

# **SUSTAINABLE DEVELOPMENT** in the **MARSHALL ISLANDS**

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# Welcome

This course is an international collaboration between the Bay Institute, located in the United States, \_\_\_\_\_ in Japan, and \_\_\_\_\_ in Colombia. This is a 12 day course comprised of an introductory lecture phase, a field work experience, and a lecture wrap-up. Lecture and field learning will cover three components of island sustainability: socioeconomic, marine, and terrestrial.

## Getting to Know the Islands

The Republic of the Marshall Islands (RMI) is a country of over 1200 tropical islands and atolls in the northern Pacific Ocean. Although widely remembered as a US nuclear test site in the 40s and 50s, the RMI encompasses much more than remnants of war. The reefs surrounding the islands are home to incredible biodiversity, with the outer islands and atolls boasting some of the most pristine reef habitat in the Indo-Pacific. The Marshall Islanders have a bright and vibrant culture that centers around the ocean and its bounty. Unfortunately, dense population centers on two islands in particular are leading to rapid environmental decline. This has led to numerous efforts and collaborations to quantify environmental health and preserve the ecosystems of the RMI.

## Geography

The Marshall Islands are composed of 1225 islands and 29 atolls in the northern Pacific Ocean. The land is arranged in two parallel curves; the sunrise chain “ratak” and the sunset chain “ralik”. Although the country spans more than 5,025,000 km<sup>2</sup>, dry land makes up less than .01% of that area. The total area of dry land is a mere 181.3 km<sup>2</sup>. The islands and atolls were formed when ancient volcanoes that had become dormant slowly sunk back into the ocean. Corals colonized the remains and grew to form the land as we see it today, which averages less than 6 feet in elevation. About 66% of the population of the RMI lives in the capital, Majuro, and on the island of Ebeye. Many of the outer islands are scarcely populated or uninhabited.

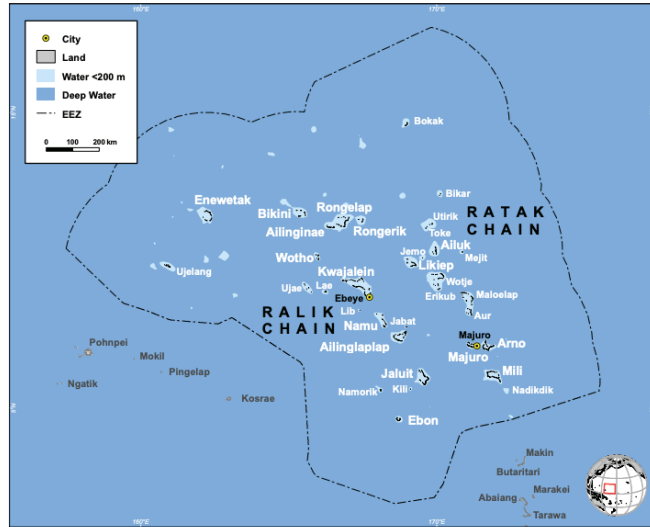


Figure 12.1. Locator map of the RMI. Map: K. Buja.

Figure 1. Maps displaying the location and geography of the Marshall Islands.

## Climate

The Marshall Islands maintain a tropical climate, with temperatures averaging at 27.8 °C and humidity at 80%. Rainfall is common throughout the year but can fall excessively in the wet season, which lasts May through November. The RMI borders the typhoon belt, though these significant storms do not regularly hit the islands.

## Environmental Stressors

### Climate Change

- *Rising sea level* – The average elevation of the Marshall Islands is a mere 2m, which leaves them exceptionally vulnerable to rising sea levels.
- *Coral bleaching/disease* – The Marshall Islands have remained relatively untouched by mass-bleaching events, although it is present in smaller scales. Majuro experienced bleaching events in 2003 and 2006 at depths of up to 10 m. Coral diseases such as *Vibrio coralliit* have been present in the Majuro lagoon, though mortality was low.

### Population Centers

- *Solid waste removal* – There is no sufficient system for managing solid waste on the islands. Majuro's shoreline has served as a dumping ground for trash and

fecal waste, resulting in polluted and plastic-filled reefs. The current landfill is nearing capacity and is a major source of toxic leachate.

- *Coastal development* – Dredging and quarrying along the shoreline has been common practice for decades. These practices increase erosion and can result in the destruction of beaches. Coral community recovery varies significantly between retired sites, with some showing promising growth and others remaining uncolonized.

