Appendix 1. (cont.)

DEFINITIONS & FOOTNOTES:

Estimate of Coral Reef Habitat: Coral reef habitat acreage estimates were generated by various management agencies and may not be comparable.

Approximate Percent No-Take: No-take is defined as complete protection from harvest, with no extraction allowed within the boundaries of the MPA.

Designated: Percentages correspond to the regulations of the particular MPA-CR. In many cases, the percentage does not accurately reflect the current level of take activity within the MPA-CR.

Effective: Percentages are estimates of the proportion of the MPA-CR that is effectively no-take. These percentages are meant to more accurately reflect the area take activity that is currently occurring within the MPA-CR.

Number of On-Site Staff: These numbers refer to staffers who are actually in the MPA on a day-to-day basis. Areas where managers are near the MPA-CR, but not actually at the MPA-CR site were not included. Note that many of the designated 100% no-take areas have no on-site staff, as defined here.

* = date reflects official transfer or designation with MPA-CR component, but may not reflect initial designation of entire protected area

? = information unknown or still to be collected

****** = final designation pending

Acronyms:

AS DMWR	American Samoa Department of Marine and Wildlife Resources
CNMI	Commonwealth of the Northern Mariana Islands
DOI	U.S. Department of the Interior
HAPC	Habitat Area of Particular Concern
HI KIRC	Hawai’i Kaho’olawe Island Reserve Commission
HI DAR DLNR	Hawai’i Division of Aquatic Resources, Department of Land and Natural Resources
HI DOFAW	Hawai’i Division of Forestry and Wildlife, Department of Land and Natural Resources
HNP	Historic National Park
FL DEP	Florida Department of Environmental Protection
FMA	Fisheries Management Area
FWS	U.S. Fish and Wildlife Service
GUAM DAWR, DA	Guam Division of Aquatic and Wildlife Resources, Guam Department of Agriculture
MLCD	Marine Life Conservation District
NM	National Monument
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	U.S. National Park Service
NMS	National Marine Sanctuary
NP	National Park
NW HI	Northwest Hawaiian Islands
PR DNER	Puerto Rico Department of Natural and Environmental Resources

APPENDIX II: Rationale for a Minimum Goal of 20% No-Take Protection of Representative Coral Reef Habitats

Ecosystem-based management recognizes that humans are an integral part of marine ecosystems but that human activities must be within sustainable limits determined by the ecosystem. No-take marine reserves, areas protected from all fishing and other extractive uses, are an essential and ecologically-based tool for protecting habitat and marine ecosystems under ecosystem management. Their use is based on both empirical data on their effectiveness, as well as on the the precautionary approach of withholding some resource from extractive use because human understanding of resources is incomplete. Ideally, marine resources should include a network of replicated and representative reef ecosystem habitats covering the geographical range of coral reefs. Although most current interest in marine reserves focuses on fisheries and short-term economic benefits, their best use is to maintain ecosystem health and function. A recent survey of Caribbean sites in the CARICOMP network showed that sites where control of fishing access was the only management tactic were the only sites where coral cover was stable or had increased over the last 10 years. Unlike traditional fishery management that takes action only after problems have been demonstrated, ecosystem, management is intended to prevent problems.

Ecosystem-based management recognizes that the true sustained yield requires preservation of the health (the capacity for self-renewal) of the entire coral reef ecosystem. The total area set aside in no-take protection should be sufficient to be self-sustaining, independent of that which happens in actively managed areas. A strategy is recommended to protect a minimum of 20% of representative coral reefs and associated habitats by no-take protection in ecological reserves while the remaining acreage is managed by traditional fishery and other resource management practices. The ultimate goal is to ensure the persistence of coral reef ecosystem structure , function, and beauty in the face of growing demands for exploitation. The minimum goal is to ensure the persistence of coral reef biodiversity in the face of human error in management and natural disasters. Persistence includes protection of species richness, population abundance and age structure, and the genetic qualities of individual species. The 20% no-take protection is based on the best available science, the precautionary approach, and represents a realistic biological target until better information becomes available.

Four lines of evidence support a minimum of 20% protection based on population biology:

1. *Theoretical support from spawning potential ratio (SPR) research and guidelines*. SPR is the ratio of spawning under fishing to spawning without fishing. It is equivalent to spawning stock biomass per recruit as determined from life tables. As SPR is reduced by fishing, an exponential increase in egg survival is required to maintain the population. If the spawning stock is reduced by 50%, for example, then every egg has to have twice its natural survival to maintain the adult stock. Due to biological compensation, some increase is expected when adult population size is reduced. As the spawning stock is reduced, the amount of compensation increases exponentially. At some point, biological compensation cannot maintain the adult population size and long-term maximum sustained yield. At 20% each egg produced must have five times its natural survival to maintain the populations. It offers a level with some margin for error before unreasonably low levels of SPR occur. At SPR levels below 20%, the rate of increase in the amount of compensation required per unit reduction in SPR increase drastically

(Goodyear, 1993). At 10% SPR, for example, each egg must have ten times its natural survival, a level unlikely to be biologically feasible. By protecting 20% of an organism's habitat and thereby, hopefully of the spawning biomass of the population, one can hope to ensure 20% SPR.

2. *Empirical observation of declines in recruitment in stocks where SPR has been estimated*. SPR based on data from fishery collapses and knowledge of fishing effects on SPR were developed for Northeast groundfish fisheries. Gabriel et al (1989) evaluated SPR and recruitment for several demersal fishes from the Northwest Atlantic and noted declines in recruitment of SPR below 20% in several species.

3. *Knowledge of fishing effects on SPR*. Fishing can drive SPR to extremely low levels. Red snapper in the Gulf of Mexico, for example, was shown to be less than 1% when first fully assessed. Mace and Sissenwine (1993) examined 91 fished stocks of 27 species and found that SPR averaged around 0.19 overall.

