

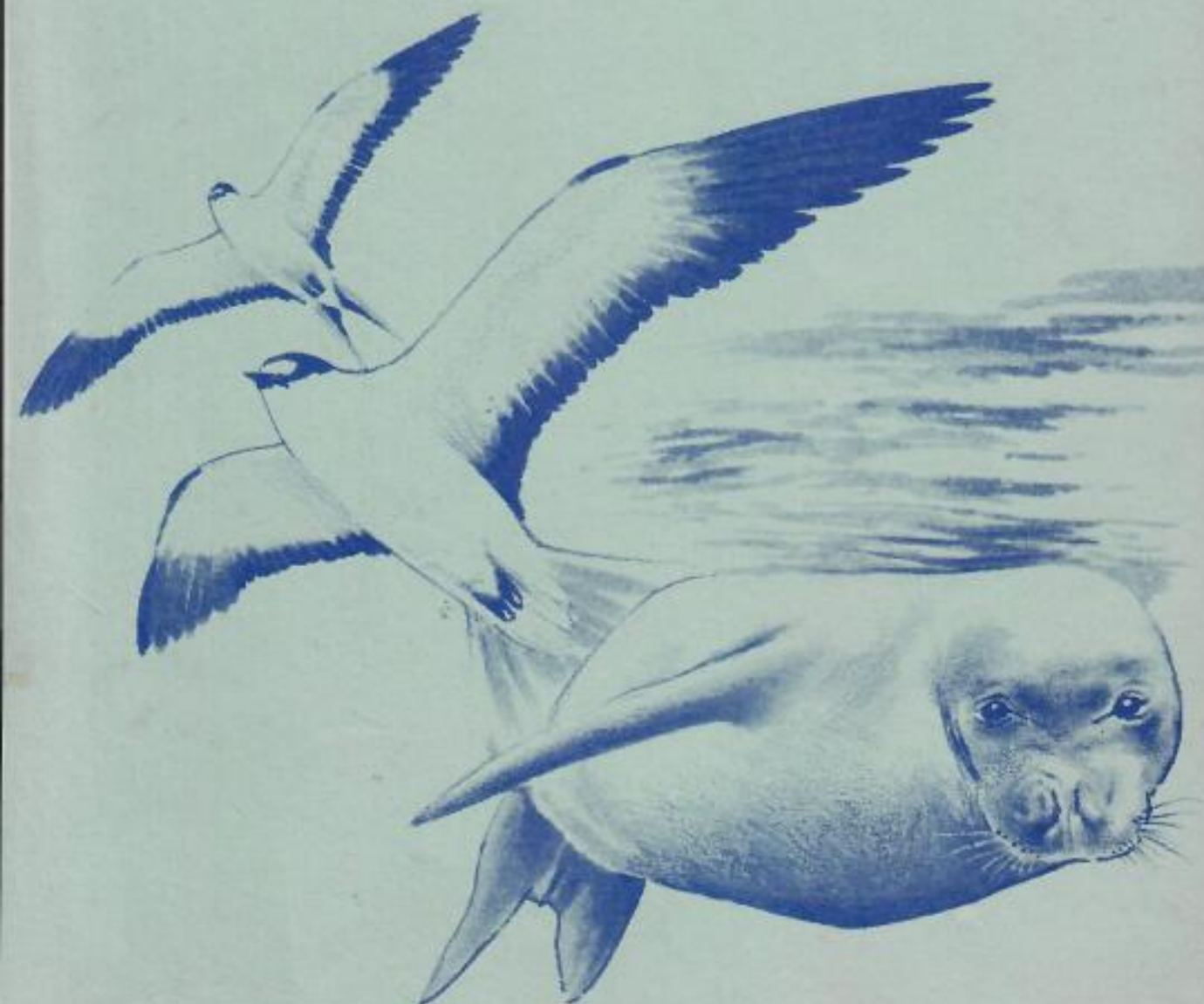
VI

**ALTERNATIVES INCLUDING
THE PROPOSED ACTION**

BALAZS

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE

MASTER PLAN/ENVIRONMENTAL IMPACT STATEMENT



Department of the Interior
U.S. Fish and Wildlife Service Region One

1986

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A. Development of Alternatives

The refuge objectives presented in Section V are the focus of various management alternatives described on the following pages. An array of management alternatives was formulated and analyzed in order to present decisionmakers with sufficient information needed to select the management scenario that best addresses the objectives of the HINWR.

The first task in developing an array of alternatives was to describe management of the HINWR as it presently exists. This description of the "present course of action" is needed to provide a reference point to compare and evaluate environmental effects associated with other alternatives under consideration. Existing management actions, which collectively are designated as the NO ACTION ALTERNATIVE (NAA), provide a "ground floor" from which other alternatives can be developed. "No Action" refers to "no change" from current management direction or level of management intensity.

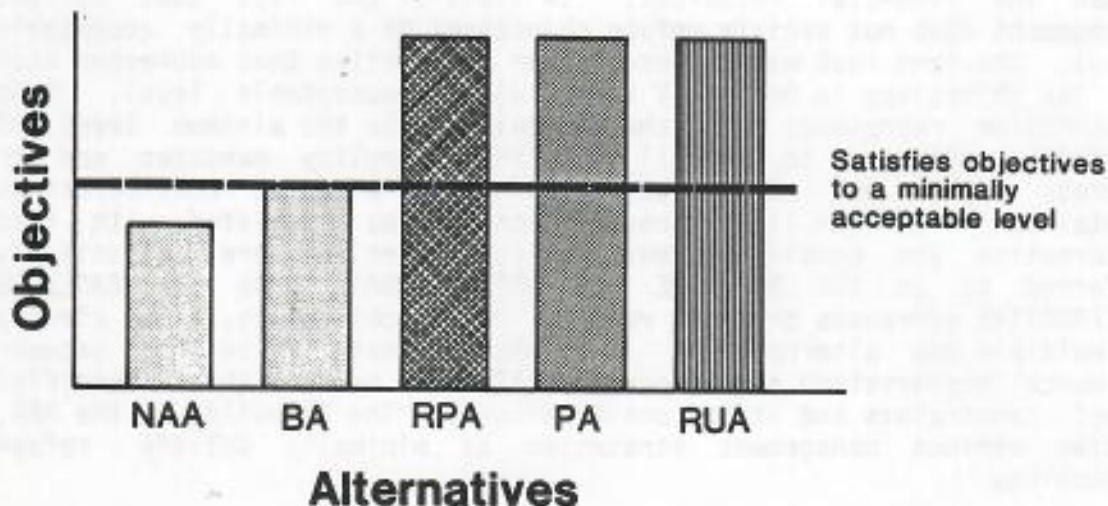
In documenting the NAA, it became apparent that current management direction and intensity falls short of accomplishing refuge objectives at a minimally acceptable level. This is due primarily to insufficient human and financial resources. In light of the fact that current management does not satisfy refuge objectives to a minimally acceptable level, the next task was to describe an alternative that addresses each of the objectives in Section V to a minimally acceptable level. This alternative represents what the FWS believes is the minimum level of activity necessary to fulfill statutory and policy mandates and to address public use considerations and other planning considerations contained in Section IV. Management strategies associated with this alternative are considered "must do" strategies and are collectively referred to as the BASELINE ALTERNATIVE (BA). As the BASELINE ALTERNATIVE addresses the full range of refuge objectives, it is clearly a multiple-use alternative. It seeks to create a balance between resource preservation and resource utilization needs within identified legal constraints and other considerations. The BA builds on the NAA, adding various management strategies to minimally satisfy refuge objectives.

Additional alternatives were created by defining other strategies beyond those included in the BASELINE ALTERNATIVE, which would further address refuge objectives. Just as the "must do" strategies were included in the BASELINE ALTERNATIVE, it was possible to portray "enhancement" alternatives that emphasized either resource preservation or resource utilization. Initially, the FWS developed four separate "enhancement" alternatives:

- 1) Resource Preservation Alternative
- 2) Intermediate Resource Preservation Alternative
- 3) Intermediate Resource Utilization Alternative

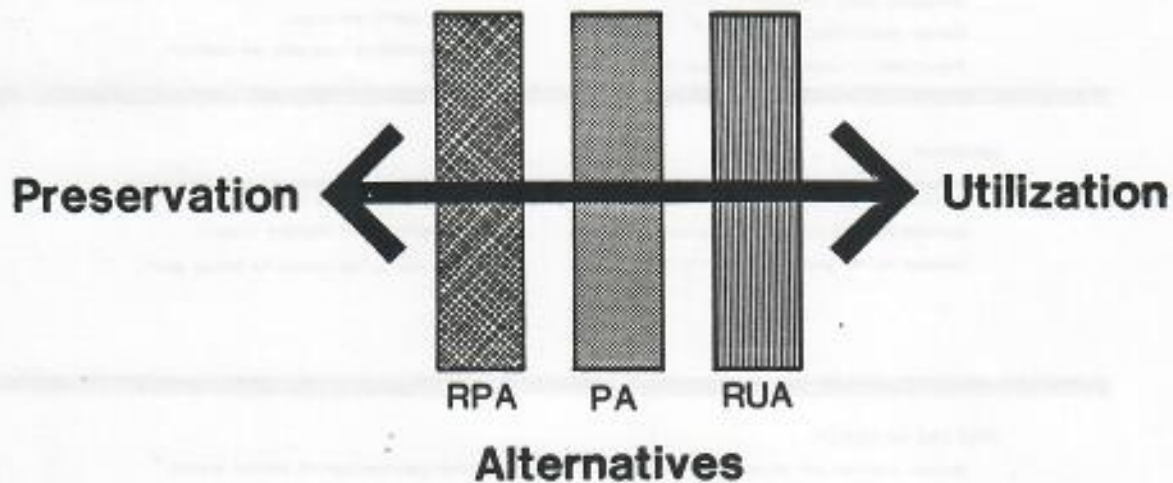
4) Resource Utilization Alternative

These four alternatives, and the strategies of which they were composed, were first portrayed in our third Planning Update (newsletter) distributed in March 1984. This presentation of alternatives was also the primary subject of discussion at the public workshop in Honolulu on March 20, 1984. Participants at the workshop were asked to comment on the specific strategies and alternatives and to select and defend a particular mix of strategies as their "preferred" alternative. Based upon input received at the public workshop and in response to the third Planning Update, together with additional background information gathered by the FWS, we reduced the total number of "enhancement" alternatives from four to three: a RESOURCE PRESERVATION ALTERNATIVE (RPA), a RESOURCE UTILIZATION ALTERNATIVE (RUA), and a PREFERRED ALTERNATIVE (PA). The PREFERRED ALTERNATIVE is a hybrid of strategies drawn from the RPA, and RUA, and it represents the FWS recommended action for management of the Hawaiian Islands National Wildlife Refuge (HINWR). The various alternatives are conceptually illustrated below in relation to accomplishment of refuge directives:



It should be understood that each of the three "enhancement" alternatives builds upon and incorporates all of the "must do" strategies that comprise the BASELINE ALTERNATIVE, which in turn builds upon and incorporates the NO ACTION ALTERNATIVE. Each enhancement strategy goes beyond the NAA and BA to include a mix of strategies that enhance either preservation of refuge resources or utilization of refuge resources. The RESOURCE PRESERVATION ALTERNATIVE contains enhancement strategies directed towards an even greater degree of fish and wildlife

preservation. The RESOURCE UTILIZATION ALTERNATIVE directs greater emphasis toward achieving educational, recreational, commercial, and other public use objectives. The PREFERRED ALTERNATIVE includes enhancement strategies from both the RPA and RUA and therefore lies between the RPA and RUA in terms of preservation and utilization of refuge resources. Schematically, the PA is located at an intermediate position on a continuum that has the RPA at the "preservation" end and the RUA at the "utilization" end.



Strategies included in the BA and each of the enhancement alternatives would be implemented over the span of a 10-20 year period, assuming funds, staffing, and appropriate involvement of cooperating agencies were obtained.

Throughout the development of management alternatives for the HINWR, the FWS has maintained that continued operation of the Tern Island field station is a necessary component of each alternative. It was concluded that many of the strategies in the NAA, BA, and the three enhancement alternatives, including the PA, are dependent upon the continued existence of the field station at Tern Island. However, because of the costs associated with the operation at Tern Island and the possibility of future budget constraints that could dictate a reduced level of operation at Tern, an analysis of tradeoffs necessitated by abandonment of Tern are presented in Section VI.G. Recognizing that the discussion of each alternative (NAA, BA, RPA, PA, and RUA) includes continuation of the Tern Island facility, the information concerning Tern Island abandonment is presented as a "management option" that could be incorporated with any of the alternatives except the NAA. (By definition, the NAA represents the present course of action. Because the Tern Island operation is presently a part of existing management, discussion of its abandonment in association with the NAA would be inappropriate.) It should also be recognized that, because the FWS views the Tern Island

Alternatives Including the Proposed Action

THE FOLLOWING IS A SUMMARY OF THE STRATEGIES ASSOCIATED WITH THE NO ACTION ALTERNATIVE (NAA) AND BASELINE ALTERNATIVE (BA). BY DEFINITION THE NAA REPRESENTS REFUGE MANAGEMENT AS IT PRESENTLY EXISTS. THE BA, WHICH BUILDS UPON AND FULLY INCORPORATES THE NAA REPRESENTS A LEVEL OF ACTIVITY NECESSARY TO MINIMALLY SATISFY REFUGE OBJECTIVES. TOGETHER THE NAA AND BA PROVIDE A FOUNDATION FOR THE ENHANCEMENT STRATEGIES ON THE NEXT PAGE. ALL OF THE STRATEGIES LISTED BELOW ARE INCLUDED IN THE NAA EXCEPT WHERE FOOTNOTED.

NO ACTION ALTERNATIVE AND BASELINE ALTERNATIVE

VULNERABLE SPECIES:

Implement high priority research and management tasks in recovery plans.¹
Monitor populations and habitats.²
Prevent/monitor/control harmful exotics.¹

Restrict access to islands/atolls.
Enhance public awareness.
Identify/protect candidate and sensitive species.

ENVIRONMENT:

Conduct archaeological survey; nominate sites to State and National registers.
Nominate emergent lands for wilderness status.²
Evaluate Marine Sanctuary status for HINAR.²

Provide research opportunity consistent with Research Natural Area (RNA) criteria.
Seek resolution of boundary dispute.
Pursue overlay IWR status for Midway Atoll.

OTHER FISH AND WILDLIFE:

Monitor seabird/other migratory bird populations.
Restrict access to seabird colonies.
Develop/implement oil spill contingency plans.

Prevent/monitor/control harmful exotics.¹
Enhance public awareness.

SCIENTIFIC AND PROFESSIONAL SERVICES:

Utilize field camps/annual boat surveys to monitor populations and habitat.
Produce/distribute research publications.

Monitor human activities and effects.
Provide logistical support for monitoring activities at Tern Island and throughout the Refuge.

EDUCATION/INTERPRETATION:

Develop off-refuge exhibits and programs, particularly at Kilauea Point on Kauai.
Develop/assist in publications and audio-visual materials.
Develop curriculum materials for school systems.²

Encourage off-site photography, journalism and art (P/J/A) activities.²
Develop educational/interpretive materials for Midway and Kure personnel.²

OTHER PUBLIC USES:

Provide recreational opportunity for authorized personnel at Tern Island.
Provide logistical support for NMCI commercial fishery operations (including use of existing emergency mooring buoy).

Monitor logistical support activities for effect on fish and wildlife.

¹ Strategy included in NAA and expanded or enhanced in BA.

² Strategy not included in NAA but included in BA.

Alternatives Including the Proposed Action

EACH OF THE THREE ALTERNATIVES LISTED BELOW BUILDS UPON THE NO ACTION AND BASELINE ALTERNATIVES DESCRIBED ON THE PRECEDING PAGE. THE RESOURCE PRESERVATION ALTERNATIVE (RPA) CONTAINS STRATEGIES DIRECTED TOWARDS A GREATER DEGREE OF FISH AND WILDLIFE PROTECTION. THE RESOURCE UTILIZATION ALTERNATIVE (RUA) DIRECTS EMPHASIS TOWARD ACHIEVING EDUCATIONAL, RECREATIONAL, COMMERCIAL, AND OTHER PUBLIC USE OBJECTIVES. THE PREFERRED ALTERNATIVE (PA) IS A HYBRID OF STRATEGIES DRAWN FROM THE RPA AND RUA AND REPRESENTS THE FWS' RECOMMENDED ACTION.

RESOURCE PRESERVATION ALTERNATIVE (RPA)	PREFERRED ALTERNATIVE (PA)	RESOURCE UTILIZATION ALTERNATIVE (RUA)
<p>Regulate and monitor nearshore vessel traffic.</p> <p>Conduct lower priority research and management action in recovery plans.</p> <p>Evaluate/establish additional populations of endemic land birds.</p>	<p>Monitor impacts of commercial fishery on listed species.</p>	<p>Monitor nearshore vessel traffic.</p> <p>Conduct limited additional research as in recovery plans.</p>
<p>Designate/support designation of critical habitat for threatened/endangered species.</p> <p>Evaluate/nominate HINER as World Heritage Site / Biosphere Reserve / Natural Landmark.</p>	<p>Nominate HINER lands. Evaluate and, if appropriate, nominate waters.</p>	
<p>Nominate HINER lands/waters to Wilderness System.</p> <p>Conduct historical surveys; nominate sites to State/National registers.</p>	<p>Permit limited access to cultural sites for religious purposes.</p>	
<p>Monitor and control disease in resident seabird populations.</p> <p>Regulate and monitor nearshore vessel traffic.</p> <p>Monitor distribution and abundance of native terrestrial species.</p> <p>Map and ground truth terrestrial and marine ecosystems.</p>	<p>Monitor the effects of the commercial fishery and other human activities on "other fish and wildlife."</p>	
<p>Conduct annual aerial photo survey.</p> <p>Conduct extended field camps and/or semi-annual boat surveys.</p> <p>Conduct comparative monitoring studies on Midway and Kure.</p>	<p>Conduct biannual aerial photo surveys of HINER islands and atolls.</p>	
	<p>Conduct limited nature tours/environmental education at Tern Island.</p> <p>Facilitate limited, supervised photography, journalism and art visits to the HINER.</p>	
<p>Regulate and monitor nearshore vessel traffic.</p> <p>Cooperate/assist in installation of a mooring buoy outside HINER boundary at French Frigate Shoals.</p>		<p>Monitor nearshore vessel traffic.</p> <p>Permit use of existing emergency mooring buoy within HINER boundary for multi-species fishery.</p> <p>Provide recreation, storage and emergency use of Tern Island in support of a multi-species fishery.</p>

operation as necessary to accomplishing certain Refuge objectives, the abandonment option would significantly reduce the ability of an alternative to satisfy objectives. It is for this reason that the option for abandonment of Tern Island is not included in the FWS' PREFERRED ALTERNATIVE.

