Peer Review Report

for

Appendix A
Records of ESA-listed Coral Species in U.S. Pacific Islands Waters And Application to Critical Habitat

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Prepared By:
National Marine Fisheries Service, Pacific Islands Regional Office, Honolulu, HI

Peer Reviewers:

Ms. Georgia Coward, American Samoa Coral Reef Advisory Group, AS
Mr. Kevin Foster, US Fish & Wildlife Service (retired), Honolulu, HI
Dr. Lyza Johnston, Johnston Applied Marine Sciences, Saipan, CNMI
Dr. Jean Kenyon, US Fish & Wildlife Service (retired), Honolulu, HI
Dr. Anthony Montgomery, US Fish & Wildlife Service, Honolulu, HI
Dr. Nadiera Sukhraj, US Fish & Wildlife Service, Honolulu, HI

Introduction

Peer review was conducted in early 2022 by four MS and PhD-level coral reef subject matter experts on the draft document "Records of ESA-listed Coral Species in U.S. Pacific Islands Waters And Application to Critical Habitat" (also referred to as "Records Document"). This document is Appendix A to the draft report "Endangered Species Act Critical Habitat Information Report: Basis and Impact Considerations of Proposed Critical Habitat Designations For Four Threatened Indo-Pacific Corals", the primary supporting document for the NOAA Fisheries proposed rule to designate critical habitat for four listed corals species in the Pacific Islands Region. The peer reviewers were:

1. Ms. Georgia Coward is a Coral Reef Ecologist who was with the American Samoa Coral Reef Advisory Group and Department of Marine and Wildlife Resources until May 2022.
2. Mr. Kevin Foster is a marine biologist who worked for over 30 years on coral reef conservation in the Pacific Islands with the US Peace Corps and Fish & Wildlife Service, retiring in 2022.
3. Dr. Lyza Johnston is a coral reef ecologist and founder of Johnston Applied Marine Sciences in Saipan.
4. Dr. Jean Kenyon is a coral reef biologist who worked for over 30 years on coral reef conservation in the Pacific Islands with the University of Hawaii, NOAA Fisheries, and the US Fish & Wildlife Service, retiring in 2016.
5. Dr. Anthony Montgomery is a coral reef biologist with the US Fish & Wildlife Service in Honolulu.
6. Dr. Nadiera Sukhraj is a coral reef biologist with the US Fish & Wildlife Service in Honolulu.

The peer reviewers were asked to review the draft Records Document, and provide peer review by answering the following 6 questions provided in the Terms of Reference:

1. *In general, does the document include and cite the best scientific and commercial information available?*
2. *Are the scientific conclusions factually supported, sound, and logical?*
3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*
4. *Are uncertainties assessed and clearly stated?*
5. *Are the methods used valid and appropriate?*
6. *Are the results and conclusions supported by the information presented?*

The peer reviews are provided below, along with any resulting revisions of the Records Document.

Peer Reviews[1]

Reviewer #1:

1. *In general, does the document include and cite the best scientific and commercial information available?*

Yes

2. *Are the scientific conclusions factually supported, sound, and logical?*

Yes

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

Yes. Recognizes that taxonomic identification has differed over time as well as expertise.

4. *Are uncertainties assessed and clearly stated?*

Yes

5. *Are the methods used valid and appropriate?*

Yes. And the summary table is a great visual.

6. *Are the results and conclusions supported by the information presented?*

Yes

Revisions of the Records Document: No revisions were necessary in response to this reviewer.

Reviewer #2:

[1] Reviewers are not named or listed in the same order as in the Introduction in order to preserve anonymity.

1. *In general, does the document include and cite the best scientific and commercial information available?*

This document represents a prodigious amount of data mining. Field survey records by 14 recognized coral experts have been scoured for records of the occurrence of each of the 7 listed species, and the quality of the observation (i.e., photo record vs. no photo record) has been incorporated into the results and conclusions. Other records (i.e., personal communication by non-experts) are noted but considered weak evidence.

For each species, detailed information is given concerning the agency through which standardized monitoring surveys occurred, the number of records in each year of monitoring and, where available, the depth range and habitat. Records by coral experts acquired in surveys other than those conducted through standardized monitoring programs are similarly detailed. Sources are cited or attributed to the informant.