4. *Studies of actual reserves*. Limited quantitative studies of marine reserves are promising and provide some support for protecting 20% of the area. Apo (10% closed) and Sumilon (25% closed) show benefits in work by Russ and Alcala (1996, and others). Sladek-Nowlis and Roberts (1999) modeled benefits from large reserves.

History

A 20% figure was originally recommended by the U.S. South Atlantic Fishery Management Council in the Snapper-Grouper Plan Development Team Report (PDT, 1990). That report was peer reviewed in 1995 as part of the American Fisheries Society annual meeting (Roberts et al., 1995). The review panel endorsed the report but never specifically dealt with the 20% figure. Bohnsack (1994) did some simple modeling of a 20% reserve using red snapper and showed the potential for higher SPR than if all areas were fished. The 20% by the year 2020 was advocated for all marine habitats in a keynote address by Dr. Jane Lubchenco at the Society for Conservation Biology meetings in Vancouver in 1997 and at the American Association of the Advancement of Science (AAAS) meeting in Seattle in 1997 while president of AAAS.

In practice target SPR may need to be higher than 20% to maximize benefits. The 20% target assumes the additional levels of protection will be provided by fishery management to achieve optimal yields with SPR at 30% of higher depending on the species. Obviously larger protected areas are necessary to support sustainable fishery production than are necessary just to protect representative examples of marine biodiveristy.

APPENDIX III: Description of Site Selection and Ranking Criteria for Coral Reef-Marine and Coastal Protected Area (modified from Crosby et al., 1997)

Natural Resource Values

A. Biogeographic Representation

The area under consideration is characteristic of the biogeographic province and region in which it is located. Representativeness is the degree to which the area exemplifies the undisturbed habitat types, ecological processes, biological communities, physiographic features, or other natural attributes associated with the province. [A related measure of biogeographic representation for MPA-CRs is the 'percentage of un-represented features or elements encompassed by a MPA-CR candidate' as determined by gap analysis procedures. Those areas portraying the most un-represented features are rated the highest.]

B. Biodiversity

The area under consideration is significant in relation to the variety and number of life forms and communities which occur within the specified habitat type or within the biogeographic province. The area contains a representative variety of species or an important sample of the diversity of ecosystems, communities, species, populations, and gene pools found within the prescribed region or habitat.

C. Ecosystem Integrity

The area under consideration, either alone or in combination with other MPA-CRs, encompasses a complete ecosystem. Such an area is characterized by its high level of primary and/or secondary production and attendant higher trophic level communities.

D. Ecological Significance

The area under consideration is of special significance because it supports:

1. ecologically limited or endemic species, or
2. ecologically important species, or
3. unique species associations or biological assemblages, or
4. unique, rare, or fragile ecosystems.

This criterion would apply to marine habitat areas upon which ecologically limited species (e.g., threatened, endangered, rare, depleted, endemic, or peripheral species) are dependent during all or part of their lives.

E. Species Maintenance

The area under consideration is important to critical life history functions, including feeding, courtship, breeding, birthing/nursery, resting/staging, or migration.

F. Habitat Structure or Features

The area under consideration is characterized by unique, rare, or unusual chemical, physical, geological, and/or oceanographic features, structures, or conditions. A convenient measure for MPA-CRs is the ‘percentage of un-represented features or elements encompassed by a MPA-CR candidate’ as determined by gap analysis. Those areas with the most un-represented features are rated the highest.

G. Special Elements Protection
Combines the 'Biodiversity Representation', 'Ecological Significance', and 'Habitat Structure or Features' criteria, and attempts to establish a meaningful independence or distinction from the 'Biogeographic Representation' factor discussed above. For the purposes of planning a network of marine and coastal protected areas and modeling a site selection procedure, 'Special Elements Protection' refers to the protection of special, atypical elements within the marine waters of a coastal state, such as species at risk, unique biological assemblages, or special habitat, oceanographic, geologic, physical or chemical features. In contrast, 'Biogeographic Representation' deals with common features. When taken together, 'Special Elements' and 'Biogeographic Representation' portray overall biodiversity.

Human Use and Historical Values

A. Renewable Resources of Importance for Sustainable Uses
The area under consideration contains fish and shellfish species, species groups (e.g. snapper-grouper complex), or other resources which are important to various modes of sustainable use and for which conservation and management are in the public interest. "Sustainability" implies preserving both the natural systems and the human uses of those systems. The area (or zone within the area) under consideration is suitable for experimental manipulation to develop, assess, and demonstrate methods for sustainable use.

B. Recreational Resources
The area under consideration contains exceptional natural resources (biological, physiographic, geomorphological, oceanographic, or other) that stimulate and encourage human interaction with the marine environment and promote recreational activities, thereby enhancing human appreciation, understanding, and enjoyment of nature.

C. Research and Monitoring
The area exhibits significant opportunities for implementing long-term research and monitoring programs to define baseline characteristics and to detect and measure changes in the status of biota or environmental conditions.

D. Educational and Interpretive Opportunity
The area under consideration provides an excellent opportunity to demonstrate and interpret the meanings and relationships of special marine resources in order to enhance general understanding, appreciation, and sustainable use of the marine environment to primary, secondary, and post graduate students, as well as the general public. The area possesses qualities that provide an opportunity to demonstrate how the site is important within the context of the national MPA-CR network and, if possible, how the site fits into the international network of MPA-CRs.

E. Historical and Cultural Resources
The area under consideration contains, or is likely to contain, submerged remnants of past life that are of special historical, cultural, archaeological, or paleontological value; or the area is of particular importance for the support of traditional subsistence and/or cultural uses of the indigenous human population.

