

WORK PLAN

A Sampling Strategy for Red Algae and Snowflake Coral in the Papahānaumokuākea Marine National Monument

A Cooperative Investigation by CCMA's Biogeography Branch and the Papahānaumokuākea Marine National Monument

GOAL

The Center for Coastal Monitoring and Assessment's (CCMA) Biogeography Branch will develop sampling strategies for alien species (AS) of red algae and snowflake coral in the Papahānaumokuākea Marine National Monument (PMNM). Sampling strategies, comprising sampling designs and survey protocols, will be produced to detect AS among coral reef ecosystems around the islands, atolls, shoals and banks of the Monument. The goal of this work is to produce useful information to effectively characterize, monitor and manage AS, and support the PMNM's Alien Species Action Plan. Anticipated products will include: 1) habitat suitability models, 2) a sampling design and survey protocol, 3) a GIS tool to support sampling design analysis, and 4) a report to describe methods and provide recommendations for future refinement.

OBJECTIVES

1. Identify and collect relevant biological and physical datasets in the study area necessary to inform a sampling design for AS of concern (i.e., *Hypnea musciformis*, *Carijoa riisei*).
2. Develop habitat suitability models for AS of concern to identify and predict species distributions, based on species habitat preferences and observed distributions.
3. Develop an effective sampling design and survey protocol to detect AS of concern using results from predictive models and are appropriate given field constraints.
4. Support Monument staff in the integration and implementation of the sampling design during a June 2009 field mission.
5. Develop a webpage to present results and a Sampling Design tool to aid sampling design development and refinement
6. Prepare a guide for PMNM to continue and refine sampling strategies

BACKGROUND

Papahānaumokuākea Marine National Monument (PMNM) in the Northwestern Hawaiian Islands (NWHI) is one of the largest marine protected areas in the world. The Monument possesses relatively pristine ecosystems due to its extreme remoteness, relatively low rates of visitation and concerted management efforts. In spite of those factors, eleven alien species (also called nonindigenous or exotic species) have been detected within the Monument. In addition, 332 other marine AS, including some considered to be invasive (e.g., *Carijoa riisei*,

Hypnea musciformis), have been detected in the Main Hawaiian Islands which are ecologically linked and ecologically similar to the NWHI.

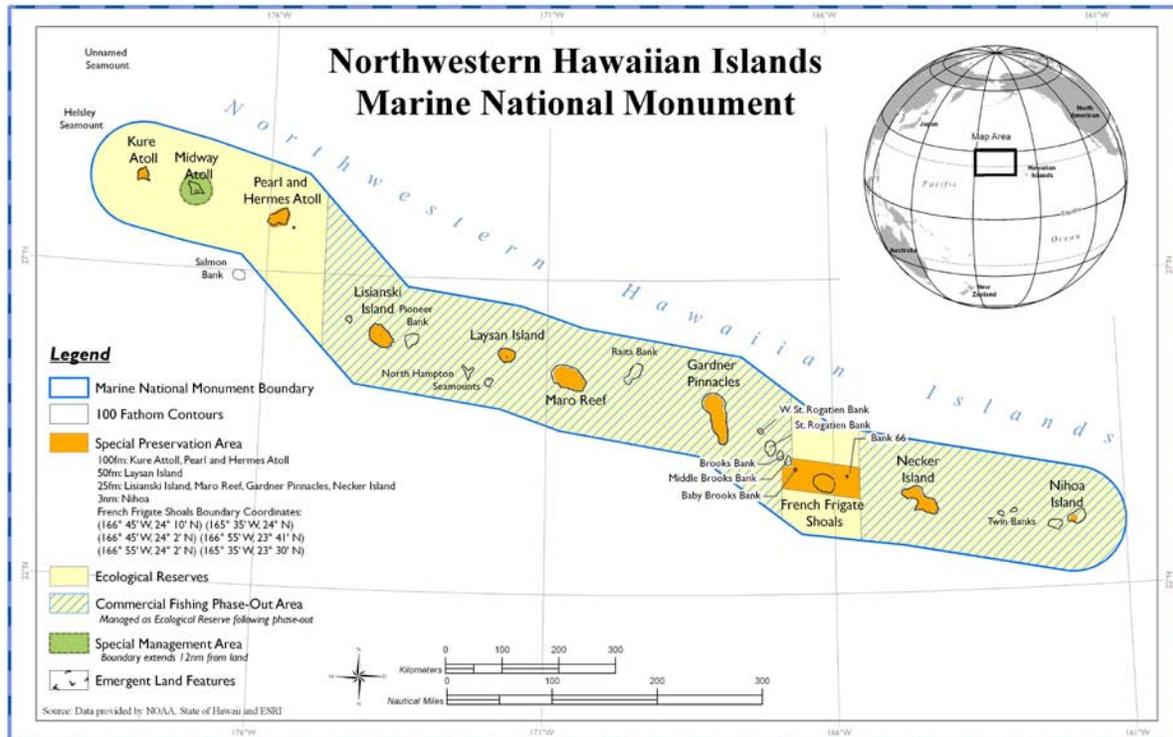


Figure 1: Locator map from PMNM website (http://hawaiireef.noaa.gov/maps/Map_of_NWHIMNM.pdf)

AS are a major threat to marine ecosystems, impacting biodiversity, ecosystem function, habitat structure, and socioeconomics. Globally, the number of AS is increasing at an alarming rate and will likely continue as global connectivity is increased and ecosystem resilience is eroded by persistent anthropogenic disturbances.