2. *Are the scientific conclusions factually supported, sound, and logical?*

Yes, the rating scale for evidence that a population of an ESA-listed species occurred on an island at the time of listing in 2014 (Table 1) is based on a combination of the quantity and quality of records and uncertainly in species identification. For each listed species, the evidence is then rated for each island using the scale in Table 1, based on the detailed records provided in Section 2.

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

While not exactly an "opposing scientific study", the validity of a species being taxonomically distinct from another is discussed where appropriate, e.g., *Acropora globiceps* and *A. humilis* are recognized as taxonomically distinct though they are sometimes confused in field studies. Similarly, while *Acropora retusa* and *A. cophodactyla* are taxonomically distinct, experts agree they cannot be reliably distinguished in the field.

4. *Are uncertainties assessed and clearly stated?*

Yes, uncertainty in species identification is clearly addressed in multiple portions of the document, as is the quality of the record on which the assessments are based (i.e., photo record, expert data record, other record). The relative identification uncertainty among the 7 listed species is addressed in Section 1.2, Species Identification Uncertainty. In Section 2, uncertainly in identification is addressed for each species. Species for which skeletal samples are necessary to provide unequivocal identification are noted (*Acropora. jacquelineae, A. speciosa*).

Efforts of the part of PIRO to decrease species identification uncertainly by providing identification workshops since the 2014 ESA listings are also noted.

5. *Are the methods used valid and appropriate?*

The results for the presence of each species on each island are based on the combination of Photo records, Expert data records, and Other Records. For each listed species, each type of record and its source(s) are described in detail. Where there is doubt about the validity of a species' identification, this is clearly stated and factored into the rating scale presented in Table 1. This methodology is both valid and appropriate.

6. *Are the results and conclusions supported by the information presented?*

Yes, the rating results, compiled in Table 2, are fully supported by the detailed records presented for each listed species.

The document (Appendix A) does not define what constitutes a "population" for the purposes of this analysis. However, as it is an Appendix to another document, a "population" may have been defined within the other document and did not require restatement in Appendix A. With the assumption that the concept of "population" was explained in the document to which this is an Appendix, the logic behind each of the listed corals constituting a population on each of the islands is clearly explained in Section 4 and supported by the evidence presented in Section 2.

If, in contrast, the document to which this is an Appendix does not clearly define "population" for the purposes of this analysis, the term requires clarification.

Revisions of the Records Document: In response to this reviewer's comments (and similar comments from one other reviewer) regarding the purpose of the document being to determine whether records of each listed coral species on each U.S. island represent a "population" at the time of listing (2014), the following revision was made to the document. Since the purpose of the Records Document is to systematically review the records of each listed coral on each island for application to coral critical habitat (see Section 1.1 of revised Records Document), and the ESA defines critical habitat in terms of "occupied areas" (see Section 1.2), the Records Document was revised to focus on interpretation of the records in terms of occupied areas instead of populations. The concept of population no longer appears in the document.

Reviewer #3:

1. *In general, does the document include and cite the best scientific and commercial information available?*

Yes.

2. *Are the scientific conclusions factually supported, sound, and logical?*

Yes.

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

Yes.

4. *Are uncertainties assessed and clearly stated?*

Yes.

5. *Are the methods used valid and appropriate?*

Yes.

6. *Are the results and conclusions supported by the information presented?*

Yes.

Revisions of the Records Document: No revisions were necessary in response to this reviewer.

Reviewer #4:

1. *In general, does the document include and cite the best scientific and commercial information available?*

Yes, I believe the document includes all available relevant information and references.

2. *Are the scientific conclusions factually supported, sound, and logical?*

Yes, based on the available information (but see below).

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

N/A.