F. Aesthetic Resources

The area under consideration encompasses seascape, adjoins coastal landscapes, or possesses other scenic or visual qualities (including both living and non-living marine resources) that exhibit outstanding capacity for engaging human interest, thereby enhancing human appreciation, understanding, and awareness of the broad importance of marine resources.

Impacts of Human Activities Value

Many of the potential MPA-CR sites are, or can be expected to become, adversely affected by the impacts of human activities. The evaluation of impacts is not expected to be highly detailed, however, as definitive environmental impact analyses are hampered by the difficulties inherent in discriminating between natural fluctuations and human-induced changes. Therefore, the impact analysis will necessarily be a brief and somewhat subjective assessment of both observed impacts and impacts projected to accumulate over time, and this preliminary assessment will be based on available information gathered from the literature, interviews, and the public.

Management Concerns Values

A. Coordination With Other Programs

The potential contribution of a MPA-CR site to enhance existing MPA-CR networks should be a factor in selecting candidate sites for designation. Depending on the location, the resources, the human activities and impacts, and the nature of the existing management framework, the program can either complement the status quo by filling specific gaps or form a management umbrella over a fragmented system to help coordinate and strengthen diverse but related efforts. There may be instances where a marine area's primary contribution to protection will be in the form of enhanced public awareness through programs in education and interpretation or research and monitoring at the MPA-CR site.

B. Size and Boundary Considerations

Establishing the optimum size and determining boundaries for MPA-CRs is a process that requires some compromise between protecting whole ecosystems and implementing effective management capabilities. The size of a MPA-CR should be determined primarily by the area required to protect the resources of significance; in the case of biological resources, the MPA-CR should encompass an area large enough to protect an integral, functioning, self-sustaining ecological entity.

C. Accessibility

Because a MPA-CR program is intended to support compatible uses by the public, consideration should be given to factors which limit or enhance public access to a proposed MPA-CR site.

D. Surveillance and Enforcement

In order to present a credible program for protecting resources, MPA-CRs should be routinely monitored both to verify that human activities are conducted within the limits that were established to ensure the viability of coral reef resources and to project the identity of the MPA-CR program in the area. In evaluating potential sites, therefore, consideration should be given to the expected requirements for surveillance and enforcement activities. While new remote sensing technologies are enhancing the ability to monitor remote island reserves, it remains logistically difficult and expensive. Nevertheless, these areas are critical to long-term conservation efforts, and should not be discounted because of logistical challenges.

E. Economic Considerations

The designation of a MPA-CR is likely to have mixed economic effects; these impacts should be expected to occur at both the local and national levels and in both the near-term and in the long-term. Designation may also create non-economic effects which may influence the public's perception of the worth of the protected area.

F. Network-wide Activities

Consideration will be given to the site's potential for enhancing the network of MPA-CR sites. This criterion would apply to sites that, because of geographic location, resource value, human uses, or other attributes of management interest, could improve the capacity of the MPA-CR program to function as an integral network of inter-related protected areas.

G. Urgency of Threat

Sites should be evaluated for the immediacy of the need to implement a program of comprehensive and coordinated conservation and management. Urgency of need for designation will be based on the imminence of degradation threats to significant resources.

APPENDIX IV: Description of Dimensionless Analyses and Delphic Priority Ranking Methodologies for Selecting Coral Reef MPA-CRs. (The following describes one of a variety of methods that have been proposed for prioritizing marine protected areas. This appendix is intended to serve as an example only, and is not advocated by the Working Group as the best or only method to be used.)

Much of the recent scientific literature on the optimal design of protected area systems on land focuses on using iterative computer algorithms for identifying the smallest number of potential reserves which will include representation of each species or feature at least once within a protected areas system (see Mondor 1997) . Most algorithms give the user complete control over the configuration and content of the network by selecting and de-selecting individual areas until, as far as possible, all representation goals have been met (Mondor 1997). The United States Fish and Wildlife Service, in cooperation with the individual states, has also examined the use of types of approaches for planning a network of reserves to protect the country's land and freshwater biological diversity (Scott et. al. 1993).

Marine and Coastal Protected Area (MCPA) selection and design strategies, like most areas of conservation biology, are rapidly evolving. Past methods for selecting potential protected areas on land or the sea have been predominantly ad hoc or opportunistic, and are not considered scientifically defensible today. And, as noted by Vance-Borland *et al.* (1996), "...what is not scientifically defensible is unlikely to be taken seriously." The *International Group of Experts on Marine and Coastal Protected Areas* (Crosby et. al. 1997) examined two widely utilized approaches for selection of MCPA sites, and Laffoley et. al. (1997) developed recommendations for improvement of these approaches to create a more idealized process for selecting potential MCPAs, developing new MCPA programs, or adding MCPAs to an existing network of sites that have already been designated. A general approach for selecting MCPA sites, based on these works, is described below.

Through local and regional site nominations and facilitated workshops, a catalog of potential MPA-CRs, with full site descriptions (see Appendix IV for examples of two formats for presenting candidate site description), will be compiled and merged with a national map of coral reef habitats in the U.S. This will enable a "gap" analysis to be conducted that will identify priority coral reef habitat types that are not currently afforded appropriate levels of management. A "short list" of potential MCPA sites will then be developed based on the gap analysis, the special significance of the sites' resource values described in the site profiles, and sites' abilities to help meet the goals of EO 13089. The next step will be to determine the priority ranking of these sites relative to each other. This is especially important in times of restricted fiscal budgets, when new MPA-CR sites may be added to the existing network at a very slow pace.

