

PART 2 OF 2

LIBRARY OF
GEORGE H. BALAZS

TERN ISLAND STUDY



VOLUME ONE - MAIN REPORT

JUNE, 1979

MANTA CORPORATION

THREATENED AND ENDANGERED SPECIES

Introduction

Plant and animal species whose present condition warrants special protective legislation and management measures to insure survival are treated separately in this report. Unique characteristics of insular environments set the stage for equally unique patterns of evolutionary development. This story is well told in numerous other documents and will not be repeated here.

The development of legislation to protect rare plants and animals, and its relationship to the Tern Island management decision, is discussed in Section 10 of this report. The following discussion will focus on the species and their habitat, and the impacts expected to occur with the implementation of various management options.

Plants

At the present time, there is only one plant species in the State of Hawaii formally listed by Federal law as endangered. This species, Vicia menziesii is known only from the island of Hawaii. A list of Hawaiian plants to be reviewed for formal listing was published in the Federal Register 1 July 1975. A more restricted list

was formally proposed for listing as endangered species in the Federal Register of 16 June 1976. As a result of the 1978 amendments to the Endangered Species Act of 1973, action must be taken on all formally proposed species within a year after enactment (by 10 November 1979) or they will be automatically dropped from consideration. These species can, of course, be proposed again for listing at a later date.

The 1975 Federal Register proposed list of Hawaiian plants included 11 endangered taxa (species or varieties), and five threatened species from the Northwestern Hawaiian Islands. The 1976 Federal Register list included only ten taxa of northwestern island plants, and omitted the threatened category. Some of these plants are believed to be endemic to a single island while others are more widely distributed. The present status of most of the proposed endangered plants in the Northwestern Hawaiian Islands is poorly known. Islands on which these plants have been recorded include Nihoa, Necker, Laysan, Pearl and Hermes Atoll, Midway and Kure Atoll. None of the proposed endangered plants have been recorded from French Frigate Shoals.

In view of the apparent absence of plants that are believed to be threatened or endangered in FFS, it is unlikely that implementation of any of the management options under consideration will have a direct effect on rare plants or will be legally constrained by applicable laws. However, it is anticipated that increased boat traffic to and from FFS will ultimately result in a greater frequency of unauthorized landings on other islands. To the extent that unauthorized landing will occur, the threat of inadvertently introduced exotic plants, insects and mammalian predators is very real. Many exotic plants, particularly aggressive weedy species, will compete with native flora. The potential impact on rare plant species is most significant. Competition for water and shading by aggressive plants may lead to the elimination of some species. Herbst (pers. comm.) indicates that at least two species of proposed endangered plants reported at Kure in 1961 have not been recorded since that date. He theorized that exotic Verbesina, established on the island since 1961, has eliminated the rare

plant species by shading or competition for water. Verbesina has become such an aggressive pest that it has adversely impacted the nesting seabird habitat, and is mowed regularly by Coast Guard personnel to keep it under control.

The threat of increased incidence of unauthorized landings, and possible adverse impacts on rare plants and wildlife, cannot be easily controlled. Adequate enforcement outside the limits of FFS, even with adequate support facilities at the site, will be virtually impossible. The only potentially mitigative action will be thorough education of fishermen and other boaters and very severe penalties for infractions. To some extent, the strong desire of fishermen to be allowed access to refuge marine resources may stimulate an effort at self-policing, and control of other vessels (including foreign boats) that will improve the meager enforcement capability of refuge personnel.

Avifauna

As indicated earlier, the Hawaiian archipelago was the scene of a unique evolutionary story, particularly among the avifauna. As few as 15 original colonist species can account for 70 or more endemic taxa of birds in the islands. At least seven taxa (genera, species or subspecies) of birds evolved on northwestern islands. Three taxa unique to Laysan Island are now extinct, in large part due to the massive alteration of habitat that occurred early in this century. These include the Laysan Rail (Porzana palmeri), Laysan Honeycreeper (Himatione sanguinea freethii) and the Laysan Millerbird (Acrocephalus familiaris familiaris). Two other taxa of birds, still found on Laysan, are listed by both State and Federal law as endangered (Laysan Duck, Anas laysanensis; Laysan Finch, Psittirostra cantans cantans). Nihoa is home for two additional taxa

of endemic birds (Nihoa Millerbird, Acrocephalus familiaris kingi; Nihoa Finch, Psittirostra cantans ultima) that are closely related to Laysan species. Both of the endemic birds at Nihoa are considered endangered by State and Federal law.

No other threatened or endangered species of birds are known to naturally occur (presently or historically) on other Northwestern Hawaiian Islands. However, attempts to establish reservoir populations of some rare species on other islands has occurred, yet all attempts have failed. Of most relevance to this report was the introduction of 27 Nihoa Finches to Tern Island and 10 Nihoa Finches to East Island on 11 March 1967. Although some birds reportedly bred successfully on Tern Island, the combination of stormy weather, lack of food and abrupt change in habitat is thought to have led to their eventual demise at FFS. No finches have been seen on East Island since 1971 or on Tern Island since 1973 (Balazs, pers. comm.)

The potential adverse impacts on endangered bird species of various Tern Island management options are similar in many respects to those described for endangered plants. The added threat of inadvertent introduction of predators (i.e. rats) in FFS or elsewhere in the NWHI should not be understated. Such an event would be particularly devastating to the precariously low population of Laysan Ducks, a ground nesting species that would be quickly exterminated if predators were present on the island. An important distinction between the problem of protecting rare plants versus the listed bird species is the very real difference in legal responsibility between species which are formally listed by Federal law as endangered or threatened and those which are only proposed for listing. As indicated in the legal section of this report, Federal agencies are legally bound to

insure that any action they carry out, fund or authorize does not jeopardize the continued existence of a listed species or adversely modify or destroy its critical habitat. Although critical habitat for land birds in the Northwestern Hawaiian Islands has not yet been formally proposed, it is virtually certain that both Nihoa and Laysan Islands, in their entirety, will eventually be so proposed and probably adopted for these species, if not for other listed wildlife as well. As part of the assessment process for the Tern Island decision, FWS will be obligated to "internally" consult with itself (Endangered Species Office) to evaluate the relationship between the Tern Island action and survival of endangered wildlife.

Green turtle (Chelonia mydas)

Hawaiian Chelonia constitute a distinct population genetically isolated from other green turtle populations in the Pacific. Over 90% of all reproduction of this Hawaiian population occurs at French Frigate Shoals (FFS). However, long distance migrations by adults regularly take place between FFS and inshore algal feeding pastures situated throughout the archipelago. The green turtle rookery at FFS is by far the largest in the United States (excluding TTPI, which is not a possession or territory of the U.S.). Green turtle reproduction does not presently take place within the main Hawaiian Islands. Individual turtles or small groups of turtles sporadically nest at Laysan, Lisianski, Pearl and Hermes Atoll, and (very rarely) Midway and Kure Atoll. However, this is minor (<10%) when compared with activity at FFS. Islets at FFS that host nesting turtles include, in decreasing order of usage: East, Whale-Skate, Trig, Tern, Gin and Little Gin. East and Whale-Skate host 85-90% of the nesting turtles at FFS.

Hawaiian Chelonia exhibit a land-basking behavior that is presently unique to the population. Furthermore, this rare behavioral trait only takes place at certain areas in the Northwestern Hawaiian Islands, with FFS being the site of greatest occurrence. Basking occurs on the islets where nesting takes place, as well as on Round, Mullet, Shark and Disappearing islets. Adults copulate, feed and sleep in the inshore waters of FFS. Observations suggest that feeding and sleeping may also take place to some extent on the outer reef slope (outside the existing FWS refuge boundary). The major food source of Hawaiian Chelonia is benthic algae.

Adult males and females arrive at FFS during late March and early April, most of these turtles depart during late July and August. In addition to the

migratory breeding colony that seasonally uses FFS, discrete aggregations of adult and juvenile turtles reside at FFS throughout the entire year. These animals regularly bask on the previously specified islets, as well as feed and sleep in inshore waters. Reliable estimates of the size of the seasonal breeding colony at FFS for each of the past six years have ranged from 200-500 adult males and females. Earlier estimates suggesting a large breeding population (Ref. 95) were shown to be erroneous (Ref. 16). Individuals do not reproduce (undertake migrations) in consecutive years, however from 1-5 egg clutches may be laid in one season.

The breeding colony at FFS has been periodically exploited and degraded for at least the past 150 years. One fisherman alone was responsible for taking about 200 turtles at FFS between 1946-1948 (Ref. 7). Habitat alteration and disturbance has at times been substantial. Historical evidence suggests that the colony has undergone declines.

On Tern Island nesting occurs along the south shore (approx. 3000' of beach) with the estimated number of females involved for each of the past six seasons ranging from 3-7. Nesting attempts have occurred at the north cove beach. Tern is the only islet at FFS used for turtle nesting that does not involve the entire land area of the islet. Copulation periodically occurs in inshore waters on all sides of the island, while basking takes place on the south, north and east (seasonal sandbar) shores, but is not common. Juveniles feed and sleep in the channel and reef flat area to the north of the island. Several adult turtles also sleep in the channel and in a sunken barge to the north of the island.

The FFS turtle population has been adversely impacted by the LORAN station and intermittent Coast Guard presence elsewhere in FFS. The types of impact can be briefly summarized 1) human disturbance from work-related

activities on Tern Island, including vehicle usage; 2) walking beaches on Tern and other islets for glass balls and other recreational purposes; 3) fishing from skiffs and other water activities (swimming, water skiing, shore fishing) at Tern Island and other islets; 4) logistical support from vessels (large and small boat traffic, minor fuel spills), and aircraft (overflights of other islets, loud noise and vibrations); 5) artificial lights on Tern Island causing disorientation of hatchlings and inhibiting turtles from nesting (note that the most obvious impact of these lights is on Tern Island itself, however illumination is visible from East Island and all other islets north of East Island, hatchlings emerging from nests on these islets may alter direction in response to this cue; 6) ground vibrations and noise on Tern Island resulting from power generators; 7) treated sewage discharge (possible chemo-reception interference); and 8) LORAN radio waves on turtle navigational abilities (unlikely but nevertheless a consideration).

