BEST MANAGEMENT PRACTICES (BMPS) TO MINIMIZE THE SPREAD OF NUISANCE ALGAE

Papahānaumokuākea Marine National Monument

The following conditions aim to prevent the spread of the cryptogenic nuisance alga *Chondria tumulosa* (*C. tumulosa*) and introduced nuisance alga *Acanthophora spicifera (A. spicifera)* when conducting permitted activities within Papahānaumokuākea Marine National Monument (Monument or PMNM). *C. tumulosa* is currently limited to known distributions at Manawai (Pearl and Hermes Atoll) and Midway Atoll (Kuaihelani) and is of unknown origin. Records of *C. tumulosa* at Manawai (Pearl and Hermes Atoll) date back to 2015 when it was first found growing in low abundance on the northeast side of the atoll. On a follow up cruise in 2019, the alga had spread and was documented growing in high density around Manawai (Pearl and Hermes Atoll) forming thick mats that had overgrown and killed virtually all sessile benthic organisms, including corals, where it was present. In 2021, *C. tumulosa* was further discovered on the northeast back reef of Midway Atoll (Kuaihelani). More recently in 2022, *A. spicifera* was discovered in isolated areas around Midway Atoll (Kuaihelani). *A. spicifera* is a new record for PMNM but is the most widespread introduced nuisance alga found throughout the main Hawaiian Islands after its unintentional introduction in the 1950's. Both of these species of nuisance algae can likely reproduce through vegetative fragmentation and via the release of single-celled spores.

Therefore, until further research proves otherwise, caution should be taken to prevent the spread of these algae. The major biosecurity components for mitigating the spread of *C. tumulosa* and *A. spicifera* include chemical disinfection protocols as well as visual inspections and physical removals during and after operations. These measures are intended to supplement and supplant biosecurity measures already in effect within BMPs 001, 007, and 011. Although these species are currently found only at Manawai (Pearl and Hermes Atoll) and/or Midway Atoll (Kuaihelani) these measures can apply to additional locations within the Monument where *C. tumulosa* or *A. spicifera* are identified.

Definitions:

Bleach removal zone: area outside of all Special Preservation Areas and the Midway Atoll Special Management Area (defined in 50 CFR Part 404, Appendix A) where bleach pools used for disinfection protocols can be disposed of.

Dry equipment: any equipment, supplies, or scientific gear which are not utilized for in-water activities (buckets, 'action packers' or similar plastic storage bins, potable water containers, camping equipment, etc.).

Midway Atoll (Kuaihelani) vessel docking threshold: a 72-hour window in which support vessels can dock at Midway Atoll (Kuaihelani) and then move to other locations within the Monument without restriction.

Nuisance Algae Mitigation Zone (NAMZ): an area of 3 nautical miles (NM) around emergent lands of an island or atoll where a nuisance alga has been detected and mitigation measures listed below apply.

Nuisance algae: *Chondria tumulosa* and/or *Acanthophora spicifera*

Permitted activity: any activity approved through the Monument's permitting process.

Small boat: any vessel or craft which is unable to transit independently into PMNM.
Submerged equipment: any gear and/or electronics that are utilized within a NAMZ that are submerged into seawater and can tolerate prescribed bleaching protocols (anchor lines, transect tapes, diving fins, wetsuits, etc.).
Specialized and sensitive submerged equipment: any gear and/or electronics that are utilized within a NAMZ that are submerged into seawater and cannot tolerate high concentration bleach protocols (hydrophones, sensors, life-support equipment/SCUBA gear, live specimens/settling plates, etc.).
Support vessel: any vessel which transits into PMNM independently and may aid in work completed by other small boats.

Triggering Requirements for compliance with BMP:
For any activities that meet a trigger event, an alien species risk assessment will be completed by a Monument Resource Protection Specialist prior to departure. Recommendations will be provided on specific locations for disinfection and visual inspections. Please allow for a minimum of 14 days to complete this assessment. Triggering events include the following:

- Any permitted activity involving use of vessels, equipment, resources and/or personnel utilized within a Nuisance Algae Mitigation Zone (NAMZ).
- For any permitted activities which exceed the "Midway Atoll (Kuaihelani) vessel docking threshold" and/or involve extensive in-water activities such as marine resource collections, in-water surveys, marine debris removal or other activities which fall outside the scope of measures discussed below, special conditions beyond those listed here may be necessary and need to be documented within a separate biosecurity plan (Appendix 1) written by the applicant in conjunction with a Monument Resource Protection Specialist and approved by the Monument Management Board (MMB). Please coordinate with your assigned permits Point of Contact (POC) for directions on this process.