For the first part of the priority ranking exercise, determination will be accomplished using the Dimensionless Analysis model described by Crosby et al. (1997) which was adapted from Mondor (1991). The model compares the resource values of each site to the resource values of the biogeographic province which that site represents, and then makes comparisons among the sites themselves in order to determine priority ranking of sites. Some strengths of this model are that (1) all criteria influencing the site selection decision, as well as the weight placed on each criterion, must be specified; (2) subjective and objective criteria can be combined; and (3) the analysis is mathematically rigorous. Candidate MPA-CR sites will be compared to each other in pairs by computing weighted ratios according to Equation 1:

Ri = ((A/B)W)I
where
Ri = weighted ratio for the ith criterion;
A = Site A score for the ith criterion;
B = Site B score for the ith criterion;
W = weighting factor for the ith criterion;
I = one criterion in a list of criteria numbered I = 1,2,...,n.

The preferred candidate MPA-CR site of each site pair is selected by generating a preference number which was based on the scores and weights assigned to the Site Identification Criteria. This preference number, P, is computed by multiplying together the weighted ratios of the site pair, as shown in Equation 2. Because P is the product of weighted ratios, the preference number tests the numerator with respect to the denominator. The preferred selection is the site whose preference number is greater than 1. The magnitude of the preference number does not confer a "degree of preference"; preference is established solely by whether the value of P is greater than or less than 1. If P = 1, the two candidate MPA-CR sites are equivalent. The formula for computing P is:

Pn = ÿ Ri Equation 2
where
Pn = the preference number
ÿ = the product of weighted ratios for criteria I = 1,2,...,n
Ri = the weighted ratio for the ith criterion (see Equation 1)

Pairs of candidate MPA-CR sites will be compared interactively using this process of preference selection. The final result will be a list of potential MPA-CR sites ordered by priority for selection as active candidates for further consideration to the MPA-CR network.

The second part of the priority ranking exercise will utilize the "Delphic" method (for a complete description, see Crosby et al. 1997) consisting of recognized experts in the field of MPA-CRs reaching a consensus on the priority ranking of the potential MPA-CR sites based on their purely qualitative assessment of each site compared with all the others.

It was the overwhelming consensus of the *International Group of Experts on Marine and Coastal Protected Areas* (Crosby et. al. 1997) that both the Dimensionless and Delphic approaches should be used to provide recommendations on the selection of potential MPA-CR. It was generally thought that undertaking the Dimensionless ranking first provided added focus to the following Delphic consideration of sites. It was felt that undertaking the Dimensionless Analysis gave a degree of "quantitative@ credibility to a process which would otherwise be seen to be relying too directly on expert judgment. The fact that the Dimensionless Analysis involved numerical analysis suggested a more rigorous process. Undertaking the ranking process in individual groups, using both Dimensionless and Delphic techniques, and comparing and contrasting differences in the overall recommendations from each group was felt to give the greatest opportunity for rigorous ranking of MPA-CRs. It ensures that standard scientific techniques are applied in a consistent manner, that agreement on selection of individual sites is maximized and that pragmatism is given an appropriate role to play in the ranking process.

Site ranking should be undertaken (sequentially at local, then national, then international levels) by at least 3 small (6-10) groups of people who have mixed skills and experience of the sites in question. Each group should include the same mixture of skills and experience. The mix of skills within each ranking group is important and it is a positive advantage to include individuals who have no direct knowledge of the sites involved. They tend to have less bias towards certain sites. The success of this process depends on the quality, level, and consistency of the advice that is used to evaluate and rank sites. The individual groups should come together in a final plenary session to jointly review and discuss each breakout group's ranking and to jointly employ the Delphic approach to reach a final recommended ranking to the MPA-CR program for site selection.

Once candidate MPA-CR sites have been ranked for inclusion into the national network, appropriate designation processes will be initiated by the appropriate agency or agencies. Draft management plans for the MPA-CR site will include a clear statement of management objectives and protocol for assessing the site's success or failure to meet the stated management objectives with respect to both ecological and socio-economic variables (see Crosby et al., in press).

APPENDIX V: CANDIDATE SITES FOR NEW MPA-CRs

In this appendix, we present two alternative formats for candidate MPA-CR site descriptions that would be used to rank and select new MPA-CR sites. The first format is a fairly straight descriptive approach addressing the criteria presented in Appendix I. The second approach addresses the same criteria is a less straightforward manner and includes charts, maps and tables to aid the evaluators. In both sets of example formats, we have elected to describe sites that we suggest should be legitimate candidate sites for US waters. However, efforts should also be made to gather candidate sites in the waters of the FAS. Collectively, these three countries possess approximately 15 uninhabited islands and atolls with coral reefs worthy of protection (for example see Holthus et al. 1993, Maragos 1994, Maragos and Cook 1995, and Maragos, 1999). Designation MPAs within such areas would contribute both to protection of biodiversity and local cultural values. The re-negotiation of the Compacts of Free Association between the U.S. and the FAS could include economic incentives to encourage the FAS to support MPA designation.

The following example sites are not meant to be representative of an exhaustive list of candidate sites. However, in the case of Kingman, Palmyra, and Wake Island, there exists a unique opportunity based on lack of human populations existing on these sites. In the case of the Southern Mariana Islands; East End of St. Croix, USVI; Papaloloa Pt. – Ofu Island, American Samoa; Cordillera Reefs, Puerto Rico; and Cocos Lagoon, Guam, we are building on a previous international symposium and workshop effort (Crosby et al., 1997). While we feel these sites are legitimate candidates for inclusion in our proposed MPA-CR network, we view these as only initial suggestions and welcome a more comprehensive nomination, evaluation and selection process.

