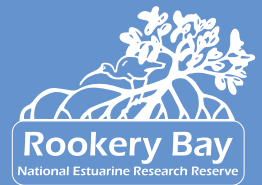


Restoring the Rookery Bay Estuary

through collaborative watershed management



Getting the water right

The Rookery Bay National Estuarine Research Reserve manages 110,000 acres of land and water including the downstream receiving waters of the Rookery Bay watershed. Located between Naples and Marco Island in southwest Florida, the Rookery Bay watershed historically provided fresh water runoff to the estuary through sheet flow which supported the delicate balance between fresh water and salt water necessary to maintain estuarine health. In the 1960's, an intricate system of canals, weirs, ditches, and ponds was developed to shunt water off the land to prevent flooding in the rainy summer season and hold back water in the dry winter season. This system has changed the natural sheet flow patterns and channelized the fresh water which now enters the estuary through ten discharge locations. As a result, the Rookery Bay estuary experiences higher mean salinities and extreme salinity changes which affect estuarine species and the ecosystem services provided to the community. Water managers must balance the competing needs of preventing flooding, recharging aquifers for drinking water supplies, and providing adequate downstream water for estuaries.

Restoring the Rookery Bay Estuary Project

To address the issues of altered freshwater flows and potential downstream impacts in the Rookery Bay estuary, the Restoring the Rookery Bay Estuary Project took place from 2012 through 2015 and focused on collaborative watershed management through hydrologic, ecologic, and social science research, education, and partnerships. Guided by a diverse stakeholder group, the effort was coordinated by the Rookery Bay National Estuarine Research Reserve and resulted in an array of management recommendations (see back page).

The project focused on:

- A better understanding of altered freshwater inflows to the Rookery Bay estuary and how that has affected the ecologic health of the estuary, and,
- A better understanding of local water resource decision-making, at both the personal and institutional levels.

The project was funded by the National Estuarine Research Reserve System's Science Collaborative, which puts Reserve-based science to work for coastal communities. The Collaborative's projects engage those who need the science into the research process.

Watershed management process

The project team utilized a watershed management process which included a series of cooperative, iterative steps to:

- Characterize existing conditions,
- Identify and prioritize problems,
- Define management objectives, and
- Develop and implement protection or remediation strategies as necessary.



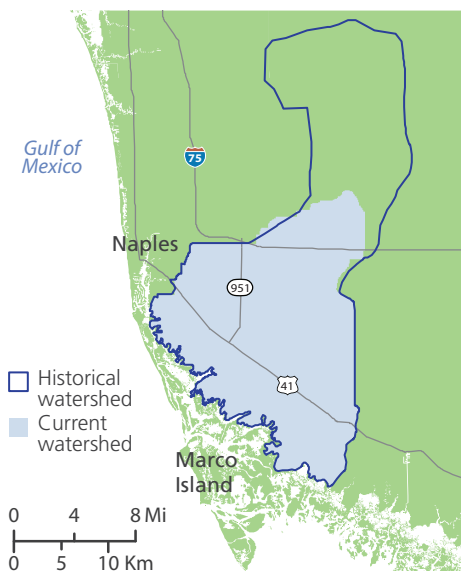
Volunteers build oyster reefs to restore estuarine habitats.

Characterizing existing conditions

About the watershed

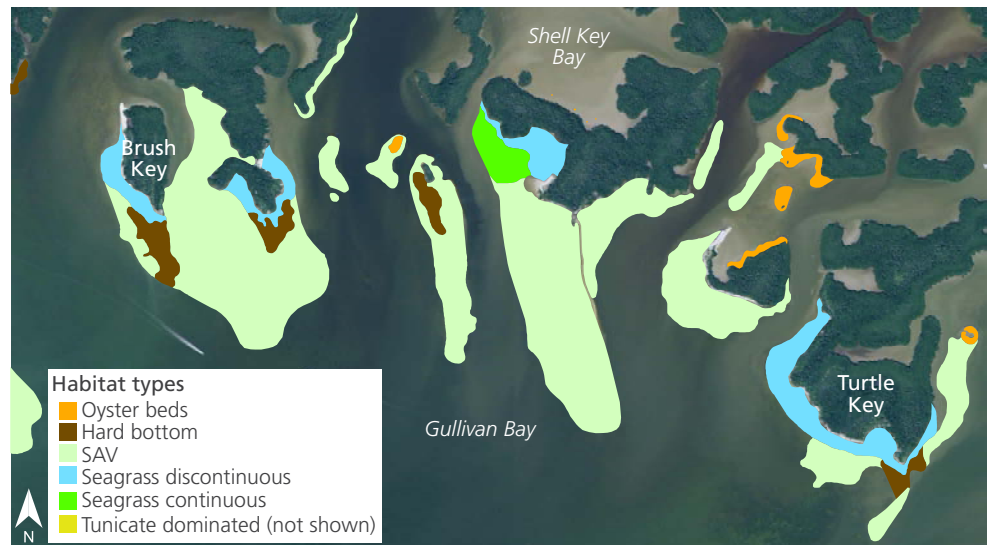
The Rookery Bay watershed is located between Naples and Marco Island in southwest Florida and was the focus of a strategic watershed management approach that characterized the watershed and health of the downstream estuary to identify and prioritize management recommendations. With input from a diverse advisory committee of local experts, the following conclusions were drawn:

- Land uses are varied and include housing, golf courses, rock mining, farming and preserve lands.
- The current watershed is 167 square miles and the historic watershed was 247 square miles. This 80 square mile difference has been caused by the construction of roads and canals.
- The overall amount of fresh water in the watershed has not been substantially altered. However, the distribution of fresh water entering the estuary has been changed and this provides an opportunity for restoration.
- Most of the 128 miles of flow-ways in the watershed are made by humans and include canals, ditches, and swales that are managed by the South Florida Water Management District and Collier County.
- The Collier County watershed Plan identifies 25 potential watershed restoration and management projects that could take place. This effort identified several additional projects.



Mapping aquatic habitats

Aerial photos of the Rookery Bay Reserve, taken in December 2014, were interpreted by Scheda Ecological Associates and Taylor Engineering to identify submerged aquatic habitats. This data was compared to historical aerial photos that were assessed for habitat signatures with the goal of identifying habitat changes over an 85-year timeframe in the Rookery Bay estuary. Benthic, or bottom, habitat signatures included seagrass beds, algae, hard bottom, and oyster reefs. This effort represents a baseline of conditions which can be monitored over time to identify changes and possible causes that can be addressed through management.



Results from mapping below-water habitats in the Ten Thousand Islands revealed six different habitat types present.

Understanding local attitudes about water

To understand how water is used and appreciated in southwest Florida, Nova Southeastern University was hired to research water attitudes, beliefs, and behaviors by interviewing local stakeholders. Results from this study can help water managers proactively resolve problems and implement collaborations with local experts based on what is important to the community.

Participants consider economic factors when making decisions about water use.

Water-related decisions seem to be based on belief systems.

Water is a primary draw for the community.

Participants link scientific data to water-related decision-making.

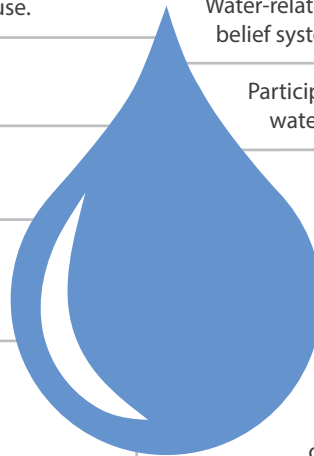
There are perceived tensions between stakeholders.

Participants would like more inclusive water management and believe better communication would foster collaboration related to water management.

Participants perceive unequal enforcement of water-related regulations.

Lack of understanding of water management practices contributes to conflict.




Conservation-related professional behavior seems to positively impact personal conservation-related behavior.



Understanding fishery trends

The purpose of this research project was to compare the results of three studies and identify trends in fish community composition and abundance. The results indicated that there have been significant changes in the fish communities of the Rookery Bay estuary since the 1970s, and these changes may be attributable to water management practices and possible habitat loss from resulting hydrologic conditions.

- Most changes occurred between the 1970s and 1990s, which corresponds to the installation of weirs in the headwaters of Henderson Creek in the 1980s.
- The composition of fish communities among four different sampling stations have become more similar to one another over time, possibly resulting from the loss of seagrass habitat observed in some locations.
- Wet- and dry-season differences in fish assemblages have increased, which could also be the result of hydrologic alterations in the watershed.
- The species of fish present in Rookery Bay has changed over time, which may be due to changes in salinity patterns, bottom types, food availability, or a combination of environmental factors resulting from alterations to the freshwater inflow to the estuary.

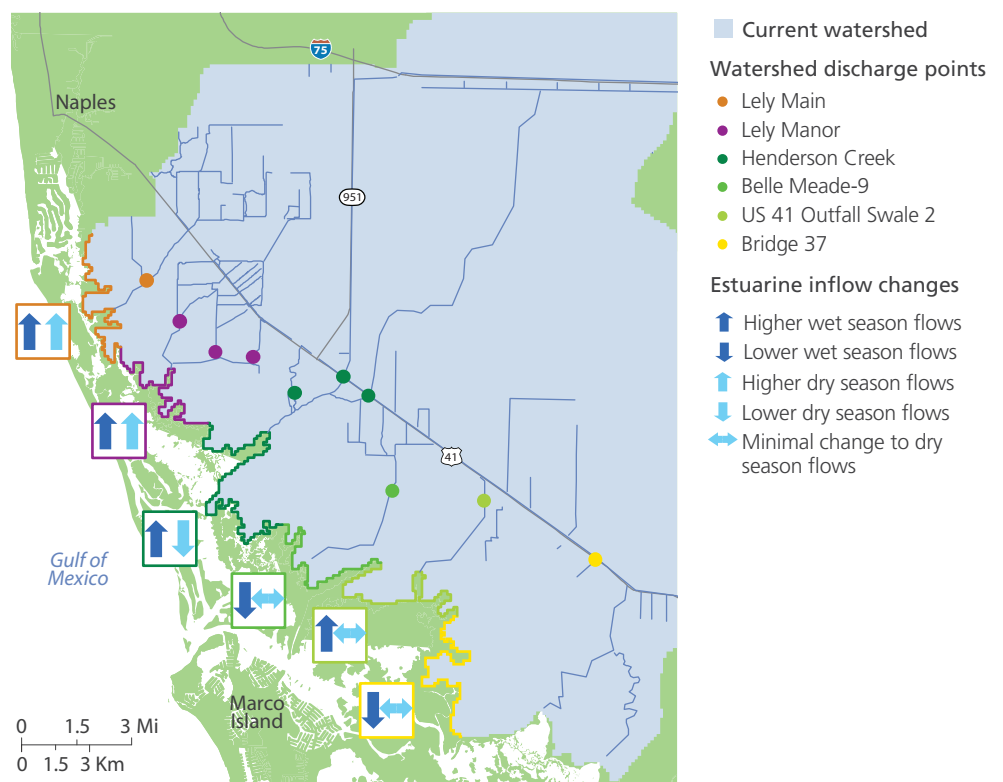
Fish composition by study year				
Fish Species		1970s	1990s	2010s
Bay anchovy		1%	6%	18%
Mojarra		30%	65%	58%
Pinfish		46%	5%	11%