PMNM has taken active steps to mitigate the threats of AS, including regulations and protocols (e.g., prohibition of ballast discharge, inspection and cleaning of hulls, treatment of snorkel/dive gear, luggage inspection and a permitting system), an Alien Species Action Plan (ASAP), and active research to develop knowledge of baseline conditions and refine AS detection methods. ASAP was developed “to detect, control, eradicate where possible, and prevent the introduction of alien species into the Monument”, and outlines strategies to achieve the desired outcome. In support of ASAP, this project will develop products to satisfy the following strategies: active surveillance to detect and monitor (AS 2.1); development of monitoring protocols (AS 2.3); mapping red alga (AS 7.1); and surveillance of snowflake coral (AS-7.2). In addition, habitat suitability models can be used as a basis for developing a geospatial threat analysis (AS 1.1)

PROJECT OVERVIEW

The Biogeography Branch, in consultation with the Papahānaumokuākea Marine National Monument (PMNM), will develop a sampling strategy for AS. Analysis and output will focus on two species of particular concern - *Hypnea musciformis* and *Carijoa risei*.

Habitat suitability models will be integral to this project. Habitat suitability models will rely on existing literature and available habitat data to define AS environmental envelopes (i.e. habitat thresholds and preferences) to predict AS distribution. Anticipated habitat data include bathymetry models and benthic habitat maps. The models will assess probabilities of establishment.

A stratified sampling will integrate information from habitat suitability models to ensure effort is focused at survey sites with the highest probability of encountering AS. A principal consideration will be to develop a sampling strategy which can be implemented within known logistical and technical constraints (e.g., planned field missions, bottom time limits, limited budget) and integrated seamlessly with existing AS fieldwork (e.g., NOWRAMP, Bishop Museum surveys). A protocol to inspect each site for AS will be developed. The protocol will maximize the probability of detection of AS at low densities and under the constraints imposed by both conventional and technical diving. In June 2009 the Biogeography Branch will support a PMNM field mission which will use the developed sampling design and survey protocols to collect AS data in reef systems at selected atolls (e.g., Necker, Nihoa, French Frigate Shoals) down to 60 m (200 ft).

The report will include descriptions of analytical methods, findings from the FY09 field mission, data gaps, and methods to refine the sampling design as new data becomes available. The report's objective is to provide PMNM managers all of the information needed to continue AS surveys and provide methods for how data and sampling designs can inform a comprehensive risk assessment.

Questions to be addressed by this study include:

Which benthic habitats are suitable for AS of concern, and where are these habitats located?

Which areas have the highest risk of invasion by AS?

What type of survey protocol and sampling design is ideal for detecting and monitoring AS given field and logistical constraints?

How can habitat suitability models and sampling results be used to develop a risk assessment for AS?

What significant gaps exist in our knowledge of biological and physical characteristics in the study area needed to detect and monitor AS?

PROJECT TASKS

Below are brief descriptions of the major tasks planned for this project. Project duration is envisioned to be 12 months, with the starting date dependent on funding availability. Planned dates for completion of major tasks are dependent on the start date.

Task 1. Work Plan

(Estimated Completion Date: 10-01-08)

Biogeography Branch and PMNM staff will refine the objectives, tasks, and products in the work plan. As such, this work plan should be considered a "living document" that will be modified

during the early phases of this project to reflect the agreed upon changes. This work plan will describe the overall project and serve as a blueprint for implementation. Although specific products are identified in this work plan, final products will depend on the quality, quantity, and availability of data for analysis. Hence, close collaboration with PMNM staff will be required to ensure the Biogeography Branch staff is well-informed.

Task 1 Products:

- A preliminary list of deliverables
- A list of AS of concern
- A draft work plan, including timeline

Task 2. Data Collection

(Estimated Completion Date: 02-01-09)

Relevant data sets for analysis will be identified through telephone surveys and a series of meetings with regional biological experts and Monument staff. Data will also be collected through searches of peer reviewed literature, internet offerings, and by review of unpublished data (e.g. gray literature). Communications will also be used to finalize the work plan and ensure a consensus is reached on project objectives.

