Appendix F. Biological Resources of Concern

F.1. Introduction

Early in the planning process, the team cooperatively identified species, species groups, and communities of concern for the Refuge. A comprehensive list of these resources was compiled based on review of numerous plans, many of which highlight priority species or habitats for conservation. The Comprehensive Resources of Concern table was further culled in developing a more targeted assemblage of Priority Resources of Concern. Most of the biological emphasis of the CCP is focused on maintaining and restoring these priority resources.

Definitions for the column headings in Table F-2 are as follows:

- Focal Species: Species selected as representatives or indicators for the overall condition of the conservation target. In situations where the conservation target may include a broad variety of habitat structures and plant associations, several different conservation focal species may be listed. In addition, species with specific "niche" ecological requirements may be listed as a focal species. Management will be focused on attaining conditions required by the focal species. Other species utilizing the conservation target will generally be expected to benefit as a result of management for the focal species.
- Habitat Type: The general habitat description utilized by the focal species.
- Habitat Structure: The specific and measurable habitat attributes considered necessary to support the focal species.
- Life-History Requirement: The general reason of use for the focal species.
- Other Benefiting Species: Other species that are expected to benefit from management for the selected focal species. The list is not comprehensive; see Appendix A for a more complete list.

Table F-1. Biological Integrity, Diversity, and Environmental Health

Habitats	Population/Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors
Lagoon	Lagoon floor (to ~98 feet depth) and back reef composed of carbonate sand and rubble, with low coral and CCA cover (< 1%). Hard-substrate pinnacles and patch reefs with moderate coral and CCA cover (>10%), supporting diverse fish assemblage and faisua Potential conservation species: faisua, sea turtles, candidate ESA coral	Intact perimeter reef (present-day height, width, biotic construction) and ava (present-day depth, width, location unblocked flow) that regulate seawater exchange with surrounding ocean and seawater flow inside lagoon; natural breakdown of calcifying organisms providing carbonate sediment	Proliferation of cyanobacteria; illegal fishing and faisua poaching; reduced calcification linked to ocean acidification

Habitats	Population/Habitat Attributes	Natural Processes Responsible for These Conditions	Limiting Factors
	species		
Perimeter Crustose Coralline Algal Reef	Living reef dominated by CCA, with intact geomorphic structure providing mosaic of microhabitats for invertebrates including corals and sea urchins Potential conservation species: candidate ESA coral species	Growth of CCA and other calcifying organisms, and accretion of carbonate through biochemical processes, maintains constructional platform between open ocean and lagoon	Rate of SLR relative to natural capacities for growth and accretion; reduced calcification linked to ocean acidification; overgrowth by non-reef-building cyanobacteria
Ava	Unobstructed channel between lagoon and fore reef with present-day depth, width, and location Potential conservation species: faisua, sea turtles, candidate ESA coral species	Natural hydrological regimes of oceanic and lagoonal seawater flow	Impedance of natural flow patterns by boat grounding or other obstacles
Beach Strand	Beach strand habitat clear of invasive introduced plants and marine debris that provides nesting sites for ground-nesting seabirds and turtles and foraging sites for migratory shorebirds	Sand and rubble formed by the action of storms and bio-erosion of living CCA reef community is deposited and re-arranged by ocean waves. Plant community on the beach strand areas are kept at seral stage by repeated overwashing and storms. Current sea level	Nonnative invasive species of plants and animals; human disturbance and trampling; interruption in the supply of gastropod shells from the reef that are used by land hermit crabs; sea level rise; reduced calcification linked to ocean acidification; increased storm frequency and intensity changing sediment distribution patterns
Littoral Forest	South Central tropical Pacific littoral forest with a native species composition typical of other intact habitats of similar rainfall and soil type. This forest provides nesting sites for arboreal and ground-nesting seabirds as well as native land crabs, insects, and migratory shorebirds	Nutrient input from seabird guano and precipitation favor pu'a vai and other species of plants dispersed by birds or ocean currents	Nonnative invasive species of plants, animals, and pathogens, human disturbance; SLR; reduced calcification linked to ocean acidification; increased storm frequency and intensity; changing sediment distribution patterns