Experiences of researchers in FFS to date underline the extreme sensitivity of green turtles (and other species of sea turtles) to human disturbances. Turtles of all sizes will flee from skiffs and divers; they will rapidly and often violently retreat to the water from land basking positions when humans are sighted. They will flee from artificial (particularly moving) lights when attempting to nest. They will often discontinue courtship and copulation when confronted with humans or skiffs. As hatchlings they become seriously disoriented from artificial lights thereby wandering inland where they die from dehydration or increased susceptibility to predators (ghost crabs and certain shore birds).

Certain legal considerations that affect the management of green turtles should be mentioned. The Hawaiian Chelonia probably represent the only

population of green turtles that do not migrate between international boundaries of two or more countries, so conservation is largely dependent upon management actions of a single country. The species was formally listed as "threatened" under the Endangered Species Act on 5 September 1978. Although the regulation accompanying the designation provides for subsistence harvest in some areas of the TTPI, the Hawaiian Chelonia population received full legal protection. A FWS draft Critical Habitat Proposal, prepared in 1978, has been withdrawn from consideration at least for the present time (C. Kenneth Dodd, pers. comm.). This proposal would have included only selected land areas in Florida, American Samoa, TTPI and Hawaii. The list of proposed Hawaiian Islands to be critical habitat included Necker, Laysan, Lisianski, Pearl and Hermes Atoll and nine islands in FFS. Although Tern Island was not included, turtle use data indicate that at least the south shore of the island would qualify for such designation.

The State of Hawaii Division of Fish and Game Regulation No. 36 (effective May, 1974) provides full legal protection for turtles in the Northwestern Hawaiian Islands. This same regulation permitted take of turtles, with size restrictions, within the main islands, but this take under State law was superseded in 1978 by the more prohibitive restrictions of the Federal Endangered Species Act. Chelonia is not currently protected under the State of Hawaii Endangered Species Act. The Convention on International Trade in Endangered Species of Fauna and Flora (CITES) lists all sea turtles under U. S. jurisdiction in Appendix 1, with no international trade allowed while the International Union for Conservation of Nature (IUCN) lists Chelonia as "endangered," but with no force of law. Finally, but no less important, Chelonia receive full legal protection by the FWS while inside the boundaries of the HINWR, independent of recent protected status under the Endangered Species Act.

Implementation of the abandonment option would eliminate all resident human disturbance to turtles and turtle habitat at Tern Island and elsewhere in FFS. As a result, increased use of Tern's southshore beach and all inshore waters would be expected. Also, this option would not require removal of sand from the south shore nesting beach area of Tern Island, to fill in eroded and deteriorated sections of the island. Such an action may be necessary for other alternatives. On the negative side, it is anticipated that this option would increase the likelihood of disturbance and direct take of turtles by unauthorized transient vessels, including boats of certain foreign fishing fleets that are known to illegally take turtles at isolated rookeries. Although this possibility could be mitigated somewhat by continuing Coast Guard aircraft and vessel patrols, it is not likely that this would be a significant deterrent.

Depending upon the scope and intensity of various work and recreational activities conducted by resident personnel, impact on turtles under the outpost station option should be lower than it has been during the Coast Guard tenure. Increased basking by adults and greater survival of hatchlings is likely to occur. However, on Tern Island, some disturbance would continue with artificial lights, limited aircraft activity and the sounds and vibrations of generators and other equipment. This option could support limited research work on other FFS islands, which in turn could also adversely impact turtle nesting areas if not rigorously controlled. Unauthorized entry into refuge waters, possibly involving disturbance to and even harvest of turtles, would be lessened considerably, but probably not eliminated. During brisk weather conditions, East and other islets to the south are not visible from the rooftops at Tern Island.

If the mid-level or full level research facility options were implemented, impacts to turtles would probably be similar to and possibly in excess of

those occurring during Coast Guard tenure at FFS. Skiff activity would undoubtedly increase, thereby creating the likelihood of greater disturbance to turtles that were copulating, feeding, sleeping or moving between islets. Direct injury could result from propeller contact, as indicated by similar incidents documented in Florida (Ref. 70). Increased interest in marine studies would increase the likelihood that SCUBA divers would be working in previously undisturbed deepwater turtle habitat. This may be particularly serious in view of the fact that the Coast Guard has never been permitted to use SCUBA in refuge waters. Activities in the terrestrial environment of other islets would undoubtedly increase as well, but the disturbing effects could be mitigated by implementation of strict controls regarding the timing and location of this work. The small size of all the naturally occurring islets makes it extremely difficult for more than two researchers at a time to function. Some biologists with experience in the area feel that one researcher per islet, on an intermittent basis only, should be considered the maximum carrying capacity of the system if all the resources (turtles, seabirds, monk seal, vegetation) are taken into account. Depending upon the types of activities that occur and the location where they occur, the impacts associated with the recreation/education option could vary considerably. Unrestricted movement of "curious naturalists" on Tern Island would probably cause greater adverse impact than the Coast Guard Station due to the intensity of interest in the wildlife and the frequency of encounters. However, it is possible that the wildlife interests of these visitors could be satisfied by time spent at Tern Island alone, where the significance of disturbance to turtles and other wildlife would be less than would access to other areas in FFS.

In view of the legal protection afforded by various pertinent laws

and regulations, it is reasonable to assume that intentional harvest of turtles within refuge waters will never again be permitted. However, certain activities associated with intentional harvest of other resources within refuge waters at FFS can be expected to affect turtle populations. Less direct impact is likely to occur with implementation of fishery support options that confine movement of fishing vessels in and out of Tern Island or only close enough to permit transfer of catch to barges (i.e. ahi, offshore trap, albacore, precious coral, aku if no bait is taken in refuge). Greater adverse impacts are anticipated with fishery options that involve nearshore activity (skiff fishery, aku bait harvest).

It is reasonable to assume that some illegal take of turtles will continue, although the economic justification of this activity is likely to decrease substantially as soon as turtle meat is off the restaurant market in Honolulu. Significantly increased numbers of fishing vessels in the FFS area, in the absence of adequate enforcement presence, increased the likelihood of illegal take. Some fishermen feel that the regulations currently protecting the turtles are unjustified. At least one albacore fisherman has recently boasted that he will stop at FFS on his way to Midway and take green sea turtles for food and burn ointment. Assemblage of a major breeding colony at FFS creates an illusion of abundance, even though in actuality the colony involves turtles from throughout the archipelago. Also, the basking habits of turtles at FFS makes the illegal harvest of turtles extremely easy. Admittedly, the incidence of illegal take in a well regulated fishery may be low, but "one bad apple" now and then can create serious problems for both the turtles and the future of a fishery within protected waters.

Depending upon the specific location of fishery activities within refuge waters, and the methods employed, a variable level of incidental take of turtles is also anticipated. Mortality has been documented from entanglement in many types of nets, hooking in the mouth or snagging on baited hooks and, less frequently, capture or entanglement in large wire fish traps. Direct disturbance of behavior in nearshore waters will occur during bait gathering operations. Use of lights at night, vibrations from motors, and discharges of fuel, bilge oil and sewage in shallow waters will also disturb turtles in FFS. Illegal trespassing on islets will disturb basking turtles, and if it occurs between July and October, could disturb the normal sequence of hatchling emergence from nests. Any of the fishery activities involving transfer of fuel, together with the movement of boats within hazardous waters, increases the likelihood that major fuel spills will occur. The level of impact on turtles and other resources will depend upon wind and weather conditions and the time of the year. If sand was fouled on islets used by turtles, the species would be adversely impacted by ingestion or external coating of hatchlings, juveniles and adults. Algal food sources may also be polluted.

Any additional dredging of new channels or maintenance dredging to reduce navigation hazards for vessels moving in and out of Tern Island could impact the quality of nesting, basking, feeding and sleeping habitat of turtles. However, in view of the limited data available on circulation patterns within FFS, impacts of major alteration of the bottom are somewhat unpredictable.

One potentially positive effect on turtle populations related to fishing options should be mentioned at this point. It has been suggested that an intensive fishing of sharks and other predatory fish

within FFS waters would reduce the natural mortality of turtles, seals and fledgling seabirds. Although shark predation on these species is well documented, it is uncertain what ecological repercussions may result if populations of top-level carnivores were depleted significantly in this marine food-web. Serious consideration of such an action should await results of extensive ecological research, some of which is now ongoing. Such research should also explore the undocumented, but plausible, theory that extensive harvesting of those fish which make up the bulk of the shark's diet would result in greater predation of seals, turtles and seabirds as alternative sources of food.

To the extent that expanded commercial fishing would increase movement of boats between Honolulu and FFS, increased disturbance of seals and turtles at Necker Island is also anticipated. This is believed to be the only place in the world where sea turtles regularly bask on a rock ledge. Adolescent and adult turtles commonly feed in Necker's inshore waters.

Hawaiian Monk Seal (Monachus schauinslandi)

The Hawaiian monk seal is one of three tropical or subtropical species of phocids. The other two species are the Mediterranean monk seal (Monachus monachus) and the Caribbean monk seal (M. tropicalis) which was last sighted in 1952.

Hawaiian monk seals are found primarily in the NWHI, but are rarely sighted in the main islands and Johnston Island. Most breeding is restricted, in decreasing order of importance, to FFS, Laysan, Lisianski, Pearl and Hermes, Kure, Midway and Necker.

Monk seal biology has been carefully reviewed in the Monk Seal Critical Habitat discussion paper recently prepared by NMFS and will not be discussed here except as it pertains to the alternatives for Tern Island. Monk seal habitat can be divided into three areas; 1) onshore, 2) inner reef and 3) outer reef and open ocean.

A great deal of a monk seal's life is spent on shore, particularly during breeding and pupping seasons. Coral sand beaches are apparently preferred, but lava beaches are sometimes used (e.g. on Necker). The major pupping season at FFS is May through June, but ranges March through August (Balazs, pers. comm.). Pups are nursed on these beaches for 5-6 weeks. It is during this period of time that they gain a critical amount of weight (3-4 times their birth weight). This weight probably helps them through the initial weeks of weaning when the mother leaves them to fend for themselves.

The shallow inner reef is also important to monk seals. It is in these protected waters that mothers teach their pups to swim and feed.

The deeper inner reef as well as the outer reef are the primary feeding grounds of the monk seal. The fish and invertebrates that have been identified from monk seal spewings and fecal samples are primarily animals of this region. Monk seals occasionally travel long distances to offshore banks and other islands.