B. No Action Alternative

As stated previously, the NO ACTION ALTERNATIVE (NAA) includes all of the management actions and strategies that are a part of present day management of the refuge. "No action" refers to "no change" from present management. Each of the strategies that follow represent what the FWS is currently doing towards accomplishment of Refuge objectives. These strategies fall short of satisfying the objectives listed in Section V. Each of the strategies represent a consolidation of various management actions and are summarized below by major output category:

"Vulnerable" Species (Endangered, Threatened, Candidate and Sensitive Species):

1) Implement high priority research and management tasks in recovery plans:

By definition, this strategy includes only those threatened or endangered species for which recovery plans have been prepared (monk seal, Laysan duck) or are being prepared (other land birds and green sea turtle). Each plan identifies certain high priority research/management tasks and assigns responsibilities to various cooperating agencies. From the perspective of population stability, recovery capacity and understanding of limiting factors, the Hawaiian monk seal is clearly the most endangered of the listed HINWR species. For this reason, the greatest research and management attention has been, and will continue to be, directed towards recovery of this species. This effort will continue to be shared by National Marine Fisheries Service (NMFS) and the FWS, with NMFS having primary jurisdiction and responsibility for management of the recovery effort. Research projects will continue to focus on identification and mitigation of natural limiting factors, documentation of habitat requirements, monitoring of population trends, and the documentation and mitigation of human impacts. The FWS will continue to share in the monitoring program and will implement management measures to minimize disturbance to seals and their habitat. Principle management measures directed at more than one vulnerable species are identified as separate strategies.

Recovery and perpetuation of land bird species in the HINWR is dependent upon maintenance of habitat quality. Seemingly minor perturbations, such as the introduction of rabbits to Laysan in 1903, can have lasting adverse effects. Although the FWS is currently monitoring habitat

conditions on Nihoa and Laysan Islands to detect and correct conditions that jeopardize habitat stability, considerably more effort is required to implement recovery plan recommendations.



Hawaiian Monk seal (*Monachus schauinslandi*).

2) Monitor populations and habitats:

This is a key strategy that is of high priority for all "vulnerable" species, but is of greatest importance for those species whose numbers are precariously low and susceptible to rapid change. Monitoring is also the method by which the effectiveness of recovery programs is evaluated. Methods which have been used and will be continued include aerial and ground photography, sampling of population numbers, assessment of sex/age class composition, documentation of reproductive output, growth studies, and determination of the movements of individual animals.

3) Prevent, monitor and control the introduction of harmful exotic species:

The vulnerability of listed species in the HINWR, particularly terrestrial species, is intimately tied to the limited presence of exotic

(non-native) species. Most of the exotic plants and insects now found on HINWR islands are either non-threatening to listed species and/or are manageable by conventional means (e.g. limited spraying, etc.). What is of greatest concern is the risk that new, harmful species will be inadvertently introduced to these islands and alter their ecological balance irreversibly before they can be detected and eliminated.

The list of potentially harmful exotic species includes various insects (predators, plant pests, disease vectors, etc.), weedy or competitive plant species, mammalian predators (rats or cats), and land birds (particularly those harboring avian disease).

The historic record of the Pacific Islands, including those in the NWHI, is replete with the documented results of such exotic introductions. Rabbits nearly eliminated the vegetation on Laysan Island, ultimately leading to the extinction of three bird species. Rats on islands at Midway and Kure atolls caused the extinction of transplanted Laysan rails during World War II and presently severely limit the production of young in ground-nesting seabird colonies. Mosquitos and flies at Midway spread avian pox in the seabird colony. Feral cats on central Pacific National Wildlife Refuges and other islands throughout the world have also wreaked havoc in seabird colonies.

Currently eradication of certain very harmful exotic species on remote islands is accomplished during annual visits to each of the Refuge islands and on an as-needed basis if detected through other means such as cooperating researchers and aerial photography.

The Special Use Permit (SUP) process is currently used to specify conditions that must be met by all Refuge users/visitors to prevent the introduction of new exotics. These conditions include management practices and techniques to control transfer of weed seeds, insects and predators from one island to another, special handling of equipment and supplies, and inspection, monitoring and enforcement by FWS personnel. Because Tern Island is used as a staging area from which gear and personnel often embark for other islands within the Refuge, and because harmful exotics exist on Tern Island presently, gear and personnel destined for other Refuge islands are cleaned and inspected to ensure that no exotic organisms from Tern Island are inadvertently introduced elsewhere.

4) Restrict access to HINWR islands and atolls:

Inherent in a program to limit unnecessary disturbance to vulnerable species is the enforcement of regulations to minimize human presence on islands and in atolls within the HINWR boundary. At present, and in the future, human access to HINWR lands and waters will be controlled through the SUP process, administered by the Refuge Manager. Authorized

activities in the Refuge must be conducted in a manner that minimizes disturbance to wildlife and habitat. These activities are prioritized to limit overall impacts and, if approved, will be scheduled to reduce cumulative effects. Although other applicable state and federal permits for refuge research will be required, they will not guarantee issuance of a refuge SUP if the work cannot be conducted with a minimum of disturbance or in the most suitable locations, as determined by the Refuge Manager. By virtue of the permitting process all authorized research and other activities within the HINWR that may affect threatened or endangered species are subject to the provisions of Section 7 of the Endangered Species Act as well.

Restrictions on access to the HINWR extend to atoll waters within the managed boundary. Regulations which now permit vessel access only for approved research projects, support for FWS operations or for emergency situations will continue to be enforced.

5) Enhance public awareness:

This strategy is highlighted here because of its contribution to accomplishing "vulnerable" species objectives. All draft and final recovery plans for threatened and endangered species have recommended actions to increase public awareness regarding the status and value of these species and the actions necessary to promote their recovery. Ongoing actions include publication of information (articles, brochures, etc.), development of audio-visual materials (films, slide shows, etc.) and presentations to various public groups. Other forms of public use opportunity addressing the public awareness objective are addressed in the Education/Interpretation category below.

6) Identify and protect candidate Threatened/Endangered and sensitive species:

By FWS definition, "candidate" species are those species which were published in notices of review appearing in the Federal Register for possible listing as threatened or endangered species. As it pertains to the HINWR, this includes 14 plant species which appeared in the December 15, 1980 Federal Register (FR 45:82480-82569) and 32 invertebrate species which appeared in the May 22, 1984 Federal Register (FR 49:21644-21675). "Sensitive" species are identified by Region One of the FWS as those species that are likely to become listed as threatened or endangered if present population trends continue. At present, only one species (sooty storm-petrel) is listed as "sensitive" within the HINWR. Because of their designation as "candidate" or "sensitive" species, the above-mentioned species should receive higher priority in monitoring and habitat protection programs than will other, unlisted species. However, due to current logistical, fiscal and staffing constraints little additional monitoring and protection efforts are made toward these species. Effort is also directed

at the identification of other, unlisted species in need of greater protection. The process of defining new "candidate or "sensitive" species is dependent upon effective population and habitat monitoring over time. Ultimately, such a program proves cost-effective and has a greater chance of success because it permits correction of conditions which jeopardize these species while their populations are most capable of rapid recovery.

Environment:

7) Conduct archaeological surveys and nominate eligible sites to state and national registers:

Important archaeological resources have been identified and subjected to preliminary surveys at Nihoa and Necker islands. These resources include remnants of garden terraces, house sites, crude shelters and temple sites. These sites have not yet been nominated for State or National Registers of Historic Places. The sites are vulnerable to disturbance and vandalism through unauthorized landings on the islands. They are also subject to natural deterioration. An archaeological survey was initiated in July 1984 by the Bishop Museum to provide a) an evaluation of the condition of identified sites; b) recommendations for site preservation and study; and c) preparation of site nomination forms for state and national registers.

8) Provide research opportunity consistent with Research Natural Area (RNA) criteria:

The research/education objective of the RNA program is to provide opportunities for scientists and others to observe, study and monitor natural environmental processes. Use of RNAs by researchers is generally restricted to investigations by advanced students and qualified professionals. All research is subject to prior approval and written agreement (in the case of the FWS, by Special Use Permit). The research use should generally be limited to non-destructive, non-consumptive, or essentially observational activities, but minimally disruptive research procedures may be permitted if determined appropriate. Particular attention will continue to be devoted to the use of RNAs as sources of baseline information for monitoring changes in environmental conditions.

9) Pursue overlay National Wildlife Refuge (NWR) status for Midway Atoll:

The FWS proposal for overlay NWR status at Midway Atoll is discussed in Section IV.F.10. This strategy addresses the need to enhance the effectiveness of fish and wildlife management programs at Midway Atoll through incorporation of the atoll into the National Wildlife Refuge System as an overlay NWR. Under this scenario, the U.S. Navy would

retain primary jurisdiction for the Midway naval operation, while the FWS would assume a greater cooperative role in fish and wildlife management. The FWS recognizes that prior to implementation of the overlay refuge, the roles and responsibilities for each agency must be clearly delineated and agreed to. This program would be similar to that presently in effect at Johnston Atoll, which is both a national wildlife refuge and a Defense Nuclear Agency facility.

10) Seek resolution of the HINWR boundary dispute:

The difference of opinion between the state and federal governments regarding the appropriate seaward boundary of the HINWR is based largely on the interpretation of public law (see Section IV.G.1). Growing concern among involved parties regarding this issue is fueled by the State of Hawaii's interest in commercial harvest of fishery resources within the disputed waters. The Tripartite Cooperative Agreement made reference to the boundary dispute, but noted that it was not the intent of the study to resolve the issue nor to detract from or add to the respective positions of the parties involved in the dispute. Rather, it was the intent of the study to gather scientific data which would be useful in managing fish and wildlife resources, regardless of jurisdictional responsibilities.

Now that Tripartite studies are completed, the FWS' ability to functionally manage resources within the disputed waters has been complicated by the State's reluctance to acknowledge FWS jurisdiction. Failure to resolve the issue clouds the relationship between the FWS and the State in virtually all situations where resource management responsibilities are shared. Therefore, this strategy addresses the need for timely resolution of the dispute in a cooperative manner.

Other Fish and Wildlife

11) Monitor seabird and other migratory bird populations:

The major focus of the FWS' research effort during Tripartite studies was the development of baseline data on seabird populations and the refinement of methods to be applied in the long-term monitoring of population health and status. This information proves particularly useful in assessing the effects of human activities, including fishery development, in waters where these species seek their food. Studies proposed to continue under this strategy include population size, reproductive success, growth rates, food habits, causes of mortality, inter-island movements and habitat requirements. Population monitoring of wintering migratory shorebirds is also proposed to continue.

12) Restrict access to seabird colonies:

The density of nesting birds on HINWR islands and the sensitivity of nesting habitat to disturbance dictate the need to minimize human activity within seabird colonies. The immediate effects on reproductive success of seabirds due to disturbance in the colony are often subtle, but the impact of repeated disturbance over the long term can be dramatic. Under this strategy, authorized visitors to HINWR islands are restricted in their activities on the island to minimize this problem. This includes restrictions both in location and time, taking into account seasonal variations in bird populations. The problem of unauthorized visitation and subsequent disturbance to nesting seabirds will continue to be addressed through education and enforcement activities as well.

13) Develop and implement oil spill contingency plans:

The critical importance of beaches and nearshore waters of the HINWR to seabirds, seals, turtles, and other marine resources raises serious concern about the potential damage that would be caused by a major spill of oil or hazardous chemicals. Logistical constraints would further add to the impact by preventing rapid and effective response to control spills or rehabilitate wildlife on remote islands. This concern was underlined in 1969 when a Japanese fishing vessel went aground on Laysan Island and in 1977, when the tanker, IRENES CHALLENGE, sank 50 miles north of Lisianski Island and spilled more than five million gallons of oil into the sea. Fortuitous weather conditions prevented this oil from reaching the islands, but the extreme vulnerability of this unique habitat was clearly demonstrated. More recent groundings of a large freighter and several fishing vessels on the NWHI, including the February 5, 1985 sinking of the CAROLYN K within the Refuge at French Frigate Shoals, have only heightened concern and, taken together, have dictated the need for improving our response capability as the number of vessels transiting nearshore NWHI waters increases.

This strategy addresses the need to continue evaluating appropriate means to respond to incidents and to determine roles and responsibilities of various agencies and organizations. It also includes the determination and stockpiling of appropriate equipment and supplies to permit effective response. Agreements and contracts for logistical support (aircraft, boats) will need to be developed in advance of a serious incident.

14) Prevent, monitor and control the introduction of harmful exotic species:

This strategy focuses attention on the need to maintain HINWR islands free of harmful exotic plant, insect and animal species as a means to maximize natural productivity in resident seabird colonies and to

maintain a more natural abundance and diversity of other terrestrial plant and animal species. This problem and strategies to address it are discussed in the Vulnerable Species category above (Strategy # 3).

15) Enhance public awareness:

The most visually obvious wildlife resource of the HINWR is the resident seabird population which numbers between 12 and 14 million birds (breeding and non-breeding) of 18 species. Many of these species frequent nearshore waters of the main Hawaiian Islands in smaller numbers, so there is at least general familiarity with the resource among many local residents and visitors. The general public is largely unaware of the other species that inhabit the islands and atolls of the HINWR. This strategy is designed to enhance familiarity through a public awareness program including publication, audio-visual materials and presentations. The details involved in implementing this strategy are treated in the Education/Interpretation category.

Scientific and Professional Services:

16) Utilize short field camps and annual boat surveys to monitor wildlife populations and habitat:

This strategy highlights the importance of repetitive field survey activity to accomplish all monitoring objectives, including enforcement of regulations. This strategy also includes year-around monitoring at the Tern Island facility. One annual boat survey of the entire HINWR, incorporating short camps, is proposed to continue as an absolute minimum level of field work necessary to address highest priority monitoring objectives.

17) Produce and distribute research publications:

One major value of research in the HINWR is the contribution it can make to future management of this Refuge and its fish and wildlife. This information can also prove highly useful to other resource managers responsible for similar species and habitats. The scientific data can also contribute to the general body of data accumulating from work around the world in pristine areas. Such transfer of knowledge is dependent upon the timely and effective publication of research publications within the body of literature that is freely accessible to other investigators and resource managers. This is also the source of information for more popular literature for the general public. With this in mind, the FWS will continue to participate in, encourage and facilitate the timely publication of research results.

18) Monitor human activities and their effects on HINWR islands and in nearshore waters:

This strategy is addressed in virtually all recovery plans and is equally applicable to other fish and wildlife resources potentially affected by human activities. A basic premise of refuge management is that compatibility of human use is judged by the effect of that use on fish and wildlife resources in that refuge. For this reason, it is critical that a substantive part of the monitoring and assessment effort be directed at the determination of human effects, both short- and long-term.

19) Provide logistical support for monitoring activities at Tern Island and elsewhere throughout the HINWR:

The unique importance of Tern Island in the HINWR resource monitoring program is singled out in this strategy. Not only does Tern Island provide year-around access to important terrestrial and marine resources, but it also provides the logistical capability to facilitate work on other islands in the HINWR and the ability to react effectively and quickly to resource management problems encountered midpoint in the archipelago. This strategy addresses this support function, within the constraints imposed by station capability and cumulative effects of human activities on the island. The role of Tern Island in support of HINWR management is addressed in detail in Section VI.G.

Education/Interpretation

20) Develop off-refuge education/interpretive exhibits and programs:

In view of the logistical problems and the anticipated conflicts inherent in substantially expanded public use on HINWR lands, the highest priority education/interpretation strategy is directed at off-refuge locations. The principal immediate focus of this effort is the FWS' interpretive facility at Kilauea Point on Kauai. This site presently attracts nearly 270,000 visitors per year. The opportunity for visitors to view several seabird species, whales and turtles from this scenic location provides a basis for expanded interpretive exhibits to enhance the quality of the experience. This is a convenient location to provide an interpretive "window" on the HINWR. This site has also proven appropriate for structured educational programs, such as teacher workshops and outdoor classrooms. Recent establishment of a cooperating association and a volunteer program at Kilauea Point will enhance educational and interpretive opportunities.

Kilauea Point provides a unique setting and opportunity for interpretive and educational programs focusing on the HINWR, but, by virtue of its location, it fails to reach the vast majority of the resident and visiting public found on Oahu. For this reason, this strategy also addresses the need to explore other Oahu-based locations for expanded FWS involvement in interpretive and educational programs relating to fish and wildlife resources of the HINWR. These programs should address

fish and wildlife resources as well as cultural resources, geological history and related topics. Possible Oahu-based locations include the Bishop Museum and the Honolulu Airport.

21) Develop and assist in the development of publications and audio-visual materials on HINWR resources:

The present availability of extensive photo documentation and published materials relating to the HINWR makes it feasible and practical for FWS personnel to publish and to assist others in publishing articles on the HINWR in popular literature. These publications are widely distributed, making a substantial percentage of the public at least generally aware of the HINWR and its unique values. Continued cooperation with the news media will also facilitate repetitive coverage of issues and topics of general interest pertaining to the HINWR. This strategy includes the expanded development of slide shows, brochures and other interpretive publications. FWS-owned movie footage will also be made available for documentary production and for use by the news media.

Other Public Uses:

22) Provide limited recreational opportunity for authorized personnel within the HINWR:

Tern Island is operated by the FWS, in cooperation with other agencies, principally in support of resource management and research programs in the HINWR. Refuge staff are stationed on the island for extended periods (up to five months) to operate and maintain the facility and to conduct long-term resource monitoring studies. In addition, shorter term station occupants include other researchers (FWS and other agencies), National Weather Service personnel, contracted maintenance personnel, and contracted pilots. Occasional authorized visitors include FWS program management staff, support vessel crews, news media and representatives of other agencies and organizations (U.S. Army Corps of Engineers, National Marine Fisheries Service, State DLNR, Marine Mammal Commission, Congressional subcommittees, State Legislature, City Council).

It is particularly important that station occupants with extended duty on Tern Island have recreational opportunities to facilitate adjustment to life on a remote island, although the recreation policy would apply to all authorized visitors. Tern Island has a few, limited recreational facilities. Within the Refuge, fishing is limited to catch and release pole fishing and jogging is allowed in non-sensitive areas. These and all other recreational activities will be permitted only in designated areas when not conflicting with higher priority wildlife outputs and are subject to approval by the Refuge Manager. Limited recreational activities for field camp personnel are also permitted on other islands in the HINWR. The exact nature of these activities will be specified by SUP.

23) Provide logistical support for NWHI commercial fishery operations:

Continued presence of Refuge personnel at Tern Island makes possible a limited degree of support to vessel traffic in the NWHI. During the period of FWS occupation since July 1979, this support has included regular transmission of radio traffic and phone messages; transport of supplies and parts on FWS contracted aircraft; transport of crew; emergency evacuations; medical assistance; fabrication and repair of equipment during vessel breakdowns; etc. The FWS has also assisted in the rescue of a stranded crew and provided aircraft and boat support in the salvage of the grounded freighter, ANANGEL LIBERTY and the fishing vessel, CAROLYN K. During the same period, the FWS has received a tremendous amount of vessel support in the operation of Tern Island from fishermen, and also from NMFS, Coast Guard, Navy, the State of Hawaii and others.

