



NOAA FISHERIES

Protected Resources

RECOVERY OUTLINE

Acropora globiceps, Acropora jacquelineae, Acropora lokani, Acropora pharaonis, Acropora retusa, Acropora rudis, Acropora speciosa, Acropora tenella, Anacropora spinosa, Euphyllia paradivisa, Isopora crateriformis, Montipora australiensis, Pavona diffluens, Porites napopora, and Seriatopora aculeata

This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, for 15 Indo-Pacific corals (listed above) that were listed as threatened under the Endangered Species Act (ESA) (79 FR 53851; September 10, 2014) until a full recovery plan is developed and approved. A preliminary strategy for recovery of the species is presented here, as are recommended high priority actions to stabilize and recover the species. While recovery of listed corals is a requirement of the ESA, NOAA has a long-standing commitment to conservation of corals and coral reef ecosystems. All efforts to recover listed corals will be done in coordination with other NOAA coral programs.

This recovery outline commences our recovery planning process. The recovery outline is intended primarily for internal use by the National Marine Fisheries Service (NMFS) as a preplanning document. Formal public participation in recovery planning for these species will be invited upon the release of the draft recovery plan for these species. However, any new information or comments that members of the public may wish to offer as a result of this recovery outline will be taken into consideration during the recovery planning process. Interested parties may contact Lance Smith 808-725-5131, Lance.Smith@noaa.gov or Kim Maison 808-725-5143, Kimberly.Maison@noaa.gov.

INTRODUCTION

This document presents the broad, preliminary outline for the recovery of 15 Indo-Pacific coral species. Three of the 15 listed Indo-Pacific corals are considered to be foreign species with current and historic ranges occurring entirely under the jurisdiction of other countries. The NMFS Interim Endangered and Threatened Species Recovery Planning Guidance (Version 3.1) stipulates that foreign species may be exempted from the development of full recovery plans because the U.S. generally has little authority to implement recovery actions for foreign species and therefore a recovery plan would not promote the conservation of the species. As such, any reference to further recovery planning in this document refers to the remaining 12 coral species that are confirmed to or may occur within the U.S. A recovery team will be assembled for these species to inform the formal Recovery Plan which will provide a complete roadmap for activities necessary to recover the species so they no longer need the protections of the ESA. Meanwhile,

this outline will serve to guide recovery-planning efforts and provide information for ESA Section 7 consultations, potential permitting activities, and conservation efforts until the formal Recovery Plan has been finalized and approved.

Listing and contact information for all species:

Scientific Name	Listing Status
<i>Acropora globiceps</i>	Threatened
<i>Acropora jacquelineae</i>	Threatened
<i>Acropora lokani</i>	Threatened
<i>Acropora pharaonis</i>	Threatened
<i>Acropora retusa</i>	Threatened
<i>Acropora rudis</i>	Threatened
<i>Acropora speciosa</i>	Threatened
<i>Acropora tenella</i>	Threatened
<i>Anacropora spinosa</i>	Threatened
<i>Euphyllia paradivisa</i>	Threatened
<i>Isopora crateriformis</i>	Threatened
<i>Montipora australiensis</i>	Threatened
<i>Pavona diffluens</i>	Threatened
<i>Porites napopora</i>	Threatened
<i>Seriatopora aculeata</i>	Threatened

Listing Date: September 10, 2014 (79 FR 53852)
 Lead Agency: National Marine Fisheries Service (NOAA Fisheries Service)
 Lead Office: Pacific Islands Regional Office, Honolulu, Hawaii

Available information on the life history, range, and habitat requirements of the fifteen coral species is described in the final listing rule (79 FR 53852). The most significant uncertainties with respect to setting recovery objectives and prioritizing recovery actions include the availability of specific information on current and historical distribution and abundance; reproduction, settlement, and recruitment processes and success; variability in bleaching response and potential acclimation to warming temperatures; the sub-lethal effects of pollution; causal factors of disease; and future projections of the primary global threats associated with climate change on local and regional scales. These uncertainties are acknowledged as playing a limiting role in the early recovery efforts for these species and should be resolved to the extent possible through coordination with the coral research community and the recovery planning process. Another significant recovery challenge is that all 15 species occur primarily or entirely outside of U.S. jurisdiction.