Example candidate format "A" for Kingman, Palmyra, and Wake Islands

The United States has sovereignty over eight remote islands and atolls in the Pacific, aside from the State of Hawaii, the Territories of American Samoa, and Guam, and the Commonwealth of the Northern Mariana Islands. The eight include Midway Atoll (at the NW end of the Hawaiian archipelago); Wake Atoll (north of the Marshall Islands), Johnston and Palmyra Atolls, Kingman Reef, and Jarvis Island (in the Line Islands), and Howland and Baker Islands (in the Phoenix Islands). All were uninhabited until this century, and five remain so (Kingman, Palmyra, Howland, Baker, and Jarvis), while the remaining three are sparsely inhabited. All eight are outside the jurisdiction of any state or territory.

Of the three unpopulated areas, Wake may soon be de-commissioned as a military installation, and both Wake and Palmyra are vulnerable to development that would likely damage their coral reefs. The reefs of all eight are subject to unauthorized and destructive harvesting pressures, especially for depleted species such as sharks, giant clams, coconut crabs, pearl oysters, lobsters, humphead wrasse, bumphead parrotfish etc. All these reefs are vulnerable to ship groundings and accumulation of derelict fishing gear. The three remaining unprotected areas (Kingman, Palmyra, and Wake) support uniquely important reef areas serving a variety of functions that warrant protected area designation. Following are evaluations of these as candidate MPA-CRs against the selection criteria of Appendix I. Kingman and Palmyra are lumped together due to their close proximity and similarity. All three have been added to this report as part of a priority list of candidate sites that warrant special, if not immediate, attention.

CANDIDATE CORAL REEF PROTECTED AREAS FOR THE U.S. PACIFIC : WAKE ATOLL [N. MARSHALL ARCHIPELAGO]

RATIONALE FOR PROTECTION

Wake would be the first atoll in all of the region of Micronesia to be afforded protection. Wake is the only atoll in the Micronesian region that is under U.S. sovereignty , and is one of only about 10 atolls that are sparsely or uninhabited in the Pacific. Wake is not a part of any state or territorial jurisdiction and was uninhabited except during the present century. Wake supports undisturbed coral reef ecosystems and a variety of rare, depleted, threatened and endangered species, including giant clams, green turtles, hawksbill turtles, groupers, napoleon wrasse, bumphead parrotfish, and abundant populations of many nesting and migratory seabirds. The endangered Hawaiian monk seal is an occasional visitor to the atoll. Previously the atoll was the only habitat for the endemic Wake rail which was driven to extinction before World War II. As an isolated northern outlier of the Marshall Islands, Wake also serves as an important “stepping stone” for the spread of marine species across the north tropical Pacific. Wake is also a World War II historic site, and is an important refueling stop for air traffic in the Pacific. The combination of ecological and historical values and existing facilities render Wake attractive for protection in a sub-region that presently lacks MPAs. Wake may soon cease to be used by the military which will provide an opportunity for protected area designation. Otherwise the atoll might be earmarked for development incompatible with the long- term protection of its coral reefs.

DESCRIPTION

Wake Atoll [19º N and 167º E] is the northernmost of the islands in the Marshall Islands complex, some 250 nm north of uninhabited Bokaak (Taongi) Atoll, 400 nm north of uninhabited Pikaar (Bikar) Atoll, and 500 nm north of Taka and Utrik Atolls. The nearest U.S. flag possessions to Wake are the Mariana Islands some 1,300 nm to the west, and Midway Atoll some 1050 nm to the northeast. Wake Atoll including its three islets is located in a very isolated region in the northwest tropical Pacific. Over the past century Wake has been a commercial seaplane base, U.S. Navy military installation, site for a World War II battle, refueling stop-over for air traffic traversing the north Pacific, and military range for ballistic missile testing. Presently the atoll is under the residual administration of the U.S. Department of the Interior, and serves as a refueling stopover for air traffic, under U.S. Air Force operation. The military previously established a seabird sanctuary on Peale islet, but otherwise there are no explicit designations to protect marine resources at the atoll.

NATURAL RESOURCE VALUES

- **Biogeographic representation** - Wake Atoll is the only U.S. possession in the Marshall Islands and eastern Micronesia and the only Micronesian atoll under U.S. jurisdiction. As such, the atoll provides the only U.S. representation of atoll habitat in the western Pacific, and the only coral reef habitat in Eastern Micronesia and the Marshall Islands, including atoll perimeter reef, lagoon, pinnacle, reef flat, patch reef, reticulated reefs, reef terrace, and ocean facing reef slope habitats.

- **Biodiversity-** Wake supports a representative suite of habitats typical of central Pacific atolls. The species are also representative of atolls, except that there are probably more of them at Wake in comparison to other U.S. sovereign atolls in the Pacific (Rose in American Samoa, Palmyra and Kingman in the Line Islands, and several atolls in the northwest Hawaiian Islands). Wake also supports large populations of rare species of giant clams, sea turtles, sea birds, and reef fish that are being rapidly depleted elsewhere in the inhabited atolls and islands of Micronesia and Polynesia. The endangered Hawaiian monk seal is also an occasional visitor.

- **Ecosysyem Integrity**- Wake is a complete, self-contained atoll ecosystem that has existed for at least 50 million years. Wake has close biogeographic and ecological linkages to other atolls in the Marshall Islands and the Federated States of Micronesia.

- **Ecological Significance-** Wake is one of the most isolated atolls in the world, 300 nm north of the closest atoll in the Marshalls (Bokaak) and about 1,000 nm east of the Mariana Islands. Wake supports species listed as endangered or threatened by the U.S. (sea turtles) and IUCN (giant clams), protected by treaties (migratory seabirds), and others depleted throughout most of their ranges (humphead parrotfish, napoleon wrasse, groupers, etc.). An atoll land bird, the wake rail (*Rallus wakensis*) was found only at Wake until it became extinct in the 1930's. The unusual geomorphology of the atoll is of a type found only in a few other atolls of the Phoenix, Line, and northern Marshall Islands.