Under this strategy, the FWS role in the facilitation of vessel activity in the NWHI, particularly commercial fishing, will continue and expand within the limits of staff time and capability. There is no intent to significantly expand the FWS' presently limited ability to provide search and rescue assistance. This strategy will not include modifications of facilities or storage of other than incidental equipment or supplies at Tern Island in support of the commercial fishing industry. The existing Special Use Permit allowing installation and use of an emergency mooring buoy within French Frigate Shoals will be continued. Use of the buoy will continue to be limited to legitimate emergency or imminent emergency situations.

24) Monitor logistical support activities for effects on fish and wildlife resources:

Compatibility of public use activities with higher priority refuge management objectives is fundamental to the continuation of those activities. Determination of compatibility (assessment of effects) will require monitoring programs that are directly relevant to those activities. Use of the emergency mooring buoy, vessel traffic and anchoring within the Refuge, and other activities relating to logistical support will continue to be monitored to ensure that they occur as specified in Refuge regulations, appropriate public notices or Special Use Permits. This strategy also involves documentation of the response of seals, turtles and other wildlife to support activities (mooring, vessel traffic, transfer of supplies, etc.).

C. Baseline Alternative

The BASELINE ALTERNATIVE (BA) incorporates all of the strategies included in the NO ACTION ALTERNATIVE and those additional "must do" strategies needed to minimally satisfy the objectives for the HINWR included in Section V. These strategies take into consideration

anticipated limitations in staffing and funding of the FWS and cooperating agencies. The strategies have been modified somewhat since the third Planning Update and the March 20, 1984 public workshop to reflect input received through public involvement. Each of the strategies represent a consolidation of various proposed actions and are summarized below by major output category:

"Vulnerable" species (Endangered, Threatened, Candidate and Sensitive Species):

- 1) Implement high priority research and management tasks in recovery plans:

This strategy goes beyond the NO ACTION ALTERNATIVE Strategy #1 to include additional research and management actions needed to more fully address recommendations in recovery plans. In particular, considerable additional effort is required to implement recommendations associated with land birds. One focus for Refuge research and management action is addressing the accelerated filling of the lagoon at Laysan Island with windblown sand from a de-vegetated dune and the effects on various land birds, including the Laysan duck.

- 2) Monitor populations and habitats:

In addition to continuation of those monitoring activities included in NO ACTION ALTERNATIVE Strategy #2, this strategy includes additional recovery plan monitoring requirements not presently being addressed. These include annual population inventories and follow-up surveys of the four endemic land birds and monitoring the status of candidate and sensitive species on a regular basis.

- 3) Prevent, monitor and control the introduction of harmful exotic species:

Because eradication of harmful exotic species on remote islands is accomplished most easily upon introduction, this strategy goes beyond the NO ACTION ALTERNATIVE Strategy #3 to conduct more frequent visits to islands to monitor/control exotic species and implement effective, standardized survey and detection methods. Logistical constraints dictate the need for remote sensing methods as well.

Environment:

- 4) Reactivate nomination of emergent lands, excluding Tern Island, for Wilderness status:

Although FWS policy holds that lands under consideration for Wilderness status be managed as if formally designated, completion of the designation process for the HINWR lands would ensure consistent

management for Wilderness values into perpetuity. The resource values for which HINWR lands are managed are consistent with the definition of "Wilderness" as found in the Wilderness Act of 1964. Although use of motorized equipment is generally prohibited in Wilderness areas, exceptions are possible when such activities are essential to accomplishing refuge objectives and/or when the use is an established practice prior to formal Wilderness designation (and must continue for proper administration of the area). Use of generators for radio communication and small boats for landing on Refuge islands would fall under this description. This strategy, therefore, includes active nomination of HINWR lands for Wilderness status.

5) Evaluate Marine Sanctuary status for the HINWR:

A proposal has been made (Harrison, 1983) to consider Marine Sanctuary status for waters in the NWHI. The purpose of the proposal is to correct a problem of fragmented jurisdictional responsibilities that hampers an "ecosystem" approach to resource management. The proposal further contends that the "existing management regime fosters needless interagency conflict, inefficient exploitation of fisheries, and inadequate protection of some wildlife species". If adopted as proposed, the NWHI Marine Sanctuary would encompass all waters seaward to 12 miles for each island in the NWHI, including Midway and Kure. The Administrator of NOAA would have overall management responsibility, but an advisory board consisting of individuals from other agencies, industry and private organizations would be established to ensure wide representation during decision making. Both the State of Hawaii and the FWS would have to agree to the inclusion of waters in the Marine Sanctuary over which they now assert jurisdictional authority.

As a mechanism to provide a comprehensive management approach where fragmented authorities exist, the Marine Sanctuary concept has considerable merit. However, the complexities of the management issues involved in the NWHI and the wide diversity of parties involved, necessitate that this proposal be given lengthy and extensive consideration before possible application in the NWHI. It is beyond the scope of this plan for the HINWR to consider with the intent to resolve, the issue of whether or not a Marine Sanctuary should be established when most of the proposed acreage to be included is outside present FWS jurisdiction. With this in mind, this strategy recommends that the Marine Sanctuary proposal be thoroughly evaluated in a open forum, involving all concerned parties, including the general public, following completion and approval of the HINWR Master Plan/EIS.

Other Fish and Wildlife:

6) Prevent, monitor and control the introduction of harmful exotic species:

This strategy focuses attention on additional management actions included in BA Strategy #3 to prevent, monitor and control harmful exotic species in seabird colonies and where they may impact other terrestrial plant and animal species.

Education and Interpretation:

7) Develop appropriate curriculum materials for the school system:

Environmental education (EE) programs in Hawaii are severely hampered by the unfortunate lack of curriculum materials directly relevant to fish and wildlife resources of the island. This strategy will address the problem by focusing future efforts on the production of EE materials directed specifically for different age groups in island schools. An expanded version of the present effort in this direction will include sound-slide shows, teachers workbooks, class exercises and other appropriately structured reading materials. Such a program is fundamental to the development of local pride in the unique Hawaiian fish and wildlife resources and cultural history.

8) Encourage off-site photography, journalism and art (P/J/A) activities relating to HINWR resources:

Beyond the assistance the FWS can provide in making resource materials available, this strategy is directed at accommodating and encouraging P/J/A activities at other main Island locations where conflicts with wildlife or logistical problems are minimized or avoided. This effort will, by necessity, focus on seabird species common to both the HINWR and the main Islands. Principal public use opportunity for P/J/A activities will be located at Kilauea Point National Wildlife Refuge and, in cooperation with other agencies, at Kaneohe Marine Corps Air Station and Oahu's offshore islands.

9) Develop educational/interpretive materials for Midway and Kure personnel:

Military personnel, civilian contractors and authorized visitors to Midway and Kure atolls are immediately aware of the presence of large, diverse fish and wildlife populations, but they are given little help in learning about those resources. This strategy is directed at the cooperative development of educational programs and interpretive exhibit materials to enhance the quality of the human experience on these islands. This effort will also serve to reduce conflicts between man's occupation of these islands and the rich fish and wildlife resources that share the space. Although Midway and Kure are not within the HINWR, the fish and wildlife species found at these locations are common to and/or move between islands and atolls of the archipelago. This educational effort must be implemented in close coordination with other agencies that have primary jurisdiction at these sites.

D. Resource Preservation Alternative

The RESOURCE PRESERVATION ALTERNATIVE (RPA) incorporates all strategies included in the NO ACTION and BASELINE ALTERNATIVES and builds upon that foundation by including additional enhancement strategies emphasizing preservation of fish and wildlife resources within the HINWR. Because of the documented and potential effects of human activities outside existing HINWR boundaries, the RPA addresses the need for the FWS to exert influence beyond its area of primary jurisdiction. Many of the RPA strategies focus on reducing the risk of adverse human impacts, increasing "layers" of administrative protection and resource recognition, and expanding research and monitoring programs. The strategies which make up the RPA are discussed briefly below:

"Vulnerable" Species (Endangered, Threatened, Candidate and Sensitive Species):

1) Regulate and monitor nearshore vessel traffic:

This strategy is directed at the need to minimize the risk of vessel groundings on HINWR islands and reefs. It is considered here under the "Vulnerable" Species category but it has implications with respect to virtually all aspects of HINWR resource management. The historic record, particularly over the last decade, makes it apparent that the risk of groundings is real, not speculative. Increasing vessel activity associated with shipping traffic and expanding commercial fisheries increase the risk substantially. The prospect of fishery support facilities at Midway, and subsequent attraction of additional fishing boats, makes it virtually certain that more vessels, with crews unfamiliar with NWHI waters, will end up on HINWR reefs and islands.

This strategy will seek to improve the regulation and monitoring of nearshore vessel traffic by working cooperatively with the State of Hawaii, the U. S. Navy, NMFS, the Coast Guard, the Western Pacific Regional Fishery Management Council (WPRFMC), and fishing industry. A working interagency committee is proposed to consider, and implement where feasible, various measures to reduce the risk of and enhance the ability to respond to groundings. Among the measures proposed for consideration by the committee are:

- a) Change the present Intergovernmental Maritime Consultative Organization (IMCO) "Area to Be Avoided" to regulatory, not advisory status. Alternatively, the nearshore portion of the area (e.g. within 10 miles of emergent land or submerged reefs) could be subject to regulation, the remaining area covered by the advisory. Include Kure into the area covered.

- b) Establish a 100-fathom contour regulation that would prohibit vessels from transiting waters within the 100 fathom isobath surrounding each island or atoll. Vessels could enter the area (outside the refuge boundary) for the objective of fishing, observation/recreation and for authorized research and/or refuge-related projects. This would reduce the risk of groundings of vessels with "no business" in nearshore waters.
- c) Require all vessels fishing in the NWHI to obtain Leeward Islands fishing permits from the State of Hawaii (not simply vessels targeting fishery resources subject to different regulations than within main Island waters, as is now the case). This regulatory process would provide a single point of contact for all fishing vessel owners and captains, facilitating education and enforcement.
- d) Implement an educational program relating to the grounding hazards in the NWHI, particularly directed at vessel owners and captains with little or no experience in the area. The program should include documents with detailed discussion of particular hazards, anchorages, wind/wave conditions, emergency actions, rescue and communication procedures, etc. Owners and captains might also be asked to attend orientation meetings which would include slides/movies of recent groundings and interviews with people involved in groundings in order to emphasize the seriousness of travel in the NWHI. Issuing of Leeward Islands fishing permits should be contingent upon exposure to the educational program.
- e) Consider vessel reporting requirements for activities within the 100 fathom isobath around HINWR islands and atolls. A more sophisticated approach could involve required satellite-monitored transponders. Radio reporting could be accomplished by the Coast Guard in cooperation with the FWS at Tern Island and the U.S. Navy at Midway.
- f) Install an EPIRB receiver and radar equipment at Tern Island. The EPIRB receiver would permit immediate detection of groundings or other emergencies in the French Frigate Shoals area. The radar equipment would allow Refuge staff to monitor vessel activity in the north end of French Frigate Shoals, including that associated with use of the emergency mooring buoy and/or a multi-species fishery buoy.
- g) Install prominent radar targets at vulnerable locations in the HINWR. This may not prove feasible in exposed reef areas where recent groundings have occurred, but should be considered.

It is envisioned that measures, such as discussed above, will not only protect HINWR resources but will also enhance the safety of vessel crews

and protect boat owners from serious financial losses. Improved monitoring of vessel activity will substantially reduce the time necessary to respond to groundings, making it possible to rescue crews and protect HINWR resources more effectively.

2) Conduct lower priority research and management actions in recovery plans:

As in the NO ACTION and BASELINE ALTERNATIVES, this strategy focuses on those six wildlife species presently listed on the federal list of threatened and endangered species. It builds upon the various high priority research/management programs implemented under the NAA and BA. As an example, such projects for the Hawaiian monk seal will include, among others, the treatment and rehabilitation of sick seals, ciguatoxin exposure and toxicity studies, shark monitoring and possibly localized control programs, marine habitat usage studies and expanded aerial surveys. For this species, the principal FWS role will continue to be in support of studies underway and planned by NMFS, the agency with primary responsibility for the monk seal recovery program. In contrast, the FWS will continue to have the lead role in the implementation of recovery actions for endangered land birds in the HINWR.

3) Evaluate/establish additional contingency populations of endemic land birds, consistent with recovery plans:

The major focus of approved and proposed recovery plan recommendations for endemic land birds concerns the protection and maintenance of essential habitats. However, because existing and potential threats could lead to catastrophic declines in natural populations, this strategy is proposed to provide a contingency against such disasters by establishing and maintaining at least one additional and disjunct population for each of the endemic land birds. The Laysan duck is presently distributed widely in several well-maintained zoological collections around the world. The Laysan finch has been transplanted to Pearl and Hermes Reef in 1967 and is well-established on several islets. These two species appear to have adequate "buffer" populations and will likely require little additional attention under this strategy. Management of any population must consider the implications of manipulation of natural processes and alteration of the terrestrial ecology throughout the HINWR. Presently it is expected that new actions associated with this strategy will be limited to transplanting millerbirds to Laysan Island depending on a scientific evaluation of taxonomic classification for HINWR millerbirds and further study of habitat requirements. Captive flocks of Nihoa finches will be pursued. Emergency capture and/or transplantation may be considered for any of the land birds in the event of natural or human-related catastrophe that seriously threaten wild populations.



Assistant Refuge Manager banding a Black noddy (*Ancus tenuirostris*) chick for life history studies.

Environment

- 4) Designate or support designation of critical habitat (CH) for threatened and endangered species:

The role of formally designated critical habitat in the protection and recovery of listed species was discussed previously (see Section IV.F.2.). This strategy is based upon the perspective that designation of CH would increase protection, enhance recovery and draw public attention to the vulnerability and value of the habitat of these species. The process of CH designation for land bird species can begin immediately by FWS action alone. Consideration of CH designation for the green sea turtle will appropriately wait until conclusion of the recovery planning process. NMFS has recently re-proposed the NWHI beaches and waters out to the 10 fathom isobath as critical habitat for the monk seal. Although the FWS prefers designation of CH out to the 20 fathom isobath, under this strategy, the FWS will support and comply with the final designation whatever it is.

5) Evaluate and nominate, if appropriate, lands and waters of the HINWR for status as a World Heritage Site, Biosphere Reserve and National Natural Landmark:

This strategy is directed at the desirability of securing additional national and international forms of protection and recognition of the unique resource values of the HINWR following a thorough evaluation of the short- and long-term implications of additional protective designation for the HINWR. While not replacing current federal or state refuge status, such formal designations would acknowledge natural and cultural resource values that transcend political and geographic boundaries. Three such types of recognition, for which the HINWR appears to qualify, are World Heritage Sites, Biosphere Reserves and National Natural Landmarks.

The International Convention Concerning the Protection of World Cultural and Natural Heritage (UNESCO, 1972) provides for the designation of areas of "outstanding universal value" as World Heritage Sites. Suitable natural properties include those which a) represent major stages of the earth's evolutionary history; b) are examples of geological processes, biological evolution or man's interaction with the natural environment; c) are examples of unique, rare or superlative natural phenomena, formations or features or areas of exceptional natural beauty; or d) are habitats where populations of rare or endangered species of plants and animals still survive. These exceptional areas must be recommended by the signatory nation responsible for the site for declaration by the International World Heritage Committee. To be designated, sites must already have long term protection and be owned and managed by a government or a non-profit corporation or trust.

Where World Heritage Sites protect cultural and natural properties of outstanding universal value, Biosphere Reserves are established to preserve ecosystems representative of the world's terrestrial and aquatic biomes. The Biosphere Reserve project was an outgrowth of the UNESCO Man and the Biosphere program. Criteria and guidelines for selection of Biosphere Reserves were developed by a UNESCO task force in 1974. Each Biosphere Reserve is to include one or more of the following: a) representative examples of natural biomes; b) unique communities or areas with unusual natural features of exceptional interest; c) examples of harmonious landscapes resulting from traditional patterns of land-use; or d) examples of modified or degraded ecosystems capable of being restored to more natural conditions. To qualify for designation, a site must also be large enough to be an effective conservation unit, should provide opportunity for ecological research and education, and must have adequate long-term legal protection.

The purpose of the National Park Service's Natural Landmarks Program is to identify nationally significant landscapes and/or ecological areas. A 1981 evaluation included approximately 50 existing or potential land-

mark sites in the State of Hawaii, 31 of which were rated against several criteria. Highest priority was given to those sites which include outstanding and/or unique examples of the geological and ecosystem features characteristic of the Hawaiian Islands and which encompass several such features. In that review, the Northwestern Hawaiian Islands (from Nihoa to Kure), were assigned the highest priority.

6) Nominate HINWR lands and waters to the Wilderness System:

Whereas the BASELINE ALTERNATIVE includes a strategy directed at Wilderness nomination for HINWR lands, greater resource protection is sought through this strategy which will also include the approximately 252,000 acres of submerged lands and water within the HINWR (see Section IV.C.2.e.). Both strategies would exclude Tern Island and adjacent dredged areas. The strategy to include both HINWR lands and waters would be consistent with the original Wilderness proposal developed by the FWS. This earlier proposal was reduced to emergent lands only in recognition of the boundary dispute and in response to concerns of the State of Hawaii that inclusion of HINWR waters would jeopardize the planned exploitation of fishery resources.

7) Conduct historical resource surveys and nominate eligible sites to the State and National Historic registers:

Human activities in the NWHI, since their discovery by European explorers in the late 18th century, have left an obvious mark on the HINWR in the form of military facilities, shipwrecks and remnants of guano operations. The value of these and, as yet undiscovered, historical resources in the HINWR is the focus of this strategy. Field survey, documentation and nomination of eligible historical sites are proposed to protect these resources, in keeping with applicable federal statutes (see Section IV.C.2.h.).

Other Fish and Wildlife:

8) Monitor and control disease in the resident seabird populations:

The potential for a serious outbreak of avian disease within dense nesting seabird colonies of the NWHI is considerable. Furthermore, the FWS' ability to detect such a problem at its earliest stages and to react effectively is severely hampered by the infrequency of HINWR island visits and the logistical problems inherent in responding to a problem. In some areas, determination of the pattern of disease outbreaks and the role of various vectors will permit development of management programs to minimize the spread of the disease and its impact on seabird populations. FWS studies of avian pox in albatross populations at Midway Atoll is such an example. Documentation of "baseline" levels and forms of avian disease will provide an improved basis for evaluation of apparent outbreaks. Determination of the nature

of existing forms of disease may permit development of measures to prevent severe impacts to nesting populations. The protocol for monitoring disease levels is well established and easily incorporated into other population monitoring programs.

9) Regulate and monitor nearshore vessel traffic:

Because of the relationship between vessel groundings or spills and the ecological integrity of HINWR islands, the future productivity of seabird colonies is as dependent upon the control of vessel activity as are the Refuge's threatened and endangered species. Ground-nesting seabirds are particularly vulnerable to predation by introduced mammals. Dependency of seabird resources on nearshore waters as a source of food makes these species even more vulnerable than terrestrial species to the direct and indirect adverse effects of a major oil or chemical spill. For this reason, a strategy involving measures to regulate and monitor nearshore vessel traffic is included under this output category (see RPA Strategy #1 for details).

