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Opportunities and challenges for coral restoration in the Pacific: Management and Regulatory considerations

National Academies

Committee on Interventions to Increase the Resilience of Coral Reefs

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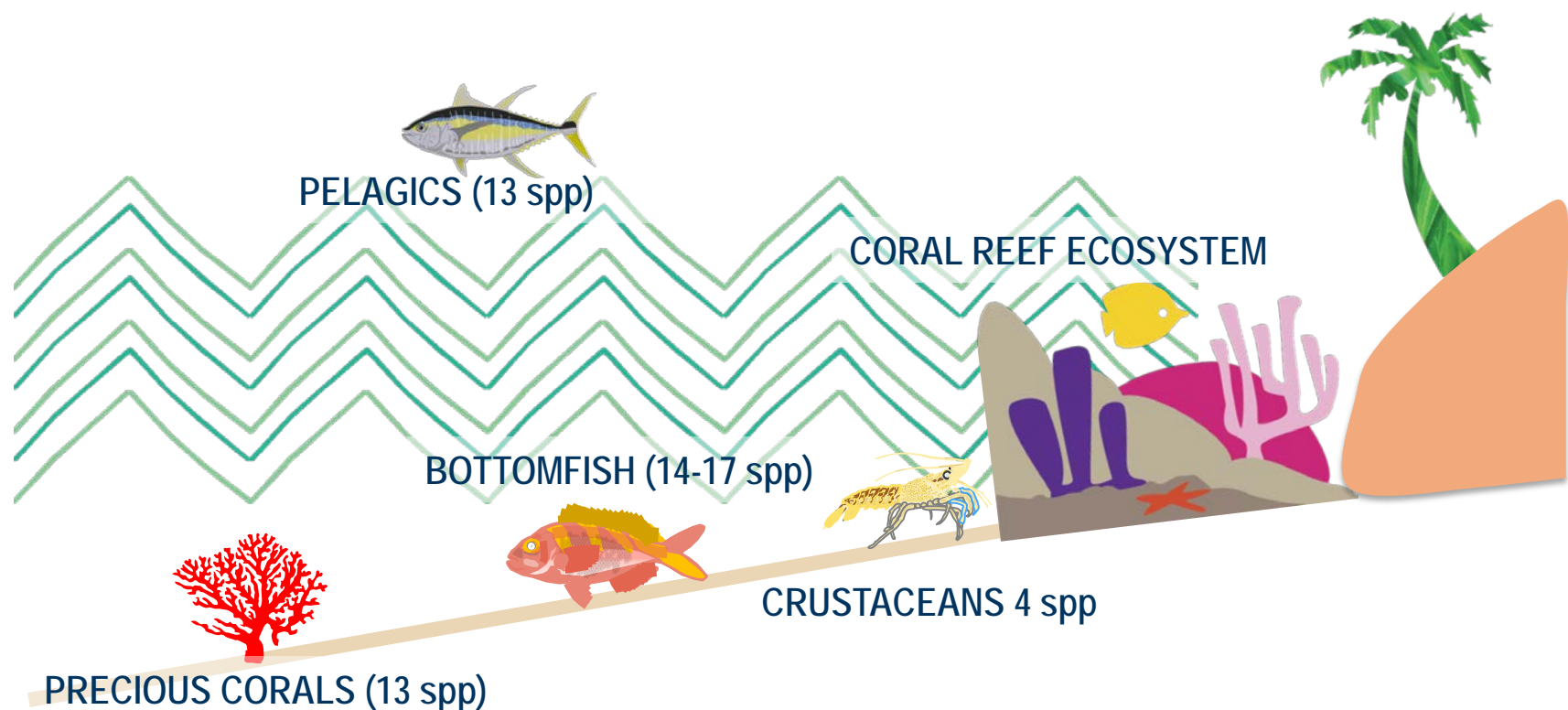
Outline

1. PIRO's EFH and ESA Coral Programs
2. Responses to Committee's Guiding Questions
3. Input on Committee's Task and Results

Essential Fish Habitat is for Management Unit Species

“those waters and substrate necessary for [federally managed] fish to spawn, breed, feed, and/or grow to maturity”