- **Species maintenance**- The atoll's structure and reefs are essential for the maintenance of all coral reef and associated species. The atoll is separated from other atolls and islands by several hundred or more miles of deep open ocean waters lacking reef life. As such, Wake has served as an important "stepping stone" for the spread of marine species across the tropical north Pacific.

- **Habitat structure or features**- Wake is one of about 400 atolls in the Pacific and one of thirty atolls in the Marshall Islands. Atolls are the largest biogenic structures existing on earth, and less than 10 are afforded protection. Wake's geographic isolation in the north Pacific affords it considerable potential for research and biodiversity conservation.

- **Special elements protection-** Wake is one of only a few atolls in the north Pacific, and one of the most isolated in the world, and the only atoll in the western Pacific under U.S. jurisdiction. Consequently, all habitats and associated species are considered special.

HUMAN USES AND HISTORICAL VALUES

- **Renewable resources of importance for sustainable uses**- Wake supports relatively un-fished stocks of giant clams and reef fishes relative to other islands and atolls in the northern Pacific. Wake shows high potential to support sport-fishing and serve as a base for commercial fishing.

- **Recreational resources-** Sport diving, snorkeling, blue-water sport-fishing, bone fishing, birding, nature photography, and historic site tours are all potentially attractive at the atoll.

- **Research and monitoring-** Wake's isolated position in the open north central Pacific render it especially important for oceanographic and meteorological research. The age and evolution of the atoll over geological time would also be of great interest.

- **Educational and Interpretive Opportunity-** Wake is accessible by air or sea, potentially allowing visitors from Asia via Guam or from the United States via Hawaii. There would be many opportunities for educational and interpretive use of resources.

- **Historic and cultural values-** From legends, Marshall islanders visited Wake for subsistence gathering and harvesting and refer to it as *Enen Kio* in their language. Wake served as an important sea-plane base for the china-clippers that traversed the Pacific between San Francisco and Manila in the mid 1930's. Wake was established as a military installation in the years before World War II, and after a fierce battle, was the first U.S. territory to fall to the Japanese soon after the outbreak of the war. The atoll was returned to U.S. control after Japan's surrender. There are gun emplacements, seaplane ramps, artillery pieces, and other structures of historic interest remaining on the atoll.

- **Aesthetic Resources-** The reefs, beaches, and lagoons of Wake have high aesthetic value, including seabirds and reef life, especially corals, reef fish and giant clams.

MANAGEMENT CONCERNS VALUES

- **Coordination with other programs-** Wake's value is enhanced because it supports a full-length jet airfield and harbor. Wake could serve as a departure point to visit other marine protected areas established or proposed by the Republic of the Marshall Islands. In fact the mere existence of a marine protected area at Wake would stimulate the Marshallese to promote park and protected area development at nearby atolls, especially Bokaak (Taongi), Pikaar (Bikar), and Taka (Toke) atolls. The atoll supports both important seabird and marine life resources and would be a logical addition to the established networks of National Wildlife Refuges already established in Guam, American Samoa, Line Islands, Phoenix Islands, and Hawai'i.

- **Size and boundary considerations-** It would be logical to include all land areas in the designation and have marine jurisdiction extend at least three to 12 miles offshore to discourage illegal fishing near the protected area.

- **Accessibility-** Although situated in a remote area of the Pacific, Wake is accessible from Hawai'i, Johnston Atoll, Majuro Atoll, Kwajalein Atoll, and Guam by air. An established commercial airline, Continental Air Micronesia, services all of these other destinations several times a week, and Air Marshall Islands and Air Nauru are other commercial air carriers nearby in the region. A protected deep water channel, turning basin and dock was constructed by the military and provides ships access and safe moorage at the atoll.

- **Surveillance and Enforcement-** Wake has been permanently occupied by the military and other federal agencies during the half century following World War II, and supports housing, utilities, and other facilities conducive to an on-site surveillance and enforcement presence. The atoll's military status over the past 60 years has further discouraged unauthorized visits or harvesting of atoll resources.

- **Economic Considerations-** Wake is owned by the U.S. government and would need to be transferred to the Fish and Wildlife Service or another federal agency for its designation as a protected area. As such, Wake would not need to be purchased. The atoll would require little capital improvements to facilitate its designation, although funds to maintain the airfield, housing, water, power, radar, fuel storage tanks, the harbor, and other facilities would be needed. The important function of Wake serving as a refueling stop for trans-Pacific air traffic could be maintained to help offset the costs of operating the future MPA.

- **Network-wide activities**- Again the designation of Wake as a National Wildlife Refuge (NWR) would fit well within the existing NWR system, allowing cost sharing of enforcement, research, restoration, and other programs to conserve fish and wildlife resources in the central Pacific. The designation may stimulate neighboring countries, especially the Republic of the Marshall Islands to establish their own MPA-CRs to promote regional tourism opportunities and a network of closely linked protected reefs and islands in a subregion that presently lacks MPA-CRs.

- **Urgency of threat**- Wake may soon be decommissioned as a military installation. Its transfer to another agency to establish a coral reef protected area could be accomplished at small cost and would prevent less compatible uses of the atoll, such as a base for commercial fishing or for commercial space and missile testing.

- **Recreational resources**- .