10) Monitor distribution and abundance of native terrestrial species:

This strategy is directed at other, unlisted species found on HINWR islands. Only very limited data are available for native and endemic terrestrial species of insects, arthropods, molluscs (e.g. land snails), and plants. Many of these species are of importance to endangered land birds, as food and cover. They are also components of unique insular ecosystems of considerable research and educational interest in their own right. This strategy will include the development and implementation of monitoring programs for key species or species groups. Quite likely, this effort would involve considerable participation by non-FWS researchers.

11) Map and ground truth terrestrial and marine ecosystems:

This strategy, as it applies to the HINWR land base, will tie directly to Strategy #10 above, as part of an overall monitoring program. Appropriate ground truthing of aerial photography in terrestrial ecosystems, in particular, would facilitate expanded use of remote sensing techniques that may be highly cost-effective. These techniques may also prove more sensitive to trends in habitat condition that are not readily apparent during ground surveys. One such trend of particular concern is the accelerated filling of the Laysan Island lagoon through wind-blown sand from a de-vegetated dune. This, in turn, appears tied to the pattern of vegetational succession on the island, a phenomenon that can be monitored effectively by remote sensing and ground survey. Aerial photography of HINWR atolls and nearshore reefs is an appropriate technique for inventory of habitat types and documentation of marine species distribution (e.g. sharks, baitfish, seals, and turtles).



Bonin petrel (*Pterodroma hypoleuca*), a nocturnal burrowing bird highly vulnerable to predation by rats.

Scientific and Professional Services:

12) Conduct annual aerial photo survey of all HINWR islands:

This strategy is singled out as a means to permit monitoring of terrestrial species and habitat, in conjunction with regularly scheduled ground survey. Photography is being used for documentation of island geological processes (e.g. change in shape of sandy islets); habitat utilization and population indicators for key species (e.g. seals, turtles and some seabirds); and baseline vegetation mapping. Annual repetition of this project will improve the FWS' ability to monitor these resources and to detect management problems at an early stage. Aerial survey will also enhance enforcement capability.

13) Conduct extended field camps and/or semi-annual boat surveys of HINWR islands:

This strategy is designed to gather additional resource data not obtainable through annual visits and short field camps, as described in the NAA. This approach will permit scheduling of surveys in a manner that allows more accurate and complete monitoring of reproductive biology for key species. Extended field camps will involve between 2-4 people in tent camps, conducting long term field surveys, principally

in spring-summer months. Several different island camps are possible in a given season.

14) Conduct comparative monitoring studies on Kure and Midway:

This strategy involves a cooperative program with the State, U.S. Coast Guard, National Marine Fisheries Service and U.S. Navy to monitor fish and wildlife resources whose distribution includes both HINWR islands and atolls as well as at Kure and Midway. These sites played an important role during recent Tripartite studies extending throughout the NWHI. Opportunities for year-around access and living quarters at Kure and Midway make possible biological monitoring studies not practical or feasible at locations other than Tern Island. In the case of seabirds, this permits inclusion of species with fall-winter nesting cycles into population monitoring programs. This strategy will also include facilitation by the FWS and cooperating agencies of appropriate non-FWS research/management studies at these sites.

Other Public Uses:

15) Regulate and monitor nearshore vessel traffic:

This strategy is included here to highlight its relevance to the expanding commercial fishery in the NWHI. Details of this strategy are addressed in RPA Strategy #1.

16) Cooperate/assist in the installation of a mooring buoy outside the HINWR boundary at French Frigate Shoals:

Although from a wildlife protection/preservation standpoint the fewer vessels in the vicinity of French Frigate Shoals the better, the FWS accepts as reality the following:

- a) Interest in commercial fishery development in waters surrounding French Frigate Shoals is increasing.
- b) The FWS has no direct control or jurisdiction over fishing activities in waters outside the HINWR.
- c) A commercial fishery mothership operating from a mooring buoy just outside the Refuge boundary is seen as environmentally preferable to a situation where the fishing industry operates outside the Refuge boundary independent of any FWS influence.
- d) Support/cooperation with the commercial fishing industry in the HINWR has in the past and would likely continue to provide benefits to both the fishing industry and the FWS. (Fishing vessels have assisted in transporting FWS personnel and supplies to Tern Island.)

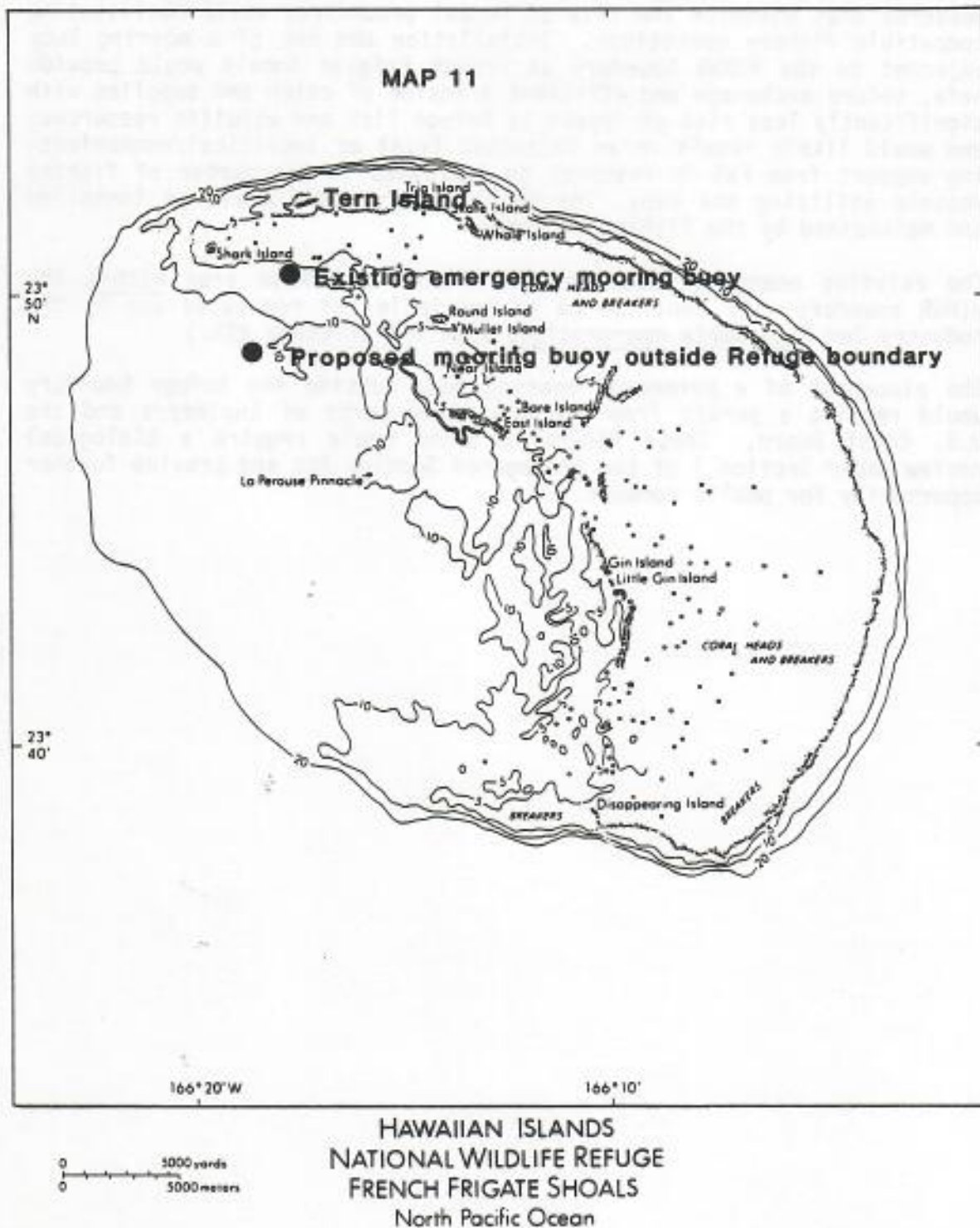
These realities considered together with the history of accidents in the vicinity of French Frigate Shoals underscore the need to implement measures that minimize the risk of vessel groundings while facilitating compatible fishery operations. Installation and use of a mooring buoy adjacent to the HINWR boundary at French Frigate Shoals would provide safe, secure anchorage and efficient transfer of catch and supplies with significantly less risk of impact to Refuge fish and wildlife resources; and would likely result in an increased level of logistical/communicating support from FWS in response to increases in the number of fishing vessels utilizing the buoy. The buoy, as proposed, would be installed and maintained by the fishing industry.

The existing emergency buoy and designated anchorage area within the HINWR boundary will continue to be available for regulated use by the industry for legitimate emergencies. (See NAA Strategy #23.)

The placement of a permanent mooring buoy outside the Refuge boundary would require a permit from the U.S. Army Corps of Engineers and the U.S. Coast Guard. These federal actions would require a biological review under Section 7 of the Endangered Species Act and provide further opportunity for public comment.



FRENCH FRIGATE SHOALS
HAWAIIAN ISLANDS
NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT



E. Resource Utilization Alternative (RUA)

The RESOURCE UTILIZATION ALTERNATIVE (RUA) incorporates all strategies in the NO ACTION and BASELINE ALTERNATIVES and builds upon that foundation by including additional enhancement strategies emphasizing public use of the HINWR. Limitations on that use are dictated by the anticipated and potential conflicts with higher priority resource management objectives for the Refuge and by the staffing and funding implications. The strategies which make up the RUA are discussed below:

"Vulnerable" Species (Endangered, Threatened, Candidate and Sensitive Species):

1) Monitor nearshore vessel traffic:

As in the case of the RPA, this strategy addresses the increased risk of vessel groundings and unauthorized landings associated with expanding commercial fisheries and other vessel activities in the NWHI. However, in contrast to the RPA, this strategy will not regulate nearshore vessel activity but it will require that vessels in the NWHI take measures to allow an improved level of monitoring of that activity. Such measures could include filing of float plans, regular radio reporting schedules through Tern Island or Honolulu and mandatory use of EPIRB's for emergency use.

2) Monitor impacts of commercial fishery on listed species:

As vessel activity increases at authorized locations within the HINWR or in adjacent nearshore waters, this strategy will address the greater need to monitor the effects of that activity and to mitigate those effects if necessary. This monitoring will be particularly important at French Frigate Shoals, because of the significance of that area to monk seals and turtles and because of the anticipated focus of expanding fisheries in the vicinity of that atoll. Population monitoring studies under the NO ACTION and BASELINE ALTERNATIVES will detect gross population changes over time, but, in themselves, will not facilitate demonstration of a cause-and-effect relationship with fisheries or other human activities. This strategy will include monitoring of the incidence of seal and turtle sightings by vessels, interactions with vessels and fishing gear, attraction of seals and turtles to vessel lights or other operations, etc. Vessel activities within HINWR waters will be monitored most closely.

3) Conduct only limited additional research indicated in recovery plans:

In contrast to the RPA, several of the second and third priority research projects identified within recovery plans will not be implemented under this alternative. Only those studies most likely to

provide data highly relevant to species recovery will be undertaken. The FWS will place even greater reliance on funding and staffing by other agencies and organizations, particularly NMFS, for low priority research involving seals and turtles.

Environment:

4) Permit limited access to cultural sites for religious purposes:

This strategy will address the legitimate right of public access to archaeological sites on Nihoa and Necker Islands for religious purposes only. It is doubtful that there remain many such religious interests since the ancient Polynesian religion is probably extinct. However, if such an interest for access to Nihoa and Necker occurs, it will be rigidly controlled and will involve FWS-supervised visits under special use permit only. Access will be scheduled to minimize conflicts with wildlife, enhance safety and be compatible with wildlife management studies. Approved visitation will be permitted on government-contracted vessels only as space allows and, at other times, at the expense of the applicant.

Other Fish and Wildlife

5) Monitor the effects of commercial fishing and other human activities on "other fish and wildlife":

Principle attention in this strategy will be focused on seabird populations. Studies of particular relevance will include the monitoring of feeding habits of key species, reproductive success, growth rates and other parameters affected by changes in food supply. Monitoring on seabird nesting islands where public access is permitted will allow an assessment of the effects of that human activity. Other studies, relating to vessel impacts, will be implemented in response to specific incidents. A recent example is the Sea Grant study of reef impacts associated with the grounding of the freighter ANANGEL LIBERTY at French Frigate Shoals in 1980.

Scientific and Professional Services:

6) Conduct biannual aerial photo surveys of HINWR islands and atolls:

This strategy addresses the value of aerial photography in a monitoring program principally directed at terrestrial wildlife and habitats. In contrast with the annual surveys in RPA Strategy #12, this project will be repeated every other year.

Education and Interpretation:

7) Facilitate limited, supervised photography, journalism and art (P/J/A) visits to the HINWR:

This strategy is provided to accommodate a limited number of requests to the HINWR for P/J/A activities. Access to the refuge will be permitted only under strictly controlled, regulated and supervised conditions. Refuge staff will accompany visitors at all times. Group size will be limited to a maximum of four individuals. Visits will be restricted to three days or less at each location. Access to seal hauling beaches will be severely restricted. Under no circumstances will disturbance of mother-pup pairs or hauled-out seals be permitted. Priority will be given to those P/J/A projects that have the greatest potential for effectively reaching both the general public and selected audiences. Examples include wildlife filmmakers, news media, television special producers, and wildlife magazine photographers/writers. All P/J/A visitors will operate under refuge special use permits. Trips will be scheduled to avoid disturbance to wildlife. Travel will be arranged on a space-available basis on FWS contracted flights or vessel charters or at the expense of the permit applicants when they cannot be accommodated otherwise. Where possible, arrangements will be made whereby products (stock footage, slides, artwork) will be available for use by the FWS at no cost for educational programs.

The principal focus of this activity will be at Tern Island where a maximum of eight P/J/A visits per year will be allowed. FWS-supervised visits to designated areas within French Frigate Shoals will also be allowed on a more limited basis. P/J/A visits to other islands and atolls in the HINWR will be restricted to no more than two annually. Emphasis will be given to cooperative projects resulting in products of high value to the FWS' environmental education/interpretive program.

8) Conduct limited nature tours/environmental education (EE) programs at Tern Island:

The purpose of this strategy will be to accommodate some of the public demand for interpretive nature tours and environmental education programs in the HINWR. The rapidly growing world-wide nature tour business has demonstrated considerable attraction to the Hawaiian Islands in recent years, focusing principally on whale watching, birding and visits to national parks and other remote areas. In recent years, several nature tour companies have approached the FWS regarding access to the HINWR. To date, none has been accommodated within the HINWR due to anticipated disturbance to wildlife and habitat, limitations on supervisory staff, problems in logistical support and safety considerations. FWS operation of facilities at Tern Island now makes it possible to accommodate a small number of visitors in a manner that

minimizes wildlife disturbance, is logistically feasible and can be implemented within realistic staff and funding limitations.

Under this strategy, a small number of tour visits (6-8 per year) can be accommodated by contracted aircraft to Tern Island. These groups will be limited by aircraft size to a maximum of six people. They will be accommodated in FWS housing while on Tern Island. Visits will be restricted to 3 days or less. While at French Frigate Shoals, visitors will be under the supervision of Refuge staff. Conditions of the special use permit concerning introduction of exotic species will be monitored and enforced. No access to seal hauling beaches will be permitted. Boat activity will be limited to supervised snorkeling in designated areas and viewing of selected islets from offshore. Trips will be scheduled to minimize conflicts with peak wildlife activities, FWS operations, and researchers.

This strategy will accommodate demand from both commercial and non-commercial sources. While school groups will not be accommodated, selected groups of educators can participate in teacher-workshops and field trips that will facilitate inclusion of curriculum materials relating to the HINWR into the local environmental education program. Commercial nature tour operations will apply for access and will be accommodated within scheduling limitations described above.

Other Public Use:

9) Monitor nearshore vessel traffic:

Same as RUA Strategy #1

10) Permit use of a mooring buoy within French Frigate Shoals for emergencies and for support of multi-species fishery:

Under this strategy, use of the mooring buoy within French Frigate Shoals will be permitted for both emergencies and for support of the State's proposed multi-species fishery operation. The buoy will be located approximately two miles south of Tern Island. It will be placed and maintained by the State of Hawaii and/or the fishing industry. An anchorage area, extending from the buoy to the Refuge boundary, will be designated for vessel use when they cannot be accommodated on the buoy or in tandem on the buoy with other vessels. The buoy could be used for transfer of catch, fuel and provisions. No pollution of Refuge waters will be permitted. Restrictions will also be imposed on vessel lights while on the buoy and on movement of vessels within the atoll. No fishing within the boundaries of the HINWR will be permitted.

11) Provide recreational opportunity, storage space and aircraft use at Tern Island in support of a multi-species fishery:

In support of the proposed multi-species fishery operation, the limited facilities at Tern Island will be made available under this strategy for recreation, storage of fishing gear and transport of equipment and people. Small boats, owned and operated by the fishing industry, will transport equipment and people between fishing vessels, the mothership and Tern Island. Air shipment of fishery catch will not be allowed. Storage space on the island is confined largely to a few empty rooms within the facility vacated by the U.S. Coast Guard. Large amounts of gear cannot be stored outside where it would occupy seabird nesting habitat except for a few months during the fall when the habitat is not utilized. Refuge staff will have little time and almost no equipment to assist with transporting gear from the boat docking area to the storage area. Daytime recreational use of Tern Island will be confined to the western end of the island. Permissible activities may include barbecues, jogging, ping-pong and snorkeling. For this strategy to be compatible with the high priority "Vulnerable" Species objectives, proposed recreation and storage activities will be subject to the same Special Use Permitting conditions concerning prevention/introduction of exotic species that FWS personnel, researchers and other visitors to the HINWR are currently subject to (NAA Strategy #3). An evaluation of this support will be conducted to specifically address the operational aspects of this strategy and to ensure that wildlife resources are not negatively impacted. As with other matters of this type, this activity will be subject to Section 7 review under the Endangered Species Act.

F. FWS' Preferred Alternative

The FWS' PREFERRED ALTERNATIVE (PA) is a hybrid of strategies taken directly and/or modified from strategies appearing in the RPA and RUA. Like those alternatives, it incorporates, as a foundation, the NO ACTION and BASELINE ALTERNATIVES in their entirety. The PA builds upon the NAA and BA in a manner that seeks to balance objectives for resource preservation and utilization. It addresses all major issues raised in the Master Plan/EIS public involvement process. The PA is consistent with the priority ranking of outputs and objectives developed in this planning process. Where strategies included in the PA are identical to those appearing in either the RPA or RUA, they are so indicated and referenced in the discussion below. Where they represent modifications of strategies in the RPA or RUA, the nature of that modification is explained.

"Vulnerable" Species (Endangered, Threatened, Candidate and Sensitive Species):

1) Regulate and monitor nearshore vessel traffic:

This strategy recognizes both the need to reduce the risk of vessel groundings and the legitimate right of the fishing industry to operate free from unnecessary regulation and invasion of privacy. Both the

interagency/industry working committee and the proposed measures for consideration under RPA Strategy #1 are recommended under this strategy as well. Satellite monitoring of vessel activity is proposed only as a last resort, if other measures prove inadequate to significantly reduce the risk, the incidence and the effects of groundings.