Management Unit Species in Fishery Ecosystem Plans



HABITAT CONSERVATION

USCRTF

Coral Tool

Resilience

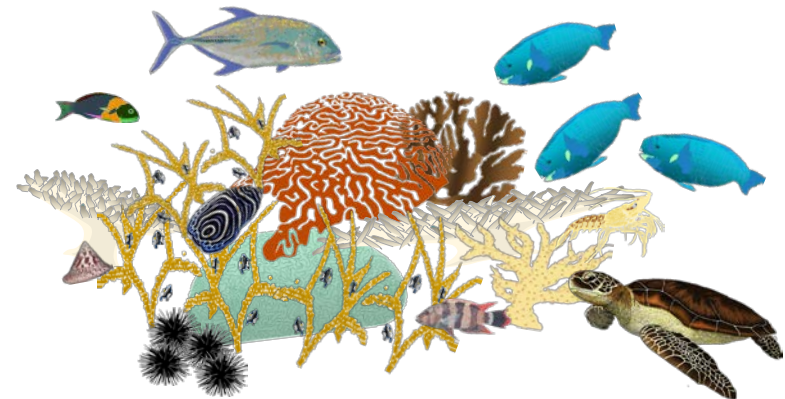
Restoration

Vulnerability

Spatial Planning

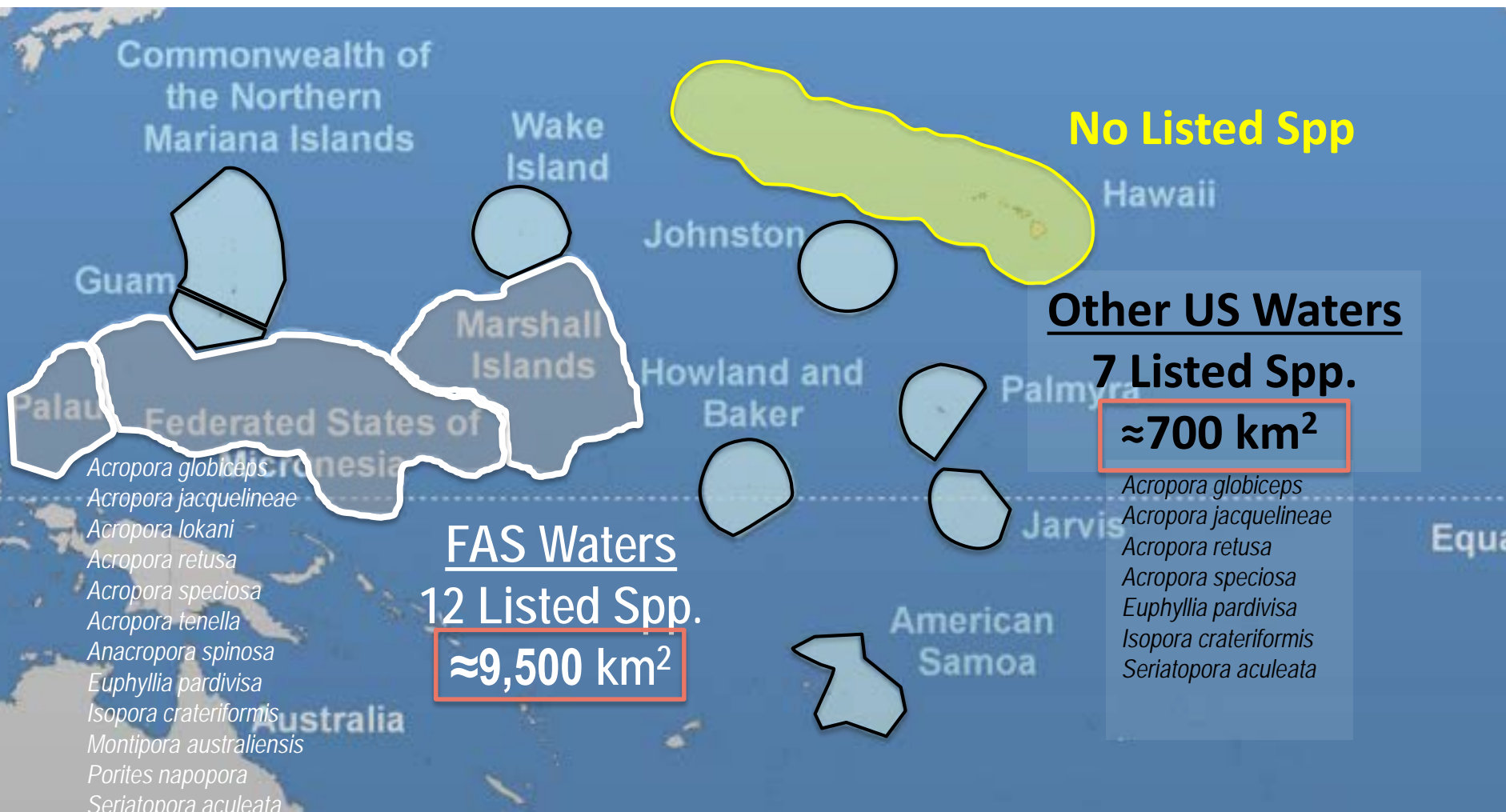
USAKA

Compact of Free Association



ESA Corals Program:

Distributions of ESA-listed Indo-Pacific Coral Species in US & FAS Waters



EFH and ESA Programs

Management Activities for Coral Reef EFH and ESA Corals

- US Waters Only:
 - EFH Consultation
 - ESA Consultation
- Freely-Associated States/FAS
 - EFH: USAKA and Compact Agreements
 - ESA: Coral Spp. ID Training Program
- Species' Entire Ranges
 - ESA: Recovery Planning for listed species
 - ESA: Potential Status Reviews of Unlisted Species

Committee's Guiding Questions:

Question #1

1. What are the current and expected future conditions in the Pacific and the expected effect on coral reefs? What are the uncertainties in predicting the condition of coral reefs in the future?
 - **Multiple, synergistic threats, both local and global.**
 - **Need change in management approach.**

Committee's Guiding Questions:

Question #1

- IPCC's AR5 projects future climate conditions under 4 different "Representative Concentration Pathways"/RCPs by 2100:

**Business
As Usual**

1. RCP8.5, 936 ppm CO₂, $\Delta T_{\text{ocean}} = +3.1^{\circ}\text{C} \pm 0.6^{\circ}$

2. RCP6.0, 670 ppm CO₂, $\Delta T_{\text{ocean}} = +1.9^{\circ}\text{C} \pm 0.4^{\circ}$

**Paris
Agreement**

3. RCP4.5, 538 ppm CO₂, $\Delta T_{\text{ocean}} = +1.5^{\circ}\text{C} \pm 0.4^{\circ}$

**Currently
≈410 ppm**

4. RCP2.6, 421 ppm CO₂, $\Delta T_{\text{ocean}} = +0.8^{\circ}\text{C} \pm 0.4^{\circ}$

IPCC, 2013: Climate Change, The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. See Table 12.2 on p. 1055.

Committee's Guiding Questions:

Question #1

- Future conditions & effects on Pac. reef corals:
 1. RCP8.5 vs 4.5, Annual Severe Bleaching, reef coral comm.¹:

Onset of ASB	RCP8.5	RCP4.5
Hawaii	2030-2049	2041-2060
Guam/CNMI	2026-2044	2037-2055
Am Samoa	2035-2044	2046-2055
PRIAs	2030-2054	2041-2065

2. All 4 RCPs, population extinction, one species²:
 - RCP8.5 = extinct 2055, RCP6.0 = extinct 2085, RCP4.5 = decline & stabilize, RCP2.6 = stabilize.
 - Adaptation was the key to popⁿ survival, transplantation hastened adaptation.

1. van Hooidonk, R., J. Maynard, J. Tamelander, J. Gove, G. Ahmadi, L. Raymundo, G. Williams, S. Heron, D. Tracey, B. Parker, and S. Planes. 2017. Coral Bleaching Futures - Downscaled projections of bleaching conditions for the world's coral reefs, implications of climate policy and management responses. United Nations Environment Programme, Nairobi, Kenya, 71 p.

2. Bay, R.A., N.H. Rose, C.A. Logan, and S.R. Palumbi. 2017. Genomic models predict successful coral adaptation if future ocean warming rates are reduced. Science Advances. 01 NOV 2017 : 01 Nov 2017: Vol. 3, no. 11, e1701413. DOI: 10.1126/sciadv.1701413



Committee's Guiding Questions:

Question #1

Conclusion

- Uncertainty:
 1. AR5's "key uncertainties".
 2. Variability in projected physical conditions.
 3. Variability in biological responses.
 4. Species ID uncertainty.

Committee's Guiding Questions:

Question #2

2. What information is needed to weigh the risk and benefit of implementing new coral reef restoration and management approaches?
 - Risk: Info on effects on other species.
 - Benefit: Consider context of climate change effects.
 - Best strategy - i.e. How to determine best path:
 - Propagate priority species
 - Develop thermally-adapted strains
 - Best techniques for growth
 - Transplantation and recruitment and at what scale.

Committee's Guiding Questions:

Question #3

3. What are the regulatory and scientific barriers and needs for permitting research and deployment of new approaches in the water?
 - Regulatory: Intervention-type actions regulated at both State and Federal levels.
 - Scientific:
 1. Site selection.
 2. Species-specific information.
 3. Nursery reintroduction
 4. Hybridized specimens
 5. Disease risk

Input on Committee's Task & Results:

How could the Committee's recommendations be applied to our ESA and EFH Corals Program?

- Coral Tool: Interventions may be an important part of mitigation efforts. Dealing with shifting baseline is a major consideration. Stronger water quality standards and application of resilience consideration could be a critical strategic factor. Depending on the development of Pacific Nurseries, this could also be a valuable mitigation tool.
- Pacific Corals Recovery Plan: Interventions may be incorporated as Recovery Actions.
- How to share information and expertise within the management efforts across jurisdictions and nation

More Information

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