*Exploitation of Marine Species* – The RMI supports a robust population of high-grade tuna, which has been the target of foreign fisheries. The industry presents unique dangers to other wildlife such as sea turtles and sharks. Shark finning operations occasionally make their way to the outer islands, which can devastate local shark populations. Majuro is also a popular spot for collection of live aquarium fish, with an estimated 52,000 fish exported in 2006.

*Nuclear history* - In the 1940s and 50s, Bikini and Enewetak atolls were utilized by the United States for nuclear testing. More than 65 nuclear detonations were tested on the air, land, and sea surrounding the atolls. Radioactive fallout was carried to Rongelap, a populated atoll, and an estimated 13 others. The tests led to the creation of 5 craters, the largest being 73 m deep. The largest of the detonations, the hydrogen bomb “Bravo” on Bikini Atoll, destroyed three islands and displaced millions of tons of sand and biotic matter, permanently altering the natural movement of sediments. While there are no detailed reports on the environmental impact of the tests, decreased human presence in the area has led to positive increases in fish groups and megafauna.

## Course Components

### Marine

The coral reefs in the Marshall Islands are exceptionally biodiverse, boasting nearly 300 species of corals and over 800 species of fish. Some of the outer atolls, farther from human influence, are considered near pristine and host plentiful megafauna. The unique ecosystems of the Marshall Islands have brought together numerous organizations interested in marine research and conservation. The islands are contained within the Small Island States Large Marine Ecosystem.

The Natural Resource Assessment Surveys (NRAS), a local non-governmental organization, worked with the College of the Marshall Islands to collect a baseline of



data on the health of the coral reefs in the RMI an establish a standard survey procedure. These surveys aim to quantify fish abundance, coral community structure, invertebrate diversity, marine algal cover, benthic composition, and more. The studies started in 2002 and concluded in 2007.

Majuro's last natural resource assessment survey was in in 2004, when 16 sites were studied. As the most populated atoll in the RMI, Majuro is on the front lines of conservation efforts. The coral reefs here are greatly affected by development and pollution. The nearshore reefs by the downtown area of the atoll along with dredging sites along the southern coast have shown to be the most impacted. Coral diversity is low, and although there were cases of COTS, there were no signs of coral bleaching. There was high microalgal cover at all the sites. While high cover at ocean sites can indicate reef health, high cover at lagoon sites can indicate a history of coral bleaching or COTS.

Table 12.2. Methodologies used for NRAS surveys. Source: <http://www.nras-conservation.org>.

ACTIVITY	TYPE OF DATA	METHOD	FINAL INFORMATION
Coral and Fish Diversity Surveys	Species list per site, semi-quantitative abundance	Timed swim	Coral and fish species lists and abundance
Line Intercept	Percent cover of coral and benthos; two or three replicates at each site, at different depths between 5 and 15 m	50 x 5 m line transect, substrate type, life forms of corals, main genera and species	Percent cover composition of benthos and main scleractinia species or genera
Belt Transect	Fish id, counts, size estimate; invertebrate id and counts; two or three replicates at each site, at different depths between 5 and 15 m	50 m x 5 m x 5 m transect, fish families and commercial target species counts and class sizes; commercial invertebrate counts	Fish abundance by families and main species; invertebrate abundance
Algae Quadrats	Percent cover of algae and semi-quantitative abundance of major groups: four replicate per transect	Four 25 cm x 25 cm quadrats	Algae families and species id and diversity
Macrofauna	Timed swims	Identify and count sharks, rays, napoleon wrasse, turtles	Abundance of macrofauna

The lack of current, updated data on the RMI's marine resources provides an excellent opportunity for students to engage in meaningful science.

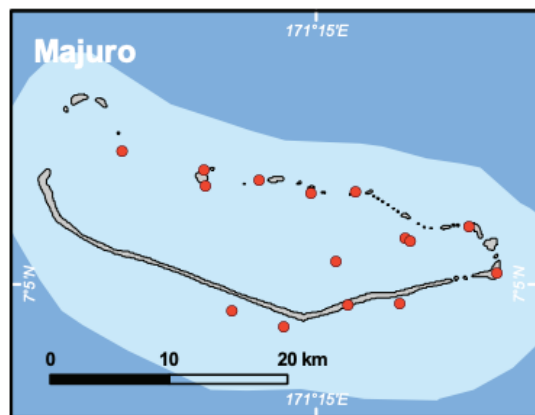


Figure 3. Previously surveyed marine sites around Majuro.

Terrestrial

Socioeconomic