Survey Protocol for Invasive Species

Summary

This protocol was developed by the Biogeography Branch of NOAA's Center for Coastal Monitoring and Assessment to support invasive species research by the Papahānaumokuākea Marine National Monument. The protocol's objective is to detect *Carijoa riisei* and *Hypnea musciformis* in deepwater habitats using visual surveys by technical divers.

Note: This protocol is designed to detect the presence or absence of invasive species. A distinct protocol is required to collect information on abundance and impact, or monitor changes over time.

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Critical Actions

1. Develop search image for species of concern
2. Conduct reconnaissance at potential survey sites
3. Collect pictures and voucher specimens of potential invasive species

Permits and Permission

Necessary permits and permissions must be obtained before implementation of surveillance in NWHI. Permits must include provisions for access and voucher specimen collection. In addition to permits from the Monument, if data will be collected at Necker Island or sentinel sites in the Main Hawaii Islands, permits from the State of Hawaii must be obtained as well.

Site Planning

Determining where to survey before a field mission will help organize effort and ensure needed information is available and understood.

Habitats most likely occupied by invasive species should be surveyed to maximize the probability of detection. A benthic habitat map or habitat suitability map are useful tools to locate appropriate survey sites. This method contrasts with probabilistic designs which attempt to infer from samples to a larger population, but which are ill suited to survey "rare events" such as an invasive species colony.

Distribution of surveys at two spatial scales will aid logistics and minimize the likelihood sites cannot be surveyed due to weather conditions. At short spatial scales, clustered sites will decrease travel time among sites and possibly allow multiple dive teams to be used simultaneously. At longer scales, clusters distributed around an island, bank or atoll can minimize the likelihood all sites are inaccessible due to weather conditions or travel distance. For instance, a cluster in the lee of an island may be accessible while others are not due to wave height.

Training

It is important for all divers to have sufficient training to effectively identify species of concern, and be familiar with the methods and data reporting requirements. These items are important to make effective use of very limited bottom time, support subsequent management actions, reduce the likelihood of false reports and lessen effort spent collecting extraneous information.

To detect *C. riisei* and *H. musciformis*, divers must have a clear search image of both species. A search image represents information that will help identify an organism, including morphology, behavior, habitat and organisms with similar habitat preferences. The search image helps paint a mental picture of what to look for. Special consideration should be given to develop a search image for *C. riisei* when polyps are open and closed. Taxonomic keys, morphological descriptions, and pictures will help develop search images.

Divers should be well trained, and familiar with all methods and equipment to be used for data acquisition. A dive at a familiar site can help train new surveyors.

Equipment

Data entry forms and writing utensils
Lights
Camera
Metal clippers
Specimen bag
Cooler with ice
Geographic positioning system on support vessel
Materials and equipment for preservation

Reconnaissance

It is highly recommended to collect reconnaissance data before sending divers to any survey sites. Reconnaissance is used to locate suitable habitat and thus decrease the probability of conducting a survey on habitat unlikely to harbor species of concern. Reconnaissance is especially important when information about a survey site is lacking or uncertain. For instance, uncertainty can arise in sites selected using remotely sensed data because of interpretation error or changes over time.

Reconnaissance data can be collected using a variety of equipment, such as remotely operated vehicles (ROV), autonomous underwater vehicles (AUVs) or multibeam sonar. Visual data in the form of video or still images are optimal for reconnaissance, because they provide data in a format that can be recorded, and used for multiple objectives, and have been used effectively in the past to groundtruth remotely sensed data. Alternatively, soundings from multibeam sonar at a resolution finer than 5m can be useful in verifying or pinpointing benthic features of interest.

During reconnaissance, it is a good idea to identify specific benthic features to be surveyed by divers. Geographic position, as well as notable seascape features in the immediate vicinity, will assist in finding the feature at a later time. Features should be prioritized according to habitat type and survey area when multiple features are identified. High priority habitat types include hardbottom benthic structures such as

- terraces
- ledges
- large plate corals
- boulders
- pinnacles
- crevices
- exposed hardbottom substrate (deeper than 65 m)

Reconnaissance data also provides information for dive planning. Helpful data includes depth on bottom, and profiles of temperature, light, current speed and current direction.

It is unlikely that data collected using an ROV or drop camera will detect invasive species, and the effort needed to inspect under ledges and in cervices can take a considerable amount of time, consequently invasive species detection should not be a priority. Rather, reconnaissance should cover as much area as possible while still collecting sufficient information to identify important features.

Diver Planning

The use of technical diving is necessary due to the need for visual surveys, and depths and bottom time required for deepwater surveillance. All divers should have sufficient training and adhere to pertinent regulations of governing authorities. If technical diving will be completed under NOAA auspices they must conform to the regulations of the NOAA Dive Center.

Expect a dive team to conduct a single or at most two dives a day due to the depths and decompression requirements involved.

Dives should be planned and executed in such a manner as to avoid gas shortages and in-water decompression times greater than 120 minutes. The “rule-of-thirds” (one third to get to the dive site, one-third to reach the first decompression stop, and one-third reserve) should be followed on all decompression dives. Consequently, divers should be prepared to complete surveys in 25 minutes or less.

A buoy carried by at least one member of the dive team is recommended if weather conditions permit. The buoy can be used by surface support vessels to safely track diver movements, and the dive team can use the buoy to communicate with the support vessel.

Visual Surveys

The probability of detection is maximized by concentrating search effort on the species and habitats of interest. Other species of concern should be searched for opportunistically.

Shallower than 65 m (213 ft) divers should focus attention on crevices, overhangs, holes and ledges or any other habitats likely to provide shade. Deeper than 65 m, divers should also inspect exposed hard substrate. If time permits, inspections of algae communities should include attached, drifting and epiphytic algae.