RECOVERY NEEDS ASSESSMENT

BIOLOGICAL ASSESSMENT:

Recovery implications of the species' demographic and genetic status

The 15 listed Indo-Pacific coral species collectively range from the Red Sea and east coast of Africa, across the Indo-Pacific to French Polynesia and the Pitcairn Islands. Seven of the 15 species have been confirmed to occur within U.S. Pacific jurisdiction (*A. globiceps*, *A. jacquelineae*, *A. retusa*, *A. speciosa*, *E. paradvivisa*, *I. crateriformis*, and *S. aculeata*), three species are considered to be foreign species (*P. diffluens*, *A. rudis*, and *A. pharaonis*), and the remaining five have not yet been observed in the U.S. but may be with increased survey and reporting efforts (*A. spinosa*, *A. tenella*, *A. lokani*, *M. australiensis*, and *P. napopora*). There are varying range sizes and distributions among the species; the most restricted include a group that occurs in parts of the Red Sea and/or Indian Ocean (*P. diffluens*, *A. rudis*, *A. pharaonis*) and a group of species that are limited primarily to the coral triangle area in the western central Pacific (*A. lokani*, *A. jacquelineae*, *A. spinosa*). The Coral Triangle area is projected to have the most rapid and severe impacts from climate change and localized human impacts for coral reefs over the 21st century. Multiple ocean warming events have already occurred within the western equatorial Pacific (which includes the Coral Triangle area) that suggest future ocean warming events may be more severe than average in this part of the world. A range constrained mostly to this particular geographic area that is likely to experience severe and increasing threats indicates that a high proportion of the population of a species is likely to be exposed to those threats over the foreseeable future. This is a factor that will affect the ability of *A. lokani*, *A. jacquelineae*, and *A. spinosa* to recover.

The 15 listed Indo-Pacific coral species collectively inhabit a variety of reef types and range from shallow reef flats down to 40 meters depth, and some species range even deeper into mesophotic depths (*A. tenella*, *I. crateriformis*). The most restricted in terms of depth range are *A. globiceps* (0 to 8m depth range) and *A. retusa* (0 to 5m depth range). Shallow reef areas can be physically diverse and complex, but are often subjected to frequent changes in environmental conditions, extremes, high irradiance, and simultaneous effects from multiple stressors, both local and global in nature. Future projections of climate change impacts to coral reef environments indicate that a shallow depth range is a factor that will affect the ability of *A. globiceps* and *A. retusa* to recover.

There is a variable amount of species-specific information available on the biology of the 15 species. They exhibit a variety of reproductive modes; most of the *Acropora* species are hermaphroditic spawners with lecithotrophic larvae, while the other listed species are gonochoristic spawners, brooders, or have unknown methods of reproduction. While there is no information available on global population sizes for the 15 species, they are estimated to number at least in the millions of colonies, some more likely in at least the tens of millions. More specific estimates are provided for four of the *Acropora* species (*A. tenella*, *A. jacquelineae*, *A.*

lokani, and *A. speciosa*) and all are estimated to have effective population sizes (number of genetically distinct individuals) of two million or fewer colonies. Because of the widespread nature of the global threats to corals, a threat event has the potential to impact many colonies at once so a species with a relatively small effective population size may have a high proportion of genetically unique individuals affected by threats at any given time within the foreseeable future. This is a factor that will affect the ability of *A. tenella*, *A. jacquelineae*, *A. lokani*, and *A. speciosa* to recover.

As discussed in the final listing rule, there is significant difficulty associated with species identification for many of the 15 listed Indo-pacific coral species. The foremost worldwide experts in coral identification often disagree on the species of individual colonies or specimens. This difficulty in and of itself represents a challenge to the recovery of these species. The inability to reliably identify many of these species renders collection and interpretation of reliable and accurate species-specific information to inform recovery actions extremely difficult.

THREATS ASSESSMENT:

What are the recovery implications of the threats facing the species?

The threats to these 15 coral species are generally the same threats affecting coral reefs throughout the world (climate change, fishing, and land-based sources of pollution) and have been fully described through the listing process. Specifically, ocean warming, disease, and ocean acidification are the three most important threats that will impact the potential for recovery of all 15 coral species. These threats are severe, ongoing, synergistic, have displayed an increasing trend in the recent past, and are projected to continue and worsen in the future. Sea-surface temperature is expected to continue to rise over time and may exacerbate disease impacts. Disease is widespread, episodic, and unpredictable in its occurrence and can result in high amounts of mortality. In order to ensure the species do not decline further, actions are needed to determine the causal and mechanistic aspects of disease and to reduce temperature stress. Ocean acidification is another global threat that will hinder recovery of these five coral species if atmospheric carbon dioxide concentration continues to rise unchecked.