Numerous censuses have been made of monk seals since 1952. These censuses involve determination of the number of animals on the islands at any one time and do not reflect the number at sea. They are therefore not population counts. They are, however, indicators of population trends that are germane to a discussion of Tern Island.

There has been a general downward trend in total population from over 1000 animals in 1957 and 1958 to 502 in July of 1978.

An increase in numbers at FFS has been recorded, from 35 in 1957 to 274 in 1975 and 196 in 1978.

A large drop in counts at Kure, Midway, Pearl and Hermes, Lisianski and Laysan has been noted. Kenyon (Ref. 105) and DeLong (pers. comm.) have attributed the drop in population at Kure and Midway to be directly related to human presence on these islands. The population drops elsewhere are still unexplained.

Little is known of the causes of natural mortality of monk seals. Kenyon and Rice (Ref. 109) feel that natural mortality is quite low. Taylor and Naftel (Ref. 161) have suggested that shark predation may be a significant cause of mortality, but it would be difficult to quantify to what extent. Large numbers of adults have been found with shark-inflicted wounds (Ref. 58) and shark wounds have been found on dead pups (Ref. 59). Shark control has even been suggested as a means of

enhancing pup survival at Kure and elsewhere.

There are several additional characteristics of monk seal biology that are relevant to the management of Tern Island. Particularly important is their sensitivity to disturbance by people. This has been stressed by nearly all who have studied them, as well as in the literature (Ref.105) and in NMFS critical habitat discussion paper (Ref.124).

Also important are the problems related to fishing gear. In general, the Hawaiian monk seal problems have been rare. The earliest reported problem is reported in a 9 May 1973 letter from Heisei Shinsato to the Regional Director of the Bureau of Sport Fisheries and Wildlife (FWS files). Mr. Shinsato reported that the vessel ELAINE fished for lobster and reef fish primarily with fence nets, but eventually had to discontinue their use because although they were effective in trapping lobsters, they were also effective in catching monk seals. Hawaiian monk seals have also been reported taking fish from a baited hook (Ref.124) and in a recent incident one became entangled and drowned in a gill net off of Kauai. Mediterranean monk seals have on several occasions been tangled and drowned in seines and gill nets, and have taken baited hooks (Ref.124). Balazs (pers. comm.) has also observed one monk seal entangled with synthetic material and two other seals with scars which may have been left in similar incidents.

Under Federal law, monk seals are protected by the Endangered Species Act ("endangered" status), and the Marine Mammal Protection Act. Additionally, the Marine Mammal Commission has recommended that certain portions of the monk seal's range be designated "critical habitat." On 12 February 1979 NMFS distributed a second draft of their Hawaiian Monk Seal Critical Habitat discussion paper (Ref.124). When and if critical habitat is formally designated for this species, Section 7 of

of the Endangered Species Act would afford the species additional protection from adverse modification of habitat. The monk seal also receives protection from the State of Hawaii's Endangered Species Act and from existing statutes (188.55 H.R.S.). In addition, while under refuge boundaries, the monk seal is also given protection under both State and Federal refuge regulations.

Environmental Consequences

Because of the potential seriousness of many of the alternatives on the viability of the monk seal population, each must be considered carefully.

If illegal entry to the refuge could be prevented, the abandonment alternative would have no negative impact upon the monk seal and would probably have significant positive impact by removing the people from Tern Island and other areas in FFS. Lack of disturbance on Tern Island could be expected to encourage monk seals to use its beaches as additional breeding sites.

By totally removing man's presence, however, abandonment also removes a possible deterrent to those who might violate refuge regulations.

Because fewer people would be involved, the negative impact of an outpost station would probably be less than the presence of the Coast Guard. The presence of any people, however, would probably be sufficient to prevent pupping. The people manning the station would need to be aware of the potential problems and careful to see that problems would not develop. Because there would be fewer people, the use of fuel would be considerably less and therefore reduce the chance for pollution that might adversely affect seals. Impact of researchers

on seal populations other than FFS would remain essentially unchanged.

Because of its size, a mid-level research station would probably have similar impacts to the present Coast Guard station. If, however, the numbers of researchers "allowed" on the other islands were not carefully controlled, disturbance to seals could be serious. All of the terrestrial biologists that were interviewed stressed the sensitivity of monk seals to human presences, particularly during the pupping season. Representatives of the Marine Mammal Division (NMFS) interviewed for this study recommended against research on seals in FFS in an effort to leave at least one population totally undisturbed.

The impacts of a full level research station would be similar to those of a mid-level research station, only more intense. Excursions to other islands would be more frequent and involve more people. In this respect the impact on monk seals would probably be more detrimental than the impact of the Coast Guard LORAN station.

The recreation/education alternative is poorly defined, and therefore difficult to evaluate. The extent of impact depends largely on the number of people involved and how they are regulated. Because of the sensitivity of seals to people any significant number of people would very likely have a very serious negative impact, especially if they were allowed within the refuge other than on Tern Island. Well conceived controls will be essential if this option is given serious consideration. Some effort should be exerted to prevent underwater disturbance within seal feeding areas.

An inshore fishery could have a serious detrimental impact upon monk seals. Particularly serious problems relate to harassment,

entanglement with fishing gear and competition for food resources.

Harassment is a particularly serious problem, especially during the pupping season. As has been stated earlier, monk seals are very sensitive to frequent human/seal interaction. The more people who are allowed to interact with monk seals, the more serious the problem becomes. Fishermen in inshore water would undoubtedly have frequent interactions with monk seals, both in the water and possibly on land. It is probably impossible to prevent unauthorized landings on the other islands if fishing is allowed within the refuge.

If nets are used to catch fish within the refuge a strong possibility of entanglement would exist. There is a documented history of the entanglement of monk seals in both gill and fence nets and the use of them in refuge waters would involve substantial risk.

Heavy fishing pressure within the refuge might also compete with monk seals for food items. Whether or not this concern is justified awaits further study of the diet of monk seals, but until the data are available a conservative course of action is warranted.

The anticipated impacts of a trap fishery could take many forms. The impact of the lobster fishery on monk seal populations has been discussed extensively in the recently published lobster management plan (Ref.). This plan discussed the relative merits of trap types and the impact of areas where they are fished. It has been shown that the use of a "California" type trap for lobsters prevents pinniped entanglement, while the use of other types of traps may present a risk. The negative impact of trap fishing will in part vary with the amount of area fished. The closer inshore that trap

vessels are allowed to fish the greater the likelihood that they will have a negative impact on the monk seals. This impact is, however, probably greatest in the very shallow reef waters (i.e. less than five fathoms). The amount of potential pollution caused by trap vessels would vary with the number of vessels involved and the conscientiousness of the operators. These vessels pose no more risk of pollution than any other research or fishing vessels. Monk seals have been observed with oil on their pelage on several occasions at FFS but the effects on their physiology or general health are undocumented.

The risk of negative impact from the offshore ahi and bottomfish fishery would be primarily associated with the limited actions that would occur within the shoals. These include transit to and from Tern Island, off loading of fish and refueling. The impact of the actual offshore fishing operations would probably be minimal if not nonexistent. Impacts associated with an albacore fishery and support facility would be very similar, depending on frequency of boat movements.

The primary negative impact of aku fishing is related to obtaining bait in the lagoons. Baitfish are obtained by surrounding them with nets and then transferring them to the aku boats. In view of past experiences with monk seals and nets, the risk of baitfishing in shallow waters of FFS is substantial.

The impact of sport fisheries on monk seals is largely dependent upon where fishing occurs. Fishing within the refuge would likely cause problems of harassment. Fishing outside of the refuge for pelagic species would cause no direct impact other than that caused by increased vessel traffic in the entrance channel and the associated risk of pollution.

The potential impacts of an aquarium fishery upon monk seals depends on the methods used, the size of the industry and the areas fished. Large fence nets used by aquarists pose the same problems as nets used by fishermen. Short fence nets (i.e. 20 feet or less) are certainly safer than the longer nets, but because of the curiosity of monk seals they still pose a threat. Aquarium collecting would also involve disturbance of seals in deeper water feeding habitat.

Since the precious coral fishery would utilize Tern Island only for supplies and moorage, the impact on monk seals would be primarily related to these activities and would be no more or less significant than any other similar sized vessel entering and leaving the island. The impact of the actual coral harvesting operation on monk seals would be minimal in view of the depths involved.

ARCHEOLOGICAL/HISTORICAL RESOURCES

Affected Environment

Primary investigations of cultural resources in the Northwestern Hawaiian Islands include visits by Emory (Ref. 71), Yen (Ref.) and Apple (Ref. 14). Emory drew immediate attention to the unique archeological remains on Nihoa and Necker Islands, which he believed to "represent a pure sample of archaic Polynesian culture." Remains of garden terraces, house sites, crude shelters and primitive temples, closely resembling the marae of Tahiti, were found on these islands. It was theorized that a small Polynesian population, possibly numbering less than 200 persons, may have existed on Nihoa as long ago as 700 years. Stone images found on Necker Island suggest it may have been a sacred island, visited only periodically. As a result of the most recent cultural study, Apple noted the need for further studies on these islands, and that possible stabilization of dry-masonry structures may be warranted to protect them from natural deterioration.

Apple (op. cit.) also visited the other more western islands of the archipelago and found nothing of prehistorical significance during his brief survey. However, he noted that natural forces (wind, rain, waves) had impacted and altered the atolls, and decreased the chance of locating surface middens or other indications of prehistoric use. At the same time, natural forces may periodically expose artifacts on vertical faces, thereby justifying the need for intermittent and prolonged archeological investigations in the future.

Historic significance of the northwestern atolls stems from the independent discovery of individual island groups. French Frigate Shoals was first visited by French expedition ships BROUSSOLE and ASTROLABE, under the command of Jean Francois de la Perouse, in November, 1786. Many

additional sailing ships visited the shoals and other Northwestern Hawaiian Islands over the next century, several of which ended their voyages as shipwrecks at French Frigate Shoals and other atolls. Historic significance continued into the early 20th century with the expanded exploitation of marine and terrestrial resources, including guano, seals, birds, fish, oysters, turtles and bêche-de-mer. Protected status began with designation of the islets and reefs of the Northwestern Hawaiian Islands as the Hawaiian Islands Reservation in 1909.