Surveys should attempt to include as much area as possible over the most important habitats while minimizing the chances an invasive species is overlooked.

Critical Data Collection

It is important to gather information that will help locate the survey in geographic space and define survey effort, especially if an invasive species or probable invasive species is detected. The survey site coordinates may be inadequate due to diver movement and inaccuracies in deployment. At a minimum, record the depth of the survey. If possible, communicate with the surface support vessel using a buoy so that the support vessel can then take a GPS fix to record geographic position. One method of communication is to pull a surface buoy line using a predetermined signal. Survey effort can be estimated using elapsed time during the survey.

The field data sheet provided at the end of this protocol was developed to help record important information. Printing the data sheet on water proof paper allows its use underwater.

Pictures of the survey site provide information to locate the survey, identify benthic habitats and communities, and assess baseline conditions. Take pictures in four cardinal direction and closeups of suitable habitats.

If an invasive species or probable invasive species is detected additional information is needed for authoritative identification, assessment of impact and identification of habitat. Voucher specimens and in situ photographs are essential for authoritative taxonomic identification. If there is any uncertainty, pictures and a voucher specimen should be collected. Still pictures provide a tangible record of invasive species and can provide information on substrate and community not recorded by the diver. Suspect organisms should be photographed in situ along with some sort of identification label so that specimens can be related to particular photographs. Multiple pictures taken at multiple distances from the target are recommended. Pictures taken at multiple distances provide information at multiple spatial scales. Pictures which can be used to describe the community and benthic habitat are desirable to quantify affected area, better understand the ecology of invasive species and refine survey methods.

Specimens should be collected from probable individuals and prepared for transport. Specimens can be collected by hand or with metal clippers, placed in sealed bags, carried to the surface by divers and put into a cooler with ice. Upon return to the support vessel specimens must be preserved and labeled with site information. All macroalgae must be drained of water and put into the laboratory freezer. Each

macroinvertebrate sample should be divided into two sub-samples, with one being preserved in 95% Ethanol and the other in Dimethyl Sulfoxide (DMSO).

Auxiliary Data Collection

If an invasive species is detected, auxiliary data which can be used to assess the local community and environment are useful. Several types of auxiliary data are described below.

Area of coverage can provide information important to quantify impacts to the community and can be used to assess change over time. Area of coverage refers to a visual estimate of the planar area inhabited by invasive species. In cases where invasive species are patchily distributed, areas should be divided into separate sites if there is a gap of more than 10 m between colonies (or individuals) or where there is a useful and obvious benthic boundary (e.g., patch reef, edge of substrate, isolated boulder). If a single individual or small colony (<100 cm^2) is observed the area of coverage can be defined as a point. If the area of infestation is one-dimensional (i.e. linear ledge), the area of coverage can be defined by a distance. If the limits of an infestation cannot be determined, provide a minimum area or distance (e.g., > 100 m^2).

The benthic habitat on which an invasive species is established can be used to refine habitat suitability models and diver search images, as well as assess impact. Benthic habitat type integrates multiple environmental parameters such as geomorphology, substrate and water movement. To be helpful, benthic habitat types must be mutually-exclusive, and consistently recorded among surveyors. Examples of benthic habitat types and their respective definitions are provided below.

Ledge - an abrupt descent at the edge of a relatively flat surface. Ledges are common at the edge of terraces created from former sea level stands and consequently are common along circumferential isobaths on insular shelves.

Reef – hardened substrate of unspecified relief formed by the deposition of calcium carbonate by reef building corals and other organisms (relict or ongoing).

Boulders - a large, detached, worn rock or piece of bedrock. Typically found at the base of ledges or steep slopes.

Pavement – exposed flat, low-relief solid carbonate rock. Generally pavement is colonized by macroalgae, sponges, coral and other sessile invertebrates.

Algal Plain – an area supporting a rich algal community, consisting of macroalgae, crustose coralline algae and rhodoliths.

Sand – area composed of unconsolidated coarse sediment typically found in depositional areas with weak currents or low wave energy.

Information on the community in close proximity to invasive species can identify communities at risk and help refine diver search images. Identification of organisms to the lowest possible taxonomic level and/or pictures of nearby organisms are useful.

Reporting

Hardcopy reports of all data collected should be retained for permanent record keeping. It is important to report findings even if invasive species were not found during a dive; these can be used in the future to identify baseline conditions. The datasheet on the next page was developed specifically for this protocol and can be used to collect and catalog data.

Date		Name		Station	
Location		Buddy(ies)			

Survey Information (circle all that apply)							
Benthic Habitat	Terrace	Reef	Boulders	Pavement	Algal Plain	Sand	
Start time		End time					
Min Depth		Max Depth					
Notes							

Specific Sighting Information					
Species	Time	Depth (ft)	Habitat Type	Area of Coverage	Notes

Date	11/4/2009	Name	CM	Station	NEC109
Location	Necker	Buddy(ies)	CC		

Survey Information (circle all that apply)							
Benthic Habitat	Terrace	Reef	Boulders	Pavement	Algal Plain	Sand	
Start time	11:02	End time	11:35				
Min Depth	150	Max Depth	180				
Notes	Moved along terrace in northerly direction, strong currents, >100ft viz.						

Specific Sighting Information					
Species	Time	Depth (ft)	Habitat Type	Area of Coverage	Notes
riisei	11:03	150	terrace	>1 m, 2 ind.	picture and voucher specimen collected
riisei	11:05	150	exposed hardbottom	3 m2	15 m from first sighting, black coral near
musciformis	11:20	180	drifting	>1 m, 2 ind.	pale