If vessels are to access the Main Hawaiian Islands and conduct activities other than docking/offloading within 30 days after departing a NAMZ, consultations with the State of Hawaii Department of Land and Natural Resources (DLNR) are necessary to address any biosecurity issues. Please coordinate with your assigned permits POC for directions on this process.

Vessel access and operation within a Nuisance Algae Mitigation Zone (NAMZ):

- Any vessels which cannot be hauled from the water prior to departure for detailed inspection and disinfection may not anchor within a NAMZ.
- Before accessing a NAMZ, small boats must be coated with an effective antifoulant paint if boats are to remain in continuous contact with the ocean water for more than 48 hours. Please coordinate with your assigned permits POC if you cannot meet this requirement.
- No small boat or submerged equipment that has been launched or deployed within a NAMZ should be used in the Monument or State of Hawai'i waters free of *C. tumulosa* for at least 30 days, even after disinfection protocols. Please coordinate with your assigned permits POC if you cannot meet this requirement. Proposed modifications are subject to review and approval from the MMB.
- If repeated access to another NAMZ (example moving between Manawai (Pearl and Hermes Atoll) and Midway (Kuaihelani)) is needed within the span of an individual

cruise, the same small boat and equipment may be used again following departure decontamination treatments as long as small boats are used at Manawai (Pearl and Hermes) prior to Midway Atoll (Kuaihelani) (outlined below).

- Efforts should be made to make the locations where *C. tumulosa and/or A. spicifera* are present the final stop(s) of a cruise. Please coordinate with your assigned permits POC if you cannot meet this requirement. Proposed modifications are subject to review and approval from the MMB.
- When operating within a particular NAMZ (i.e. operating between islets or reef within Manawai (Pearl and Hermes Atoll)), the small boat, motor, deck and ground tackle (if utilized) should be visually inspected for algal fragments. All algal fragments (regardless of species) detected on the small boat or equipment during operations within the NAMZ may be removed and disposed of overboard. Overboard disposal should occur in areas where known populations exist, to the extent practicable/if possible.
- Inspections and removals of any algal fragments and other organisms from all vessels, gear and equipment (consistent with BMP 011 Level IV subsection B Cleaning Tender Vessels) will occur at least daily.
- Any small boats staying within a NAMZ longer than a full day should be hauled out of the water to reduce exposure time, if feasible.
- Small boats which remain in the water must follow standard boat hull and gear maintenance every two weeks, including scrubbing with a brush or comparable maintenance tools (in water cleaning may be done if it is not feasible to pull the boat from the water). Please coordinate with your assigned permits POC if you cannot meet this requirement. Proposed modifications are subject to review and approval from the MMB.
- To reduce exposure to and contamination by the nuisance algae or spores, felt-bottom footwear (tabis) should not be used.
- If personnel unexpectedly encounter *C. tumulosa* or *A. spicifera* outside a NAMZ, or in areas not documented to have either nuisance algae, the permittee or field principal investigator should notify their respective PMNM permit POC immediately.

Specific measures for departing a Nuisance Algae Mitigation Zone (NAMZ):

- All submerged equipment and objects used within a NAMZ should be disinfected by completely submerging for a minimum of 10 minutes in a minimum of 6% solution of an 8.25% hypochlorite commercial bleach solution (0.5 % active chlorine, see Table 1). Objects that must be disinfected include but are not limited to: dive booties, lab and sampling equipment, wetsuits, snorkel and mask. Following disinfection, all items should be labeled and not intermixed with those not utilized in a NAMZ. Exposed items should be stored dry and should not be used in other Monument waters free of *C. tumulosa* or *A. spicifera* or State of Hawai'i waters outside the Monument free of *C. tumulosa* for at least 30 days.
- All submerged specialized and sensitive equipment used within a NAMZ should be submerged in 3% bleach solution (per BMP 011) for at least 30 minutes. For buoyancy compensating devices, the bladders should be filled with the 3% bleach solution for 30 minutes before being rinsed.
- If bleach cannot be used, a separate biosecurity plan must be written by the applicant in conjunction with a Monument Resource Protection Specialist to address alternative

disinfection techniques. Please coordinate with your assigned permits POC for directions on this process.