Table F-2. Priority Resources of Concern

Focal Species	Habitat Type	Habitat Structure	Life History Requirements	Other Benefiting Species
Pu'a vai (*Pisonia*)	Littoral Forest	Sandy and phosphate soils with elevation sufficient to avoid overwashing in all but the largest storms (> 6.6 feet)	All	Tree-nesting seabirds fua'o (red-footed booby), atafa (lesser frigatebird), atafa (great frigatebird), gogo (black noddy), white tern (manu sina)
Littoral forest tree species – *Cordia subcordata, Tournefortia argentea, Hernandia nymphaeifolia, Terminalia samoensis, Neisosperma oppositifolium,* and *Hibiscus tiliaceus*	Littoral forest (mesic)	Sandy and phosphate soils with elevation sufficient to avoid overwashing in all but the largest storms (> 6.6 feet)	All	Matu'u (Pacific reef heron) for nesting habitat and aleva (long-tailed cuckoo) for wintering, molting, and foraging
Tava'e'ula (red-tailed tropicbird)	Littoral forest	Ground under vegetation in understory and base of trees; sites that provide adequate shade for nestling for the duration of the growth period	Nesting	Gogo (brown noddy), fua'o (brown booby)
Fua'o (red-footed booby)	Littoral forest	*Tournefortia* and *Pisonia* trees that provide appropriate structure for nest construction above the ground	Nesting	Atafa (lesser frigatebird), atafa (great frigatebird), gogo (black noddy)
Land hermit crabs *Coenobita perlatus* and *Coenobita brevimanus*	Littoral forest	Sandy and phosphate soils, vegetation and shade protection from tropical sun	Reproduction – aquatic larvae, terrestrial adults, foraging, proximity to sea water source for osmoregulation and gill maintenance	Tuli prey upon land hermit crabs. Entire forest community benefits from *Coenobita* acting as scavengers and nutrient recyclers

Focal Species	Habitat Type	Habitat Structure	Life History Requirements	Other Benefiting Species
Gogo uli (sooty tern)	Beach strand and littoral forest	Open beach habitat or forest sites with minimal understory that provide open access for landing and takeoff and visibility for these highly social nesters	Nesting	Gogosina (gray-backed tern), gogosina (black-naped tern), bristle-thighed curlews, ruddy turnstones that prey on sooty tern eggs
Tuli (bristle-thighed curlew)	Beach strand and littoral forest	Open beach habitat or open forest	Wintering, molting, feeding	Tuli (ruddy turnstone), tuli (sanderling), tuli (wandering tattler), tuli (whimbrel), tuli (Pacific golden plover)
I'a sa (green turtle) and laumei uga (hawksbill turtle)	Beach strand/littoral forest/lagoon	Sand with access to the water but above the high tide line	Nesting (i'a sa only), resting, feeding	
Tamole (yellow purslane, *Portulaca lutea*)	Beach strand	Open sand, no over story	All	
Malie (gray reef shark)	Lagoon, ava	Pinnacles, patch reefs, back reefs	All	Malie alamata (blacktip reef shark), whitetip reef shark (*Triaenodon obesus*), bumphead parrotfish, Maori wrasse, gatala-uli (peacock grouper), leopard grouper, coral hind, strawberry grouper, mata'ele (flagtail grouper), honeycomb grouper, gatala-aloalo (dwarf spotted grouper), masked grouper

Focal Species	Habitat Type	Habitat Structure	Life History Requirements	Other Benefiting Species
Amu (stony corals) *Acropora, Astreopora, Cyphastrea, Favia, Leptastrea, Montastrea, Montipora, Pavona, Platygyra, Porites, Psammocora, Stylocoeniella* spp.	Reef crest, back reef, lagoon pinnacles and patch reefs	Hard substrate, depth and water clarity sufficient for light penetration, moderate temperatures, seawater immersion time sufficient to prevent desiccation, low nutrients, low algae and cyanobacteria, herbivorous fish and invertebrates	All (growth, feeding (endosymbiosis, and plankton capture), reproduction)	Reef fish; other benthic invertebrates (soft corals, mollusks, crustaceans, worms, echinoderms, tunicates)
Faisua (giant clam) (*Tridacna maxima*)	Lagoon pinnacles and patch reefs	Hard substrate, water depth and clarity sufficient for light penetration	All (growth, feeding (endosymbiosis, and filter-feeding), reproduction	
Sea urchins (tuitui)	Reef crest, back reef, lagoon pinnacles and patch reefs	Hard substrate, available holes for occupancy, algal films and turf for grazing	All (growth, grazing, reproduction)	Corals, CCA
Turban shells (*Turbo crassus, Turbo setosus, Turbo argyrostomus*)	Reef and lagoon habitats	CCA reef flats with epilithic algae for grazing	Foraging (herbivores and detritus feeders)	Land hermit crabs (*Coenobita perlatus* and *C. brevimanus*) that use shells of these gastropods
Crustose coralline algae (*Porolithon* spp., *Hydrolithon* spp.)	Reef	Hard substrate, moderate temperatures, low cyanobacteria, herbivorous fish and invertebrates	All (growth, photosynthesis, reproduction)	Stony corals