The potential strategic value of French Frigate Shoals to a future war effort was recognized as early as 1928. It was noted that the site was strategically located and that it provided a protected anchorage and sufficient land area for construction of a landing field and shallow calm water for landing of seaplanes (Ref. 7). The shoals were used intensively before World War II for seaplane maneuvers. Both Japanese and American forces used the shoals during the first months of the war. As a direct result of the battle of Midway, the decision was made to construct an airfield at FFS to refuel aircraft between Pearl Harbor and Midway, to act as an emergency landing field and to serve as an outpost for aerial defense of Pearl Harbor. The history of the Tern Island site, since the construction of the Naval Air Facility was discussed briefly elsewhere in this report.

As a result of continued use, and extensive modification, little remains on Tern Island of potential historical significance but the island itself. Other sites or structures of potential historic significance include the various shipwrecks (if located) and the dredged seaplane runways. The entire shoals may also be considered of historical significance in view of its long strategic role.

Several Federal laws relate directly to the preservation of cultural resources. Among the most significant to this assessment are the Historic Sites Act of 1935, the Reservoir Salvage Act of 1960, the National Historic Preservation Act of 1966, the Archeological and Historic Preservation Act of 1974 and Executive Order 11593 of May, 1971. The general intent of this legislation is to make Federal agencies responsive to the potential damage they may cause to significant historical or archeological resources. They require agencies to identify, evaluate and seek necessary protection for these resources as an integral part of the planning process. Of particular importance to the protection of these resources in the Northwestern Hawaiian Islands was the Executive Order 11593, requiring all Federal agencies to "locate, inventory and nominate to the Secretary of Interior all sites, buildings, districts, and objects under their jurisdiction or control that appear to qualify for listing on the National Register of Historic Places," no later than 1 July 1973. It was this order that stimulated field research in the Northwestern Hawaiian Islands by Apple (Ref. 14). As a result of this work, Apple felt that sites on Nihoa and Necker were clearly eligible for nomination to the National Register. The special significance of Midway and French Frigate Shoals to the war effort were also considered by Apple to be sufficient justification for nomination to the National Register. He did note, however, that nomination of the atolls of the archipelago, as islands of a historic group, should await the first significant archeological discovery on any of the atolls.

Final amendments to regulations of the Advisory Council on Historic Preservation, published on 30 January 1979, clearly restate the responsibility of Federal agencies to identify National Register or eligible property

located within lands that may be affected by proposed actions. The regulations also define a consultation process necessary to insure compliance with pertinent laws to protect these resources. In the case of the Northwestern Hawaiian Islands, Apple's 1972 study fulfilled the first obligation of the FWS under Executive Order 11593, to identify sites of potential eligibility. However, the FWS has not yet followed through in its legal responsibility to nominate the sites which were considered eligible for the National Register. The State Historic Preservation Office has expressed an interest in pursuit of further cultural resource studies in the Northwestern Hawaiian Islands, particularly in light of data from other sites that has been generated in recent years. (F. Watanabe, pers. comm.).

Environmental Consequences

Anticipated adverse impacts on cultural resources resulting from implementation of various Tern Island management options are limited, for the most part, to the effects of unauthorized landing on islands known to contain significant sites. The most significant archeological sites are believed to be restricted to Nihoa and Necker. It is likely that any of the support station alternatives that increased the number of boats traveling between Honolulu and FFS would increase the likelihood of unauthorized visits to these islands. Potential damage to the resources includes physical alteration of sites and pilfering of archeological resources (i.e. bones, lures, bowls, adzes, fish hooks, etc.) Even authorized research activities on these resources need to be carefully reviewed for relevance and impact, as such efforts may preclude further studies at a later date.

It is not likely that any of the management options for Tern Island would lead to major direct impacts to cultural resources on other islets in the atoll. On the contrary, research support at Tern Island would facilitate accelerated research on these islands which may lead to significant historical or archeological discoveries. Areas of sandy atolls with the greatest likelihood of yielding important cultural information (i.e. escarpments) would need to be identified in order to minimize inadvertent impacts of authorized research on the islands. The abandonment alternative at Tern Island could conceivably be interpreted as a failure of the FWS to adequately protect a resource of recognized historical significance, as abandonment would accelerate the rate of deterioration and prevent enforcement of refuge regulations preventing access to other islands.

AESTHETICS

Affected Environment

Several interrelated factors work together to determine the aesthetic characteristics of an area. The sounds, smells and visual conditions all play a determining role. The significance of aesthetics will vary with the frequency of human visitation and the personal attitudes of those people involved.

Those natural and man-induced factors that affect the noise and air quality characteristics of FFS have been discussed. Those visual conditions that adversely impact upon the natural aesthetics of the area include visible air pollution (i.e. smoke), oil and discharged sewage effluent on the water surface, deteriorating equipment and facilities, and the simple presence of a manmade station within a natural area. Although recent clean-up efforts at the former LORAN station on East Island have removed most of the signs of earlier human presence, the remaining debris still detracts from the natural visual qualities of the atoll islet. It is tempting to ignore or downplay the possible significance of aesthetic environmental qualities in the planning process, as they cannot be easily valued economically. However, it should be noted that historic recognition of the refuge has stressed natural values and the importance of protecting unaltered areas from change.

Environmental Consequences

It is important to stress at the outset that Tern Island is not now nor ever will be in what could reasonably be considered a natural state. However, the selection of management options for this site will directly affect the aesthetic characteristics of the island and FFS. With extensive funds and manpower, the facilities at Tern Island could be destroyed and

removed, and vegetation could be encouraged to cover virtually all the island. The relatively "natural" condition of East Island, less than three decades after the LORAN station was abandoned, illustrates an apparent reversion to a condition at least superficially similar to its natural state. However, such a reversion could not occur at Tern Island even with complete removal of the existing structural seawall, a virtually impossible and economically unfeasible task. Also, the diversity and abundance of introduced plants on the island would insure that it could never return to "natural" state.

Neither the outpost facility nor any of the non-commercial fishing management options are expected to lead to any significant degradation of aesthetic qualities by comparison to the current condition of Tern Island. However, the "significance" of the current aesthetic environment would increase as new people visited the site, particularly those seeking research, recreation or educational opportunity in a "natural" area. The extent to which operation of a research or fishing support station led to further adverse visual impacts would, in part, affect the quality of the experience for the visitor to the site.

Activities which are anticipated to significantly affect the visual aesthetics of the area under various management options include 1) increase in the extent of Tern Island facilities (i.e. buildings, tanks, processing equipment, etc.), 2) increased water surface pollution (oil, sewage, garbage, processing wastes, etc.), 3) increased turbidity due to dredging, 4) increased frequency of boat movement to and from Tern Island and throughout the refuge waters, 5) addition of structures of other islets (i.e. outpost research facilities), and 6) further dispersal and encroachment of exotic plants.

It should also be noted that among the various visual elements that together make the "natural" environment aesthetically pleasing are the various forms of wildlife that inhabit Tern Island and other islets in the atoll. Abandonment of Tern Island by seals and turtles, or reduction in bird colonies, as a result of intensified on-island activities, would be construed by many to be a significant adverse impact on the aesthetic environment.

RELATIONSHIP BETWEEN DIFFERENT MANAGEMENT OPTIONS

Introduction

The current controversy regarding management decisions for Tern Island and the other Northwestern Hawaiian Islands focuses on the relative merits of inviolate protection, non-consumptive use and consumptive use. A brief comparative examination of each of these concepts of resource management will provide a foundation for assessing the relationship between different management options under consideration for Tern Island.

Inviolate Protection

Although conflicting use of refuge lands and waters has been discouraged in management policy since designation of the Hawaiian Islands Reservation in 1909, total exclusion of consumptive and non-consumptive use of the area has never been seriously considered as a long range management objective for this area. Lands, waters and wildlife of the Northwestern Hawaiian Islands are protected by a variety of State and Federal regulations, many of which are overlapping in jurisdiction. However, none of the finalized regulatory authority (i.e. National Wildlife Refuge, Research Natural Area, State Wildlife Refuge) or the proposed regulations (i.e. Wilderness Area, Critical Habitat) provide inviolate protection. However, each of these forms of protective designation do clearly specify the critical need for rigorous control of all uses of the refuge.

Non-consumptive Use

Primary non-consumptive uses of the Northwestern Hawaiian Islands generally fall into the categories of research, education and, to a lesser degree, recreation. The first biological survey in the northwestern islands was in 1891 by the schooner KAALAKOI, although pertinent hydrographic and

and other data had also been recorded on prior visits. Major scientific expeditions to FFS and other atolls occurred in 1902 (Albatross expedition) and 1923 (Tanager expedition). Amerson (Ref. 7) records more than 80 separate visits to FFS between 1859-1969 in which some scientific data were recorded. These studies led to the publication of 100 research papers, and several more have been published subsequently. Biological research topics have included virtually all major groups of organisms. Additional studies of geology, oceanography, hydrography and climatology also stand out in the record of visits to FFS. Fisheries research began in 1948 with the initiation of the Pacific Ocean Fisheries Investigation, and continue to this day. The first territorial biologist visited Tern Island in 1946, but repetitive wildlife studies did not begin until 1957. Activity increased when the Pacific Ocean Biological Survey Program began work in 1963 and continued intensive natural history studies through 1968. POBSP investigators alone spent 203 days at FFS during this period. FWS biologists began repeated visits to the atoll in 1964. More recently, FFS has been the principal study area for investigations of green turtle biology, and one of several sites where intensive studies of the Hawaiian monk seal are ongoing. Intensive cooperative studies by FWS, NMFS, Hawaii Division of Fish and Game and Sea Grant involve considerable field time within FFS. Defense related research at Tern Island has involved prolonged visits by representatives of the Defense Mapping Agency, Pacific Missile Range and the Atomic Energy Commission. The National Weather Service has obtained weather data from Tern Island, with the cooperation of the Coast Guard since 1943.

The importance of FFS and other atolls of the Hawaiian Islands National Wildlife Refuge has long been recognized in the scientific community. The lands and waters of the refuge were designated as a Research Natural Area in 1967 because of this recognized importance. The purpose of the RNA status is "to preserve a representative array of all significant natural ecosystems and their inherent processes as baseline areas . . . and "to obtain through scientific education and research, information about natural system components, inherent processes, and comparisons with representative manipulative systems." Other proposals to insure a greater degree of protection for refuge resources (i.e. Wilderness Status, Critical Habitat for endangered species) recognize the value of continued scientific research on a non-interference basis.