The percent composition of total catch of three fish species which were all present during the three studies.

Identifying freshwater flows

To understand how fresh water reaches the Rookery Bay estuary, hydrologic modeling was used to create a computer-based representation of the water cycle, which is the movement of water on, above, and under the earth's surface. Data inputs included precipitation, evaporation, transpiration, irrigation, and land use. A local scale model was created for the Rookery Bay watershed and was based on models used by Collier County and the South Florida Water Management District. Results included:

- When compared to historical model results, freshwater flows at all ten watershed discharge locations have been altered by the construction of canals, roads, and developments with varying effects on the timing and amount of water reaching the estuary.
- In areas with medium to dense residential development, current flows were greater than historical flows year round.
- Two sub-basins east of Henderson Creek typically showed water deficits, likely due to flow diversions into canals, or flow obstructions such as developments and roads.



The historic watershed was 247 square miles of undeveloped wetlands that provided fresh water to the estuary through uninterrupted sheet flow. The current watershed is 167 square miles with ten freshwater discharge locations. The arrows (map above) show the changes in flow under current conditions when compared to historic conditions.

Management recommendations

Based on the best-available science, the following recommendations support the restoration and continued health of the Rookery Bay watershed and estuary:

Address altered flow distributions by correcting inflow excesses and deficits by sub-basin. The general trend is excessive flows to the west of Collier Boulevard/Henderson Creek and deficits to the east.

Restore hydroperiods within the southern Belle Meade flow-way to historic conditions by mitigating the draw-down and draining effects of nearby canals (Collier Boulevard/Henderson Creek, US 41, and I-75 Canals).

Increase dry season flows to the Henderson Creek sub-basin to as close to historic levels as possible (3–5 cubic feet per second).

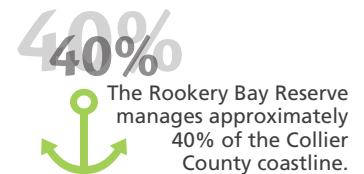
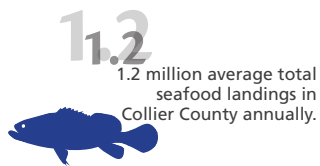
Increase comprehensive and inclusive watershed planning and prioritization in the region to better accomplish cost-effective management goals, including the implementation of these recommendations.

Complete a salinity model for the estuary and couple it with the Rookery Bay watershed model to develop a comprehensive and predictive upstream/downstream management tool to evaluate restoration efforts and capital improvement projects.

Conserve the remaining habitat of economically-important species and guide restoration efforts in impacted areas by monitoring juvenile sport fish, such as snook, tarpon, and redfish/red drum, that were not represented in the reviewed fisheries studies.

Establish comprehensive monitoring and mapping efforts at the 10 watershed discharge points and the corresponding downstream open water estuary sites to evaluate the success of restoration projects.

Conduct comprehensive mapping of submerged habitats in the Rookery Bay estuary, including species identification and on-going monitoring, to determine if management recommendations are effective in restoring lost fisheries habitat.



Project Advisory Group

The Project Advisory Group (PAG) was comprised of stakeholders with knowledge and expertise in water resources management including representatives from local, state, and federal governments, non-profits, and the business sector. Contractors were included on the PAG to provide technical advice as necessary. A series of thirteen meetings were convened between September 2012 through May 2015 with a focus on watershed and water resources management through field trips and presentations.

The Project Advisory Group was formed to advise and guide the research process, and included approximately 30 stakeholders.



Rookery Bay Reserve

Funding for this project was provided to the Rookery Bay National Estuarine Research Reserve in 2012-2015 by the National Estuarine Research Reserve System's (NERRS) Science Collaborative which is a cooperative agreement between the National Oceanic and Atmospheric Administration (NOAA) and the University of New Hampshire under NOAA grant NA09NOS4190153.

For more information, visit www.rookerybay.org/restoreRB
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