cyanobacterial bloom of *Lyngbya majuscula* that infested northern Moreton Bay, Queensland.

Three Lessons

Know Your Participants

As mentioned earlier, popular education focuses on the direct needs of the community and seeks to empower those, such as the fishers in the Lyngbya case study, who may be politically, socially, or economically marginalized (Hale 2005; Whelan 2005). As popular educators, the authors found it important to know their participants.

This may seem self-evident, so such a statement deserves some justification. Specifically, they found it important to know how the fishers defined (or "problematized") whatever had led to their marginalization and how it affected them, others, and their surroundings; what was important to them in terms of the problem and why; what they knew already about the problem and what else they felt they may need to know; and what actions (if any) they felt should be taken to resolve this problem. These activities involved "walking in each other's shoes," as much as possible. Trust was also an important factor. Without trust, relationships falter and learning and action are impossible.

Table 2 sets out some questions that may help to guide this reflection and learning and link them with key factors that help to describe the case study context. These questions and key context factors have been derived from the larger reflective project in which the authors are involved.

Space limitations preclude responding to all of the above questions in relation to this specific case study. The following discussion touches on five factors - knowledge, resources, empowerment, emotions, and equity.

Bill Dennison and Minister for Environment Dean Wells (upper left), Malcolm Robb from Western Australia talking about Peel-Havery Lyngbya blooms (upper right), backhoe removing Lyngbya from Deception Bay beach (lower left), Bill Dennison with reporters at Deception Bay bloom site (lower right).

In terms of knowledge, Bill spent a great deal of time on the water with fishers studying the bloom, in meetings and socially. He learned that the fishers were excellent observers of nature and seasonal, spatial, and other changes that were occurring in the marine ecosystem in which they were fishing. With the fishers' help Bill set about organizing needed resources and engaged the media to raise the public profile of this huge cyanobacterial bloom. They gained $AUD 600,000 in funding and in-kind support from political and departmental leaders in local, state, and federal government for urgent research to be undertaken to look at causes and management of the bloom. This was very empowering for the fishers.

Bill also came to understand emotional and equity issues relating to the bloom - whether the fishers thought what was happening was fair and how they felt. Over time cordial, trusting relationships developed between academics and fishers that helped to expose these aspects.

Bill's wife, algologist Dr. Judy O'Neil, was part of the research team. Bill comments, "Judy was talking to the wife of one of the fishers. She explained that they were thinking of enrolling the kids in school next year and wondering, given the loss in catches due to the bloom, whether they would have the money to pay for tuition. What did Judy think they should do?" He found himself contrasting the worry and angst of the fisher's wife, against the demeanor of prospective researchers who were contacting him about their possible involvement in the Lyngbya research; some of whom he felt were simply seeking funding for their "pet" project, rather than focusing on really solving an environmental problem that fishers viewed as unfairly impacting on the lives of their families. Such conversations helped Bill develop greater empathy for the fishers and their plight. It did not mean that he became less objective in his Lyngbya research, but that he developed very similar motivations for solving the bloom problem as those of the fishers and their families.

Judy O'Neil and Greg Savige holding Lyngbya warning sign, Deception Bay, Australia.

Research undertaken as a result of Bill and the fishers' labors has discovered the causes of the Northern Moreton Bay Lyngbya bloom, and efforts have been undertaken to address them. Causes include "the presence of bio-available nutrients including iron, phosphorus, and nitrogen; dissolved organic matter; and favorable light, salinity and temperature conditions in the environment" (Queensland Government 2012).

A Lyngbya Management Strategy has been developed, listing "agreed management actions for addressing the mitigation, investigation and catchment protection issues associated with Lyngbya blooms in Moreton Bay coastal waters, particularly in northern Deception Bay" (Moreton Bay Catchment and Waterways Partnership 2002: ii). However, due perhaps to the scale of the problem, at the time of writing, blooms are still occurring (Savige 2012).

The questions listed in Table 2 have been gained from an analysis of a wide variety of popular education examples in which the authors have been involved. Responding to them also helps to shed considerable light on this particular example. Being an effective popular educator involves knowing your participants very well and allowing them to also know you, not just as a researcher or teacher, but as a person. It is indeed important to walk in each other's shoes. Participants have much to learn from each other, as discussed below.

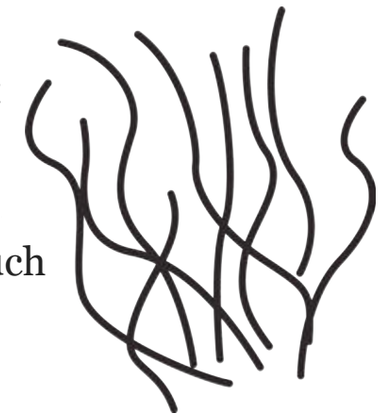


Table 2. Questions and key context factors to guide reflection.

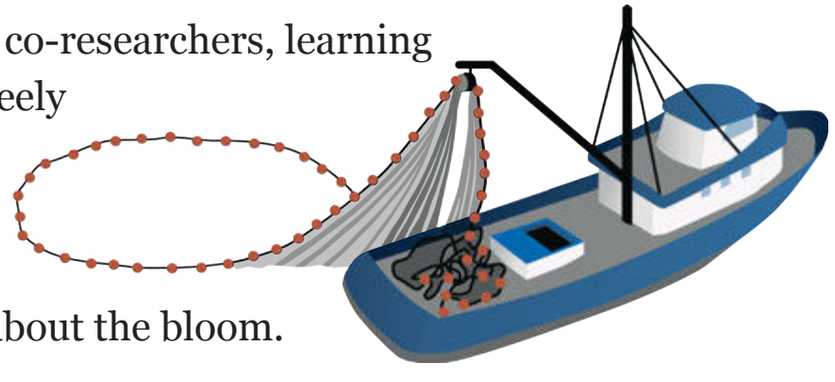
Questions	Key context factors
What do participants know?	Knowledge
What do participants believe?	Beliefs
How much do participants care?	Emotions
Do participants think what is happening fair? Why?	Equity
Do participants agree on the nature of the problem? What else might they need to know?	Problem consensus
Do participants feel able to act? Why?	Empowerment
Do participants agree on what needs to be done?	Action consensus
Do participants have what is needed to solve the problem? What else may they need?	Resources
Do participants have the knowledge and skills to solve the problem? How might they gain necessary skills and knowledge?	Technical capacity

Teachers and Learners

This lesson follows on from the first question stated in Table 1 - in terms of knowledge what do participants know? Many participants want to share with others what they know about the problem at hand. Our job as educators is to provide this opportunity. At various times participants take on different roles as "teachers" and "learners." However, for popular education to be effective, we need to learn together. Many participants want to share with others. We all need the opportunity both to teach and learn about what is important to us.

Bill was very keen to learn as much as he could about the Lyngbya blooms. Typically, there are several ways to do this including library research, literature reviews, communicating with other academic experts, and undertaking laboratory and field research. Bill chose an additional path. He decided to learn what he could from the fishers. They were the "on-water" (rather than "on-ground") experts on this particular Lyngbya bloom. Bill took a relationship-based rather than formal approach to do this. He went out on the water to inspect the bloom with them. Notably, he went in their boats. This was important both symbolically and practically. In terms of power, they were the captains. They were in charge. They were the teachers.

Significantly, at another time, he went to the local bowls club with the fishers. They shared food and drank beer. The fishers became the teachers and Bill the student. The fishers were "at home," in their own environment. Bill and the fishers became co-researchers, learning together and freely sharing and critiquing what they were learning about the bloom.



In this example, power was redistributed and shared within the researcher- fisher relationship. They developed a common, shared motivation. It became obvious to all involved that Bill was not just there to write another research paper or score another grant to further his career. He wanted to manage the bloom, to control it so that the fishers could still make a living fishing in the area (Savige 2012).

Like Freire (1993), Bill felt that research grounded in local understanding, consistent with local motivations and involved those affected by research outcomes as active co-researchers and co-learners, had more chance of success. As mentioned earlier, sharing motivation with the fishers involved sharing emotion – for example, realizing that poor fish catches result in little income and an inability to provide things like school fees for those you love. Bill and Peter contend (with others) that our emotional state impacts on how and what we learn, and what we do as a consequence (Pedler 2011; Pekrun 1992). The following section uses the Lyngbya case study to explore the relationship between learning, emotion, and action.

Head, Heart, and Hands

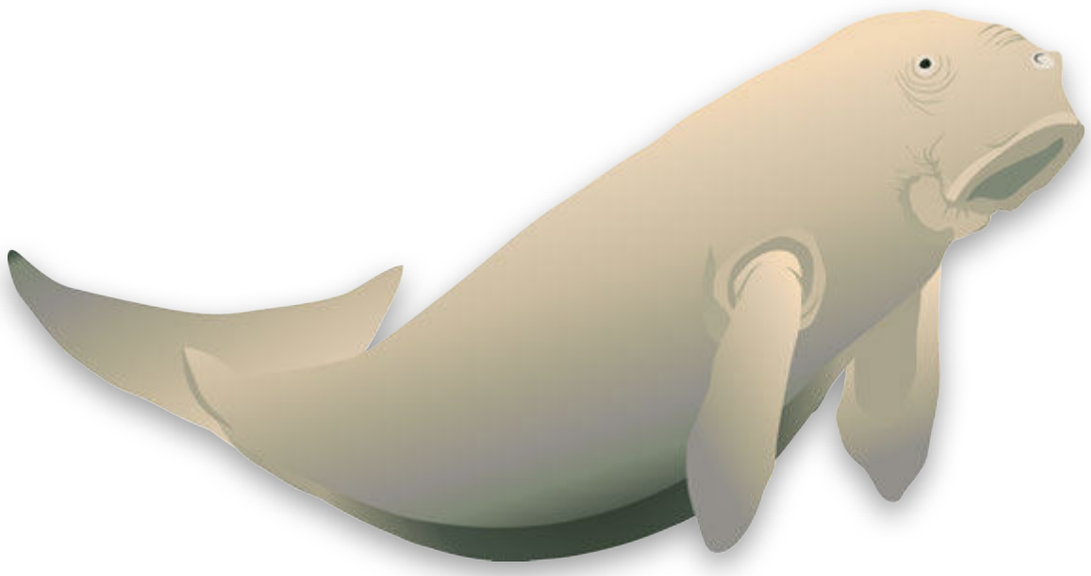
"Head," "heart," and "hands" - thought, emotion, and action may be thought of as being dialectically (i.e., interactively) related. Thinking situated around such dialectical relationships has proven useful in counseling and community building (Kelly and Sewell 1988). The authors have also found it very useful in terms of popular and other forms of education. In the Lyngbya case study, the authors recognized that it was not useful, in fact impossible, for the fishers to compartmentalize their thinking, so that they thought "unemotionally" about the Lyngbya bloom and its impact on their lives. Emotion gives meaning. Emotion gives motivation. Emotion can drive people to learn and to act. While the fishers were understandably emotional and quite motivated to discover the causes of the Lyngbya bloom and to remedy the situation, the authors found that the rest of the local community, including local and state government decision-makers, were often disinterested.

Through the local catchment association, the fishers put out a series of media releases about the bloom (Savige 2012). These received mixed responses from community members, with several people being very critical of the catchment association issuing media releases before long weekends. For example, the owner of a fast food shop on Bribie Island rang one of the fishers to tell him he didn't like him talking about the bloom in the paper. He felt that telling people about the bloom and working out how to manage its causes were important, but something that should not be done now, especially with the long weekend coming up. "We will lose trade" (Savige 2012)! He was not alone, real estate agents and accommodation business people

also berated the catchment association president for going public about the bloom. Thought, emotion, and action can be linked in different ways and lead to different outcomes.

In response to this community feedback, Peter decided to implement a community education program. He sought to complement the research and popular education activities that Bill was leading and the catchment association media campaign. He wanted to make learning about the bloom, its causes, and the importance of seagrass meadows in coastal marine systems fun – not emotionally or economically threatening.

So he devised a series of music and cartoon characters to convey these messages. These were pitched at young people, six to eight years old, the idea being that this would not be threatening or controversial. Adults were an important secondary audience. So, Doug the Dugong, and the Dugong Rock were born.



Music from the Dugong Rock CD can be downloaded from the Healthy Waterways website. On Dugong Rock, Doug sings:

I'm Doug, I'm a dugong and I live in the bay

For years there man it's been OK

You really gotta' dig the Dugong scene

We eat seagrass, sweet and green

But the waters goin' muddy

The light is dim

There's not much seagrass

The future's grim

And all I want to do is the Dugong Rock!

Doug's song contains key message about seagrass and managing coastal ecosystems. Figure 1 shows Doug the Dugong as a cartoon character. He figured in a coloring competition in the local paper, the Near North Coast News, with Dugong Rock CDs for prizes. Doug the Dugong developed a public profile. His character has had longevity. He lives on from the time of this work (1997 to 2000) to today and can be heard on the soundtracks of current videos on YouTube. In 2003, Dugong Rock - The Musical played at the Woodford Folk Festival at the children's part of the festival, as well as at other locations around southeast Queensland.

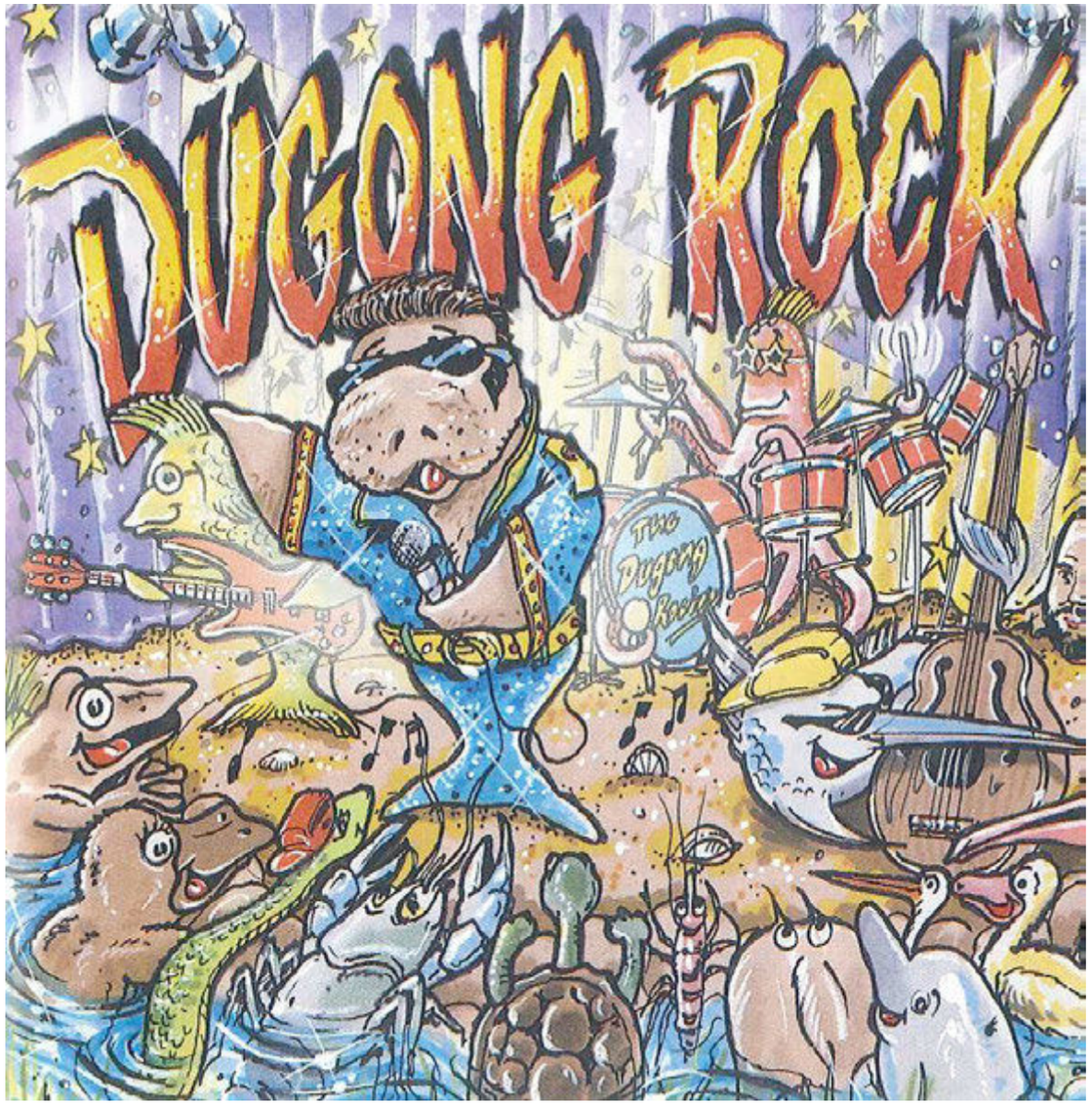


Figure 1. Doug the Dugong - a cartoon character.

Over time, with the help of the media, school and other public education activities relating to research, such as those outlined above, public awareness of Lyngbya blooms in Moreton Bay has risen. While pre-surveys and post-surveys of the impact of these activities on general levels of public awareness are not available, a current google search (25 May 2012) using the key terms - *Lyngbya majuscula* and Moreton Bay, revealed 6,090 results. A google search of the phrase "Doug the Dugong" revealed 160 results, with a YouTube search using "Dugong Rock" revealing the posting of 20 videos with a total of 14,656 hits. Interestingly, others have also thought it useful to adopt a similar approach with the Burnett-Mary Regional Group, even going to the extent of purchasing an $8,000 human-size dugong suit so they could undertake similar types of activities in Hervey Bay. This life-size walking dugong figures in two video clips and a community service announcement about Hervey Bay and associated stream catchments (Smith 2012). This is an example of popular education and community education finding ways to focus, motivate and energize participants in what Freire (1993) terms "conscientization," "knowing reality in order to better transform it" (Lather 1986: 67). The Lyngbya case study highlights that knowledge, emotion, and action are linked in ways that can be both positive and negative. The work of the Burnett-Mary Regional Group lends validity to this assertion. Being aware of this and consciously linking knowledge, emotion, and action can greatly help popular educators to be effective in their work.

In Conclusion

This paper uses the experiences of the authors, and the work of others, to reflect on popular education for water sustainability using a case study involving research, education, and community action on a *Lyngbya majuscula* bloom in northern Moreton Bay, southeast Queensland, Australia. The authors have undertaken a process of systematic personal and dialogic reflection and deliberation

on this case study, to reveal three key lessons in terms of popular education.

First, know your participants. Walk in their shoes. While this may appear self-evident, reflection and action on this point are fundamental to all educational activity. Such reflection should focus on the following context factors: knowledge, beliefs, emotions, equity, problem consensus (whether participants define the problem in the same way), empowerment, action consensus (whether participants agree on what action needs to be taken to resolve the problem), resources, and technical capacity.

Second, when it comes to working as popular educators, we are all learners. We are all teachers. We need to learn from each other and evaluate knowledge and the purpose to which it should be put by working together. Lyngbya blooms are complex. Understanding and managing such blooms are complex activities. No one will know everything about such an occurrence, and people will perceive the impact of such a bloom upon their lives and their surroundings in different ways. It is only by working together that we can paint a rich picture to inform action.

Finally, in all this there is an important place for emotion. What is important to our hearts, will impact our thoughts and knowledge, and what action we take to remedy our situation. We should not ignore the fact that knowledge, emotion, and action are dialectically related. As popular educators we have much to gain from sharing what is in our hearts with others.

Immersive education

Study nature - not books.

LOUIS AGASSIZ 1807-1873

SECTION 1

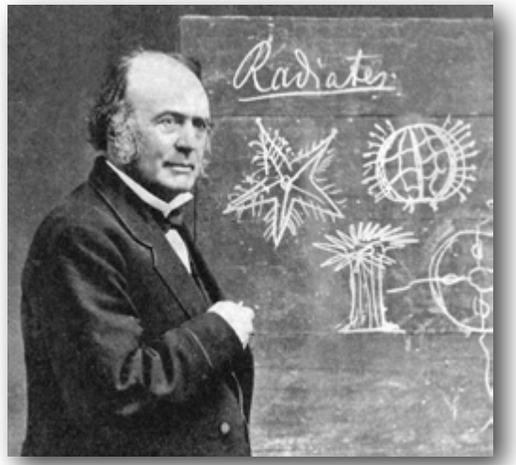
Studying Nature *In Situ*: Immersive Education for Better Integrated Water Management

This chapter is a replication of a journal article titled 'Studying Nature *In Situ*: Immersive Education for Better Integrated Water Management' written by Bill and Peter, and published in the March 2013 issue #150 of the *Journal of Contemporary Water Research and Education*.

The full publication citation and references are located in section 1 of Chapter 15: Bibliography.

ABSTRACT

The term immersive education is currently used in two educational areas - language education, which involves students being totally immersed in a language and its culture; and virtual education, where teachers use computers and simulation games to immerse learners in a virtual, computer-generated environment that mimics a real-world environment and allows learners to interact with it. This paper uses examples from university teaching practices in marine studies and coastal zone management to make a case for a third definition for immersive education in tertiary settings - educating water managers by immersing and guiding them through real-world situations that involve understanding and managing water, biodiversity, catchments, and people, and the interactions between them. Immersive education of this third kind, and traditional tertiary education approaches such as lectures and demonstrations, are compared, and the advantages of immersive education are discussed. The examples from practice and discussion presented show immersive education as being experiential and real, process-driven, trans-disciplinary, collaborative, participatory, and active, encouraging critical thinking and a renegotiation of power in relationships between participants. Such immersive education develops passion and persuasive capacity in students, providing personal experiences that are memorable and potentially life-changing. Challenges to immersive education in tertiary education, including lack of finances, teacher burn-out, safety concerns, and inertia to maintain the status quo of traditional education, are highlighted, as are ways to overcome these.



Jean Louis Agassiz in 1870

Louis Agassiz (1807-1873) declared, “Study nature, not books,” on a sign at the entrance to his summer field course on Penikese Island off Cape Cod, Massachusetts, in the 1870’s. Agassiz was a Swiss geologist who had correctly interpreted the impact of continental glaciers in forming the landscapes of northern Europe and North America. Agassiz emigrated to the U.S. and set up a field school that ran for several years on a small remote island until his death in 1873 (Wilder 1898). This course and teaching style were emulated by the Marine Biological Laboratory, set up in nearby Woods Hole in 1888. The Marine Biological Laboratory, the second oldest marine lab in the world, developed immersive summer courses and went on to create one of the world’s premier biological libraries, which ironically, is appropriately where the sign now resides (Addante 2009).

Agassiz was renowned for starting his course by placing a whole fish in front of each student and asking them to draw and interpret what they could about the fish. When the students wanted to start dissecting the fish or doing experiments, Agassiz said to just leave the fish intact and observe. He then informed them that this was a half day exercise, and it would take a while for the students to realize that they needed to begin using their eyes and their brain. Agassiz deliberately was teaching them to look, really look at the fish, and begin thinking about how the fish sensed the environment, how it moved through the water, and how it was put together. This exercise got the students to make detailed drawings and sharpen their observational skills (Anon (a) 1879).

What can we learn from Agassiz’s adage “Study nature, not books” from the nineteenth century? The progressive era of education (1917-1957) saw educators move away from experiential education to methods that were deemed more efficient such as lectures, text books, and demonstrations (Tolley 1994). With the rapid growth of the natural sciences literature in the form of scholarly journals and books, and the explosion of sensors that can stream data directly to the laboratory, it may be argued that such “progressive” ideas should still hold sway.

Significantly, the study of nature is increasingly linked with the study and management of land, water, and human systems. What can we learn about managing water by immersing ourselves in the real world? Why not just send students to online literature and the computer to download and interpret data or play simulation games?

This paper makes a case for immersive education as a way to learn about and better manage water, the things that live in it, and the way that we interact with it and the surrounding landscape. From the management of coastal zones to

integrated water management more generally, we need to create real, participatory, collaborative, trans-disciplinary learning experiences in which students study nature, land, water and human systems and the ways we might manage the interactions between them in situ, not from behind a computer screen.

Retrieving a surface plankton net aboard R/V Westward as part of Sea Semester.

Immersive Education

The term “immersive education” is currently used in two ways. The first is in language education. Language educators have long realized that the most powerful way to teach a second language is to immerse students in situations where that language is the sole communication medium for daily living and learning. The culture associated with that language becomes the dominant culture of the educational process (Cummins 1998).

The second use of “immersive education” relates to the development and use of virtual realities and game-based learning systems for educational purposes (e.g., Immersive Education Initiative 2012).

This paper proposes a third use for the term, arguing that learning about land, water, biodiversity and their management is a task best undertaken in situ, immersing the learning process in the setting that is the actual focus of management.

We contend that this conceptualization of immersive education has utility in terms of teaching about water - managing water more sustainably by understanding and managing land, water, the living things that live in and depend upon water for life, human systems, and the interactions between them. In the associated area of environmental education, Lucas (1979) wrote of it having

essentially three foci - being about, in, and for the environment.

We characterize immersive education as emphasizing the second of these three foci, being immersed in the environment, leading participants to learn more about that particular topic and them also becoming advocates for issues of sustainability relating to that topic. Students and teachers become active participants in real situations. Their learning is experiential. They collaborate. Their learning involves many disciplines. The term “immersion” is metaphorically appealing when we think of learning about water in this way. It may also be a useful educational vehicle in other settings.

In our experience, immersive education can mirror many of the characteristics of popular or participatory education, as described by Paulo Freire (1993). This is particularly true in relation to renegotiation of power relations between teacher and student and the development of a critical consciousness. In this model, students do not accept information at face value, but, like the students examining the fish in Agassiz’s laboratory classes, examine what they learn about water more deeply, from diverse points of view, and through a range of disciplinary lenses to detect any factors which may detract from or add to the authenticity of their findings.

The authors have over sixty years of combined experience in water education in formal and nonformal settings. In terms of formal education, this experience ranges from teaching in primary schools, and outdoor and environmental education centers, through to secondary schools and universities. Topics taught have included biology and marine botany, and broader subjects such as marine studies and coastal zone management, through to secondary school environmental education and a post-graduate program in integrated water resource management.

Bill educating state officials on Maryland’s Coastal Bays.

Based on this experiential foundation, this paper compares traditional classroom teaching with immersive education, discusses advantages of an immersive approach, and proposes ways to overcome impediments to its implementation.

Immersive education is defined based on aspects of the marine studies and coastal zone management education examples that follow. Finally, the paper proposes that immersive education may have use in many areas of water

education from disciplinary-based water topics through to broader, more encompassing areas such as integrated water management, as this field is portrayed in the literature (e.g., Biswas 2004; Ferreyra and Beard 2007; Global Water Partnership 2012; Rahaman and Varis 2005). While immersive education may also have a place in nonformal water education and management settings, this is not the focus of what follows.

Comparing Traditional Classroom Teaching and Immersive Education

The traditional classroom setting has a teacher at the front of the room using a chalkboard for illustrations and the students dutifully taking notes as the teacher imparts knowledge. The chalkboards have been largely replaced with various technologies that serve to bring even more knowledge to the students, who can passively watch the "show." The following comparisons can be made between traditional classroom teaching and immersive education.

Traditional classroom teaching is content-driven. The subject matter is presented in a series of lectures. Immersive education is process-driven. Students learn how to do science. Traditional classroom teaching is broken up into disciplines (e.g., chemistry, biology, physics, geology) and content delivered accordingly. Immersive education is topic-driven and multi-disciplinary, as studying integrated water management inherently involves crossing the disciplinary boundaries.

Over the last thirty years, while they may not be labeled as such, examples of immersive education can be found in many areas of higher education, particularly those where solutions to problems are not readily found within a single disciplinary domain and field settings that allow for immersion are accessible to educators. Examples include health, engineering, and environmental science (Ashford 2004; Gilbert 2005; Jacobsen 1990).

Bill Dennison and Judy O'Neil leading a field trip on the Great Barrier Reef, Australia.

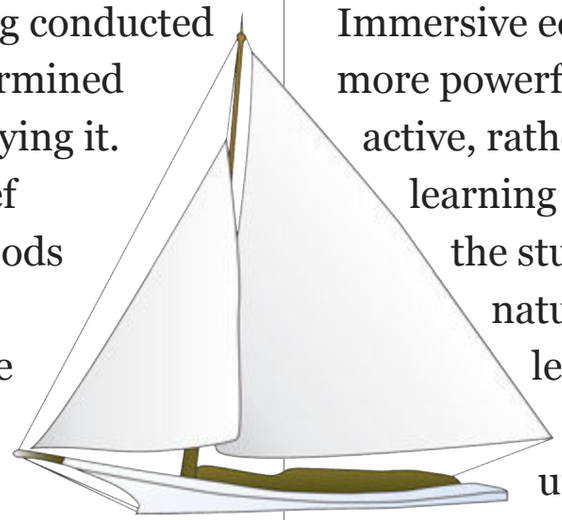
Looking at what is in front of us in a field setting, rather than content from a single discipline, can turn teaching and learning on its head. In Bill's teaching he would often turn over a piece of coral rubble and ask students to identify which kingdom the encrusting organisms belonged. Sponges, tunicates, and algae can be difficult to distinguish, or which process had formed the rubble itself. Botany, zoology, and

geology quickly become inter-twined with epiphytic algal succession and the nutrient sources of coral lagoon eutrophication processes.

Traditional classroom teaching has the teacher at the front of the room as the focal point. Immersive education has the teacher rotating between student groups, and at the end of the course, it is the students in front of the class. Power relationships between teacher and students are re-negotiated. Learning becomes participatory with students sharing responsibility for both teaching and their own learning (Freire 1993).

Traditional classroom teaching ultimately is a forgettable experience. Immersive, experiential learning is truly unforgettable. Bill often says, “Put me in front of a classroom, and both the students and I will quickly forget what I said in class, but give me a student for several weeks on a ship or a field station and I will change their lives forever, and enjoy myself in the process.”

Immersive education is experiential. Science being conducted by students is “real,” not an exercise with predetermined answers. The students are doing science, not studying it. Before Bill’s first voyage aboard a tall ship as Chief Scientist as part of the Sea Semester, based in Woods Hole, Massachusetts, he kept badgering the more experienced scientists about how he would be able to recognize the major oceanographic provinces as they transited the North Atlantic Ocean.



Bill was worried that they would sail right over Georges Bank, through the Gulf Stream and into the Sargasso Sea before noticing any changes. His colleagues kept saying, “Oh, don’t worry. You’ll know when you get to the Gulf Stream.” He was not satisfied with their answer and they finally relented and said to watch the sea surface temperature for the signal.

Well, sure enough, as they sailed up to the Gulf Stream, there was a line of clouds along the boundary between the cooler greenish continental shelf water and the deep blue Gulf Stream, the weather was different, with wind and waves changing, and fish were jumping and birds diving along the oceanographic front of the West Wall of the Gulf Stream. The Gulf Stream literally smelled different.

They then experienced the Gulf Stream for several days, as they hove to under bare poles during a storm, but still were carried along at four knots. In reading the student journals at the end of the six week voyage, it was clear that they were all going to remember the Gulf Stream for the rest of their lives.

Immersive education is an active learning experience. It is more powerful than simply “teaching,” and connotes an active, rather than a passive experience. The objective is learning through experience and the subject content that the student absorbs is through these experiences with nature and their surroundings, rather than via lectures. When a student picks up a book or reads primary scientific literature, it is in the context of understanding an observation or interpreting their

results, rather than content that is delivered by an instructor for later testing.

Aboard the R/V Westward as part of Sea Semester.

Immersive education is participatory and collaborative. Group work is central to the process. Students form small groups or "student research teams" (generally 4-6 students per team) that work together to study an aspect of nature. The teams are given enough time together to formulate hypotheses, design observations or experiments to test their hypotheses, and divide up the tasks between themselves. While the instructors circulate among the groups to ensure they are coming up with doable and interesting questions, the students are encouraged to self-organize and develop allocations of tasks that are equitable and utilize the different skill sets that individual team members possess.

Advantages of Immersive Education

There are several advantages of immersive education over traditional classroom teaching for teachers.

1. Teachers are generally "learning junkies," and immersive education provides them with new data and new ideas which can stimulate further research.

2. The immersive setting provides teachers with insights into the personalities and capabilities of students. It is easier to assess a student project when the student is in front of you and there is more than a faceless name on a piece of paper. Advising or selecting students for future academic or professional development becomes easier as well.

3. Teachers get good feedback on the student's mastery of a subject, and can better appreciate what aspects of their teaching need to be modified. More than correct answers on an exam, the teacher can determine whether the students can apply their learning.

4. The enthusiasm of students being exposed to nature can serve to reinvigorate teachers. Being able to see something through the eyes of students who are seeing or doing something for the first time can inspire a teacher to better teaching.

Peter Oliver inspecting sand castle models on a field trip.

After teaching in immersive settings for thirty years, we would like to reflect on the life lessons to both teacher and student that transcend the course content or subject matter.

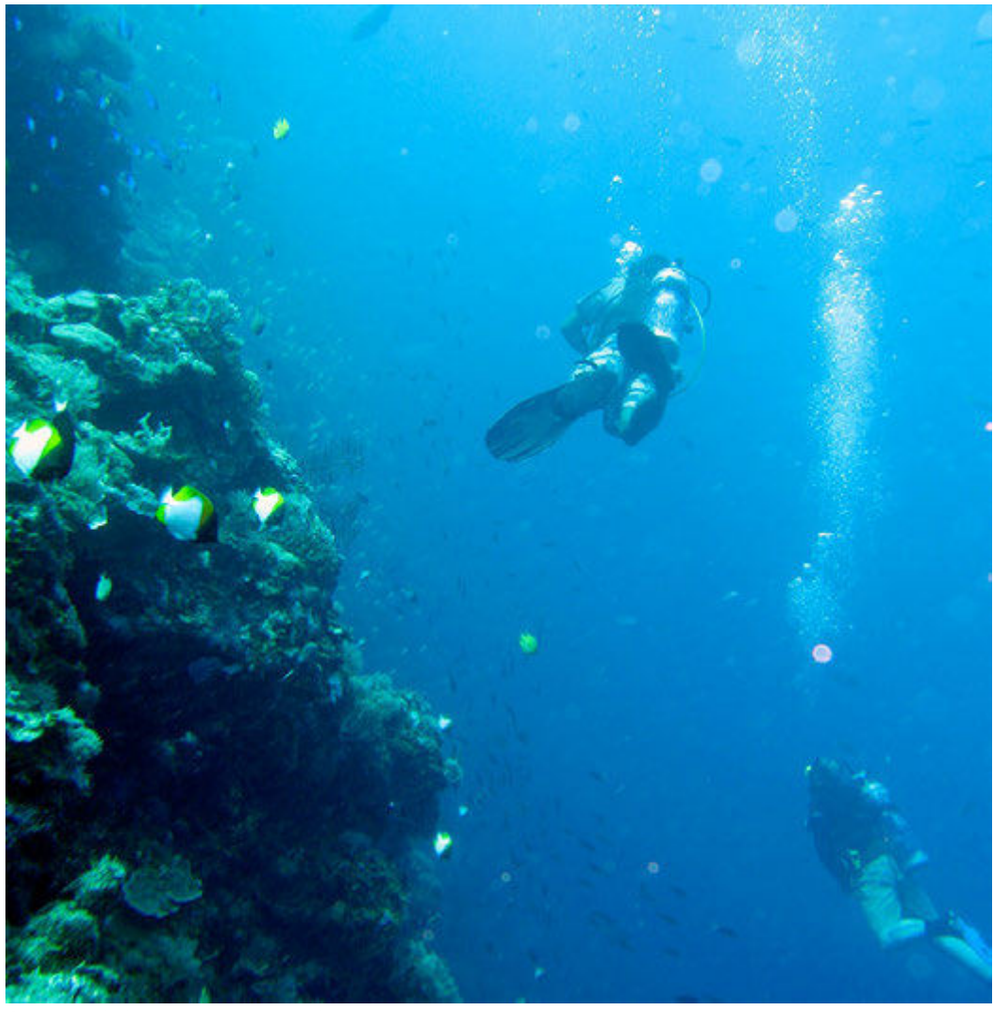
1. The amazing amount of research and learning that can be accomplished by a small team of focused people in a short amount of time is an important illustration of what is possible, given the right conditions. This can promote students and teachers to enable these right conditions for productive collaborations in other endeavors. As Margaret Mead said, “A small group of thoughtful people could change the world. Indeed, it is the only thing that ever has.” (Anon (b) 2012).

2. Immersive education provides both student and teacher with memorable events and meaningful experiences. Observing bioluminescence, stars, or sea creatures can be memorable, and pushing one’s boundaries physically, mentally, or emotionally by working closely together can be meaningful.

3. Developing personal relationships in an immersive learning setting can lead to life-long relationships. Meeting and getting to know interesting people is facilitated by the immersive nature of the setting. Bill’s ground rules on personal relationships for students and instructors during a course are no “special relationships” that serve to disrupt the group dynamic.

4. Both as students and instructors, we have been inspired by experiences in immersive education settings. We feel as though we learned more, and learned more deeply. The enthusiasm generated by group dynamics has fueled our passion for environmental science and for the preservation of ecosystem health so that future generations can experience nature.

There are some biological realities that traditional classroom settings attempt to ignore. One reality is that the attention span of an average adult, particularly young adults, is twenty minutes or less. This means that the typical one hour long class is well over the limit. Simply sitting still for extended periods causes the brain to function at reduced capacity as well. Young adults have a lot of energy and forced inactivity does not promote constructive thinking. Another reality is that different people learn better in different ways, often divided into visual, auditory, and tactile learning modes.



Scuba diving on coral reef.

The traditional classroom is largely auditory, with varying amounts of visual and little if any tactile learning. An immersive education experience can promote a variety of learning opportunities. Many academics believe that students typically learn more from their classmates than they do from their instructors. This means that the teacher-centric classroom setting where students are admonished to "keep quiet" is working at odds with the learning style of students. Given these realities, why do we persist in delivering most of our teaching through traditional classrooms?

Overcoming Impediments to Immersive Education

There are several impediments to implementing immersive education over traditional classroom teaching in university settings.

1. Financial. The financial efficiency of a single instructor delivering a lecture course to tens or even hundreds of students is contrasted with the need for a teacher and teaching assistants to deliver a course to only two dozen students who need to be housed and fed in remote settings. While this is false economy, the costs of running a field course are often an impediment to students (travel costs and additional fees) and institutions (remuneration based on credits and student numbers).

2. Burn-out. The immersive setting means that teachers are interacting with students intensely. This is challenging

emotionally. Leading field trips and trying to keep up with students that are decades younger can be exhausting. Upon returning to campus after an exhausting field course, colleagues typically treat the teacher's time away as vacation.

3. Inertia. The challenge of doing something that is off-campus, uses different testing and assessments, and is difficult to assign credit hours takes extra energy on the part of the teacher and the various university administrators. It is always easier to resort to the tried and true lecture setting.

4. Safety. The opportunity for accidents to occur in remote settings without easy access to medical facilities can be a deterrent for both students (particularly parents of students) and university administrators.

Bioassays used in a student project on mapping nutrient limitation.

While financial, burn out, inertia, and safety issues do pose very real deterrents to delivering immersive education experiences, various mechanisms have been developed to overcome these concerns. Creative funding models that tap additional resources to underwrite student costs, and/or provide remuneration via a lecture-based course component are examples used to overcome financial barriers. Developing a time- in-lieu policy which allows instructors to recover from field trips can reduce burn-out. Reward systems for teachers and support personnel can encourage them to overcome inertia to create and maintain immersive education programs. A fairly strict code of practice needs to be developed for students, as well as provision of first aid supplies and training for teachers.

Two examples of immersive education follow. They illustrate the teaching effectiveness of this approach and the difficulties in sustaining these programs.

Examples of Immersive Education

Example 1

Sea Semester. This program is operated by a private, non-profit organization, Sea Education Association, based in Woods Hole, Massachusetts. The basic course format is to teach students both nautical science and marine science in a classroom setting for six weeks in a shore component. This is immediately followed by a six week sea component where the students join a tall ship and serve as deck hands and

SEA semester tall ship at sea

scientists. By the end of the six week sea component, the students are expected to run the ship and the science program, providing a powerful motivator for learning.

This program has been running for forty years, has an impressive set of alumni, logged over a million nautical miles with an impressive safety record, yet struggles every year financially. The costs of running seagoing vessels are considerable and prone to inflationary pressures, and the students have an increasing diversity of less expensive (and less challenging) options for a semester abroad or a shorter version (e.g., two week sail vs. a full semester).

Class size is limited by ship berths, so approximately twenty-five students per ship can be accommodated. Each student conducts a project aboard the tall ship and presents their findings to the class at the conclusion of the course. Some of the data collected by students are published in scientific journals.

Example 2

Field course in coral reef biology and geology. This course was team-taught at The University of Queensland for over twenty years by academic instructors from zoology, botany, and geology. A full semester course was delivered on the main campus which had enrollments in excess of one hundred students.

The top twenty five students from the on-campus course were offered the opportunity for the two week course at the Heron Island Research Station on the southern Great Barrier Reef. The field component included reef walks, snorkeling and diving trips, topical lectures, and projects with written and oral presentations at the end of each week. The number of students who went on to professional careers in marine science was considerable. The course was discontinued when key faculty retired or left the university.

Snorkeling trip on the Great Barrier Reef

Some Outcomes of Immersive Education

Three important personal traits can be fostered in immersive, experiential learning; knowledge, passion, and persuasive capacity. Knowledge, particularly deep knowledge about an ecosystem, is obtained from extended direct exposure to the ecosystem, supplemented with a strong intellectual framework obtained through academic teaching and research findings. Passion for an ecosystem is also generated from extended direct exposure. In addition, the increased understanding of ecosystem features and threats often creates a conservation ethic that leads to passion. The persuasive

capacity to convince other people of the need for appropriate actions to preserve or restore ecosystems is generated from the knowledge and passion, analytical and communication skills gained in experiential learning, and can lead to social change.

Collecting water samples using Nansen bottles aboard R/V Westward.

There are several key components to immersive education that enhance both individual and group learning. An important component is the written and oral communication of research findings at the end of the research projects. The act of synthesizing and communicating the findings provides an opportunity for insights and improved understanding. Sharing research findings between the different research teams also provides a synergistic opportunity for comparisons and contrasts that can create broader synthesis than could be generated with individual projects. Students also obtain a sense of satisfaction for the completion of their project and can appreciate their accomplishments by finishing in a timely manner.

Another component that can result in group learning is a constructive, facilitated critique after the presentations in which the clarity of the science and the communication of the science are discussed by the entire class. In this way, students learn by both direct and indirect critiques, as well as learn how to ask good questions, and how to analyze and interpret scientific results. It is often the first opportunity they may have to develop the skeptical rigor necessary for the proper analysis of scientific results, as well as receive constructive feedback on their work from classmates.

Finally, most students need to be dissuaded that they have not collected enough data or done enough analysis for their work to be considered a “real” scientific study. In fact, peer review publications can be generated from student project results,

and the data generated in student projects can stimulate further research proposals and projects.

Defining Immersive Education

The above examples show that immersive education places students directly in the water environment that is home to their interests and uses the experiences they gain as a way to learn about, reflect on, and advocate for, the better understanding and management of this water environment (Lucas 1979). Immersive education echoes the exhortations of Agassiz, refocusing both the student and the teacher on the object of study and the context in which it occurs. The examples presented here highlight many aspects of immersive education. In summary, immersive education:

• Is experiential and real. Students are face-to-face with the object of their study. They are physically and mentally surrounded by and enmeshed in the environment that supports this object.

• Is process-driven. It involves formulating and testing hypotheses, linking and testing relevant content, processes, and personal and social values.

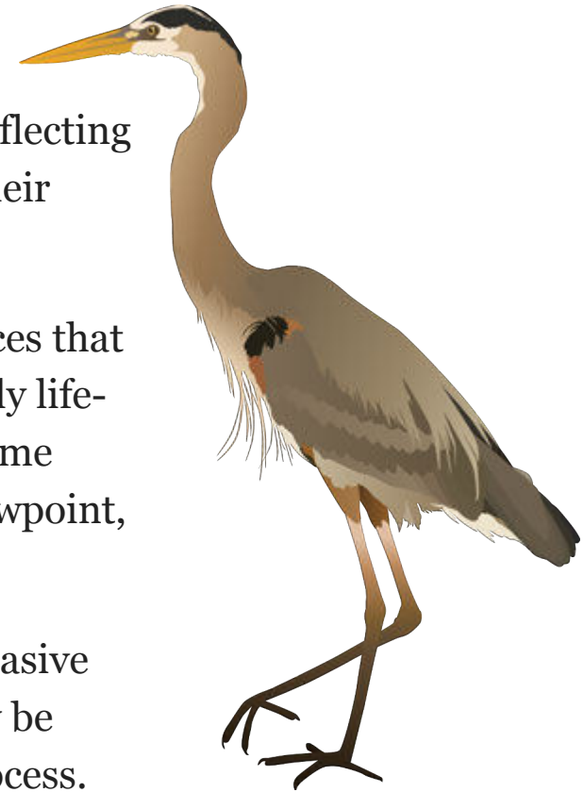
• Is trans-disciplinary. Students view the object of study through many disciplinary windows and seek links between knowledge gained and ways to value that knowledge.

•Encourages critical thinking. Observations are not accepted at face value. All data collected and analyzed are subject to close scrutiny, as are any conclusions derived from this analysis.

• Renegotiates power in relationships between participants. In traditional classroom situations teachers control the pedagogic process. In immersive education students are empowered to guide the learning process.

• Is participatory and active. Where possible, data are gathered directly and students are purposefully involved in gathering, analysis, and synthesis of findings.

• Is collaborative. Students work in groups. All aspects of the immersive process involve students working with and reflecting on their findings with both their peers and teachers.



• Provides personal experiences that are memorable and potentially life-changing. Students may become advocates for a particular viewpoint, based on these experiences.

• Develops passion and persuasive capacity. Advocacy skills may be developed as a part of the process.

In Conclusion

While the above list of characteristics may appear somewhat idealistic, it may be a useful checklist for teachers designing immersive education programs. Many of the characteristics found in the two examples and the discussion in this paper (e.g., process driven; trans-disciplinary; requiring critical thinking and renegotiation of power found in relationships between participants; participatory; collaborative) are also, or ideally should be, characteristic of emerging, complex fields of knowledge such as integrated water management.

Our anecdotal observations of the high rates of career success in graduates of immersive education lead to the supposition that there are lasting positive impacts of learning in this style that transcend the actual course and benefit the students (and instructors) later in their careers. A case could be made for developing some good longitudinal studies in which the career trajectories of students with and without immersive education are compared over many years. The pre-selection of students drawn to this teaching mode is also relevant, as the most enthusiastic and keen students will vie for these opportunities. Another aspect that is not typically valued, but can be quite important to individuals, is the personal realization that students may gain from the intense exposure that a certain subject or career path is, in fact, not what they wanted after all. Young people often need to learn what they do not want to do so that they can better decide what they do want.

There are many powerful reasons for developing immersive education to either augment or replace traditional classroom teaching. There are advantages of this mode of delivery for both students and instructors. In addition to giving students a deep knowledge of the subject matter, there are some good life lessons to be gained. Teaching in a non-traditional mode does present some challenges, but innovative approaches and persistence can overcome the impediments. Examples of immersive education demonstrate both the tremendous capacity that these programs can unleash, but also the fragility of maintaining these programs. The long-lasting impacts of this type of learning can be appreciable, and research as to such impacts is needed. Our conclusion as immersive educators is that Louis Aggasiz's succinct, hand-painted sign, "Study nature, not books," still resonates today.

Bill conducting a science communication workshop.

Communicating science

If you can't explain it simply, you don't understand it well enough.

ALBERT EINSTEIN 1879-1955

Recommendations to effectively communicate science

Recommendation 1. *Communicate science unto others as you would have them communicate unto you*

Probably everyone who has attended school has been subjected to some really BAD science teaching. Modern movies and television programs often cast a nerdy science teacher droning on in a monotone voice about a science topic with little relevance to the bored students. In our personal experiences, we have been subjected to both the best and the worst science teaching. Bill started his university program majoring in biology, but after several really bad teachers, searched around for alternatives until a fortunate set of circumstances landed him in a class with a gifted science educator. Single teachers can and always will be key to the career paths of students.

Peter teaching science students on a field trip.

Science is typically taught as a body of knowledge, with facts, laws and theories. Science teaching typically involves memorization of lots of names regarding the subject at hand. In addition, science is taught in a series of course subjects in a prescriptive order with various prerequisites that do not often appear relevant to the students. Thus, there is a considerable initiation cost before students are allowed to experience the joy of discovery that underlies the scientific approach. Because of the educational system's failure to deliver science to all but the most persistent students, the public perception of science and scientists is generally not positive. Yet, we are in an age when science literacy is crucial for major societal decisions. For example, the climate change debate - pitting a well-considered scientific consensus versus a few climate

change deniers has become a politically driven debate, with the science taking a back seat.