4. *Are uncertainties assessed and clearly stated?*

While uncertainties in species identification were addressed, I do not believe that uncertainties due to sampling bias/sampling effort were adequately assessed or discussed. Many more surveys, observations, and photos occur on populated islands compared to the remote, uninhabited islands, increasing the likelihood that records will exist for the former. This bias could lead to potentially erroneous conclusions that populations do not exist on the less sampled islands. For instance, for many of the uninhabited islands in the Northern Mariana Islands, the only potential for records after the listing (when species identification improved for several listed species) is from one PIFSC research cruise in 2017 (after a major bleaching event in 2014). Additionally, having conducted coral surveys on the 2017 PIFSC MARAMP cruise, I don't believe that the survey methodology is adequate to assess the presence or abundance of uncommon

corals, as only relatively small areas of reef are surveyed at each site, and on some islands, few sites are surveyed at each depth bin.

5. *Are the methods used valid and appropriate?*

For the most part, yes. However, standardized monitoring surveys were given substantial weight in the ranking process, with no discussion of the particular methods used. The PIFSC surveys, in particular, were prominent in the assessment as they are the only surveys to occur on many of the islands, but, as noted above, the PIFSC methodology may not be the most appropriate for assessing populations of uncommon corals. While this isn't much of an issue on islands where other surveys and observation occur frequently, it could bias conclusions for islands that are extremely data limited.

6. *Are the results and conclusions supported by the information presented?*

I believe that the overall conclusions are supported by the available evidence. However, the limitations and potential sampling bias discussed above should be clearly stated and discussed in the document.

Revisions of the Records Document: In response to this reviewer's comments (and similar comments from one other reviewer), the following revisions were made to the document:

1. The purpose of the records document is to use existing records for application to critical habitat. However, as the reviewer points out, the records were collected by different experts at different times using different methods, further compounded by much greater quantities of records available from the most heavily populated islands than the other islands, as well as species identification uncertainty. Such variability in the quantity, quality, age, and survey effort introduces numerous biases into the records, as does species identification uncertainty (since it varies by species). A new section was added to acknowledge and describe these sources of bias (Section 1.3 Sampling Biases and Potential Implications).
2. The challenges of interpreting the records while acknowledging and accounting for the biases are addressed in Methods (Section 2), which includes sub-sections on compilation, assessment, and application of the records. In particular, Assessment sub-section (2.2) describes how variability in the quantity, quality, age, and survey effort of the records was addressed, as well as species identification uncertainty and other factors. This section acknowledges the limitations of PIFSC's standardized monitoring survey methods.

3. Since PIFSC completed another monitoring cruise in the Mariana Islands in 2022, all islands in the Records Document have been surveyed at least twice. Results from the 2022 cruise have been added to the document (e.g., for the *S. aculeata* Guam and Saipan sections). While the numbers of surveys vary greatly from island to island, the numbers of surveys and their results are described for each listed species and island, thus the available data are clearly acknowledged throughout the document.

Reviewer #5:

1. *In general, does the document include and cite the best scientific and commercial information available?*

This document provides a very thorough collation of the best available scientific and commercial information.

2. *Are the scientific conclusions factually supported, sound, and logical?*

All available data records have been appropriately presented, discussed and analyzed. I consider the ratings and conclusions to be factually supported.

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

Any relevant taxonomic changes have been considered and discussed where applicable, including recognizing species identification uncertainties.

4. *Are uncertainties assessed and clearly stated?*

Any uncertainties pertaining to the available scientific and commercial data, communications and photographs etc. have been clearly accounted for a discussed. Data gaps have also been acknowledged appropriately. I believe that in many instances, a cautionary approach has been taken when determining appropriate rating scores.

5. *Are the methods used valid and appropriate?*

I consider all methods and evaluation procedures to be valid and appropriate. Each species' results and record interpretations are clearly presented and supported with data.

6. *Are the results and conclusions supported by the information presented?*

This is a very clear, factual and concise report evaluating ESA listed corals in the Pacific Islands Region. All available data has been collated, presented and evaluated very thoroughly. The results and concluding remarks are supported by the information presented for each ESA coral species, and an equal assessment has been conducted for each species by region.

Revisions of the Records Document: No revisions were necessary in response to this reviewer.