- When permitted activities involve operations which could contaminate the support vessel's deck (e.g. small boat loading/unloading, submerged equipment deployment/recovery, etc.) the support vessel's deck should be visually inspected for *C. tumulosa* and/or *A. spicifera* fragments and disinfected twice with a 10% of an 8.25% hypochlorite commercial bleach solution (0.5 % active chlorine, see Table 1) and left to sit for 10 minutes between treatments.
- Any large volume "bleach-pools" used for disinfection protocols should be diluted with salt or fresh water before entering the ocean (for example running a saltwater hose into the container holding the large volume "bleach-pool" and flushing it out over a period of roughly 30 minutes) and occur in 'Bleach Removal Zones' defined above. All other bleach water discharge incidental to disinfections protocols can occur outside 'Bleach Removal Zones'.

The following measures are specific to departing a NAMZ on a support vessel with small boat operations:

- Prior to final departure from a NAMZ, all small boats (including motors, deck, bilge, anchor, anchor chain, anchor line and other components) should be visually inspected for *C. tumulosa* and/or *A. spicifera* fragments, disinfected and scrubbed with a brush or comparable boat cleaning tools within the NAMZ. All algal fragments (regardless of species) detected during disinfection protocols may be removed and disposed of overboard. Overboard disposal should occur in areas where known populations exist, to the extent practicable/if possible.
    - Additionally, small boats in continuous contact with the ocean water for more than 48 hours should conduct their final in-water cleaning prior no more than 24 hours prior to final pick up.
- Upon pick up by a larger support vessel, the small boat should be rinsed with freshwater or seawater while alongside (if it can be done safely) before being positioned on the deck. If the support vessel's deck is highly porous or contains spaces where *C. tumulosa* and/or *A. spicifera* fragments could become lodged (i.e. wood planks, drainage grates, etc.) a covering such as a tarp should be used before bringing the small boat on the deck. Once on the support vessel's deck, the small boat should be visually inspected for nuisance algae fragments and disinfected twice with a 10% of an 8.25% hypochlorite household bleach solution (0.5 % active chlorine, see Table 1) and left to sit for 10 minutes between treatments.
- Bleach solution should be applied into crevices not readily accessible to manual brush cleaning (spray, pour, wipe etc.). Care should be taken to ensure that bleach solution and scrubbing occurs in any part of the vessel that has come into contact with water including: the deck, scuppers, motor, bilge, storage compartments, anchor, anchor well, ropes etc. The small boat should be stored dry and should not be used in other Monument waters free of *C. tumulosa* or *A. spicifera* or State of Hawai'i waters outside the Monument free of *C. tumulosa* for at least 30 days.
    - Upon completion of above small boat disinfection measures, the support vessel's deck should be visually inspected for *C. tumulosa and/or A. spicifera* fragments and disinfected as described above.

- Dry equipment, which otherwise would not receive disinfection measures, that is splashed with seawater within a MZ during small boat transits or cleaning outlined above should be rinsed with freshwater and allowed to completely dry (preferably by exposure to direct sunlight for a period of 2 or more hours) before final storage.