Considerable scientific attention has recently been directed towards the atoll environment. Many scientists have stressed the need to investigate the least complex ecosystems to develop a basic understanding of the interrelationships of organisms and their physical environment. Low coral atolls provide such an opportunity. Moreover, investigation of atolls subject to different physical influences provides a comparative picture. Important subjects of study include the dispersal and colonization of species, the effects of natural weather phenomenon (i.e. storms, tidal waves) on the biological environment and the comparative ecology of reef ecosystems under variable oceanographic conditions.

Studies of the atoll environment have occurred in recent years throughout the Pacific, but continued investigations have been hindered by logistical constraints. Facilities at Eniwetok, Kaneohe Bay, Johnston Island, Midway and Kure Atoll have all provided some support for continuing

marine and terrestrial research. Although these facilities may continue to support research efforts, they cannot totally replace the opportunities provided by the existing station at Tern Island and the other islets of FFS.

On the one hand, the tenuous nature of research support arrangements at all of these facilities, including the Mid Pacific Marine Lab at Eniwetok, threatens the continuity of research efforts. Also, the present facility at Tern Island does and could continue to provide support for research not possible at other sites. This would include studies of rare Acropora coral colonies, green turtle biology and a Hawaiian monk seal colony that appears to be increasing in number rather than decreasing. A Tern Island research facility would also provide important logistical support for studies of a great variety of nesting seabirds in a relatively undisturbed environment.

Knowledge of reef ecology would be greatly enhanced by comparative studies at FFS and Eniwetok, as the former site is in a subtropical environment and the latter is in a tropical environment. (J. Maragos, pers. comm.)

Recreational or educational use of Tern Island and FFS, independent of that related to specific research objectives, has been very limited. Logistical considerations and traditional refuge management policy have directed less priority to these objectives. However a limited number of newspaper reporters, authors and filmmakers have visited several Northwestern Hawaiian Islands, including Tern Island. The results of these trips have been seen in a small number of articles and films, some of which have reached international audiences. Federal wildlife biologists have accompanied each of these visitors to the refuge islands. A 1970 HINWR Master Plan noted the importance of interpretive efforts to inform the public of refuge resources, but stressed the hazards of unofficial visitation to the area for recreational or educational purposes. As

an alternative, the plan recommended construction of an interpretive center in Honolulu. The FWS has received numerous requests from individuals to visit the refuge for non-consumptive recreational/educational purposes, but, for the most part, these requests have been denied, because of the potential damage to wildlife resources in the absence of adequate enforcement capability. A notable exception to this rule was a 1978 dive charter trip on the vessel MACHIAS that involved diving outside refuge boundaries at FFS, but included a landing on Tern Island, with FWS permission. Limited recreation for Coast Guard personnel has also been allowed at FFS under agreement with the FWS. These activities include: 1) periodic trips to other islands to collect glass balls; 2) select fishing for local consumption from the Tern Island shoreline and from skiffs within a two mile radius of Tern Island, a two mile radius of La Perouse Pinnacle and outside a 1/2 mile distance from other islets within two miles of Tern Island; 3) snorkel diving (within a two mile radius of Tern Island, except within 1/2 mile of adjacent islands); and 4) waterskiing within a 1/2 mile radius of Tern Island. The lack of refuge personnel permanently on island has prevented close monitoring of activities off Tern Island, but the Coast Guard has been cooperative. The outer island trips have also contributed data on seal and turtle distribution.

Consumptive Use

Several Atoll Research Bulletins portray the history of consumptive use of marine and terrestrial resources in the Northwestern Hawaiian Islands. Recorded exploitation of resources in FFS began as early as 1859, with exploratory efforts to extract guano (Ref. 7). Subsequent commercial exploitation included seals, reef fish, sharks (oil, fins, skin), turtle, beche-de-mer and birds (principally down). As early as 1917, requests to open FFS to commercial fishing were received in the offices of public officials. Initial requests to

establish a fishing station and cannery at FFS were denied. Several boats fished intermittently at FFS and elsewhere in the refuge up until World War II, but serious efforts at commercial fishing accelerated at FFS after disestablishment of the Naval Air Facility at Tern Island in 1946. The first air shipments of fish and turtles from Tern Island occurred in November 1946, and continued intermittently until as recently as 1959. Research investigations of potential commercial fishery yield began with organization of the Pacific Oceanic Fishery Investigation in 1948. Most of the early efforts of POFI at FFS involved exploratory harvest of bait fish. These surveys at FFS and other islands have continued intermittently since the POFI studies under the auspices of the Bureau of Commercial Fisheries, and subsequently the National Marine Fisheries Service. The results of these early attempts at commercial exploitation, the data gathered during fisheries research, the declining stocks of some main island fishery resources and growing concern over exploitation of Northwestern Hawaiian Island fishery stocks by foreign vessels have all contributed to a pattern of increasing interest in commercial exploitation of these waters. Tern Island is viewed by some as a potential support facility that would facilitate resource use. Pertinent data on fisheries stocks, including estimates of potential commercial yield, are addressed in the draft Hawaii Fisheries Development Plan (Ref.63) and will not be repeated here. The results of the ongoing Tripartite Cooperative Agreement and Sea Grant investigations will hopefully contribute sufficient data to objectively evaluate estimates of potential yield, particularly as it relates to fisheries stocks that could be exploited from a support station at Tern Island.

COMPATIBILITY OF VARIOUS MANAGEMENT OPTIONS

Considerable speculation has been directed towards the question of compatibility of different management options under consideration for Tern Island. An attempt at evaluation of compatibility requires acceptance of certain assumptions, while at the same time allowing for some flexibility in implementation. For example, we have maintained the assumption that the FWS will not tolerate, under any circumstances, a support station at Tern Island that will sustain more people than does the present Coast Guard facility. We have also assumed that all types of consumptive or non-consumptive use of refuge waters will be rigorously evaluated for their potential effects on refuge ecosystems. To the extent that various management options we have selected can not be defined in detail, considerations of compatibility must be open to adjustment. Compatibility is as much a function of logistical constraints as it is a function of legal, socioeconomic and other factors.

ABANDONMENT

The assumption is made that selection of an abandonment alternative would be made to minimize impacts of human disturbance on refuge wildlife. A secondary consideration may be the conclusion that the cost of rehabilitation/maintenance of a facility was not warranted when compared to those benefits that might accrue from implementation of one or more of the other management options. The abandonment option would not be compatible with any of the other management options as they have been described in this report. However, some of the objectives of the other options could be at least partially satisfied. A field camp that would permit some research could be established on Tern Island at a later date,

but access would have to be by boat. Deterioration of abandoned equipment and facilities would leave little that was usable for this purpose. This site would have no real advantages over other islands for establishment of a field camp. No air evacuation would be possible from Tern Island once the seabirds had taken over the runway. Abandonment would not necessarily preclude commercial fishing within or outside refuge waters at FFS. Long-range vessels are now successfully fishing waters outside the refuge with no support whatsoever. In order for mid-range vessels or skiffs to fish the area, support facilities could be provided by a mother ship. This vessel could provide fuel, supplies, processing facilities and a place to offload catch. This is the principle behind the ongoing experimental albacore fishery at Midway. Although this alternative may prove to be prohibitively expensive, it should be evaluated.

OUTPOST FACILITY

This management option was designed to allow maintenance of air evacuation capability and to provide a minimum level of support for research. It is incompatible with either of the higher level research station alternatives, as the objective would be to spend the least amount of money necessary to keep the runway open, while maintaining the lowest possible human presence in the refuge. The option would not preclude any of the fishery options that involved exploitation outside refuge boundaries, but if these fisheries needed support, it would have to come from a mother ship or similar offshore facility. Whether or not non-consumptive uses other than research (i.e. recreation/education) was permitted within refuge waters would depend on refuge

management policy, but it would not automatically be excluded by the outpost management option.

MID-LEVEL RESEARCH STATION

This option would require, on the average, half the living support facilities now on the island. However, in view of the fact that most, if not all, support facilities and equipment would be maintained at a full capacity level, other options that required support for 10 or less residents on the island could be made compatible with this option. This would include any of the education/recreation options, the offshore fishery options, and the inshore fishery, assuming that it would be economically viable with a total crew of less than 10 people. Compatibility of fishing and research uses would depend upon whether or not the presence of fishermen and harvest of resources within the refuge was not so disturbing to wildlife as to conflict with research investigations. Some investigations may be intolerant of any explosive use or ongoing disturbance whatsoever. Also, some social conflicts between fishermen and researchers living on the island together may occur as a result of fundamental differences in objectives and attitudes.

FULL-LEVEL RESEARCH STATION

Implementation of this option would preclude any other options that required on-island living support for more than 2-3 people because available facilities would be directed towards a research priority. Also, a full research station would tax existing support capability (water, power, waste treatment, fuel tanks, etc.) to its present limits, so additional equipment or facilities may be required if fishery uses are also to be accommodated. Compatibility of inshore fishing activities with research on and around other islands of the refuge would depend

upon the type of studies conducted and the methods, location and intensity of fishing activity. Those fisheries requiring a minimum of shoreside support (i.e., albacore, precious coral, etc.) would be most compatible. Fisheries that required frequent air shipment involving maintenance of a bird-free runway may conflict with on-island research objectives.

RECREATION/EDUCATION

Non-consumptive recreational and educational uses could conceivably be accommodated in refuge waters at FFS without any support at Tern Island, so the abandonment or outpost options are not necessarily incompatible with this use. However, access would need to be by vessel. Uses of refuge waters would necessarily be very restrictive, if allowed at all, because of the lack of enforcement presence. If, however, restricted recreational or educational uses were determined to be compatible with refuge management objectives, they would not be precluded by any other option or combination of options unless living space on Tern Island was necessary, but unavailable. Because of the problems relating to disturbance of wildlife, it is doubtful that recreational/educational use of inshore waters elsewhere in FFS would be compatible with either research objectives or refuge management policy. Glass ball collecting or other on-shore recreation activities on other islands at FFS would create unnecessary disturbance of wildlife and would likely conflict with wildlife research studies. The most compatible version of the recreation/education option would be to allow one day flights to Tern Island, with on-island supervision by refuge personnel and/or to allow educational tour vessels, under permit, to visit restricted portions of the refuge waters, also under supervision.