Recommendation 2. ***Take direct responsibility to effectively communicate science: Don't rely on intermediaries***

One of our central tenets is that scientists need to take direct responsibility for effective communication. Rather than rely on intermediaries like journalists or media people, and even science journalists, we feel that it is the responsibility of the scientific community to communicate well. Good science journalists can and do produce magnificent works, but they are increasingly rare. The basic questions that scientists ask should be clear and relatively straightforward. These clear questions should also have fairly direct answers.

What is quite complicated and difficult to understand to people outside the field of specialty is the technology used to address these questions. The physical tools that scientists use can be very sophisticated, from telescopes to particle accelerators to DNA sequencers, and the analytical tools like neural networks, statistics and computational models are equally sophisticated. Yet the questions and answers are what really count in science communication, not the technology used to address the questions. It is incumbent on the scientists to communicate those simple questions being addressed and provide relatively simple answers to these questions, without invoking the sophisticated techniques used to achieve those answers.

Much of our motivation in the realm of environmental conservation has been to explore better science communication models using song, theater and visual graphics to create a more informed citizenry - from fishermen to mayors. The Healthy Waterways Campaign that both of us contributed to was a large-scale experiment in science communication. We produced sound bites, newsletters, books, PowerPoint presentations, web materials, and environmental report cards; as well as conducted workshops, led field trips, wrote songs, and did media interviews over the course of many years in an effort to communicate science to people living in Southeast Queensland.

Bill Dennison interview during launch of Shifting Sands book.

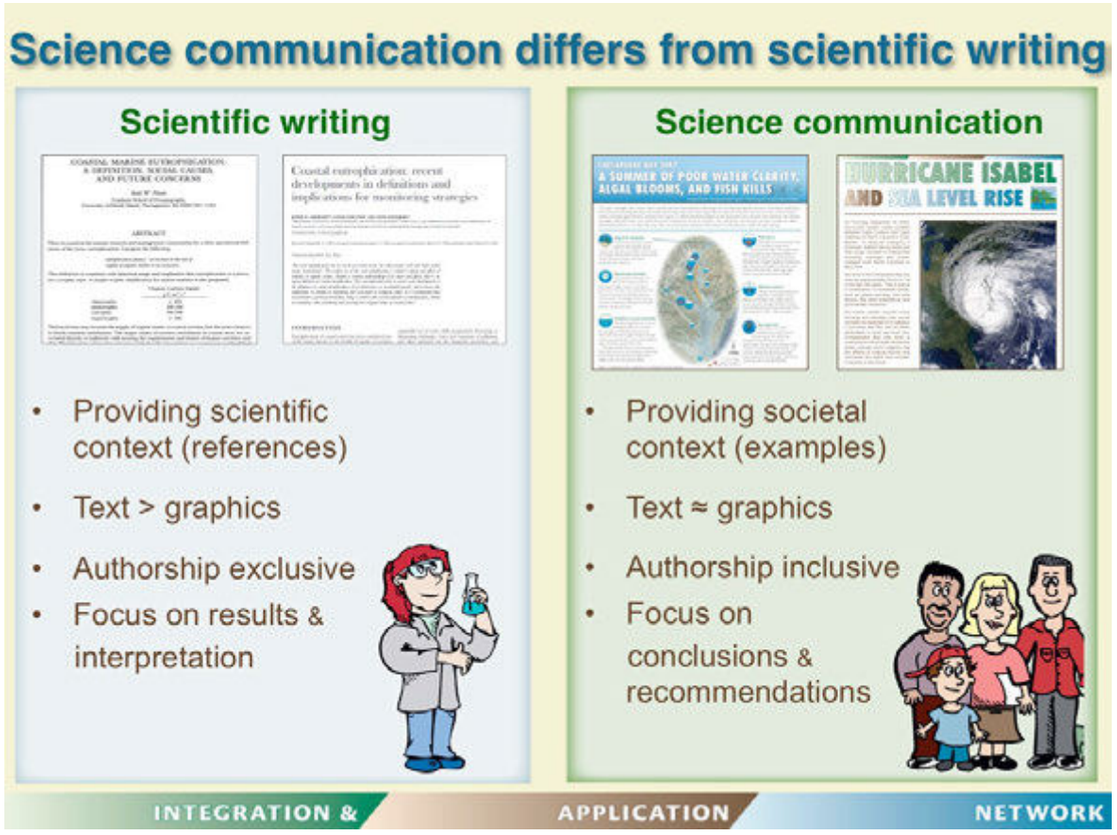
Independently, Bill created a group of Science Communicators and Science Integrators at the University of Maryland Center for Environmental Science, who partner with federal agencies (e.g., US National Park Service) and

non-government organizations (e.g., Secretariat of the Pacific Regional Environmental Programme), to create and develop science communication products and programs. Peter developed an environmental educational program with the International WaterCentre (IWC) that serves to train and educate environmental leaders from around the world.

Recommendation 3. ***Distinguish science communication to broad audiences vs. scientific papers to peer colleagues***

Scientific writing is highly stylized, with care given to wordings that minimize ambiguity. The attempt in science writing is to be precise about what is being said and to distinguish facts (data) from inference. The referencing of scientific literature is designed to allow the reader to drill back to the original sources of each element of the intellectual foundation of the thesis being presented. The peer review system was created to insure that the facts presented are sound, the inferences drawn from the facts are appropriate, and the references to the literature are accurate. Science writing is also regimented into sections, typically abstract, introduction, methods, results, discussion and references. The overall length is constrained and attempts to invoke creative writing techniques rejected by the editors and reviewers.

All of these constraints on writing style were created to provide a fair and accurate portrayal of scientific findings. But these constraints also serve to make scientific writing inaccessible to outsiders and reduce the ability of scientists to communicate to wider audiences. The adage that an average scientific paper's title is read by 1000 people, the abstract by 100 people and the paper by 10 people provides an indication of the select audience of these papers.



Contrasting the difference between scientific writing (left) and science communication (right).

Science communication to an audience beyond the scientific peer group is something that Peter and Bill have attempted throughout their careers. We have defined science communication as 'the successful dissemination of knowledge with a wide range of audiences including non-scientists.' Bill has developed a cadre of Science Communicators who work at the interface of science and art. These talented people develop colorful, information-rich print and electronic materials in

which scientific data, concepts and theories are made accessible to school children, elected officials, fellow scientists and interested people.

Workshop with the U.S. National Park Service rangers at Shenandoah Nation Park.

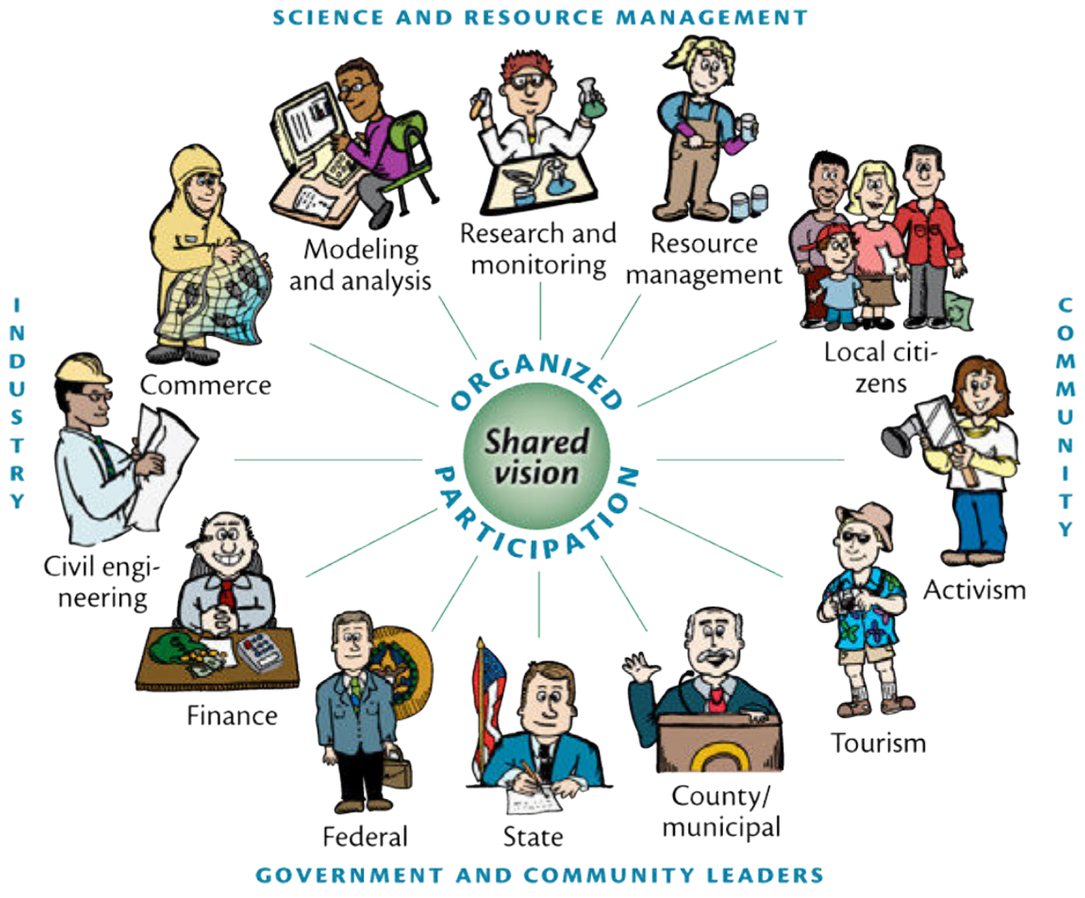
Partnering with scientists from federal agencies (e.g., U.S. National Park Service), state agencies (e.g., Queensland Department of Premier and Cabinet), large non-government organizations (e.g., Conservation International), small non-government organizations (e.g., Midshore Riverkeeper Conservancy), the Science Communicators source, access and crop illustrative photographs, construct clear and information rich maps, create conceptual diagrams in which relationships and processes are illustrated, and provide graphs and tables of data which use the essential information needed to convey meaningful information.

The process of weaving these visual elements into a story combined with text in which all terms are defined and wording is carefully chosen to promote understanding by non-specialists, is the work of Science Integrators. This is another group of talented people who facilitate the creation of a 'storyboard,' in which the scientific data providers are paired with Science Communicators to develop a mock-up of the final product, page by page, section by section. The Science Integrators then work with Science Communicators to produce initial drafts and various edits of the storyboard material, ultimately producing a high quality product with multiple authors in an intensely collaborative process.

Recommendation 4. ***Attempt to broaden the reach of science communication rather than narrow the focus***

The first question that the professional media specialist will ask is "Who is your audience?" This question then leads to a focused and targeted media campaign aimed at this target audience. When Bill moved from his active role in the Healthy Waterways Campaign in Southeast Queensland to the Chesapeake Bay region, he was constantly asked this question of "Who is your audience?" He reflected on the fact that he

had not once been asked or addressed this question in the Healthy Waterways Campaign. Yet, major policy changes were enacted and the direction of environmental degradation reversed. What that question implies is that there will be a target audience and a non-target audience. By focusing on a particular segment of the population, there will be other segments that are not addressed. Targeting is great if you want to sell soap or some other commodity, or to get someone to vote a particular way on a given date.



Each stakeholder plays a part in the shared vision of an environmental campaign.

But environmental campaigns are for the long haul - no single vote or purchase will be enough to sustain the behavior changes that are advocated in an environmental campaign. In addition, the amount of marketing money spent to convince people to choose one product over another or vote for a certain candidate far dwarfs the relatively small amount of funding typically available for an environmental campaign. Commodity marketing and political campaigns may be able to afford to segment the population and deliver tailored messages to various demographics, but environmental campaigns rarely have that luxury.

One approach that we have used to provide some degree of targeting is to develop a broad consistent message, often known as branding, which is delivered at every opportunity. This broad message is followed by a more targeted message aimed at a more specific audience (e.g., what this means to you). For example, in the Healthy Waterways Campaign, the broad message was the first element of a presentation, but then the next component was targeted either geographically or topically, depending on the audience. It was often important for everyone to see what the other segments of the population were doing. There are a couple of reasons for this: 1) there is an inevitable finger pointing if people felt that another group contributed to their environmental problems and 2) people would join into an effort if they perceived that everyone else was already involved.

The different modes of education a) formal (e.g., classroom), b) informal (e.g., museums) and c) public (e.g., media) provide different opportunities to communicate environmental or scientific topics.

Each educational mode offers opportunities for creativity in their delivery. Good visualizations and real world examples will enhance the teaching effectiveness. While some people often argue that we should only focus on children because they will become the decision makers of the future, we feel as though this is just another targeting method that reduces the efforts we take to convince current decision makers. Also, focusing on children often takes us into the classroom setting that does not facilitate the engagement of children in nature. It is those experiences in nature that can build an environmental ethic with an emotional attachment to nature.

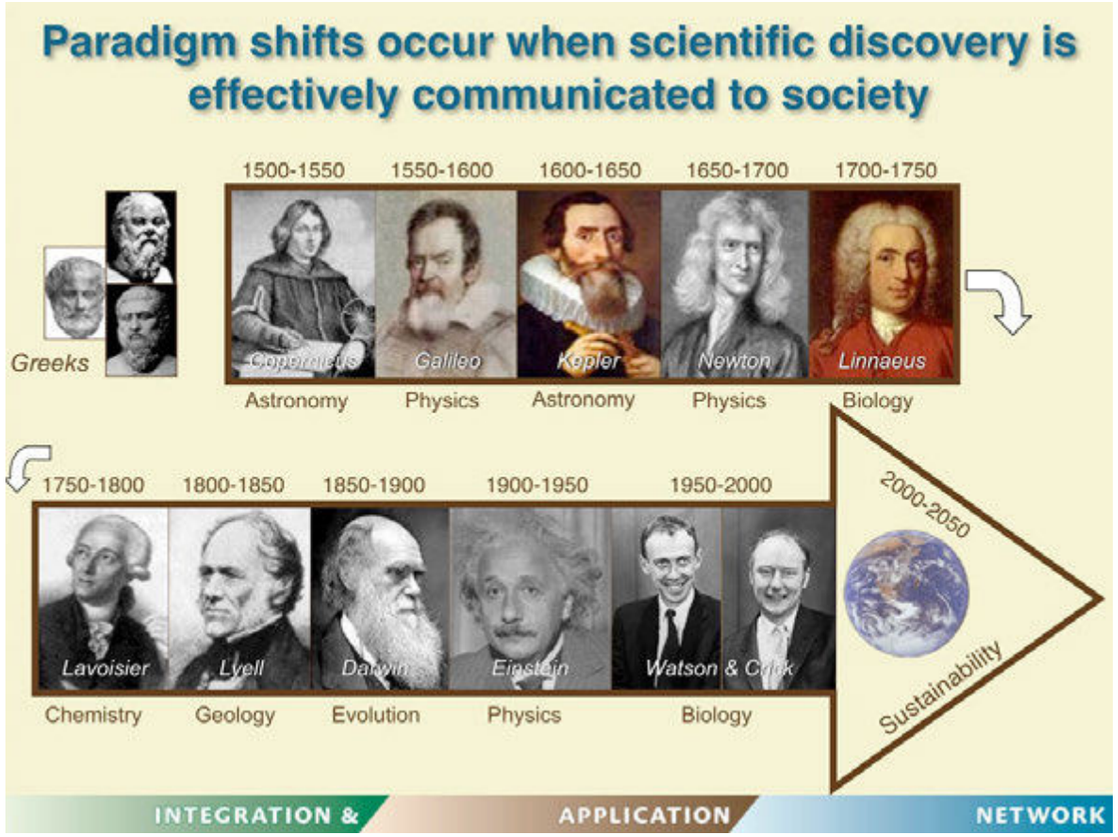
A child's innate curiosity about the natural world.

The current generation of children are 'digital natives' who have an affinity for electronic devices. Digital natives access information in very different ways compared to their parents and grandparents. Thus the mode of delivery to this generation needs to match their learning modes. If they receive their news via YouTube, Facebook, Twitter, Instagram, etc. rather than newspapers, magazines and television, then the environmental issues need to be presented in ways that digital natives will access them.

Recommendation 5. ***Appreciate the power of effective science communication***

Bill has written about the history of science communication using examples of iconic scientists who effectively communicated their ideas to a global audience, thus fundamentally changing the way people think. These iconic science communicators were identified in half century increments:

Nicholas Copernicus (1500-1550) with his revolutionary idea describing that the earth revolved around the sun, Galileo Galilei (1550-1600) developing the law of gravity, Johannes Kepler (1600-1650) articulating the elliptical movement of planets around the sun, Carlos Linnaeus (1650-1700) creating a nomenclature for naming plants and animals, Anton Lavoisier (1700-1750) creating the field of chemistry, Isaac Newton (1750-1800) describing the laws of thermodynamics, Charles Lyell (1800-1850) interpreting the geological history of the earth, Charles Darwin (1850-1900) describing natural selection and evoking evolution, Albert Einstein (1900-1950) developing the theory of relativity, and Francis Crick and James Watson (1950-2000) discovering the structure of DNA.



The history of scientific paradigm shifts since 1500.

Each of these iconic science communicators addressed a fundamental societal question: *Where are we in the universe? Where did we come from? What are we made of?*

The next pressing societal question that needs to be addressed is the following: *Can we sustain human life on this planet?*

This pressing question of future sustainability on planet earth underpins the quest that Peter and Bill have been making throughout their careers. Developing sustainable solutions to the environmental issues created by evermore people consuming evermore resources provides a grand challenge. A practical thoughtful environmental philosophy is needed to guide this quest, which at times feels quixotic considering the enormity of the problems. However, the revolutions of thought created throughout history illustrate how major changes in perception can occur when effectively communicated to society.

These changes in perception create 'thought revolutions,' just like the Copernican Revolution changed the way people thought about the earth and the sun, and a sustainability revolution can lead to effective solutions to pollution, climate change and habitat destruction. This provides us with an underlying optimism about the future and motivates us to continue our search for effective ways to educate and communicate our environmental philosophy.

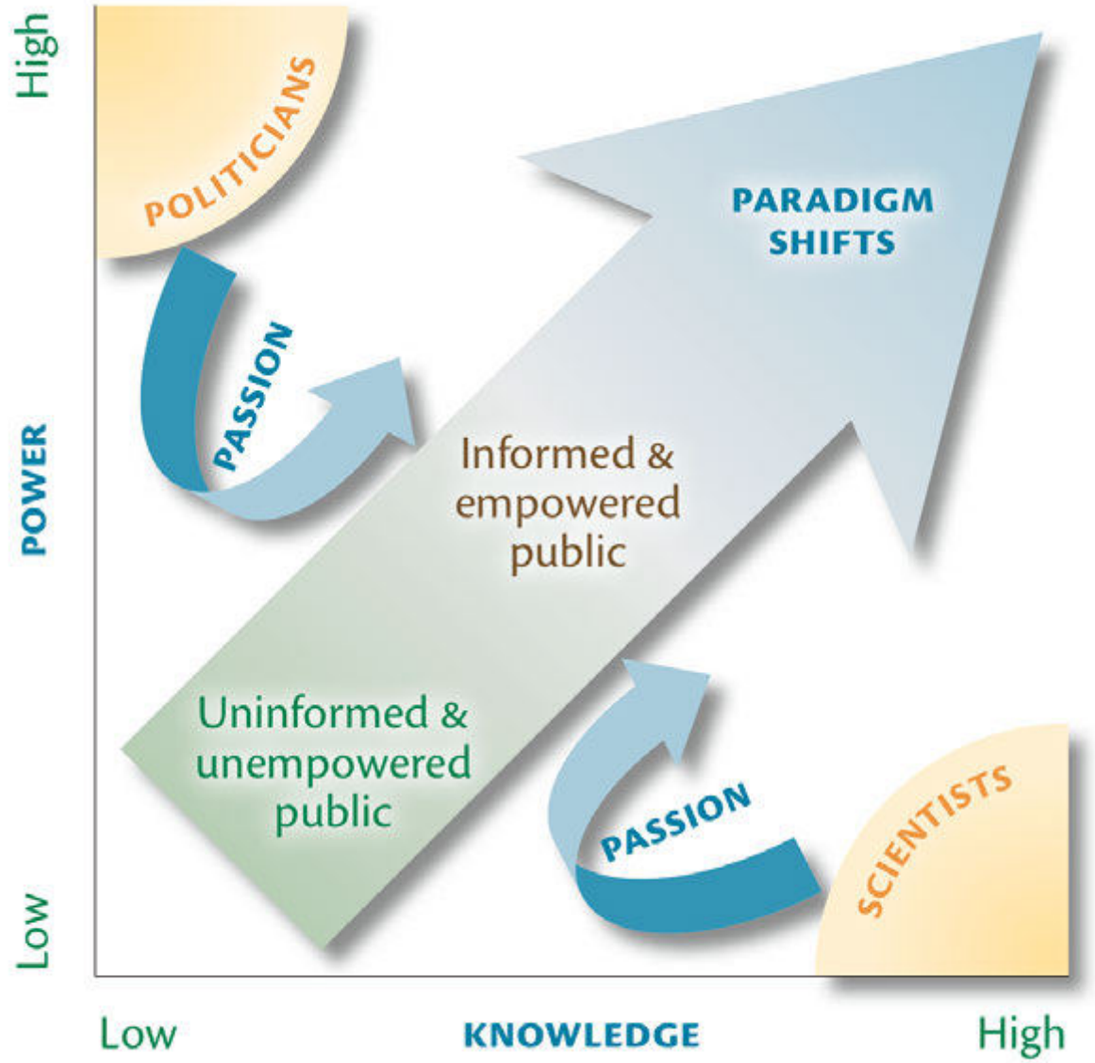
Recommendation 6. ***Build relationships that will make science communication more effective***

We have found that building key relationships with decision makers and their staff is important in delivering meaningful scientific advice at the time of decision making. Making policy is often messy business and a well-planned strategy of science communication is often subverted by a late phone call or passing comment at a reception or field trip. Thus, having a relationship in which regular interactions with policy makers allows the opportunity to convey scientific advice at the critical juncture. Good political leaders will seek opportunities to learn about issues first hand. They will want to see these issues for themselves to help filter the various inputs that they will receive from opposing viewpoints.

We have found that taking political leaders on field trips is an effective way to educate them about key issues and begin developing relationships with them and their key staff. Being politicians, they often enjoy meeting people and appearing in the media, so field trips that involve assembling groups of people and having press along will encourage them to attend future events.

One of the primary motivations to producing environmental report cards is to speak 'truth' to 'power.' 'Power' is vested in elected officials and community leaders and it is our tenet that these elected officials and community leaders need to make their decisions based on 'truth.' While absolute 'truth' is elusive and the scientific method of developing and testing hypotheses does not produce 'truth,' it is the concept of using the best scientific understanding to inform environmental decision making that is meant by speaking truth to power.

Environmental report cards that employ transparent methods to convert data to scores or grades, allow everyone to assess the status of the ecosystem. As with school grades, the comparisons with others is important and the trend in scores (improving or degrading) is important. To be effective over the long term, environmental report cards need to be produced by an honest broker, not a special interest group or a group with a political agenda.



Combining knowledge, power, and passion leads to societal paradigm shifts.

Recommendation 7. *Use science communication to tell stories*

An ancient and valued form of human expression is story telling. Since science is often focused on gathering and interpreting facts, the art of story telling is often lost. However, whenever a scientist can string together the various facts and weave it into a story, the result can be a powerful communication device. Stories often feature people, which

natural science does not emphasize (apart from social science aspects). Stories are often more compelling when they feature people. The race to discover natural selection was made more compelling when Darwin was challenged by Alfred Wallace, and a hundred years later the race to discover DNA was compelling, pitting Watson and Crick against luminaries like Linus Pauling. This human aspect to scientific discovery is often lost, yet it can help form a compelling story.

In Dancing with Dugongs, we are attempting to provide a storyline, retrospectively and reflectively. This is very personal - it is about how we think (head), how we feel (heart) and how we act (hands).

The whole concept of creating a story out of our life experiences is an attempt to tell a story that connects what we know to what we have done.

We have thought long and hard about our environmental philosophy, and while the story may be somewhat disjointed, it is the product of two people who have spent a lifetime striving to develop an integrated philosophy.

Recommendation 8. ***Use science communication to take people from uninterested to interested to informed to engaged***

An environmental campaign requires transitions from uninterested to interested, from interested to informed, and from informed to engaged. Each of these transitions requires different approaches.

Peter used his pirate motif in a shopping mall to get uninterested people to become interested. These shoppers did not come to the shopping center because they were interested in the environmental integrity of Pumicestone Passage, where Peter was the Catchment Coordinator, but the image of a grown man dressed as a pirate and saying “Arghh” captured their attention long enough for Peter to engage them in a conversation about Pumicestone Passage issues.

Cartoon character created for ‘Dugong Rock’.

Peter also stimulated the creation of a large stuffed dugong that featured in the Dugong Rock videos. The Healthy Waterways Campaign eventually created a large mascot, Hugo the Turtle, with a person dressed up in a large stuffed animal costume attending various fairs and public gatherings. In

addition, broad media exposure to unique environmental features, ecotours, and iconic animals can be celebrated to garner attention and convert uninterested people to interested people.

The transition from interested to informed is where science communication has a major role. The development of visually rich publications and web materials using newsletters, fact sheets, posters, flyers, books, booklets, report cards, and interactive web content serve to inform people interested enough to read more about a topic. With the explosion in virtual information sources, the importance of written material and attending presentations in person is often overlooked. Yet, the importance of having someone show up in person and talk about issues and answer questions is vitally important.

In addition, one of the things that Bill has learned in his public speaking, as part of the Healthy Waterways campaign, was the importance of shutting up and listening. People often came along to a talk because they had something they wanted to say, and a scientist with a working knowledge of their issues or ecosystems is exactly the person they wanted to talk to. These comments from the public often expressed concern, illuminated new issues, or provided insight. Bill learned that his public talks were typically only half of the event, with listening and follow-up discussion continuing well after the talk was completed, constituting the other half of the event.

The final transition, going from informed to engaged, requires yet another approach. People need something that they can do to become engaged and an environmental campaign needs to provide ample opportunities for involvement. This can be in the form of stream restoration activities, tree planting, and citizen science participation in monitoring, local environmental organizations, or advocacy.

The overall purpose of the environmental campaign is to take the uninformed to informed and the informed to the engaged.

When Bill was involved in the Healthy Waterways campaign 'road show,' we learned to send along someone just to help sign people up for various activities and to introduce them to local organizers. The other component to environmental report cards that Bill's group produces is to indicate what individuals can do in their everyday life to improve their environment. These suggestions are often incremental solutions, with a slight behavior change (e.g., use less water and energy, plant trees), with the hope that large numbers of people making slight changes can make a difference and that small behavior changes could pave the way for larger, more substantive changes at a later date.

Recommendation 9. ***Use visualizations to communicate science***

One of the techniques that we use as often as possible is to provide visualizations. We often work hard to take political leaders on field trips so that they can see the issue first hand. Bill felt that if he could show an elected official both the good and the bad sides of an issue (crossing environmental gradients or contrasting good versus bad environmental practices), then the contrast would serve as a learning moment that would last for a long while. Peter felt that having fishermen describe the issue in their own words in a setting where they were comfortable (e.g., their boat) would make the issue very real to the elected officials.

Peter Oliver on a field trip in Vietnam.

As part of the attempt to explain issues to broad audiences, we learned that people would become much more engaged if they were viewing a visual element that they felt that they could contribute to. The photos, maps and graphs were not viewed as something they could modify or add value.

In contrast, a conceptual diagram in which various ecosystem attributes and processes were presented in a visual style that used intuitive symbols (e.g., a fish looked like a fish, or an arrow coming from a pollutant source into a waterway conveyed a transport mechanism), we found that people would become animated and offered suggestions for modification.

In addition, these conceptual diagrams could be created de novo with community members generating the ideas and expressing their environmental values through the prioritization that occurs in drawing the ecosystem in a diagram. In this case, the people involved in the diagram developed an ownership of the diagram that can be effective for achieving 'buy-in.'

In order to meet the needs of various groups to create conceptual diagrams that depicted the issues they cared about and to create a sense of place when viewing the diagram, it became necessary to hire people with graphic art capacity. Over time, it became obvious that to effectively communicate scientific issues, the graphic artists need to be conversant in science.

What was needed was a unique combination of scientific background with its rigor and ability to synthesize information along with artistic flair and graphic artistic capability. While this combination could be achieved in two ways - training graphic artists in science versus training scientists in graphic arts, we found that the most effective way was to train scientists in graphic arts.

Creating conceptual diagrams.

Not everyone could bridge the science and graphic arts chasm, but software developments in graphic arts have facilitated the transition of scientists into graphic arts. Bill started this process using graduate students at the University of Queensland, but then developed a cadre of Science Communicators at the University of Maryland Center for Environmental Science.

With the need for new symbols for each new diagram, it soon became apparent that a master list of these symbols was necessary. With the development of the Internet, these symbols could be shared widely and new ones added as they were created. Our first thought was to have everyone creating symbols add them to a symbol library. But we soon learned that, to maintain quality control, we needed a gatekeeper approving or editing new symbols to ensure a common look and feel. Some people were inclined to develop cartoon-like depictions, but the scientific conceptual diagrams were attempting not to be cartoons, rather abstract depictions of ecosystems.

Thus, we evolved our symbol library into a searchable database of symbols that were generated by a wide variety of people with a common look and feel. This symbol library has continued to grow and be used by a wide variety of people from around the world. As a result, what started out as an attempt to capture ecological issues in Southeast Queensland has grown into a global symbol language. This language is being grown organically (by the need to create a symbol for a particular diagram communicating a specific issue). The thousands of symbols are language and culture independent. That is to say, a turtle symbol is recognizable to anyone who has ever seen a turtle. Other devices, like using universal colors to depict danger, good and bad, or using size and position of symbols to connote relative importance serve to make the conceptual diagrams meaningful to the broadest possible audience.

Recommendation 10. ***Create memorable moments to help communicate effectively***

An important communication technique that we have employed is to create memorable moments in presentations or workshops. Creating a memorable moment enhances the likelihood of the message being remembered by the participants. Peter has used songs as a way to create a memorable moment. He sings songs that are related to the topic and draw people into the overall story. 'Sing-alongs' also serve to create a shared sense of community. Peter will often bring his guitar to an otherwise staid event.

Peter creating a memorable moment on stage.

Bill uses poems or songs in his presentations as well, but without the singing ability. Another technique to is do something different than anyone else. At the end of a long conference of continuous powerpoint presentations, Bill has given 'naked' talks without using any powerpoint slides. This once occurred when Bill was about to give a presentation at a national meeting and the computer malfunctioned. It was indeed memorable for all who attended, as he had to resort to a chalkboard presentation.

Presenting information in a unique style can make a difference in getting the message through to the audience. In all cases, the danger is that the people will remember the style, but not the substance. For this reason, it is important that the song or poem or humor is topical - just singing a song is entertainment, but singing a song that addresses the topic in a novel way is enhancing communication.

Communicating science: Storyboarding, teaching philosophy, and self-realization

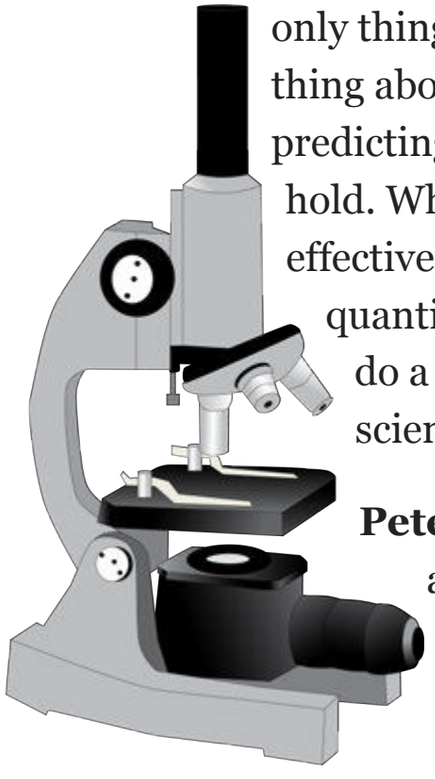
Peter: So tell me about storyboarding.

Bill: What we do in our storyboards is literally mock up page-by-page. We decide what is going to be our title page, and then there will be a two-page spread for each of the following pages. And we will have a topic, and we will get a photo here and put a map in there. Then we go to the next two-page spread, and then of course, we identify the text that we need that will fit into the available space. The next two-page spread we can think about maybe a diagram or your big landscape item, which may be a two-page bit. It can go across two pages. So the storyboard process is literally a page-by-page layout. Now that is storyboarding at a sort of detailed level. Once this is done, we have a pretty good draft. We can do a whole book, section by section.

You cannot do the whole thing at once. I find it to be incredibly intense. I find it an interesting experience. This approach is how we did all of our Moreton Bay books. I could only do a half a day at a time. I could only do a few hours and then my brain would explode. It is not something you can do all it once and just power through, but you can pick away at it. One way to do that is just to do it a chapter or section at a time. Lay it out, have a look at it, then sort of evolve from there.

Bill: One of the things I do in the class I teach is at the end, I give advice to the students. I break it up into pitfalls like 'death by consensus,' 'documenting environmental declines,' or 'hypercritical science' - those kinds of pitfalls and what to

do to avoid the pitfalls. Then I talk about how scientists fit in society, how scientists can and do change the way people think. Science is a very human activity, so the cultural bias and upbringing does influence your approach. You have got to recognize it. Science is not totally objective. The moral and ethical code applies to scientists as it does to the rest of society. We talk about this in class. If you are not honest with yourself, you cannot be honest to other people. There are social and political ramifications of what is being studied and how it is being conducted. Human scientific enterprise is by world citizens by which a free exchange of information and ideas is essential. Political boundaries tend to need to be transcended. Then science is one of many activities that society undertakes.



So I think science is critical, but it is not the only thing. Anyway, I go through this whole thing about being a good scientist and predicting what I think the future is going to hold. What they should learn to do to be effective - communicate effectively, have quantitative skills, business skills, how to do a thesis, and how to justify your science.

Peter: There are other stories that are about teaching. What you are talking about is spreading your wings.

Bill: Right. It is sort of a light mentoring, more of a life coach.

Peter: There is definitely something about people that you have mentored. Be careful because we will start quoting examples. So-and-so did that, or so-and-so, which is crap. I do not mean it like that. I mean more along the lines of - oh just use some good examples of people who have taken that advice. The young guy I am talking about has done our course and has just gone “Bang.” You know? Like, I am setting up my independent water management consultancy because I can see there is an opening here. I was a geologist and I can see that there is more than just gas in this. I have worked with indigenous corporations looking at access to land, and I think I have these community engagement skills and these communication skills. I want to marry all of these things up and get the mining industry, water, the community, land holders, and indigenous people more engaged and working together. So he is doing mainly land access things at the moment. But he is also doing his first big integrated water management thing looking at shale gas and water in communities.

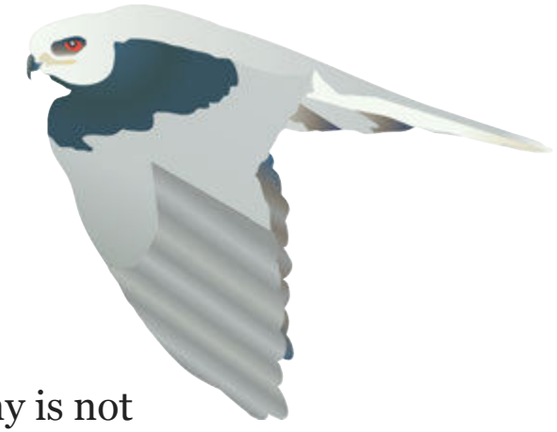
It is not about what is in the future. It is about what is happening right here, right now, enjoying that. And one thing I read recently, if you took all these humans out of the world, and you were suddenly some sort of being that could go in and talk to the birds and the animals and the plants and say, “So what about yesterday? Whatever happened - what happened last week?” And the birds wouldn't care and you would be going, “What?” There is the conflict of time. It is just what is

happening now and not what might happen tomorrow. But just seeing this - I am granted this perspective. I have this philosophy. I might have some sort of loose plan about what it is that I want to do. But what I am really going to do is just try and make the most of absolutely every instance of time, right now.

Bill: But that has to be balanced with the self-realization of your station in life. I will tell you a joke to provide an alternative perspective. So a guy is on a bus and he is looking over - he is middle aged, 50-something - and he is looking around sitting in the middle of the bus. And the 19-year-old is looking at him and the 19-year-old is all grungy. And the guy, the 50-something-year-old, looks at this kid. And he realizes he used to be that kid. And when he was that kid he would be looking at what is now himself and saying, "Old man, if you knew what I was up to last night, if you knew what was going on in my life, it would blow your mind." And the old man, he is looking at the kid now and he says, "You know what, punk? You do not know shit." And his personal observation was "Wow, it is great to be 'right' your entire life."

So if you only live in your moment, if you are only focused on your bit, your perspective, you can lose that thing that we talked about, that spiritual connection that you get when you realize that you are an insignificant speck in the history of time in the vastness of the universe.

Peter: Right. And the challenge is to always try and do better.



Bill: So that is the Zen, to get into the 'here and now' but appreciate the past and the future and the significance of where you are.

Peter: And, and that is why developing a sense of philosophy is not just a philosophy of where you think you are, it is maybe just a little bit deeper than that. Whether you want to call it a life force that has surveyed the earth or we call this thing the spirit of God...

Peter: I am reading a series of philosophy books, but I am finding quite a disappointing book at the moment by a Buddhist. Buddhism basically relies on the fact that humans have a life force or a soul, a spirit or something, but this guy is actually saying, "Nope, no, we do not. Now Buddha never said anything about that. He said just that practicing of Dharma and, and freeing oneself from craving which comes from desire. He just says there is a path to Dharma where you get to enlightenment, but there is nothing in the teachings of Buddha about humans having a soul." Then, I read things in other religious editions that say, well, actually there is something that lives on.

And I happen to think it lives on in whole lines of things. And so what do you? There are facts much deeper. When we get to the philosophy that the spiritual, the personal, and the

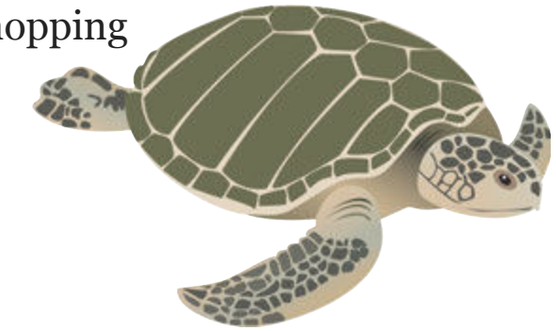
professional philosophy actually do have to be sort of integrated for somebody.

Bill: Okay. If the journey fits in with the personal philosophy - Developing a Personal Philosophy, that is fine. I liked what you said about how we have converged here and now on this project, but we have come at it from really different life journeys. Because I came from a science background and went into environmental stuff, and you came from a community background into environmental stuff and applied science to your community engagement, and I sort of learned about community engagement.

So we kind of learned each other's complementary backgrounds or skills. But we have ended up in the same place. Here we are, right here, right now, with the same mindset, working together on a combined project that we would not have predicted even five years ago. Would not have predicted 15 years ago. Would not have predicted 50 years ago. So, anyway, I think that there is something to that life journey what shaped you. And for us, our investigation – by telling each other's stories, our investigation of what shaped those stories and what shaped us to be in the space here together now, and what readings, what mentors, what inspiration, what priorities we have developed, what personal code of conduct we live by—that has all come about independently but convergently. And so by kind of comparing across those convergences, we can look at what are the key themes or elements that make it work.

Peter: Because our stories both have something – like the times they are a-changing - which is more toward bringing about change. The need for transdisciplinarity for people who are trying to sort of step outside their boxes has changed markedly in the last 30 years. But that's sort of what I'm trying to say, so that people like us 30 years ago wouldn't have met. There wouldn't have been a mechanism.

Bill: True. There wouldn't have been the mechanism. Well, I'm glad that we met. I might have seen some bloody pirate as I'm going about my shopping and thought, "What's that idiot on about?"



Awakening passion

The more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for destruction.

RACHEL CARSON 1907-1964

Awakening environmental passion

‘Awakening Environmental Passion’ refers to tapping the environmental passion created when people publicly say “I care about this place.” This caring about a place comes from the heart, and environmental passion can create the motivation to accomplish change (hands) and persist to face of adversity (head). These heart, hands and head aspects of awakening environmental passion are key to an environmental campaign.

It is proving more difficult to develop environmental passion about a particular location due to increased personal mobility, decline in outdoor activities, and perceptions of danger with unsupervised children. Yet there are various approaches that can be taken to awaken environmental passion in spite of these challenges. The following table (Table 3) provides activities to address the hands, head and heart aspects of environmental passion through expression, experiences and excellence:

Table 3. Activities to address the hands, head and heart aspects of environmental passion

	Expressing	Experiencing	Excelling
HANDS	Athletic; runs, swims, triathlons, walks, boat races	Stewardship; clean ups, tree planting, stream restoration	Completion; product release, report cards, legislation
HEAD	Intellectual; symposia, workshops, training	Learning; field trips, overflights, snorkel/dives	Influence; petitions, membership, demonstrations
HEART	Artistic; songs, paintings, sculptures, poetry	Nature; observe biota (fish, birds, flowers), phenomena (bioluminescence, night sky)	Acknowledgement; indirect (see or hear your words repeated), direct (awards, prizes)

The expression of environmental passion can be kindled through a variety of different means. For the athletically inclined, having runs, swims, bike rides, triathlons, walks and boat races provide opportunities for people to experience nature in a social and/or competitive setting. The environmental message can be included in the course choice, advertising, and media opportunities. For the intellectually inclined, various symposia, workshops and training sessions

Peter's impressions of Saltwater Church II

can provide opportunities to gather people together to learn more about issues, share experiences and develop networks. For the artistically inclined, various songs, paintings, sculptures and poetry can celebrate environmental issues.

Environmental experiences can foster stewardship through clean up days, tree planting, stream restoration and other activities that result in improved environmental conditions. Deep learning experiences concerning the environment through guided and self-guided field trips, overflights or snorkeling and diving in aquatic habitats can also help create environmental passion, ‘to know something well is to love it’. Simply observing nature in person can provide strong feelings, particularly when observing biota like birds, flowers or fish, or memorable occasions when observing unique phenomena like bioluminescence or sunsets.

Creating a sense of excellence in environmental activities can provide motivation for practitioners. The satisfaction of completing specific tasks in a seemingly endless journey can be important, so celebrating the completion of various products (e.g., books, websites), report card releases, or legislation enacted provides participants with a sense of completion.

The ability to influence other people and expand the impact of an environmental campaign is a measure of effectiveness. The use of petition drives or membership campaigns provides quantifiable measures in terms of people who have joined. Demonstrations or public events also can engage people in environmental campaigns. The acknowledgement of individual or group effort can be powerful motivators. Indirect acknowledgement, like hearing your own words repeated, and direct acknowledgement, like receiving awards or prizes, can motivate people well beyond the acknowledgement.

Various aspects of nature encounters can create visceral experiences, enhancing environmental passion. In terms of the hands (body), the feel of sand beneath your bare feet or

warm, soft mud squeezing between your toes provides a strong connection with the earth. The feel of a rounded stone or a smooth piece of wood provides a tactile connection with inanimate objects, while petting an animal or smoothing the feathers of a bird provides a tactile connection with living beings.

Smells of nature can also invoke strong memories and connections, like the aroma of flowers in bloom, crushed herbs, low tide at the beach, or the musk of wild animals. The sounds of nature like the call of the loon, the trumpeting of elephants, or wind through tree leaves, can evoke strong feelings as well. The taste of freshly picked fruit like berries or apples or honey from a beehive is memorable.

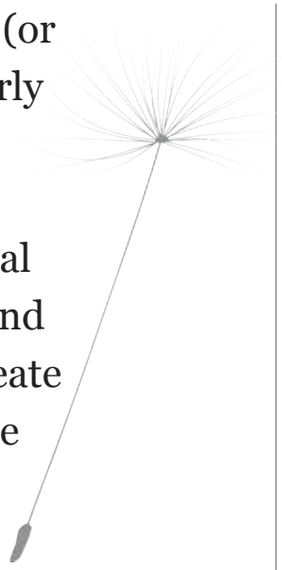
The views of sunrise and sunset, moonrise, stars and planets in the night sky, distant mountain ranges, cloud formations and broad prairies create connections as well. There is also an exhilaration that comes with tapping natural forces for movement. Examples are the exhilaration created from surfing ocean waves, sliding down snowy hills or sailing along the surface of the water. These experiences can be enhanced with technology (e.g., surfboards, skis, snowboards, sailboats), but the basic feeling of being aided by wind, water, and gravity creates the exhilaration.

In terms of the head (mind), the act of discovery can create lasting memories. Coming upon an alpine lake, an underwater grotto or a group of animals is memorable. Discovering new insights into how nature works is also inspiring, such as learning what eats what or learning how plants and animals are connected.

Peter's impressions of The Windover

Understanding where you are in relation to other objects, particularly the celestial objects, is inspiring - obtained when viewing the night sky. Understanding where you are in relation to the formation of the universe or earth or evolution of life on earth is humbling and awesome. Capturing the feeling that your life is but a short flicker of time in the immensity of the universe is a special moment and invokes the importance of looking after the planet during our lifetimes.

In terms of the heart (spirit), oneness with nature (or a deity) can be obtained with mediation, particularly when in quiet (unplugged) settings. Having quiet moments with natural viewsheds (e.g., mountain ranges, forest canopies, rocky outlooks) and natural soundscapes (e.g., ocean waves, birds chirping, wind blowing through leaves) can lift your spirit and create a connection with nature. The viewing of any of the seven natural wonders of the world can be a spiritual experience.



Seven natural wonders of the world

The original “seven wonders of the world” were manmade structures, often in iconic settings. The impact of seeing these manmade creations was what made them the wonders.

Similarly, the seven natural wonders of the world are focused on the iconic settings that impact those viewing them. These natural wonders are both physical and biological, united in their ability to create lasting memories in those who view them. They are not everyday occurrences like sunrises or sunsets, but rare enough to induce a sense of awe and wonder in those viewing them. A common feature of the natural wonders is that photography rarely does them justice - the live experience of observing the natural wonders transcends the photographic memory.

The seven natural wonders of the world are the following: 1) Aurora (borealis or australis), 2) eclipse (solar or lunar), 3) green flash at sunset, 4) bioluminescence, 5) storms or tectonic events (hurricanes, tornados, earthquakes, volcanoes), 6) mass spawning, and 7) live birth of large animals.

Aurora borealis (northern lights)

1. Aurora borealis in the Northern Hemisphere (northern lights) or aurora australis in the Southern Hemisphere (southern lights) are natural light displays in high latitudes which can produce colorful curtains, dancing across the night sky. They are ephemeral and typically viewed in winter months standing outside in frigid conditions, as it is difficult to view night skies in high latitude summers.

Thus, the experience of seeing them is made more memorable because of the viewing conditions. They are created from solar wind interactions with the earth’s magnetic force, and are thus a function of the earth’s position within the solar system, a concept that reinforces their uniqueness. Bill has great memories of cross-country skiing and watching the magical aurora displays while at the Institute of Marine Science, University of Alaska, Fairbanks.

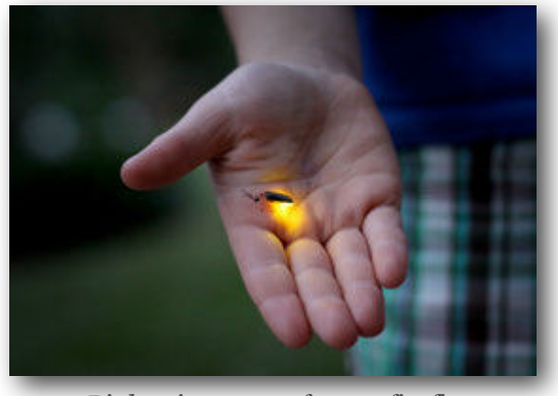
2. Another astronomical phenomenon which creates awe and wonder is when the alignment of the sun, earth and moon causes an eclipse, either a solar eclipse where the moon blocks out the sun or a lunar eclipse where the earth's shadow covers the moon. Total eclipses are rare occurrences, that, combined with requiring clear skies, make them difficult to view. Another type of eclipse is the transit of Venus across the sun that occurs at intervals of less than twice a century. The rarity of viewing these phenomena and the realization that they involve various celestial bodies makes them particularly special. For me, the solar eclipse is spectacular, but I enjoy watching some memorable lunar eclipses, because they are easy to watch (no special viewing aids needed) and really provide a three dimensional image of the moon.

Total lunar eclipse

3. One of the vigorously debated wonders is the green flash at sunset. There are many skeptics who believe the green flash is a myth, but there is photographic evidence as well an optical physics explanation to support its existence. Part of the problem is that it is more of a green glow than a green flash, and it is best viewed with sunset over a water horizon. The green flash is a rare event, and some people view sunsets for years or decades without seeing a green flash. Bill had the good fortune of watching the green flash three days in a row while helping a friend deliver a 32' double-ended Bristol Bay gill-netter from Seward to Sitka, Alaska across the Gulf of Alaska.