2) Conduct lower priority research and management actions in recovery plans:

Same as RPA Strategy #2

3) Evaluate/establish additional contingency populations of endemic land birds, consistent with recovery plans:

Same as RPA Strategy #3

4) Monitor impacts of the commercial fishery on listed species:

Same as RUA Strategy #2

Environment

5) Designate or support designation of critical habitat for threatened and endangered species:

Same as RPA Strategy #4

6) Evaluate and nominate, if appropriate, lands and waters of the HINWR for status as a World Heritage Site, Biosphere Reserve and National Natural Landmark:

Same as RPA Strategy #5

7) Reactivate Wilderness nomination for HINWR emergent lands; evaluate and nominate, if appropriate, HINWR waters:

This strategy builds upon BA Strategy #4 by nominating HINWR emergent lands for Wilderness status and recommending that further consideration be given to the nomination of HINWR waters to Wilderness status. While these waters appear to meet the Wilderness criteria, some uncertainties remain regarding the implications of ongoing and proposed management and fishery support activities on the qualifications of these areas for Wilderness status. In question are small boat traffic, mooring of fishing vessels, potential limited dredging or quarrying activities for Tern Island seawall repair, aircraft surveys, etc.

The issue of Wilderness nomination for HINWR waters is also complicated by disputed jurisdiction between the FWS and the State of Hawaii. Resolution of the boundary dispute (NAA Strategy #10) confirming FWS

jurisdiction would facilitate timely Wilderness designation whereas a legal decision in the State's favor would prevent such designation.

The PREFERRED ALTERNATIVE recommends delaying action to nominate HINWR waters to Wilderness status until these uncertainties can be resolved. In the meantime, emergent lands and waters will continue to be managed as de facto Wilderness, consistent with National Wildlife Refuge System policy applying to lands and waters under consideration.

8) Conduct historical resource surveys and nominate eligible sites to the State and National Historic registers:

Same as RPA Strategy #7

9) Permit limited access to cultural sites for religious purposes:

Same as RUA Strategy #4

Other Fish and Wildlife

10) Monitor and control disease in the resident seabird populations:

Same as RPA Strategy #8

11) Regulate and monitor nearshore vessel traffic:

Same as RPA Strategy #1

12) Monitor distribution and abundance of native terrestrial species:

Same as RPA Strategy #10

13) Map and ground truth terrestrial and marine ecosystems:

Same as RPA Strategy #11

14) Monitor effects of commercial fishery and other human activities on "other" fish and wildlife:

Same as RUA Strategy #5

Scientific and Professional Services

15) Conduct biannual aerial photo surveys of HINWR islands and atolls:

Same as RUA Strategy #6



Trig Island at French Frigate Shoals.

16) Conduct extended field camps and/or semi-annual boat surveys of HINWR islands:

Same as RPA Strategy #13

17) Conduct comparative monitoring studies on Kure and Midway:

Same as RPA Strategy #14

Education and Interpretation

18) Facilitate limited, supervised photography, journalism and art (P/J/A) visits to the HINWR:

Same as RUA Strategy #7

19) Conduct limited nature tours/EE programs at Tern Island:

Same as RUA Strategy #8

Other Public Uses:

20) Regulate and monitor nearshore vessel traffic:

Same as PA Strategy #1

21) Cooperate/assist in the installation of a mooring buoy outside the HINWR boundary at French Frigate Shoals:

Same as RPA Strategy #16

G. Relationship of Tern Island to HINWR Management

The Tern Island station plays an integral part in the achievement of wildlife resource objectives in the HINWR. Many of the strategies discussed above could not be feasibly implemented without a FWS presence at Tern Island. The discussion which follows establishes the extent to which attainment of objectives is dependent upon the continued operation of the Tern Island facility. In addition, a Tern Island "abandonment" scenario has been developed. Abandonment is considered a possible management option in light of continuously escalating operations and maintenance (O & M) costs associated with the Tern Island station. Tightening budgetary constraints require that the FWS take a critical look at all field operations, assessing trade-offs in the event of a severe cutback in funding. The abandonment option focuses on trade-offs that would need to be made if Tern Island were abandoned. (Because an abandonment option would be possible under all alternatives except for the NO ACTION ALTERNATIVE, the option is discussed once and not repeated in each of the alternatives.)

Description of the Tern Island Facility and Operation

Dredging for construction of the Tern Island runway began in August 1942. A 12,000' ship channel was dredged to 20' deep and an 8,000' seaplane landing area was cleared of coral heads. Approximately 660,000 cubic yards of dredged coral fill was placed behind a partial rim of steel sheet piling to "create" a new island 3,100' by 350'. This project increased the original island from approximately 11 acres to 37 acres in size. The total project, including construction of buildings and fuel tanks, cost approximately two million dollars.

A Naval Air Facility was commissioned on Tern Island on March 17, 1943. The station was placed in caretaker status one month after the war ended in September 1945 and was decommissioned in June 1946. After some additional construction on Tern Island, the Coast Guard LORAN facility from East Island was moved to Tern Island and became operational in 1952. Repairs were made to the seawall in 1959 and to station buildings in 1964. A major storm in December 1969 required helicopter evacuation of

station personnel and subsequent rebuilding of living quarters and generator building in 1972 at a cost of nearly \$1,215,000. The Coast Guard LORAN station was decommissioned on June 30, 1979, at which time the FWS occupied the facility.

Four major buildings are now present on Tern Island: a) shop and equipment storage building; b) generator building; c) living quarters; and d) boathouse. Two smaller buildings house the fresh water pumps and gasoline drums. Five 27,000 gallon diesel fuel tanks are on the island, with two of these in use. The roofs of the major buildings provide water catchment capability. Redwood water tanks are used for fresh water and salt water storage. Power is generated by two 17.5 kw Onan generators, operated on alternate days. Caterpillar 250 kw generators, used for the LORAN station, are operated intermittently. Communication is by single sideband radios with the Honolulu office and by VHF radio with vessels in nearby waters. Logistic support of the station is provided by contracted aircraft (twin engine Beechcraft), chartered fishing boats, volunteer fishermen and the Coast Guard. Vehicles on the island include a Case tractor with backhoe and a Dodge truck. Boston whalers with outboard motors are used for research and management studies within the atoll.



Tern Island.

Present staffing includes two assistant refuge managers resident on the island for 10 months of the year on a rotational schedule. A biological

technician based in the Honolulu Office provides support for the facility and rotates onto the island for approximately four months of the year. Additional FWS biologists, management personnel and volunteers spend varying lengths of time on the island. Staff time on Tern Island is devoted to station maintenance and operations, biological studies and support of research work underway by other station visitors.

Operation of the HINWR with Tern Island

Vulnerable/Endemic Species

Continuance of the biological field station on Tern Island would permit the FWS to fully satisfy high priority wildlife objectives for vulnerable and endemic species. Year-round monitoring of endangered monk seals from the Tern Island base has facilitated studies of productivity, age/sex composition of the population, population recruitment, intra-atoll movement and re-population of Tern Island--all of which have added to overall understanding of seal populations, their breeding habits and habitat requirements. For example, detailed monitoring of the seal population at French Frigate Shoals (FFS) since the departure of the Coast Guard in 1979 has shown a steady increase in seal use of Tern Island. The increase is attributable to the decline in human activities on Tern. However, there is still no evidence to show that the total seal population is increasing. Rather, what appears to be the case is that seals are returning to Tern Island in preference to other islands in FFS. Because seal activity is centered on FFS, the presence of a permanently-manned station at Tern is expected to greatly facilitate efforts to recover this endangered species. Further monitoring will be needed to show whether successful pupping takes place on Tern Island. (Several aborted attempts at pupping have been recently documented.) Production and maintenance objectives for the monk seal call for maintaining existing populations at FFS, Necker and Nihoa Islands, while recovering populations at Laysan, Lisianski, Pearl and Hermes Reef to mid-century levels. The research, monitoring and protective actions implied by these objectives make a field support base on Tern Island indispensable if objectives for the monk seal are to be satisfied.

Like the monk seal, the majority of the threatened green sea turtle population also occurs at FFS. Over 90% of the remaining Hawaiian population nests on East and Whaleskate Islands at FFS. The geographic location of the Tern Island facility makes it ideal for studying turtles. The field station has greatly facilitated studies of reproduction, growth and turtle habitat requirements. Research on the turtle has been primarily conducted by non-FWS personnel, but again, the availability of a support base on Tern Island has been instrumental in expanding understanding of this species. Maintaining and increasing nesting populations at various locations throughout the archipelago, as stated in the objectives for this species in Section V, will require

continual monitoring and research efforts. Such efforts can best be facilitated by perpetuation of the Tern Island station.

Endemic Terrestrial Species

The central location of the Tern Island station at a midpoint in the archipelago also facilitates attainment of objective for all endemic terrestrial species, including four endangered landbirds--Laysan finch, Laysan duck, Nihoa finch and Nihoa millerbird. The objective covering these species calls for prevention of ecological disturbances on Laysan, Nihoa and Necker Islands and maintenance of natural diversity. The most serious threat to these species (and to endemic terrestrial biota in general) is the inadvertent introduction of exotic species. Predators such as rats and carnivorous ants can destroy populations of endangered birds and native invertebrates. Exotic weeds can seriously alter the habitats of these animals while displacing rare native plants (Conant, et.al, 1983). The presence of a permanent manned station on Tern Island has had a deterrent effect on illegal island landings, which are a potential source for introduction of exotics. Obviously, however, the FWS does not now have (and does not anticipate ever having) sufficient resources to patrol the entire archipelago for illegal entries. The station also facilitates rapid response to accidental groundings in the archipelago, another source of exotic organisms.

Perhaps the greatest beneficial impact of the Tern Island station is the rapid response capability which the station offers in the event of an emergency or other incident where exotics could be introduced. Communication facilities on Tern make possible a speedy response to accidental groundings, oil spills, spills of hazardous chemicals or other incidents with potential for adversely impacting the unique terrestrial biota of the NWHI. The recent (February 5, 1985) grounding and sinking of the fishing vessel, CAROLYN K within the lagoon at French Frigate Shoals is a case in point. Refuge personnel at Tern Island rescued the crewmen and provided radio communication and coordination between the sinking vessel, the U.S. Coast Guard and Refuge officials in Honolulu in an effort to minimize the adverse impacts of the event. Tern Island personnel and facilities also made possible the rapid response of the salvage operation which patched the hull, refloated the vessel and towed it out of the lagoon and back to Honolulu eight days later. Had the Tern Island station not existed, human lives and wildlife populations would have been endangered. The vessel would likely have broken up in the lagoon with the consequent spill of 1,000 gallons of diesel fuel.

Seabirds

Seabird research and monitoring studies, a necessary component of FWS objectives for marine bird production and maintenance, are similarly facilitated by the Tern Island base. The detailed studies on seabird

reproductive biology, food habits, flight patterns, vision, growth rates and bio-energetics conducted during the Tripartite effort could not have been accomplished without the extensive equipment and supplies made available by having a base of operations on Tern Island. The opportunity to study FFS seabird populations year-round, at a location midpoint in the archipelago, provides important benefits to the FWS' overall seabird management program. Together with seabird data collected on the main Hawaiian Islands and data from the vast seabird colonies on Midway and Kure, seabird research at FFS provides important comparative data. FWS staff and volunteers have monitored the repopulation of Tern Island by seabirds since 1979 with the departure of the Coast Guard. The result has been new information on the effects of human activity on seabirds.

Research Studies

The objective for research studies perhaps exhibits the greatest dependency on the continued existence of the field station at Tern Island. The station is vital to the FWS objective to gather scientific data on refuge resources and the environmental impacts of public use. Operation of the FWS research facility at Tern Island has facilitated the implementation of a broad, multi-disciplinary research program involving representatives of several agencies and organizations. Recent or ongoing studies have addressed reef ecology and productivity, reef trophics, algae, ciguatera, lobster reproductive biology, geology and reef growth patterns, turtles, seals and seabirds. Although some work directly associated with the Tripartite project will not continue at Tern Island, several studies are anticipated to continue and new studies are planned. As an example, deep water submersible studies of bottomfish and mineral resources were conducted in September 1984.

Tern Island also provides an essential support base for research conducted throughout the archipelago. Tern has been a frequent stopover site for research vessels enroute to other locations in the NWHI. Aircraft transport to Tern Island has made possible the transfer of personnel and supplies, improving the productivity and variety of studies possible on vessel-supported research cruises. Tern Island personnel have also facilitated these projects by repairing both research equipment and support vessels in need of assistance. Studies involving remote sensing by twin-engine aircraft continue to be totally dependent on Tern Island for refueling. Refuge staff at Tern also provide radio communication support for field camps on more western islands that are unable to communicate effectively with Honolulu.

Public Use

Fulfillment of the public use objectives are equally dependent on the existence of a manned station on Tern Island. Opportunities for on-site environmental education, interpretation and photography will be greatly

facilitated by the availability of housing, utilities and water, even though most visits will likely not exceed two or three days. The airstrip is a critical feature, without which it would be difficult, if not impossible to conduct any form of on-site public interpretive and/or educational program.

Other Public Uses

An obvious benefit of the Tern Island station is the support it currently provides for the NWHI commercial fishing industry, one of the compatible public uses identified in this Master Plan/EIS. Parts and supplies are regularly transported on FWS aircraft to fishing vessels at FFS. Fishing crew rotations have also occurred on a space-available basis. Refuge staff, using station equipment, have assisted in several vessel repair operations. Radio support is provided to fishermen to facilitate communication with co-workers and suppliers. Additional support (storage of equipment, recreational opportunity, provision of fuel and ice, etc.) has been proposed in the past and has been considered in this planning process. (Because National Marine Fisheries Service has concluded in an August 14, 1985 Biological Opinion that such additional support would likely jeopardize the continued existence of the Hawaiian monk seal and Hawaiian population of the green sea turtle, this strategy, though considered in the RESOURCE UTILIZATION ALTERNATIVE, was not adopted by the FWS as a part of its PREFERRED ALTERNATIVE.

Management Actions

Since occupation of Tern Island by the FWS has occurred only recently, the data being accumulated are considered essential baseline information necessary to relate changes in future resource status. The FWS plays an important part in facilitating management actions carried out at FFS by cooperating closely with the National Marine Fisheries Service. Personnel stationed at Tern Island participate in year-round population monitoring activities and monthly aerial population surveys. The monk seal "Headstart" program was aided by FWS personnel and equipment at Tern Island. Refuge personnel were critical to efficient completion of a translocation program for aggressive male monk seals. Tern Island facilities and personnel are important to the green sea turtle program as well. The presence and law enforcement capabilities of personnel at Tern Island are vital for maintaining undisturbed nesting and basking areas for 90% of the green sea turtle population. Seabird baseline data collection and population monitoring activities are currently being carried out by FWS personnel at Tern Island. Management actions are limited to encouraging propagation of selected vegetative types for nesting habitat, reducing disturbance by limiting unwarranted visits, and public relations efforts with commercial fishermen. The future is unclear in regard to what management actions will be carried out following baseline data collection, but it is quite clear that the

future of the HINWR and Tern Island holds the promise of increased potential for disturbance of this fragile environment when expanded commercial fishing opportunities and new undersea mining interests are developed. The data collected now and in the immediate future will be extremely important when the FWS is faced with decisions that will affect the well-being of fish and wildlife in the NWHI.

Other Benefits of Tern Island Station

The above discussion directly links the Tern Island station to the attainment of specific categories of Refuge objectives. There are also indirect links which are equally critical to meeting objectives. They include the following:

1) **Enforcement of Regulations** - A manned station on Tern Island greatly enhances FWS capability to control illegal access to islands and atoll waters at FFS. Additionally, FWS personnel on Tern monitor the activities of all authorized personnel (researchers) to ensure that all regulations specified in special use permits are rigorously adhered to. Strict enforcement has reduced potential conflicts between research activities and critical populations of monk seals and turtles. This proved to be particularly important during the height of the Tripartite studies at FFS, when research activity on the island was at an intensive level. It was, in fact, this capability of monitoring on-going work that made it possible to accommodate such a variety of studies with little or no adverse impact.

2) **Oil or Chemical Spills** - Implementation of an effective response to an oil or chemical spill is dependent upon the rapid deployment of appropriate equipment and trained personnel. The Tern Island station provides capability to support such an operation that would not be possible if the station was abandoned. The station played an integral role in support of the salvage and post spill study after the ANANGEL LIBERTY grounding in 1980 through air and boat support, living quarters and radio communication. An immediate and effective response is particularly important at FFS where principal NWHI populations of monk seals and green sea turtles are found. The FWS oil spill contingency plan will require a manned station on Tern.

3) **Accidental Groundings** - Four vessels (three fishing boats and one freighter) have grounded at French Frigate Shoals since 1980. Tern Island refuge staff played an instrumental role in the salvage and/or rescue operation in each case. Radio communications and a rapid response to the situation prevented or substantially reduce potentially harmful effects to seals, turtles and other wildlife forms.

4) **Rescue and Emergency Response Capability** - There is no well-documented record of the historical use of the Tern Island airstrip for emergency evacuation of vessel crewmen. There were at least two

documented cases during Coast Guard occupation when injured crew from fishing vessels were taken to Honolulu. Others were treated by medical corpsmen at the LORAN station. Since FWS occupation in 1979, there have been three emergency evacuation flights involving vessel crewmen and one involving a FWS volunteer. With increasing numbers of fishermen, researchers and visitors associated with interpretive/educational excursions the need for emergency evacuation (and emergency medical treatment capability) will become increasingly important.

Costs of Operating Tern Island

As documented above, the Tern Island station performs critical functions in the attainment of objectives which span virtually all the objective categories identified in Section V of this document. However, those functions are not executed without significant costs to the FWS. Costs associated with the operation of the Tern Island station currently run on the order of \$150,000 per year, which covers staffing, logistical support and supplies. This represents about 50% of the total (\$305,000) O&M for the HINWR. Under the PREFERRED ALTERNATIVE, it is estimated that total refuge O&M costs would perhaps double. Assuming that Tern Island O&M remains more-or-less a fixed proportion of the total, Tern Island costs can also be expected to double to around \$300,000.

In addition to O&M costs, major rehabilitation of the seawall will be required in the near future. The seawall, which is composed of steel sheet piling, has deteriorated over the years from constant wave action and exposure. Options for rehabilitation of the seawall are currently under study. Other major rehabilitation projects for which costs have not yet been developed include the boat hoist, caterpillar generators, fuel tanks and runway. Costs are estimated to range between two and four million dollars--spread over the expected 20-year lifetime of the facilities.

Some of these costs might be defrayed if station management, operations and funding responsibility were shared with other agencies or organizations with interests in the NWHI. National Marine Fisheries Service, in particular, could play a greater role in this project, due to its expanding responsibilities for implementation of monk seal and turtle studies and management actions. The State of Hawaii, with its shared responsibility for fisheries and wildlife management, could also play a more involved role at Tern Island. The fishing industry could also share in the operation of the facility beyond the present level of support, in view of the existing and anticipated role that the station plays in support of fishery development.

