



adapting to climate change

Maintaining ecosystem services for human well-being in the Verde Island Passage, Philippines

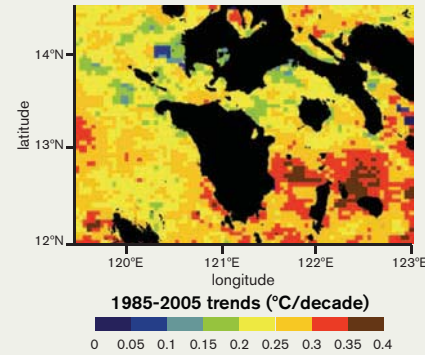
The Verde Island Passage in the northern Philippines is located within the globally significant Coral Triangle, an area considered the center of the world's marine biodiversity, and as such, has a wealth of coastal marine resources that support the livelihood and well-being of over 7 million people living in the five surrounding provinces. Climate change has already altered the balance of the oceans with serious and irreversible consequences for marine ecosystems and the services they provide. The disruption of ecological functions and ecosystem services has severe impacts on the human communities, especially in coastal areas like the Verde Island Passage, where dependencies on the oceans are high. Immediate and substantial actions need to be taken to increase the adaptive capacity of coastal marine ecosystem and the people that depend on them. Adapting to climate change is the only solution to ensure ecosystems and human societies can survive and maintain their well-being when exposed to climate change impacts.



Verde Island Passage vulnerability to climate change impacts

Increased sea surface temperature

Sea surface temperature varies among years, but an increase of 0.06 °C/decade over the last 100 years and 0.2 °C/decade for the past 20 years has been observed (right). Increases are most pronounced in bays with low circulation, e.g., Mabini.



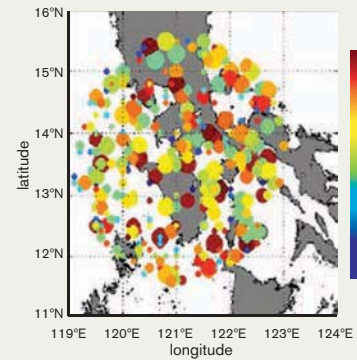
NOKA-Coral Reef Watch

Sea level rise

As sea water temperature increases, it expands resulting in sea level rise. Over the last five years, sea level surrounding the Verde Island Passage has been increasing at 0.5 to 1.0 mm per year.

Increased storm frequency and intensity

Between 1952 and 2008, 160 typhoons passed within 200 km of the Verde Island Passage (right). With increasing sea surface temperatures, predictions are that the number and intensity of storms are likely to increase.



Japan Meteorology Agency

Increased rainfall

Rainfall shows high variability in the Verde Island Passage, but a general increase has been recorded in the region. Although it is unclear how climate change might affect rainfall patterns, increased rainfall is expected in some Verde Island Passage areas.



Ocean acidification

As the ocean absorbs the excess carbon dioxide (CO₂) from emissions released into the atmosphere, the acidity of the ocean increases, dissolving the calcium carbonate skeletons of marine organisms.

Ecological vulnerability

Climate change in the Verde Island Passage has high potential to impact key components of marine ecosystems, including fish, coral, mangrove, seagrass, and seaweed communities. As these communities are highly connected, the combined effects are likely to be even larger.

Fish vulnerability: HIGH

- Many fish species are predicted to be pushed farther offshore due to increased sea surface temperature. In addition, higher temperatures will reduce upwelling resulting in lower ocean productivity and food for pelagic fish species.
- Fish larvae development will be reduced by increasing sea surface temperature and loss of mangrove habitat. Those impacts, exacerbated by salinity changes from sea level rise and increased rainfall, are predicted to reduce fish production by 13-20%.
- Lower fish recruitment, diversity, and abundance is likely to result from habitat loss and decreased habitat complexity due to increased storms and ocean acidification.



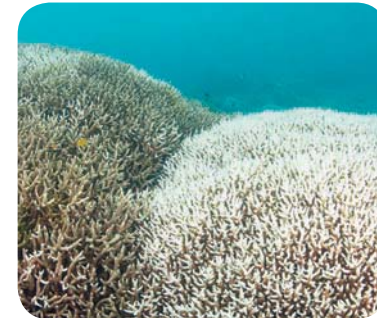
benthic reef fish



fish and coral diversity

Coral vulnerability: HIGH

- Rising sea surface temperature will increase coral bleaching and mortality. A loss of 3-20% in live hard coral cover is expected.
- Ocean acidification will have a negative effect on coral growth and cause reef degradation which will be enhanced by increases in storm events.
- Loss of coral diversity, growth, and cover may occur offshore due to sea level rise, and inshore due to detrimental effects on water quality (nutrient and sediment input) from increased rainfall.



coral bleaching

Mangrove vulnerability: MEDIUM

- Decreased seedling production, survivorship and regeneration, leading to forest degradation, may result from increased sea surface temperature.
- As outer forest edges become too deep due to sea level rise, and coastal development precludes movement onshore, mangrove expansion areas will be reduced.
- Destruction of mangrove forests is likely to result from increased storm events, affecting seedling production.



mangrove forest regrowth

Seagrass vulnerability: MEDIUM

- Extreme heat stress from increased sea surface temperature may impede seagrass growth and reproduction, especially in shallow meadows reaching 35 °C, or periodic rises above 40-45 °C.
- Increased storm intensity and rainfall can cause physical removal and burial of seagrass in sediment runoff, as well as affect salinity, causing shifts to more tolerant seagrass species.
- Sea level rise and increased rainfall may result in seagrass loss due to light limitation, both in deep and shallow areas.



seagrass meadow

Human vulnerability

Natural resources of the Verde Island Passage are essential to the livelihood of the more than 7 million people living in the five surrounding provinces, 30-50% of whom reside in coastal communities. The influence of climate change has the potential to impact not only their livelihoods and infrastructure, but also their food and health.