Sunset in Samoa

4. Bioluminescence, the production of light by living organisms, can create wonder, particularly when large aggregations of fireflies, worms, dinoflagellates, jellyfish or fish congregate and bioluminescence. The flickering light generated by living organisms in an otherwise dark background provides a stark contrast. Bill's favorite bioluminescence experience was Bahia Forforescente near La Parguera, Puerto Rico. The points of light in three dimensions when surrounded by bioluminescing organisms created an amazing immersive experience.



Bioluminescence from a firefly

5. Experiencing nature in its full fury in either storms or tectonic events can be both frightening and memorable. Hurricanes, typhoons and cyclones (different names for the same large low pressure systems in different parts of the world) are awesome events, so much so that they are assigned unique names. Tornados or waterspouts are smaller, but more intense wind events that can be devastating. Tectonic events like earthquakes, volcanoes, and tsunamis can be devastating

and unpredictable. Bill has experienced several hurricanes, the most memorable of which occurred while he was aboard his boat in Hadley's Harbor, near Woods Hole, Massachusetts during Hurricane Gloria in 1985.

6. Mass spawning events occur when some species or groups of organisms synchronize their reproductive efforts to overwhelm predators and enhance fertilization success. The timing of these events can be quite precise and related to solar and lunar cues. For example, mass spawning of corals on the Great Barrier Reef occurs several hours after sunset, two days after the full moon approaching summer solstice. The sudden appearance of pink coral eggs and sperm packets in the water, triggering a feeding frenzy by worms and fish, is a remarkable event. Bill was able to take University of Queensland students to watch coral spawning on Heron Island reef for many years and it never ceased to amaze.

Brain coral spawning

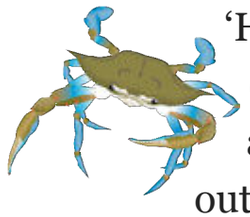
7. Live birth (or hatching) of animals is a memorable event. While it is more common to witness birth of domesticated animals (e.g., horses, cattle, cats or dogs) than wild animals (e.g., whales, dolphins, bears or lions), both are remarkable events. Human birth is an awesome event, inspiring wonder. The settings for live births distinguish them, from hospitals to barns to wilderness, and the more remote births generate more awe and wonder. There is an element of danger in live births, for both the mother and the baby. Watching the mad scurry of sea turtle hatchlings from the nest to the water is an amazing event.

Having fun

Dance like nobody's watching
Love like you've never been hurt
Sing like no one is listening
Work like you don't need the money
Live life every day as if it were your last.

UNKNOWN

Having fun while developing an environmental philosophy



'Having fun' refers to enjoying the journey of an environmental campaign. Environmental issues are typically serious business and people burn out by being serious all the time. Having fun conjures up images of smiles and chuckles. Having fun warms the heart, and makes the experience more memorable. Having fun can inspire people and make them want to do more.

We need to employ an 'eco-psychology' to be more effective, with a self evaluation: *Did I enjoy myself*? *Would I want to do more*?

There are various approaches to having fun and the following table (Table 4) provides activities to address the hands, head and heart aspects of having fun through expression, experiences and excellence:

Table 4. Activities to address the hands, head and heart aspects of having fun

	Expressing	Experiencing	Excelling
HANDS	Physical humor; getting muddy, dirty, and wet, being silly, wearing silly clothes, making gestures	Group activities; field trips, group projects, singing and dancing	Sense of accomplishment; applying skills to new situations, overcoming obstacles and fears
HEAD	Games & activities; playing, play acting, topical and relevant activities	Learning; increased knowledge through reading, lectures, data analysis	Catalytic validity; ability to inspire others to change the way they think
HEART	Respectful & kind; humor with love, self deprecating, not poking fun at other's expense	Friendships; opportunities to share experiences and life experiences, teamwork, share meals	Personal growth; developing a philosophy for growth, reflecting on actions and impacts on others

Hands: Physical humor is universal. A timeless activity that always serves to invoke a smile is when people get muddy, dirty and/or wet. Field trips that involve getting muddy, dirty and/or wet often become memorable. A strategy that Captain Cook invoked when his men were sent ashore to collect freshwater was to immediately have the men

stand in waist deep water. This way they did not waste time or risk injury when trudging upstream to access freshwater. How many times have you carefully avoided mud or water only to eventually become dirty and/or wet, and then joyfully splashed along once already soiled? Another aspect of physical humor is being silly by acting silly, wearing silly clothes or making silly gestures. Physical humor has the advantage of being language and culture independent.

Catherine Chaston and Joelle Prange returning from a mangrove field trip.

Hands: Group activities to connect people. Field trips are an excellent way to conduct a group activity while experiencing nature. Group activities offer many dimensions of formal learning, through instructors but also importantly through interactions with fellow students. Group field trips also allow for informal learning experiences, particularly when a diverse group makes different expertise available to group members (e.g., bird expert, tree specialist). Working together as a team on a group project can facilitate team building, build confidence, and result in a whole which is greater than the sum of the parts.

Hands: Developing a sense of accomplishment. It can be fun to finish projects and gain a sense of accomplishment. By applying your skills to a new project and achieving a satisfactory end result, you can create a lasting positive attitude about the project and enjoy the process enough to want to tackle another project. There is something quite satisfying about overcoming obstacles and tackling new challenges. Overcoming personal fears about undertaking something new and different serves to build confidence and self-assurance. The fun part of this accomplishment is in the self-actualization that occurs by overcoming fears.

Head: Playing games and activities. There are many studies which show that playing games provides an excellent form of training. The intellectual aspect of playing games is often not recognized by the participants, as they are having too much fun to notice that they are actually learning something. Having competitions for prizes or recognition can

enhance the games, but simply playing games is often sufficient motivation.

Play-acting can be a good game to draw out the different roles and responsibilities that different sectors of society have regarding environmental issues, and some latent acting talents may be revealed. Topical and relevant games need to be utilized in a teaching environment, for example; Bill's IAN group uses the game 'Conceptionary' used to help teach science communication.

Having fun as part of an IAN Science Communication Course.

Head. Learning and gaining knowledge. The act of learning is inherently fun. Knowing more than when you started, more than your neighbor or more than the average person provides a positive reinforcement for learning. Being 'on the inside' with knowledge that not everyone else possesses allows you the opportunity to be better informed and you are often eager to share this knowledge with friends and family. The acquisition of environmental knowledge can come from personal observation, reading, attending lectures, or analyzing data. Regardless of the source, gaining new knowledge is a 'heady' experience.

Head: Catalytic validity - changing the way people think. The ability to inspire others to change the way they think is known as 'catalytic validity.' Since effective environmental management often invokes behavior change, there is a need to change the way people think about an issue in order to convince them to change their behavior. This convincing can be done through a variety of means, e.g., leading by example, providing compelling arguments, or by exerting peer pressure. The fun aspect of catalytic validity is figuring out which approach to take and the satisfaction of succeeding in connecting to people and knowing that by doing so, you have made a difference.

Heart: Respectful and kind humor. Humor can be cruel and demeaning, especially when it is at someone else's expense. In contrast, respectful and kind humor can be both funny and inclusive - serving to bind people together. Self-deprecating humor is particularly useful to break the ice in establishing new relationships and in allowing everyone to share in the laughter. Topical and relevant humor is needed, rather than one-liners out of context. Humor can alleviate tense situations, provide strong memories, and help forge positive personal relationships.

Heart: Developing friendships. Working together on various projects creates opportunities for people to share experiences and forge new friendships. Friendships that spring out of teamwork can reinforce the group dynamic. The trust and sharing that friendships provide gives people positive reinforcement for continuing their involvement in an environmental program. Friendships can catalyze new and different projects.

Chris Roelfsema, Bill Dennison and Andrew Watkinson in Deception Bay.

The friendship that sprung out of Peter and Bill working together on an environmental project (e.g., The Perfect Slime) is what promoted the creation of this book. Friendships can be fostered by using teamwork based approaches to problem solving, sharing meals and/or accommodations, and providing opportunities for self directed project development, which allow self assembled groups of people to tackle issues.

Heart: Personal growth opportunities. The personal growth that can come from tackling important problems and working collaboratively can be a very satisfying experience. Allowing for time to reflect on your actions and assessing your impact on others can promote personal growth. Recognizing personal achievement, particularly by using metrics that demonstrate progress or by realizing your impact either through testimony of colleagues or personal realization can enhance personal growth. Creating personal growth opportunities is an important management tool. These opportunities require mentoring but also need to allow for experimentation and not penalize failure too severely.

Having fun: Pirates, dugong rock, humor, and telling stories

Bill: It occurred to me that you being a pirate is about taking risks and being willing to be made fun of, being the scapegoat, being 'out there' is what is so important. Self-deprecating humor, being prepared to put yourself out there, Peter. I think that's key, and I flashed on that the other night when I was thinking, there's something about bloody Peter dressing up as a pirate and not being afraid of what people would think, or being...

Peter: Actually, I'm terrified, but I still do it.

Bill: Okay, but the point is you do it.

Peter: Yes, you still do it. So there's something about the institution of academia, it's a culture that is undergoing change. Everything's quite different, in a lot of ways. When I went to do a Diploma of Education at the University of Queensland, the staff actually sat there with me and said, "Oh, well, even though you've done an Honour's Degree, you haven't done enough to teach biology. And you haven't done enough to teach geography. You have to do some undergraduate subjects here." So I took a geography course and I said, "You show me your course syllabus and I'll show you what I haven't covered." It just was a joke.

So what I'm really saying is that things have really changed, and they're still changing. And I don't think the deep underlying thinking as to how you cope with that change has been well articulated for people who are suffering from that change. There is a lot of anguish when people go into their workplace where academia is changing. You're going to have to have some sort of quite robust yet flexible way of looking at the world and your place in it if you're going to survive what's coming up.

Any of the good work that I feel I've done, I've done a lot of 'not good work,' but any of the decent work I've done, I've

done because I became friends with the person I worked with. It's about developing real trust in relationships. I talked to my old school principal yesterday, and he's quite different, and he's been very seriously ill. And he said to me, "Well, one thing having a life-threatening illness has taught me is that I need to develop deeper personal relationships with people. You know my whole life I've had a staff of 100, and so I've had quite superficial relationships with those people, and I just don't like it." And I thought, "Wow, man, you are really changing." But to do good environmental work, have you ever had a really good colleague where you haven't been like a friend to that person? You've seen them out of hours or you do things with them?

Bill: Good point. My personal observation is that any successful scientific collaboration that I've been involved in, we break bread together. We bring each other to our houses. We see each other in our home setting. That's kind of a rite of passage. And so, absolutely, establishing a personal relationship is key. If it doesn't happen, the collaboration winds down. We have an acronym, NKA, for writing proposals; it stands for No Known Assholes. The idea is to never write a proposal with a known asshole. An asshole may emerge in the course of the project, but it is deadly to start a project off with a known asshole.

Peter: When it gets down to environmental project work, yeah, you just check them out. I like a quote from an Inuit that I heard which is, "I have 60 words for a friend, and one of them is I like him, but I wouldn't want to go seal hunting with him." And I think, yes, there's something about partnerships. I guess this is why I did my PhD on partnerships. I just got to the point where I thought this is an overused term, but here we are resurrecting it.

Bill: In terms of having fun, it is the diversity of activities that is fun. Anything you do would get tedious. It does not matter what it is, whether it is performing as a musician (which could be considered cool) or it could be traveling, writing, or going on field trips. Anything that you could design that would be viewed in such a way that you would say, "That is a fun activity" can become tedious. If that activity is all that you did, that becomes "not fun." In fact, do you know what they do in prisons to torture people? The prison still has to feed them, but they feed them the same food breakfast, lunch, and dinner for a week. If you eat meatloaf every meal for a week, it will drive you crazy.

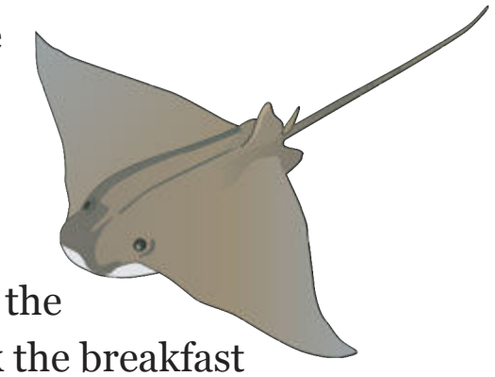
And so the idea is that no matter what it is, variety is the spice of life. And if you cut off the variety, you have damaged the human spirit in some way. So a part of having fun is having diversity, having new, different, and interesting challenges. And what is needed is enough training to cope with that diversity, to be able to tackle those new challenges, without being thrown in the deep end without knowing how to swim. But to be able to do a little bit of this and a little bit of that, and have a theme that knits it all together - having fun is diversity.

I think going out in the field is a lot of fun, but when I did that for a living every day when I was a young guy in Alaska, it became tedious. We had to go out in the rain and the sunshine. And I never had any time to go and do anything like banking or laundry or any of those mundane creature things because I was always out in the field. I would come back feeling dead tired and I would sleep. I was living out of a backpack or a duffle bag, and it became tedious after a while.

I enjoyed working on construction jobs for my father's construction company during summers. But the old men that were there had been doing it their whole lives. They would be bored to death, “Here we are at another job site.” To me it was like, “Wow, we are at a job site. This is interesting; we're building a water tower. How cool is that?” And they were saying, “Yeah, we build water towers all the time. No, we do not get excited.” For me, it was the novelty of working construction.

I believe that is why we are attracted to tropical rain forests and coral reefs: it is the biodiversity that we find attractive. It is a very compelling innate human aspect to be attracted to biodiversity.

I do not mind washing dishes when I am at a party doing it with three or four people. The task just flies by. But washing dishes the next morning by yourself becomes tedious. With other people, you can make a fun activity out of it. So you are right, Peter, it isn’t just the diversity, but it is also the people you do it with. And if you have the ability to make a game out of it, it makes it fun.

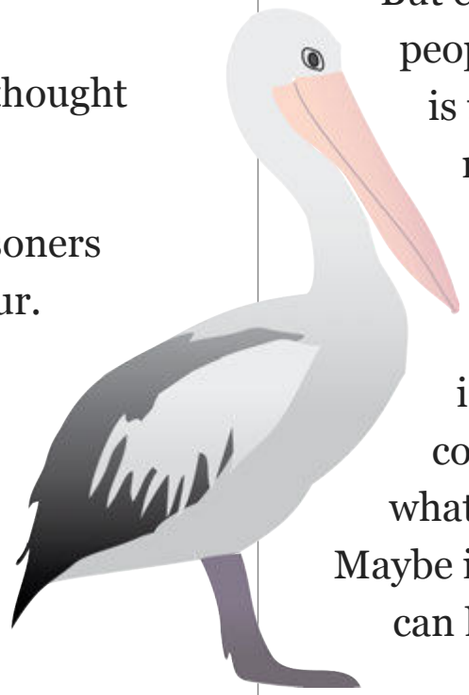


I worked in a kitchen at my undergraduate university at six in the morning. I had to get up and work the breakfast shift. I would get the trays as they came in, clean the dishes off, and run them through the dishwasher. That could be considered pretty brutal for a college student to be up at five thirty to start work at six. It was pretty challenging, but I learned that I could be up at five fifty-five and make it to work on time. The point is that I had a lot of fun because I had other people to work with in a similar situation. Sad as that may seem, I actually looked forward to going to work, but it was because I got to work with pretty girls and fun guys.

Peter: I am thinking of even more mundane labor. I worked at a job once when I was going through university, a bookshop. And it was called The Circle Bookshop. I lived there in Queens, UK, and it was a bookshop that specialized in spiritualism, metaphysics and the occult. I went in there with a reference from a Catholic priest. And the priest was like, “Are you sure you want to sell those?” I said, “Oh sure, it will be great.” The woman who ran the bookshop was an Astro Traveler. The husband of the woman who ran the bookshop was an Astro Traveler also. They were a pretty funny couple.

Anyway, they listened to me. I was putting up bookshelves one night. And it was a very tedious job. You got a nut and a bolt that fit into the holes. And I am singing, “One, two, three, four, five, six, seven, eight.” It is boring as shit, there is no one else around. She came in the bookshop and she says, “You would be on the Capricorn beyond Sagittarius, wouldn’t you? You make a game of everything.” And I looked at her and I thought, “Well, yes I do, if I get really intensely bored with something, I will have to try and make it work for me and I will make some game of it.” Yeah, she was right. But she might have known. “You have been looking at my Employment Record, haven’t you, you bastard?” I thought that was what she had done.

But it makes me think of what they do with the prisoners when they first come here to prisons like Port Arthur. They put prisoners in the dark, in sensory deprivation and solitary confinement, no one can talk or whatever. And they go mad. But the uniforms for the prisoners had buttons on them. And so what these guys would do in the dark is rip off a button and throw it to the other end of their cell, and then they would make a game of counting along to come to find it. And then they would throw it the other way. If they did get to talk to people in church on Sundays, and Church had a sermon so you could see the Preacher, but you could not see anything else. You could only see one person. So sometimes they are trying to tell each other how to get the buttons I suppose in Church, but it was just a game for themselves.



And when I thought of it, this woman really made me think, because when I have done boring things I do try and make a game of it. Does that mean sometimes I take things not seriously enough? Probably. But that is why I ask questions. And so just having fun, sometimes it can happen at almost a self-entertainment level I think.

But essentially you get to a thing where it can be the people you are working with, as you said. And then there is this something else that this works because it pushes more buttons. The things that are really essentially believing, and that is that not just having fun with, “One, two, three, four, five, six, seven, eight, because I count,” that sort of thing. It is fun, but it is more a deeper sort of sense of satisfaction and contentment, that all is right with the world, because what you are doing and what you feel are important. Maybe it is not the right word, fun, but that is what I think can happen at that sort of level too.

There is something that you said before, too. In Australia we call it self-deprecating humor. Is that a common thing for you in people that you work with in America or do they take themselves pretty seriously?

Bill: No, that is very Australian. That is not American so much. I do get chastised over stuff often. Yeah, Americans

take themselves pretty seriously here sometimes. I will see a visible reaction, “What, did you just say that to me?” Or, “Did you just say that about yourself?” They tend to be much more direct and much more serious in general. And so that humor is definitely not as prevalent in the workplace. Now it is different when you are in a social place, but I think the difference in Australia is that it permeates the whole of the culture. There is very little of that here in the workplace.

In America, people get in trouble for making any jokes about anything that could possibly offend anybody. So, they choose to stay away from it. It is tough on your soul to be serious all the time. I mean we miss it when we are in the States. Here are two examples from when we moved to Brisbane for our sabbatical:

We get this rental, and there is nothing in the house. We’ve stacked the unpacked suitcases. We get there in the morning and we have the fridge coming, and we have some furniture coming. But right then and there, there was nothing but a stack of suitcases. And the guy comes in with the fridge on the trolley, looks down at the pile of suitcases, and looks around at this big empty house and says, “I love what you have done with the place.”

And then Judy is in her office at UQ, and she is sharing it with a seventy-year-old Queen's Counsel who is writing a book and a very dry, serious kind of guy she thought. He walks in just as she had picked up a coffee cup and had forgotten that there was some water in it and spilled it. And Judy says, “Oh I forgot, I had water in the cup.” He just shook his head and says, “Oh, there is so much to remember in this world.”

And we love that quick and dry humor, we just get a kick out of that. That is fun stuff.

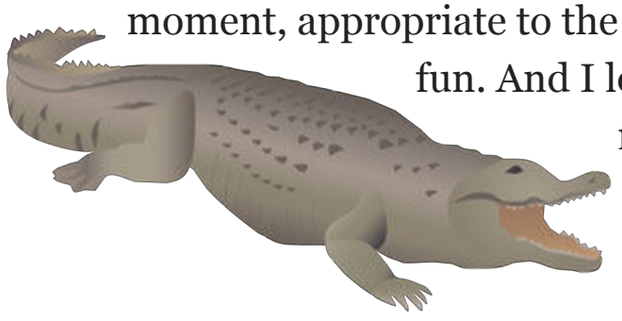
Peter: I think sometimes I say things that are quite inappropriate, probably mostly either way, but I am not certain.

Bill: Well, I think you have to set that scene. I do the same thing. I think you get away with a lot if people come to expect it. If you are the person that is known for “being out there,” dressing up as a pirate or singing Dugong Rock, then they are not going to be thinking, “Oh, what’s going on?” They are going to be, “Peter, good on you.”

I think that what we do in our personal relationships is set up peoples’ expectations of our behavior. If you want to be always serious and always thoughtful and quiet and respectful, then that is what you are going to do. Then if you were to do something out of that line, everybody would be shocked and horrified. If that is not your style and you set up your style differently, then people have different expectations of your behavior. And I think that is a part of this thing I was getting at about you not being afraid to be a pirate or me not being afraid to get up and draw stuff on the board or write little songs or poems and share it.

I was down in Louisiana working with folks there on their Master Plan of how to manage their coastal restoration. So at the end of these pretty intense three days of meetings and PowerPoints and discussions about what to do - you know “Me and Bobby McGee”? - I wrote "Steve and Bobby Twilley," a parody about the guys that were in Louisiana. I said, “Busted flat in Baton Rouge and heading for the Plan, feeling pretty talked down in a few days, probably put her panel together to help us deliver a team, and took us all the way to New Orleans. She made her delivery comments to the delivery team and talked it through while Bobby sang the blues, with those many deadlines keeping time, and Bobby clapping hands, we finally covered all the points that we all knew.” This is my favorite: “Planning is just another word for nothing else to do. Planning ain’t worth nothing but it’s free. Feeling good was easy Lord when Bobby sang the blues. Feeling good was good enough for me. Good enough for Steve and Bobby Twilley.” And then it goes on.

If I am going to do one of these kinds of workshops or something, I will do something of that sort like every time. In the middle of the night- that is when I wake up and write these. It is like you and your songs, that is where my mind goes. It is the silly kinds of little things that are of the moment, appropriate to the time and place, that are fun. And I love doing that, and I do not mind the fact that it is stupid and it is not very erudite and professional.



But, it is what I do. I like doing that.

Peter: When I was working as a teacher, at the first school that I ever taught, it was in Math and Science. And the principal there gave me some feedback after the six months and said, “Yeah, you are really good at this, but you want to be careful because you have a pretty flip way of speaking sometimes.” And he said, “That can get you into trouble.” You know, “Just be careful. That can get you into trouble.” I thought about it the other day when I went to this new place to have chemotherapy, but I did not think about it at the time.

There are sort of curtains in between the chairs. I saw this woman probably about my age come in and she seemed quite a pleasant and friendly sort of woman. She was sitting over in one chair, and there were a few other people in this big room. Mostly sick people, but you cannot see all of them. And some nurse comes in and said to me, “How are you?” And I said, “Good, thanks.” Just as she is giving me this big, long needle in my chest. This woman was in there and she is getting injected with something as well, and I hear voices pop out from behind the curtain, “Well, you are not really, are you? Otherwise, you would not be here, right? None of us that are here are really very good, are we? But, I understand what you mean.” And you hear these little giggles all around.

There have been a few times I have actually heard some humor in the chemotherapy room. So when I went up to this new place, it was a lot more crowded, curtains all the way back, we were all meant to be friends. Some looked like they

did not have to be here at all, some looked ready to fall off the bench. And this woman says, “We got lost. We were very worried. We could not find it.” And I went, “Oh, it’s a beautiful thing.” With the rest of the group, one guy is down there having a blood transfusion; he doesn’t even have enough blood to take the chemo. He says, “Did you just say, it’s a beautiful thing?” And I went, “Well, yeah.” And he laughed. So she comes over with his drug.

I said something else to her later on, just as she is about to poke me in my chest. And I said something that I thought was, I cannot think of what it was now, but I thought it was funny. And she said, “Are you being sarcastic?” And I said, “You do not know me. I am not being sarcastic. I am only being a little black. A little self-denigrating, a little of making the best out of a bad situation. I did not think it was sarcastic. I am sorry if I was.” I thought maybe she was offended by my words, but I do not how the hell we even got onto this. It is something that I think it is important enough to take yourself seriously enough on the occasions, but to have it so you pick your own occasion. When I do work in water management with Asian groups and mixed groups, I will stay very, very serious. And I will be until about halfway through day two.

Bill: That’s right, fair enough. You start off tough. I think there is something about being willing to be the butt of a joke, to be the lightening rod. There is something about being out there that is liberating.

Peter: You can afford to do that if you have in your head that you are the person in the room that is the expert for your material. And you are comfortable, and then you can afford to take that risk. If you are comfortable, then the risk-taking will come more naturally.

Bill: That is definitely a part of it. And one of the reasons I like working with Paul Greenfield is he does have a good sense of humor. And we will share that. He will make the dry things fun. He will make it worthwhile. And it is topical humor. It isn't like you are going to entertain the masses like a standup comic, but it is humor directed at the topic and the event and the people that are at that event. That is what it is about. That is why your song Storm Water Stomp is relevant for people trying to do something about the stormwater management. It is topical.

I was at a conference in Canada where they brought in Second City, which is a pretty famous comedy troupe that has generated lots of good material and many comedic movie stars. And a half an hour before the show, they were given some key words and people to make fun of, to try to relate their generic humor to the topic at hand. They did a couple of things, it was very minor in the end, because I guess they had tried it the year before and had tried to do too much and it fell flat. Because they did not know the people, and so making fun of people that you do not know is not the same as making fun of people that you know very well. When you are in this group setting and this partnership arrangement, then you can make more fun of people because you know them well, but you do it

with love, so it is not all negative. It is celebrating each other's foibles and not having a vindictive streak to it. There is a negative humor, which I really dislike in general, by the way. Modern comics will just go out and just slash people. I find them to be really tiresome. I might laugh at the time, but it gives me a bad taste in my mouth afterwards.

Peter: My kids have done that for me recently after I'd had chemo. One works at a video shop and he will say, "I'll get you some DVD's." And I would say that comedy is what I want. And he will bring back some comedy and sometimes it is not funny. It is not uplifting. At the end of it I do not feel good.

Bill: Exactly, and there is a lot of that negative humor in a way that I just do not enjoy it. I do like to take the Mickey out of people and myself as well. But you can do it with love or not. And I think when it does not have love it is not the same.

Peter: I had a really good example of that in my life. And I was working as a catchment coordinator one day. At morning tea I was listening to all the people talk about the start of a theatre review. This nursery that does a hundred and fifty thousand plants a year, they are raising money to revegetate creek systems and all that sort of thing. They employed a hundred members in a town of five thousand. I was listening to someone over there that was calling someone the "Government Grant Girl." So I started, "Born in the mythical land of Lemandra. His mother's name was Propagation. His father was a rogue plant, spurned by all respectable vegetation. He made his way to Australia where a band of super heroes gathered around. There was Government Grant Girl with Developer Dick."

And, it just went on and so this guy Dr. Fergus Riley who had a PhD in Computing. There are a lot of people there from the University of Edinburgh, but that is funny. And he took him aside and said, "Do you mind if I use that as the start for a Theatre Review?" And he wrote a thirty-minute Theatre Review called, "The Legend of Landcare Man." There was a Government Bureaucrat called Brunhilda the Bent. There were just all of these things going on, so we played it like this, "Being in Landcare was made all the rage. It is a good thing to do, being in Landcare is good for me and for you."

We played it at a statewide conference, and we knew two hundred of the four hundred people in the room between us, and some of them really well.

And then a Landcare group in a couple of places took it on the road. This is something that happened all because of a discussion at morning tea. At one point we were touring around Queensland and it didn't work at all. We got to one place where one guy thought that he would do the same thing. And he got a clipboard and he said, "Who is in town?" They had a barbeque to say goodbye to us the next day, and only two people came. And one of them was the person who was running the barbecue. The other one was the chairman of the Landcare group.

Bill: Right, that is a perfect example of the topical humor with love with people you know, versus trying to apply that outside. It does not travel well. It is about the time and place. It actually gets back full circle with the Buddhist thing about being in the moment, not being there at the wrong time. That is where that humor is relevant. It is relevant for that time and place, but you cannot just uplift it and jam it in somewhere else.

Peter: So there is something that comes out of it, that they are not forcing comedy. They are not forcing you to laugh. The comedy has to be appropriate for context, then. And it has to be delivered with love. So that you are taking just as much from yourself, or more, than you are from them.

Bill: Yeah, we also do a lot of funny awards. The thing is if you are going to go to the awards, you have to give everybody, including yourself, an award. It has to be equal. You cannot just pick on one person and say, "You got the award for the stupidest thing." You have to find something to give everybody a little bit of a rib, but it all has to be equalized.

Peter: I think some people just believe they are really not funny- that they are not entertaining and are very serious all the time. So I like to get our folks to start to do things that are out of the ordinary and in the end, people are going to say, "Hey, maybe I can be funny." And maybe, "Yeah, you are going to make your talk more interesting and you can give awards and do silly stuff too." You can give humor with love and it can have enough context for everybody to join in. There is something about having fun, like knowing what your deeper needs are that need to be met philosophically about yourself. And being in tune with other people and feeling what their needs are, and helping their needs be met. And in the end, people will say, "Well, that was really enjoyable. It was shit, but it was just really enjoyable."

Bill: Yeah. I did this thing with my colleague where we are doing a science communication training and I said, "How are you going to wrap it up at the end? How are you going to do this to connect with everyone?" She had not thought about it yet and I said, "Maybe this is a chance. You have an opportunity." Every time when we teach we put PowerPoint's together at the end of our one-day or multiple day course. We put diagrams that people have drawn into the PowerPoint and make fun of them. We bring the photos that we take around the place and put little captions, little thought balloons, speech balloons. I collect them. I have a whole bunch of those things, but it is also a chance to reinforce what we have learned and kind of poke fun at each other in the process. I do it every time I run one of those workshops and now it is standard for all of our staff to do this fun summary.

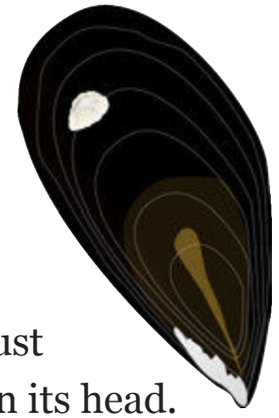
Peter: All right. I just want to say something that applies. There are some things that you can do just with the structure of the work to make it more entertaining and more on the spot, and people just go, "They did what?" I facilitated this 2007 state Landcare conference. And they

wanted me to do closing remarks on the panel. So there are a few other people in the room, and I am thinking, “How boring is a panel?” A panel can be good, but it can be really quite boring. And also a closing presentation, if you get it right, can be quite good. If you do it wrong, it can be pretty boring.

So I thought, “What if I did this as a piece of theater?”

It was in an auditorium with a proper theater stage. We had the three flying people come down from the ceiling and into the back of the stage. I was at the front of the curtain. Why I did that was because I said to people, “We are now going to go back in time, and you are in my lounge room at home the day before this conference closes. It is after the conference has closed for the day and I’ve got Ron and Lynn and Bobby coming around for a beer or a cup of tea. They are sitting in my lounge room. These are the people who you would have on the panel, and I am going to show them my presentation and we are going to have a beer or whatever. Let’s just see what happens.

So, that is what we did. We had lounges. We had no table in between us. I said, “I am so glad you came.” And Uncle Ron is saying, “Hey, bloody good to meet you. Sit down. I love what you have done to the place. This is the panel and we are here to watch your closing presentation.” And we sit down, “Yeah, Ron, the more I think about this bloody presentation, the more I think - What do you think, Lynn?” So I had Bobby and the whole range of people there, and the first time she is going, “I don’t know if I can do this?” And so I am giving them a presentation and I had the PowerPoint projected up behind me. That was my only mistake - it was behind me so that the audience could see it, but I could not see it, so I had to sort of remember.



Anyway, the long and short of it was we just turned the whole idea of a presentation on its head. And at the end the lights go up, and I am just going, “Holy smoking ducks, we were not alone. Look at all these people. Okay, some of you had questions, what were they?" I came over there and Ron was sitting there chewing on these ginger nuts. People loved it. We ran out of time. We went way over time. But I thought I would do that again if there were a group of people over three or four days that I knew, I would go back in the time machine and say, “This is the day before the end of the conference,” and proceed to put on a lounge room panel discussion.

Peter: Steve van Matre, an environmental educator who founded the Earth Education movement, talked about developing creative ways to teach environmental sciences. I have never seen one of these large models built, but I have seen the plans for them. He had a whole conceptual framework with a picture of the whole Earth including mythological concepts. He had scripts you had to use when you were teaching these sorts of lessons; you could only run it his way.

But what I loved was something he developed early on in life, and was in a couple places in the States, these things he calls his “Institutes for Education.” He had a large-scale model for photosynthesis; he had cross sections of leaves that were whole rooms that kids could actually climb into. And you could climb through the leaf. And you could see chlorophyll. And kids would sit on the top of the leaf, and kids would sit on the bottom of the leaf. Kids would sit inside the leaf. They would actually have these styrofoam balls that went together in certain ways.

So what would happen in the end is the kids would be sitting in the chloroplast, and he would be getting lots of carbon dioxide in through the stomata. He would be getting water coming up into the leaf. And he would be producing photosynthesis by having kids are throwing these lightening bolts in the chlorophyll. And the whole thing would only go together in one way. Then they had these big molecules, and they were oxygen and glucose, or sugar. And those things just rocked. So kids would play the photosynthesis game. And they were like ten or eleven years old. And they knew everything about photosynthesis by going to the Leaf Room. It was like, "How good is this?”

Guys could play games when I was teaching the Food Chain, where you have the notion of energy transfers and you say, “Only so much energy goes from one trophic level to the next.” You have kids on a hill and you have a vegetarian food chain and you have carnivorous food chains, and then you do food webs, and then you have trophic losses using cans of water that have holes. So you will only get so much. And you have a loss if you only get about two percent of whatever it is. And so the food chain can only get this long because you have run out of energy.

Bill: I love that. We think of that as being elementary education, at very primary school level to do those kinds of things, kids doing that stuff. My first semester of teaching at the University, there was an ex-high school teacher who was helping us with the first year Biology, which I was teaching. And she knew that the high school kids were not very different than the University kids and needed to get up and move every twenty minutes, because the blood just pools down at their feet. Their brains are starved for oxygen and they are not functioning any more. Both physical and mental kinds of activities were critical to making things happen, to liven the class.

One of my teaching ideas was to dress up like Charles Darwin and deliver a lecture in character, using slides to talk about my trip aboard the HMS Beagle, my Down House in the English countryside, and my thoughts on natural selection. And I would think about in preparing for every class, “What can I do in the middle of this forty-five, fifty minute lecture to break it up? What can I do? Okay, let’s go outside for five minutes. I have to show you something. We are going to check something out.”

Even at the University of Queensland when I had three hundred kids in a massive lecture hall, I would take balls for photosynthesis and throw the balls as a photon. And then have kids pass the ball down like "hot potato" to the front of the room where at the Reaction Center, I got somebody to wear an Reaction Center hat, and then he would toss it up to me on the stage to signify an increased energy level. It was only five minutes or ten minutes out of the lecture, but I always did it midway, to do something tactile, to emphasize a point and break up the monotony of PowerPoint slides.

Peter: There is something about having fun and teaching that go together, too. And at those sorts of things you do not have to be the life of the party sort of thing. But there is an activity, something that you can learn that will make your teaching fun. There is a thing that you can learn that will enhance your ability to organize a group of people for learning. There are some learned behaviors and techniques that you can get into that will make your teaching fun.

Bill: So it's not that you are the entertainer, but you are orchestrating an activity so that people can entertain each other. I think humor is underrated for its power and its ability in learning. If I'm teaching a class and I'm not getting laughs, I figure there's something wrong. Now with that said, for ten years I taught eight o'clock lectures and I would tell the same joke at an eight o'clock lecture as I would at a ten o'clock lecture. And I'd have them rolling in the aisles at ten o'clock. I'd have them barely half comatose at eight a.m. with not even a chuckle. So there is a time of day feature there. I couldn't do much at eight a.m. to get them going. I barely got them into the classroom, let alone to be responsive. But, if I'm getting some laughs, I know that I'm getting somewhere. At least that's my little, informal measure.

And I kind of revert to teaching techniques that are going to be fun. We have activities, and we do modules as you mentioned earlier. Using modules is a great way to break things into manageable chunks. And in each module, we do an activity. We give silly prizes and we give them feedback. We make fun of their drawings or their titles; we really try to have a way to connect with them. And in that way also, I get to learn their names. You know, that's the other trick. I always try to pick up on their names pretty quickly. And I can usually do that in a class that is 25 or less. I can pretty much do it in a couple of hours. When the numbers get big, it's really hard. All the little girls that have names starting with letter "K" start blending in. You know the, Kathy, Katherine, Kate, Katy and Karla names. They all just start blending in. But if I can have them for a few hours, I can pretty much get a name and face recognition. Now I can't remember a day later, but at least while I'm teaching I can do that.

But what do you do? You do a good job. I mean the dressing up as a pirate is pretty funny in and of itself. So you've got a side gag going right there.

Peter: When I started teaching school in the early '80's, I actually had a principal say to me "You are funny, but it might very much annoy others, you know?" And he said, "You'll have to be careful with that." And what he's thinking about is people in authority or whatever, that I might be having a go at someone. Either parodying someone, or assuming a certain physical body posture. All pulling a gag or whatever, or asking questions at what might be seen as an inappropriate time to illicit some sort of response and get something going. And he sort of cautioned me a bit and I thought, "Oh yeah, well, I think I'm a better teacher than you, so piss off." But after watching him for a while I felt that I had been acting really arrogantly. Really, I took that to heart for a while you know. And just sort of thought, "Maybe I have something to learn."

There's a saying in teaching secondary and primary schools about not smiling before Easter. What it means is, the start of the year in Australia is in January and Easter is around March, April. You don't smile before then if you've got that group of students for a year.

I've got a lot of those teaching tricks. There are great differences between students and adults and I like working with them; they are different but also have great similarities too. I think sometimes too much is Pedagogy. But, there's a difference between what they call Pedagogy, working with young people, and Andragogy, or working with adults or people who are assuming adult roles. I think you use humor differently. But I just think it's always appreciated. And I couldn't say when I go to teach usually, what it is I'm going to say that will be funny. It will just come to me, "Oh yeah, I can put this together in a certain way," or I'll have something pop into my head and I'll just do it.

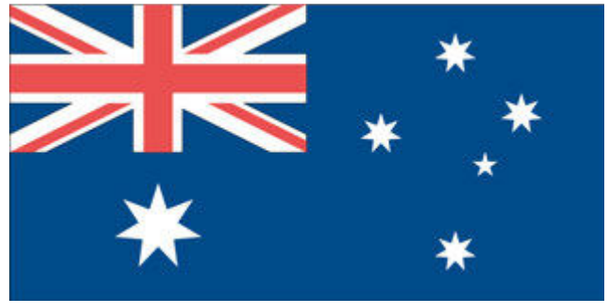
Occasionally, I'll have some sort of gag you know, lined up. Some sort of side gag ready to go.

The other thing that I've found interesting is actually using the humor and using music and using poetry with different cultures. I've worked the last couple of years in a few different places that - well, diversity is fun, you know. I've run with other staff from different universities in other places. We did a course in Water Resource Management in Libya for example. You know, the place with Colonel Gaddafi. We didn't get to meet Gaddafi, but we got to meet one of the Ministers. But even though we didn't get to meet the Colonel, he's everywhere. His picture is everywhere - and he's their 'friend' you know. So in all of these instances, when someone is a bit shy, I would try to draw them out. But I did notice something. When exposing students to theory or experience, it's good to use case studies to speak about, interpret them, and analyze those experiences with confidence. But also, that I could just be funny and relate to people through the stories coming out of these experiences. By about day four when I'm singing a song and then say, "I'll sing you a song, and then you sing me a song."

And with courses that I've taught for the conservation organizations like in Indonesia, I've found that I consciously use the model of engaging people in discussing Water Resource Management. If you're going to drink water or use it to water plants, we think of it as a resource. I'm sure that the sewage engineer doesn't think of it as a resource. You know, thinking about water in a more integrated way and how the land is joined to the stream, is joined to the sea, and is joined to us. We're a part of all of this. You will have to have something that appeals to people's hearts. You'll have to have something that appeals to their hands. And you'll have to have something intellectually that appeals to their heads and that makes sense.

Bill: Yeah, well I think when you get multi-cultural, and even moving from the U.S. to Australia the first year I taught, my jokes fell flat, because I was using cultural references that we didn't share. I had assumed they were shared, but they weren't. So I had to learn different cultural references to refer to and that's just between two English-speaking nations. And then when you jump to a Muslim culture, a different language or a different religion, then you really have to respect people who are funny multi-culturally. I really think that's magic. Those are the really funny people. People that can transcend their culture are fantastic.

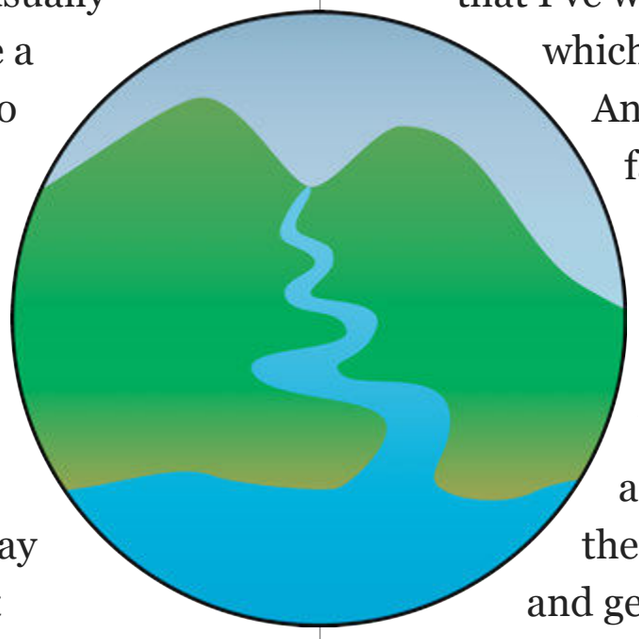
And it does mean, though, you really have to get down to the basics - I think it's better to really relate to the human condition at a fundamental level and be self-deprecating and open to and aware of the things around you. That way, you



can draw on these things to which everybody is related and develop that shared experience. So again, it's easier when you're in a field setting. When you're going out somewhere, you've got these shared experiences that you can draw upon. But it's harder in a sort of stilted classroom setting. But it's really good to do and some people you realize you can poke fun of and some you can't. But if they're willing to be poked fun of, it's good to give them a ride and let them sort of bask in the attention, even if it's somewhat poking fun of them.

I had a student once impersonate me. He would get up to the chalkboard and he would impersonate my mannerisms, my speech, my accent, and I caught him doing it. And he was all embarrassed. So I ran out and I got his roommate to help me. I took his clothes and put them on. He used to wear these Bali pants and these little, funny colored glasses just for effect, not for sight. And so I wore his clothes, and I came in and imitated him imitating me. And it was a great moment; I'll never forget doing that. And then he was inspired, he wrote a song about me. It wasn't very complementary, something about saying the word "neat" too often. I can't remember what he called it. Unfortunately this young fellow, Anthony White, died last year, as he was in Veterinary School. He was a young guy with his whole life ahead of him. It was really quite tragic.

Peter: Oh, that's sad. So that use of humor for me is often quite situational. The last time I was in central Vietnam, I ran a couple of water management courses for people from throughout South and Southeast Asia and I had over twelve different nationalities in the room, English being the language of instruction. But you know, English is the language of education for everybody, but not their native language. So I would do a lot of things of a physical sort, running around the room and also a lot of stuff looking at emotion from other levels. Everybody has got a family. So families usually work - but indigenous classes can sometimes be a little bit tricky, you've got to work out who's who and what's where before you can start to use family as an anchor point in the same way.



Actually in this last group that I had last December, we did a case study on a Vietnamese river basin, using a situational analysis, looking at the economics of it, the biology of it, and to the sociology of it. All the way to the demography you know. We would look at what's happening in the basin and the group studying this case study would come from different places around Asia. So we'd study this river basin in Vietnam and then the students would relate that back to what was happening in their basins. And we'd go on a field trip.

And there was this one guy who spoke not a word of English- I will call him Mr. Tran. So I had one of my former students with me who does some translating and just sort of smoothing out all of the things that are happening, and coming back to me and going, "If things aren't working particularly well with our Vietnamese host. You should be picking up on all their nuances." You know if I made a faux pas culturally, she would let me know. They just think of me as sort of a big funny white man that knows a lot of things, sort of, "What discipline are you from Mr. Peter?" They couldn't really peg me for what I did. So it's sort of interesting. We had keynote speakers come in, but Mr. Tran was the most interesting. I was singing a song that I've written called "From the Roads to the City," which is about folks I worked with in Queensland. And I tell my stories about the fishers and the farmers and everything being connected.

And Mr. Tran took it to heart and he came back to me next time with a poem he had written about what they call, "The American War." It was about the village and the river, and a nearby mountain. It was about going up the mountain, and he was proud to drive a bus and get caught in landslides and do all sorts of wild adventures and things. He would get out and look at things and see things. Anyway, when he was a boy of about 15 in the war, his job was to be stationed up at the river. And that river had really deep symbolism for him. He was protecting that river you know. And he was scared about dying; he was scared the Americans and the Australians were going to kill him. But he thought, "No, the river is beautiful, and I will protect this river." And it's a river that runs over a long distance.

But what's happening now, there's a lot of hydro-powered things that have been put in to the point where, when the last typhoon came through, the one that took out Manila and the Philippines, it came through and just went bang and hit Mr. Tran's river, causing river flooding and storm surge. This river flooding and storm surge aligned and there was a lot of flooding. But then the guys upstream who do the hydropower let out water- they continued generating hydropower. The demand for electricity in Vietnam is great. And so they put two meters of water onto the flood plain and lots of people died because of the bloody hydropower. Which is also, from Mr. Tran's way of thinking, stuffing up the river, so he's incensed.

He's reading me this poem in Vietnamese, which is being translated to say, "I fought for this river against people like you. And by now I'm sad. I cried, because it's not anyone else that's wrecking this river, it's us." We can manage this river you know. And that's why I like looking at Integrated Water Management. Because Mr. Tran is working for the National Resources Agency there and he's just got such big challenges. I watched him the year before when we went over there, and I knew he was pretty senior. But a bloke came from the hydropower system. Mr. Tran almost had a fistfight in the workshop. I'm there sort of breaking it up and I can see it's getting heated. The Vietnamese and the interpreters are going crazy, and I'm saying, "Time out guys, that's enough. Mr. Tran over there, that's enough. Okay, if you're going to do that, it's outside, or I'm not with you. No more, mate."

And so they were really fiery because the city plant could run out of water because the hydropower is being used, the power plant is using the water at inappropriate times. So there's just some real deep sort of issues. And I think sometimes the use of humor, the use of poetry, and the use of really contacting the heart is immensely important. And Mr. Tran's poem was one of the most powerful things in the whole workshop.

Bill: That's very cool. To me when a student is inspired to do something, to write a song or a poem, or to perform in any way, you know you've made an impact. You know you've got them motivated and thinking and creating. And I think that's a great story, that's fantastic. It's sort of like viewing bio-luminescence in nature. Its ephemeral, you can't really capture it properly. It's about the moment. You're in the moment, you're sharing something with this group that you've gone on this emotional journey with and it's truly magical. But it's also ephemeral.

I've heard a story about Sir Laurence Olivier. It was during a Shakespearian play in a performance in London. I can't remember, King Lear or something. There's a big, central part that Olivier played. And apparently, one night he was absolutely brilliant, just riveting. And the audience was very taken by the performance and they came back to the dressing room and he's storming around and he's banging around and mad as a hornet. And they asked, "What's the matter?" And

they said, “That was riveting, that was the best performance ever.” And he said, “I know, but I don’t know why.” It really bothered him that he knew he was great that night, but he didn’t know what it took to do it again. And so part of that was the magic of the moment that you get. And teaching has its magic moments. We ask ourselves, “How do I recapture that?”

You know, you get good classes and bad classes, a good group of students and one that’s just not responding. And try as you might, you don’t control everything. There are a lot of factors outside of the classroom that control your interactions between students. That’s why those immersive environments are better in one sense, because you can control more of the outside influences. But that’s still not enough, there’s still magic. But the magic makes it special.

Peter: Yeah, I think people recognize that that’s what it is. Basically, the more I see from China and the Philippines as well in other field settings that they "get it," you know. I get them to tell me about what’s important culturally to them and about their Chinese culture, and ask "What were your stories?" And in that workshop where Mr. Tran was, I found out that on a couple of occasions that they’re there-the people who "get it." If you ask them how they would solve such and such a problem. And the engineers, they’ll give you perfect engineering solutions. And I’m just thinking, once I experienced these sort of things, that they’re sort of saying things like, “Well, you might want to think about the people." And I’m sure they do.

And I know when we had a field trip in Libya, for a bit of what I’m seeing, I want for my own country, you know. The capital of Tripoli is 70 kilometers of coastline along the Mediterranean Sea and it has gotten to be unswimmable by putting mostly raw sewage into the Mediterranean. And you know, when we go and look at these things, and you look at all the solid waste, it was a bit sad really. All along the shores you can see and smell the sewage slick. And you can just see it offshore there and it’s quite a nice beach and they have these huge multi-story buildings. A whole lot of different people have come in, met with the leadership and built all of these luxury resorts. And they’re going to be among the jewels of the Mediterranean, but the sea just smells.