INSHORE FISHERIES

Existing living facilities on Tern Island would be sufficient to support an inshore fishing fleet of approximately 10 two-man boats. Depending upon what level of exploitation was minimally viable economically, this fishery could be incompatible with other research or fishery options that require maximum on-island support. This fishery would not necessarily preclude other uses of Tern Island, inshore waters, other islands, or offshore waters. Movement of boats within the refuge could facilitate transport of research biologists and insure greater safety on remote islets, but it would also conflict with research studies requiring minimal disturbance of inshore wildlife, including seals and turtles. Resource harvesting that includes prey of large sharks could lead to greater predation of seals and turtles to compensate for lost food. The inshore fishery station would not conflict with any of the offshore fisheries that don't require on-island living support, and could share expenses to maintain the facility and transport fish to and from Honolulu. This fishery may conflict with other demands for storage capability on the island and require additional sources of power.

TRAP FISHERY STATION

The primary demands that this alternative would put on the island would be fish storage, ice, fuel and moorage. All harvested marine resources would be taken outside the refuge waters. This option would not necessarily preclude any other alternatives, but additional support (water, power, storage) may be necessary to accomodate two or more options. Additional live storage and processing facilities might be required on island for crustaceans, but this would only affect other uses by its requirements for space, water and power. Requirements for frequent air shipment of live catch and disposal of processing wastes

could conflict with some on-island research requirements or refuge management policies.

AHI, BOTTOMFISH, SEAMOUNT GROUND FISH FISHERY

Same as offshore trap fishery, although does not share on-island processing requirement.

AKU FISHERY

If pelagic bait sources were utilized or bait was supplied by mother ships from other areas, aku boats would visit Tern Island only for fuel and ice, with less frequency than if they required land-reared bait or inshore bait harvest. This option would not preclude any other options for Tern Island, but it would be likely to conflict with research uses of inshore waters and other islands in the refuge if bait were taken in these waters. Requirements to use the full runway and support frequent air shipments would not be compatible with some on-island research or education/recreation objectives. There is no apparent conflict between the aku fishery and the other fisheries.

ALBACORE FISHERY

Provided sufficient storage capacity and fuel can be provided on the island, this offshore fishery is compatible with all options, other than the abandonment or outpost alternatives.

SPORT FISHERIES

The sport fishery management option could be compatible with all other options except abandonment and an outpost station. Conflicts between refuge and research goals would have to be resolved. For instance, restriction of sport fishing activities to deeper waters of the refuge or in offshore waters would make the option more compatible

with research and refuge goals. Sport fishing could be compatible with commercial fishing. In view of the competition for living space on Tern Island, the sport fishery would not be compatible with the full-level research or other combined high use options unless sport fishermen were able to live on their boats. Some problems may arise if living facilities were not considered adequate for the type of clientele that the fishery attracted. Sport fishermen may create conflicts with on-island research investigations if they disturb the nesting seabird colonies or other wildlife.

PRECIOUS CORAL FISHERY

This fishery would be compatible with all other management options except abandonment. It would be incompatible with an outpost station if vessels required fuel or other supplies from the island.

SAFETY CONSIDERATIONS

Any consideration of future management options for Tern Island and FFS should include evaluation of current and anticipated safety hazards. Effective planning can incorporate measures to prepare for and respond to accidents or other incidents requiring medical attention. More appropriately, this planning effort should strive to minimize safety risks and to avoid situations that can be expected to lead to serious problems. To date, on-island medical problems have been handled by Coast Guard personnel, including a medical corpsman stationed on the island. Medical evacuation for CG personnel and fishermen has occurred in the past, but we were unable to obtain a record of the frequency of this activity. Boating hazards have been minimized in FFS by the Coast Guard by use of radio communications and a policy that requires use of two boats together for distant trips. However, even this system is not without risks, as at least one trip some distance from Tern Island proved, when motors on both boats failed. Rehabilitation of the station since the waves overtopped the station and damaged the facilities has led to the reconstruction of living quarters to allow waves to pass under. Whether or not this effort will be successful in preventing serious damage or hazard to life remains to be seen.

The types of safety hazards anticipated with the various management options are varied, and some of the risks involved can be significantly lowered or perhaps even eliminated. Some of the safety hazards include: 1) grounding of vessels, 2) vessel breakdown away from the island; 3) diving injuries (i.e. decompression, drowning, shark

and eel attack), 4) fishing injuries, 5) on-island fires, 6) aircraft accidents (at Tern Island, or enroute), 7) weather related injuries (i.e. storm or tidal wave damage), 8) other accidents or illness requiring immediate treatment by a physician.

Simplistically, it is tempting to assume that risks will increase proportionately with intensity of activity, but this is not likely to be the case. Fishing is likely to be more injury prone than is research work, although the frequency with which SCUBA is used will increase the likelihood of injury related to research, aquarium fishery or education/recreation use. Also the risk of being lost at sea due to engine failure will decrease with greater number of boats in the area.

Several suggestions are offered to minimize safety hazards, although whether or not it would be considered prudent or necessary to implement each or all of these suggestions would depend upon which management alternative(s) are implemented. At the very least, any management option requiring movement of boats to and from Tern Island justifies maintenance of channel markers. The Coast Guard intends to remove their buoys in July 1979. FWS should enter into an agreement to retain these buoys by agency transfer, or have the Coast Guard place and maintain FWS buoys. Hazards of interisland travel by small boat should be minimized by maintaining adequate radio communication, traveling in paired boats and employing twin engines on all boats. Proper engine and boat maintenance schedules should also be enforced, and each boat should be equipped with survival supplies, including an emergency radio beacon.

Diving injuries can be minimized by enforcing strict compliance with decompression tables and by taking prudent steps to avoid unnecessary

contact with sharks. Divers should also be equipped with protective equipment such as bangsticks. If research or fishing activities involved a substantial amount of diving, consideration should be given to equipping the facility with a portable recompression chamber. Fishing injuries can probably not realistically be prevented but they can possibly be reduced through proper techniques. One potential hazard of unknown significance is the threat of injury due to inadvertent explosion of mines that were placed within FFS during the war.

The risk of fires on the island and on boats can be reduced through proper techniques, but it can not be eliminated. Storage and frequent transfer of large quantities of fuel, particularly gasoline, will markedly increase the hazard. Precautionary measures should include intelligent placement of storage tanks, strict enforcement of proper transfer techniques, use of adequate fire control equipment and education of residents.

The risk of aircraft accidents can be reduced by proper maintenance of the runway, but a management decision will need to be made regarding the pros and cons of bird control. The Coast Guard will not fly C-130's to the island any more because of the risk of accident due to bird strike, and have expressed a desire to fly any rescue operation that required a Tern Island landing with a light twin engine aircraft. Hazards of long-distance travel by light aircraft are increased significantly by difficulties in navigation. It is imperative that for implementation of any option other than abandonment a radio beacon and suitable communication equipment be maintained in operation on the island. Also, it would be advisable to store some aviation gas on island to add a

measure of safety for aircraft returning to Honolulu and to permit aircraft to conduct search operations in the vicinity of FFS if considered necessary.

Weather related incidents are somewhat unpredictable, and presumably the modifications made to the station after the 1969 incident will be adequate to prevent serious injuries or loss of life. Precautions should be taken to insure that adequate survival equipment (including access to communication gear) is available in a suitable location if a similar situation arises again.

Miscellaneous injury and illness is virtually certain to occur. Some will require immediate medical attention and others will not. Fish poisoning (ciguatera) is one particularly significant medical hazard, although research on this problem is inadequate to date to accurately predict the likelihood of problems at FFS. It would be advisable to station at least one person with training comparable to a medical corpsman on the island for any of the options involving relatively intense activity. Even those persons on the island for an outpost station should be adequately trained medically to be able to handle all first aid requirements. Medical supplies on the island should be adequate to react promptly to most emergency situations. Some arrangement for communication with medical personnel in Honolulu in the event of an emergency may facilitate rapid and effective response.

LEGAL CONSIDERATIONS

A. Synopsis:

Two legal considerations should be taken into account in evaluation of various management alternatives for Tern Island:

1) Current statutory and regulatory directives and limitations affect which options are legally or politically feasible and 2) Rendering a decision unfavorable to State of Hawaii interests will probably involve FWS in either litigation or the political process where the State will seek a more favorable decision.

Federal laws and regulations have preempted almost entirely all current State of Hawaii regulation of the HINWR area or resources. Although there is nominal legal authority of the State of Hawaii over the waters and resource of the Refuge, this authority is partially in conflict with at least two federal statutes, the Marine Mammal Protection Act and the Endangered Species Act. Strict compliance with the EIS requirements of the National Environmental Policy Act, as defined by the new CEQ Guidelines, and a rigorous analysis of the alternative decisions, should make any FWS decision legally sufficient.

B. Preliminary Legal Background:

1. Federal Preemption in the Area of Wildlife Protection

Federal wildlife regulation has become, in the last 60 years, dominant over state authority in almost all areas. This federal preemption of state regulation derives from several authorities in the U.S. Constitution and is best illustrated in a historical analysis of the Migratory Bird Treaty Act. This statute, passed by Congress to implement a convention (treaty) between the United States and Great Britain (for the benefit of Canada) was upheld by the U.S. Supreme Court in a landmark case (Missouri v Holland) which said, in essence,

that the power to make treaties with other nations was solely a federal power. The Court rejected the state theory that it "owned" the wildlife in question and found federal regulation, which also protected the habitat of the birds, necessary since "but for" the treaty, there would be no birds to protect.

Treaties that recognize the importance of protecting endangered species or of regulating commercial fishing are a current example of this constitutional authority and there is no longer any serious challenge by the states to federal preemption in wildlife regulation. Further, statutes such as the Endangered Species Act and the Marine Mammal Protection Act specifically state there is such preemption of state regulation.

However, some federal statutes are also designed to permit surrender of part of this authority to the states. The Endangered Species Act, for example, provides the authority to the Secretary of the Interior to approve the state management of certain areas where there are endangered species. The following section on federal statutes also notes other laws with similar provisions. At the other extreme are statutes such as the Coastal Zone Management Act, which sets certain federal standards for management plans that are to be developed and enforced by the state. States are encouraged in the endeavor by federal funding and the promise of "federal consistency" with the approved plan. Similar to this is the Clean Water Act under which the State of Hawaii now administers the National Pollution Discharge Elimination System (NPDES) permits.