Global threats to all 15 coral species are exacerbated further by local threats such as nutrients, sedimentation, predation, trophic effects of fishing, and collection and trade, which degrade coral condition and habitat and increase synergistic stress effects (e.g., bleaching, disease). Actions also need to be taken to reduce local threats posed by human activity (e.g., construction, dredging, run-off, water pollution, overfishing). Addressing and reducing local threats may increase the resilience of these coral species, i.e. their ability to withstand the more severe global threats over time.

Additional threats that are less significant but still negatively impact the species include sea level rise, toxicants, and physical damage from storms and anthropogenic sources. The extent to

which each of these threats impacts the species' status and recovery will be scrutinized during the development of the Recovery Plan.

CONSERVATION ASSESSMENT

What steps have been taken to address the species' recovery needs?

Thus far, seven of the 15 listed Indo-Pacific coral species have been confirmed to occur within U.S. Pacific jurisdictions and three are considered to be foreign species, as noted above. Others may occur in the U.S. and this information may change as more surveys are completed and more data become available. Some laws, regulations, and policies governing U.S. waters are not specifically directed toward the conservation of these listed coral species but provide various protections for coral reefs in general. Some examples include the Clean Water Act (CWA), Coastal Zone Management Act, Coral Reef Conservation Act (CRCP), Magnuson-Stevens Fishery Management Act (MSA), National Marine Sanctuaries Act, and several others. The NOAA CRCP has been working to reduce the impacts of threats for conservation of coral reefs since 2000. Current conservation measures consist of restoration efforts following physical damage from ship groundings and relocations and other methods for mitigation and minimization of impacts from permitted coastal construction activities through Essential Fish Habitat consultations under the MSA and CWA. Additional measures intended to protect the coral reef ecosystem include mooring buoys and navigational markers which also afford protection to these 15 species. At least seven of the 15 coral species are found within the boundaries of several different marine protected areas (MPAs) in Guam, American Samoa, CNMI, and the Pacific Remote Island Areas (PRIA). These regulatory mechanisms and conservation efforts are fully described in the final management report for the coral listing (NMFS 2012).

As part of the listing process we researched laws and regulations in foreign nations within the species' ranges as well. General patterns included the following: (1) fisheries management regimes regulate reef fishing in many parts of the collective ranges of the proposed coral species, albeit at varying levels of success; (2) laws addressing land-based sources of pollution are less effective than those regulating fisheries; (3) coral reef and coastal marine protected areas have increased several-fold in the last decade, reducing some threats through regulation or banning of fishing, coastal development, and other activities contributing to localized threats; and (4) the most effective regulatory mechanisms address threats other than climate change.

Numerous governmental and non-governmental agencies, institutions, and organizations are involved in conservation awareness for coral reef resources. These entities provide an active conservation constituency and are integral to the recovery of these species.

SUMMARY ASSESSMENT

Overall, available data indicate that coral cover throughout the Indo-Pacific has shown variable trends over space and time but there is an overarching downward trend over the last few decades. Population trends for the 15 listed Indo-Pacific coral species are unknown. Recovery will

depend on protection of coral reef habitat in areas where these species occur, reducing mortality of extant populations, and increasing resilience to global threats. The key challenges will be moderating impacts of ocean warming associated with climate change and decreasing susceptibility to disease which may be achieved through reduction of local stressors. Additional key challenges include species identification issues, which inhibit the ability to find and collect reliable species-specific data to inform recovery actions, and the widespread and international nature of the vast majority of all 15 species' ranges. Recovery of the 12 listed species within the U.S. will require an ecosystem-based approach including habitat protection measures, a reduction in threats caused by human activity, additional research, collaboration with foreign nations, and time. Because of the species identification issues and the fact that the 12 listed species are intermingled among dozens of other coral species on reefs with high levels of diversity throughout the Indo-Pacific, we intend to take an ecosystem-based approach to the conservation and recovery of these coral species. By focusing our efforts at the ecosystem level and conserving coral reefs where these species occur, recovery actions will benefit the listed species as well as the habitats on which they depend.