And I was talking to other people on the field trip and after a while, one young engineer came over to me and he said, “Peter, you have to understand that we see all of this as a problem, and that one day it will have to be fixed up. If we want to swim, we aren’t silly enough to swim here; we go 40 kilometers that way. Don’t swim here, you’ll get sick, and don’t eat the fish. We tell them fishing is illegal here, but still they fish.” Like people would go and say, “One of these days we will have an Integrated Water Management Plan for Libya." At the moment, you’ve got just a concept. And we talked to the Minister, and the Minister said that he would be pleased to accept an Integrated Water Management Plan. Now these people in the room are going, “You’re kidding.”

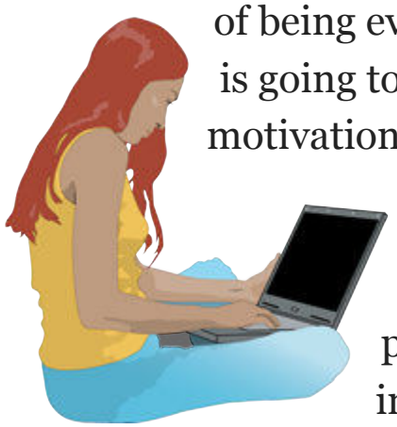
Bill: So that's key, you have empowered them. You've said this isn't just an exercise, this is real. And once you make that transition to say, "This is real," you get them motivated, a motivating factor that can't be beat.

Peter: Whether he was really going to do it I don't know.

Bill: I know, but that really doesn't matter.

Peter: They take it seriously.

Bill: Exactly, they take it seriously. I used to get somebody from Queensland EPA, or whatever they called it at the time, to come along at the end of the semester and listen to the student presentations. And they didn't have to say a thing; they just had to be there. The students are thinking, "This is real, this data counts. It's not an exercise." It just changed the whole dynamic of the class and the same thing is true with the class projects. I said, "Look, we've published this data, we've taken student projects and published it. We're not doing this for fun; we're doing this because we want the answers." So it's a mindset, it's just a pivoting of the mindset that means that this is not an exercise that's going to be just for the experience of being evaluated. This is actually something that is going to be used. It just changes the whole motivation.



Peter: So I did get more into it with that. By far and away the smartest person in that group in Libya, the most intellectually agile and clever was a woman.

Bill: That must have been interesting for an Arabic culture.

Peter: She was a metallurgist by trade, and she had her translator with her. She could understand English, but she always called him in for translation. But going with just English for a start, she was able to just cut through any sort of situation and say, "This is what we're thinking, these are the implications, this is what could be done here." And I just looked at them and thought, "Wow, you should be applying for a scholarship to come and do a Master's with us or something." And that got translated to somehow, "We will offer scholarships to everyone." You know, you've got to be careful with translations, or you'll get the whole class to come. But anyway, the way that the women conducted themselves with men was very, very interesting. They were mostly engineers who are building the Great Manmade River. You've heard of the Great Manmade River?

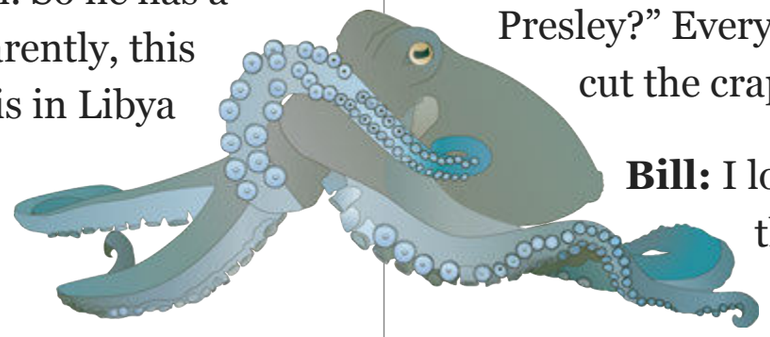
Bill: In Libya?

Peter: Depending on the figures that you can acquire from the internet, there are 120-200 deep wells in the Sahara that are mining fossil water that was put down when the Sahara was a forest. They've got subsidiary pipe systems and they are mining this water. So 80 percent of it is being used for agriculture. The integrated water footprint for Libya is horrifying. There's no reuse. The water is being used for agriculture, there's not much thought to irrigation and how it should be done, or not that I saw. And so reuse would be a

good thing to do and water demand management would be a good thing to do. They could reduce shower time, there's a whole range of different things involving the community in making decisions about how they would reuse and manage the demand for their water.

So the water engineers, they know how to build pipes and pipe water. They are teaching the world about water engineering. People would go to Libya to learn how to build pipes and pipe water. But they didn't know squat about a whole range of other things. The women were just so much more widely read. The men would say something and one of these women would walk in, she'd turn around and she'd say something in Arabic to these men and they would just shut up. And I'd look and they'd go, "I just called stupid, and I just got told." And the engineers would ask each other, "Are you okay?" instead of, "She makes me so mad." Was she right? Yes, she was right by the way. It really turned the tables.

That's another thing of some of the stuff I've seen: more and more empowered women, speaking as a white male. A role for women and people from the minority groups was to be very practical. This Libyan woman was smart enough that Gaddafi knows that she's just top notch, she's a brain. So he has a group that he calls when he needs help apparently, this is for emergency situations. If there is a crisis in Libya and he needs some fine minds for advice, she's one of the ten people he calls into the room.



Bill: Wow.

Peter: Because there was a whole range of Environment Management courses that they were running from their "Environment General Agency". They just got her to take all of them because she can just be good at anything. She's just brilliant, you know. And I just think, "Oh, okay, that's good." And what she liked from what we brought to Libya was the human aspect, the stories, and the poetry. She thought all of this way of learning was completely novel. When I said I was going to sing tomorrow, she got very excited.

Bill: Right.

Peter: We needed to come up with some possible topics and they'd be like, "You can't, you're not." These people just went, "Hey look, this would be terrible." And I thought, "Well, we'll be lonely then won't we, because we'll have another ten days in Libya with no work to do." They handled it fine, and they loved it in the end. They thought, "Who is this Ph.D.? What type of guy runs this course by walking around dancing and singing? This is wonderful, you know." And this was tremendously important for being effective. One student asked, "Your singing is very good, do you do any Elvis Presley?" Everybody just had some fun. It was, "Let's just cut the crap and have some fun."

Bill: I love these stories. They're great, and I like that we're touching on different cultures. It's the cultural dynamic and the gender

aspects that make it more universal. Women and men and culture, I think that's just enriching to talk about it in those contexts. And that's a unique experience that you've gained by doing this stint with the International WaterCentre. That's something that you would never have done as the Catchment Coordinator of Pumicestone Passage.

Peter: Yeah. Just one more story from when I was in Papua New Guinea last year where I finished up at the bar, not that I really ever drink too much. But there were some guys from the Solomon Islands and we were drinking until light. And we started doing some singing and stuff. And at the place we were staying in PNG [Papua New Guinea], there was another workshop or conference going on in this resort. And Isaac, one of the guys that I was with from the Solomon Islands, got his beer and he hid it down in between his legs and just sat with his legs together hiding his beer with his hands over it, as this particular woman who was from that conference walked past. And I'm asking, "Isaac, what are you doing?" And he said, "That woman is from the Solomon Islands, she is from my church. If she sees that I am drinking beer, I could be in big trouble." And Charlie, his mate also from the Solomon's, said, "Peter, you've got to understand, Isaac is the choirmaster for that church. We have a congregation that is over 400 people."

Bill: And in the Solomon Islands, they sing.

Peter: And so it got to the point where I finished up doing Dugong Rock and doing some other things as part of the workshop and Isaac sang choir music to me. They enter competitions for who is the best choir in the Pacific. This choir music is just beautiful, heart wrenching stuff. It's in perfect four-part harmony with people swapping harmonies. The music is just very, very touching and it's all unaccompanied, all with Isaac just going and doing his hand waving method. I said, "Do you read music, Isaac?" And he said, "No, I use the hand waving method," which is these hand signals to let you know what note you should be on.

Bill: I sailed to the Solomon's and walked around and just loved to listen to the kids that would be singing from the school room or singing holding hands on the way to school. They would just break into song in these little voices, just magical.

Peter: I look at cultures like that and I think, "I could live here because you do that." I feel a little sympathetic. I go to Ireland and I think, "Yeah, I don't mind this place with these people who talk too much. I like the pubs and like the music. And I just think there's something about cultures that wear their hearts on their sleeve a little bit more. Maybe you'd run into some trouble in that way too, but it is a very rich thing. And if we go and look at some of the environmental issues that we've got, we've got to connect all those things back to that culture.

Bill: That's good. Yeah, that's a good way to wrap it up. I like the way that that came full circle, the heart, mind, and body.

Integrating heart, hands and head

A man who works with his hands is a laborer; a man who works with his hands and his brain is a craftsman; but a man who works with his hands and his brain and his heart is an artist.

LOUIS NIZER 1902-1994

The integration of heart, hands and head

There are three things that the community needs to be able to say collectively in order to successfully confront an environmental challenge. The community needs to be able to say, “We care” about a specific environmental issue, which comes from the heart. The community also needs to be able to say, “We know” what the right thing to do would be, which comes from the head. Finally, the community needs to be able to say, “We can,” referring to their ability to institute the appropriate actions. These three simple statements, “We care,” “We know,” and “We can” are expressions of community caring, community knowledge and community commitment - they are not first person statements; rather, they convey a sense of group ownership of the issue.

In order to make social, economic, and ecological change, three things are required: strong leadership, technical knowledge, and management effectiveness.

Strong leadership is needed to develop the shared vision that results in the “We care” commitment. This leadership can be found both within and beyond political leadership. Various leaders can form strong alliances with community groups, scientific leadership can be found with those willing to practice praxis and phronesis, and political leaders can articulate an environmental cause and motivate people to care. A degree of technical knowledge is also needed to ensure that the community fully understands the issues, including the tradeoffs and the consequences of various actions.

It is common for this knowledge to be held exclusively by scientists and engineers with technical abilities, but the measure of success in the realm of environmental management is the level of widely shared community knowledge. Finally, the management effectiveness is the adoption of those actions that will deliver the desired results. With strong leadership coming from the heart, technical knowledge coming from the head, and effective management coming from the hands, the desired change can take place.

Various resources are necessary for social, economic, and ecological change. Organized activities that motivate people

require coordination and willing volunteers. Science is needed to provide insights as to the issues and possible solutions, which requires resources.

Finally, money is necessary to purchase the equipment, acquire the property, or hire the people to be able to enact the various necessary measures. While resources like money, facilities and institutions are necessary; they are not sufficient for change to occur - a commitment by community leaders and members, scientists, and resource managers is a key component of an environmental program.

The use of the heart, head and heads trilogy is common in many religions; mind, body, and spirit are often used in describing a spiritual goal.

However, most of the previous focus on integrating heart, head, and hands is on the individual. It is our contention that it is the integration of these facets of the broader community that makes for social, economic, and ecological change. Passion that is only shared by a few, or knowledge restricted to the technically savvy or financial resources that are confined to a select few do not lead to good environmental outcomes.

Integrating heart, hands and head: Partnerships, stakeholders, naiveté, and cultural diversity

Peter: There was a little extension officer working for DPI [Department of Primary Industries] at Emerald, for farming industries. He had the technology and his talks were very good but boy oh boy, he could have used PowerPoint as well. So he was one of those people that made certain they went out in pairs, and then afterwards they would debrief. One of them would give the presentation and the other one would just watch and listen. And after the debrief, they would ask "How do you think that went? What do you think of that question? Did I answer that question right? Did I understand what they were saying? What where the main things they were saying to us, that we need to take on?" And not taking any notes, not being rude enough to take notes while people are talking. Actually, it was really useful in trying to remember, and then immediately afterwards debriefing and taking down bucketfuls of notes.

Bill: That's interesting because one of the things we did in the road show, as we called it, is we drove and if we went and I told the story by myself…but a lot of times several of us would go, two or three of us, and we'd ride together and so we would have the ride home and we'd do the exact same thing - take notes. And you know while you're presenting even though you're looking at the audience and even though you're listening to their questions, half of you is watching and listening but the other half of your brain is getting ready for your next answer to the question, or the next slide in the presentation. Whereas the person coming along can devote their energy and time to really listening, because they know

what you're going to say. They can ignore you and focus on the audience and so they get a different and better perspective on how it's going over, how it's being received. And can look at the thing with a little fresher perspective because there's not ego involved either.

Peter: I think that's an important thing if you're going to do your stuff is that doing it with others - I don't know the percentage on it, but it's a lot more effective to have two people going along at least. At least two people.

Bill: Although, I think you have to balance it, Peter, because I think you can overwhelm people. If you go with a half a dozen and then you get somebody who's programed to laugh at your jokes and...

Peter: Bill Stapp from the University of Michigan had some material he used to quote. I don't know where the study came from, but he worked with young people and he wanted them to take action about rivers and streams. He said if you can educate someone that they can take action and effect change in the place where they are living, they can make positive change in their surroundings. If they can feel they can do that by the age of 15, they'll feel that they can do it for the rest of their life. You'll have actually produced an adult who is an empowered adult. He said most people never have that experience and so most people actually don't feel that they are empowered to take action for change.

And I don't know where he got that research from, but it just struck me that good environmental education is just good education. The subject could be about the environment, it could all be education. In the environment where you take people out and you point at trees and you collect bugs and do whatever, or it can be education for the environment. And...

Bill: What do you call 'education for the environment'?

Peter: The education where people are being empowered, where you set something up where the idea is that people will take some form of action as a result of the education. Or that the education process is something that involves action, necessarily. And so then people start to see taking action about the environment as normal, not something extraordinary that people do.

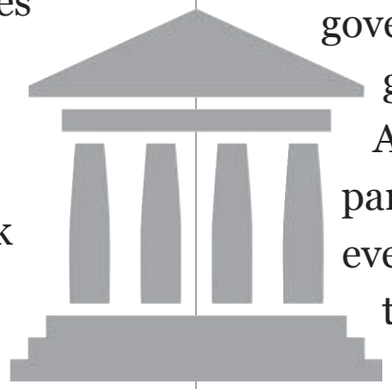
And that was where we talked about how once the government got hold of something, they gave it uniformity. They gave quality assurance. They gave it in-service support for people to do things, training in some capacity. But they also took away the idea that you might take a risk.

Bill: And they take away the passion, so they suck the energy out of the room.

Peter: I found in government that people who were good in government and bureaucracy where the people who were not risk takers, who did what their job was. People who actually could put off making a decision as long as possible.

Bill: Always push it down the road.

Peter: Don't want to make decisions, but put them off. So there is the tension, since we need to have government on board. We need to be working in a way that, when we form these relationships that are about supporting environmental change, there is that dynamic tension. Government does some things well and other things poorly. Community and business…we all do some things well, and other things not so well. Schools, educational institutions, researchers will have that sort of mix and then we work at how you put those things together. And at the Earth Summit 2002 in Johannesburg, people were looking at business, civil society, and government partnerships. And it was all about partnerships.



Bill: Peter, one of the things that we're touching on is that a group of individuals with their different backgrounds, by marrying their strengths, can create something bigger than any one sector of society could create, and then you alluded to partnerships being a similar thing. Government has strengths, NGOs have strengths, educational institutions, etc. have different strengths that can be combined.

But there's a huge transaction cost in forming and maintaining these partnerships, individually or in more corporate or institutional things. And those transactional costs aren't really factored in. You must have had dozens and hundreds of meeting and phone calls and interactions to maintain - build and then maintain the dialogue that's needed to be effective.

Peter: That's a really good point; the idea about partnerships has become in the early part of this century quite jingoistic. And I know some people in the UK, for example, that have researched in this area. The national government of Britain really wanted to have a much bigger effect directly on local government, and there's no intermediate form of government in Britain. It's local and then national. And they could see that local government was more parochial. The Mayor's son eventually became the Mayor even though people weren't enamored with them, and there was low voter turnout at the elections for local government. Local government had a whole lot of responsibilities that it wasn't adequately discharging. National government thought it was pretty clever and their work wasn't being well used by local government.

And so they actually said to local government, you're going to have to form a renewal plan for your local government authority area. And you will have to work in partnership with business and the community to come up with these plans for urban renewal, for environmental protection, for housing, whatever it was. And we'll give you money when we see that you've got an active partnership going. Now there were some people working for the University of Warwick who studied

this and found out that they were doing so much work in partnerships, they couldn't remember who their employer was. There was such high level of transaction cost for all of these things that the national government was making them do, that it was ineffective in the end.

I think what you really got to do is, there's literature on this…you've got to ask yourself a few questions. There are some simple questions:

• How do you find the problem that you're working on?

• Can you solve this problem working by yourself- yes or no? If no, is there anyone else who has an interest in the problem?

• Do they perceive this problem, define it in a similar way to you?

• Can you agree on what would be a solution?

• When will it be fixed?

• How would you determine that?

• When you start an organization, is the organization prepared to devote energy and resources to this?

• Can you see a way that you might be able to form a relationship somewhere together to do it?

So you don't form partnerships about everything. There were some things that I saw in the first part of this decade where people were being asked to form partnerships for things that were manifestly someone else's business. I looked at some environmental situations and saw something happening with this partnership approach. And they would say, "Oh we've got a working partnership with the community to do this." And I'm thinking, "You've got a perfectly good environmental protection act there, you use it." So often environmental solutions are a mixture of techniques. Enforcement is just one tool, so we started these partnerships and collaborations and working together, that tool, when really the best approach might be legal instruments, it might be planning instruments, or it might be economic instruments.

But it might be these collaborative relationship ways of working. But generally, any environmentally problem, if it's going to be solved, I think, has a mix of those tools. And the skill isn't finding what that mix is, is this a partnership - relationship based thing that we need to do here? I counted up at some stage, I think from my Ph.D., how many laws that were related to environment in Australia at different levels - there were hundreds. And I thought why don't we just use some of them? Well, our work is in those situations where there are perfectly good laws that could solve a problem, but they weren't being enforced for political reasons. So, yeah, I really take a point that there are some situations where people are all running together and having group hugs and trying to

work together. High transaction cost, wondering why they're doing it and it's just a waste of time.

Bill: There's a little classic example that I've watched unfold in the last couple years at Chesapeake Bay. The Chesapeake Bay program was formed in the 1983 by three states: Maryland, Virginia, and Pennsylvania. And that covers 90 percent of the watershed and there's a little bit of West Virginia, a little sliver of Delaware and a hunk of New York state. The hunk of New York state, however, is way, way up and it's largely forested. It's a low impact region, and it's actually depopulating. So we've got two slivers and a hunk of land with not much of an impact. So they brought in a fresh young face to run the Bay program and he was in the business of conflict resolution. So his reaction was, "Well we only have three of the six states, we need the other three states." So he incorporated the other three states, and now instead of three it's six. So it doubled the workload in some senses, doubled the number of state legislatures and the states' statutes and governors and staffers that need to be involved.

And I sit there and watch his successor interact with those - they call them headwater states. And they're not really even headwater as much, I mean, they are at the tops of these catchments. But only West Virginia's is truly a headwater stream from a mountain, the rest of them are just flat as pancakes. Anyway, these headwater states give them a hard time. Well they're new; they haven't been trained. The other states have been doing this for nearly 30 years and so they know how to interact. They know what the issues are and they've got their heads around it. These new states are naive to the issue because, frankly, most of their focus is on the Hudson River for New York or the Ohio River Basin for West Virginia or the Delaware Bay for Delaware.

So the Chesapeake hasn't been in their vision. So there's this learning curve and they're also distant, with the whole program revolving around Annapolis, Maryland as sort of a center point between Maryland, Virginia, and Pennsylvania. And these guys in the so-called headwater states don't travel down there much at all because it's a long hike. And alternatively the people in Annapolis don't travel out to those far-flung reaches., particularly since the sliver of the state is very far away from the capital city of these other states. So they created this huge problem now in that these states are feeling left out and on a learning curve and very antagonistic. And they see this as a big government takeover kind of thing, so no matter what you do, even if it makes sense, they're going to resist it. And so it just bogs down the whole program.

So this was a bad strategic choice, to increase the partnership. And I don't think we often really evaluate who else should we have in here? Well we should bring the fishing group, we should bring the farmers, the list goes on. But you have to ask for what issue and what reason and are they really going to bring value? Do you have to be inclusive to every part of the process? Or should you just be inclusive after you have a working group or a working partnership, then present yourself to a broader group? So I think it's easy to say, "Oh, let's increase our partnership and let's be more inclusive," but not understand the downside of that choice.

Peter: Yep, I couldn't agree with you more. With our students doing integrated water management, we talk about stakeholder analysis and who actually should be involved when you're doing some of these river basin or water management sorts of activities. It's an important thing that we realize all stakeholders are not the same. And I think when I first started doing this work I used to think, "Yeah, you had to go and treat everybody equally." And it was just silly, there's a whole body of staff and stakeholder theory.

There's a paper by Mitchell, Agle, and Wood where they talk about stakeholder attributes of power, legitimacy, and urgency. They put these attributes into a Venn diagram. You have one circle and you call that power and another circle and you call that legitimacy and another circle and you call that urgency. If you put those three circles together and make something where they all overlap, then you've got the little space in the middle there as well - you can actually map stakeholders on to that. That's one way to do it and say, well if he's got power, who's got the urgency, who's got the legitimacy? Who has a right to be involved and other people think they have the right to be involved. Who needs to be involved because these things really affect them? And who's got power to actually affect change and do some things, got resources, or whatever it is?

Bill: So what's the intersection of the Venn diagram? Is that behavior change?

Peter: The intersection of the diagram in the center is the definitive stakeholder.

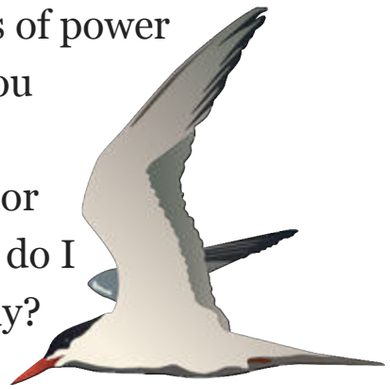
Bill: Oh, I see.

Peter: What I will do sometimes, if someone came into the catchment coordinator office, they were just really in your face and wanting things all the time. Let's take an example from Pumicestone Passage where there was a fellow who wasn't a definitive stakeholder, but, he occupied a lot of my time. When there were other people who actually had power, urgency, and legitimacy, I didn't get to them because I was talking to this one stakeholder. A lot of the time, people weren't taking this fellow that seriously. People didn't think that he had legitimacy - he had urgency, but he didn't have power to affect any change. And there I was spending

a lot of time working with him because he was a nice bloke and I liked him. When I think about it now strategically, that was not a good thing to do.

Bill: Yeah. Well, you know I wrote a book chapter and as I wrote it, I called it the "My Three Things" - three different ones, power was included, but I defined power as the persuasive power, the power of a coach to coach their team to greater things. And I defined passion as the public expression of a passion for a place or an issue, so it was the passion that I care about this creek that you guys had. And then the knowledge, and that's the deep knowledge. The stuff that you know in your head, you know intuitively and you can express without looking it up. And so I felt like in analyzing what was important in that definitive stakeholder concept is knowledge, passion, and power. I don't know how that translates, maybe legitimacy is the knowledge. Power is power. The urgency is the passion. So maybe we really are talking about the three similar things, but we're just doing it with different words.

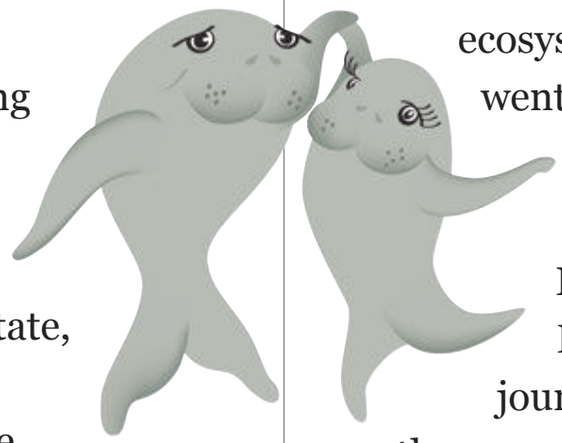
Peter: Yeah, there are other things that you can do too. You can just put people on a numberless graph. I love numberless graphs and I think they're fun because you've got one axis which is power, and one axis which is interest. And you just say who are the people that have got power to affect some situation, who have been persuasive or have some sort of power. Having resources, having money, or access to resources or information, and who's really interested? And you put them somewhere on that x/y field, the two dimensional field. And who's got a lot of power but little interest? Who's got little interest but lots of power and so on? And then you sit down and you say...or as a catchment coordinator, as a basin coordinator, as a project coordinator of the Chesapeake Bay, or whatever it is, do I deal with all of these people the same way? Well no, people down here in the corner with lots of power and no interest, why don't I think of a way to make them interested? All of these people up here that have got power and are extremely interested and passionate about this, I've got them already. I'll deal with them in a relationship that we'll develop, but it will be a different one.



And you actually develop a much more sophisticated way to interact with people than you may have had previously when treating them all the same. And for some of my students, that's a real change in perspective, and when I really started to reflect on my own practice, I started to think I did waste a lot of time. Sometimes I really should have been thinking a little more...I should have been reflecting more in my practice - and that's another thing we haven't talked about at all. Yeah, it was just reflecting on my practice that is important. And I should have really looked at, "Who are the people I haven't got to, that I need to get to?" And once I think we start to think like that, there's a potential to do much better work with fewer resources. But it's a really hard thing to do. To get that... to sit back for a start and do a really good stakeholder analysis, and not just, "Oh well, there are three states, but we got to have all six. They're all going to be treated the same."

Bill: One thing that's prickling at me is that you mentioned there's this whole literature on this topic, and I'm sure there is and there's probably literature on every topic we've touched on. And yet, when we got involved in Healthy Waterways, we were very naïve and yet that naiveté, for instance, was liberating.

I'll never forget, we were putting a proposal in to the constellation of councils that were involved at the time to develop a monitoring program. And we didn't have an idea; we couldn't figure out what it was that we were going to do because it just wasn't working for us. And late one evening, we were working on this up against a deadline. And we said, "Well, what is it we're trying do with a monitoring program?" We have the conceptual diagrams we had done, the early rudimentary conceptual diagrams. We said here's the historical diagram, here's our current state, and then we had started developing some future scenarios. And we said okay, we just have to figure out ways to measure those transitions.



And so it's really about the health of the system, it's the 'ecological health' is what we used as a term. We got all excited, we developed and formed a nice team and we did all that and we got funded and went off and started measuring stuff. And then we analyzed it and refined it and it generated what ended up becoming a very good program now called the Ecosystem Health Monitoring Program, EHMP. But at the beginning we didn't read it in literature and we thought we made that term up, ecological health.

Then we read later that it turns out there's a whole society, there's a whole journal, there's a whole suite of people out there thinking about ecosystem health, and so we changed it from ecological health to ecosystem health. Ecosystem health because it's the health of the ecosystem, not the health of ecology. So, we were convinced that it was worth a name change. So that became our thing, ecosystem health and we even ran an international conference on ecosystem health, and I went to the library, read all the journal articles in ecosystem health and it was a pretty new society. I went through every issue.

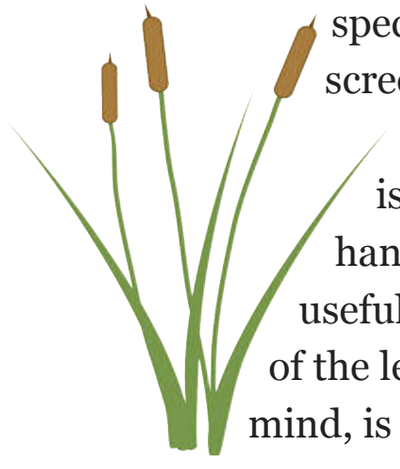
Peter: I remember that conference.

Bill: Yes, and you sang and we performed Dugong Rock. And yet, at the end the society and journal didn't help us on the ground. It turns out they were all talking about it, they weren't doing it. And so the theory from academia was really not very interesting, it was the practitioners that we were interested in. We wanted to know "Who else has tried to do this?"

In fact, there's an interesting video out there called "Talking Science," going back to our communication theme earlier. Randy Olson, a friend of mine, put that together - this video. It's very cute, very well done, a lot of humor. And he interviewed academics who are experts and who've taught communications and he interviewed Hollywood practitioners.

Randy lives in LA. He got his degree from Harvard, and got a tenure track job. The day he got tenure at the University of New Hampshire, he resigned, because someone had died and left him a lot of money and he woke up and said, "I don't want to be doing this for the rest of my life. I want to go to film school." So he took the inheritance money, went to film school and now he's loosely associated with the University of Southern California, but off producing short films. He's an interesting character. What Randy did in this "Talking Science" video was interview Hollywood people, people that he had met through this film school. So he went to a Hollywood producer and a Hollywood cinematographer and a Hollywood lighting specialist, and brought them to a scientific conference and said, "Tell us what we're doing, what we're doing badly."

And I asked him after he'd done that video, what he learned from that process. And he said the most important thing he learned where the practitioners had something real to say and offer constructive insights. In contrast, the theorists, the academics, were talking in platitudes. The practitioners had specific comments about needing bigger screens, you need this kind of aspect ratio, you need to do this, use the color, this is good, but this isn't. They were very hands on, very practical and much more useful. So it was kind of interesting that one of the lessons he learned, that I retained in my mind, is that the practitioners are always the place of real knowledge because they've tried and done it.



And when I go back and review what we did with our Ecosystem Health Monitoring Program, we were fortunately naïve enough to try to do it and develop it from scratch and incorporate some things that were really quite novel, still to this day ten plus years later, incorporating remote sensing as a monitoring tool. Not as a demonstration, a pretty picture, but remote sensing actually functionally used as a monitoring tool. Also, incorporating a biological indicator using stable isotopes and so instead of your traditional water quality samples, a bioindicator that was developed by some of my graduate students. That's actually pretty ground-breaking and thank God we didn't know too much.

So naiveté has something to do with not being afraid of trying new things. I love the fact that this power, legitimacy, and urgency tracks so well to something I kind of generated without reading any of this literature, just by my personal experience reflecting on our journey through the Healthy Waterways of knowledge, passion, and power. That's pretty cool.

Peter: Well, a lot of stuff on stakeholder theory actually comes from the literature on corporations and business. When you run a big business, they'd like to know who their stakeholders are. Who's going to buy their product? Who's going to recommend their product? Who their competitors are and so on? So...

Bill: And they have funding to do it properly.

Peter: And so with some of the stuff I've been looking at in collaborative water planning is the TRaCK (Tropical Rivers and Coastal Knowledge) program in Northern Australia. I worked with John Mackenzie from Charles Darwin University. John Mackenzie and I started just getting into different literatures because we realized that the stuff that was in the business literature that we could learn from business is that if it doesn't work, they won't use it. It could be one of those elegant theories, but if it doesn't work and doesn't help you turn a profit, it'll be discarded tomorrow. So one thing that I do try to do is take the students back to that.

And the other thing also that I think is important with this one you talked about practice is I've got very much into Aristotle over the last 10 or 15 years, and notions of Phronesis and Praxis. Aristotle's view of knowledge was that there was nous, that which is known to be true but cannot be explained. My father used to say to me when he was alive, "Oh, Peter, use your nous." And I would think "What was that?" and then I read Aristotle and that's what it is. Sophia was wisdom, which could be traditional knowledge, could be a range of things. But Aristotle talked about Episteme, which was theory. He talked about Techne, the application of theory, which is technology. And then he talked about two other things, Phronesis and Praxis. And Phronesis is basically a prudent understanding of what should be done in a practical situation; Praxis is simply practical, thoughtful doing.

And so what I actually get down to with my students is to say basically it is all very good to understand the theory. It's all very good to understand the theoretical things that we talked about. But really the real world is a lot more complex than that and we're grappling with institutional issues, biophysical issues, cultural issues, educational issues, gender issues, etc. when we talk about water. What's the prudent understanding of what should be done in this situation, and how are you going to do it? So one thing that I give them very early on, the first sessions that I have in the morning - the first grade of water management - is I take them back to Aristotle. And I say all this stuff has been known for a couple thousand years or more.

But because of the reduction of science, which has delivered for us some wonderful, wonderful things, we've lost sight of what were two very important areas of knowledge - Aristotle's knowledge paradigms, Phronesis and Praxis. And so I said was "Let's work 'phronectically' here. What the hell should you be doing? And how are you going to do it? What's the basis of your knowledge in which you're going to take action? And what would be the action that you'll take?"

And it's lovely stuff, I think, when you connect all the way back to Aristotle. It wasn't in any field of study

though that I've had. Now, I think...it's just beautiful. And the Renaissance and the enlightenment and Newton deliver for us wonderful things, but they split ideas of phronesis...marrying culture, institution awareness and just that transition that we take on with this word, and saying "Practically, what are you going to do?" And now you've made a difference.

I was talking yesterday to young water leaders from Brisbane City Council and other professionals coming along from the AWA, Australian Water Association, and so on. They all want to be involved in solving problems...and one thing that someone said just straight up, they said - and it really gets to me when I see that we're talking about crossing disciplines. In the course that I'm teaching, I'm working with students in very much the trans-disciplinary program I've just described. Anyway, the student said, "When I get to Brisbane City Council they'll be in one discipline, they'll be under a water and sewer person, or an engineer. And I'll be a planner or a policy person. And I'll see that there's nothing about being trans-disciplinary. There's nothing about being problem focused." He said that policy is all very short-term and he ran off a list of a whole lot of things and he said so many young people last about six to eight months and they say, well this is institutionally dysfunctional. Please give us the world at the University where we talked about trans-disciplinary or whatever.

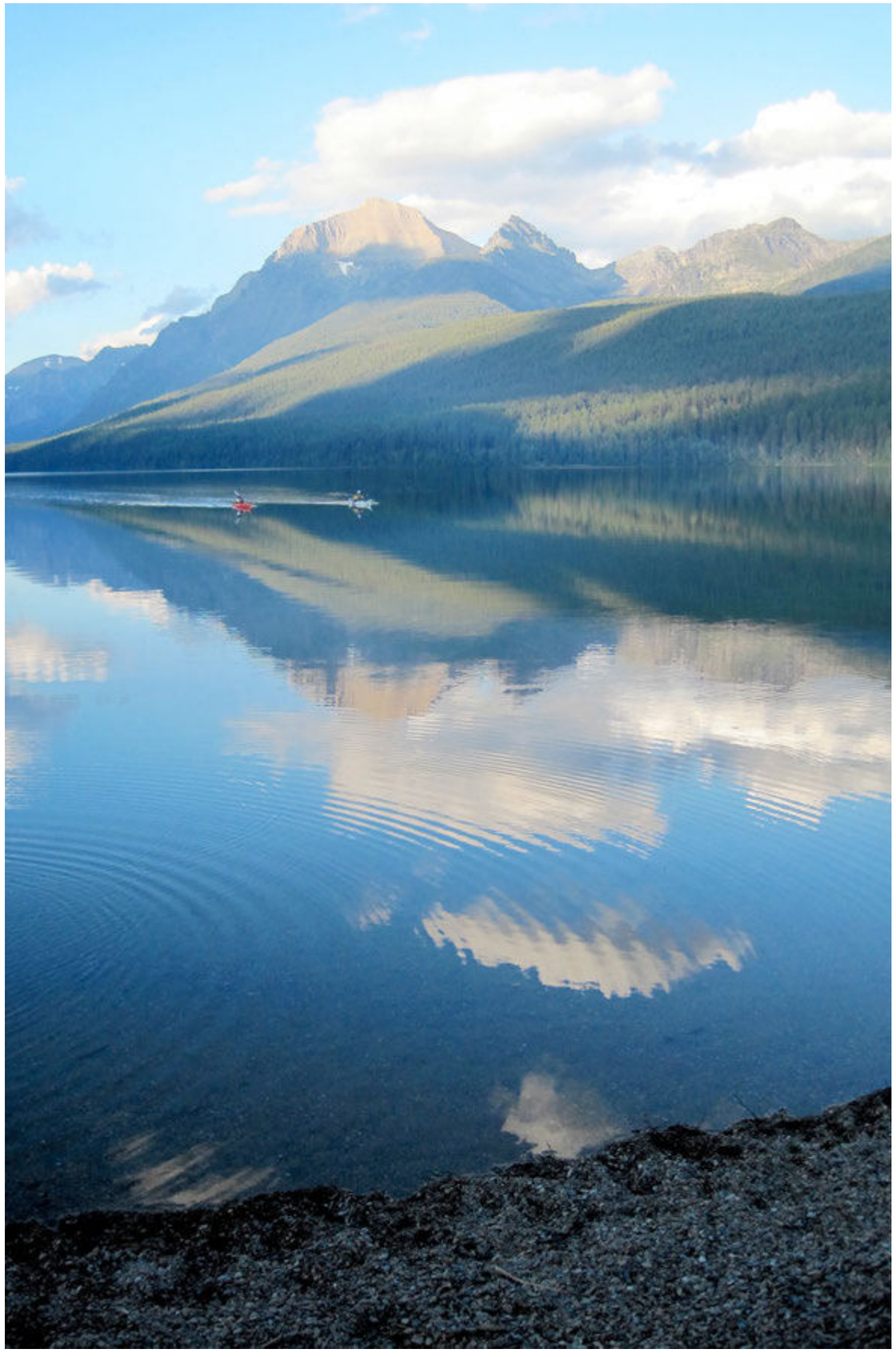
So there's a long way still between the university and reality, I suppose. I'm arguing against myself in someway, because what I'm saying is, I try and get them to think in another way that maybe they're not so familiar with, with just undergraduate training. And yet, when they go out and are armed with their Master's Degree or whatever it is, the world that they're put straight back into has the attitude that to think across disciplines is not favored or rewarded. To think in a practical and applied way is not always favored and rewarded, yet we can see clearly that's what needs to be done. So yeah, it's...that's frustrating.

Bill: I think that we both have been teaching at different levels, but pretty much teaching forever. I'm also thinking about a fellow called Tom Wisner in Chesapeake Bay, recently passed away, who was a wonderful song writer and performer, but not a great business man, but was provided for by some very thoughtful people, including this great scientist we have in our institution, Walter Boynton. People said to Tom, "Oh, you're like so-and-so, another musician who does stuff about this place or another region. And Tom would say, "Well, no; they write about the people, I write about the Chesapeake Bay. I write about the place, the water, not about the people." And so I'm kind of interested in teaching stories and talking about how that works, but I'm also interested in focusing on the environment - the water itself. The water is a link, water as a thread in human life and human history.

Convergent journeys

It is our inward journey that leads us through time -
forward or back, seldom in a straight line, most often spiraling.
Each of us is moving, changing, with respect to others.
As we discover, we remember; remembering, we discover;
and most intensely do we experience this when our separate journeys converge.

EUDORA WELTY 1909-2001



Hands, head and heart: Aspects of convergent journeys

One of the things that we discovered in the process of writing Dancing with Dugongs was the convergent journeys that our lives had taken. Although born halfway around the world from one another and not knowing of each other's existence until later in life, we learned that our life trajectories had been pointed toward one other.

The convergence of experiences and ideas was a remarkable finding and we reflected on our convergent journeys so that others may seek to discover people they have not yet met who may have similar journeys that can be shared. Just in other sections in the book, we have divided our convergent journeys into expressing, experiencing, and excelling with the hands, head and heart - as shown in Table 5. Each of these will be taken in turn.

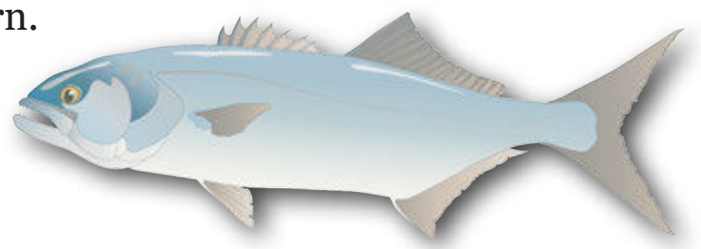


Table 5. Peter and Bill's convergent journeys

	Expressing	Experiencing	Excelling
HANDS	Action-oriented research; engaging with stakeholders, communicating results, citizen science	Nature activities; canoeing, boating, diving, swimming, hiking, sailing, climbing	Innovative approaches; Healthy Waterways Campaign, long term consistent efforts, focus on outcomes
HEAD	Teaching; formal classrooms, immersive education experiences, aspire to inspire	Lifelong learning; reading, listening, traveling, meeting new people, open to different perspectives	Deep thinking; writing dissertations, newsletters, press releases, popular science venues, this book
HEART	Artistic expression; songs, poems, drawings, games, humor, playacting, celebrating milestones	Sharing; leading field trips, participating in philosophical discussions, giving away ideas and books, spiritual experiences associated with nature	Enjoying the journey; optimistic outlook, variety of great jobs, wonderful mentors and students, loving families, strive to live in the moment

Hands: Action-oriented research. We both have chosen to engage with stakeholders as part of our research activity. In Peter's case, he explicitly studied stakeholder interactions as part of his dissertation. In Bill's case, he has developed tools for citizen scientists and been involved with public education campaigns in Chesapeake Bay and Moreton Bay. Also, we both have been interested in probing or perturbing various social and ecological systems, monitoring responses to these perturbations, and analyzing results to better understanding those systems.

Peter Oliver on a field trip in Australia.

Hands: Nature activities. We have been attracted to experiencing nature throughout our lives. We both paddled canoes in remote areas, camped under the stars and hiked through forests. Peter led student groups in extensive camping trips and Bill led groups aboard a tall ship. We both also met our wives while on field trip experiences. While Peter did more terrestrial nature activities (e.g., climbing, hiking) and Bill did more marine nature activities (e.g., sailing, diving), we both loved the outdoors.

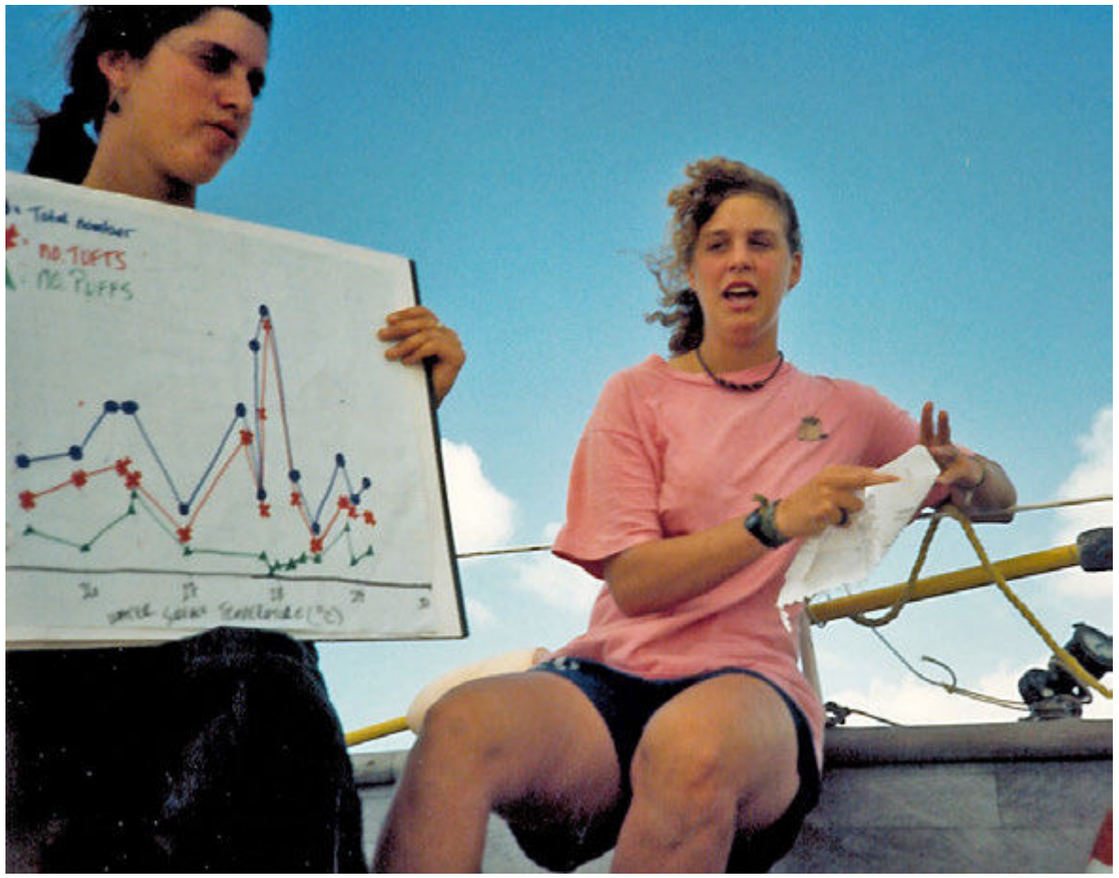
Hands: Innovative approaches. The way that we have attempted to excel in the realm of developing an environmental philosophy is by experimenting and innovating. We independently concluded that a long consistent effort is needed to achieve the desired outcomes. The identified blockages or impediments that need to be overcome provide an impetus to innovation. We were both involved in the Healthy Waterways campaign and developed a variety of different approaches to engage stakeholders.

Head: Teaching. We have both been involved in formal teaching at a variety of different education levels. Peter was a high school teacher, an undergraduate lecturer and a graduate student advisor. Bill was an undergraduate and graduate teacher and advised a diversity of graduate students. We particularly enjoyed immersive education and actively participated in public education programs. We found that we were energized by teaching and interacting with students.

Head: Lifelong learning. We both find that learning new things, visiting new places and meeting new people is exhilarating. We like to read books and articles about a wide range of topics. We try to remain open to new perspectives. One of the goals that Peter strives for is to be able to "walk in

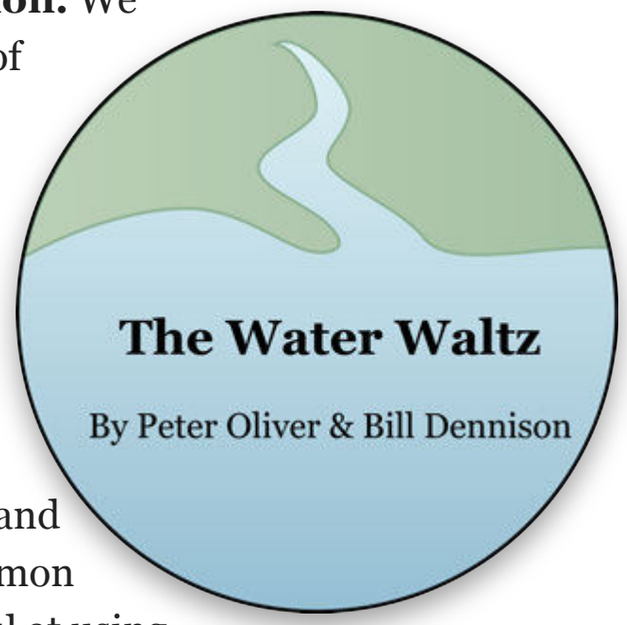
the shoes of others," which he finds enables lifelong learning. One of the gifts of education is knowing how much you don't know and this, too, enables lifelong learning.

Head: Deep thinking. We both enjoy thinking deeply about topics regarding environmental philosophy. Since writing helps us clarify our thoughts and provide more rigor in our thinking, we have written in a variety of venues including writing dissertations, books, journal articles, newsletters and a variety of media reports. We both have embraced historical origins of thought, with Peter tracing back to the Greeks and Bill exploring the history of scientific paradigm shifts.



Students aboard a SEA Semester tall ship presenting their scientific results.

Heart: Artistic expression. We found that an appreciation of artistic expression is one of the things that unites us. We love silly topical songs and even collaborated on a song - 'The Water Waltz.' We like to write and/or recite poems as well. Integrating the use of drawings, including conceptual diagrams and artwork, into our work is a common thread as well. Peter is masterful at using playacting in teaching. We both make a point of celebrating interim milestones, commemorating the event with some sort of artistic expression.



Heart: Sharing. A big part of teaching is sharing. Since we love sharing our love of nature, leading field trips is one of our favorite activities. We like to engage in philosophical discussions and are willing to 'give away' ideas. We have had spiritual experiences witnessing nature, and we like to share those experiences with others. Taking students on field trips where they can view stars or wild animals provides us with an intense sense of satisfaction.

Heart: Enjoying the journey. We feel strongly that we should strive to enjoy the journey as much as the destination. We have developed an optimistic outlook on environmental management, partly as a result of having had a succession of great mentors and students in a series of wonderful jobs,

while being supported by loving families. We have had our challenges and tribulations, but maintaining a positive outlook has been something that has characterized our careers.

Peter and Ann Oliver (seated) with colleagues at the Healthy Waterways Gala 2012.

Reflecting on our lives, we found the convergent features of action-oriented research, teaching, and artistic expression are things that we share in our careers. We also found that we love experiencing similar things; nature activities, lifelong learning, and sharing. Finally, we share the aspirational goals of developing innovative approaches, engaging in deep thinking, and enjoying the journey.