The statutes identified in this section providing the strongest mandates to FWS all preempt state regulation (NEPA, Endangered Species Act, Marine Mammal Protection Act) and, by the interpretation of this part in a most strict construction, close out some management alter-

natives regardless of any types of jurisdictional changes. That is to say, irrespective of the size of the boundaries of the Refuge, its designation as a Wilderness Area, or the eventual return of Tern Island or other portions of the Refuge to the State of Hawaii, there will be no lessening of authority under these Acts.

2. Jurisdictional Background and Conflicts

The basic jurisdiction of the FWS over the Hawaiian Island National Wildlife Refuge (and Tern Island) derives from Executive Order No. 1019 of President Theodore Roosevelt on February 3, 1909 which declared it the "Hawaiian Island Bird Reservation". A map accompanying this Order showed "boundaries" of the Reservation, but there has never been a serious attempt to legally enforce the boundaries in the original executive order as anything more than an indication of the general area of the Reservation. Through other Presidential actions and federal statute, the area was eventually transferred to the Department of the Interior and designated the "Hawaiian Islands National Wildlife Refuge".

Two types of legal conflict between the State of Hawaii and the FWS regarding boundaries are indicated. First, there has been a challenge by the State over the inclusion of Tern Island itself in the Refuge. Second, there has been a challenge by the State over the seaward boundaries of the Refuge, particularly in those atoll groups with extensive shoals such as FFS. Since the present boundaries include submerged lands, this is, in effect, a challenge to the jurisdiction of FWS over the "waters" of the Refuge.

Without belaboring a complex issue, it is our opinion that a challenge in the courts against FWS jurisdiction over Tern Island, if based on the ownership of this land or the proper legality of the

action of the federal government that achieved this ownership, would probably not be successful. The United States expressly reserved the right to make such appropriations of land from the governmental lands of the Republic of Hawaii by the Joint Resolution of Annexation. The subsequent Organic Act which established the Territorial Government of Hawaii then provided that this public property could remain in the "use, possession, and control of the Territory of Hawaii...until... taken for the uses and purposes of the United States by the direction of the President..." The resulting Executive Order No. 1019 is therefore a proper exercise of this authority granted by this federal statute.

However, while it appears that a challenge to the ownership of Tern Island on a purely legal basis would be unsuccessful, the State of Hawaii could be expected to attempt to gain ownership or limited jurisdiction over Tern Island by the political process. It would be clearly within the authority of Congress to accomplish this, in spite of the status of Tern Island as a part of the Refuge. Similar action could be taken, both in the courts and through the political process to reduce the geographical area of submerged lands over which FWS now claims jurisdiction. Current policy of the National Wildlife Refuge System provides a vehicle for periodic review of refuge lands and waters to evaluate areas that may be surplus to refuge needs. However, it is highly unlikely that inshore areas, particularly in FFS, would ever be considered "surplus" in view of their obvious value to refuge wildlife. Also, a decision by FWS to release jurisdictional control over these areas would be constrained by various acts (Endangered Species Act, Marine Mammal Protection Act) and by public controversy.

C. The Legal Climate of a Management Decision

1. Introduction

The previous section has noted that a decision for several particular alternatives for the future of Tern Island by the FWS will most probably produce a conflict with the State of Hawaii and this can be correctly considered to be a "legal consequence" of the decision. For the purposes of this report, it is not considered necessary or possible to predict precisely the final results of such consequences; the decision-makers of FWS should be, aware, however, of such consequences and they will be briefly discussed in Part 1 of this section.

Of more immediate concern is the effect of any management decision on current statutes and regulations and the methods by which various federal and state statutes and regulations constrain any management decision. Part 2 of this section briefly synthesizes federal statutes, Executive Orders, and regulations that will affect any decision and also characterizes the alternatives that are most strongly constrained by the particular statute. Similarly, Part 3 of this section discusses the relevant State of Hawaii statutes and regulations and their affects on the management decision.

It will be obvious from the discussions of each statute and regulation that varying degrees of control on a management decision are displayed. Some management alternatives are absolutely prohibited by a statute, some uses are regulated by conditions or permits, and some actions contemplate mitigation for certain uses. Except for those management uses that are prohibited outright by a particular law or regulation, this section should provide the decision-makers wide latitudes in which to exercise their discretion.

2. Pertinent Federal Statutes and Regulations:

- (a) Lacey Act (Refuge Trespass Act - 18 U.S.C. Sections 42-44, 16 U.S.C. Sections 667e and 701)

The Lacey Act is historically the first federal regulation of wildlife. The Lacey Act made it a federal crime to transport interstate any wild animal or birds killed in violation of state law regulating the same. It further authorized states to apply their own regulations to such animals and birds killed outside their boundaries, if such were violations of the state's laws.

These sections of the criminal statutes have been extensively amended through the years. For example, added in Section 41 is a provision to make it a criminal offense to kill or disturb any wildlife on a sanctuary or refuge. Sections 42 and 43 now more carefully regulate the importation and interstate transport of all wildlife and authorize the Secretary of Interior to promulgate regulations to govern such commerce.

The remaining sections in Title 16 (667e and 701) remain unchanged since 1900 and, as stated above, empower the states to regulate the disposition of dead wildlife even taken outside their borders and further provide a statement of policy for the Secretary of Interior to regulate game and wild birds.

Major effect: In view of more recent statutory enactments that provide similar penalties and a more detailed regulatory scheme, it is unlikely that this statute will have a significant effect on a Tern Island management decision.

- (b) Migratory Bird Conservation Act (16 U.S.C. Sections 715-715d, 715e, 715f-715k, 715n-715r) Migratory Bird Treaty Act (16 U.S.C. Sections 703-711)

These statutes are interrelated, of course, in their purpose to provide a regulatory procedure for the protection of migratory and other birds. Both derive, however, from several treaties between the United States, Great Britain and Mexico. Similar treaties with Japan and Russia have been developed more recently. The treaties are significant in that they establish the pre-eminence of the federal government over the states in this type of wildlife regulation and, further, define species of birds and other minimum regulation that each signatory nation is to implement for the protection of wildlife.

The Treaty Act provides a definition of term used in the conventions, such as the "taking" of migratory birds and makes such taking, killing, possession or interstate transport of these birds (and nests or eggs) illegal unless such actions conform to regulations which the Secretary of the Interior is further given the power of enforcement: to make searches and arrest violators, specific penalties are provided for Violations of the Act.

The regulations published by the Secretary of the Interior provide further explanations of the statutory definitions of terms and provide a list of migratory birds which includes the seabirds of the HINWR (50 CFR Part 10). Less relevant to the HINWR are also extensive regulations for the "taking" through hunting of game birds. (50 CFR Parts 20-21) but "taking" for other purposes is also administered by a permit system (50 CFR Part 13).

The Conservation Act was passed ten years after the Treaty Act to remedy certain deficiencies of the original statute and provides authority for the Secretary of the Interior to acquire "refuges" which were then deemed necessary for waterfowl protection. The statute also creates the Migratory Bird Conservation Commission to

select and acquire refuge lands. Unique under this statute is the right of states to approve the acquisition of such lands before they may be accepted by the Secretary of the Interior into the refuge system.

These statutes interact with the other sections of Title 16 & 50 CFR that provide for the National Wildlife Refuge System. Although the original purpose of the Conservation Act was to establish "inviolate areas", the Secretary is now given the authority (Sections 668dd(d)(1)) to allow other uses of these lands if he finds there is compatibility with the "major purpose" of the refuge.

Major Effect: These statutes provide the basic authority and responsibility for the Department of the Interior to protect the sea birds cited in the international conventions. Any management alternative which predicts a conflict with these basic responsibilities may be a violation of the statutes. This would include options that required "control" of sea birds nesting on Tern Island, although this action could be authorized under permit if considered necessary for refuge management. Any action that adversely impacted sea bird species through depletions of food sources or other disturbance may also be in conflict with the legislation.

Although the state is given approval authority over the conversion of non-federal lands into refuge status under the Conservation Act, this section (Section 715f) is only applicable to the above enumerated sections of the Conservation Act and the acquisition of lands or interests under other statutes (i.e., National Wildlife Refuge Administration Act) mentioned in this Part of the report is not affected.

- (c) Fish and Wildlife Act of 1956 (16 U.S.C. Sections 742a-754);
Fish and Wildlife Coordination Act (16 U.S.C. Sections 661-667e)

These statutes provide an "organic act" for the Fish and Wildlife Service and specify a process of coordination that is to be followed by other federal agencies with responsibility for water resource projects that have potential impacts on wildlife resources. The Fish and Wildlife Act makes only brief mention of "wildlife" and rather develops extensive policy for the promotion of the fishing industry and recreational fishing. However, policies developed in other statutes, such as the Refuge Act, and the Endangered Species Act have since balanced this initial emphasis.

The Coordination Act has been somewhat overshadowed by the National Environmental Policy Act and agencies avoid the problem of separate mandates to some extent by combining requirements. The coordination process for water resource projects then is normally accomplished as part of environmental assessment or EIS process. The Act includes both water resource projects of federal agencies and those other water resource projects which require a federal license or permit, such as that issued by the Corps of Engineers under the Clean Water Act.

Major Effect: The most likely effect of the Coordination Act will be requirements for federal permits for certain modifications to Tern Island or near shore waters. Since the stricter standards of the Endangered Species Act would also be brought into play as a result of this prospective "federal action", the net result would be the same if only the Endangered Species Act was considered.

(d) National Historic Preservation Act of 1966 (16 U.S.C. Section 470); Historic Sites Act of 1935 (16 U.S.C. Section 461)

The original statement by Congress in 1935 to declare a policy of preservation of sites, objects, and buildings of historic significance for the "inspiration and benefit" of the people of the United States was later expanded in the 1966 statute to include both an expanded policy statement, a procedure, and funding for a operable program that would accomplish these goals.

Both the statute and a later Executive Order (No. 11593, May 13, 1971) designate the Secretary of the Interior as the responsible official for administering the procedures for nomination, registration, and protection of historic sites. All federal agencies are directed by both statute and the Executive Order with the responsibility of identifying both potential and actual historic sites that may be affected by their agency action and implementing procedures that will carry out the policies of the statutes.

Where federal agencies have implemented regulations to carry out this responsibility, these regulations include consultation with the affected State Historic Preservation officer and the federal Advisory Council on Historic Preservation and public notice and meetings. The most recent amendment to this statute makes mandatory the consultation process with the Advisory Council for all federal agencies either undertaking an action or expending funds that directly or indirectly affect properties in or eligible for the National Register (Section 470(f)).