Fisheries vulnerability: HIGH

- All fisheries, including the aquarium trade, are vulnerable to degradation of coral reef habitat resulting from increased sea surface temperature, ocean acidification, and increased storms.
- Damage to fishing infrastructure such as boats, fishing equipment, aquaculture ponds, and seaweed farms are likely from increased intensity of storms.
- A reduced inshore fish harvest, especially impacting municipal fishers, is likely with degradation of seagrass and mangrove habitats resulting from increased sea surface temperature, sea level rise, and rainfall.



aquarium fishing

Tourism vulnerability: HIGH

- Reduced tourism and livelihood may result from coral reef degradation, and loss of charismatic species (e.g., whale sharks and sea turtles) and inshore habitats as a result of all aspects of climate change.
- Destruction of tourist boats and coastal resorts may result from increased storm intensity and flooding due to sea level rise and increased rainfall.



seaweed farming

Foreshore development vulnerability: HIGH

- Entire villages may be damaged and flooded with serious consequences for human safety and property loss due to sea level rise, and increased storm frequency and intensity, and rainfall.
- Increased storms and flooding due to sea level rise may result in interruptions to commercial operations, causing a loss of production and livelihood.



tourism livelihood

Human health vulnerability: HIGH

- More vector borne diseases and toxic algal blooms are likely to result from increased sea surface temperature, as well as increased flooding from sea level rise, and increased rainfall and storm events.
- More frequent flooding, resulting from increased rainfall and sea level rise, may contribute to pollution from industry and water contamination from wastewater.
- Injuries, loss of lives, and damage to coastal health infrastructure may result from increased storm events.



coastal infrastructure

Food security vulnerability: HIGH

- As a result of all climate change impacts, a reduced finfish harvest resulting from declining fish populations and diversity, may lead to possible food shortages.
- Saltwater intrusion and flooding caused by sea level rise, and increased rainfall and storm events, may degrade agricultural lands and aquaculture ponds, and affect freshwater availability.
- Reduced marine snails and bivalves available for harvest as a result of increased ocean acidification affecting their growth and ability to build shells, thereby negatively affecting food availability.



aquaculture ponds

Climate change recommendations

The following recommendations should be implemented to reduce Verde Island Passage vulnerability to climate change.

Implement:

- municipal management strategies that are climate change-smart and efficiently used, and ecosystem monitoring and evaluation that address climate change.
- sustainable aquaculture practices that minimize the impacts to the natural ecosystems (i.e., low density finfish pens and chemical-free shrimp ponds).
- a review of existing local, regional, and national policies and ordinances focused on resource management and reform to include ecosystem-based adaptation, and enable new frameworks where necessary.
- guidelines and best practices for coastal and foreshore development planning that take into account the potential for increased storm activity, salt water intrusion, and other climate change impacts.

Regulate:

- artificial reef development, channel dredging, and seaweed farming through zoning activities.
- to establish better enforcement of illegal fishing including blast fishing, cyanide fishing, and shark fin fishing.
- use of sustainable fishing gear to minimize bycatch.

Instigate:

- the improvement and retrofit of existing infrastructure to make sure they can sustain climate impacts.
- appropriate engineering of ports, quarries, and foreshore development so as to not impact long shore sediment movement.
- use of best management practices for fishing on coral reefs, seagrass beds, and mangrove forests, and increased enforcement towards illegal and destructive practices (i.e., dynamite fishing and push nets).

Establish:

- climate-smart Marine Protected Areas that apply adaptive management approaches to address current and future climate change impacts.
- outreach programs to create awareness and engage communities on climate change and its impacts on marine resources.

Protect:

- natural mangrove, seagrass, and coral habitats that act as natural coastal defense mechanisms reducing erosional processes and buffering storms and other extreme weather events.
- a variety of habitats including seagrass, seaweed, and mangroves as they support various life stages of multiple fisheries species.
- areas (i.e., Mabini, Puerto Galera), species (i.e., whale sharks), and ecosystems (i.e., mangroves, coral reefs) that sustain important tourism activities, providing income for local communities.

Diversify:

- livelihoods for coastal miners (i.e., pebble picking) to reduce coastal erosion and enable revenues to derive from sustainable practices.
- livelihoods, particularly for climate change-vulnerable activities such as aquarium fishing.
- opportunities for solid waste and chemical disposal that favor the spread of disease, pollution, and burial of important coastal ecosystems (i.e., seagrass meadows and mangrove seedlings).

References

Japan Meteorology Agency. RSMC Best Track Data. Updated 21 June 2009. Storm track data from 1952-2008 within 200 km from Verde Island. Japan Meteorology Agency, www.jma.go.jp/jma/jma-eng/jma-center/rsmc-hp-pub-egl.
NOAA. Sea surface temperature increase (°C/year) in the Verde Island Passage from 1985-2006. NOAA-Coral Reef Watch, coralreefwatch.noaa.gov/satellite.

For further reading

Carpenter, K.E. and V.G. Springer. 2005. The center of the center of marine shore fish biodiversity: the Philippines Islands. *Env. Biol. Fish.* 72:467-480.
IUCN. 2008. Status of the World's Marine Species. International Union for Conservation of Nature Red List, www.iucn.org/redlist.

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