Convergent journeys: Lyngbya, fishermen, taking risks, and friendship

Bill: I thought we should start by telling stories. I think that should be the way to try to develop this book. Because we can write all the facts in the world and it's never as convincing as telling a good story. And I think we should tell some stories and then try and string them together later. Let's worry about a theme and everything later, but let's just tell stories.

And I thought we could start by telling a story that we shared, a mutual story of the early days of Lyngbya because we both have different versions of the same thing. And it'll be a launching point from which we can go. I mean, ultimately, all the books that I have written, the Healthy Waterways books - these books that I produced - are just ways of synthesizing scientific knowledge. But they're not stories, and they're not very compelling. And I really think we need to tell compelling stories. So that's...

Peter: Well, do you want me to tell you how I met you?

Bill: Yeah, and then I'll tell you what I remember. Start from your end.

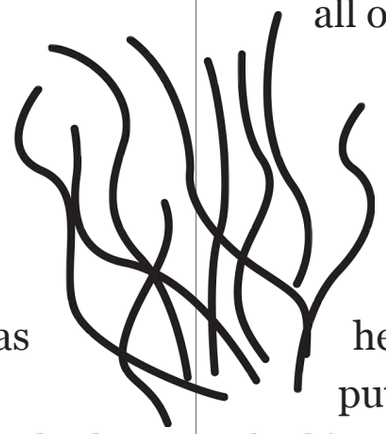
Peter: Well, from my end - I can't even think of the date actually. I think it was probably in 1997. I think it was about May...I got it in a diary upstairs anyway. But what had transpired was I was setting up integrated catchment management, as they called it then, a program on Pumicestone Passage, or the Pumicestone Region, as we call it because it took you north into Deception Bay as well and included the Caboolture River catchment. And we were looking to try to get all of the stakeholders involved. But many of the stakeholders didn't want to be involved with the fisherman. But when I had my listing, I'd done my soft analysis of who I thought to be involved. The fisherman didn't want to be involved, because at that time they were being

excluded from fishing in Pumicestone Passage. This was the first commercial fishery exclusion. I think there were 11 of them. And the minister for Prime Ministries was closing down Pumicestone Passage as a fishery. So they were suing the state government.

And I was employed by the state government and I didn't want to be involved. So I had to talk to Joe McCloud, who was a fisherman up in Tin Can Bay talk to a fisherman down on Bribie Island, who was Greg Savige. And I got Joe to go ahead of me and ring, and then I'd ring Greg. So I did, and Greg said you can come along to the general meeting of the commercial fishermen on Bribie Island and give a talk if you like. And that was interesting, they were all very polite.

But there was an old guy by the name of Frank Palmer who was sitting in the middle at the front row and it was in the days before PowerPoint, and I had my overhead transparency slides. And I was telling them all that if we had big group hugs and everything would be fine if we all worked together - collaboration was key and we all had a stake in this.

And meanwhile, Frank Palmer was sitting in the front at the middle, and he's a sand crabber. And his body was just covered in rashes, and blistering nicely. He just looked like some sort of person that you didn't want stare at, but you were going to stare at. So at the end of it I said, "Any questions?" And Greg just said, "That's all very bloody good. What are you going to do about the blue-green algae?" And I said, "What blue-green algae?" And he said, "You blokes from the government never really get out. You need to go and have a look." I said, "Will you take me out and show me?" And he said, "Would you come?" And I said, "Yeah." I said, "If you bring me back."



And so Greg and others took me out and we charted the algae and we took a baggie of it down to you. We took some photos of Frank's legs down to you. We chartered a Cessna and flew over Deception Bay and mapped it and the bloom area was about 7 square kilometers, it was big. And that was the start of all of that. What happened was, actually, I said to the fisherman, "Has anybody identified this?"

Bill: I remember you walking into our lab holding a plastic bag full of this "gungy" algae, and you were just kind of wandering. You said, "Is anybody around here that can identify this?" And we grabbed Judy and put your sample under a microscope. I remember kind of looking over her shoulder because she was the one who knew what she was doing. Judy went through the process of deciding that it was a) a blue-green algae and b) probably Lyngbya.

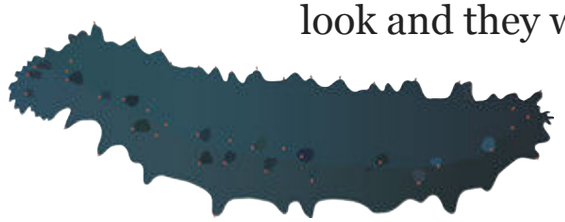
At that point, she wasn't sure whether there were other species mixed in. I think there were three species mixed in, but clearly there was one dominant species. And she was able to give it the name Lyngbya and then after a bit she did a little more research to really confirm the identification. I think it took her a couple weeks before she was really positive.

And several years later, it turned out there was a cyanobacteria conference up in Noosa. And she ended up having the world's cyanobacteria expert, he was a Hungarian, confirm her identification. She never felt totally comfortable until she got the final confirmation. Anyway, I remember you walking in with a plastic bag full of this nasty stuff, trying to figure out what it was and what it was doing to the fishermen. So what happened after we gave it a name and you chartered a plane?

Peter: After we gave it a name - what happened? Let me think. The DPI [Depart of Primary Industries] Fisheries had not been out and actually had a look at the extent of the bloom. They didn't trust fishermen and fishermen didn't trust them.

Bill: Has that changed at all? Has that ever been any different?

Peter: No. I'd suspect now that it's pretty endemic in their relationship. But in the end they did get out and go have a look at it. One of them was into holothurians or sea cucumbers and he went on about what it was doing to the sea cucumbers. But the only thing they did say was the extent of the bloom was...well, they used some adjective, but it was amazing. They did get off their bums and go out and have a look and they were actually stunned. I think not long after that transpired that - who was it? Jim Soorley became involved...



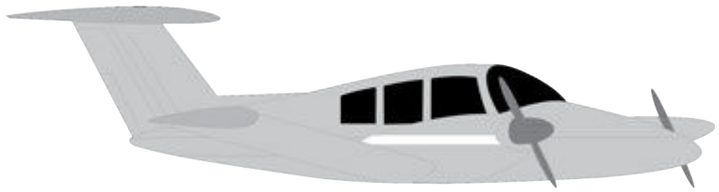
Bill: Well, I'll tell you what happened there. I remember the Jim Soorley connection. He was the Brisbane Lord Mayor and in 2000, I took him a video, an underwater video that was about 3 minutes long. The video showed the bloom underwater and then we showed bits of it floating. It really made a difference with him. He really was impressed and he said, "Well, what do you need?" And I said, "Well, we need to map it. We need to try to understand the causes. We need to look at the impact. It's going to take a lot of scientists. We have this great baseline study going, but we can't really...those projects are already happening." And he said, "Well, how about...what if I can get you half a million dollars this year?"

Peter: Six hundred thousand.

Bill: That's right, six hundred. He said "I'll put in a 100 from Brisbane City Council. I'll get the other councils to match my 100. We'll match our 200 with the state government; and we'll match it with the federal government. So he did the calculations in his mind. And so I walked out of City Hall thinking, "Oh my God, now this guy really wants results...I'm on the hook, we've got to do something. He really is going to go out of his way." And at the time all we had to show what might be causing it was the black water coming out of the canal estates. What's the name of the canal estate there?

Peter: Pacific Harbour.

Bill: Pacific Harbor, that's right. Yeah. And so what we had done is we had been on the research boat, we saw - we were



out sampling and saw that black water plume because of the ebbing tide. We ran the boat into shore and dropped off Alan Goldizen, our lab manager, and I gave him a checkbook and said, “Alan, go find an airplane and take the camera and go get some pictures of this because the tide is going to turn, or the wind will come up. We have a magic moment here. Go up and film this.” So he went to Caboolture Airport. He got a cab from - I think we put him off right at the shore of Deception Bay. We called a cab to come down and meet him. And he grabbed the cab to the airport, and talked somebody into flying him. He was zooming around while we were collecting water samples.

And we got a look at those photos and we could see the black water coming right out of Pacific Harbor. There were two openings I believe. One near the bridge and there was a creek just up the passage a little bit. And both places were bleeding black water. And the black water was coming right out over the Lyngbya. So then Alan had to find his way back out to the research station on Stradbroke Island. I don’t remember how he was able to accomplish this, because it was really a heat of the moment kind of thing we did. Because we were staging out of Straddie, the logistics were that we were on the boat and for us to take the boat back and get a ferry and come back, it would have taken forever so that’s why we jumped at the opportunity. What we had in terms of a smoking gun was black water coming out of the canal estate.

Well, it turns we showed the Lord Mayor the video that we had taken and we showed him the aerial photos and he asked, “Can you say that it’s the canal estates?” And I said, “No, we can’t. All we can say is there’s black water coming out and it’s flowing out onto the area where Lyngbya is blooming. We can’t really blame the canal estates at this stage. I’m not comfortable with that. I can’t go there.” He said, “Well, how about if I go there?” And I said, “Well, it’s up to you.” So he went out, literally, out of that meeting, out of City Hall and went to a press conference, and said, "Let’s have a moratorium on canal estates." And it turns out, that was a very shrewd political thing to do because Brisbane doesn’t have any canal estates. That was Caboolture Shire Council, Redcliffe City Council, and Redland Shire Council that had canal estates.

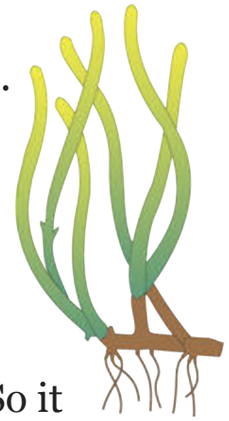
Peter: Yeah, that was a pretty shrewd move because he didn’t have any estates in Brisbane City at all.

Bill: That’s right. So he could make that call. And of course the next day, I get a call from the lawyer and a call from a scientist who represented Pacific Harbour. They were pissed off big time, and I was ducking for cover. But it really was not me who made the statement and I just told them that I was trying to get to the bottom of what was happening. In the end, when we established the connection between the rapid deforestation behind Pacific Harbour, with the runoff of humic-rich water through the canal estate, the Pacific Harbour guys were off the hook.

Let me tell you another little story, though, about taking the mayor out. We took him out on the brand new research vessel. The University [of Queensland] got a jet drive Catamaran shallow draft vessel so we could float in on shallow water, Moreton Bay being as shallow as it is. And so we said, "We'd like to take you out and show you this in person." The Mayor said, "Right. We'll do that." And it turns out, his schedule was always so busy six days a week, Monday to Saturday, that we could never book anything more than an hour in the week.

So we always had to do these special trips with him on Sunday. So we booked a trip on a Sunday morning. So we take him out there in our jet drive boat, but just to be ready, I sent a student out there on Thursday to map it and make sure he came back with some samples and GPS [Global Positioning System] coordinates, so we know exactly where to go and can just plug in the GPS and go straight to the site. It turned out between Thursday and Sunday the bloom actually evaporated. And the student who actually went out to check out the bloom is now a professor at Cornell University here in the states—Ian Hewson. And he actually wrote a paper on the viruses that attack the cyanobacteria. And so the bloom, as fast and voracious as it blooms, also crashes really quickly. And of course we learned that the hard way. So on Sunday it's gone. The bloom is gone.

So we're looking around and we're there because the Mayor picked the day and the time, so we couldn't pick the tide. Well, it turns out, we were out there on a falling tide. And I'm jumping in the water desperate to find something. I find a little scrap of it in the end. And then as I'm wading back to the boat in thigh-deep water, I realize, "Hmm, this is getting kind of shallow. We better get out of here."



It turned out the boat was in a bit of a bowl. So it was floating, but just. So I said, "We got to get out of here, let's go, right now. We've got to go." So the skipper started out and we bumped into the wall of the bowl and then we bumped over here, bumped over there. And I'm thinking, "Oh, this is bad news, man. How are we going to get the Mayor back? We're going to have to ferry him into shore…and get a cab from Deception Bay to…this is really ugly. This is not going to be good." Well, then the skipper, being pretty shrewd, put it in reverse. And because the jet drive had lifted the back of the boat up a little bit, just enough to get over the lip of the bowl and out. We escaped by the skin of our teeth. In another 10 minutes, that tide was dropping so fast we would have been struck high and dry.

Peter: Yeah. So there are a few other things that happened at that time as well. After that press conference that he held, Jim Soorley got stuck straight into a helicopter, the Channel 9 helicopter, and flew up to see Greg Savige. And sat on the beach with Greg and just talked to him about what this thing was doing to Greg's fishing and the fishing of other people. Which was pretty grass roots and astute. That was not

assigning an advisor to the issues, but that was, "I'm going to go out and look for myself." Which I thought was just, quite frankly, amazing really. There's something in this story about Jim Soorley that's key, isn't it?

Bill: Absolutely.

Peter: He did sort a lot of things out very, very quickly. And I know as well we...Greg Savige actually - how can I put it? There are a few things where he said to me interesting things. Greg used to say I found out how to do the wrong thing and the right thing at the same time. He said we needed to put out a press release about Lyngbya and the Pumicestone Catchment Association. And I thought, "I know I work for the state government but wow, look at that. Look what I just did."

So it was interesting because I remember one of those press releases, it was coming out - it must have been the following year. It was coming up to Easter and we put out this press release and it got lots and lots of news coverage, both locally and in South East Queensland, and on radio and TV as well. Anyway, Greg rang me up and we were talking about different things and he just said, "Okay, you have to be careful. We've been getting a bit of feedback about that press release and the media about Lyngbya," and I said, "Yeah, a few people have rung me up. They're not very happy." And I said, "How many people have rung you up?"

And he said - he's a fisherman so he logged things, he liked writing things down every time he got a phone call - " I went the last 24 hours and 37 people have rung me up. And they told me that now is not a good time to talk about Lyngbya, before Easter when the holidays are coming for Bribie Island." That's very, very bad. The bait shop, to the fish and chips shop, the real estate agents, Chamber of Commerce, all sorts of people had rung up and said, "You can't do that."

And I said to him, "How do you feel about that? You're almost like a sort of outcast on your own island." Greg said "Well, it's hard to do the wrong thing and the right thing at the same time, and I reckon I'm doing the right thing." He said people have got to know about this algae. He said that some people, said "Yeah people do need to know about it, but they don't have to know about it just before Easter when we have a big holiday period on the island."

They said that's not a good time and Greg said, "Well, would you tell me when is a good time? You tell me when's a good time to let people know about this. When's the really right time to let people know that there's a stinking sort of sliming thing that makes you really sick and it's taking out our ecosystems, and people's incomes. And tell me when's a good time." And I thought, powerful stuff.

Bill: Peter, can you tell the Greg Saiage story about the Minister for Environment? Can you...that's a great story.

Peter: In all of these things I was really in a - not in a difficult situation - but I was a state public servant. So Greg and the fisherman would keep me a little bit on the side. My bosses would say, “You are working as a coordinator for this non-government group, but don’t you get involved because you could get in trouble.” They’d ring me up sometimes and say, “Who told you, you could do that?” I’d say, “No one said I couldn’t.”

But so there was a community cabinet meeting on at Caboolture and it was a very hot day. And Greg Savige and Peter Spindler, a commercial corn farmer, and Robert King where making a presentation to the minister about Lyngbya and about catchment management things in relation to Moreton Bay and Pumicestone Passage. And it was Peter Spindler who brought along a whole big tray of prawns and stuff and Greg had some seafood and things there.

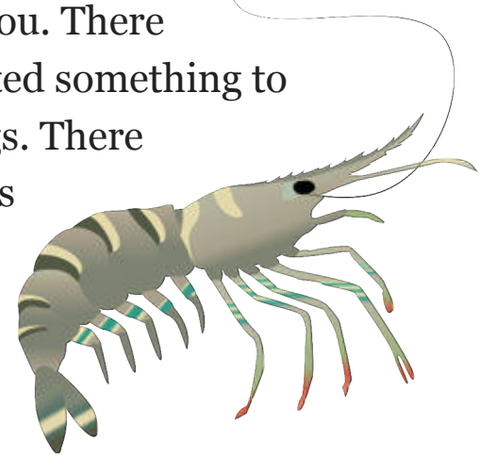
But I also had a bag of Lyngbya and the Director General of the Department of Environment was Barry Carbon. I was sitting outside and Greg, Peter, and Rob were talking to him. And this was really funny because Greg Savige was saying, “This bag’s got Lyngbya in it.” And Barry Carbon, as the advisor to the Minster, said "No it doesn’t, that’s something else. I know marine cyanobacteria, and that’s not it."

Bill: Because he’s from Western Australia where they had blooms of Microcystis.

Peter: Yeah. And he was just waxing on about what cyanobacteria looked like. And because it was a fisherman who said it, and not a scientist like Barry, he just said this is crap. So anyway, he put his hand in the bag and then took his hand out of the bag. And it was a hot day and he went to rub his face and Greg Savige said, "I wouldn’t do that. I wouldn’t touch it, don’t rub your face."

And the Director General said these people are just silly. Really they were knowledgeable about fishing but they’re just amateurs about this sort of thing. And then his face started to swell up and so he had these big welts coming across his face. And Greg Savige just said to him, "Well, I did tell you. I told you it would make your face swell. I told you not to do that." And he had to wash his face then. It wasn’t egg he had on his face, it was sort of like slime he had on his face. But later on when Ken Weiss from the LA Times did contact him, because you told him to contact me, I told him that I didn’t actually get to see it, I had to sit out-bloody-side because I was considered too lowly to sit with the Minister, it had to be a Director General. But anyway, yeah, that did happen.

And so there were a whole lot of things going on at that time. I mean, there were people like Greg. There were people like Jim Soorley. There were people like you. There were people that just sort of wanted something to happen and could see some things. There where people trying to stop things from happening, protecting their own interests. And the Pacific Harbor people were pretty much in that last camp, I suppose.

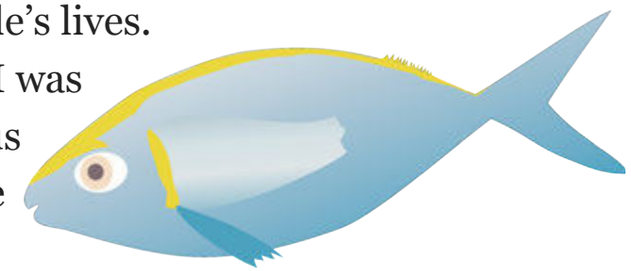


Bill: So they were blaming the fishermen. The Pacific Harbor people were saying it was the fisherman's fault. They over fished the rabbitfish, so the natural predation of Lyngbya was removed and, therefore, they caused the problem, brought the problem on themselves. That was a pretty good ploy.

Peter: Not clueless, actually. And in many respects, they did sort of lift their game in terms of coastal management over time. With a little bit of prompting everybody from the island...

Bill: By the way, Judy just got a paper submitted to review. She's an editor for a journal called "Harmful Algae". And she received a paper that was submitted and Greg Savige is a co-author on a scientific paper on Lyngbya. What a turnaround from a fisherman who didn't want to have anything to do with you. Now he's writing papers in scientific journals. But what I learned from my scientific colleagues is that they saw the six hundred thousand dollars that we lined up as a big windfall to fund what they wanted to do anyway. And I had a really difficult time trying to convince them that, no, we are obligated to try to solve the problem. Not just study it. We have to figure out what we can do to help manage this and prevent these blooms from occurring.

And it was really poignant when I got Greg and his wife Julie telling us, "We're thinking about enrolling the kids in school next year and we're wondering whether we're going to have money for tuition. What do you think we should do?" And this really brought it home for me. This isn't just an academic question, this affects people's lives. This is important. And so I was really committed...that plus I felt a connection with the Mayor that he went out on a limb to get the money for us. And then I saw my scientific colleagues lining up at the door to get their pet projects funded, and I was really kind of disgusted with that attitude. It was a bit of a wakeup call for me.



So we managed that project pretty tightly and pretty rigorously because we really wanted to make sure the money went towards the right science. And in fact, the Mayor came over and visited us at the lab and toured around the lab. We showed him what we were doing in the full swing of things. To me, it was a real opportunity to show the value of doing good science that could have application, rather than a bunch of egghead scientists running around doing pet projects.

Peter: I remember you started your research at the caravan park.

Bill: Yeah, the Bribie Island Caravan Park.

Peter: Next to the Bowls Club. And you actually went and had sausages and chips with Greg Savige and a couple of others. And I thought there's something in this story as well about communication. About science communication, communication of a different sort that's really just based on conversation and based on relationships to get some things happening.

Bill: Even that Caravan Park deal was…I don't know, was it you? Somebody helped us organize that because we kind of took over the Caravan Park. Because we had couple of the Caravans for eating/sleeping, then we had a lab set up. And then we parked our boats there and we used the Bowls Club for meals. We'd get dinner over there, except they kept kicking us out for wearing thongs [flip flops] and we just couldn't get enough clothing on our students.

Peter: You were probably wearing hats inside too or something.

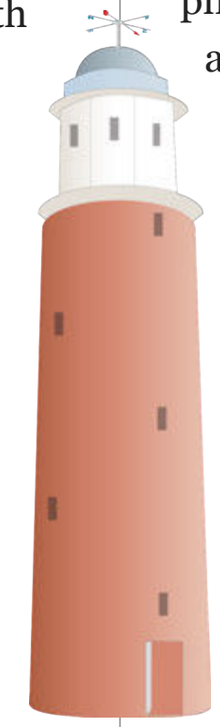
Bill: Yeah, that was a problem.

Peter: So, yeah. But I sort of just keep coming back to that. There's something about particular scientists with that sort of attitude, that it wasn't too much to actually do that relationship-building thing. There was something there with Jim Soorley. There was something there with Greg that meant that things were a bit different. And I think you picked up on that if Greg can say 37 people have rung me in 24 hours about this, it wasn't important to just him either- it was important to a whole lot of people on the island.

Bill: Have you read any of those Malcolm Gladwell books like "Tipping Point"?

Peter: Yes.

Bill: Well do you remember the story about Paul Revere?



He was the guy that rode to warn people when he saw the signal: one if by land, two if by sea. The British are coming, the British are coming. And Gladwell's point in that book was it was important there was a messenger, but it was very important that that messenger was Paul Revere. Somebody respected in the community, somebody who only had to say, "The British are coming," and they knew that it was real. They knew they had to act, they knew it was important. I think Greg Savige served as a focal point for that fishing community, because Greg is a very reasonable person, a very down-to-earth and not-prone-to-hyperbole person.

Peter: Yeah. I think the Malcolm Gladwell book actually talked about three different sorts of people you need to have change when social epidemics happen. One was a networker like Paul Revere. Someone who you give them a page of the phone book and they know five times as many people as anybody else. Five times as many. He said that they need those networkers. You need sales people, people who could actually explain something clearly. And you need mavens, which was a Yiddish word for a person who knows all manner of things. And wishes you no ill will, wishes you only good will. So maybe you're the maven.

Bill: And Greg is a connector.

Peter: Greg's probably a connector, but there is something about having those combinations of things. And often when I see communications activities in science, they're not pegged at those sorts of things for

social change. They're pegged at things about getting out a message, which are surely two different things. For what you were looking at doing there, you were looking at actually trying to solve a problem, not just doing some really neat science. And saying let me assure everyone we're done some really neat science and here's some nice journal articles or something about it. So…

Bill: That's why I don't like the word "outreach." A lot of scientists and a lot of agencies use the word "outreach". They say, "We need outreach." Well, outreach I think is just the glossy brochures. It's just a one-way communication. It's not two-way. It's scientists distilling or dumbing down, in many times, their information. And I think when it's a two-way dialogue, you realize that people aren't stupid; you don't have to dumb it down. You just have to raise the bar. You just have to give them the terminology and the context. De-jargon it and talk about the simple questions that we're asking. We're using very complicated technical tools to answer them, statistics or stable isotope analysis, or gas chromatography. Those are very complex things and they're easy to get overwhelmed by, but it's really a simple question and we're finding simple answers to simple questions. So to me, it's about getting that dialogue going so you have two-way communication, instead of outreach, one-way communication.

Peter: And that was probably when the Coastal CRC [Cooperative Research Centre] setup and they were talking about citizen science - that was one of the things that they were trying to do. I don't know how successful it ever was, but that idea goes back to the mid-90s when Alan Irwin wrote a book called "Citizen Science". It's very much Erin Brockovich, people actually working with scientists and actually sort of working as a scientist themselves. Adopting the same sort of mode of investigation and trying to come up to speed in the same sorts of ways. But "de-jargonified," if you like.

Bill: Well, actually, I'll tell you something about Julie, Greg's wife. That when we first started, when I got the name *Lyngbya majuscula* for the cyanobacteria, our first reaction was to run to the scientific library and look up all the papers on *Lyngbya majuscula*. Turns out there's a big literature on this species. There was one fellow in Oregon whose whole career is on identifying secondary compounds, these weird and wonderful chemicals. It's a whole pharmaceutical little engine room, that blue-green alga. And so we were going down the science track, Julie came back and said, "You know I just Google searched and I found in Hawaii that there's all this Lyngbya." So sure enough, we saw some papers from Hawaii but she got the newspaper articles that were calling it 'Stinging Limu.' So that launched it, and I went to Hawaii and visited the guys that had written the paper. And we went and tracked all that down.

But it was interesting that it was her reaction to go the popular press. Our reaction was to go to the scientific

literature. Both were right, both were important. And nowadays it's so easy we do Google searches all the time. But at the time it was late 90s, it was as common to go do a search and have…we had dial-up, old funky connections and everything. But it was definitely eye-opening…I learned something right away: Google before you do anything. Don't just look in the scientific literature, look in the popular press too.

Peter: So this…in terms of a little object lesson about science and, not so much popularizing science, but applying science, making science useful. Making it part of people's everyday conversations and solving problems. There has got be a sort of pattern when you look at the elements. Some of the stuff that you said about with Malcolm Gladwell comes out. I think some of the things too are just having a science champion and people on the ground who are persistent and consistent. Those things come out as important as well. There was also the Healthy Waterways Study, or whatever it was called at the time. There was also some flexibility, which was important then. The things weren't tightly locked down.

I remember at one stage sitting on the beach at Sandstone Point with somebody from the Department of Environment. I said, "You should see this filamentous cyanobacteria and this thing is here. You should have a look at this, this just stinks and it's got this white stuff over it and it's revolting." And he said, "The sampling for Moreton Bay is already sorted out and what you're looking at is probably Trichodesmium." I said, " You wouldn't know Trichodesmium, would you?" It was just amazing that what I saw wasn't really there in his mind. And the water quality program wasn't really sampling in that northern part of Moreton Bay. And there was a whole other thing happening in that northern part.

Bill: Well, it's true about the flexibility. We had some scientific research money that we diverted and we just said, well, look we have 2.1 million dollars to do the physics, the chemistry, the biology of Moreton Bay in two years. And in the middle of that study, this bloom started and we recognized that if we ignored the bloom and just focused on the stuff that we had contractually gotten organized and set up, that we'd fail. We would fail the mission of achieving healthy waterways. We'd fail the citizens, we'd fail the program because we'd be ignoring the most compelling thing going on: these fishermen's livelihoods being taken away.

And this nasty scourge washing up on the beach and causing… remember the woman in that little subdivision down there, and her silver was tarnishing because of the sulfide emanating from the rotting Lyngbya on the beach. It was affecting house owners as well as fishermen. It was such a mess and so we definitely diverted our effort accordingly because it was so compelling. And it truly was compelling because we didn't know what was going…this was pretty unprecedented, this scale of this bloom, this event and its impact. It was very compelling.

Peter: So what's happened in the end? What's the postscript of the story?

Bill: Well, one of the postscripts is that it's not gone away. It's persistent. We think that we've resolved the scientific stuff, which was pretty cool. We had a connection with iron because of Trichodesmium. Judy had been working with a bunch of her colleagues on Trichodesmium and they were looking at the effect of iron dust coming from the Sahara Dessert onto the Atlantic Ocean and bringing out these blooms. So we had iron on the mind so went looking and there are little streams coming out into Pumicestone Passage on both sides of the passage that were orange. They were literally orange. So we said well, there's iron around and we didn't know enough about iron at the time. We thought, okay, that's a sign of iron, which it was. What orange is is a sign of oxidized iron, ferrous hydroxide, which precipitates out. And so it's not biologically available anymore once it does that. So what we did was we got an iron chemist involved, David Waite from the University of New South Wales.

And so he came along and figured out the whole iron chemistry story of how it could be bound to the tannins, the blackwater that we had seen coming out of Pacific Harbour. Well, it turns out the pine plantation had been knocked down because of the bushfire and the economic shift and so they clear-felled all of those pine plantations. All the tannins were coming out with the wet weather and so it's one of these perfect storms. So you had a clear-felling combined with wet weather and we had lots of coffeerock and iron available coming into the marine environment and just stimulating this Lyngbya. So we had a perfect storm for establishment of the bloom, but once you've got it established, it seems that it's very persistent. And it's never been as much of a scourge, from my understanding, from year to year as it was in the late 90s. But it's still present. And we then were on sort of high alert for Lyngbya, and we went up to Fraser Island and found it. We found it up on Hardy Reef, on the Great Barrier Reef, associated with helicopter platform.

So it turned out, Lyngbya is lurking in the shadows everywhere, but it needs the combination of adequate phosphorus stimulated by iron and it can make it own nitrogen. I think we did pretty well at discerning the proximal causes of the bloom. Managing it turns out to be difficult, and at some level you just got to clean up the mess. You got to clear the beaches and try to rake it up when you can because once it's in the system and that profusion, it's really hard to really wipe it out. Kind of like an introduced species, once there, in that you can control it, you can't eliminate it.

Peter: Alan Cribb talks about it being around for a long time, doesn't he?

Bill: Yeah, he identified in the '70s, early '70s, I think. And up Harvey Bay way, it's been up there in the fisherman's reports.

Peter: It's sort of like there's a constant background but it's more prevalent than it was. Things change, and it just becomes more dominant as a species.

Bill: Right. Yeah. And I don't think we've totally written the postscript. I think there's more to be found. I'm not sure that we're done with the Lyngbya story. They're still monitoring it; they're still doing research. It's still an active area of management and research. How's the fishing in Bribie Island? Have you talked to Greg? Or…

Peter: I haven't heard anything for a while. Greg and Julie have been in touch with me, actually, since I've been ill. Quite a bit. In fact, Julie sort of knew I was ill before I knew I was ill.

Bill: Really?

Peter: Yeah. It's a bit spooky. I had a bad back, and I was having scans for a bad back sort of thing for six months, a year or so ago. And one day, out of the blue, while I was sort of hiding in between going to doctor's appointments, I was still working, I had no diagnosis of cancer or whatever. And Greg rang me up and said "Are you at home?" I said "Yeah." And he said, "We're up at Maleny and Julie wants to talk to you. She really has to see you." And I went, "Yeah, okay. So come over this afternoon." They came over and had a cup of tea and just as they were leaving, she looked at me she said, " You have an incurable disease." She said that I know you have an incurable disease. And Greg looked at me and he said, "She doesn't just say this to anybody. If she's telling you something then you need to listen." As it works out, her mother is a Christian scientist. And so she feels that she's got - and I think she might have something, sort of gift or whatever. But she left some books with me.

Bill: No medicine, right?

Peter: No medicine, you're made perfect in God's image. You trust in Christ and you're just going to be saved.

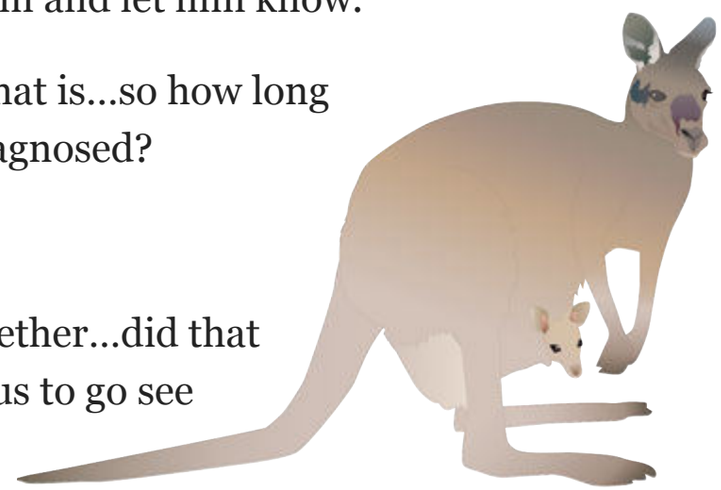
Bill: After this week, you might agree.

Peter: Yeah, maybe. But nonetheless, it was very nice of her to come along and she had that very strong feeling that she had to come and see me.

Bill: If she hadn't seen you…so she felt the need to see you in person and then after seeing you, she told you that you had a disease.

Peter: She had a message from God, basically, so Peter is really sick he has this very serious life-threatening illness, you need to go and see him and let him know.

Bill: Really? Wow, that is…so how long later until you got diagnosed?



Peter: Three weeks.

Bill: Did it affect whether…did that give you more impetus to go see the doctor?

Peter: I went and saw the doctor but I got misdiagnosed by the doctor. Julie's diagnosis was better than the doctors' first time. So yeah, it was…there's more things happening in the world that I can see, let's put it like that.

Bill: Fair enough.

Peter: And these things I don't understand. But…so, yeah. We've, Julie and Greg and I, have kept in touch over the years but that was just the most recent thing. And that was the first time that I found out about her having that sort of gift, if you'll call it that. She'd never ever talked to me about that before. But I have had friends say to me "I'm deep in the Church of Christian Science, and they say that to everybody." And then if you turn out to have something, they go, "See, I was right." But I don't think that's the case at all with Julie. I think she just felt that she had some sort of message that she had to give me. So that was really a little bit amazing. So, yeah.

Bill: Interesting. Last time I was in Brisbane, not last week but the last time a year ago at the RiverSymposium, I called him up, just called Greg just to…I just felt the need to say hello and I had a very nice chat to him. He was doing very well, seems like, in terms of raising his family and doing his thing. So it was fun talking to him.

Peter: Yeah, I think all of that stuff that we started up on Pumicestone Passage is now fallen by the wayside. That was all state government supported. I think the Catchment Association is closed, last I heard.

Bill: So we're talking about maybe back to the theme that it gets down to personalities and it gets down to how people interact. And the example of the Lyngbya story that we were telling- it's about having individuals who have learned how to effectively communicate and move things forward. And there are other individuals out there that can derail that. It's overcoming the obstacles that are presented by people who are counterproductive and enabling those who can actually forge a way forward.

And what keeps me up at night is that successful programs, that we see through the RiverPrizes or the Healthy Waterways experience where we know we were making a difference and doing something, is that they're clearly the exceptions around the world. For every one of those success stories, there are hundreds of programs that just aren't making progress. Programs that are locked into unproductive behaviors and business as usual and special-interest dominated. And every once in a while, you get a major oil spill like what's going on in the Gulf of Mexico that wakes people up a little bit.

But otherwise, these insidious environmental degradations are going on globally. So this is what makes me wonder - what it is that makes it work? And is it just magic? It can't just be magic. It's got to be something that we can replicate in other

places, more regularly than having it appear like a rare bloom, every once in a while and in various different locations.

In fact, I went to visit one of the RiverPrize winners of ten years ago, the Grand River. And they clearly had some magical times but now it's becoming routine. It's becoming bureaucratized. It's becoming a business as usual and it doesn't have that energy, or the transformative power that it had in the early days. And in the Chesapeake Bay Program, clearly, in the '70s and early 80s it was an exciting vibrant place to be. But it's not now and it hasn't been for years. So it's...how do you capture that? And how do you make that happen?

Peter: One thing that comes to me is...well, it's a couple things. Whatever is happening at the time when this sort of magic happens, it's that it's important to a number of people and there is a sort of a shared vision or motivation. It might not be a vision but a motivation like this thing is really, really, really important and we have got to do something about it. I think the other thing is...how do I put it? Some people are risk takers and some aren't and when they're really motivated they will take risk.

I've worked in catchment management where someone has passed the interview to come and be my assistant, or a project officer or something. And I've gone, yeah, well they've passed all the things and they're good. And you realize they can do the job. What you realize after a couple of weeks, or even before that, is that this person is a good public servant. They are good at defining what your job will be and you define their job. They'll even come to you and say, "I'd like to do that but that's not in my position description, that's not my job." And you'd get another sort of person that just goes, "This seems really important to me and I'd like to do more than my job. No one's told me I can't do X. So guess what? I'm going to do it and I'm going to take a risk."

And the thing is that good public servants generally are people that don't take risk. People that get rewarded in the public service are people who are slow to make decisions, who are slow to do things, who are sure. The people that we are talking about that get things done are probably not going to be seen as being good scientists are they? Because they're going to put themselves on the line to try and solve a problem rather than going - I'll take this one step and see if I get a journal paper out of it. I might even get two papers if I make it 20 percent different. They actually want to do something and that's not going to be the way some of these things are going to be solved. The things will be solved by passionate people who are risk takers, who do have high levels of personal motivation that they can share with others.

And there are some other characteristics there that we can go through. I sat down and looked at 19 different case studies of people who were good at getting things done. And what I worked out was that no one case study had all of the dozen or so characteristics but together, collectively, the case studies

had them all. And the one that actually went the closest to getting things done were the bird watchers on Bribie Island working with the canal estate people. When those two groups of people both had very high levels of motivation for wanting to sort out the problems with the migratory birds on Bribie Island. One because it was stage three of the canal estate and that was where they made all the money. In fact, consultants had a look at the bird risk for these developers. And the others because they loved the birds. They were just a force to be reckoned with. They would take risk, they would pool resources, they did all sorts of things that were just…public servants would never do. But people in business would do them as a matter of cost because the bottom line mattered and the bottom line could be measured.

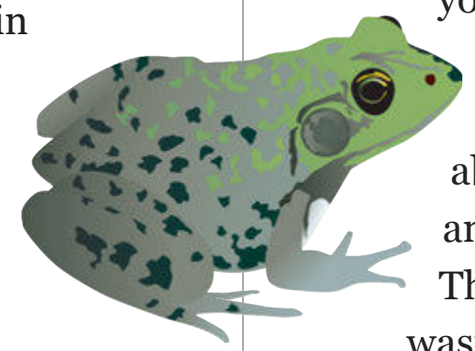
So there are…there's not a recipe and there's not some sort of normative thing of take off these 12 things. But once they occur, you can see them and if they're not there I think you can sort of say, well we haven't hired the right sort of people for this. We need some people that are going to drive the public service bosses insane a little bit, because they won't have their budgets done and they won't have things done the right way, they won't have written the right report. But they'll have very good relationships with the people that they need to have them with. And they'll have actually taken risk.

I'm not saying that I'm some sort of weird risk taker but in the work that I was doing I actually had my boss ring me up one day because I used to have a weekly chat with the editor of the Caboolture North Coast News. And she'd say, "Is there any news?" Because there's nothing happening here. Like a man farts could be a lead story sometimes. There was nothing going on. So she'd ring me up and say, "Is there anything happening?" And I'm not meant to talk to the media. I was never meant to talk to the media.

But I'd say, "Yeah, we just got one of the street sweepers and we got a dugong painted on the side. Do you know every week those street sweepers pick up 72 tons of litter and foreign particular matter off the streets in one week. What's going down the drains? Have you any idea what bloody good job they do?" And that was front page the next day. Seventy tons of litter in my street. And my boss rang me up, my big boss at the time was General Manager. And he said, "Who told you, you can say that?" I say "Well, no one said I couldn't." This was a lie, because everyone told me not to go to the media at all. And he says, "Well it's lucky the Minister liked it" or something. I thought, well, good. I'm very happy, I'm pleased.

But you're not going to get rewarded for taking risk in the public service. So there's something where people are wanting to do that sort of facilitative thing and linking and I sort of…who employs them? Maybe at universities that employ them. And at universities are places where people are in some respects freed up and allowed to take some sort of risk. But I'm not there.

Bill: I'm not so sure about that, Peter. I think that academia's one of the most conservative institutions on the planet. It's old. Academia's been around for 1,000 years. And the way we go about doing things and the whole tenure process is really about not taking risk. And so incremental science, well-documented, conservative science is rewarded. I think academia is actually a quite conservative group, in general. I think that the researchers are less conservative but then the teachers, so to speak, they're sort of the great divide, those who teach and those who do research. And I do think academia isn't necessarily that good at…I'll tell you in my example of going up for promotion within my institution, all the work I did with Healthy Waterways and the books that we produced didn't count in my tenure. It was only the scientific publications that counted. The ones that went to journals.



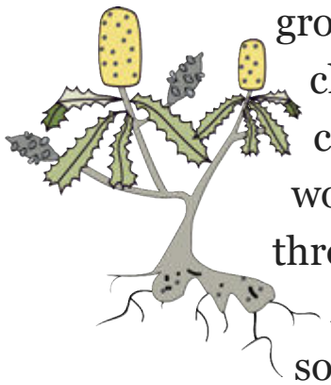
Peter: I understand and I agree with you. I suppose what I'm saying is that maybe there is a place for a good public scientist. I don't know what you call them, but the French have a lively intellectual life where they have public philosophers. Where you can be a philosopher in France and you're a philosopher or a scientist or something. But if you're a philosopher in Australia you're a…what's it, you're a dickhead. I think there's something about an academic doing community service, doing teaching and doing research. And those things being in sort of balance, maybe not in the same proportions for everybody. But I think it is where people are free to take…are empowered to take academic sort of risks. Where is it?

Bill: I'm not sure where it is. But I think that each sector of society, whether it's public service, or academia, or NGOs, or an industry has risk takers in all those fields and I think there is a small minority no matter which endeavor. I think that you're right and the public service probably does more than any to weed out the risk takers. I think it's pretty rare and I think you need to have some sort of security to know that you're…you can't care about your job. I mean, you have to be willing to lose your job, essentially, and realize that you'll be okay. Because if you're absolutely fearful of your job, you wouldn't do anything that would potentially upset the apple cart. That's what tenure was created for in academia. It wasn't just job security, it was academic freedom so that people could go out and say things that were relevant and important to society that needed to be said that maybe weren't popular.

Peter: It's turned out to be the opposite, isn't it?

Bill: It has. It has backfired. It's actually turned people into being more conservative to avoid saying anything controversial.

Peter: Actually, I've just got to say the one person I've seen who is that sort of risk taker is James Whelan. He's down living in Newcastle in New South Wales. He's set up with a

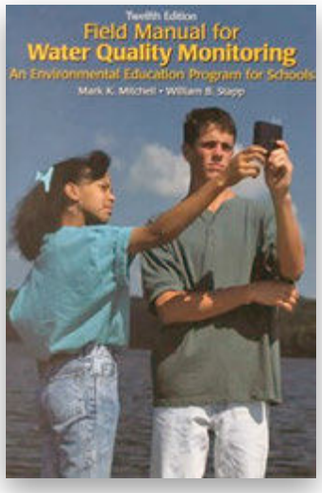


group of other people, a collective of social change workers throughout Australia. It is called the Change Agency, and they've worked throughout the Pacific and throughout Southeast Asia and throughout Australia. Doing strategic planning, doing social planning work, doing a whole lot of community and popular education work for everyone from NGOs to unions. Trade unions to you-name-it, a whole list of clients. Indigenous groups, all sorts of things. And had a really big list of clients, part of an extensive Web site.

What I found really interesting about James is he's never really worried about his job, he's just sort of gone, "I don't want to take any of those jobs that I can't be taking risks." To the point where I said to him once when he was just looking at what might come next. I said there's a job in the Department of Natural Resources, and he went, "I'll take that job. Just after I chew off my left arm." And when I look at the sorts of things that he's embarked upon, they're all sort of things that standard academics couldn't sort of dream of. And he's actually, in the end I think, achieved that whole idea of tenure too. Still working very much as a public academic, but working in quite a different way. The world's not perfect you know, but I see there is a way that we can create more space for people to be able to take those sorts of risks using social science to do things. Or they've just got to be ballsy enough to go out and try.

Bill: I just read a really short book called "Tribes" which somebody new to our group who came to our annual retreat recommended. He said, "You've got to read this book. This is what you have. You have a tribe." And the tribe was a group of individuals that have a shared vision, that are collectively working together for a shared vision. And it just fit the bill, it was exactly defining the way we work internally in our Integration and Application Network. But what you're talking about is a large tribe, it's that shared vision and working together on that vision. You're bringing your own perspectives and your own backgrounds, but you're working towards that shared vision. That's pretty empowering, it's very exciting.

Peter's top ten books about science

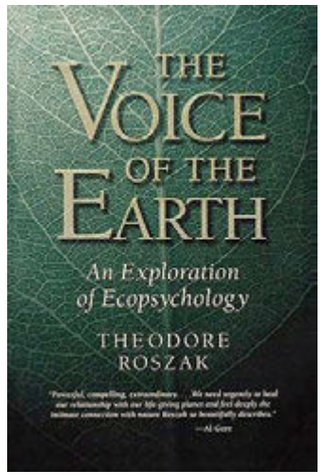


Field Manual for Water Quality Monitoring in Schools: An Environmental Education Program for Schools, Keith Mitchell & Bill Stapp

I found this to be a very useful book when I started showing kids how to monitor streams. There are some inspirational things in the book, particularly where they talk about all the different places in the world where this approach is being used.

Shouldn't Our Grandchildren Know? An Environmental Life Story, Graham Chittleborough

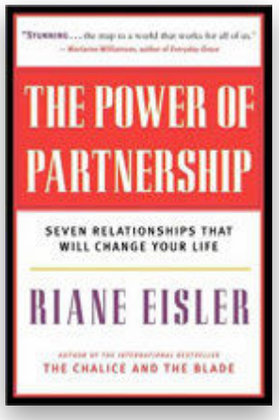
Chittleborough was a scientist with CSIRO in Western Australia who wanted to show his grandchildren some of the things he thought were special, but found that many of them were gone. Chittleborough had the skills and the knowledge about the environment and he wrote this book to attempt to impart this knowledge to the next generations.



The Voice of the Earth: An Exploration of Ecopsychology, Theodore Roszak

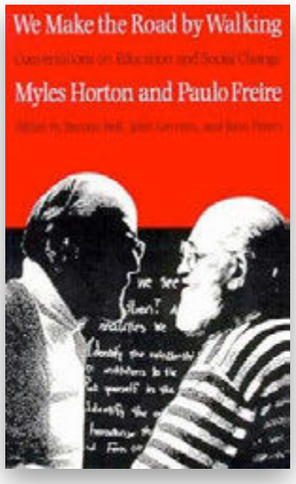
Roszak talks about the 'neon telephone' where there is someone from an Eastern block country and they go into a store in Hong Kong and it is full of neon telephones. This person leaves the shop crying and says, "I don't understand, how many telephones can one person want or need?" He walks into the next shop with 25 brands of toothpaste and he was used to only seeing one brand in stores in the Eastern block country. He considers this variety a form of madness. Roszak points out that it is stupid to have so many choices, yet we like to have choices. For the environmental educator, the concept that having many choices may not be a good thing and there are certain best

practices that we should be promoting. But the human desire for lots of choices becomes a bit counterintuitive, and this is something that we have to deal with.



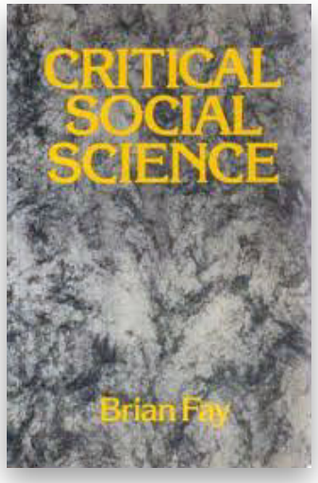
The Power of Partnership: Seven Relationships that will Change Your Life, Rains Eisler

Rains Eisler is an organizational consultant and I read her book because when I worked for the government, partnerships were the rage and everyone talked about partnerships (e.g., win-win situations). I could see that effective partnerships were not happening, so I read "The Power of Partnerships". What Eisler talked about was a partnership culture and a dominated culture, and mainly we work in a dominated culture where power is used so that one group of people has dominance over another group of people. Partnership power is where power is really shared, where people are given power to really do something.



We Make the Road by Walking: Conversations on Education and Social Change, Myles Horton and Paulo Freire. Brenda Bell, John Gaventa and John Peters (eds)

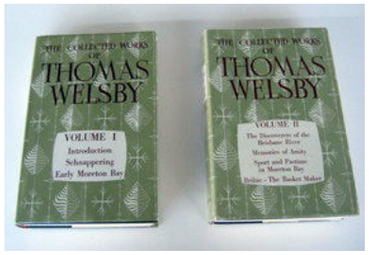
Horton and Freire are two of the biggest educational thinkers in the world. Freire was a Brazilian educator who raised the issue of pedagogy of the oppressed. Horton was an American educator who was famous for his role in the U.S. civil rights movement for African-Americans. The book is essentially two old blokes having a conversation like the one that stimulated Bill and me to write this book. The title, "We Make the Road by Walking", provides great symbolism. You don't have to know exactly where you are walking, but you have to know what you are doing.