PRELIMINARY RECOVERY STRATEGY

RECOVERY PRIORITY NUMBER WITH RATIONALE

Each of the 15 coral species should be assigned a recovery priority number of 7 based on moderate threats due to continuing habitat degradation, low to moderate recovery potential due to complexity of threats and the high cost of required management actions, and the potential for economic conflict due to climate change and existing and increasing coastal development and maritime activities.

RECOVERY VISION STATEMENT

Populations of the 15 listed Indo-Pacific corals should be present throughout as much of their historical ranges as future environmental changes will allow, and may expand their ranges into new locations with more favorable habitat conditions in the future. We acknowledge that changing environmental conditions on a global scale are the primary drivers of the status of these listed corals and we therefore cannot reasonably expect that their future distributions will reflect the past. Coral reef ecosystems where these species occur in the future should experience low levels of local anthropogenic impacts, retain their ecosystem function, and show increased resilience to global environmental changes. Recovery of these species will require conservation of the coral reef ecosystem through threat abatement and facilitation of adaptation to changing conditions to ensure a high probability of survival into the future.

INITIAL ACTION PLAN

Given that many of the important threats to the recovery of the listed Indo-Pacific corals are not directly manageable, the recovery strategy must pursue actions in the short and long term to address global and local threats. The initial focus will be to protect extant populations and the species' habitat through reduction of local threats. In addition, we must gather information through research and monitoring on the species' current distribution and abundance; variability in bleaching response and potential acclimation to warming temperatures; sub-lethal effects of pollution; causal factors of disease; and reproduction, settlement, and recruitment success. Public awareness through various outreach efforts may play a role in generating voluntary protection actions. Additionally, we will continue to support and facilitate existing coral ecosystem conservation programs. All of these actions must be undertaken throughout the species' ranges both domestically and internationally and implemented within an ecosystem-based approach.

Specific actions that will be undertaken early in the process may include the following:

- Identify specific areas used by the species and further identify those areas that require habitat conservation.
- Through research, improve understanding of population distribution, abundance, trends, and structure through monitoring and modeling.
- Reduce locally-manageable stress and mortality sources for coral reefs (e.g., acute sedimentation, nutrients, contaminants, over-fishing on coral reefs).
- Improve understanding of genetic and environmental factors that lead to variability of bleaching response and disease susceptibility.

Recovery actions needed in the longer term include:

- Develop and implement U.S. and international measures to reduce atmospheric carbon dioxide concentrations to curb warming (and its effect on coral disease) and acidification impacts.
- Implement ecosystem-level actions to improve habitat quality and restore keystone species and functional processes to maintain adult colonies and promote successful natural recruitment.

PREPLANNING DECISIONS

PLANNING APPROACH

A Recovery Plan will be prepared for the listed Indo-Pacific corals within the U.S. pursuant to section 4(f) of the ESA. The scope of the plan will include all 12 species that are confirmed or have the potential to occur within U.S. jurisdiction as the three foreign species are considered exempt from recovery planning. Because these listed species share a biotic community and rely on protection or restoration of their ecosystem to reach recovery, an ecosystem recovery plan is

appropriate for this group of listed species; most recovery actions will be directed toward ensuring the sustainability of the ecosystem upon which all of these listed species depend.

A recovery team consisting of key stakeholders and coral experts will be assembled to develop the recovery plan. Recovery planning efforts will be coordinated with the Southeast Regional Office NOAA Fisheries, NOAA Sanctuaries, and the NOAA CRCP.

INFORMATION MANAGEMENT

All information relevant to recovery management of the 15 Indo-Pacific coral species will be housed in NOAA Fisheries Pacific Islands Regional Office administrative files.

STAKEHOLDER INVOLVEMENT

Key stakeholders:

- Federal, state, territorial, local, and international agencies
- Domestic and foreign universities and research organizations
- Domestic and foreign conservation organizations

Stakeholder involvement strategy:

Representatives of key stakeholder groups will be invited to participate in the recovery planning process. As needed, meetings and/or conference calls will be held to discuss particular issues, and stakeholders will be invited to participate as warranted. All stakeholders will be afforded an opportunity to review and comment on a draft of the recovery plan in conformance with the ESA. Stakeholders may also be asked to contribute directly in the development of implementation strategies for planned actions.