Reviewer #6:

1. *In general, does the document include and cite the best scientific and commercial information available?*

Overall, there are many sources and other information used to compile this synthesis. That is a daunting task. However, it seems that not all of the information from American Samoa was used or incorporated, or at least it is not clear. Montgomery et al 2019a (10.3897/zookeys.849.34763) provides an in-depth review of all coral species records including all the species examined here and some others. While the paper does not provide all the full length detail due to paper length, the raw data compiled for the paper is publicly available on GBIF (https://www.gbif.org/dataset/34e5d258-a1bc-49c6-8c25-56609a300015). The raw data will allow anyone to narrow down to each individual species record and its source, taxonomy, and type of evidence the source provides. This would represent the most current data available on coral species distributions within American Samoa.

2. *Are the scientific conclusions factually supported, sound, and logical?*

The conclusions are based on a formulaic approach to classifying uncertainty and providing that into categories that decisions can be based. While this approach is generally appropriate and often warranted when multiple lines of uncertainty are stacked and decisions need to be made, there are some concerns on how things are interpreted and the intent. See below for comments under methods.

3. *Where available, are opposing scientific studies or theories acknowledged and discussed?*

There seems to be a quick assumption that coral records that are singular in nature or rare in general are considered waifs. The citation to waif is Fishbase 2021 which is not the best source of an ecological term. Generally, this term is used in a geographic context and not a habitat context in the literature, despite the dictionary definition. I would recommend a reconsideration of the overuse of this term and the conclusions based on this assumption. I recommend going back into the primary literature and cite the best use of waif. I do not believe it to mean the way it is used in this paper. The actually definition of this term matter tremendously as it ties into the biogeographically distribution of a species as well as rarity in general. The way it is used here indicates you are capturing waifs at small ecological scales which would indicate habitat differences. Rarity becomes an important concept in this context. Most species are

inherently rare and threatened species are almost by definition rare, so the fact that one species is even more rare despite some uncertainty (see below for methods of concern with uncertainty) should not be a disqualification for evidence of a population. Classifying something as a waif out of hand been when the species based on clear, sound scientific evidence is documented to be present does a disservice to the conservation of a listed species.

4. *Are uncertainties assessed and clearly stated?*

Overall, there was clear and extensive uncertainties stated. However, there seems to be an oversight when it comes to our current state of knowledge of species distribution at the island or habitat scale. Often times, shallow water coral species surveys are repeated in the same types of habitat and often targeted in areas where they is higher biodiversity or interest for monitoring. This often overlooks under surveyed areas such as highly disturbed areas and depths bellow standard scuba. For example, the term "mesophotic" was only used three times in the text of the document and in those cases only in the two species that surveys found listed species. This is an inherent gap in the data and that has a tremendous influence on the decision as no data is treated as no evidence. This is a significant uncertainty that is not addressed and may be a factor for other species.

5. *Are the methods used valid and appropriate?*

The general approach to classifying the uncertainty is a reasonable approach. However, the methods used here seem to represent a new way going about classifying where a species population is present on an island. It would seem that despite clear evidence of a species being present on an island even with the stated uncertainties described, a species presence does not represent a species population based on the methods and the interpreted results. It was stated that: "The records are interpreted in terms of the level of evidence that a population of the species occurred on the island at the time of listing in 2014" (page 1). It was only well into the document that I realized we may be thinking of "population" differently and this term was not put into context for the document. If it is meant to be a viable self sustaining reproductive population, then there obvious needs to be more than a single species record if you assume that record represents a reasonable effort across habitats. This would also mean that there is no stated criteria for what is enough for there to be considered a population present. If it is meant to be that the species is present within an island, then one would assume that a single documented record would be sufficient. In respect to the uncertainty of what is meant by population, there is no consideration of commonality of a species across habitats. *Acropora jacquelineae* is a good example of this. There is no stated opposition to its presence, but it is discounted from a population on Tutulia because it is the only one. This was explained away as a "waif" without fully documented the ecology context of waifs. There is a significant difference in waifs from another island compared to from

another habitat. Waif is not generally a term that is used for a species that extends unusually into a different habitat, but more broadly in biogeography. When considering habitats, it is more about rarity and ecological niches, so concluding that a species population is not present as describing it by a single one off and no consideration of habitat preferences and uncertainty in our understanding of the habitat preferences seems to be a flaw in the methodology used to assess species population presence.