Critical Social Science: Liberation and its Limits, Brian Fay

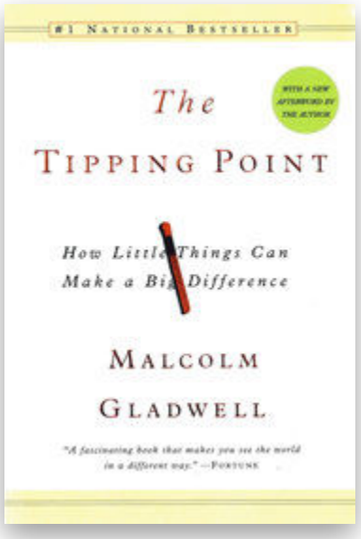
When I use the terms enlightenment, empowerment, and emancipation, I am mostly thinking in terms of critical social science. There are different sorts of social science; there is some that is very positivist, treating people as objects. We observe people, and often don't let them know that they are being observed. We conduct experiments and analyze one parameter at a time like in laboratory experiments. Then there is interpretive social science, starting with anthropologists who not only observed people, but also asked them why they did what they did and learn from them. In a way, the scientists handed over the clipboard and asked people to be involved. There is a third social science, Brian Fay's critical social science, in which the clipboard is fully handed over to people who act as co-researchers and we will work on something that is important to the people being studied. The new knowledge generated forms enlightenment, the knowledge then informs and empowers people for social

change. Critical social science fits very well with praxis (practical, thoughtful doing) and solving wicked problems.



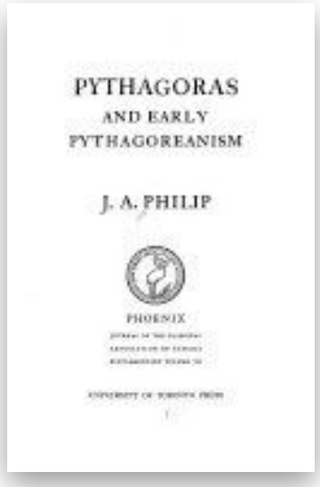
The Collected Works of Thomas Welsby: Volumes 1 and 2, A.K. Thompson

A beautiful story in this book is about two brothers who are very reliable witnesses reporting that they observed a herd of dugong about a mile and a half long and three hundred yards wide in between Moreton Island and Bribie Island. They said that at any one time there were a hundred dugong breaching to breathe. You tell this to young people today and they won't believe you. When a young scientist says that the Bay is in good condition, then I tell them that they need to read Welsby. Understanding the environmental history of a place is crucial.



The Tipping Point: How Little Things Can Make a Big Difference, Malcolm Gladwell

I put "Tipping Point" on the list because it is about social change. When we do all this thinking (phronesis), we get to the point where we want to do something. We have a prudent understanding of what should be done, so let's go do a bit of doing (praxis). Malcolm Gladwell gives us some practical clues about what is needed: salesmen, mavens and networkers. If you produce 'sticky' ideas with the right numbers of people involved, you can have social epidemics that work for the good. An example is creating a social epidemic about articulating values clearly so that scientists know where to channel their efforts for future management of the Great Barrier Reef. Developing the power relationships where power is shared among stakeholders, like farmers in the catchments of the Great Barrier Reef, could develop 'sticky' ideas that could benefit the reef. Tipping Point affected me because it was practical.



Pythagoras and Early Pythagoreanism, J. Philip

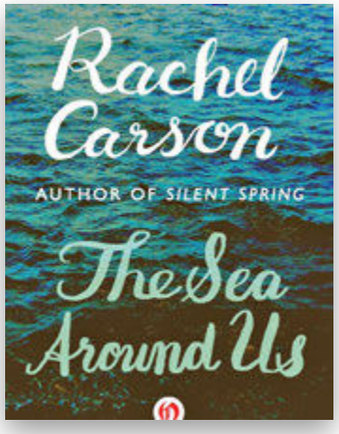
When I started my Masters, my supervisor sent me on a task of finding the first occasion in Western thought. What I was reading this book for was attempting to find the origin of thinking that influenced me. I learned that what I consider to be true is not often examined. For example, we base our whole economic system on the assumption that resources are infinite. Yet, that is not using our 'Nous' (that which is known). This book helped crystallize my environmental philosophy.

Citizen Science: A Study of People, Expertise and Sustainable Development, Allen Irwin

There are a few different origins of what we call citizen science that sprung up around the world. Irwin provides a strong case for what comprises citizen science. He also believes that

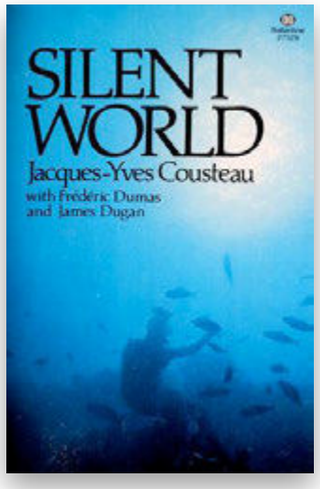
citizen science helps communicate the scientific approach to the surrounding area. Irwin also calls for more social science and more risk assessment. I enjoyed the way citizen science as Irwin describes it changed the power relationship between teacher and student.

Bill's top ten books about science



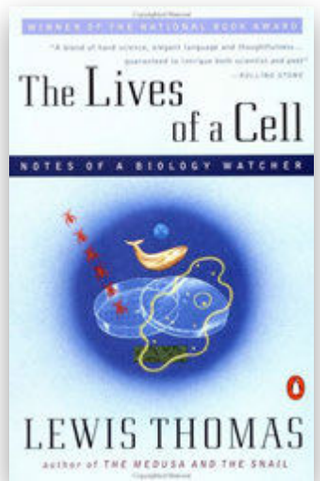
The Sea Around Us, Rachel Carson

In seventh grade in Ohio, in the heartland of America and without ever actually seeing the ocean, I read Rachel Carson's "The Sea Around Us". I had become very enamored in everything to do with water, but my experience was confined to freshwater in the streams, rivers and lakes of Ohio, Michigan, and Canada. I chose The Sea Around Us for a book report in science class and recall that I finished summarizing the book, but still needed more words to complete the assignment. I began to write about how much I liked the book and how it exposed me to an aspect of the world that I had not experienced. It turned out that the teacher was looking for this aspect of reflection and I was pleasantly surprised to receive top marks. The Sea Around Us really did change my life, as it stimulated my lifelong interest in the sea. I was also taken by Rachel Carson's poetic descriptions and sense of wonder about the natural world.



The Silent World, Jacques-Yves Cousteau

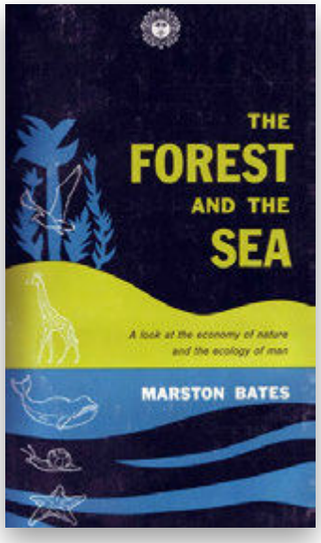
I wanted to learn to SCUBA dive at a young age and found a course that allowed me to learn at a Boy's Club at the age of twelve. What had inspired me were National Geographic specials by Jacques Cousteau on television and this led me to read his book "The Silent World". The mixture of water-related adventure, travel to exotic places, and nature was a perfect mix for a young boy who loved being in the water. The Silent World was indeed a new world that awaited me when I was old enough to find my way to the ocean. Cousteau was not a scientist, but he did embrace science in his explorations, which kindled my interest in studying the ocean. I continued to SCUBA dive in the lakes of the Midwest and eventually in the ocean, spurred on by The Silent World.



The Lives of a Cell, Lewis Thomas

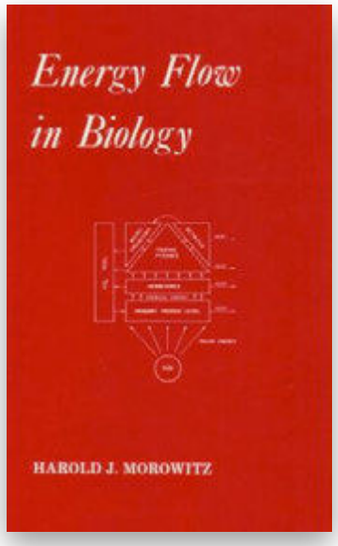
As a biology undergraduate major at Western Michigan University, I came across the book "The Lives of a Cell" by Lewis Thomas. This wonderful set of essays was inspirational to me in the way Thomas celebrated science and provided a perspective that science could be a way to

viewing the natural world. Even though Thomas was a physician, his theme of the interconnected web of life was similar to the Gaia hypothesis put forth by James Lovelock. He also enjoyed the etymology of words and made interesting connections between human cultures and language, which was the first time I had been exposed to this perspective. Thomas also explained how more and better science was needed for the future and this became a creed that I have lived by.



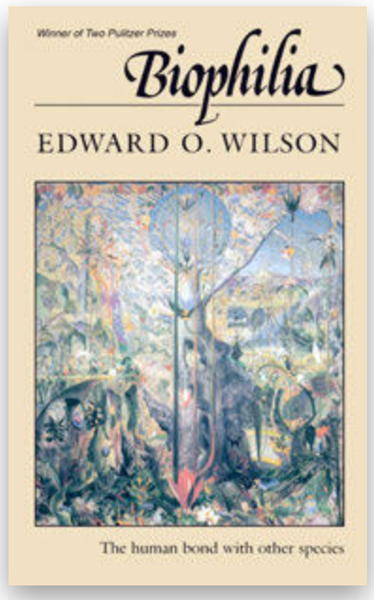
The Forest and the Sea: A Look at the Economy of Nature and the Economy of Man, Marston Bates

As a Master's student at the University of Alaska, I was attracted to the book "The Forest and the Sea" because of the evocative title. I was studying the leaf canopies of seagrasses and became intrigued by comparisons with leaf canopies of forests, thus my interest in the title. What I found in reading the book was much more than a book about nature, but about how humans interacted with nature. This connection between nature and human culture was woven in such a way that I began to appreciate how inextricably nature and human values are linked. The other aspect of reading a book featuring tropical rain forests made me want to experience the tropics, and I began to migrate closer to the equator over the next several decades.



Energy Flow in Biology, Harold Morowitz

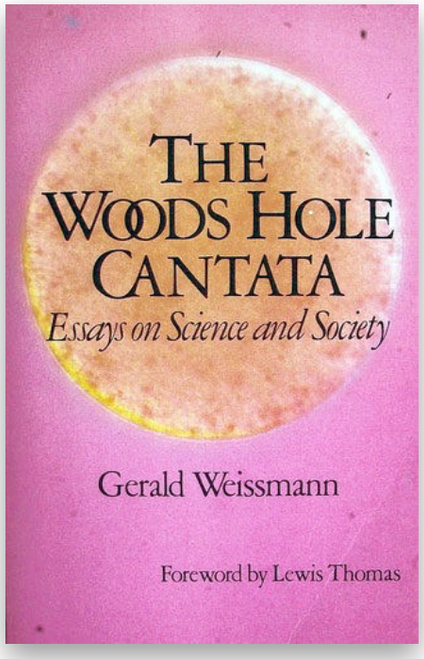
As I was finishing my Master's degree, a professor gave me a copy of "Energy Flow in Biology" by Harold Morowitz. He gave it to me after I had (by some miracle) successfully completed a graduate course in Physical Chemistry (P chem). This little book by a physicist about biology was profound and Morowitz's ability to distill the essence of biology into discrete and fundamental pieces was remarkable. Reading this book provoked my interest in investigating the underlying scientific basis of living things. It also showed me how physics, chemistry, and biology were interrelated in nature. Energy Flow in Biology also made me aspire to do a PhD, as it made me want to be able to think deeply about nature.



Biophilia, E. O. Wilson

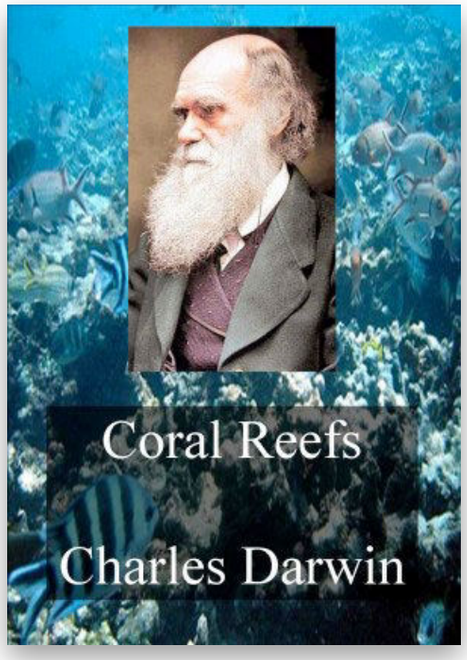
During my PhD at the University of Chicago, I read "Biophilia" by E.O. Wilson while conducting my thesis research in Woods Hole, and was taken by his thesis that humans loved living things. I was enjoying being immersed in seagrass meadows and coral reefs and loved to think that I was tapping into a primal human urge to be surrounded by

life. I had recently met surgeons and found that they were enamored with marine biology just as I was enamored with surgery and gross anatomy. I concluded that we both had Biophilia, a love of life that we wanted to express by being literally immersed in living things: a human body or surrounded by living things underwater. Wilson's attractive writing and solid reasoning was enjoyable and I began to see that an academic career following one's passion was an attractive option.



The Woods Hole Cantata, Gerald Weissmann

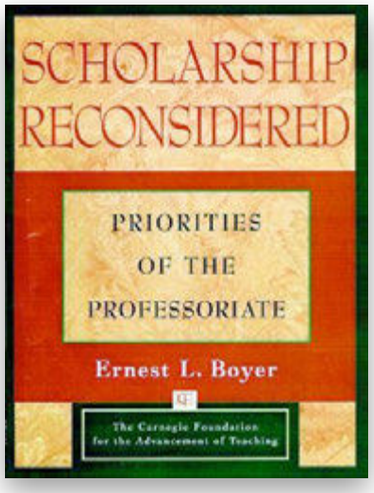
As I began my postdoctoral fellowship at Stony Brook, New York, "The Woods Hole Cantata" by Gerald Weissmann was recommended to me by an erudite actor that I met through my Hollywood-based brother upon learning that I had just spent a few years in Woods Hole. This book, like Lives of a Cell, was a collection of essays by a physician that brought together literary allusions, science and nature. I enjoyed Weissmann's emphasis on avoiding reductionist science as I was aspiring to think more synthetically. The description of the buzz of excited chatter following Friday night lectures at the Marine Biological Laboratory described my feelings accurately, as I continued to visit Woods Hole regularly. The blend of science and humanities by Weissmann was an inspiration to me.



The Structure and Distribution of Coral Reefs, Charles Darwin

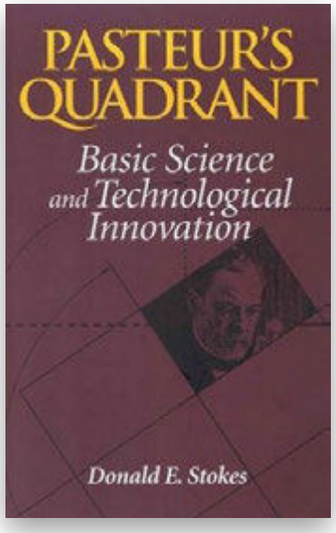
At the University of Queensland, I had the opportunity to study and teach on the Great Barrier Reef. I rediscovered the brilliance of Charles Darwin in his first science book, "The Structure and Distribution of Coral Reefs". I loved the woodcut figures illustrating Darwin's theory of the formation of coral reefs, and his poetic metaphor of corals as monuments marking the burial of extinct volcanoes. Darwin's clarity of thought created a hypothesis of how coral reefs were formed that could not be tested for over a hundred years, but was supported and made Darwin seem prescient.

The part of the book that I found particularly amazing was the careful map that Darwin assembled through extensive correspondence with ship captains and naturalists around the world. Darwin mapped areas of coral atoll subsidence and uplift and from his writing, he appears that he was on the cusp of discovering plate tectonics, but was lacking enough data. Darwin's book inspired me to be a better science communicator.



Scholarship Reconsidered: Priorities of the Professoriate, Ernest Boyer

When I was interested in joining the University of Maryland Center for Environmental Science to lead the Integration and Application Network, the book "Scholarship Reconsidered: Priorities of the Professoriate" by Ernest Boyer was recommended to me. Boyer describes four elements of scholarship: discovery, integration, application, and teaching, and this description of a multifaceted suite of academic pursuits resonated deeply with me. At the University of Queensland, I had begun to do more applied research and write synthesis books for broader dissemination than to my scientific peers. Boyer's short, succinct book allowed me to begin to form a vision of what the Integration and Application Network could aspire to achieve and helped convince me to make this career transition.

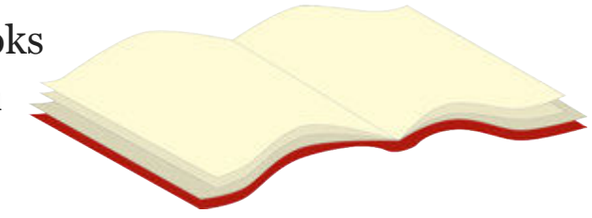


Pasteur's Quadrant: Basic Science and Technological Innovation, Donald Stokes

As part of an institutional review, a visiting reviewer observed that what we were trying to do at the University of Maryland Center for Environmental Science was to achieve "Pasteur's Quadrant". I eagerly read Donald Stokes' book to find out what it meant to be in Pasteur's Quadrant. Stokes described the French microbiologist Louis Pasteur doing both use-inspired research and understanding-inspired research. The book inspired me to rekindle my interest in seagrasses while continuing my integration and application activities. Pasteur's Quadrant also inspired me to look for examples of scientists who combined use-inspired and understanding-inspired research.

Reviewing this list of my favorite books over my career, I can see that their impact was related to the stage of my career when I read them. As much as these particular books have meant to me, I would not likely recommend this complete set to anyone else, as their relevance was dependent on where I was at the time I read them. A big part of why these books made my top ten list was that they provided me with some aspirational goals that affected my career path. Another common feature is that they are relatively short books, but they packed big ideas and communicated them effectively.

They were books that I would have liked to write myself. The clarity of thought expressed by the authors was an inspiration. A measure of their impact is that I have revisited them on occasion, something that I do not tend to do with books. These ten books have served as milestones on my career journey.



Bill's top ten quotes

"Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has." Margaret Mead (1901-1978)

This Margaret Mead quote is my favorite quote associated with building a team of competent people working on environmental issues. The quote is very empowering, as it reminds us that changing the world is not simply in the province of large organizations or powerful individuals. Often the motivation for environmental research is to indeed 'change the world,' but we are often afraid of over-reaching and will not verbalize our underlying desire. The Margaret Mead quote opens that door for anyone with aspirations to really make a difference. Margaret Mead was an interesting scientist and her personal history makes the source of this quote meaningful.

Margaret Mead

"It is amazing what you can accomplish if you do not care who gets the credit." Harry Truman (1884-1972)

Harry Truman

I did not know the origin of this quote until recently, as it was drilled into to me by my maternal grandmother, Avis Cullen (1898-1996). She was an amazing woman, serving as a newspaper editor in a small college town and very active in the community. She was often motivating volunteers, and she emphasized how much more challenging it was to motivate them versus employees. Being committed to a cause over personal advancement was something that is antithetical to the academic 'publish or perish' rubric, and I like that the quote can be attributed to an underrated Midwestern President, Harry Truman.

"I've never let my school interfere with my education." Mark Twain (1835-1910)

It would be hard to put together any list of quotes and not include one from Mark Twain, whose wit and insight are

timeless. The distinction between formal education and learning is made here, and I heartily endorse the distinction, even though most of my career has been in higher education. I feel as though my personal learning has benefited as much from the reading and experiences that have occurred outside my academic training as the formal education. This is one of my motivations behind my desire to transform academic training to experiential education. I also had an early experience of working alongside construction workers who were clearly intelligent but poorly educated, illustrating Twain's distinction.

Mark Twain

"Americans will always do the right thing, after they've exhausted all the alternatives." Winston Churchill (1874-1965)

This Winston Churchill quote has been very applicable to me while living in the British Commonwealth. Being American has some baggage, but also carries some cache, as the quote so accurately conveys. The quote also has a lot of particular relevance in Australia, since Australian culture has been straddling British roots and modern American influences.

Winston Churchill

I also enjoy telling this quote as a joke, with a pregnant pause in the middle providing dramatic effect. If the first part is said with authority, it can sound quite pompous, but the zinger pokes fun at my own expense. Another aspect of telling a good Churchill quote is that it conjures up so many other excellent Churchill quotes. It is worth noting that Churchill's mother was American, so he knew what he was talking about regarding Americans.

"Wisdom consists not so much in knowing what to do in the ultimate as knowing what to do next." Herbert Hoover (1874-1964)

The reason that I like this Herbert Hoover quote is the distinction between creating the broad vision, which is more easily shared among individuals, and making the difficult decisions about what is the immediate priority. The other aspect to this quote that I appreciate is the implicit assumption that the immediate next step is constrained by the time and resources available. What I read into the quote is that rather than waiting around for all the resources to be available before starting out, the quote is conveying the need to get started with what is available. Before Hoover became US President, he was a successful practical engineer who traveled widely, including a stint in Western Australia.

Herbert Hoover

David Starr Jordan

"Wisdom is knowing what to do next, virtue is doing it." David Starr Jordan (1851-1931)

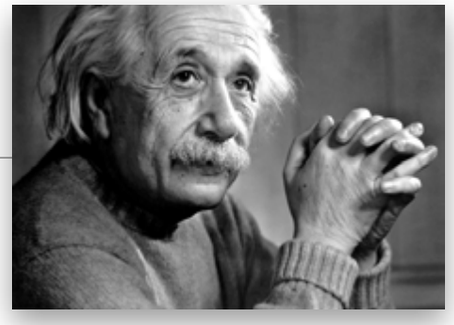
I like to follow the Hoover quote about wisdom with this David Starr Jordan quote. In this quote, the appeal is to differentiate between the intellectual understanding and the application of this knowledge. In many respects, the quote embodies the intent of the Scholarship Reconsidered tenets of scholarship: integration (wisdom) and application (doing). I also like that 'virtue' is the aspiration of this quote, and differentiates virtue from wisdom. It is not enough to be smart, but it is your actions that really count. It is interesting that this quote comes from a prominent academic scientist. Jordan was an ichthyologist and became President of Stanford University.

"There are no such things as applied sciences, only applications of science." Louis Pasteur (1822-1895)

Louis Pasteur

It was after becoming aware of Louis Pasteur's 'Quadrant' (Pasteur's Quadrant: Basic Science and Technological Innovation; D. Stokes, Brookings Institution Press, 1997) and becoming interested in Pasteur's life, that I came upon this quote. Pasteur embodied the best combination of conducting fundamental research (e.g. creating the field of microbiology) and also solving pressing problems (e.g. developing a rabies vaccine), which makes this quote from him resonate. I have fought making the distinction between basic and applied research throughout my career, and really appreciate the way Pasteur destroys the artificial separation.

"Make everything as simple as possible, but not simpler." Albert Einstein (1879-1955)

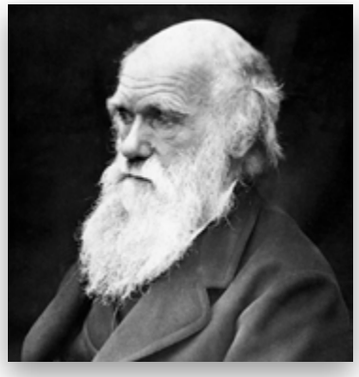


Albert Einstein

This quote addresses my belief that there is something particularly elegant about determining the essential elements of knowledge and effectively communicating these elements. The first part of this quote sets the goal of simplifying as much as possible, but I also like the idea that there is a fundamental limit to the degree that something can be simplified. This second part of the quote is attractive, since it is our mantra of science communication that we like to 'raise the bar,' rather than 'dumbing it down.'

I think that Einstein's famous equation, $e = mc^2$, is the ultimate simple, yet profound equation. There is a lot of math to derive and fully explain the concept of relativity, but the simplicity of the equation captures the essence of the concept.

"My love of natural science has been steady and ardent." Charles Darwin (1809-1882)



Charles Darwin

In his autobiography, Charles Darwin considers his tenacity and persistence in thinking about an issue as his strongest attribute. This tenacity is derived from his passion about natural science, as expressed in this quote. I share this steady and ardent love of both nature and science. I greatly admired George Beadle, the geneticist at The University of Chicago who would spend time with my graduate student colleagues and me. He continued to conduct experiments and write papers after he retired from the Presidency of the university and long after he received his Nobel Prize for Physiology. Beadle practiced science for as long as he was able to, and this is an expression of his steady and ardent love of natural science, which was not extinguished from his bout with administrative duties.

"Life is what happens when you are busy making other plans." John Lennon (1940-1980)

This line from a John Lennon song "Beautiful Boy (Darling Boy)" makes a nice quote, as it affirms the vicissitudes of life's journey and the unforeseen circumstances that affect the journey. To me, this quote, coming from a Liverpool boy who rose to unprecedented fame, does not mean that only bad things happen, rather unexpected good things can also happen. I also like the reminder that planning can only go so far, particularly 'strategic planning,' something I believe is overrated (see Rework, by Jason Fried for a strong case against strategic planning). Beyond strategic planning, this quote calls for an openness to change and realization that our life journey is something that.

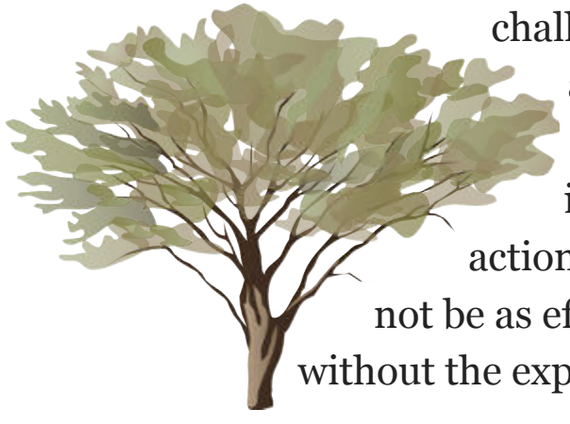
John Lennon

These favorite quotes are ones that I actually remember and carry around with me at all times. This is particularly relevant since I do not have a good memory for words and travel 'light' regarding quotes or facts. But I have had multiple occasions to call upon this short library of quotes, as I often find opportunities to share them. A reason that these quotes made my top ten list is that they touched something quite meaningful to me - and not once, but on several occasions. I used to enjoy reading the book Bartlett's Familiar Quotations, but now there are many websites that list thousands of quotes, so it is easier to find a few quotes that are meaningful to each person. I think that it is a useful exercise to find those quotes from predecessors that have particularly meaning to each individual.

Top ten principles for environmental actions

1) Start now

Don't wait for the 'perfect time.' Do something and learn by doing. There is no perfect time to start. Like the answer to the question "When is the best time to plant a tree?", which is "Ten years ago", the important thing is to begin environmental actions sooner, rather than later. There are several reasons for this strategy. A compelling reason is that environmental degradation is very difficult to reverse - prevention is much more cost effective than restoration. Waiting to initiate actions can result in more difficult challenges with more restoration and less protection needed. Another reason for early initiation of environmental actions is that initial actions may not be as effectively targeted or managed without the experience of testing the approaches and training the people involved. Starting out with small scale, pilot projects allows for a ramping up of activities.



2) Build and maintain momentum

Often little attention is paid to the importance of momentum in environmental campaigns, yet building and maintaining momentum is crucial for effective campaigns. It is very difficult to make sustained progress when the activities include extended gaps or time lags. The need to create a cadre of trained people with institutional memory can only occur with program continuity. When there are fits and starts, the other thing that is lost is public support and involvement. People get frustrated when websites are not current, phone calls or emails are not answered and will divert their energies to other causes. One of the key transitions is between the 'builders' or 'creators' who effectively build momentum and the subsequent 'consolidators' or 'stewards' who maintain momentum. The energetic 'builders' devote a large amount of effort to get things started, but are often not good at maintaining programs, which require more nuanced and consistent efforts.

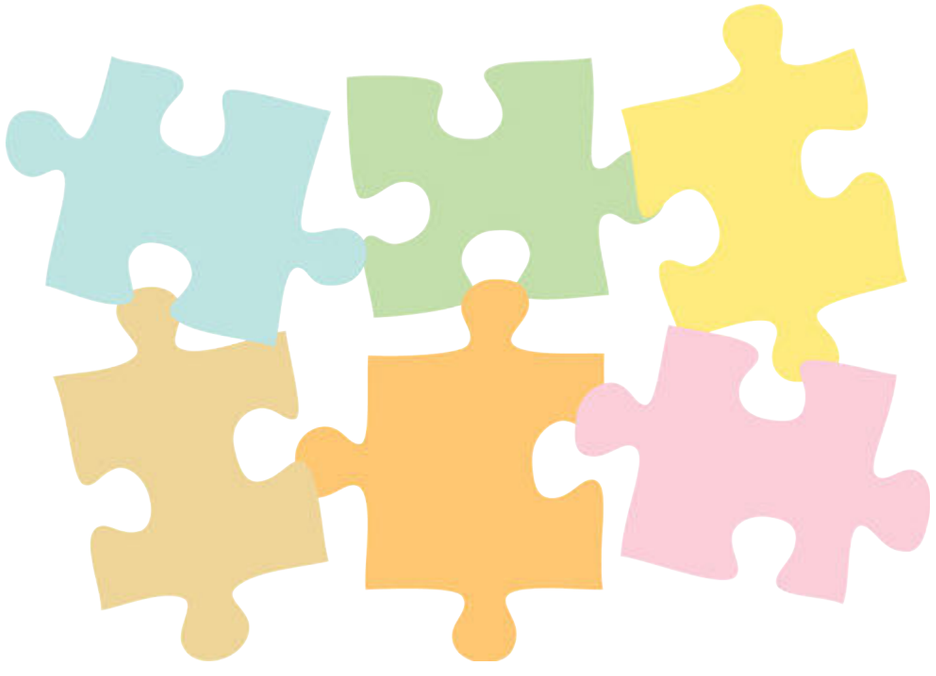
3) Focus efforts

Developing a focus, particularly early in the program, helps to establish program credibility. It is the ability to do something well, and satisfaction of getting things accomplished, that provides positive feedback for both the individuals and the program as a whole. A lack of focus can also lead to piecemeal

efforts that do not provide any demonstrable results, leading to funding fatigue and lack of personal satisfaction. Focused effort is particularly important when large interventions are contemplated, as the raised expectations lead to heightened scrutiny and interest. Without a focused effort, the expectations could exceed any possibility of achieving them.

4) Learn by tackling progressively more difficult challenges

Using a staged or incremental approach provides time for reflection and refocusing. Becoming complacent and being afraid to innovate can lead to a program becoming static. Using an adaptive management approach, learning by doing, is necessary in order that environmental management is effective. Deep learning is the education achieved by attempting to do something and evaluating the results objectively.



5) Experiment and unleash creativity to every component of the effort

Avoid mindless repetition and look for better ways to achieve desired environmental results. There is some risk in experimenting, so several things are needed to enable experimentation. First, an environment in which failed experiments are not treated as personal failures, but rather as learning opportunities is needed. Second, scaling initial efforts so that experimentation can be tested without undue repercussions. Third, the creative efforts of team members need to be acknowledged and rewarded to incentivize further experimentation. Creative approaches can be employed in science, in management interventions, in reporting, in communication, in financing, in every aspect of the program.

6) Empower others by providing adequate training and learning

Empowering others can be used to share the load. Giving people successively more difficult tasks with enough guidance, support, and training can create a team of competent and capable people with confidence to tackle bigger problems. Scientists need to be able to share data collection, analysis, and reporting with citizen scientists, for example. Resource managers need to be able to share the governance with stakeholders. The motivation that comes from having people empowered with responsibility and knowledge can serve to keep the program active and vibrant.

7) Celebrate victories, even small ones

The overall goals of environmental management programs are often ambitious and extremely difficult to reach in a short amount of time. Environmental management programs are often initiated long after the degradation began. There really should not be an expectation that something that took decades or centuries to develop can be cured overnight. Thus, the important thing to do is to celebrate the milestones along the way. Converting the overall goals into smaller increments that can be tracked and celebrated when they are achieved helps maintain momentum. The other aspect of developing incremental goals is relevant to political timescales. Elected officials have relatively short timelines on their appointments, and setting lofty, long term goals allows them to remain unaccountable for their actions. Smaller increment goals that can be tracked and reported provide a mechanism for real time accountability of elected officials.

8) Strive for more and better results

Don't be satisfied with accomplishments, always strive to improve and once a goal is achieved, it is time to set new goals. The continued striving serves to attract the best and the brightest people. Since many environmental problems are very insidious, with population pressures, climate change, and new contaminants providing additional challenges, complacency will not suffice. Striving to improve every aspect of an environmental program can keep everyone on their toes.

9) Awaken passions, the environmental passion of caring about a place enough to attempt to improve its status

The collective passion of many people can provide the motivation and means to achieving environmental improvements. We feel that awakening passions is so important that it is the topic of another chapter of this book.

10) Enjoy the journey

Have fun. Be silly, laugh.

Remembering Peter Oliver

A heart is not judged by how much you love, but by how much you are loved by others.

L. FRANK BAUM 1856-1919

SECTION 1

Dugong Rock: Using iconic creatures in conservation

The appeal of iconic creatures has long been used to generate support in the conservation movement. Whales and dolphins in the sea and pandas, gorillas and other apes on land have been and still are conservation icons. WWF still uses the panda in their logo, for example. Icons like birds, particularly raptors, are fairly global. Other icons are rather regional, like Komodo dragons in Indonesia or lemurs in Madagascar. Icons like penguins and polar bears in antarctic and arctic regions, respectively, may not be viewed in situ by many people, yet they remain globally significant. A conservation icon in northern Australia is the dugong, a marine mammal that feeds on seagrass.

Several years ago, Peter wrote a song called "Dugong Rock." One of the reasons that Peter chose a dugong for his song, as a conservation icon is that dugong feed almost exclusively on seagrasses. Seagrasses are the 'coastal canaries', in that they are particularly susceptible to light reductions due to turbidity.

In Queensland, flooding in 2011 led to light reductions and subsequent seagrass loss. Since human activities on the watershed influence the amount of sediments and nutrients that are in floodwaters, the message is that to properly look after dugongs, we need good watershed management. Resource managers were anxiously watching for dugong migration as they searched for food; as well as potential mortality as the dugongs succumbed to starvation.

Recently, some conservation groups have asked for help in publicizing the water quality issues they are facing and Peter's response was to launch a video competition for groups to produce and post 3 minute videos using his song "Dugong Rock."

Peter even initiated a mini-flash mob with his own organization, the International WaterCentre. On a sunny lunch break in downtown Brisbane, the IWC staff, joined by the International RiverFoundation staff, went out onto Cathedral Square and danced to "Dugong Rock." They entrained a random street person, startled the business crowd on their way to lunch and clearly had a good time.

Several other groups responded to the “Dugong Rock” challenge and have posted their version of “Dugong Rock” on YouTube. The Healthy Waterways group performed with “Hugo the Turtle” and “Doug the Dugong” on the Kirpala Bridge. A school group of fifth grade students performed on stage of their school.

I joined the IWC students enrolled in the Masters in Integrated Water Managementcourse in their rendition of “Dugong Rock”, performed along the Brisbane River in the Botanic Gardens. They took turns playing the part of “Doug the Dugong,” inside a large, heavy foam dugong costume. The funniest thing was when a small Chinese student tripped over her dugong flippers and softly fell to the ground but was laughing too hard to escape from the costume.

While having dancing dugongs in downtown Brisbane may not do much to change the world, it sends the right message about conservation of these iconic creatures and the habitats they depend on (seagrasses). It is also good fun, and it is hard to take yourself too seriously when cavorting in public with “Doug the Dugong.”

Bill Dennison and ‘Doug the Dugong’

My hope is that the fifth grade school children will remember their wonderful performance and sometime later in life will make the right decisions that insure that the dugongs will have a place in the world. When I reflect on all of the things I will have done during my sabbatical in Australia, dancing to “Dugong Rock” will be high on my list of favorite things.

Peter's retirement lecture

Bill Dennison introducing Peter Oliver for his retirement lecture.

Peter gave his "Retirement Lecture" at the Brisbane Convention and Exhibition Centre in Queensland, Australia on 23 August 2012. I provided the introduction to Peter's lecture and the text of that introduction is what comprises this section. Peter provided a thought provoking, funny and well delivered talk, with audience participation and interaction. He also sang songs, culminating in 'Dugong Rock.' My speech to Peter was as follows:

Thanks to Paul and thank you to Mark Pascoe and his merry band at the International WaterCentre for hosting this wonderful event. We are here today because of a very special person, Peter Edward Oliver, and I feel that it is my duty to thoroughly embarrass Peter in full view of his family, friends and colleagues.

There are ten words that come to mind when I think of Peter's life and his impact on me and others. Three of these words are fairly obvious: Teacher, Singer and for the past two and a half years, Cancer.

1. 'Teacher' refers to what Peter has been most of his life, either as a science and maths teacher at Maleny State High School, a natural resources officer in the Queensland government or Senior Lecturer in the Master of Integrated Water Management program at the International WaterCentre. Peter developed a variety of novel approaches to teaching, from having students build sand castles on Stradbroke Island, to singing about digestion or line dancing as amino acids. Students remember Peter's lectures and field trips and he produces lasting learning experiences.

2. 'Singer' refers to Peter's integration of song with many facets of his life, including environmental issues. He will show

up on field trips or workshops with his guitar, but will also sing a capella at the drop of a hat. I remember the first time I went on a field trip with Peter, when he regaled our dive team during a surface break with several songs, relevant to our discussion of catchments, runoff and water issues. Peter uses songs to connect people in powerful ways and a session with Peter is not complete without a song creeping in.

Peter Oliver performing as part of his retirement lecture.

3. 'Cancer' refers to an insidious disease that has resulted in Peter enduring numerous chemotherapy and radiation sessions, surgical procedures and medical tests. But Peter has NOT let cancer define him simply as a victim. It is in the face of cancer, where Peter has defined himself as a man of great courage, unflagging spirit and incredible strength. Peter has comforted US when we have gone to comfort HIM. Peter has also publicly advocated for better lung cancer awareness, treatment and research.

There are seven other words that are less obvious, but particularly important in the life of Peter Edward Oliver. These seven words are family, pirate, Lyngbya, dugong, connections, philosophy and love.

4. The word 'family' is very important to Peter. Peter was born into a teacher's family in 1957. Peter's parents, Colette Oliver and the late Ted Oliver raised their family of five children in various locations throughout Australia. Peter's mother Colette, brother Tim and sister Sandra, and nieces and nephews are here today. Peter's eyes sparkle when he talks about his wife and children. I have never had a extended discussion with Peter in which he did not mention in glowing terms his lovely wife Ann. He and Ann have raised three very special children - Jayne, Katie and Michael in their Maleny house where Peter's parents had lived.

5. The word 'pirate' is particularly relevant for Peter, as he has an alter ego, Pirate Pete, aka Greybeard. As a Catchment Coordinator, Peter dressed up as Pirate Pete, growled "Argghhh" quite convincingly and engaged shoppers in discussions about catchment issues at shopping centres. More recently, at Relay for Life events at the Maleny Showgrounds, which raises funds and awareness for cancer survivors, Peter's

family and friends dress up as a gang of pirates known as the Jolly Ollie's and they terrorize the other less fierce groups.

Pirate Pete, aka Greybeard, with a crew member.

6. The word 'Lyngbya' is a scientific name for a noxious slime that grows in Moreton Bay and first brought me in contact with Peter fifteen years ago. Peter was developing a working relationship with fishermen of the Deception Bay region when they asked him to do something about the slime that was inducing severe skin rashes. Peter came to the University of Queensland and wandered around campus clutching a plastic bag of slime until he found someone who could identify it. It turned out that my wife Judy O'Neil had just done her dissertation on Cyanobacteria or blue-green algae and she was able to identify the slime as Lyngbya, a cyanobacterium. We proceeded to develop an active Lyngbya research and management program which continues to the present, and includes some of the same fisherman like Greg Savige who first identified the problem.

7. The word 'dugong' refers to large marine mammals, the original sailor's mermaids, or sea sirens, that help make Moreton Bay so special. If you stand on one of the Glasshouse Mountains and look to the East and use your imagination, you can see Bribie Island as a large dugong feeding on the Deception Bay seagrasses. Peter has written a song called 'Dugong Rock' which has inspired singing, dancing and some considerable cavorting about. He recently sang a verse of Dugong Rock in his acceptance speech when he won the Healthy Waterways Champion Award. A large stuffed dugong, known as Dewey, has been spotted at various locations around Queensland catchments, inspired by Peter. Peter even has a fighting dugong tattooed on his arm to signify his battle against cancer. The title of the book that Peter and I are collaborating on is 'Dancing with Dugongs.' Incidentally, writing this book with Peter is one of the best decisions I have ever made in my life. Dugongs are clearly a theme in Peter's life and I often wonder if Peter sees a personal resemblance in those rotund, whiskered beasts.

8. The word 'connections' refers to Peter's ability to connect people to each other, connect people to the land and water and connect people to a deeper understanding of life. When Peter walks into a room, it is not to say "Here I am," rather it

is “There you are.” Peter loves making unlikely connections: fishermen and Ministers of the Environment, marine biologists and land managers, or catchment coordinators dressed as pirates and motorbikers. Peter leads interesting and informative field trips which serve to connect students to the land and water. Peter also catalyzes a deeper understanding of life through sharing his experiences and encouraging self guided learning. In spite of illness or distance, Peter remained connected to his IWC colleagues and even US colleagues through Skype, and connected to his family and friends through houseboat trips, wood fired pizza parties and visits to Maleny.

Peter Oliver via Skype.

9.The word ‘philosophy’ refers to Peter’s approach to life and death, and his intellectual journey of learning. Peter received his Bachelor of Science degree from Griffith University in 1978. He received his diploma of Education from the University of Queensland in 1981 and his Masters of Education from Deakin University in 1995. Peter’s dissertation was entitled “Developing effective partnerships in natural resource management” and he received his Doctor of Philosophy from Griffith University in 2004. Note that Peter’s highest degree is Doctor of Philosophy. Peter is indeed a philosopher who reads widely, thinks deeply and writes eloquently.

10. The word ‘love’ refers to what has brought us together today. There is a great line from “The Wizard of Oz” where the Wizard says to the Tin Man the following: “A heart is not judged by how much YOU love, but by how much you ARE loved, . . . by others.” I would like to modify the last word of this quote and invite Peter Edward Oliver to the podium to present his retirement lecture. Peter, as you gaze out on all of us here, please think of these words, “A heart is not judged by how much YOU love, but by how much you ARE loved, . . . by us.”

The many faces of Peter Oliver

Philosopher

Peter's retirement sermon: Greek philosophers, jelly babies, wicked problems, and dugongs

Peter gave his final lecture entitled "Effectively communicating wicked problems - emotion, ethics, action and those funny little things called facts" at the Brisbane Convention and Exhibition Centre.

Peter Oliver delivering his retirement lecture.

The lecture was originally scheduled to be held at the University of Queensland, but the interest was too high and Peter's desire was to have people seated at tables to facilitate a workshop that was embedded into the lecture, so the venue was moved to accommodate the crowd of about one hundred and fifty participants, including colleagues from academia and the International WaterCentre. A bus load of people came from Maleny that included Peter's friends and family. Through the audience and photographs, we saw the many faces of Peter Oliver, including school teacher, outdoor educator, singer/songwriter, traveler, philosopher, and family man.

The lecture discussed concepts introduced by Greek philosophers. Various Greek words were used to explain the evolution of science. The terms Sofia (wisdom) and Nous (that which is known but cannot be explained) were used to describe historical scientific knowledge. The terms Techne (applying knowledge) and Episteme (systems of knowledge) were used to describe modern science. And the terms Phronesis (intersection of values and knowledge) and Praxis (practical, thoughtful doing) were used to describe the scientific approaches needed to develop sustainable solutions. Peter's favorite quote by the Greek philosopher Socrates is "Know thyself," which he said underpins everything he does.

Peter showed a conceptual landscape model that included interesting landscape features like a 'Knowledge Swamp,' an 'Energy Everglades,' and a 'Governance Grove (of Trees)'. The river that flowed into a 'Better Bay' had tributaries of actions, things, stuff and people.

The topic of 'Wicked Problems' was introduced, and these messy, sometimes evil problems are value driven. Peter thought that Aristotle would probably say that wicked problems are phronetic and that solving them involves praxis. He classified wicked problems as being those that are important but don't threaten human life and those that can impact directly on loss of human life. He described water issues in Libya, where humans have been living in a desert at the edge of the sea since Roman times and finding it difficult to manage water sustainably. Peter identified the importance of developing solutions that integrated facets of the head, heart and hands. He also described the importance of walking in the shoes of the 'other.'

Peter challenged the audience to ask the questions:

1. *Is all human life of equal value?*

2. *Can we practice the Golden Rule, Do unto others as you would have them do unto you?*

He passed out small jelly candies shaped in a human form called 'Jelly Babies.' He asked everyone in the audience to place the candy in their mouth and think of a loved one, and he asked them to consider each unit of life as a unit of love.

Peter Oliver giving his retirement lecture.

Then he proceeded to provide some statistics on lung cancer, the most lethal cancer in Australia. Lung cancer continues to kill more people every year than breast, prostrate and ovarian cancer combined, yet receives very little funding for research on early detection, treatment or care. The mismatch between the mortality rates of different cancers and the funding levels is particularly acute for lung cancer. Peter asked the audience

to keep in mind that the numbers (7,500 fatalities due to lung cancer each year in Australia, with 10-15% of victims being non-smokers) were actual people (= units of love). He pointed out that out of the $6 billion generated annually from tobacco taxes, $61 million went to advertising the dangers of smoking but only $1-6 million went to lung cancer research.

These funding discrepancies involving statistics reflected on the value of a human life, as each number represents a real person who is loved. To ensure that the numbers did not obscure emotions, Peter presented photographs of friends and their families who had succumbed to lung cancer. He then conducted a participatory workshop in which the audience was tasked with coming up with recommendations and potential solutions. The audience generated ideas that can be categorized as educate, advocate and legislate. Research funding allocations, better linked to mortality rates, could be used to investigate early detection, treatment and causes beyond smoking. The targeted audiences included medical practitioners, legislators and the public, and it was suggested that lung cancer be given a human face, beyond that of smokers.

Peter performed “From the Range to the Sea” and then led a rousing sing-a-long of “Dugong Rock” to close out the lecture (with a lasting standing ovation).

In many ways, Peter Oliver’s lecture was a spiritual experience not unlike a church service. At the start, Peter asked people to stand, participate in an icebreaker sing-a-long (= processional hymn) and introduce themselves to someone they didn’t know (= peace offering). He presented a thought-provoking set of questions (= sermon), asked people to consider jelly baby candies as unit of life/units of love (= communion) and ended with a sing-a-long (= recessional hymn). The lecture was followed by tea and coffee (= reception) and like a good church service, the congregation was moved by the experience and provided with powerful ideas that both challenged and reinforced their belief systems.

Mark Pascoe (standing center) and his International WaterCentre staff being entertained by Peter’s song.

Peter Oliver reflections

The sad news that Peter passed away on 20 November 2012 arrived during our week of Thanksgiving. There was some solace in learning that after many months of medical insults (e.g., chemotherapy, radiation therapy, etc.), Peter's last moments were not painful. We also can give thanks for having had the wonderful opportunity of working with Peter over the past 15 years. He was a powerful force of nature, a man so full of life that it is difficult to imagine a world without him in it.

Peter was many things to many people, and accumulated more descriptors than anyone I know, including teacher, social scientist, scholar, researcher, activist, pioneer, visionary, mentor, friend, singer/songwriter, philosopher, catchment manager, and pirate. Each of these descriptors has real meaning, and just by reading this long list of different facets, you begin to realize that Peter was a multi-faceted gem of a person. The light that shone through Peter's exuberant multi-faceted personality served to enlighten those of us lucky enough to know this special man.