Measures for collection of biological samples within a Nuisance Algae Mitigation Zone (NAMZ):

- Any intentional collections of *C. tumulosa, A. spicifera* and/or other benthic samples should be discussed in a separate biosecurity plan written by the applicant in conjunction with their respective permits POC and a Monument Resource Protection Specialist. Maximum efforts must be taken to control and prevent unwanted fragmentation.
- All algal collections/samples should be collected within sealed plastic bags, and then the bags should be directly placed within a designated, closed container (such as a cooler) when brought onto the boat. Note: many native algal samples which contain *C. tumulosa* and/or *A. spicifera* fragments are not immediately visible, so this method should be used for ALL algal samples. At this time, no live specimens of *C. tumulosa* and/or *A. spicifera* can be transported outside the NAMZ in which they are found. All samples must be frozen and/or preserved in a manner such that they are non-viable.
- Any research projects intentionally working with live *C. tumulosa* and/or *A. spicifera* samples should occur within a self-contained lab (either on vessel or on-land lab within the known distribution of the nuisance alga species), and include protocols that involve regular floor sweeping, inside and outside lab doormats, removal of shoes, etc. to limit the unintended spread of nuisance algae fragments. These protocols should be described in the biosecurity plan.

Marine debris collections and transport within a Nuisance Algae Mitigation Zone (NAMZ):

- All permitted activities involving the collection and/or transportation of marine debris from a MZ should be discussed in a separate biosecurity plan written by the applicant in conjunction with their respective permits POC and a Monument Resource Protection Specialist. The biosecurity plan should include all phases from staging, to transport to larger support ships, to containment, and to disposal.
- If marine debris are to be brought back to the Main Hawaiian Islands, consultations with DLNR are necessary to address any biosecurity issues.

Table 1: Calculations for using commercial bleach (8.25%) for disinfection protocols									
Bleach Concentration Refence in BMP	% Hypochlorite	1 Liter		20 Liters		1 Gallon		5 Gallons	
		Water	Bleach	Water	Bleach	Water	Bleach	Water	Bleach
100%	8.25%	0ml	1000ml	0 L	20 L	0 oz	128 oz	0 oz	5 gal
10%	0.83%	900ml	100ml	18 L	2 L	115.2 oz	12.8 oz	576 oz	64 oz
6%	0.495 %	940ml	60ml	18.22 L	1.18 L	120 oz	7.5 oz	602.5 oz	37.5 oz
3%	0.2475 %	970ml	30ml	19.4 L	600 mL	124 oz	4 oz	620 oz	20 oz
Assumptions: % active chlorine = g/100 ml active chlorine and 1 ppm = 1 mg/L = 1 mg/kg									
Conversion Chart: (1 Gallon = 128 Oz) (1 Quart = 32 Oz) (1 Pint = 16 Oz) (1 Cup = 8 Oz)									
If intending to use baseline bleach concentration that is not commercial bleach (8.25%) coordinate with POC to ensure conversions are correct									

Appendix 1: Process for determination, submission and review of a supplemental biosecurity plan.

Step 1: Applicant submits permit application.

Step 2: Interagency Permit Coordinator (PC) group reviews application, determines if proposed actions trigger compliance with BMP and/or a supplementary biosecurity plan needs to be written.

- Step 2.1: PC group determines activity fully captured within the scope of BMP, no biosecurity plan needed.
- Step 2.2: PC group determines activity requires supplemental biosecurity plan to be written, and biosecurity plan *WAS NOT* included with original application. Move to step 3.
- Step 2.3: PC group determines activity requires supplemental biosecurity plan to be written, and biosecurity plan *WAS* included with original application. move to step 4 (biosecurity plan is reviewed in parallel with the application).

Step 3: Applicant develops biosecurity plan in conjunction with designated permit POC to determine which aspects of proposed activities require additional evaluation. The intent of the biosecurity plan is to mitigate contamination risks which fall outside the scope of measures listed above.

Step 4: POC forwards biosecurity plan for Monument Management Board (MMB) Agency Review. Allot minimum of 2 weeks to review documents and provide feedback. Each respective agency is to ensure relevant Subject Matter Experts (SME's) are included in the review.

Step 5: Upon completion of MMB Agency review, each agency is to either:

- Approve plan as is. Assumption is that if a plan is approved, risk and impacts would be mitigated to a level below significant (based on what is currently known about *C. tumulosa* and *A. spicifera*)
- Reject plan and provide justification with recommendations on how to move forward (this could include, but not limited to, follow-up questions for the applicant, special permit conditions, or changes to the activity).
- Reject plan and provide justification on why no recommendations can be made at this time to allow the application to move forward