CANDIDATE CORAL REEF PROTECTED AREAS FOR THE U.S. PACIFIC : PALMYRA ATOLL & KINGMAN REEF [N. LINE ISLANDS]

RATIONALE FOR PROTECTION

Palmyra and nearby Kingman Reef are the only two atolls in the wet belt of the tropical central Pacific which have remained essentially uninhabited for most of their contemporary history. Palmyra is a privately owned U.S. Territory and Kingman Reef is an unincorporated U.S. possession under U.S. Navy jurisdiction. The close proximity of the atolls to the Equatorial Countercurrent and Intertropical Convergence Zone promotes unusually high species diversity and habitat variety including submerged reef, estuarine, and lagoon conditions. Presently the two atolls are among the least disturbed of the approximately 500 atolls in the world and support intact coral reef ecosystems including large populations of adult reef fish and many larval fish. Rare, depleted, threatened, and endangered species that depend upon the atoll include groupers, napoleon wrasse, bumphead parrotfish, giant clams, coconut crabs, green turtle, hawksbill turtle, many nesting seabirds. The beach and adjacent forests on land are among the best undisturbed examples known. Palmyra atoll is also periodically visited by the endangered Hawaiian monk seal, and supports spectacular populations of manta rays, barracudas, surgeonfish, and parrotfish. The shallow reef pools are among the most beautiful known in the Pacific, supporting colorful varieties of fish and corals. The combination of aesthetic and biodiversity values render Palmyra among the highest priority candidates for reef protection and compatible eco-tourism in the Pacific. However, several other active development proposals (commercial fishing base, nuclear spent fuel storage site, satellite launch facility, etc.) threaten these values.

DESCRIPTION

Palmyra Atoll and Kingman Reef [6° N, 162° W] are the two northernmost atolls in the Line Islands, about 1000 nm south of Hawai‘i. Their nearest neighbors are located in the Lines and include Teraina (Washington) Atoll, Tabuaeran (Fanning) Atoll, and Kiritimati (Christmas) Atoll, all of which are inhabited and a part of the Republic of Kiribati, some 100 to 250 nm to the southeast. The nearest U.S. possessions are Jarvis Island 360 nm to the south, Howland and Baker Islands 700 nm to the west, and Johnston Atoll 700 nm to the northwest. Kingman is about 30 nm northwest of Palmyra, lacks vegetated islets, and has been uninhabited throughout its history. There is little scientific information available for Kingman. Palmyra supports 50 islets with lush vegetation but has remained mostly uninhabited except for a few episodes of brief occupation. Voyaging Polynesians likely visited the atolls during the past millennium, and the U.S. Navy constructed a military air station, dredged and filled reefs, and occupied the atoll for 20 years, beginning shortly before World War II. Other federal agencies also occupied the atoll during these years before it was returned to its owners in 1960, a family living in Hawai‘i. Yachters and other boaters occasionally visit the atoll as a stopover between French Polynesia and Hawai‘i. Presently the landowners are attempting to sell Palmyra, possibly to The Nature Conservancy. The owners also claim ownership of nearby Kingman Reef, a claim not recognized by the U.S. Government.

Over the years Palmyra has been proposed as a marine and wildlife sanctuary, commercial fishing base, storage site for nuclear spent power reactor fuel, missile test range, satellite launching facility, resort complex, and eco-tourism destination. At present there are no explicit designations to protect marine resources at either Palmyra or Kingman, but there is recent evidence of commercial fishing, including shark fishing, at Palmyra. Presently the atoll is under the administration of the U.S. Department of the Interior.

NATURAL RESOURCE VALUES

- **Biogeographic representation –** Kingman and Palmyra are the only U.S. atolls in the equatorial Line Islands and central Pacific, and are two of only three wet atolls under U.S. jurisdiction. The atolls straddle the most frequent position of the meandering Pacific Equatorial Countercurrent, the only large current running west to east in the tropical Pacific. As such the atolls provides the only U.S. representation of atoll habitats in the equatorial Pacific and central Pacific, including atoll perimeter reef, lagoon, sub lagoons, pinnacle, reef flat, patch reef, pass, reticulated reef, reef terrace, estuaries, and ocean facing reef slope habitats.

- **Biodiversity-** Palmyra and Kingman support a representative suite of habitats typical of central Pacific atolls. The species are also representative of atolls, except that there are probably more of them in comparison to other atolls in the Line Islands and Hawai‘i. Both atolls support populations of rare species of giant clams, nesting and swimming sea turtles, nesting sea birds, and large schools of reef fish that are being rapidly depleted elsewhere in the inhabited atolls and islands of the central Pacific.

- **Ecosysyem Integrity-** Palmyra and Kingman are complete, self-contained atoll ecosystems which has existed for at least 60 million years or more. The atolls have close biogeographic and ecological linkages to other atolls in the Line, Phoenix, and Marshall Islands.

- **Ecological Significance-** Palmyra is the only wet vegetated atoll still uninhabited in the Pacific, the rest having been recently settled or occupied for thousands of years. The wet climate promotes the development of lush beach forests, and estuarine conditions in the lagoon, providing support for additional fish and wildlife species and habitats. The Pacific Equatorial Countercurrent, which passes by the atolls, serves as a migratory pathway for many migratory and pelagic fisheries, and the waters surrounding the atolls are rich fishing grounds and nursery areas. Palmyra and possibly Kingman support nesting and feeding habitat of endangered or threatened species listed by the U.S. (green and hawksbill turtles) and IUCN (giant clam, coconut crab), protected by treaties (migratory seabirds), and other fish depleted throughout most of their ranges (humphead parrotfish, napoleon wrasse, groupers, etc.). Seabird nesting colonies of red-footed boobies and black noddies at Palmyra are among the largest in the world.

- **Species maintenance-** The structure of the atolls and their reefs are essential for the maintenance of all coral reef and associated species. The two atolls are geographically close to one another but represent separate and distinct ecosystems. The semi-enclosed lagoons of Palmyra support species adapted to sheltered and estuarine conditions.