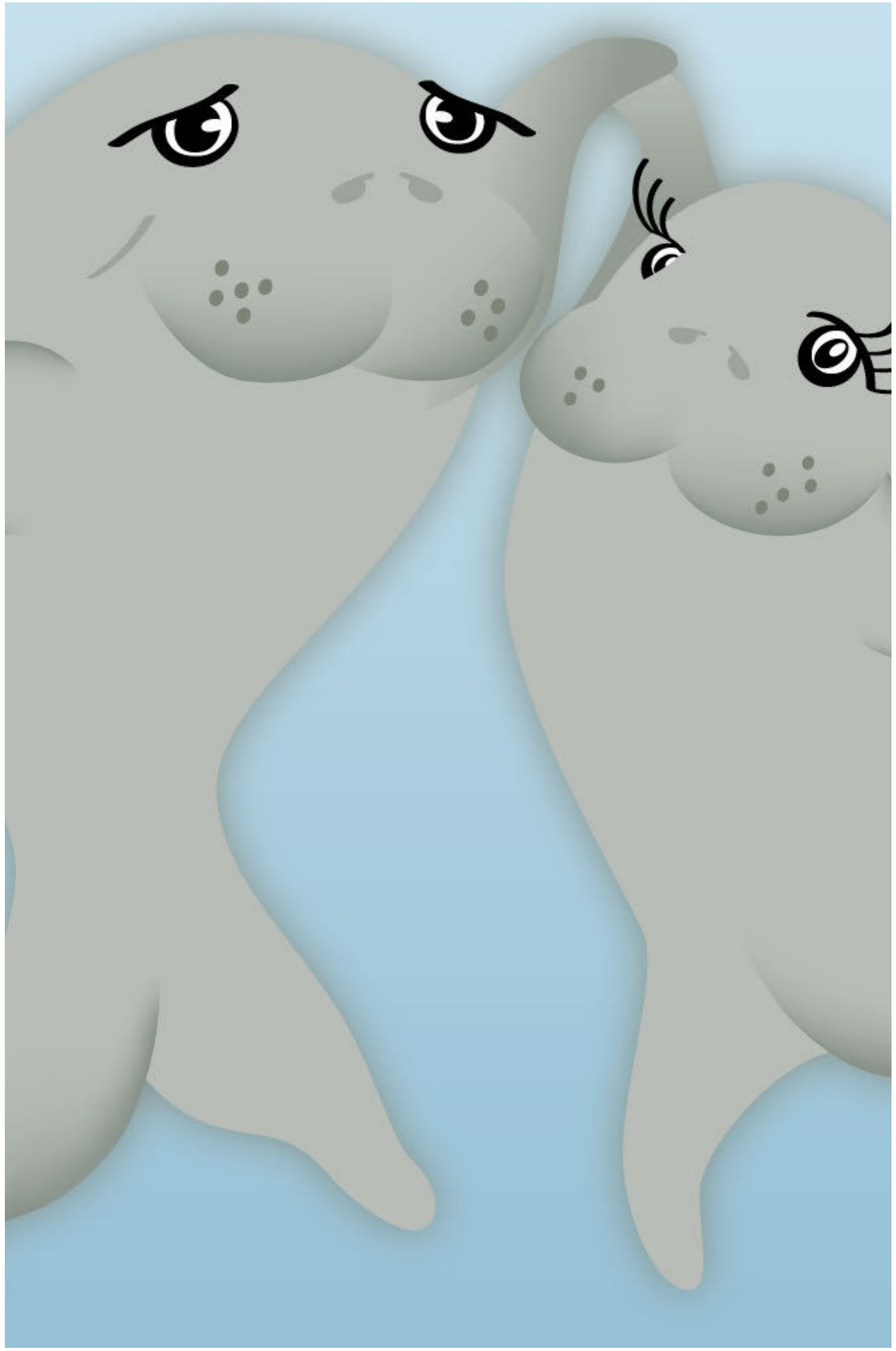
Peter Oliver

CHAPTER 13

Invitation to dance with dugongs

Put your left hand high up in the air
Shake that seagrass from your hair
Put your right hand down and feel the sand
Move your tail to the dugong band
Roll to the left, roll to the right
We're really gonna boogie tonight
We're really gonna do-the dugong rock!

PETER OLIVER 1957-2012



Dancing with dugongs

What we have found from working on messy problems in the phronesis area where values intersect with knowledge is that people often have the technology (techne) or epistemology (episteme) necessary, but there are blockages or impediments to employing them. In some cases, there is the knowledge of the issue, but the affordable technology is not available. In other cases, the people who need to be involved do not believe, feel or care about the issue in the same way that you do.

There are more important things in their lives than your environmental issue. Until you make the things that you believe, you feel about and you care about important enough to other people, you will not be able to effect change. Another important aspect is fairness and equity. If people think that more is being asked of them than others, they are reluctant to participate. Until you walk around in the shoes of others, you won't know what people think is fair; you won't know what they believe, feel and care about; and you won't know if they have the necessary knowledge to make good decisions. In the end, you may realize that it is unreal, unreasonable, and unethical for you to be working on a project without, at the very least, a partner who is affected by the results.

Table 6. Hands, head and heart summary

	Expressing	Experiencing	Excelling
HANDS	Tackle important problems	Experience nature	Be creative
HEAD	Aspire to inspire	Keep learning	Stop & reflect
HEART	Awaken passions	Have fun	Enjoy the journey

Hands: Tackle important problems. This recommendation is to choose your battles, and pick an issue that is important. First and foremost, it should be important to you. It should also be an environmental issue that has ramifications in your region. This issue that is important to you may not be recognized as important by others, but that can be your role - to elevate the issue in the minds of others. By working on messy problems that you care about, you are giving yourself a challenge that will provide goals and rewards for achieving those goals.

Hikers in Waterton Park, Alberta.

Hands: Experience nature. This recommendation comes from our mutual opportunities to experience nature in various outdoor activities (paddling, diving, hiking, etc.) which served to give us a deep knowledge of a region, and this working knowledge augments any additional information that is obtained. Having a personal frame of reference allows additional information to be better assimilated. The other aspect of experiencing nature on a personal level is that it provides personal inspiration to protecting and preserving these regions. It is also a good strategy to find other people to experience nature with you, because the more people who develop a deep knowledge and a passion for a region, the more chance of leveraging positive environmental outcomes.

Hands: Be creative. There is no magic formula for achieving positive environmental outcomes. No matter what the administrative structure or composition of environmental leadership, there is no 'right way' to proceed. There will be a unique suite of challenges, and a variety of different personalities to contend with, and creative solutions will be necessary. If your original approach does not work, it is important to search for alternative approaches and keep trying to find a way to achieve the vision that you have developed.

Head: Aspire to inspire. It takes many hands to achieve meaningful results, thus it is important to inspire others to share your vision and commit themselves to the journey with you. A motivated person will add their energy, creativity, and passion to the program if they are truly inspired. Creating this motivation is something that takes a concerted effort. Meaningful nature experiences can be inspirational. Excellent presentations by passionate and knowledgeable people can be motivational as well. The goal is to get informed people to become engaged in an environmental program, so providing them with knowledge is not enough - they need inspiration as well.

Head: Keep learning. This advice is relevant on two levels - individual learning as well as community learning. The need to keep learning serves to enrich our understanding of nature, which can enhance the environmental program through better targeting of management actions and better monitoring of those actions. Increased individual learning keeps the

program interesting and vibrant, reinforcing involvement and sustaining interest. Increased community learning keeps the program from going stale and energizes newcomers.

Bill teaching a science communication course.

Head: Stop & reflect. There is often a tendency for programs to exclusively look forward, and rarely stop and reflect on where you have been to better understand where you are going. Stopping and reflecting often seems like a luxury that cannot be afforded, particularly in tight fiscal conditions. The need to carve out quality time to occasionally reflect is crucial in order to sharpen your focus, challenge your assumptions, evaluate your progress, and renew your enthusiasm. While it may seem that there is never time available to stop and reflect, the danger of not stopping and reflecting is to end up drifting along without focus and dwindling enthusiasm.

Heart: Awaken passions. Environmental passion, the deep caring developed about nature, is often dormant in people. Even if this passion is latent and has not been actively expressed, it is inherent as 'Biophilia,' the love of nature in all humans. This environmental passion needs to be awakened to fully engage people in an environmental program. This awakening can be accomplished through field trips, lectures, or other activities that kindle an interest in the environment.

Heart: Have fun. Environmental issues are typically serious business. They involve tough issues that require behavior changes and rarely receive the necessary funding levels. These challenges often promote a serious nature to efforts, but we assert that having fun is equally important. People are attracted to programs that are fun, and designing activities that are fun can help recruit and retain people in environmental programs. And most importantly, life is too short to not have fun doing the things you love.

Heart: Enjoy the journey. Environmental programs do not have a natural ending - no matter what has been accomplished, there will be more to do. An environmental campaign differs from a political or military campaign in which definable victories can be assigned in that there is rarely a definable victory in an environmental campaign. This makes it all that more important to enjoy the journey and celebrate the small successes along the way. Developing

interim milestones and goals can help sustain enthusiasm and provide focus.

Peter enjoying a field trip.

The journeys really converge when we know ourselves well, we know what we are immersed in, we know how our research is being communicated, and we know what is being done in response to our research.

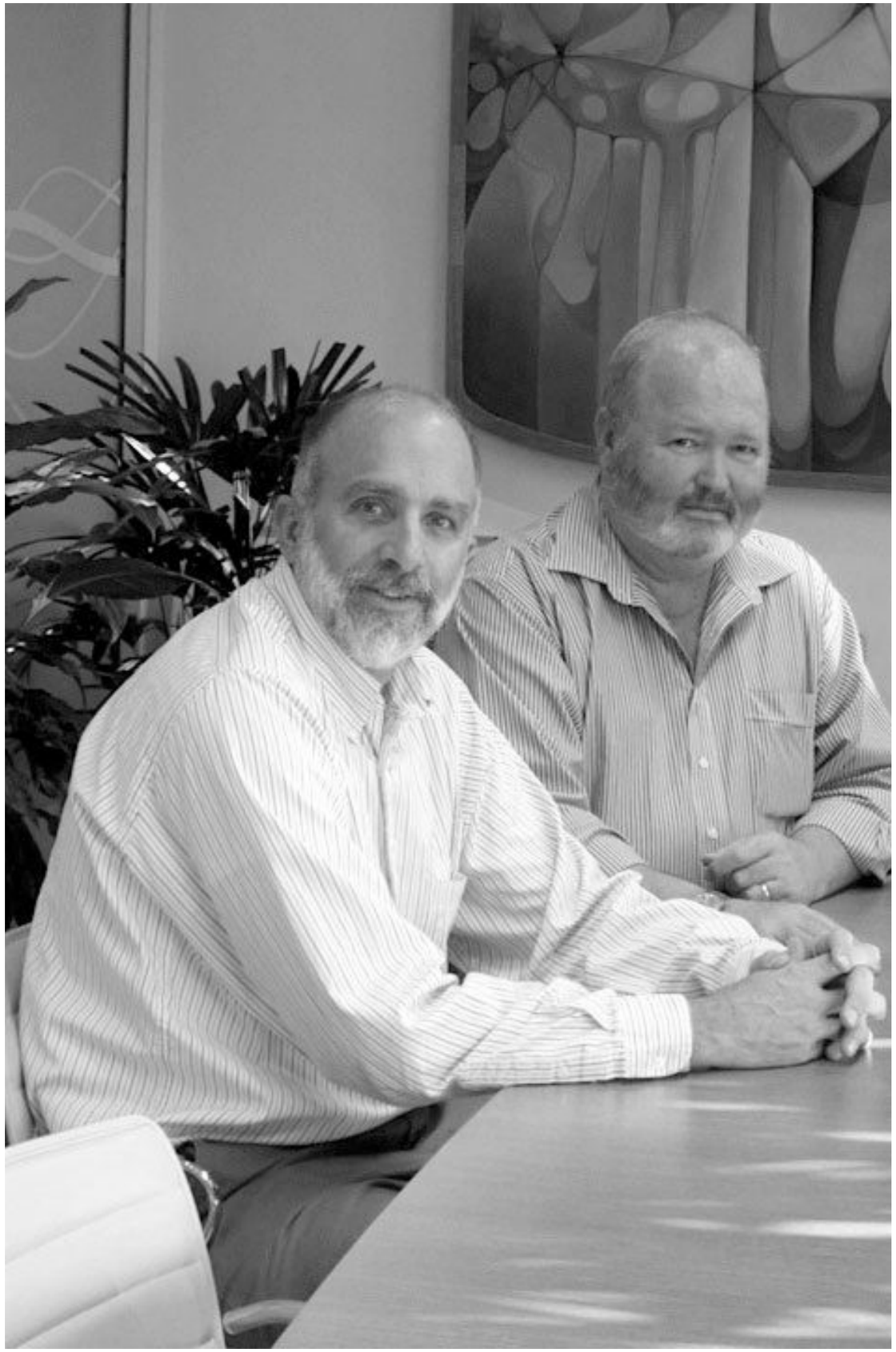
Finally, do you want to play? By play, we mean to find your own patch, to develop a place you feel at home, with values and issues that are important to you, so that you can create knowledge, and apply that knowledge in a big phronetic pond where you can take a refreshing swim by developing praxis. Through knowing yourself, equipping yourself and others with knowledge, be willing to take risks, have fun, awaken passion, then you are ready to dance with dugongs.

CHAPTER 14

Acknowledgements

If I have seen further it is by standing on the shoulders of giants

ISAAC NEWTON 1643-1727



Peter Oliver

Peter Oliver

I would like to acknowledge the support of my parents who gave me life and nurtured me. My Mum and Dad were my first teachers. Our three big sisters and my younger brother and I went to small schools where Mum and Dad were the head teacher and assistant teachers, as well as being our Mum and Dad. The schools we went to and the communities we lived in were so small, they taught us on both sides of the school gate, so to speak. Sadly, my father's first wife and mother to my three elders sisters died four years before I was born. My father re-married. My younger brother, Tim, and I arrived with three big sisters already there to love and spoil us. Our father was a dairy farmer's son. On various occasions moving around the Queensland countryside, I remember him commenting on the way various farmers were looking after, or, as the case may be, not looking after their waterways, that I had some of my earliest lessons on integrated catchment management.

After marriage, for nearly 28 years I have shared life with my beautiful wife Ann and our children Jayne, Katie, and Michael. From a water point of view they have learned of life's ups and downs, as I have from them, as I have been buoyed along by its current. We have learned more about our connections with waterways and metaphorically 'danced with dugongs' at home, at work and on holidays, in various parts of our small, water-dependent mother planet, Earth. Drinking, swimming, washing, sailing, camping, canoeing, drawing, painting, dancing, measuring, singing, watching, listening, advocating, protecting, loving, having fun - we've done many

things as a family together and with friends on our streams and waterways. My love for Ann, my family and and planet continue to grow.

Peter's family

Peter and his parents

In terms of my academic growth over the last 30 years, I would like to acknowledge the following supervisors, including Dr. Annette Grenall-Gough, Emeritus Professor Roy Rickson, Professor John Fien and Dr. Roger Shaw. In terms of praxis - practical, thoughtful, doing - I have gained much from working with Mr. Jim Pulsford and Mr. Peter Armstrong. In terms of ethics, I found insight from working with Mr. Greg Savige, who has taught me it's hard to do the wrong thing and the right thing at the same time. In terms of persistence I learned much from working with Mr. Rob King. I have also had the privilege of working under some excellent leaders - Mr. Jim Dale, Mr. Paul McDonald, Mr. Steve Kelly, and Mr. Graham Smith.

Mr. Mark Pascoe, you are a 'master manager', a leader, without peer. You have lead the International WaterCentre to become a truly international organization that cares for both the individual and the group in a way that is unique. Everyone I know learns from you Mark. Thank you for sharing your phronesis.

I met the late Professor Bill Stapp, from University of Michigan, and his wife Gloria in 1988. We were introduced by the late Edwin Butt and his wife, the late Hermione. A whole new world of environmental education opened up for me. Dr Annette Greenall-Gough, from Deakin University, supervised my masters thesis. It focused on the world of community-based water quality monitoring on the Mary River and introduced me to people from federal, state and local governments and a range of landcare groups down the 310 kilometer length of the Mary River in southeast Queensland. Bill and Edwin introduced me to school and community-based water quality monitoring. I, in turn, introduced it to the Maleny community, Barung Landcare, our local group. From there it meandered throughout Queensland with Bill Stapp helping government and landcare to spread the idea of integrated catchment management.

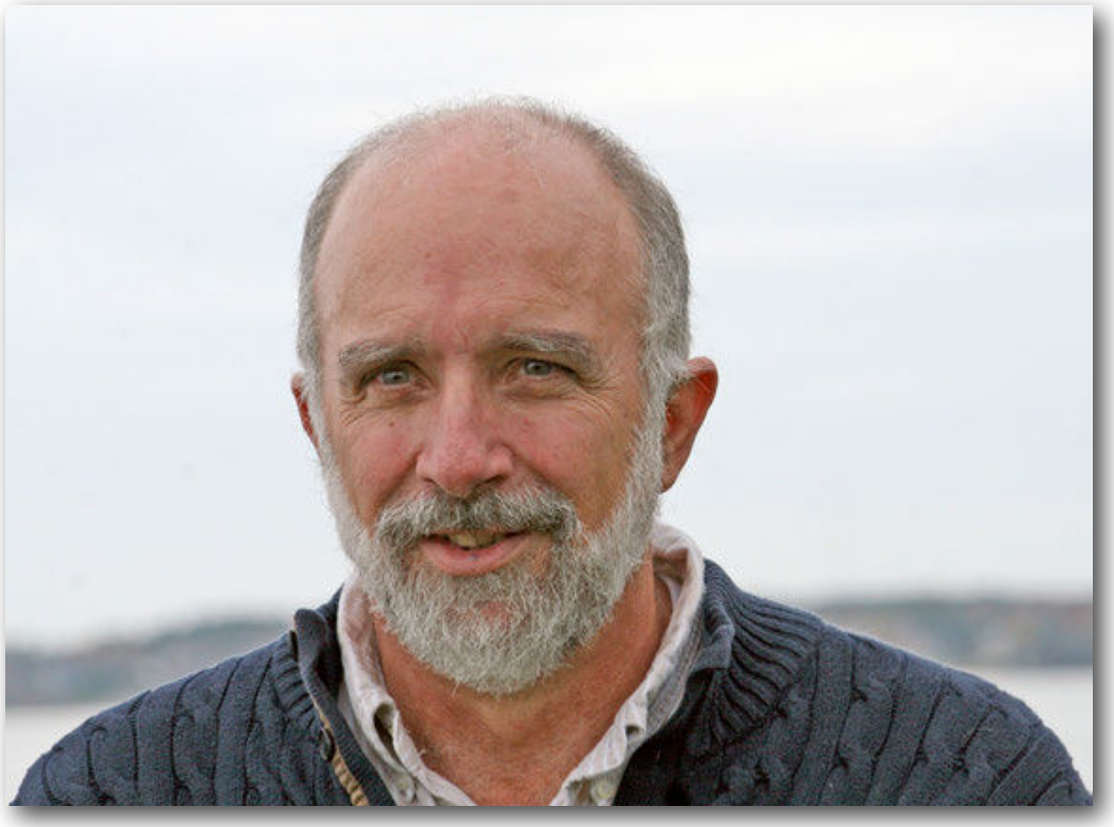
Peter and Mark Pascoe

I thought this was all about building partnerships between participants, where differently empowered groups and individuals worked together to share risk, power and reward to solve shared, important problems that neither could solve individually. So did many of the participants I worked with. However, sometimes I observed the term 'partnership' was used mainly as greenwash by government and seemed to mean, "I am from government and we are going to work in partnership. This is what you will do." I learned from government that we generally seemed to have real problems sharing power in partnerships. However, I observed that industry and community people involved in integrated catchment management trying to work together in similar settings were not so encumbered. I thank them for this lesson and will comment more on it later!

Alex Bond and Bev Hand continue to teach me about Indigenous perspectives about land, people, and waterways. To watch, listen, and learn as they do unselfishly, but carefully share cherished knowledge of waterways and coastal areas with IWC Master of Integrated Water Management students, visiting fellows, staff and others, and me - really is a beautiful thing. Thank you to you both.

Finally, I would also like to acknowledge one of Nature's true gentlemen, Professor William C. Dennison, my co-author and friend. Bill has supported Ann and I during one of the most difficult periods of our lives. No one expects something like a cancer diagnosis to reach out and cut your life short. Somehow, working with Bill, writing this book together, and sharing time with him, during such a difficult time, has both taught me more about life and the true meaning of words like compassion and empathy than I thought possible. Thank you Bill for teaching me this great lesson. Thank you also Bill for making me think more deeply about the notion of "reflective practice" - along the lines of Donald Schon. I think our joint efforts are of value and modestly yet heartily commend them to the reader.

Bill Dennison



Bill Dennison

I come from a family of teachers who have been teaching me my entire life. My parents, John and Rhoda Dennison, taught me about loving life, every minute of every day. Both sets of my grandparents lived in Oxford, Ohio and they taught me about small town values combined with global thinking. My aunts and uncles were great mentors in art, science and nature. My brother, sister and cousins taught me about diversity in life choices and served as strong advocates at all times.

For the past nearly 30 years, I have shared my joys and my sorrows with Judy O'Neil. We have sailed many miles, through fair winds and rough seas. We created a life together on two continents and produced two delightful girls, Lizzie and Laura. It has only been from this strong base that I could take on the challenges that provided me with the life experiences that I drew upon for Dancing with Dugongs.

My academic journey was a circuitous route in which some key mentors played important roles. My undergraduate mentor was Richard "Doc" Pippen at Western Michigan University, my Master's advisor was Peter McRoy at the University of Alaska, my PhD advisors were Randy Alberte at the University of Chicago and Ivan Valiela at the Marine Biological Laboratory, and my postdoc advisor was Doug Capone at Stony Brook University. I have been fortunate to have had several excellent mentors during my academic career; George Stewart and Paul Greenfield at the University of Queensland and Don Boesch at the University of Maryland Center for Environmental Science.

Bill's family

Bill, Lizzie, and Laura Dennison, and Judy O'Neil

A major source of inspiration for me has been the incredible students that I have had the pleasure of working with. Immersive educational experiences that I have been involved in have been transformative, not just for the students, but for me. I revel in the successes of former students and enjoy continuing to work with them.

Peter's mentor and colleagues at the International WaterCentre were amazingly supportive. Mark Pascoe, who Peter said could 'charm a cat out of a tree,' gave Peter the latitude to focus on Dancing with Dugongs, telecommute using Skype, and entertain the stream of visitors from Brisbane to his house in Melany. Brian McIntosh and his group of committed IWC educators and scientists were Peter's intellectual lifeline and afforded me many wonderful opportunities including hosting my sabbatical in 2011. Peter's family served to inspire not just Peter but me, with their buoyant spirits and amazing warmth.

The production of Dancing with Dugongs was aided with editing by Danny Levey and Alexandra Schwaab, Integration and Application Network Science Communication Interns; as well as Anthony Kung and Brian McIntosh from the International WaterCentre. Catherine Ward, Science Communication Assistant, provided invaluable assistance in sourcing materials, layout and design, and editing.

Peter's cancer stimulated both of us to undertake this book. Peter needed something to focus on in terms of leaving a legacy of ideas and approaches, and I needed to learn more about Peter's magic - his ability to light up a room and inspire people to 'think and do' and ultimately become a better person. Of the various decisions that I have made in my career, the decision to co-author Dancing with Dugongs with Peter has been one of the truly great choices I have made. It was a privilege to be allowed into Peter's life and share his final journey in life, which he did with style and grace.

Paul Greenfield

CHAPTER 15

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Live as if you were to die tomorrow. Learn as if you were to live forever.

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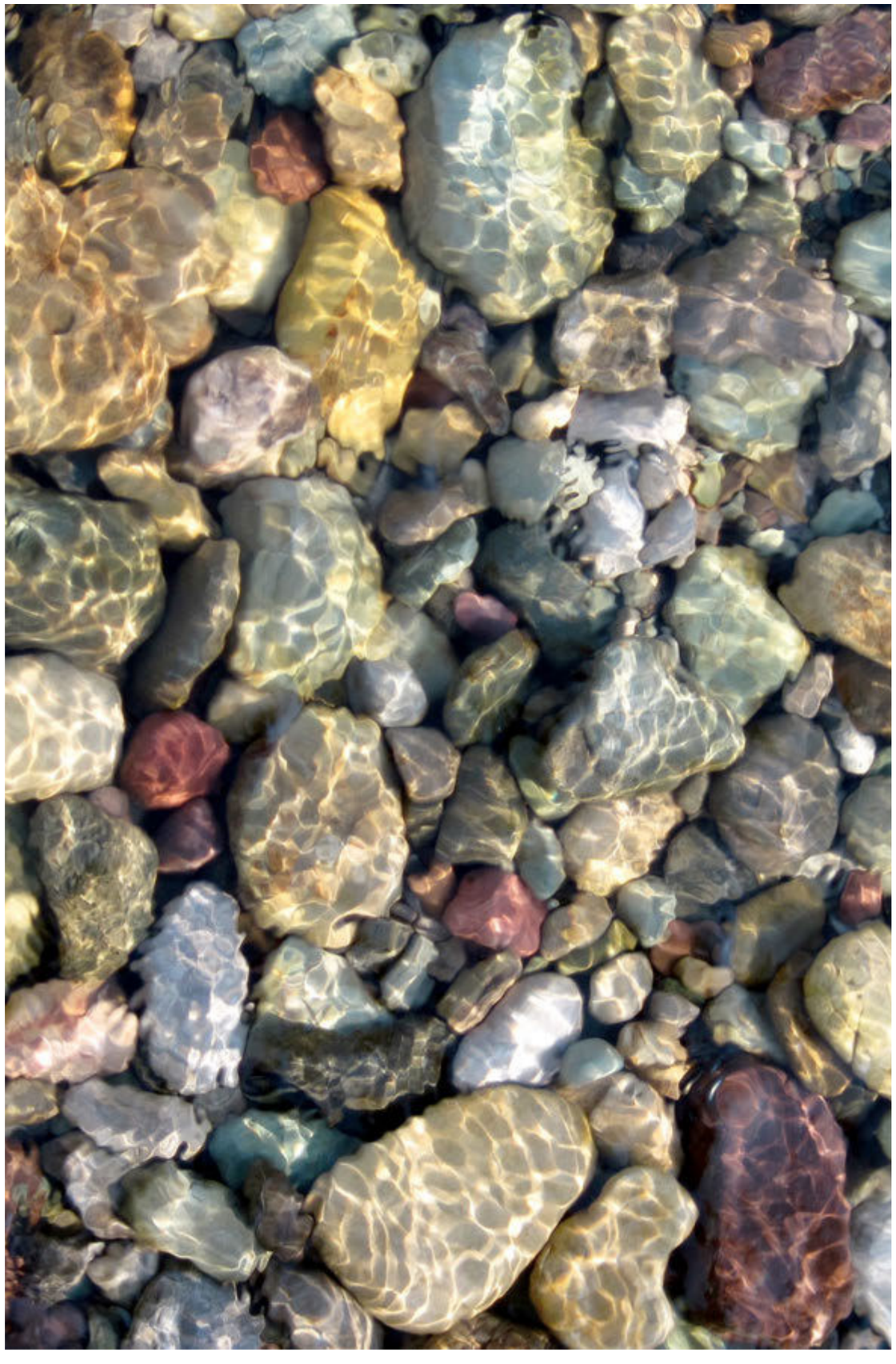

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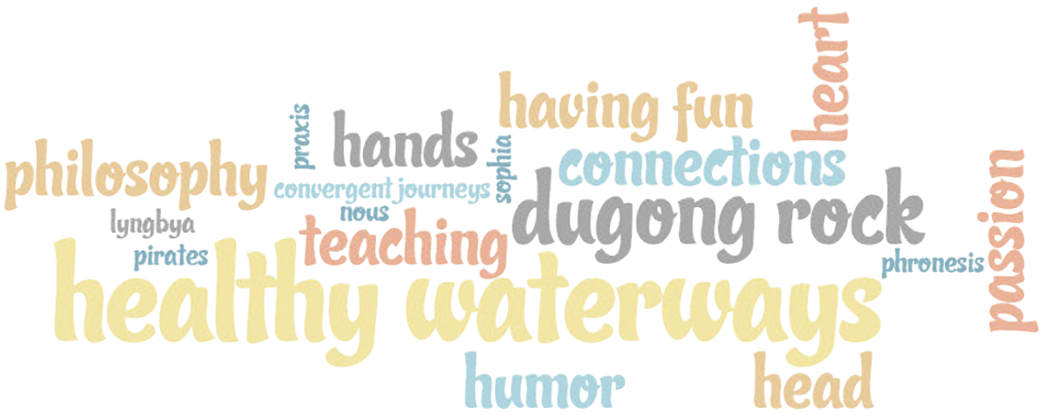

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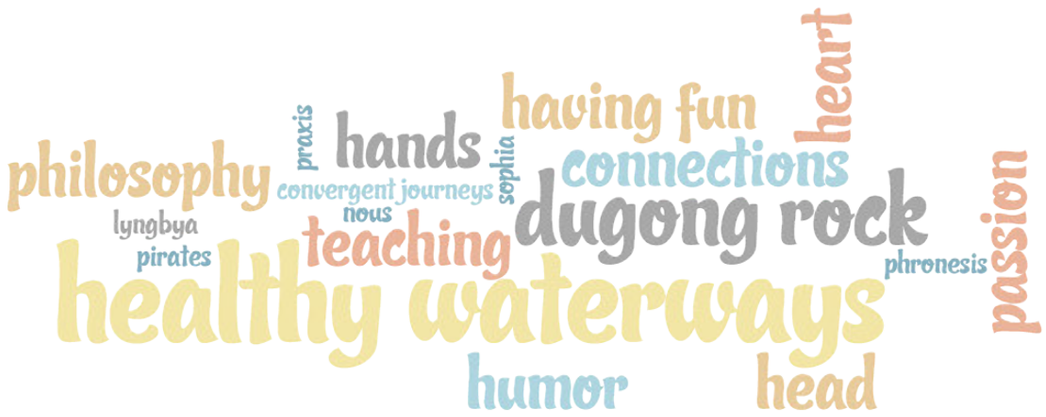


Participation

Arnstein, S 1969, 'A Ladder of Citizen Participation', Journal of the American Institute of Planners, vol.35, no.4, pp. 216-224.

This article is known widely for its identification of eight steps in which to achieve citizen power and ultimately citizen control. Arnstein created this ladder of participation as a way to identify what types of participation are most beneficial and how they can be misinterpreted or misunderstood as productive. The information from this article is still relevant today and a useful tool in understanding how to achieve citizen control and empowerment for community members. This article is easy to read and understand; I would recommend it as a starting point to identifying what real participation is and how it can be achieved.

Cooke, B & Kothari, U 2001, "Participation the new tyranny", Zed Books Ltd, London.

The book was made for the purpose to critique, question and be more critical of participatory development then has been conducted in the past and was written after a conference on the benefits of participation. It is a set of chapters written by different authors. The chapters address issues of power, practice, success, knowledge and empowerment and the social psychological analysis of how participation works and why it is important etc. These chapters show the weaknesses of participation development and why it has been unsuccessful in industries and communities. This book is a new and critical way to evaluate a theory that is accepted for its usefulness. I believe the text is a useful and interesting way to look at how participation can be negative and not simply taken as a necessity as is often implied in management and academic teachings.

Creighton, JL 2005"The Public Participation Handbook: Making Better Decisions Through Citizen Involvement", John Wiley & Sons Inc, San Fransisco.

The purpose of this book is to show the practices of designing and conducting public participation programs. This book is meant for those in government agencies, community organizations or corporations who specifically would like advice on how to involve the public in decision making. An outline for effective public participation is illustrated; how to design a program, an overview of public participation

techniques, designing and conducting interactive meetings, public participation tools and case studies on participation strategies. The author has used his own experiences in the implementation of public participation programs. One of the faults in the design of the book is that it is very vague in regards to specific tools and steps needed to implement a participation program. However the document is easy to read and understand which makes it an enjoyable read.

Hemmati, M 2002, "Multi-Stakeholder Process for Governance and Sustainability", Earthscan Publications Ltd, UK.

This book is key to demonstrating how people from different backgrounds are able to successfully work together in a real environment; that is one that has social, political and economic complexities. The authors have claimed in the book that they are not introducing any new ideas or concepts of multi-stakeholder processes' but rather common sense; this can be positive or negative depending on how the audience wants to view this. It is a good resource for those wanting background information in developing a multi-stakeholder process without the constraints of set guidelines.

Friere, P 2007, "Pedagogy of the Oppressed", Continuum, New York.

Frieres' ideas may seem farfetched from modern ideas of social capital, however he introduces many ideas of social oppression, freedom and empowerment which lead to concepts such as empowerment and revolution. This is a useful historical book on where such concepts began and how thought processes for social development began.

Howe, J 2009, "Crowdsourcing: How the Power of the Crowd is Driving the Future of Business", Random House Business, London.

"Crowdsouring" is a collection of many stories of successful crowdsourcing. however there is no clear definition on what it is or summarizing from each story saying what the point of this is and how it links into other topics etc. The history of crowdsourcing is examined so as to understand how and why it is used in the present as well as how it can predict future problems. It looks at the negatives of crowdsourcing, why it is so important and obvious in communities as well as the information and collective knowledge it can supply. I found this book difficult to read as there was no flow to the chapters or easily identified links to participation and society. However the author was clearly interested in case studies and how "crowdsourcing" has been used and identified in modern history. Therefore those requiring specific cases on this topic would find this reference most relevant.

Sarkissian, W, Perlgut, D & Ballard, E (eds) 1986, "The Community Participation Handbook: Resources for Public Involvement in the Planning Process", Impact Press, Roseville.

The book has been designed as a guide to help individuals involve themselves in community participation. It is a useful tool for those designing participation programs as specific

methods and guidelines are identified on the most effective type of participation. The book was written in 1986 so it does not have modern concepts of participation however many of the ideas of participation still remain relevant. This book is intended for many different audiences as it applies to those in government, planners, social workers and those in many other industries. This resource will be most useful for those wishing to run and conduct community participation and stimulate participation.

Wondolleck, JM & Yaffee, SL 2000, "Making Collaboration Work: Lessons From Innovation in Natural Resource Management", Island Press, Washington D.C.

This book was written for many different audiences; students, mid-career professionals and is relevant for many different issues, not just environmental but public policy health etc. Eight themes are used throughout the book to identify successful collaboration by providing a base framework to work by. Wondolleck & Yaffee provide tools to help people understand collaboration, why it is important as well as its relevance, as well as providing case studies where this has been effective to management and in environmental problem solving. Collaboration is essential for achieving effective environmental management, more often than not is a starting point to management resource problems. It is a process of communication, decision making and problem solving which is why it can be so difficult to achieve, especially when few know how to achieve or management successful collaboration. It is something that needs to be ongoing, an evolution and continuing process and inclusive of many stakeholders and groups. This book has useful case studies and guidelines for implementing and understanding collaboration, with specific reference to Natural Resource Management.

Yankelovich, D 1999, "The Magic of Dialogue: Transforming Conflict Into Cooperation", Nicholas Brealey Publishing, London.

'The Magic of Dialogue' is a fantastic and innovative book on the importance of good communication and dialogue. This book is both easy to read and understand; making it the perfect literature for students, government workers, educators, business people and many more. Two types of dialogue are described in detail; spontaneous and planned dialogue. Yankelovich describes in detail what dialogue is, how it can be misunderstood and ways to create effective dialogue. He demonstrates this via a list of strategies and uses case studies as examples of effective or ineffective dialogue.

He believes that genuine dialogue is very rare in our society as it is not simply a conversation between parties but a way of understanding and appreciating others points of view. It should create bonds, show new ways of thinking and open one's mind up, respect and dignity. Dialogue should not necessarily be harmonious, but rather an understanding of the other view point and relating to them. Dialogue is a part of the process and should be more important than the decision making. It is an excellent book of communication techniques,

practices and values and can provide skills applicable to people from many walks of life.

Activism

Alinsky, SD 1971 “Radicals: A Pragmatic Primer for Realistic Radicals”, Vintage Books, New York

Alinsky used this book to impart his knowledge on social activism; specifically meant to target organizers of social movements and give them advice from his own experiences. This book is specifically targeted at the younger generation, the ones he believes is most likely to engage in radical behavior. He gives advice on how to construct and build effective social activism movements in a sensible and effective way and is an interesting read.

Gardner, M 2005, “Linking Activism: Ecology, Social Justice and Education for Social Change”, Routledge, New York.

The experiences of thirty activists are documented on how they went about dealing with social justice; specially chosen because of their environmental work. Their ultimate aim was to address what makes a socially just and ecologically viable community and how linking activism can assist with this. Problems with activism are identified as well as how it can be unsuccessful and why/not activism has worked. This book would be most useful to those who require specific information on environmental activism.

Shaw, R 1996, “The Activists Handbook: A Primer for the 1990s and Beyond”, University for California Press, California.

Walls, D 1993, “The Activists Almanac: The Concerned Citizens Guide to the Leading Advocacy Organizations in America”, Simon & Schuster, United States.

Empowerment

Craig, G & Mayo, M (eds) 1995, “Community Empowerment: A Reader in Participation and Development”, Zed Books, London.

This book shows the relationship of empowerment to public policy and social movements. Case studies are used as an example of communities and control. The chapters in this book promote sustainable social development, social justice, community participation and empowerment. “Community Empowerment” is a good starting book, showing strong connections to government and the role of community empowerment.

Kaufman, A S 1960 "Human Nature and Participatory Democracy," in Carl J. Friedrich, ed., “Responsibility: NOMOS III”, The Liberal Arts Press” New York, reprinted in Connolly, WE ed 1969, “The Bias of Pluralism”, Atherton Press, New York.

Kaufman believed that democratic participation would lead to empowerment for individuals and communities. He was one

of the first theorists in America to be recognized for this hypothesis of participation and the role communities play in bringing about their own empowerment. Kaufman developed the theory of 'participatory democracy'; this was developed at the time of the student's power movement in the US. He continued to work in social justice and write books and articles relating to socialist issues. The case studies may not be relevant in modern society; however his beliefs on participation are an important link to the history of community empowerment.

Pateman, C 1970, "Participation and Democratic Theory ", Cambridge University Press, Cambridge.

Pateman refined the theory of participation and empowerment to specifically include the idea of equal power, and that this would ultimately improve political construction and community structure.

Social capital

Hanifan, LJ 1916, "The Rural School Community Centre", The Annals of the American Academy of Political and Social Science, vol.67, pp.130-138.

Lyda Judson Hanifan describes the importance of having capital in society before social construction can begin. He uses his experience in the school community as examples of how to improve and strengthen society by developing social capital. His conclusion is that the greater the social capital on a society, the greater social investment there will be for that community. This article articulates how important a unified and interactive community is, which is still relevant in modern society.

Marx, K, 1867 "Capital", Engels, F (ed), Charles 2 Kerr & Company, Chicago.

Karl Marx introduced Social Capital in his books "Capital" in 1867, it was the first of three volumes, however he died after the first one was published. These pieces may seem outdated and difficult to read, however it is important to note Karl Marx when discussing social capital as he is often thought to have introduced the idea of social capital; specifically he talks about capital and capitalism in society.

Putnam, R 1995, "Bowling Alone: the Collapse and Revival of American Community", Simon & Schuster, New York.

This book discusses the role of social capital in society and how changes and the norm in society are the cause of this social capital. Putnam identifies the changes to community life and participation through history and how involvement in organizations has dropped in recent times despite of all of our education on community participation. He talks about this disconnection from organizations and why it has changed through history; specifically America and how trends in society can influence these different methods of participation. Putnam highlights flaws in society, which explain why this inclusiveness is not relevant in organizations such as the work place and how socializing and society has changed over the years. He explores many different types of organizations and

how these different organizations function, and why some have been more functional with participation and social inclusiveness than others.

There are many things that `contribute to civil society and therefore its social capital. Religion is a good example of this; just because people are part of this organization does not necessarily mean they are participants. Putnam identifies two types of people in society; Machers and Schmoozer's. Machers are those who make things happen within a community and are the formal type of social connectedness. They attend community events, church meetings, community projects, are aware of current events, give to charity, involve themselves in politics, and attend meetings. Schmoozer's are those who spend time in informal conversation and are identified as the informal social connectedness. They are involved in social life however they are less organized and their social life is less purposeful, with spontaneity being their key. Putnam makes many key observations about communities and the importance of social capital throughout the book. Community and institutional bonds need to be improved so that trust can be re-established in America and it should occur individually and institutionally.

Social theory

Bandura, A (ed) 1995, "Self-Efficiency in Changing Societies", Cambridge University Press, Cambridge.

Bandura, A 1977, "Self Efficiency: Toward a Unifying Theory of behavioural Change", Psychological Review, vol.84, no.2, pp.191-215.

Bandura, A 1978, "Social Learning Theory of Aggression", Journal of Communication, vol.28, no.3, pp.12-29.

Albert Bandura wrote many books and journals on social theory. His 1978 article was the most famous as it was believed to be the first mention of social learning theory in modern times and he is often thought of as the founder of this concept. He looks at social learning through aggression and how this is a behaviour learned through mimicry and observation rather than instinctual. This is a descriptive article on what social learning is and how influential it can be in matters such as aggression and behavioural problems.

Giddens, A 1979, "Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis", University of California Press, California.

Gladwell, M 2000, "The Tipping Point: How Little Things Can Make a Big Difference", Little Brown and Company, United States of America.

Gladwell observes how small things can make a big difference, and how behavior of one can influence another. He identifies how different types of people can either cause these changes or follow them, and all are influential to the concept of social theory. I found this book to be an interesting approach to

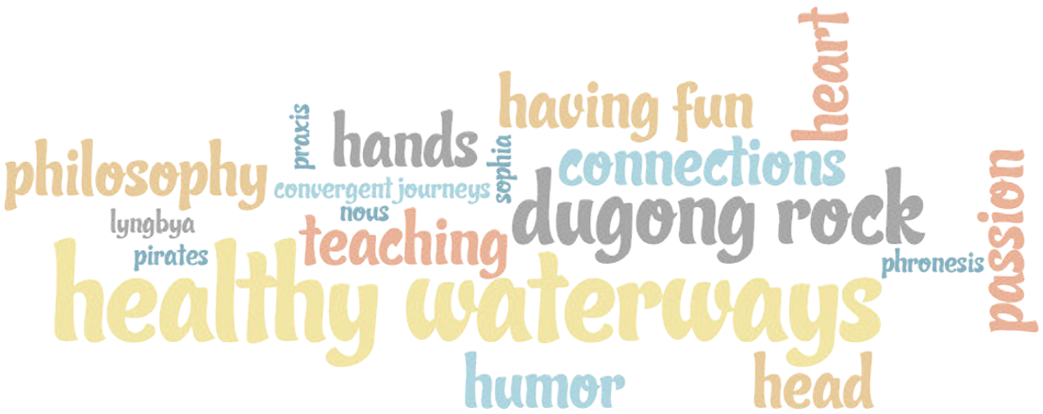
social theory; where examples and case studies highlighted the tipping affect of human behavior still relevant today.

Yearley, S 2005, "Making Sense of Science: Understanding the Social Study of Science", SAGE Publications, London.

Yearley writes an interesting book on the missing link in sociology and how science and technology are needed to bond and understand the social world. This link is identified as an extremely important part of society, people and institutions as well as how these societies and cultures operate. Sociologists fail to notice such scientific expertise and issues such as that relating to risk, scientific laws and technological systems. He believes that because of this, there are limits to what sociologists are able to do, and that understanding these scientific and technological parts of society should be put into more capable hands.

Yearley shows the connection that sociology has with science and how important it is in understanding and interpreting the social sciences. Utilizing science in sociology is so important because science looks at how the world works, and find true and accurate information based on observation that is not swayed by bias or emotions. Different theories are identified which show how to understand society, such as the Actor-Network Theory and The Edinburgh School. He uses many different case studies to try and identify these links; such as feminism, evolution, farming, medicine and diseases. He identifies why the social science and science community often ignore the other discipline and why they believe theirs is better/the most important tool needed in identifying and explaining the subject. He looks at different authors and theories associated with these subjects and critiques why they may work in the analysis and explanation of the issue. Yearley identifies the thought processes and theories in science studies as well as how the natural world is and should be shaped. This book shows how different disciplines should be interconnected for management and progress.

Photo credits



Forward

pg. vi: Bribie Island, separated from the mainland by Pumicestone Passage in Southeast Queensland, Australia. Source: NASA, Wikipedia Commons

Chapter 1

Cover: Setting the Trotline in Oxford, Maryland. Jim Kidd (IAN Image Library)

pg. 2: Bill Dennison and Peter Oliver. Credit: Kate Hodge

pg. 8: Peter Oliver. Credit: Anthony Kung

pg. 8: Bill Dennison. Credit: Hans Paerl

pg. 10: Bill Dennison introducing Dancing with Dugongs at the 14th Annual International Riversymposium in Brisbane, Australia. Credit: International WaterCentre

Chapter 2

Cover: Peter Oliver. Photo courtesy of Peter Oliver

pg. 20. Peter Oliver, teacher in 1987. Photo courtesy of Peter Oliver

pg. 21: The proposed batching site of Sellars Holdings concrete batching plant. Photo courtesy of Peter Oliver.

pg. 22: Coral Street - Maple Street intersection photographed in 1990 (left) and 2011 (right). Photo courtesy of Peter Oliver.

pg. 23: Danny Rose. Photo courtesy of Peter Oliver

pg. 24: The Sellars Holding Concrete Batching Plant situated next to Maleny State High School in 1990. Photo courtesy of Peter Oliver

pg. 25: Danny Rose (seated at left) and other members of FABS Alan McGlure (standing); Peter Oliver; Lindsay Kruger (standing); Cesca Ennis and Lesley Synge. Photo courtesy of Peter Oliver

pg. 26: The platypus is endemic to Obi Obi Creek and so is an ideal icon or mascot for a campaign such as FABS which aims to protect its habitat. Courtesy of Peter Oliver

pg. 27: An article from the local weekly Maleny paper, The Range News, on 28 June 1991. We had by this stage recovered from the shock of our initial legal bill. Courtesy of Peter Oliver

pg. 31: Lindsay Kruger. Photo courtesy of Peter Oliver

pg. 33: Lesley McClure. Photo courtesy of Peter Oliver

pg. 36: Obi Obi Creek in 2012. Photo courtesy of Bill Dennison

pg. 38: Peter and his guitar. Photo courtesy of Peter Oliver.

Chapter 3

Cover: Lyngbya majuscula. Photo courtesy of Bill Dennison

pg. 40: Microscopic view of Lyngbya filaments (left) and skin rash induced by Lyngbya (right). Photos courtesy of Bill Dennison

pg. 44: Judy O'Neil. Photo courtesy of Bill Dennison

pg. 44: Greg Savige. Photo courtesy of Peter Oliver

pg. 47: Driving on the beach on Fraser Island. Photo courtesy of Bill Dennison.

pg. 50: Andrew Watkinson. Photo courtesy of Andrew Watkinson

pg. 51: Lyngbya fouling the fishermen's nets. Credit: Peter Oliver

pg. 53: Deception Bay shoreline during Lyngbya outbreak, with warning sign and backhoe for removing Lyngbya beach wrack. Photo courtesy of Bill Dennison

pg. 54: Rafts of floating Lyngbya in Moreton Bay. Credit: Judy O'Neil

pg. 55: Stained water from pine plantation runoff (left) and seawater from Deception Bay (right). Photo courtesy of Bill Dennison

pg. 56: 'Heart reef' formation on Hardy Reef. Photo courtesy of Bill Dennison

pg. 57: Lyngbya clean-up effort on Deception Bay shoreline. Photo courtesy of Bill Dennison

pg. 59: Bill Dennison on a field trip in Deception Bay with a student. Credit: Peter Oliver

pg. 60: Judy O'Neil performing Lyngbya experiments in the laboratory. Photo courtesy of Bill Dennison

pg. 61. Chapter cover in Healthy Waterways Healthy Catchments: Making the connection in South East Queensland, Australia by Abal E.G., Bunn S.E. and Dennison W.C.

pg. 62: Floating tuft of Lyngbya in Deception Bay. Credit: Andrew Watkinson

pg. 63: Minister for Environment Dean Wells (left) being briefed by Healthy Waterways Scientific Coordinator Eva Abal (right). Photo courtesy of Bill Dennison

pg. 64: Ian Hewson and Bill Dennison reviewing Lyngbya data at the Moreton Bay Research Station, Stradbroke Island. Photo courtesy of Bill Dennison.