Task 2 Products:

- A final work plan
- Preliminary data inventory

Task 3. Analysis and Sampling Design Development

(Estimated Completion Date: 06-01-09)

Biogeography Branch staff will evaluate and select data sets and analytical techniques that are most appropriate for habitat suitability models. **Figure 2** shows the general analytical process that will be implemented. Analyses may range from simple correlation to advanced multivariate techniques and model output may range from simple presence/absence to continuous surfaces of abundance. The variety and limitations of the various data sets are expected to have a major influence on the character of analyses and model output.

The sampling design will be stratified according to habitat suitability model output to efficiently allocate survey effort. For instance, if habitat suitability models reveal *C. riseii* prefers ledges of at least 5 m in height, sampling effort will be focused at these sites. The sampling design will cover reef systems between 0 – 60 m among the islands, atolls, banks and shoals within PMNM. The sampling design will also consist of a survey protocol to maximize the probability AS detection if it is present at a survey site. Both the sampling design and survey protocol will be designed to work through the use of conventional and technical diving.

Task 3 Products:

- Maps showing habitat suitability for AS of concern
- A sampling design customized to maximize the probability of detecting AS

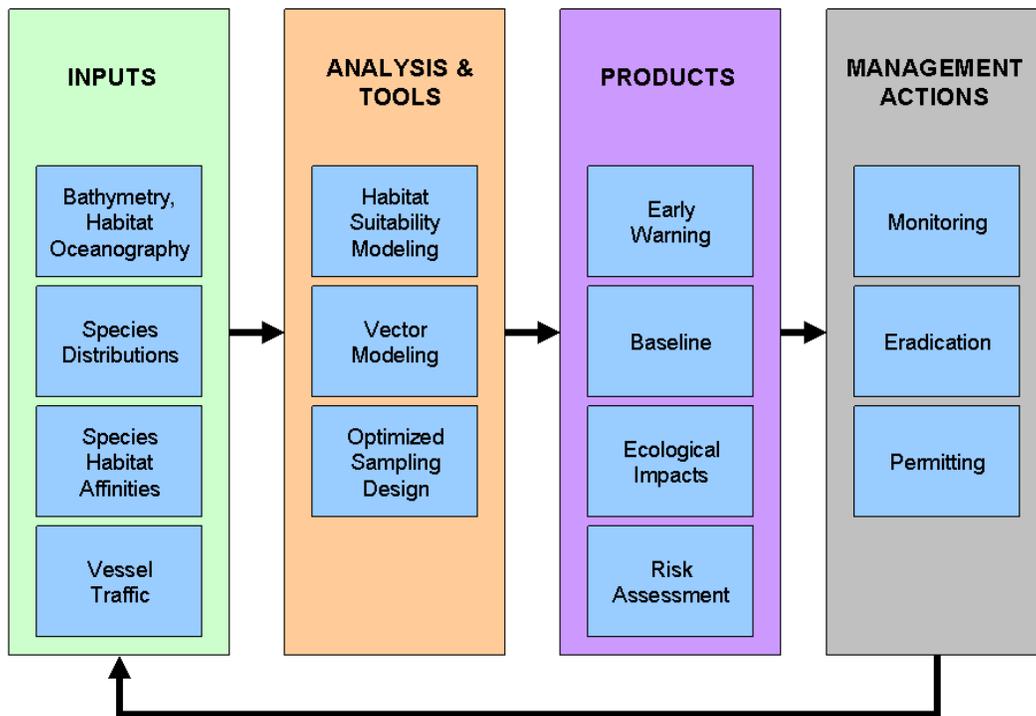


Figure 2. The Biogeography Branch's approach to invasive species research.

Task 4. Field Support

(Estimated Completion Date: 08-01-08)

Biogeography Branch staff will support the use of the sampling strategies designed in Task 3 during a June 2009 field mission to NWHI. Support may comprise travelling with Monument staff onboard a NOAA research vessel to NWHI sites and/or travelling to Midway atoll to conduct shallow water surveys while Monument staff conducts deep water surveys. Biogeography Branch staff will use field work to evaluate design effectiveness and, if needed, recommend alterations.

Task 5. Report

(Estimated Completion Date: 10-01-08)

A report will be produced for PMNM with the objectives of documenting findings and guiding future survey missions. In addition, the report will discuss how to integrate survey data into a comprehensive risk assessment. Biogeography Branch staff will travel to Hawaii to present findings and recommendations, and train Monument staff in the application of sampling strategies and a GIS tool.

Task 5 Products:

- Final report

Task 6. GIS Tool and Web Page Development

(Continuing throughout project)

In order to design and carryout surveys in an effective and efficient fashion, a tool will be developed that will integrate survey design planning and analysis into a GIS environment. This tool will provide a user friendly interface for PMNM researchers to refine sampling designs as new information becomes available and plan field missions. In addition, Biogeography Branch staff will develop a web page to communicate results.

Task 6 Products:

- A sampling design tool for ArcGIS
- Web page

PROJECT TEAM

The Biogeography Branch of the Center for Costal Monitoring and Assessment will lead this collaborative effort. Other project members include staff from Papahānaumokuākea Marine National Monument.

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