- **Habitat structure or features-** The atolls represent two of about 400 atolls in the Pacific and two of six atolls in the Line Islands. Atolls are the largest biogenic structures existing on earth, and less than 10 worldwide are afforded protection. Palmyra's and Kingman's geographic location near the equator and the Pacific Equatorial Countercurrent and rich fishing grounds affords them considerable potential for reef research, refugia for harvested fisheries, and sanctuaries for sea nesting seabirds, sea turtles, and fish larvae.

- **Special elements protection-** Palmyra and Kingman are two of only a few atolls in the central equatorial Pacific, and the only wet uninhabited atolls left in the Pacific. Both are the only equatorial atolls under U.S. jurisdiction.

HUMAN USES AND HISTORICAL VALUES

- **Renewable resources of importance for sustainable uses-** Both Palmyra and Kingman support relatively un-fished stocks of estuarine, lagoon, nearshore pelagic, and reef fishes relative to other nearby islands and atolls in the central Pacific. Palmyra shows high potential to support blue water sport-fishing, bone-fishing and serve as a base for commercial fishing.

- **Recreational resources-** Sport diving, snorkeling, blue-water sport-fishing, bone fishing, birding, nature photography, and historic site tours are all potentially attractive at Palmyra and to a lesser extent at Kingman.

- **Research and monitoring-** Palmyra's and Kingman's extensive reef terraces, close proximity to the Countercurrent, equator, wet climate, open ocean estuarine conditions, and the plethora of rare and abundant fish and wildlife render them especially important for a variety of research and monitoring activities. The age and evolution of the atolls over geological time would also be of great interest.

- **Educational and Interpretive Opportunity-** Palmyra is accessible by air or sea, potentially allowing visitors from Asia or Hawaii. There would be many opportunities for educational and interpretive use of resources. Airfield and shoreside facilities require repair and upgrades to support adventure tourism.

- **Historic and cultural values-** Based on archaeological evidence at nearby Fanning and Christmas atolls, Palmyra and possibly Kingman may have been periodically visited by the voyaging Polynesians during the past millennium. Palmyra was established as a military installation in the years before World War II, and was bombed by the Japanese on December 8, 1941. However it did not play a major role in the war. There are pill boxes, a seaplane ramp, a hospital, and other structures of historic interest remaining on the atoll.

- **Aesthetic Resources-** The reefs, submerged terraces, beaches, mature beach forests, and lagoons of Palmyra have high aesthetic value. The shallow reef holes off the western reef flat are among the most spectacular coral gardens and natural aquaria in the Pacific. Many fish and wildlife, including seabirds, dolphin schools, corals, reef fish, sea turtles, manta rays, parrot fish schools, humphead wrasses, jacks, and giant clams would also be very popular aesthetic attractions.

MANAGEMENT CONCERNS VALUES

- **Coordination with other programs-** Palmyra's value is enhanced because it supports a full-length jet airfield (if repaired), abundant freshwater resources, and a protected deep-draft port. Palmyra could serve as a departure point to visit other marine protected areas including Kingman Reef and those established by the Republic of Kiribati. Palmyra and Kingman support both important seabird and marine life resources and would be logical additions to the established networks of National Wildlife Refuges already established nearby in the Line Islands, Phoenix Islands, and Hawai'i.

- **Size and boundary considerations-** It would be logical to include all land and marine areas at Palmyra in the designation and have marine jurisdiction extend at least 12 to 50 nm (the latter to the northwest to encompass Kingman Reef). These designations would protect coral reefs and discourage illegal fishing now occurring in the region.

- **Accessibility-** Although situated in a remote area of the Pacific, Palmyra would be accessible from Hawai'i, Johnston Atoll, Majuro Atoll, Kwajalein Atoll, Tahiti, and Christmas Atoll by air. Established commercial airlines including Continental Air Micronesia, services most of these other destinations, at least weekly. A protected deep water channel, turning basin and dock was constructed by the military and provides ship access and safe moorage at Palmyra.

- **Surveillance and Enforcement-** Palmyra was occupied by the military and other federal agencies during the two decades encompassing World War II, and supports residual facilities conducive to an on-site surveillance and enforcement presence, if essential facilities are reconstructed.

- **Economic Considerations-** Kingman is claimed by both the United States and the present owners of Palmyra. Although Palmyra is privately owned, it is a sovereign possession of the U.S., and would need to be purchased by the government or a conservation organization in order to realize its potential as a marine protected area. Palmyra would require capital improvements to facilitate its designation and use for adventure or nature tourism, including funds to restore and maintain the airfield, housing, water, power, aviation fuel storage tanks, the harbor, and other facilities.

- **Network-wide activities-** The designation of Palmyra and Kingman as National Wildlife Refuges (NWR) would fit well within the existing NWR system, allowing cost sharing of enforcement, research, restoration, and other programs to conserve fish and wildlife resources in the central Pacific. The designation would likely stimulate neighboring countries, especially the Republic of Kiribati to establish their own coral reef MPAs to promote regional adventure and nature tourism opportunities.

- **Urgency of threat-** Palmyra is attractive for other forms of development, and is still being actively pursued as a site for launching satellites, commercial fishing base, nuclear spent power reactor fuel storage, or exclusive resort development. There is evidence of fishing activity on its reefs. Palmyra and Kingman are perhaps the highest priority sites for coral reef and wildlife protection in the U.S. Pacific due to their relatively pristine nature, high value coral reef areas, important resources, and real threats from potentially incompatible development.

- **Recreational resources**

Example candidate format "B" for Southern Mariana Islands, Commonwealth of the Northern Mariana Islands and Cordillera Reefs, Puerto Rico. **Note**: these examples are included for format purposes only; the content may be outdated.

Due to formatting difficulties, this section is only available in hard copy. If you would like to receive a copy, please contact Karen Koltes at the Department of the Interior, karen_koltes@ios.doi.gov, (202) 208-5345.

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