Chapter 4

Cover: Low tide on the Chesapeake Bay. Credit: Melissa Jo Keever Bridges (IAN Image Library)

Chapter 5

Cover: Sailboat near Eastern Shore. Credit: Ben Fertig (IAN Image Library)

pg. 72: Conversation between Bill and Peter. Credit: Kate Hodge

pg. 74: Warning sign for Lyngbya bloom in Deception Bay, Queensland, Australia. Photo courtesy of Bill Dennison

pg. 75: Cyanobacterial bloom of *Lyngbya majuscula* that infested northern Moreton Bay, Queensland. Photo courtesy of Bill Dennison.

pg. 76: Bill Dennison and Minister for Environment Dean Wells (upper left), Malcolm Robb from Western Australia talking about Peel-Havery Lyngbya blooms (upper right), backhoe removing Lyngbya from Deception Bay beach (lower left), Bill Dennison with reporters at Deception Bay bloom site (lower right). Photos courtesy of Bill Dennison

pg. 77: Judy O'Neil and Greg Savige holding Lyngbya warning sign after field trip to Deception Bay, Australia. Photo courtesy of Bill Dennison

pg. 81: Figure 1. Doug the Dugong - a cartoon character. Courtesy of Peter Oliver

Chapter 6

Cover: Courtesy of Peter Oliver

pg. 85: Jean Louis Agassiz in 1870. Source: Schweizerischer Beobachter,14/2011, p. 36, Wikimedia Commons

pg. 86: Retrieving a surface plankton net aboard the tall ship R/V Westward as part of Sea Semester

pg. 87: Bill educating state officials on Maryland's Coastal Bays. Credit: Ben Fertig (IAN Image Library)

pg. 88: Bill Dennison and Judy O'Neil leading a field trip on the Great Barrier Reef, Australia. Photo courtesy of Bill Dennison

pg. 90: Aboard the R/V Westward as part of Sea Semester. Photo courtesy of Bill Dennison

pg. 91: Peter Oliver inspecting sand castle models on a field trip. Photo courtesy of Peter Oliver

pg. 92: Scuba diving on coral reef (Palau). Photo Credit: Jane Thomas (IAN Image Library)

pg. 93: Bioassays used in a student project on mapping nutrient limitation that resulted in a scientific publication. Photo courtesy of Bill Dennison

pg. 94: SEA semester tall ship at sea. Photo courtesy of Bill Dennison

pg. 94: Snorkeling trip on the Great Barrier Reef. Photo courtesy of Bill Dennison

pg. 95: Collecting water samples using Nansen bottles aboard R/V Westward. Photo courtesy of Bill Dennison

pg. 97: Bill Dennison conducting hands-on science communication workshop in Mackay, Queensland, Australia. Photo courtesy of Bill Dennison

Chapter 7

Cover: Science communication course. Credit: IAN Staff (IAN Image Library)

pg. 99: Peter teaching science students on a field trip. Photo courtesy of Peter Oliver

pg. 100: Bill Dennison interview during launch of Shifting Sands book. Credit: Ben Fertig (IAN Image Library)

pg. 101: Contrasting the difference between scientific writing (left) and science communication (right). Courtesy of Bill Dennison

pg. 102: Workshop with the U.S. National Park Service rangers at Shenandoah Nation Park. Credit: Ben Fertig (IAN Image Library)

pg. 103: Each stakeholder plays a part in the shared vision of an environmental campaign. The collaboration among these stakeholders is key to a successful campaign. Credit: Jane Thomas (IAN Image Library)

pg. 104: A child's innate curiosity about the natural world. Source: mikeyp2000, Compfight, Creative Commons.

pg. 105: The history of scientific paradigm shifts since 1500. Courtesy of Bill Dennison

pg. 106: Combining knowledge, power, and passion leads to societal paradigm shifts. Source: Integrating and Applying Science, Figure 2.13, pg. 25.

pg. 107: Cartoon character created for 'Dugong Rock'. Courtesy of Peter Oliver

pg. 108: The overall purpose of the environmental campaign is to take the uninformed to informed and the informed to the engaged. Source: Integrating and Applying Science, Figure 4.4, pg. 50.

pg. 109: Peter Oliver on a field trip in Vietnam. Photo courtesy of Peter Oliver

pg. 110: Creating conceptual diagrams. Credit: IAN Staff (IAN Image Library)

pg. 111: Peter creating a memorable moment on stage. Photo courtesy of Peter Oliver

pg. 112: Bill Dennison and Peter Oliver. Credit: Kate Hodge

Chapter 8

Cover: Blackwater National Wildlife Refuge. Credit: Steve Apille (IAN Image Library)

pg. 118: Painting of Saltwater Church II by Peter Hudson. Courtesy of Peter Oliver

pg. 119: Common Kestrel. Credit: Juan Lacruz, Creative Commons

pg. 121: Aurora Borealis (northern lights). Credit: Adrian Jones (IAN Image Library)

pg. 122: Total lunar eclipse. Source: Wikimedia Commons

pg. 122: Sunset in Samoa. Credit: Tracey Saxby (IAN Image Library)

pg. 122: Bioluminescence from a firefly. Source: Compfight, Creative Commons

pg. 123: Brain coral spawning. Credit: Emma Hickerson, Wikimedia Commons

Chapter 9

Cover: Blue Crab studies. Credit: U.S. Navy (IAN Image Library)

pg. 126: Catherine Chaston and Joelle Prange returning from a mangrove field trip. Photo courtesy of Andrew Watkinson

pg. 127: Having fun as part of an IAN Science Communication Course. Credit: Caroline Wicks, IAN Image Library

pg. 128: Bill Dennison introducing Peter Oliver for his retirement lecture. Photo courtesy of International WaterCentre

pg. 129: Bill Dennison and Peter Oliver. Credit: Kate Hodge

Chapter 10

Cover: Geese fly at sunset, Maryland. Credit: Kate Boicourt (IAN Image Library)

pg. 152: Bill Dennison and Peter Oliver. Credit: Kate Hodge

Chapter 11

Cover: Bowman Lake, Montana. Credit: Jane Hawkey

pg. 165: Peter Oliver on a field trip in Australia. Photo courtesy of Peter Oliver

pg. 166: Students aboard a SEA Semester tall ship presenting their scientific results. Photo courtesy of Bill Dennison

pg. 167: Peter and Ann Oliver (seated) with colleagues Dana Kelly and Peter Wegener at the Healthy Waterways Gala 2012, where Peter received the Healthy Waterways Champion Award. Photo courtesy of Healthy Waterways

pg. 168: Bill Dennison and Peter Oliver. Credit: Kate Hodge

pg. 194: Margaret Mead. Source: Edward Lynch, Library of Congress, Wikimedia Commons

pg. 194: Harry Truman. Source: Chase-Statler, Library of Congress, Wikimedia Commons

pg. 195: Mark Twain. Source: A.F. Bradley, Library of Congress, Wikimedia Commons

pg. 195: Winston Churchill. Source: J. Russell & Sons, Library of Congress, Wikimedia Commons

pg. 195: Herbert Hoover. Source: U.S. National Archives and Records Administration, Wikimedia Commons

pg. 196: David Starr Jordan. Source: Smithsonian Institution, Wikimedia Commons

pg. 196: Louis Pasteur. Source: Wikimedia Commons

pg. 196: Albert Einstein. Source: Belem.marvilla, Wikimedia Commons

pg. 197: Charles Darwin. Source: J. Cameron, Wikimedia Commons

pg. 197: John Lennon. Source: Paul Vera-Broadbent, Compfight, Creative Commons.

Chapter 12

Cover: Peter Oliver. Credit: Ian Perdrisat

pg. 203: Bill Dennison and ‘Doug the Dugong’. Photo courtesy of Bill Dennison

pg. 204: Bill Dennison introducing Peter Oliver for his retirement lecture. Photo courtesy of International WaterCentre

pg. 205: Peter Oliver performing as part of his retirement lecture. Photo courtesy of Bill Dennison

pg. 206: Pirate Pete, aka Greybeard, with a crew member. Photo courtesy of Peter Oliver

pg. 207: Peter Oliver via Skype. Photo courtesy of Bill Dennison

pg. 208: The many faces of Peter Oliver. Photos courtesy of Peter Oliver

pg. 209: Peter Oliver delivering his retirement lecture. Photo courtesy of International WaterCentre

pg. 210: Peter Oliver giving his retirement lecture. Photo courtesy of Bill Dennison

pg. 211: Mark Pascoe (standing center) and his International WaterCentre staff being entertained by Peter’s song. Photo courtesy of International WaterCentre

pg. 212: Peter Oliver. Photo courtesy of Peter Oliver

Chapter 13

Cover: Dancing Dugongs. Credit: Jane Thomas and Ann Oliver

pg. 215: Hikers in Waterton Park, Alberta. Credit: Jane Hawkey (IAN Image Library)

pg. 216: Bill taking a science communication course. Photo courtesy of Bill Dennison

pg. 217: Peter enjoying a field trip. Photo courtesy of Peter Oliver

Chapter 14

Cover: Bill Dennison and Peter Oliver. Credit: Kate Hodge

pg. 219: Peter Oliver. Photo courtesy of Peter Oliver

pg. 220: Photo gallery of Peter Oliver's family. Photos courtesy of Peter Oliver

pg. 221: Peter Oliver and Mark Pascoe. Photo courtesy of Healthy Waterways

pg. 222: Bill Dennison. Credit: Jane Hawkey

pg. 223: Photo gallery of Bill Dennison's family Photos courtesy of Bill Dennison

pg. 223: Paul Greenfield. Photo courtesy of of Healthy Waterways

Chapter 15

Cover: Bowman Lake bottom, Montana. Credit: Jane Hawkey (IAN Image Library)

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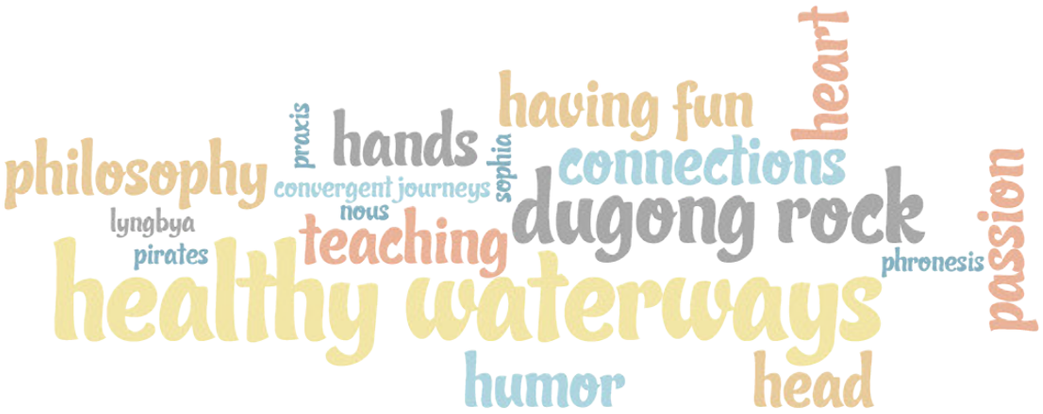
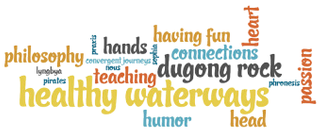



Dancing Dugongs. Credit: Jane Thomas and Ann Oliver



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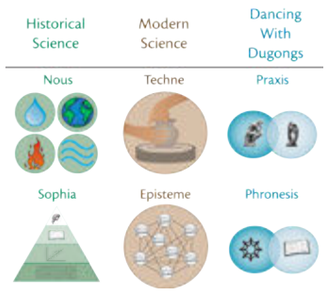

Symbols depicting Greek words: Nous, Sophia, Techne, Episteme, Praxis, and Phronesis . Credit: Brianne Walsh


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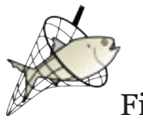
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Litoria caerulea (Australian Green Tree Frog). Credit: Dieter Tracey (IAN Image Library)


Kayaking. Credit: Tracey Saxby (IAN Image Library)


Map of Maleny, Australia. Credit: Brianne Walsh


Trichoglossus haematodus (Rainbow Lorikeet). Credit: Tracey Saxby (IAN Image Library)


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Ornithorhynchus anatinus (Platypus). Credit: Diana Kleine (IAN Image Library)


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Cocos nucifera (Coconut Palm). Credit: Tracey Saxby (IAN Image Library)


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Map of Moreton Bay, Australia. Credit: Jane Thomas

Cyanobacteria. Credit: Diana Kleine (IAN Image Library)


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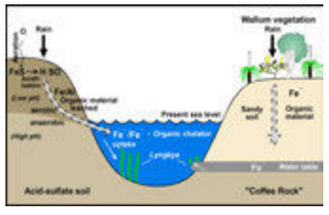
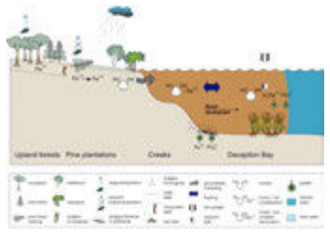
Rhodophyta (Red Algae). Credit: Diana Kleine (IAN Image Library)

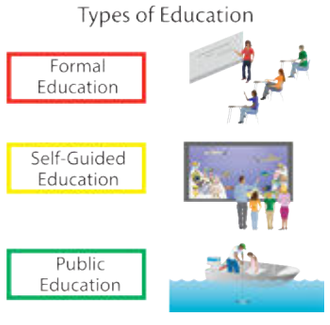


Initial conceptual diagram of the causes of the Lyngbya blooms. Source: Moreton Bay Study: A scientific basis for the Healthy Waterways Campaign. 1999. Dennison, W.C. and Abal, E.A. Southeast Queensland Water Quality Strategy, Brisbane. 245 pp.

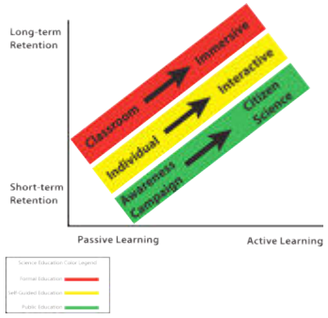

Environmental funding. Credit: Catherine Ward


Conceptual diagram of Lyngbya blooms of Deception Bay. Source: Healthy Waterways Healthy Catchments: Making the connection in South East Queensland, Australia. 2005. Abal, E.G., Bunn, S.E., Dennison, W.C. (eds.) Moreton Bay Waterways and Catchments Partnership, Brisbane. 240 pp.

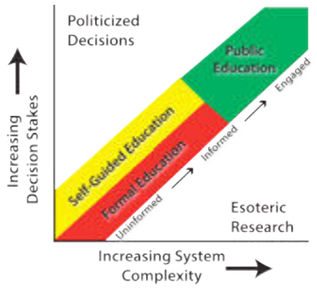

Playing cards. Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)



Types of education. Credit: Alexandra Fries



Active vs. passive learning. Credit: Danny Levey



Guide to using education forms. Credit: Danny Levey

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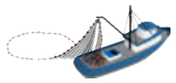
Planning meeting. Credit: Tracey Saxby (IAN Image Library)

Fish school. Credit: Tracey Saxby (IAN Image Library)



Purse Seine. Credit: Tracey Saxby (IAN Image Library)

Integration of hands, head and heart. Credit: Danny Levey

Dugong. Credit: Jane Hawkey (IAN Image Library)

Footprints. Credit: Jane Hawkey (IAN Image Library)

Scuba diver. Credit: Dieter Tracey (IAN Image Library)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Ardea Herodias (Great Blue Heron). Credit: Tracey Saxby (IAN Image Library)


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Microscope. Credit: Jane Hawkey (IAN Image Library)


Elanus leucurus (White-tailed Kite). Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)


Lepidochelys kempii (Kemp's Ridley Sea Turtle). Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)


Seed parachute. Credit: Jane Hawkey (IAN Image Library)


Eretmochelys imbricata (Hawksbill Turtle) hatchling. Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)


Callinectes sapidus (Blue Crab). Credit: Chip Chenery (IAN Image Library)


Pinus virginiana (Virginia Pine). Credit: Tracey Saxby (IAN Image Library)


Rhinoptera bonasus (Cownose Ray). Credit: Tracey Saxby (IAN Image Library)


Pelecanus spp. (Pelican). Credit: Diana Kleine (IAN Image Library)

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Scylla serrata (Mud Crab). Credit: Dieter Tracey (IAN Image Library)


Dacelo novaeguineae (Laughing Kookaburra). Credit: Tracey Saxby (IAN Image Library


Heteropogon contortus (Pili Grass). Credit: Jane Hawkey (IAN Image Library)


Mytilus galloprovincialis (Mediterranean Mussel). Credit: Jane Hawkey (IAN Image Library)


Child swimmer. Credit: Tracey Saxby (IAN Image Library)


Student at desk. Credit: Alex Fries (IAN Image Library)


Tap with water. Credit: Caroline Wicks and Catherine Ward


Australian flag. Credit: Jane Thomas (IAN Image Library)


Watershed management. Credit: Tracey Saxby (IAN Image Library)


Lontra canadensis (North American River Otter). Credit: Tracey Saxby (IAN Image Library)

No fishing sign. Credit: Tracey Saxby (IAN Image Library)


Scientist using laptop computer. Credit: Jason C. Fisher (IAN Image Library)


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Map of Chesapeake Bay. Credit: Tracey Saxby and Kate Boicourt (IAN Image Library)


Group presentation. Credit: Tracey Saxby (IAN Image Library)


Sterna spp. (Tern). Credit: Tracey Saxby (IAN Image Library)


Typha x glauca (White Cattail). Credit: Jane Hawkey (IAN Image Library)


Water drop. Credit: Tracey Saxby (IAN Image Library)


Pomatomus saltatrix (Bluefish). Credit: Tracey Saxby (IAN Image Library)


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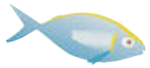
Light aircraft. Credit: Diana Kleine and Jason C. Fisher (IAN Image Library)


Zostera capricornii. Credit: Diana Kleine (IAN Image Library)


Surf Fishing. Credit: Tracey Saxby (IAN Image Library)


Penaeus monodon (Tiger Prawn). Credit: Jane Hawkey (IAN Image Library)


Siganus spp. (Rabbitfish). Credit: Dieter Tracey (IAN Image Library)


Lighthouse. Credit: Tracey Saxby (IAN Image Library)


Algae. Credit: Diana Kleine (IAN Image Library)


Stenella longirostris (Spinner Dolphin). Credit: Tracey Saxby (IAN Image Library)


Haematopus longirostris (Pied Oystercatcher). Credit: Jane Thomas (IAN Image Library)


Macropus fuliginosus (Western Grey Kangaroo). Credit: Tracey Saxby (IAN Image Library)


Anchor. Credit: Tracey Saxby (IAN Image Library)


Ginglymostoma cirratum (Nurse Shark). Credit: Tracey Saxby (IAN Image Library)


Roadside trash. Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)


Rana clamitans melanota (Northern Green Frog). Credit: Tracey Saxby (IAN Image Library)


Banksia spp. (Banksia). Credit: Lana Heydon (IAN Image Library)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Acacia spp. (Acacia). Credit: Kim Kraeer and Lucy Van Essen-Fishman (IAN Image Library)


Puzzle. Credit: Jane Hawkey (IAN Image Library)


Light bulb. Credit: Jane Hawkey (IAN Image Library)


Eighth notes. Credit: Jane Thomas (IAN Image Library)

Glossary

Donald Schon

Schon, D 1983, “The Reflective Practitioner: How Professionals Think in Action”, Basic Books, Inc. United States of America.

The Pythagorean Table of Opposites

Philip, J 1966, “Pythagoras and the Early Pythagoreans”, University of Toronto Press.

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Lee, H 1960, “To Kill a Mockingbird”, HaperCollins Publishers, New York.

Dynamic Popups from iBooks version

Reflective Practice (p. 6)

Donald Schon believed that skilled practitioners are professional practitioners, reflecting on their own and others' experiences in order to create the most effective strategies possible, and is thought to be the first to propose this theory of reflective practice (Osterman 1990). Schon proposed that practitioners often know more in their professions then they can describe, the reason being that they learn things on the job of which they may not even be aware (Schon 1983). Schon believed that some processes must be learned through reflection on personal experience and practice rather than learned from scientific theory (Krol 1997). Reflective practice is meant to be an individual task of reflecting on one's own work and experiences so as to improve oneself in his or her area of expertise (Osterman 1990). This reflection can help improve an individual's work by encouraging the individual to critique oneself, rendering him or her more self aware, and thus ultimately better skilled in the workplace and in life (Osterman 1990).

Many believe reflective practice is so effective because learning means individuals are able to reflect on themselves and therefore try to improve and become more efficient (Osterman 1990). In order for an individual to be a reflective practitioner, he or she must want to actively improve and grow professionally (Krol 1997). Constantly learning, refining one's studies, and trying to be critical of his or her practices and behaviors are the most important qualities of a reflective practitioner (Krol 1997). Reflective practice can be quite a difficult task, as it if often hard to break patterns of behavior that, although unproductive or inefficient, have become habitual (Osterman 1990).

Krol, C.A. 1997. Coming to Terms: Reflective Practice. The English Journal 86(5): 96-97.

Osterman, K.F. 1990. Reflective Practice: A New Agenda for Education. Education and Urban Society 22(2): 133-152.

Schon, D.A. 1983. The Reflective Practitioner: How Professionals Think in Action. Basic Books Inc. Publishers, New York.

Deliberative Practice (p. 7)

Deliberative practice is the undertaking of an activity or practice for the sole purpose of improving one's

performance (Meinz and Hambrick 2010). This concept goes with the belief that the more you practice and study, the better you will be. However there are arguments that this will only extend to an individual's professional domain or physical/intellectual capabilities; that is, there will be exceptions to this rule (McKinney and Davis 2003). Sir Francis Galton was believed to be the first to introduce this concept in his book Hereditary Genius (1982). He believed that it is impossible to improve oneself through repetition, and an individual is only capable of doing as much as "nature has rendered him capable of performing" (Ericsson et al 2006, p.16).

Deliberative practice requires critical listening, constructive arguments, and learning from cultural institutional norms (Forester 1999). In order for deliberative practice to be effective, it needs to be constantly repeated and feedback to improve performance needs to be available (McKinney and Davis 2003). By engaging in an activity, it is believed that skill will be improved and can be applied to activities such as sport, music, or everyday tasks (Meinz and Hambrick 2010). Forrester (1999) expanded on this, demonstrating how deliberative practice can bring about effective participatory planning processes.

Forester, L. 1999. The Deliberative Practitioner: Encouraging Participatory Planning Processes. MIT Press, Cambridge.

Galton, F. 1982. Hereditary Genius: An Inquiry into its Laws and Consequences. In Ericsson, K.A., N. Charness, R.R. Hoffman, and P.J. Feltovich (Eds) 2006. The Cambridge Handbook of Expertise and Expert Performance. Cambridge University Press, New York.

Meinz, E.J. and D.Z. Hambrick. 2010. Deliberate Practice is necessary but not Sufficient to Explain Individual Differences in Piano Sight-Reading Skill: The Role of Working Memory Capacity. Psychological Science 21(7): 914-919

McKinney, E.H. and K.J. Davis. 2003. Effects of Deliberate Practice on Crisis Decision Performance. The Journal of Human Factors and Ergonomics Society 45(3): 436-444.

Danny Rose (p. 23)

Danny tells me that in his younger days he was a drop-out, dole-living, angry young man, smoking pot and taking acid. He says there was a, "lot of anger in the air around him." He cured himself by getting married and having kids and was off all drugs by that time. He started selling fruit and vegetables and feels that going into business made him more respectful of others. He was primed to volunteer for the role of respondent-by-election in the Court process and was very pleased to do so.

"I have always been a fan of science and of politics. I respect people who get involved and believe they are doing the right thing, be it in politics or in any institution. That's how society improves," said Danny, "I am not madly

incautious. I was prepared to be sued for whatever I had, so I found it easy to volunteer at the public meeting."

Choosing the right method is key for Danny. He recalls that- although conflict did not play a large part at all amongst the FABS group-when things became long and drawn out, there were some disputes about what path FABS should actually take. "Going in there and undoing that bolt or getting to the critical parts of the problem was what worked for us," continued Danny, "You got to have a language that people will respond to. Standing round in suits and collars and spouting science and law is only going to get to a percentage of the population. Logos, art, symbols, and music are also essential. Pete Seeger, Bob Dylan, Arlo Guthrie inspired my music."

While there were many factors that were critical in our success, two stand out for Danny: obtaining Legal Aid and gaining publicity for our cause on ABC Television. "Obtaining Legal Aid set a precedent. It showed we were on about science, evidence, and legal process – not just emotion. It made other people seeking to develop inappropriately more cautious. It also showed that we had audacity, even in asking for Legal Aid and that we had the stubbornness to continue." Danny feels that obtaining Legal Aid made Sellars Holdings back out.

"ABC Television coverage was critical in terms of publicity," commented Danny, "even if we were parodied to a certain extent. Our opponents would not have liked to see us get such publicity, even if it was not all about the batching site."

"Our meetings went on for years," remembers Danny, "Food and drink became an important part of making the meetings pleasant! FABS helped my group communications skills, patience, and dealing with people. I even finished up on the Board of Directors of UpFront Club after FABS. I also did a facilitation course - something I probably would not have even contemplated beforehand."

So what's a concrete batching plant? (p. 24)

It is a collection of storage bins, hoppers, and machinery that makes ready-mixed concrete by mixing sand, gravel, cement, water and other additives. The concrete is usually delivered to a building site or wherever it is needed in a concrete truck with a revolving mixer. The concrete that is produced is usually of a better and more consistent quality than that produced by mixing concrete at the building site.

The picture below was taken in 1990. It shows the Maleny Concrete Batching Plant located next to the High School. In theory, batching plants can recycle all the water they use. In practice, they may leak and cause alkaline runoff to occur. While mitigation activities can be undertaken, they can also be noisy and dusty and can generate heavy vehicle traffic, which can congest roads. Road surfaces that are not sturdy enough to carry the heavy weights of the trucks that supply the plant with sand, gravel, and cement, and transport concrete from the plant can also be damaged.

Social Learning (p. 28)

Social learning is a philosophy; that is one who is interested in learning more about a topic, asking questions and analyzing issues (Laland 2004). It is what one person has learned from the collective works of others (Koutsouris and Papadopoulo 2003). An individual can learn how to do something by observing others and gaining knowledge from the influences of others around them and from the past (Sim and Manz 1982).
Information is gained and accessed by deconstructing information from the past and critically analyzing it so that it may by useful in current times (Koutsouris and Papadopoulo 2003). Social learning can be a fast way to gain information through observation and interaction with others- that is, learning from others (Gruter, Leadbeater, and Ratnieks 2010).

Social learning must be procedural and process learning, as well as address issues of social structure (Koutsouris and Papadopoulo 2003). This means that individuals must not only use the knowledge given to them, but also contribute information themselves. Social learners benefit from the knowledge gained from those in society and both in the present and the past (Laland 2004).

Sharing information ensures that society advances and that knowledge is passed on, ensuring knowledge and information is constantly being updated, improved, and advanced (Gruter, Leadbeater, and Ratnieks 2010).

Gruter, C., E. Leadbeater, and F.L.W. Ratnieks, 2010. Social Learning: The Importance of Copying Others. Current Biology 20(16): 683-685.

Koutsouris, A. and D. Papadopoulo..2003. What is Social About Social Learning. The Journal of Agricultural Education and Extension 9(2): 75-82.

Laland, K.N. 2004. Social Learning Strategies. Learning and Behaviour 32(1): 4-14.

Sims, H.P. Jr. and C.C. Manz. 1982. Social Learning Theory: The Role of Modelling in the Exercise of Leadership. Journal of Organizational Behaviour Management 3(4): 55-63.

Social Capital (p. 32)

“Social capital applies to peoples’ shared expectations, norms, values, and beliefs, their commitments to each other and eventually their associative capacities to knit the ‘social fabric” (Landhauber and Ziegler 2006). Broken down, this definition states that social capital is the value that community engagement, social involvement, and communication can have to individuals.

Social capital is identified once there has been a benefit to the parties from this social interaction and commitment (Coleman 1988). It is a resource that can be created through networks, communication, and personnel connections (Baker 2001). Social capital is something that can be found and developed in a family or a community situation (Coleman 1988).

Social capital implies that there will be greater assets to the community once individuals are socially connected (Landhauber and Ziegler 2006). Individuals who have obtained social capital tend to have a stronger sense of community and belonging and as such unite together (Blair and Carroll 2008; Baker 2001). It is to do with the quality of relationships and what benefits individuals can bring to each other (Landhauber and Ziegler 2006). In order for social capital to be successful in a community, there needs to be a level of trustworthiness in the social structures (Coleman 1988).

However, social capital can have a negative side, in that it excludes particular groups of people and forms high standards and guidelines that must be conformed to within that community (Blair and Carrolll 2008). That aside, it can be a very beneficial way to connect and commit to community members and feel a sense of belonging.

Blair, J.P. and M.C. Carroll. 2008. Social Capital. Economic Development Journal 7(3): 42-49.

Baker, W. 2001. Social Capital. Executive Excellence 18(8): 9.

Coleman, J. 1988. Social Capital in the Creation of Human Capital. The American Journal of Sociology 94: 95-120.

Landhauber, S. and H. Ziegler. 2006. Social Capital. The International Online 8(1).

Lindsay Kruger (p. 31)

Lindsay felt that at the time the community was becoming more aware of the importance of the creek and environmental issues in general. Creeks were becoming much more than just drains and were an important feature of the area. He was aware FABS had widespread support throughout the community, as was evidenced by number of signatories to the petition and the success we had in fundraising.

“I was incensed by the way powerful groups like big business could overrule community,” said Lindsay, “After FABS I felt more confident, more empowered. I recognized that ordinary people who were informed, persistent, and organized could achieve a positive result.”

“FABS was an altruistic group. None of us stood to gain personally from the batching site going elsewhere. It was only the creek and the community in general who benefited from our actions,” continued Lindsay, “However, Centenary Drive residents benefited due to not overlooking a heavy industry site and having their real estate values negatively affected as a result.”

One of the strengths Lindsay observed in FABS was that its members came from diverse backgrounds and brought their different ways of seeing and valuing the world to bear on the batching plant issue. Members brought these differing perspectives to bear along with intellect and skills. It was also important that we believed in the institutions and structures of the day and needed to work within them to achieve a positive result.

“People with money rely on opponents simply ‘going away’ over time,” advised Lindsay, “You have to have stamina, persistence, and foresight. The initial emotion of the issue will not be enough to carry you through. Look objectively at the issue that faces you. Is the issue a concern? Can community be informed, learn and teach each other about the issue? Will the community become involved? Is the law on your side?”

Lindsay felt that, like any other group, there was conflict within the FABS group from time to time, but the group was really focused and energy went into that focus.

“We did not lose sight of the issue,” concluded Lindsay.

Lesley McClure (p. 33)

Lesley told me she had been involved in other environmental campaigns, mostly associated with groups

who were on the far left of politics, before she moved to Maleny. She observed in these earlier endeavors that conflict seemed to be endemic in these earlier groups with whom she worked, and that folk involved were always arguing and trying to score points off one another - even though they may have been working towards a common goal - in an effort to bolster the validity of a particular ideological view point to which they subscribed. Conflict, according to Lesley, seemed to be the norm on the extreme left and right of politics, leading it to be very often expressed in group settings.

However in FABS, Lesley observed that, while there was conflict, it normally never occurred over practical things such as fundraising or discussions on tactics regarding the most appropriate course of action to achieve a desired result. There was no point scoring for the sake of ideology as people focused on the common goal.

Lesley felt that FABS was a great personal learning experience encompassing everything from aquatic ecology to law to politics. Like others, Lesley also felt that being involved in FABS was personally empowering in that it led her to see that she could use her skills and knowledge to make a positive difference in her community.

Cyanobacteria (p. 42)

Cyanobacteria were originally known as blue green algae, but in the 1960s were renamed as a bacteria (Haselkorn 2009). They can be present in many different waterways: coastal, estuarine, and eutrophic inland (Paerl and Fulton 2006). Cyanobacteria blooms occur from the combination of many conditions; such as nutrients, warm temperatures, an amount of light penetration, low turbidity, and the correct air and water circumstances (Ressom et al. 1994). This bacterium is such a concern because of its extreme adaptability and the way it has evolved through history to suit different environments (Paerl and Fulton 2006). Rainfall is a contributing factor to the spread of the bloom, as it transports nutrients from the land into the waterways in the form of runoff (Queensland Government 2003). Cyanobacteria need a supply of iron to grow and are distinguishable as blooms on the water surface (Ressom et al. 1994). They can be many colors - brown, red, green or blue- and can be many inches in thickness (CDC 2011). There are many environmental and human health issues associated with Cyanobacteria, including impacts on water quality, fisheries, and sea creatures. Specifically, cyanobacteria impacts corals, seagrasses, mudflats and infauna by overtaking and smothering them (Paerl &

Fulton 2006). Some forms of Cyanobacteria have extremely harmful toxins that are known to scientists as some of the most poisonous natural poisons (CDC 2011). Cyanobacteria is dangerous to the environment because it blocks sunlight from the water, thus reducing nutrients and oxygen within the water body on which marine life depends (CDC 2011).

The problem with this bacterium is how quickly the blooms form in optimal conditions (Ressom et. al. 1994). Cyanobacteria blooms cause problems to humans and their health (Paerl and Fulton 2006). In humans, Cyanobacteria has been known to cause gastroenteritis, skin and eye problems, and kidney and neutrotoxicity (Ressom et al. 1994). One of the most effective management tools in preventing the spread and formation of Cyanbacteria is to reduce the nutrient load entering the waterways, especially occurring from pesticides and fertilizers (CDC 2011).

Centers for Disease Control and Prevention. 2011. Facts About Cyanobacteria & Cyanobacterial Harmful Algal Blooms. Department of Health and Human Services, Washington, D.C. Available at: http://www.cdc.gov/hab/cyanobacteria/pdfs/facts.pdf

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Lyngbya *(Lyngbya majuscula)* (p. 43)

Lyngbya majuscula, also known as 'fireweed', 'mermaid's hair' or 'stinging limu' is a species of cyanobacteria, or blue-green algae. Cyanobacteria are among the most ancient life forms on the planet and have been around for 3.5 billion years.

Lyngbya contains toxins that can induce severe skin rashes, eye irritation, and breathing difficulty in people that come into contact with it. Lyngbya grows as tufts of long filaments in shallow, warm, and clear marine waters, and can form intense blooms. Few organisms directly graze Lyngbya and intense blooms can affect the marine food web, biogeochemical cycles, and coastal habitats.

Judy O'Neil (p. 44)

"My first encounter with Lyngbya was the plastic bag that Peter Oliver brought into the lab. My first glimpse of it in the field was at the Bongaree boat ramp where we were launching the boat and it was floating in the water. My first underwater view was in Deception Bay on a trip with Greg Savige. I was amazed at how much of the seagrass was covered by Lyngbya and how 'hairy' it was. It reminded me of the bloom in the Bahamas that we had seen, where I likened the bloom to a field of troll hair.

My memorable encounter was working on it at the Bribie Island Caravan Park where I worked on it all day outside on the front steps, sorting it for bioassays. Even though I had been outside in good air, that night my eyes swelled up and my throat swelled up and I began to wonder where the closest emergency room was located. It seemed like an allergic reaction that was very scary, I was pregnant and I was worried about the baby as well as myself. I took an anti-histamine which helped. On one field trip, Simon Albert was driving back to the university and he had to wear his facemask in the car because of the Lyngbya samples in the rear were causing his eyes to water.

I once picked up some seagrass and Lyngbya and there was a deadly blue ringed octopus hiding beneath it, which I barely missed picking up with no gloves on, which was very scary. I remember finding an amazing patch of rotting Lyngbya that was rolling around in a deep gutter next to the Eastern banks of Moreton Bay. We could smell the sulfur from this rotting mat on the surface. And then, several years later when I returned with the crew from National Geographic for the Critter Cam project, we watched the green sea turtles behavior from the cameras we attached to their shells. The turtles were swimming to the bottom, and were hiding under the rotting mat of Lyngbya, which was another possible source of exposure to the Lyngbya toxins.

The Lyngbya project was very rushed, with intense public attention. Sometimes, we were not able to perform some of the basic science because of the push to address the management issues. This was stressful and left some holes in the basic biology and physiology. When I did some subsequent research in Florida, we were able to conduct some of this basic physiological research without the intense public pressure and time constraints."

Greg Savige (p. 44)

“We had Peter [Oliver] knocking on our door when he was starting up the catchment association. But being with the government- and we weren’t very trusting of the government after they shut down Pumicestone Passage for commercial fishing- most fishermen didn't want to have anything to do with government associations. But Peter persisted even after I said, “No”, but Julie [Savige, Greg’s wife], being Julie, said, “Yes, we’ll do it.” Julie couldn’t make the first meeting, so I went along and it turned out to be the best move I ever made. I got completely involved to the point where I was President of the Pumicestone Passage Catchment Association at one stage.

We had this blue-green algae growing, not to the extent that we couldn’t work, but it was causing this burning and other symptoms. We made phone calls to various government agencies and to council, but nobody would have a bar to do with it. I took some along to one of the meetings and gave it to Peter. That’s when Judy [O’Neil] came into it and identified it for us.

Peter printed off a map of the area and showed it to me, so I drew on the map where I knew the Lyngbya was growing. When Andrew [Watkinson] came along, we had something to show him. For the monitoring that I now do for EPA, I use a GPS and record the longs and lats, but in the beginning, the hand drawn maps were the best we had.

We had a community meeting in Caboolture with several ministers attending: Minister for Health, Minister for Agriculture, and relevant politicians. We met with the DG [Director General] for Environment, Barry Carbon, and he was a typical government worker who had the answers for everything. I said to him, “This stuff burns your eyes and your arms,” and he referred to his notes and said, “No, the algae doesn’t do that.” I told him that it affected your private parts as well. He grabbed the bucket off me and took some photos. I could see him rubbing his eyes and when he came back, his eyes were watering. What a ripper. We got our twenty thousand dollars, and our big mistake was not asking for more money.

I trawled up in Hervey Bay and got such a bad rash I had to walk bowlegged back on shore. At the ramp, I said to the deckhand who had been in jail a couple of times, “Mate, you’re off this boat when we get in, I picked up something from you in the toilet.” He said, “You’ve got a case of the ‘dick-weed.” It was most embarrassing. On the way in, I was thinking, “What I am going to tell Julie? How can I explain this rash when I get home?”

One day, out on my boat with Peter Oliver, I felt a bit awful,

putting Peter on the spot, when I asked him if he was really going to do something about this blue-green algae. But I found out that he was very passionate, real fair dinkum and had principles. We became friends after that conversation when I learned what Peter really was about.

Recently, I spent five years trying to get the local government the ability to use coastal management plans to get developers who were putting nutrients (iron, phosphorus, nitrogen, etc.) that caused harmful algal blooms into the water. It took nearly five years at different meetings to get that legislation passed. We had to fight the housing industry and other opponents, but it's in there, so councils have the ability to protect the water.

There still is a bit of Lyngbya around. I saw some at the mouth of the little creek that comes from the sand mine. Bit of worry, that sand mine has gotten massive. But one of the things that came from the Lyngbya research is that they keep the land flooded now, so they don't have the acid sulfate runoff. We have progressed, believe or not."

Andrew Watkinson (p. 50)

"My first knowledge of Lyngbya was on my first field trip to Straddie as part of the Brisbane River and Moreton Bay Wastewater Management Study. I was helping out on a few of the Marine Botany projects, and when I learned Lyngbya was something that had a direct impact on people, it was of interest to me. My Honours project on Lyngbya was the first time that I had an opportunity to lead a project, so it was very exciting for me.

The late bloom of Lyngbya and the GC [gas chromatograph] that was not working starting ringing alarm bells for my Honours project. But the Lyngbya eventually did show up and it showed up with a vengeance that year—it really went berserk. I had a long time to prepare and when it did get started, I was good to go. Once it started, it was with all guns blazing.

It was funny, but I never had a severe reaction to Lyngbya. Some of the people I took on field trips would end up with red, swollen eyes though. But after spending full days in the water with Lyngbya for an entire summer, my skin would get irritated on my neck and my joints.

I remember the time that we got stranded at low tide on Amity Banks. It was a lovely wait for three or four hours,

but we did some opportunistic sampling with the PAM [Pulse Amplitude Modulated] fluorometer while we waited for the tide to come in. I also recall the time we almost got stuck aboard the big new university research vessel with the Lord Mayor on board up in Deception Bay. I remember having to push the boat and navigate in front of the boat with snorkels to find patches of deeper water.

Greg Savige was fantastic. One of the things that I would do is listen to the weather forecast and hear about some high wind warnings. But before I would cancel the field trip, I'd ring Greg and tell him the forecast, and he'd say, "Rubbish, it will be fine." And it would. He had an incredible knowledge of the weather and conditions. And he also was invaluable in showing us around the field site and how it functioned.

We were sampling once on Bribie Island after rainfall and the standing water on the dirt track that we were driving on was so black you couldn't tell how deep it was. We would send someone ahead on foot walking through these ponds. They were mostly only ankle or knee deep and we could drive through, but we couldn't tell by the color of the water. It was incredible how organically rich the island was, these black waters were visible emanating from the creeks from an airplane.

I remember taking David Waite and his crew on a field trip up Pumicestone Passage. It was a miserable day, and I was the only one with a proper spray jacket. They were drenched when we got back to the Bribie Island Caravan Park. And then Ian [Hewson] backed the trailer into the fence and dented it. But that was what I loved the most about my research was the great times we had as a team living and working from the Bongaree Caravan park and out on the sandstone point sandbanks.

One of the biggest things I learned from the Lyngbya project was that there are no simple answers. In my Honours, we learned a lot, but we never had the full story. There were always more questions, in spite of the amount of knowledge we gained. As a student, I was optimistic and thought that I would be able to find THE answer."

Dugong (*Dugong dugon*) (p. 80)

Dugong (*Dugong dugon*) are herbivorous marine mammals that feed almost exclusively on various species of seagrass. Their feeding has been termed 'cultivation grazing' based on their repeated grazing on specific seagrass meadows. The repeated grazing maintains the seagrass

meadow in a colonizing state, with juicy, sweet rhizomes (underground lateral stems) that dugong prefer. There is a quasi-symbiosis between seagrass roots and the microbial community of nitrogen-fixing bacteria in the root microzone.

In this way, the seagrasses can replenish their nitrogen through uptake of the nitrogen fixed in the root microzone and repeated grazing by dugong does not deplete the nitrogen. Thus dugong can graze these productive seagrass meadows month after month, year after year, decade after decade, century after century and even millennia after millennia.

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Communication (p. 99)

Communication can be described as a set of activities undertaken on a daily basis, such as obtaining information, conversing, entertaining, and being entertained (Carey 2002). Communication is a teachable skill as well as something inbuilt into human nature and understanding (Zoppi and Epstein 2002). Communication originates from the Latin word communicare, meaning to “impart, share or make common” (Durham Peters 1999, p.7). Darwin was particularly interested in the idea of communication-human language and signals in particular (Hauser 1996). Funnily enough, communication was originally the word used for intercourse, as the meaning applied to human dealings (Durham Peters 1999). To put it simply, communication in modern times means to have access to information and knowledge (Durham Peters 1999).

Communication has many different functions in symbols and speech, understanding, interaction and social processes, transfer/transmission or interchange (Dance 1970). There are many different ways to communicate: transition (broadcasting), consultation, conversation and registration (Spurgeon 2009). Irene Leonard (2010) has identified seven steps in which to obtain successful communication in the workplace or personal relations. These are: verbal communication, good listening, sound counsel, openness, curiosity, value, and persuasion (Leonard 2010). Everything in nature communicates to each other in some form, even though there are often constraints in the effectiveness of this (Hauser 1996). Communication is how social bonds and relationships form in society (Carey 2002). Communication should have some

form of reciprocity, both in technological communication and in personal and interpersonal relations (Durham Peters 1999). Since post-industrial media, mass communication has been deployed; that is, communication on a global scale via internet and mobile connectivity (Spurgeon 2009). Modern technology enables us to move information on a much faster scale and communicate to a much larger audience (Hauser 1996). Modern inventions of technology have solved previous issues with communication, such as electricity closing the gap of distance (Durham Peters 1999).

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Saltwater Church II by Peter Oliver (p. 118)

"This painting of a hammerhead shark, the moon and a stingray is what the artist, Peter Hudson, calls authentic art. Authentic art is where he will get an image in his mind for one, two or three things that he will draw quickly. From this drawing, he will form a basis for a painting and he will not change where the objects are on the page, as he has learned that moving the objects changes the art in a way that it does not work. He can't tell where the inspiration for the original drawing comes from, but it is this inspiration that forms his paintings.

In Saltwater Church Two, the view is looking up from the bottom of the sea toward the sky. Peter Hudson said that

the painting is about a church, not a church building, but a spiritual experience. When a fisherman, Greg Savige, looked at the painting for the first time without ever meeting the artist, he said ‘That is two days off the full moon, and you can see from the thickening on the dorsal side of the ray that it is two days off giving live birth to one hundred to one hundred and fifty baby rays.’ My response was ‘Holy snapping ducks’.”

The Windover by Peter Oliver (p. 119)

“The poem, ‘The Windover’ by Gerald Hopkins, about seeing a kestrel or other bird of prey, resonated with me. It is about how a bird maintaining a stationary point in the air is magical.

You go, ‘Wow, how amazing is that?’

This poem is a difficult poem, as the language is all over the place. Hopkins used different rhythms and rhymes, forming language in odd ways. He was a religious man and he saw God in nature everywhere he turned. When you see nature in this way, you see explosions of brilliance that allow you to see a huge life force in nature. Hopkins managed to put that into words in a way that is understandable to me.”

The Windover

by Gerald Hopkins

I caught this morning morning's minion, king-

dom of daylight's dauphin, dapple-dawn-drawn Falcon, in his riding

Of the rolling level underneath him steady air, and striding

High there, how he rung upon the rein of a wimpling wing

In his ecstasy! then off, off forth on swing,

As a skate's heel sweeps smooth on a bow-bend: the hurl and gliding

Rebuffed the big wind. My heart in hiding

Stirred for a bird, – the achieve of, the mastery of the thing!

Brute beauty and valour and act, oh, air, pride, plume, here

Buckle! AND the fire that breaks from thee then, a billion

Times told lovelier, more dangerous, O my chevalier!

No wonder of it: shéer plód makes plough down sillion

Shine, and blue-bleak embers, ah my dear,

Fall, gall themselves, and gash gold-vermilion.

Phosphorescent Bay by Bill Dennison (p. 122)

“Phosphorescent Bay is the English translation for *Bahia Forforescente*, a little embayment surrounded by mangroves in Puerto Rico that has permanent blooms of a dinoflagellate, that are these microscopic phytoplankton that, when disturbed, emit bioluminescent light. For two years, I taught a class in Puerto Rico and took the class there.

Imagine if you will a pitch-black night, a moonless night, no clouds, the Milky Way and the stars overhead, and then beneath you, sparkling dinoflagellates in the water. Three hundred and sixty degrees of stars because the little dinoflagellates in the water. Fish that swam through the bloom would leave a trail. Fish jumping would stream the bioluminescence as the water ran off them. When we jumped into the water we could hear manatees (our dugong equivalent) snorting around. Then, when the people are in the water, swimming, they are creating an outline. Nobody on that trip has forgotten that night, for the rest of their lives. That transformed them. That changed them forever.

In the Bahamas, they had a phosphorescent bay, and they had so many tour boats coming in that they dredged the channel to allow more tour boats. They changed the hydrology, and the dinoflagellates went away. Puerto Rico fortunately learned their lesson. Their bay remains intact. But this is a very powerful thing. If you experience this, you’re at one with nature. You’re at one with your God. You’re at one with yourself in a way that is truly powerful. For that brief instant, you feel like a creature on this tiny speck of a planet in this universe of stars, surrounding by these living things.

It is hard to remember that because we get trapped about our emails and our cell phones and our busy lives and our possessions, that we forget how primal and insignificant our lives and our place in the universe are. But occasionally, when we get these experiences, these educational experiences, they’re transformative.”

Hands, head and heart (p. 151)

Integration of hands, head and heart to create social, economic and ecological change. Leadership promotes the attitude of ‘We care’; technical input informs to obtain ‘We know’; and resource management enables ‘We can’ - so that these community values enable change.

Bluefish (*Pomatomus saltatrix*) (p. 164)

The bluefish is a common tropical and subtropical fish and Bill has caught and eaten them in Chesapeake Bay and in Moreton Bay, where it is known as ‘tailor.’ This symbol and Bill share an American and Australian distributional range. In Australia, they tend to be smaller, but in both locations they are delicious if cooked and eaten shortly after being caught.

The Water Waltz (p. 166)

By Peter Oliver and Bill Dennison

There are more and more people everyday

Who like to live on a waterway

Guess what we people do

We make lots and lots – of poo!

We flush our wastes away

And hope that it will be OK

Don’t spend much to clean the stuff

The future sure looks rough!

We let our soil wash away

Right into our streams and Bay

Our creeks and streams turn real brown

From where we are on down!

Bridge

So do the right thing

Take your partner by the hand

We're all in the same boat

Come waltz ain't it grand, da, da, da!

Chorus

Come do the Water Waltz

Shake a leg, do the Water Waltz

Latest craze to hit the town!

Come do the Water Waltz

Shake a leg, do the Water Waltz

Let's have clear blue seas – not brown!

We gotta sample the water

Gotta sample the mud

We gotta sample in the dry

Gotta sample in the flood!

We gotta sample the veggie

Gotta sample the meat

'Cause it's the flora and fauna

That make it complete!

There are signs we all should heed

When the waterways begin to bleed

Seagrass beds get choked in time

With algal blooms and silt and slime!

Bridge and Chorus

Let’s test what we’re doing

Let’s act on results

Then have a good time

Doin’ the Water Waltz!

Bridge and Chorus

The many faces of Peter Oliver (p. 208)

Teacher

Adventurer

Traveler

Musician

Philospher

Family man

Ann Oliver

Peter's Family (p. 220)

Peter and his parents

Peter and Ann's wedding

Peter's children – Jayne, Katie, and Michael

Bill's Family (p. 223)

Bill and his family on a whale watching trip, Hervey Bay

Bill, Lizzie, and Laura Dennison, and Judy O'Neil