It is clear that all these parties, and others less directly, benefit substantially from the continued operation of the station. Whether or not the benefits they derive, and the management responsibilities they share with the FWS, warrant greater administrative and financial

involvement is a matter for future discussion and negotiation. However, as part of the HINWR, activities at Tern Island will be dictated by the outcome of the Master Planning process and budgetary/staffing constraints, regardless of the degree of shared involvement by other agencies and organizations.

Operation of the HINWR without Tern Island

Vulnerable Species

In the event that severe budgetary cutbacks were to force abandonment of the Tern Island station, serious shortfalls could be expected with respect to each of the objectives discussed above. Principal shortfalls foreseen are as follows:

1) Vulnerable/Endemic Species - Research, monitoring and protective actions required to meet production and maintenance objectives for the monk seal could not be fully implemented under an abandonment option. Year-round monitoring of the seal population at FFS would not be possible and therefore any adverse changes to the population would not be quickly detectable. Additionally, inability to monitor the population year-round would result in voids in mortality and survivorship data. Research and monitoring teams would be unable to record this data during the winter months when sea conditions can make vessel landings extremely hazardous. Because the substantial majority of the seal population is found at FFS, recovery team personnel would likely continue to monitor the population at Tern Island during those months of the year when weather conditions were favorable to vessel landings. This would require more boat charters and extended field camps on Tern. Whether such measures would be sufficient to take corrective actions to halt factors adversely impacting the population is uncertain. What is certain it that without year-round monitoring, the risk to the population associated with a catastrophic event is increased and consequently the likelihood of satisfying stated production and maintenance objectives for this species declines.

The same line of reasoning applies to the threatened sea turtle population. Year-round monitoring permits an immediate response to potential inimical factors which might otherwise have devastating effects on the population. In the absence of aircraft, small boat support, lab facilities, electrical power, maintenance equipment, etc., some high priority research tasks for turtles, would be impacted. To the extent that such research contributes to our understanding of turtle growth, reproduction and habitat requirements, FWS objectives for increasing nesting populations would be negatively impacted. Field camps and vessel support could provide a partial substitute for present station facilities, but without efficient land-based facilities and support, studies such as turtle tracking studies, that require the use of elaborate radio equipment, would be difficult, if not impossible to

implement. Again, the voids that would be created in baseline population data would hinder development of effective management techniques and consequently impact our ability to reach stated objectives for the turtle.

Endemic Terrestrial Species

Without a manned station on Tern, FWS capability to prevent potential ecological disturbances on Laysan, Nihoa and Necker Islands would be seriously impaired. In the absence of any deterrent or response capability, illegal entries and accidental groundings would present a larger potential risk for introduction of harmful exotics to the Refuge. Consequently, recovery of the four endangered landbirds could be further jeopardized and unique endemic terrestrial forms be adversely impacted.

Seabirds

Under a Tern Island abandonment scenario, the comparative data on seabirds made possible by year-round monitoring would not be available, or at least not available to the same extent as at present. Comparative data on seabird populations from either end of the archipelago, and from a location near a midpoint in the archipelago have shed new light on population dynamics, reproductive patterns, migrational movements, etc. However, since available data would indicate that all seabird populations are in a healthy state (with the exception of the sensitive sooty storm-petrel), abandonment of Tern would likely not have any direct adverse impact on seabird populations. What would be affected is FWS capability to conduct research and monitor those populations for potential impacts associated with human activities.

Research Studies

Research and ecological monitoring are means to an end rather than an end in and of themselves. The multi-disciplinary research program in the NWHI and the extensive wildlife monitoring efforts of the FWS ultimately support objectives to either maintain or increase populations of key wildlife species. Without the Tern Island station, research and monitoring efforts would undoubtedly need to be scaled back. FWS and other agencies involved in research in the NWHI would likely seek other means for carrying on the critical research work, but what is and is not critical would depend on the availability of resources (dollars and staff) for conducting the research. The high cost involved in chartering vessels and conducting extended field camps could result in significant reductions in research over current levels. The precise impacts of such reductions on threatened and endangered species is uncertain; however, without basic research to clarify habitat requirements, reproductive cycles, intra-atoll movements, etc., FWS would be at a clear disadvantage in formulating effective management strategies to effect recovery of these species.

Public Use

Proposed visitation to Tern Island for photography, journalism and art (P/J/A) activities would not occur if the station was abandoned, except as space and funding allowed access via chartered vessels supporting field monitoring programs. The total effect would be that the vast majority of P/J/A activities including nature tours and environmental education programs proposed for Tern, would not be possible under this scenario. Unpredictable weather and wave conditions, landing safety hazards, long inter-island distances and conflicts of human activity on undisturbed HINWR islands would, together, prevent opportunities for nature tour/environmental education at HINWR locations other than Tern Island.

Commercial Fishing

Without the Tern Island station, FWS would be unable to provide any logistical support to the commercial fishing industry. However, this would likely not be a serious impediment to the development of commercial fishing in the NWHI, because the State's current proposal calls for a mothership operation that could function independently of any land-based facilities. While the mothership and catcher vessels could always encounter mechanical problems that might require transport of spare parts, these problems presumably would be taken into account beforehand by the fishing crews. Thus, if Tern Island were abandoned, the fishing industry would be forced to provide for its own needs with respect to vessel repair, medical evacuations and other emergency situations that might develop on the fishing grounds. (The reciprocal arrangement that currently exists between FWS and the fishing industry is of benefit to both parties. Fishermen assist the FWS in transporting supplies, equipment and personnel between Honolulu and Tern Island; FWS assists with radio communication, emergency equipment repair, transport of crews and spare parts as space allows aboard contract air carriers, etc.)

Costs Considerations Associated with Tern Island Abandonment

As noted above, abandoning Tern Island would not imply total elimination of costs associated with activities that Tern Island currently supports. Rather, the FWS would need to fall back to some basic level of monitoring and research that would, at a minimum, prevent extinction of threatened and endangered species. What this minimum would mean in terms of costs for charter vessels, field camps, etc., has not been calculated. However, if charter vessels and extended field camps were used to provide the same level of research and monitoring currently supported by Tern Island, costs for these "substitutes" are estimated to be significantly higher than the costs now incurred for the operation of Tern Island.

Other Implications of Station Abandonment

An argument can be made that reduced human activity within French Frigate Shoals resulting from abandonment of the Tern Island station would have beneficial effects on fish and wildlife populations. Management actions and research studies designed to assist in recovery of listed species or to maintain populations of other species are, in themselves, potentially disturbing to wildlife and habitat in the HINWR. Clearly, the risk of transplanted exotic plants, the disturbance to seals and turtles and the disruption of breeding seabird colonies all increase as the level of research on HINWR islands increases. Measures can and are being taken to minimize this effect, but it cannot be eliminated.

The dramatic repopulation of Tern Island by monk seals lends credence to the argument that human activities on hauling beaches has a significant effect on seal behavior. We can only speculate on whether or not this repopulation would have occurred at an even more dramatic rate had the station been abandoned when the Coast Guard left in 1979. Abandonment of the station at this point would only very gradually result in additional beach sites becoming available to seals and turtles. Expansion of seabird colonies onto the runway would also be gradual. It should be noted that virtually all, if not all, of the recent expansion of seabird and seal utilization of Tern Island is the result of movement from other islets at FFS. Whether or not the recolonization of Tern Island will ultimately result in increased total wildlife populations at FFS remains to be seen.

Conclusion

While the above analysis has identified the trade-offs associated with abandoning Tern Island, the clear "bottom line" in this discussion is the realization that human activities of all types in the HINWR must be rigorously evaluated to ensure that the benefits of that activity are compatible with refuge purposes and outweigh actual or potential adverse impacts. The integral role that the Tern Island station will play in the implementation of key strategies, in the judgement of the FWS, will outweigh the potentially adverse impacts that permanent human presence and associated research will have on fish and wildlife resources. Benefits associated with Tern Island include facilitating recovery efforts for the endangered monk seal and the threatened green sea turtle; continuing research/monitoring efforts on breeding seabirds; facilitating studies of unique floral and faunal forms; facilitating archaeological and/or historical surveys; providing increased opportunities for wildlife interpretation/education; and providing logistical support for commercial fishing.

However, if high priority objectives for listed species are achieved in the near future, the benefits and costs associated with the Tern Island

station operation would likely not favor its continuation. In this regard, considering that at this point in time and for at least the next five years, accomplishment of several high priority Refuge objectives is contingent on Tern Island, it is appropriate to continue operating Tern Island and pursue needed O&M and rehabilitation actions on Tern, including repair of the sheetpile seawall.

Comprehensive evaluation of the FWS' operation of Tern Island should occur in five years (and likely every subsequent five years of operation) to determine the appropriate FWS management role at Tern Island. Based on the outcome of the evaluation, appropriate management actions and Master Plan/EIS modifications would be made.

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**ENVIRONMENTAL
CONSEQUENCES**

Environmental Consequences

A. Introduction

The purpose of this section is to consider the anticipated environmental consequences likely to result from adoption and implementation of the Hawaiian Islands National Wildlife Refuge (HINWR) Master Plan. The consequences of various alternative plans are considered and compared. The format for this section follows that presented in Section III, Affected Environment (Physical, Biological and Social Environment). Only those aspects of the various alternatives that are expected to "significantly affect the human environment" both adversely and beneficially are considered in any detail. The anticipated consequences of the NO ACTION and BASELINE ALTERNATIVES are considered first and, by definition, are incorporated into the discussion of the other three "enhancement" alternatives. As the continued operation of the Tern Island facility is inherent to all alternatives, the significant environmental consequences of that operation are considered within the NO ACTION ALTERNATIVE (NAA).

Among the considerations taken into account in review of environmental consequences are the following: 1) when and where the effect will be felt; 2) the magnitude and significance of the effect; 3) the degree of certainty that the effect will occur; 4) the indirect or cumulative effects of the action; 5) the irreversibility of the effect; and 6) the possibilities to mitigate the effect. To develop this discussion, this section of the master plan draws heavily upon the results of previous field studies, including the results of recent Tripartite research in the Northwestern Hawaiian Islands (NWHI). The plan also draws upon information obtained through interviews and questionnaires addressed to knowledgeable and concerned individuals, representing themselves, agencies, and other organizations. Most notable among these sources of information were the FWS-contracted Tern Island Study (1979) and the Tripartite "Delphi" study (Miller and Davidson, 1983). Similar information was also gathered through responses to the Planning Update newsletter, interviews, meetings and workshops held as part of this planning process.

The prediction of environmental consequences is an inexact science. In the case of the HINWR, we find ourselves dealing in the gray area of "risk" when discussing topics such as the anticipated effects of increasing human activity on wildlife and the likelihood of vessel groundings associated with increasing boat traffic. Where pertinent data are available, they are cited, but it is apparent that as the plan is implemented and new data are gathered, the plan must be flexible and adaptable to reflect our developing perspective on resource management in the HINWR.

It is the opinion of the FWS, following a January 10, 1985 internal consultation under Section 7 of the Endangered Species Act of 1973, that adoption and implementation of any of the alternatives considered would

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promote conservation of the six species of endangered or threatened wildlife addressed in this Master Plan/EIS. Furthermore, the National Marine Fisheries Service (NMFS) conducted a separate biological consultation under Section 7 of the Endangered Species Act (NMFS shares responsibility for the management of threatened green sea turtle and endangered Hawaiian monk seal populations with the U.S. Fish and Wildlife Service) and has concluded that implementation of this revised, final Master Plan/EIS Preferred Alternative, provided it addresses modifications recommended by NMFS, is not likely to jeopardize the continued existence of the Hawaiian monk seal or the Hawaiian green sea turtle. (The two substantive modifications recommended by NMFS and incorporated into this revised, final Master Plan/EIS are: 1) eliminate from the Preferred Alternative, the strategy to provide recreational opportunity and storage space at Tern Island in support of a multi-species fishery; 2) add additional restrictions to the Preferred Alternative Strategy regarding photography, journalism and art opportunities on the refuge.)

B. No Action Alternative (NAA)

1. Physical Environment

A single, major project involving alteration of the physical environment is anticipated, but not likely to have a significant, long-term effect. Depending upon methods selected for the work, future shore protection at Tern Island could involve localized alteration of the reef within or adjacent to previously dredged areas to obtain fill material for the rehabilitation of the sea wall. This plan could involve enlargement of the dredged access channel or turning basin, which in turn, would have localized but insignificant effects on water circulation patterns around Tern Island. Periodic alteration of structures on Tern Island are not considered significant regarding manipulation of the natural physical environment.

No other manipulation of the physical environment of the HINWR is proposed under this alternative.

Projects under consideration by others involving the potential harvest of precious corals, manganese nodules or crust, or other deep sea mining activities are expected to occur well outside the HINWR boundaries. Such proposals would require comprehensive environmental evaluation by the appropriate sponsoring agencies and include FWS input if the proposals have potential to impact resources of the HINWR.

Preparation and implementation of an oil spill contingency plan (NAA #13) will enhance protection of Refuge water quality. The emergency mooring buoy at Tern Island (NAA #23) will provide additional protection to the reef by reducing the amount of indiscriminate anchoring. This and other logistical support will reduce the risk and subsequent effects of groundings, both at French Frigate Shoals and elsewhere in

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the HINWR. These actions combined will have an overall positive effect on water quality within and surrounding the Refuge, and ensure continued compliance with State of Hawaii Water Quality Standards.

While no direct effects on the physical environment are anticipated, the various strategies involving research and monitoring in the HINWR (NAA # 1, 2, 3 and 8) will continue to expand our understanding of physical processes and characteristics. As an example, aerial photography and surveys have and will continue to reveal information relating to the ocean circulation patterns, changes in the shape and size of sandy islets and other aspects of the physical environment.

2. Biological Environment

Strategies incorporated within the NO ACTION ALTERNATIVE are directed principally at the protection of the biological environment. With this in mind, it is not surprising that the most significant consequences of the various alternatives under consideration are anticipated to occur in this area.

Strategies under the NO ACTION ALTERNATIVE relating to "Vulnerable" species (NAA #1-6) are designed to result in the protection of habitat and, ultimately, the recovery of listed species and the maintenance of candidate and sensitive species populations. Based upon historic and recent trends, land bird species and the green sea turtle have the greatest potential for maintenance of existing populations and habitat through the implementation of these key strategies. The monk seal, having experienced a dramatic population decline in recent years, is in substantially greater jeopardy. Yet, the timely implementation of high priority research and management programs for the monk seal is anticipated to stabilize the population. As several proposed studies and management actions for seals and turtles will focus on the marine environment, other species will benefit indirectly as a result. Restricted access within atolls, in particular, will minimize disturbance to the nearshore marine environment.

Strategies under the "Environment" category (NAA #7-10) will have a mixed effect on terrestrial species. Cultural resource studies (NAA #7) have the potential of disturbing endangered land bird and seabird habitat on Nihoa and Necker Islands, but if adequately controlled, this disturbance will be minimal.

Overlay National Wildlife Refuge status at Midway Atoll (NAA #9) has been under consideration by the FWS for several years and is currently under review by the Navy. While not within the HINWR, Midway shares many fish and wildlife species in common with the Refuge. In addition, wildlife management and research projects underway or proposed at Midway contribute indirectly to the management of HINWR resources. Overlay NWR

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status will accomplish the following objectives relating specifically to NWHI biological resources: 1) recovery and maintenance of seabird populations and diversity (through effective predator control, disease control and habitat management); 2) gradual recovery of the depleted monk seal population; 3) maintenance and enhancement of wildlife habitat; 4) enhanced opportunity for long-term monitoring studies of fish and wildlife; 5) expanded technical assistance to the Navy; 6) more timely and efficient interagency coordination; 7) improved environmental education and interpretive opportunities for station residents and visitors; and 8) improved continuity of resource management programs. In addition, overlay status will facilitate the Navy in achieving full compliance with pertinent statutes, policies and directives relating to resource management.

Strategies to be implemented within the "Other Fish and Wildlife" and "Scientific/Professional Services" categories of the NO ACTION ALTERNATIVE (NAA# 11-19) will provide additional safeguards of considerable significance to both the terrestrial and marine biological environments. Seabird monitoring studies (NAA# 11), utilizing methods developed during Tripartite research, will enable detection of natural and human-related phenomena affecting status of population and habitat. Long-term monitoring at Tern Island will prove particularly important in this regard (NAA# 12). This work, in turn, may permit corrective action where appropriate. Researchers involved in these and other studies have the potential of, themselves, disturbing nesting species and transmitting seeds of exotic plants. Research protocol will address these potential impacts and reduce their significance. Studies to monitor human effects (NAA #18) will further enhance our ability to prevent and correct problems created by our own activities within and adjacent to the HINWR.

Completion and implementation of an effective oil spill contingency plan (NAA# 13) will result in enhanced protection for both terrestrial and marine species and their habitats. Particularly vulnerable to oil or other chemical spills are seabirds, seals and turtles. Logistical constraints and adverse ocean conditions will severely limit spill detection and response capability in the HINWR, but the contingency plan can address measures to react as effectively as possible. This alternative does not provide strategies to prevent or reduce the risk of spills, except to the extent that vessel activities within atolls will be limited by regulation.

As the NO ACTION ALTERNATIVE incorporates the continued operation of the Tern Island facility, the anticipated effects of that operation on the biological environment should be addressed. The Tern Island Study (1979) assessed the consequences of various alternatives for Tern Island, including a facility similar to that currently in operation and proposed under the NO ACTION ALTERNATIVE. This study predicted that a reduction of human activity after closure of the LORAN station would

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benefit seal, turtle and seabird populations at French Frigate Shoals, and Tern Island, in particular. After five years of station operation, this prediction appears, at least, partially true.

Monk seals: The number of monk seals utilizing Tern Island beaches during the last several years of Coast Guard occupation was not accurately recorded, but infrequent surveys rarely documented more than five seals on the Island. Since FWS occupation in July, 1979, beach counts at four day intervals have demonstrated a dramatic increase in use of Tern Island (See Table 4). That the rate of increase is leveling off during certain months of the year, may be an indicator that the Tern Island beaches may now be approaching a saturation level. No successful pupping has been documented at Tern Island, although stillborn pups were found in each of the last three years. As adult female seals demonstrate considerable site tenacity in pupping on other islets in the Shoals, it is reasonable to expect that successful pupping will occur at Tern Island in the future as young females without an established history of pupping on other islands reach reproductive maturity.

Table 4
Average Monthly Counts of Hawaiian Monk Seals
Utilizing Beaches on Tern Island

	1979	1980	1981	1982	1983	1984	Mean*
January		10.8	29.6	33.9	60.1	97.7	46.4
February		14.2	28.8	31.6	72.4	72.0	43.8
March		24.5	25.9	39.3	56.6	67.9	42.8
April		13.9	28.0	36.9	50.6	49.6	35.8
May		14.9	22.9	28.4	40.8	35.2	28.4
June		16.7	19.6	30.5	35.3	41.6	28.7
July	5.7	17.7	20.7	43.0	43.2	50.8	35.1
August	5.3	21.9	27.3	46.6	53.2	69.4	43.7
September	4.3	19.5	28.3	44.3	47.6	56.7	39.3
October	2.5	23.4	43.4	49.9	61.4	72.1	50.0
November	9.0	22.9	43.5	56.1	68.7	94.5	57.1
December	13.7	33.5	37.5	48.6	52.0	90.6	52.4

*Mean value is for 1980-1984.