6. *Are the results and conclusions supported by the information presented?*

The results are generally supported by the information presented but there appears to be a gap in the information presented. As stated above, there are uncertainties in our knowledge in species distributions, particularly across depth. There is no easy solution to this when limiting the knowledge only to a specific area. However, more information could be utilized that uses knowledge from other areas. With habitat distribution from other areas, one could close the knowledge gap to a degree and develop some assumptions based on the best available information instead of classifying a record as a waif.

Revisions of the Records Document: The document was revised as described below in response to each of the 6 responses by this reviewer:

1. The referenced paper (Montgomery et al 2019a) and raw data were reviewed to ensure that all records for ESA-listed coral species in American Samoa had been included in the Records Document. However, no records were found that hadn't already been included. The cited document and raw data include an error (record for *A. globiceps* on Swains I. in Am Samoa is actually a record of that species from Swains Reef in Australia, thus we still have no records of *A. globiceps* from Swains I.).
2. Several revisions were made in response to the general concern expressed in this comment. The specific revisions are described in the following responses.
3. The concept of waif colonies is important in coral critical habitat because the definition of critical habitat in the ESA does not include areas used solely by "vagrant individuals" (i.e., waif colonies, in the case of corals), as explained in the first paragraph of Section 1.2. The commenter provides several constructive critiques of the treatment of waifs in the peer review draft of the Records Document, and in response we have made the following changes to the final draft:
    a. The definition of waifs ("a single individual or small group of individuals found outside of its normal range") is based on the primary literature

(Johnson et al. 2000), as is the the occurrence of waifs among reef corals (Turak and DeVantier 2019) and coral reef fishes (Franklin et al. 2019).

b. The commenter notes the importance of spatial scale in considering waifs, i.e., that waifs should be considered in a geographic context not a habitat context. The spatial scale of critical habitat, including application to waifs, was clarified by adding paragraphs to the end of Section 1.2. That is, the occupied areas of coral critical habitat are determined at the island scale (not the archipelago or habitat scales). Likewise, the potential that a solitary record may have been a waif is now only done at the island scale, and only in those cases when many surveys have been conducted on the island within the habitat of the species. As a result, only one record (*A. jacquelineae* on Tutuila) is now considered as a possible waif.

c. The overall use of the term "waif" has been substantially reduced in the revised document. The potential that a solitary record of a coral species from a heavily surveyed island is mentioned in one case (*A. jacquelineae* on Tutuila), but it is only considered as a possible waif.

4. The uncertainty resulting from the fact that habitats and depths are not equally represented in the records was addressed by adding Section 1.3 Sampling Biases and Potential Implications to the document. This new section describes the geographic, habitat, depth, methods, effort, and personnel biases inherent in the records, along with their potential implications.

5. In response to this reviewer's comments (and similar comments from one other reviewer) regarding the purpose of the document being to determine whether records of each listed coral species on each U.S. island represent a "population" at the time of listing (2014), the following revision was made to the document. Since the purpose of the Records Document is to systematically review the records of each listed coral on each island for application to coral critical habitat (see Section 1.1 of revised Records Document), and the ESA defines critical habitat in terms of "occupied areas" (see Section 1.2), the Records Document was revised to focus on interpretation of the records in terms of occupied areas instead of populations. The concept of population no longer appears in the document.

6. The "gap in the information presented" (i.e., lack of records because some habitats and depths were much less surveyed than others) is acknowledged with the new section (Section 1.3 Sampling Biases and Potential Implications). No records are classified as waifs, although the possibility that one record may be a waif is mentioned.

Literature Cited

Franklin, E.C., Gray, A.E. & Mundy, B.C. 2019. Three new records of coastal fishes in the Hawaiian Islands. Journal of the Ocean Science Foundation, 33, 99–106.

Johnson, R.K., Zahuranec, B.J., Boltovskoy, D., and Pierrot-Bults, A.C. 2000. Glossary of Pelagic Biogeography. Scientific Committee on Oceanic Research, Working Group 93. 163 p. Available for download from https://scor-int.org/group/93/

Turak, E., and L. Devantier. 2019. Reef building corals of the upper mesophotic zone of the Central Indo-West Pacific. In: Loya, Y., Puglise, K.A., Bridge, T.C.E. (eds.) Mesophotic Coral Ecosystems, p. 621-652. Springer.