While the beach count data reflects increasing use of Tern Island by seals, there is no evidence as yet that there has been a net increase in the total number of seals at French Frigate Shoals as a result of the new habitat now "available". Pup production and recruitment data for monk seals at French Frigate Shoals are not available before 1980, and reliably accurate data (based on marked pups) are only available for 1983. These data do indicate a range in pup production over this period

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of approximately 90-110 pups/year, but it is not certain whether the information reflects any actual trends.

Green turtles: French Frigate Shoals is the site of over 90% of all green sea turtle breeding in Hawaii (Balazs, 1980). Although East and Whale-Skate Islands are most important, Trig, Tern, Gin and Little Gin Islands are also used for nesting. From 1973 to 1978, nesting on Tern Island involved an estimated 3-7 females each year, while basking on shore was reportedly uncommon (Manta Corporation, 1979). By 1981, basking on Tern Island had increased noticeably, with one or more turtles recorded on nearly two-thirds of the beach surveys conducted. A turtle study conducted on Tern Island before the normal nesting peak in the summer of 1982 documented six active nesting pits (Sheekey, 1982). High site fidelity for nesting and basking turtles, as well as the lengthy growth period (over 50 years), make it likely that an actual net increase in population due to reduced disturbance at Tern Island would only be expected over a long time period.

Seabirds: As in the case of monk seals, data prior to FWS occupation of Tern Island do not provide a reliable basis for comparison. However, data recorded over the last five years have demonstrated a substantial (50-150%) increase in nesting populations of Laysan albatross, black-footed albatross, black noddies, red-footed boobies and sooty terns on Tern Island. Roosting populations of great frigatebirds have also increased substantially. Most of the increase appears to be the result of movement from other islets within the Shoals.

In summary, it can be said with certainty that wildlife have responded positively to the change in human activity and habitat at Tern Island that has occurred since FWS occupation of the station. For turtles, seals and seabirds, overall net increases in population are anticipated over time, as the total amount of desirable habitat has clearly increased. This positive response is expected to continue under the NO ACTION ALTERNATIVE and no conflicts with proposed strategies are contemplated. Some control of nesting birds, particularly sooty terns, may be necessary in the interest of safety for aircraft operations. This can be accomplished, for the most part, by preventing nesting rather than collecting eggs or adults, as was done periodically during Coast Guard occupation.

Strategies included in the "Education and Interpretation" category are not likely to directly affect the biological environment of the HINWR, as these actions will occur outside of HINWR lands and waters. However, the off-site strategies will significantly increase public awareness of the natural resources and management issues in the HINWR. This greater feel of awareness is likely to result in a broader base of support for management actions implemented to protect HINWR resources while, at the same time, increasing demand for access to the area. The proposed

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activities are fully compatible with resource management programs on the off-refuge sites considered for these strategies.

Strategies within the "Other Public Uses" category of the NO ACTION ALTERNATIVE are designed to accommodate legitimate on-refuge human activity while minimizing the adverse impacts of that activity. Recreational opportunity for personnel involved in authorized research and management will be located, timed and otherwise regulated in a manner that will virtually eliminate adverse impacts to terrestrial and marine resources (NAA# 22). Evidence of this fact has been the dramatic increase in use of Tern Island by monk seals, turtles and seabirds since mid-1979 when FWS refuge staff occupied the Island and unregulated access to the beach and nesting colonies ceased. Within-refuge recreational activities (NAA# 22) will be non-consumptive only, in keeping with management of biological resources in the HINWR principally for their ecological and research values. Continual monitoring studies of various wildlife species will permit an ongoing assessment of recreational impacts and permit timely change in activities if necessary.

Proposed logistical support for the NWHI commercial fishery (NAA# 23) will be a continuation of present support activities directed at reducing the incidence of groundings and providing reciprocal support of HINWR operations (including station support and research). Both terrestrial and marine biological resources will benefit directly. It is not anticipated that this level of support will result in a greater number of vessels operating in the NWHI than would be the case without the support, but it will make the ongoing operations safer, more cost-effective and subject to less risk. Monitoring the effects of this activity on marine resources, in particular, (NAA #24) may result in some future modification of the fishery support program, in the interest of preventing adverse impacts.

3. Social Environment

Archaeological resources of the HINWR will derive additional protection through implementation of contracted field studies, expected to result in State and National Register nomination and subsequent projects to maintain and restore, where appropriate, these unique sites (NAA #7).

Other strategies which limit access of visitors to Nihoa and Necker (NAA #1, 4 and 12) will enhance protection for cultural resources. Strategies resulting in greater public awareness of HINWR resources (NAA #5, 20 and 21) will increase support for refuge programs, but will also stimulate greater demand for access to cultural sites and may increase the risk of unauthorized landings and possibly vandalism of some sites. The risks associated with these unauthorized landings

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can be minimized, to some degree, by the manner in which the educational message is transmitted and through the monitoring and enforcement of refuge access regulations during scheduled research visits to these islands and during FWS or Coast Guard overflights. Strategies under this alternative would not specifically address historical (post-European contact) resources on the HINWR, although strategies that seek to maintain conditions in terrestrial habitat or limit access will provide some degree of protection for these resources. No actions are planned that would alter known historical resources, with the exception of shore protection project under consideration at Tern Island.

Educational opportunity is addressed specifically in NO ACTION ALTERNATIVE strategies #20 and 21, although the focus of these strategies is off-refuge. There will be a substantial increase in the public's indirect exposure to refuge resources through this program, but existing and/or latent demand for educational opportunity within the Refuge will not be met. The exception to that rule will be those research projects that are judged compatible with other Refuge management objectives. Pursuant to Research Natural Area status and in support of resource monitoring objectives, approved research would be encouraged on HINWR lands and waters (NAA #1, 2, 6, 7, 8, 11, 16, 17, and 18). Facilities at Tern Island can support a level of continuing research comparable to that which occurred during the Tripartite program. Current Refuge policy limits extended on-site occupation at Tern Island to 10 people, including Refuge staff(4), based upon a 1982 Section 7 Endangered Species Act evaluation of Refuge programs by NMFS and FWS. Field camp limitations on other HINWR islands have been and will continue to be even more restrictive due to conflicts with other resource management objectives and the absence of living facilities.

On-site recreational opportunity for the general public will not be permitted in these or other strategies. Some will view the limited "selective" recreational opportunity for Refuge staff and approved visitors as unfair and unresponsive to public demand. Yet, the proposed recreational opportunity for station personnel on the site for other management related purposes is considered appropriate in adjusting to a remote, isolated existence. Furthermore, expressed demand for recreational access by the general public has been very limited and infrequent, in part due to the great distance from population centers, difficulties and high costs in reaching Refuge areas and limited on-site support capabilities. When considered together with other factors (e.g. anticipated conflicts with higher priority outputs, limitations in FWS staff/funding, and inherent safety hazards in remote island activities), the FWS has determined that the provision of public recreational opportunity will not be incorporated into the NO ACTION ALTERNATIVE.

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Economic data concerning recent FWS funding of the Hawaiian and Pacific Islands National Wildlife Refuge Complex, and the share devoted to the HINWR, are presented in Section III. Between FY 80-84, annual FWS funding attributable to the HINWR grew from approximately \$235,000 to \$305,000. Within that figure, direct costs for Tern Island are approximately \$150,000 (includes Tern Island staff salaries and travel, contracted air/vessel support, and other operational expenses). This figure does not include projected major rehabilitation costs. HINWR costs beyond that directly attributable to Tern Island include staff salaries (management, biological, administrative), travel, field supplies, contracted vessel support, and a share of general office overhead.

In addition to this funding, other agencies with shared resource management responsibilities in the HINWR have expended and are expected to continue expenditure of funds for their programs. Most notable in this regard has been the NMFS research program for seals and turtles. NMFS funding to address high priority recovery objectives for these species has varied between \$300,000-\$400,000/year in the recent past. Finally, it is worthy of note that the National Weather Service has expended approximately \$10,000-15,000/year in the operation and maintenance of a remote weather station at Tern Island.

FWS funding under the NAA would likely remain in the \$300,000-310,000 range over a 10-year planning period with appropriate adjustments required for inflation. NMFS and National Weather Service funding are expected to remain the same as in the current year.

The economic consequences to the fishing industry resulting from continuation of the NO ACTION ALTERNATIVE are difficult to predict. While the State of Hawaii has asserted that land-based support at Tern Island is desirable for the expansion of the NWHI fishing industry, those fishermen currently fishing in the NWHI are generally satisfied with the current level of logistical support provided by the FWS (and proposed to continue in the NO ACTION ALTERNATIVE). Furthermore, the economic projections associated with an expanded fishery in the NWHI are subject to considerable debate (HFDP, 1979; Miller and Davidson, 1983). The NO ACTION ALTERNATIVE will not prevent entry into the NWHI fishery beyond those limits established by the State, Western Pacific Regional Fishery Management Council, or other authorities, of other vessels similar to those presently involved. However, the limited market for frozen fish may be a critical deterrent to an expanded fishery. The NO ACTION ALTERNATIVE will preclude fishing for bait and other species within lagoon waters, thus preventing what economic gain may be associated with this fishery of questionable magnitude. The NO ACTION ALTERNATIVE will not prevent implementation of mothership (multi-species) fishery, as the proposed mooring buoy could be installed outside the Refuge boundary or the project could be initiated in the absence of a mooring buoy. In some respects, the

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latter option has greater merit than a fixed location for the mothership anyway, as it would shorten the running time for catcher vessels working a distant fishery and reduce the risks that fuel spills, groundings and nearshore vessel traffic would have on wildlife resources in the Refuge.

The NO ACTION ALTERNATIVE will address "other social considerations" to the extent that various strategies satisfy that component of the general public intensely concerned about the long term protection of unique fish and wildlife resources of the HINWR. In addition, strategies which address the special needs of extended residents will enhance the quality of their experience, improve the quality of their contribution and increase their personal safety and efficiency.

C. Baseline Alternative (BA)

As described in the introduction to Section VI, the BASELINE ALTERNATIVE (BA) builds upon and incorporates all of the strategies included in the NO ACTION ALTERNATIVE. In this regard, all of the anticipated environmental consequences described in the NO ACTION ALTERNATIVE should be considered a part of the BASELINE ALTERNATIVE consequences as well. To eliminate duplication, these have not been repeated in the discussion that follows. Only those anticipated environmental consequences associated with the BASELINE ALTERNATIVE that are not already included in the NO ACTION ALTERNATIVE are discussed below.

1. Physical Environment

Only one strategy associated with the BASELINE ALTERNATIVE is likely to have a localized effect on natural physical processes of the HINWR. BA #1 involves measures to physically retard the movement of sand into the Laysan lagoon to preserve Laysan duck habitat. These measures consist of installation of a "snowdrift" type fence on Laysan Island to control the movement of wind-blown sand into Laysan Lagoon. No other manipulation of the physical environment of the HINWR is proposed in the BASELINE ALTERNATIVE.

Designation of emergent lands as Wilderness will provide additional safeguards against adverse land-based actions. The Marine Sanctuary option, if implemented after future review, could extend controls over projects altering the physical environment well beyond Refuge boundaries and further enhance protection of water quality.

2. Biological Environment

Additional effort directed toward priority research and management actions associated with recovery plans will enhance achievement of recovery plan objectives. More frequent and systematic monitoring

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visits will enhance protection of listed, candidate and sensitive species and "other fish and wildlife" from harmful exotics.

Wilderness designation of emergent lands (BA #4) will enhance protection for terrestrial species and habitat and will increase public awareness of these areas. The effect of resolving the boundary dispute (NAA #10) will depend on the result. If the FWS boundary, as presently managed, is upheld, potentially conflicting nearshore fishery activities are less likely to occur within HINWR atolls, providing a greater degree of protection for seal, turtle and seabird populations. Land bird populations would not likely be affected, regardless of the boundary dispute outcome, as nearshore fisheries are not under serious consideration in disputed waters at Laysan Island and nearshore waters at Nihoa Island are not in dispute.

3. Social Environment

While not directly related to HINWR management, development of effective environmental education and interpretive materials for Midway and Kure atolls (BA #9) will enhance resource management programs on these areas, which share in common many of the fish and wildlife species found in the HINWR.

Over a 10 year planning period, excluding projected major rehabilitation costs at Tern Island, FWS expenditures necessary to implement the BASELINE ALTERNATIVE for the HINWR are expected to average approximately \$350-375,000/year. This represents an approximate 20-25% increase over current year funding (\$305,000). NMFS expenditures relating to monk seals and turtles in the HINWR are expected to average about the same as in the current year (\$300,000/year). Additional researchers involved in HINWR projects are likely to expend between \$100,000-150,000/year, given anticipated opportunities for logistical support. Finally, the National Weather Service operation at Tern Island is expected to continue at approximately \$10,000-15,000/year. The indirect multiplier effects of these expenditures are likely to be felt almost exclusively within the State of Hawaii. There is a limited opportunity for reduced FWS and other agency expenditure through improved coordination in scheduling of various activities within the HINWR, reciprocal support with the fishing industry, expanded participation in refuge research/management programs by non-federal parties and the expanded use of volunteer labor.

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D. Resource Preservation Alternative (RPA)

1. Physical Environment

No additional strategies with direct impacts on the physical environment are included within the RPA. Additional protective designation for HINWR lands and waters (RPA #4, 5 and 7) will provide additional safeguards against activities that may adversely alter the physical environment. There is also a possibility that such designation would complicate or even preclude some projects (e.g. shore protection and dredging at Tern Island) due to restrictions in activities inherent in these forms of protective status. This problem could be avoided by excluding those areas likely to be affected from such designation.

RPA strategies relating to the regulation and monitoring of nearshore vessel traffic (#1, 9 and 15) are expected to substantially reduce the risk of vessel groundings and their associated effects on the physical environment, particularly water quality. These RPA strategies will ensure compliance with State of Hawaii Water Quality Standards. Expanded monitoring studies, particularly those projects involving aerial photography and mapping (RPA #10, 11 and 12), will contribute additional information pertaining to the characteristics and status of the physical environment. Opportunities for geological and oceanographic studies will increase, in coordination with other research programs.

Installation of a fishery mooring buoy outside the Refuge boundary, in the absence of additional logistical support on Tern Island, is not expected to result in significant impacts on the physical environment under this alternative. Measures to regulate and monitor nearshore vessel activity are expected to offset any increased risk of groundings attributable to an increase of fishing effort associated with use of the mooring buoy. Furthermore, use of the buoy will, itself, reduce the risk of groundings in the French Frigate Shoals area and limit the physical impact to the reef associated with indiscriminate anchoring.

2. Biological Environment

The principal emphasis of the RESOURCE PRESERVATION ALTERNATIVE (RPA) is the preservation of the rich biological resources of the HINWR. Virtually all of the additional strategies proposed in the RPA provide a greater degree of protection or means to improve the management of these resources through a more intensive data-gathering effort.

Strategies to regulate and monitor nearshore vessel traffic (RPA #1, 9 and 15) will be implemented almost exclusively outside the HINWR boundary and, hence, will require extensive cooperation and coordination with other agencies and industry. It is anticipated that this program will significantly reduce the risk and adverse effects of vessel groundings in the HINWR. Additional strategies specifically

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relating to "vulnerable" species (RPA #2 and 3) will help maintain their populations and promote recovery where appropriate. RPA strategy #3 provides for the transplantation of endangered land birds to other HINWR islands as a buffer against possible extinction on the islands to which they are endemic.

RPA strategies in the "Environment" category (#4-7) provide additional layers of protective status and recognition to the HINWR and its biological resources. Most notably, these strategies go beyond the NO ACTION and BASELINE ALTERNATIVES to effectively address the marine environment in the NWHI. Critical habitat designation for endangered terrestrial species will provide greater protection and recognition for these habitats, but it is not expected to affect proposed management programs. It will preclude any future activities that "adversely modify" terrestrial habitat on Nihoa, Laysan and Pearl and Hermes Reef (transplanted Laysan finch population), as these activities can occur only by FWS permit. Designated critical habitat for monk seals and turtles would also include nearshore habitats around other HINWR islands. Although FWS prefers the 20-fathom contour for monk seal critical habitat, the final determination is a NMFS responsibility. Both the 10 and 20 fathom critical habitat boundaries would extend protection of monk seal habitat beyond the present HINWR boundary. The other forms of additional protective designation included in RPA strategy #5 (world heritage site, biosphere reserve and national natural landmark) will provide substantially greater national and international recognition for biological resources of the HINWR.

RPA strategy #6 differs from the BASELINE ALTERNATIVE in that it includes nearshore waters of the HINWR into the formal Wilderness proposal. As these waters have been and will continue to be managed as de facto wilderness (pursuant to Refuge policy), this strategy seeks to formalize this protective designation and recognition without resulting in a substantive change in Refuge programs. Greater consistency and longevity in protection of nearshore resources is anticipated as a result.

RPA strategies relating to the "Other Fish and Wildlife" category focus on the gathering of additional management data beyond that possible under the NO ACTION and BASELINE ALTERNATIVES. RPA strategy #8 addresses disease in HINWR seabird populations as a condition that should be monitored and controlled, where appropriate and feasible. Monitoring of the incidence and severity of disease will facilitate determination of the effects of other human-related factors, such as a depletion of food supply related to localized overfishing. RPA strategy #10 addresses those terrestrial species (plants and invertebrates) that are covered only to a minimal extent in the NO ACTION ALTERNATIVE and have been poorly studied to date. Future studies directed at these species are expected to produce results that benefit other terrestrial species, including endangered land birds. As an

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example, ongoing studies of insect fauna associated with the Laysan Island lagoon are contributing data useful to the Laysan duck management program. These terrestrial studies will also indirectly contribute information relating to the status of exotic species, facilitating early management and control, where appropriate. Mapping and ground truthing of the marine and terrestrial habitats (RPA #11) will facilitate management of fish and wildlife species, enhance our ability to detect environmental change and assess the results of management programs.

RPA strategies in the "Scientific and Professional Services" category simply highlight basic methodology for implementing the key research and management studies and projects covered elsewhere in this alternative. Particularly relevant in the assessment of environmental consequences is RPA strategy #13. Extended field camps are absolutely necessary for the efficient gathering of life history and population data on key species, but these visits do not occur without their own associated impacts on the biological environment. With each visit, and particularly with surveys that visit several HINWR islands, comes the risk of introduction and translocation of various exotic plants and insects. This problem will be mitigated through rigorous enforcement of protective measures to inspect for and remove seeds and insects from personal clothing and equipment.

Researchers in extended camps may also disturb terrestrial wildlife and have the potential to inhibit productivity in key species. Of particular concern, based upon historic data for occupied islands, is the effect that human presence can have on the hauling and pupping patterns of monk seals. The dramatic increase in seal use of Tern Island beaches over the last five years demonstrates that rigorous controls on human beach access are effective in mitigating or eliminating disturbance on this island, at least. Researchers may also impact seabird productivity by disturbance to nesting birds, crushing of nesting burrows, losses of eggs and chicks when attending birds are flushed (predation by finches or heat stress when exposed to the sun). These impacts can also be minimized by proper scheduling of camps and activities within the colonies, establishment of suitable access trails and absolute restrictions on access to particularly sensitive areas. Overall, it is anticipated that extended field camps will cause limited disturbance to wildlife and their habitat but that this disturbance can be minimized to the point where the benefits of this field work substantially outweigh the adverse impacts. In addition, the presence of Refuge staff and other authorized researchers on HINWR islands acts as a deterrent to illegal entry and enables the detection and more timely response to resource problems which arise.

RPA strategy #14 adds Kure and Midway to the HINWR areas where monitoring studies are proposed to continue. Given the history of human activities on these islands, additional studies are not likely to

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adversely impact biological resources if these studies are properly planned and coordinated with resource managers and military personnel. Comparative data generated by these studies will improve resource management programs both on these islands and in the HINWR.

In the "Other Public Uses" category, the RESOURCE PRESERVATION ALTERNATIVE does not differ appreciably from the BASELINE ALTERNATIVE. Regulation and monitoring of nearshore vessel traffic (RPA #15) is highlighted here as it is directly pertinent to anticipated increases in commercial fishing activities in the vicinity of the HINWR. RPA strategy #16 addresses the State's proposal for a multi-species fishery mooring buoy at French Frigate Shoals but recommends that it be placed outside the Refuge boundary. It is anticipated that these measures will facilitate commercial fishery development in a manner that will not seriously jeopardize HINWR biological resources.

3. Social Environment

Cultural resources of the HINWR are addressed directly in this alternative by RPA strategy #7. This strategy extends beyond the NO ACTION ALTERNATIVE to include historical as well as archaeological resources in a program of survey, assessment, management planning, protection and, potentially, restoration or salvage. The principal threat to the historical resources is natural deterioration as no significant alteration of the terrestrial or marine areas of the HINWR is contemplated (other than shore protection at Tern Island and dune stabilization at Laysan Island). While the location and timing of historic events on HINWR lands and waters is generally known, the status and condition of cultural resources and sites that remain from those events is only poorly documented. This strategy would address that shortcoming. Other strategies that provided additional layers of protective status and recognition (RPA # 4, 5 and 6) are also compatible with the intent of long-term security for important historical resources.

Clearly, the opportunity for monitoring studies (RPA # 14), at Midway and Kure is directly dependent upon the cooperation of the land managing agencies involved at these two sites. It is the FWS opinion that a modest expansion of research programs, particularly at Midway, could occur without adverse impact on military programs or the biological resources found on these sites. Research opportunity, beyond that in the NO ACTION and BASELINE ALTERNATIVES, is found in RPA strategies #2, 3, 7-15. Emphasis would continue to be placed on studies expected to yield management-related data, with highest priority directed at "vulnerable" species. Strategies to insure long-term protection and international recognition (RPA # 4-7) would insure perpetuation of research opportunity and attract considerable interest among the research community.

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Recreational opportunity is not specifically addressed in the RPA beyond that provided specifically for Tern Island residents (NAA #22).

From an economic perspective, direct cost to implement the RESOURCE PRESERVATION ALTERNATIVE will be substantially higher than the NO ACTION ALTERNATIVE or the BASELINE ALTERNATIVE. The majority of the additional cost can be attributed to additional studies and management programs proposed for this alternative. On an annual basis, these studies alone are likely to add \$100,000-200,000/year to the BASELINE ALTERNATIVE estimated total of \$350,000-375,000. Within these figures there is considerable room for savings to be gained by involvement of the fishing industry (logistical support) and other parties (university researchers, volunteers, etc.).

The cost of implementing RPA strategy #1 (regulation and monitoring of nearshore vessel traffic) will be dependent upon the specific actions implemented after interagency and industry review. None of the actions proposed for consideration is anticipated to add substantially to the "cost of doing business" in the NWHI, with the possible exception of radar targets at specific sites. If the program reduces the risk of groundings, as expected, lowered insurance rates, reduced cost of rescue operations, and other savings would offset any additional costs of the regulation/monitoring program.

The economic effects of the RESOURCE PRESERVATION ALTERNATIVE on the fishing industry are not likely to differ appreciably from those associated with the BASELINE ALTERNATIVE. None of the strategies to add protective status to the HINWR or neighboring waters (RPA #4-7) are expected to result in additional restrictions on fishery activities beyond those already imposed by the HINWR management program. Proposed expansion of research activity will result in increased contracting of local fishing vessels, as has occurred in recent years. Additional costs incurred by the proposed mothership fishery due to regulations preventing use of a buoy within French Frigate Shoals, if any, would be identical to the BASELINE ALTERNATIVE.

E. Resource Utilization Alternative (RUA)

1. Physical Environment

There are no activities proposed in the RUA that will involve direct manipulation of the physical environment of the HINWR that are not also included in the RESOURCE PRESERVATION ALTERNATIVE (RPA). However, the RUA will significantly increase the frequency and magnitude of vessel traffic within the HINWR at French Frigate Shoals, in support of the proposed multi-species mothership fishery (RUA # 10). Regular use of a mooring buoy well within the Refuge will increase the risk of groundings and pollution of lagoon waters with fuel, sewage and garbage. Even in

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the period of less than one year that an emergency mooring buoy has been utilized within this lagoon, there has been at least one incident in which the buoy and 6000 lb. anchor were dragged a mile or more in heavy seas. Routine inspection as well as regulation and monitoring of the mooring buoy will reduce the potential for this type of incident to re-occur. The proximity of the proposed multi-species mooring site to shallow reefs and islets increases the risk of a grounding incident. Regulations to prevent dumping of fuel and wastes would be employed, but they cannot be enforced at all times by Refuge staff on Tern Island.

To the extent that the mooring buoy within the Refuge facilitates an expanded fishery near the islands and atolls west of French Frigate Shoals, the risk of vessel groundings will increase as well. This will be particularly true if the new fishery attracts new vessels with skippers and crews unfamiliar with waters of the MWHI. As the RUA deletes the proposal to regulate nearshore vessel traffic and includes only monitoring (RUA # 1, 9), the risks associated with the expanding fishery will not be fully addressed. Monitoring of vessel activity, in itself, will probably do little to reduce the risk of groundings, but it will facilitate timely response. Incidents such as groundings and oil spills could be catastrophic to Refuge resources. Furthermore, the likelihood of occasional noncompliance with State of Hawaii Water Quality Standards would increase.

2. Biological Resources

The principal differences between the RPA and RUA are found in their anticipated effects on biological resources of the HINWR and adjacent waters. As they relate to "Vulnerable" species, the RPA and RUA differ in the emphasis they place on research and management actions of secondary priority in recovery plans. Dropping the emphasis on vessel regulation (RUA # 1) in nearshore waters will increase the risk of vessel groundings and its associated effects on the terrestrial and marine biological environment. In particular, the risk of fuel pollution and rodent introduction increases. RUA strategies #2 and #5 (monitoring impacts of fishery on "vulnerable" species and "other fish and wildlife") seek to mitigate, where possible, the associated impacts of expanded fishery development. Yet, pertinent information gathered for all but the most obvious incidents of conflict (e.g. seals in traps and oiled birds) will be difficult to interpret and draw cause-and-effect relationships.

With the exception of those types of status (emergent lands in Wilderness, and National Historic Site designation for archaeological sites) contained in the BASELINE ALTERNATIVE, the RUA drops all the various types of protective designation included in the RPA. This, in turn, eliminates the additional protection and national/international recognition such designation would provide for

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terrestrial and marine resources of the HINWR (e.g. improved continuity of programs, expanded research interest, other funding sources, and greater public awareness).

In contrast to the RPA, the RUA addresses the small, but established, demand to visit sites of archaeological significance in the HINWR for religious purposes (RUA #4). Such visitation may conflict with management programs to protect terrestrial and marine species (particularly monk seals) from disturbance. This conflict can be mitigated by proper scheduling of visits, involvement of Refuge management and research staff, and strict limitations on visitor activities while on the islands (principally Nihoa and Necker). Means will have to be developed to evaluate the likely number and impacts of religious visits and to accommodate unexpectedly high demand if it occurs. Such visitation may need to be controlled or even eliminated if such a program cannot be implemented with minimal disturbance to wildlife and habitat.

In the area of "Education and Interpretation", the RUA will increase visitation to HINWR islands and atolls, particularly Tern Island (RUA #7, 8). Such public use is expected to produce resource benefits in the form of significantly greater public awareness and understanding of HINWR wildlife and conservation programs. Impacts on biological resources can be minimized through strict supervision and proper scheduling of activities, but these impacts cannot be totally eliminated. The effects of this activity on wildlife (e.g. breeding productivity, distribution patterns, etc.) can be monitored and the activities modified or curtailed as needed. These activities can be scheduled to minimize conflicts with ongoing or proposed research projects.

The principal difference between the RPA and RUA in the area of "other public uses" is the location of the proposed multi-species fishery mooring buoy. Under the RPA, the buoy inside the Refuge boundary is to be placed within 2 miles of Tern Island and used for emergencies only. Under the RUA, this or another buoy at the same site will be used for support of the proposed multi-species fishery operation as well as for emergency use. The significant increase in vessel activity within the atoll will increase the risk of groundings on adjacent reefs, will result in more frequent pollution of lagoon waters (fuel, garbage, sewage) and will increase disturbance of Refuge wildlife in the vicinity. Observers on commercial fishing and research vessels anchored in the NWHI have noted the attraction of turtle hatchlings to lights. Coston-Clements and Hoss (1983) report the attraction of hatchlings to lighted structures at sea and describe the disorientation that can result from artificial illumination. Fishermen in the NWHI routinely report the presence of seals around their vessels at night speculating they are attracted by lights and fish. This may prove particularly

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significant during the period of the year when newly weaned seal pups and turtle hatchlings are most prevalent within the atoll. These impacts can be mitigated through enforcement of strict regulations on vessel activities (fuel transfer, dumping of sewage/solid waste, light pollution), but this enforcement will not be a simple task for Refuge staff based at Tern Island.

The multi-species mooring buoy proposal in the RUA also includes the associated use of Tern Island for temporary storage of some equipment and for recreational use by vessel crews. Such use will significantly increase the frequency of small boat traffic in and out of the entrance channel to Tern Island. Disturbance of wildlife on and adjacent to Tern Island will also increase. These impacts can be reduced but not eliminated by scheduling and prioritizing of activities on the Island.

3. Social Environment

With respect to cultural resources, the RUA will differ from the RPA in its deletion of historical site surveys and possible formal nomination procedures (RPA #7). Other forms of protective status included in the RPA will also be deleted from the RUA, thereby reducing what additional protection and recognition they provide for cultural resources in the HINWR. The RUA does provide for limited visitation to archaeological sites for religious purposes (RUA #4). Providing such use can be supervised sufficiently to prevent disturbance to these resources, this visitation can provide greater understanding and overall public support for the continued protection of these unique sites.

The RUA addresses the public demand for education and recreational access to the HINWR, but does so at a very limited level to ensure compatibility with higher priority resource management objectives. Tern Island and French Frigate Shoals become the focal point for such use. Under this program, educational/recreational opportunity will be limited to those non-consumptive wildlife oriented pursuits (nature study, birding, wildlife photography, journalism, art, and snorkeling) that can be accommodated with a minimum of impact to wildlife, habitat and support facilities. This use will have to be entirely self-supporting, including the additional costs associated with its supervision and support by Refuge staff.

While the HINWR would retain its existing Research Natural Area status under all alternatives, actual opportunity for research would be substantially less under the RUA than under the RPA. Several research and monitoring strategies relating to "vulnerable" species and "other fish and wildlife" would be omitted in the RUA. Also, the additional forms of site recognition and status proposed under the RPA (# 4-7) would not be included in the RUA, resulting in less assurance of research opportunity over the long-term.

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Direct economic cost to the federal government of implementing the RUA will be greater than the BASELINE ALTERNATIVE but significantly less than the RPA. Principal reductions in cost will be found in the lower emphasis on second priority "vulnerable" species research, the absence of regulatory controls on nearshore fisheries (RPA #1) and the reduced frequency of aerial surveys (RPA #12). All strategies relating to other public uses of the Refuge (multi-species fishery buoy/support, and educational programs on Tern Island) should be self-supporting. In the case of fishery programs, this should include any additional research, monitoring and enforcement activity implemented specifically to address the impacts of fishery activities. Additional savings to the government can be realized by a cost sharing arrangement with the fishing industry for the Tern Island operation, in return for the support provided by the FWS. Expanded vessel activities relating to a mothership fishery can also result in savings in supply of the Tern Island station and in support of field camps on other islands.

It is beyond the scope of this plan to address the economic implications of the proposed multi-species mothership fishery to the industry itself. Suffice it to say that there is considerable debate regarding the economic potential of the proposed multi-species mothership fishery. This topic is currently under study by the State of Hawaii in the same manner that the Midway albacore fishery station proposal was evaluated. Part of the problem inherent in this evaluation is the wide disparity in predicted resource availability characteristic of a fishery with limited resource assessment data and a very short track record. As it relates to the HINWR, it will be appropriate in future analysis of the fishery to clearly elucidate the difference in economic picture when proposed fisheries independent of the Refuge are compared to the same fishery with Refuge involvement (e.g. logistical support, mooring buoys, land based facilities, etc.). In a plan published as Tripartite studies were just underway, fishery support facilities in the NWHI were considered fundamental to the successful economic exploitation of NWHI fisheries (HFDP, 1979). In contrast, it was the general conclusion of "experts" evaluating NWHI fishery alternatives in a more recent study that the expected revenues projected from fishery development facilities in the NWHI (specifically Tern and Midway) are not large enough to offset adverse wildlife impacts (Miller and Davidson, 1983).

Implementation of the RESOURCE UTILIZATION ALTERNATIVE will, in contrast to the RPA, provide opportunity for at least some of the general public to directly experience the aesthetic beauty of the HINWR (RUA #7 and 8). In addition, the support of supervised photography, journalism and art (P/J/A) visits into the refuge will have secondary benefits in the greater number of photographs, films, articles, paintings and other types of media relating to the HINWR to which the general public will be exposed. The greater frequency of visitation to Tern

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Island in the RUA as opposed to the RPA has mixed implications for the resident staff on the Island. The degree of isolation and personal privacy will diminish, a fact that will be viewed by some as positive, by others as undesirable. The work load of resident staff will increase in support and administration of public visitation and commercial fishery operations associated with the mothership buoy. Additional permanent or volunteer staff may be required.

F. FWS' Preferred Alternative (PA)

1. Physical Environment

Anticipated effects of the FWS' PREFERRED ALTERNATIVE (PA) on the physical environment are virtually identical to those attributable to the RESOURCE PRESERVATION ALTERNATIVE (RPA).

2. Biological Environment

As the primary purpose of the HINWR is the protection of its biological resources, it is not surprising that the anticipated effects of implementing the PA on the biological environment most closely resemble those attributable to the RPA. They differ mostly in degree of protection afforded.

As it relates to the "vulnerable" species, the PA shares the strategies in the RPA, except that the project relating to preservation of endangered land birds under the PA would not include transplantation to other HINWR islands except under compelling circumstances. The purpose of captive propagation would be to enhance or restore populations on their native islands only. This approach will avoid the potential ecological problems attributable to introducing species or subspecies to habitats in which they were not found naturally. Also avoided will be the issue of whether or not it is appropriate to alter patterns of "natural" species distribution within a Research Natural Area. This approach does not provide the absolute safeguards against extinction that a widespread transplantation program would.

In the "Environment" category, additional protective designation (world heritage site, biosphere reserve, natural landmark) for the entire HINWR and for its waters (wilderness) would await further study and evaluation. This is, in effect, a compromise that acknowledges the fact that these types of designation may increase the protection of HINWR resources, but not without some potential drawbacks (e.g. limited management options) that should be seriously considered. Each type of designation would involve its own nomination and review process, with opportunity for further public and agency review. This approach would not adversely effect the level of protection currently provided biological resources in the HINWR.

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The overlay national wildlife refuge proposal for Midway (NAA #9) is retained in the PA as it contributes to the protection of HINWR fish and wildlife resources while improving the management of Midway's wildlife simultaneously. The resource values attributable to the overlay NWR are addressed in discussion of the NAA.

The PA includes a cultural site access strategy (PA #9) in common with the RUA. Properly managed, this type of public access opportunity can increase interest and awareness in the HINWR without adversely impacting biological resources.

In addressing the "Other Fish and Wildlife" category of outputs, the PA strategies are virtually identical to those in the RPA. An additional strategy (PA #14) in common with the RUA is included to monitor effects of commercial fishery activities on these species. The strategy is singled out for this group, as research direction for these species is not found in recovery plans or other related documents. Monitoring for effects likely to be attributable to fishery activities will provide a basis for updating strategies such as those in RPA #1 so as to remain responsive to HINWR management objectives. Depending upon the results of such monitoring, regulations or programs such as those in RPA #1, to minimize the adverse effect of the fishery may be relaxed, strengthened or left alone.

As above, the "Scientific and Professional Services" category of strategies for the PA draws from both the RPA and RUA. The PA calls for biannual aerial surveys and extended field camps to implement research and monitoring strategies addressed above. The PA also addresses the need for comparative monitoring studies on Midway and Kure (PA #17). The rationale and environmental consequences of these strategies are addressed in more depth in the discussion of the RPA.

In the "Education and Interpretation" category, the PA draws heavily from the RUA to provide limited and strictly controlled P/J/A visits to the Refuge and conduct limited nature tours and environmental education programs.

The PA strategies for "Other Public Uses" draw principally from the RPA. These strategies are expected to reduce the risk of groundings, spills, pollution and direct disturbance of wildlife when compared to a fishery mooring buoy close to Tern Island, as in the RUA.

3. Social Environment

As it pertains to cultural resources of the HINWR, the FWS' PREFERRED ALTERNATIVE draws on strategies from both the RPA and RUA. Included will be both historical survey and site nomination (PA #8) and limited religious access to cultural sites (PA #9). These strategies will lead to greater protection and general public awareness of these resources.

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Strategies that result in additional protective status will also contribute to long-term security for cultural resources (PA #5-7).

Opportunity to conduct research within the HINWR under the PREFERRED ALTERNATIVE is not substantially different from that possible under the RPA or RUA. Specific strategies addressing research needs include PA # 2, 3, 8, and 10-17. Support provided the commercial fishing industry at Tern Island will continue to satisfy most of their needs while resulting in some reciprocal support of research programs and the Island operation.

Direct cost to the government in implementing the PREFERRED ALTERNATIVE is likely to be greater than the BA, RPA or RUA. This is principally because the PA will include most of the research and educational programs of both alternatives. The public use strategies (education, fishery support) should be self-supporting, but they will place additional demands on Refuge staff and facilities. Cost-sharing arrangements for the operation of the Tern Island facility can reduce the government expense as can the role of mothership-supported fishing vessels willing to facilitate Refuge research projects.