Funding for the preservation of historic sites is available as matching grants to states and the National Trust for Historic

Preservation, but not directly to the federal agency with jurisdiction over the property.

Major Effect: There are no properties in the HINWR that have nominated or placed on the National Register of Historic Sites but as referenced in the Section on Archeological Historic Resources, potential sites have been identified in HINWR.

Therefore, FWS has the responsibility to examine the criteria for nomination (36 CFR Part 800) and, as suggested by these regulations, to include the necessary historic site evaluation in a Environmental Impact Statement that evaluates refuge management alternatives.

- (e) National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. Sections 668dd-ee); Refuge Recreation Act of 1962 (16 U.S.C. Sections 460k-460k-4); Land and Water Conservation Fund Act (16 U.S.C. Sections 4601-5-4601-11)

These statutes together represent the authority of the Secretary of the Interior to administer wildlife refuges according to standards and policies established by Congress. Funding is provided for the management of refuges and for the acquisition of lands for both wildlife refuges and specifically, for the protection of endangered or threatened species, as also specified in the Endangered Species Act (compare Section 4601-9(a)(1) with Section 1534a)

The Administration Act has been amended, most significantly in 1976, to provide standards that must be met before the Secretary of the Interior can dispose of any refuge lands. These standards include consultation with the Migratory Bird Conservation Commission

and a finding that the lands are no longer needed for System purposes.

The basic statute establishing the National Wildlife Refuge System brought together several previous authorities, jurisdiction and designations of this type of land. The most important section of the Act is the recognition of multiple uses of refuge lands. Although the conservation of fish and wildlife is the dominant theme, the Act recognizes the public interest in hunting, fishing and other recreational interests and allows the Secretary to make regulations that will allow such activities where there is compatibility with the "major purpose" for which the refuge was established.

Therefore, there is a basic compatibility with the Refuge Recreation Act, which also allows certain parts of refuge land to be used for public recreation, so long as there is no conflict with the "primary objective" for which the refuge is established. The Refuge Recreation Act also allows the acquisition of land and specifically mentions such acquisition for the protection of threatened or endangered species.

The Land and Water Conservation Act provides, in addition to proceeds from entry, license, and various other fees, significant appropriations of funds from Congress for the acquisition of lands for refuge and other purposes. The initial controversy between this statute and the Recreation Act, which

seemed to allow only such acquisition where there was a public recreation value of the lands, has now been eliminated. There is now clear authority and funding to acquire lands, such as a critical habitat for a threatened or endangered species. The Act also specifically mentions the acquisition of "interests" in land that could be legally defined to include, for example, the as yet legally unrecognized "interest" of the State of Hawaii in Tern Island or in other parts of the HINWR. Funding is also permitted to the states on a matching basis, but only where the state has developed a comprehensive outdoor recreation plan that meets certain standards and is approved by the Secretary of the Interior.

Major Effect: Challenges to the authority of the Secretary of the Interior to make regulations on the basis of this statute which may exclude certain activities from refuges have not been upheld by the courts. More significantly, where the Secretary of the Interior has permitted recreational uses (and, by implication, almost any other use not "primary" to the refuge purpose) without a clear finding that the recreational use would not "interfere with the Refuge's primary purpose as an inviolate sanctuary for migratory birds", the court has overturned those regulations. (Defenders of Wildlife v. Andrus, 11 ERC 2098 (1978)). Although this opinion was from a federal district court, it can provide the basis for a citizen's group to similarly challenge a FWS management decision allowing an activity that they consider not to be compatible with the "primary purpose" of the HINWR.

The funding authorities made available by the two statutes here mentioned and also by the Endangered Species Act should also

be considered as a method to negotiate with and acquire from the State of Hawaii any "interests" in the Refuge.

Finally, the disposition of any portion of the refuge to the State will invoke those provisions of the statute which require coordination by the Secretary of the Interior with the Migratory Bird Conservation Commission and a finding that the lands are no longer needed for the purposes for which the System was established. A decision to consider disposition of a portion of the refuge would also invoke other federal mandates (NEPA, Endangered Species Act, Marine Mammal Protection Act and others).

(f) Research Natural Area (40 FR Sections 8127-28)

The Federal Committee on Ecological Reserves has established policies and standards for both federal and other lands which can be designated "research Natural Areas". These areas enjoy no legal status of their own, but the suggested policies and management practices of the Committee were intended to be guidelines for federal agencies in selecting and managing Research Natural areas. Also, the Committee states that the policies can be included "verbatim" in agency regulations. Research Natural Areas on national wildlife refuges derive regulatory protection through 50 CFR. The basic theme of the committee policies and agency regulations to implement them is the protection of ecosystems in a natural state with no intervention of man except to preserve the system.

Major Effect: The designation of lands and waters of the HINWR Research Natural Areas in 1967 can be considered by the FWS as supportive "policy" that should favor a decision for a management alternative which closely preserves either the status quo or other options which include stringent natural preservation. The policies

governing Research Natural Areas and their related goals are likely to play an influential role in the management decision for Tern Island. Designation of RNA Status is demonstrative of FWS management policy, as enforced by other refuge regulations.

(g) The Wilderness Act of 1964 (16 U.S.C. Sections 1131-1135)

This statute establishes the policy of Congress to allow certain federally owned land to be designated "wilderness areas" within a National Wilderness Preservation System. Such designation does not change the agency or department that heretofore managed those lands, but rather provides the strictest standard in law for regulation of land use. Generally speaking, all commercial enterprises, permanent roads, use of mechanized vehicles and structures are prohibited in these areas.

The Act mandates the Secretaries of Agriculture and Interior to review lands within their jurisdiction and make recommendations within ten years after enactment for inclusion within the wilderness designation of areas larger than 5000 acres that would qualify. Singled out in the Act are "roadless islands within the national wildlife refuge".

The Northwestern Hawaiian Islands Wildlife Refuge has been twice proposed to Congress for designation as a wilderness area. The initial proposal included all land and water within the refuge boundaries (with the exception of Tern Island and adjacent waters) and the current proposal includes the much smaller area of emergent islands only (also excluding Tern Island). Strong State of Hawaii opposition to the designation of any area of the Refuge that will prohibit commercial fishing activities has been instrumental in preventing adoption of either.

Major Effect: If the original wilderness proposal was adopted, restrictions on commercial activities within FFS waters would make inshore fishing and bait harvest for aku fishing unfeasible uses for Tern Island. Other fishery options could conceivably continue if boat movement and their activity were confined to the dredged channel and immediate area surrounding Tern Island. Wilderness designation of emergent islands (excluding Tern Island) would not necessarily inhibit commercial or non consumptive use of nearshore waters, but it would prevent placement of permanent structures on other islets. It may also provide additional restrictions to adjacent activities that could adversely impact the designated lands (i.e., oil spills, unauthorized landing, etc.). It should be noted that the Wilderness Act does not provide any additional funds nor authorities for management in areas so designated, nor are penalties provided for violations of the wilderness standards. However, refuge regulations can be developed to enforce wilderness management guidelines.

(h) Endangered Species Act

Formal involvement by the Federal government in endangered species legislation began with the Endangered Species Preservation Act of 1966 (80 Stat. 926). This Act required the Secretary of the Interior to publish a list of animals threatened with extinction. The first list of Hawaiian species was the result of an evaluation of existing biological data by State and Federal biologists. The 1966 Act was amended by the Endangered Species Conservation Act of 1969 (16 U.S.C. Section 668aa). The 1969 Act provided Federal prohibition against the taking or possession of native endangered fish and wildlife, with broadened coverage to include all vertebrates, molluscs and crustaceans. Between 1969 and 1973

three editions of a publication entitled Rare and Endangered Wildlife of the United States (3rd edition was Threatened Wildlife of the United States) were distributed by the Department of the Interior. A list published in May 1972 included 28 Hawaiian birds and one Hawaiian mammal, the Hawaiian bat.

The Endangered Species Act of 1973 (P.L. 93-205, 85 Stat. 884) became effective on 28 December 1973. The new law extended protection to include plants as well as animals. It also established a "threatened" category to include species likely to become endangered within the foreseeable future throughout all or a significant portion of their range. Section 7 of the Act explicitly instructed Federal agencies to carry out programs for the conservation of listed species and to insure that their actions do not jeopardize the continued existence of listed species or their "critical habitat". The 1973 Act also prohibited the "taking" of listed species. Subsequent regulations have further defined terminology in the Act, including the words "take" and "critical habitat". Procedures for interagency consultation were established in regulations published in the Federal Register in January 1978.

In May 1974, the first list of endangered fauna since the 1973 Act was published by the Department of Interior. In addition to those Hawaiian species which appeared in earlier lists, the new list included some marine species (several whales and two turtles occasionally found in Hawaii: Hawksbill, Loggerhead) whose wide distribution includes Hawaii. Since the 1974 list, one Hawaiian mammal (Hawaiian Monk Seal) and two Hawaiian birds (Po'ouli, Hawaii Creeper) have been added to the endangered list;

one turtle (Green Turtle) and one bird (Newell's Shearwater) have been added to the "threatened" list. In addition, one plant species has been added to the endangered list and two cave invertebrates on Kauai have been formally proposed for listing.

The Act was amended in November 1978. The amended Act described a process of interagency consultation with the FWS (or NMFS, depending upon which species are involved) to insure that Federal actions do not conflict with the Act. The formal consultation process involves a review of proposed Federal actions by the FWS (and/or NMFS) to determine if an action is likely to jeopardize the continued existence of listed species or destroy or adversely modify "critical habitat". The FWS (or NMFS) will then render a formal biological opinion to this effect. If the agency proceeds with the action, in conflict with the Act, this agency is liable to public suit under the provisions of the Act. It is important to note that the FWS must also undertake its own "internal" consultation (or consultation with NMFS) for actions which may conflict with the Act.

The new amendments also provide for a process by which a Federal agency may seek an exemption to the restrictions of the Act if the consultation process leads to an irresolvable conflict with FWS or NMFS. The exemption process involves two major steps, including evaluation by a Review Board and a Cabinet-level Endangered Species Committee. An exemption can be granted only after a finding that there are no reasonable and prudent alternatives, that the benefits of the action clearly outweigh

the methods of conserving the species and the action is of regional or national significance.

Major Effect: The Endangered Species Act will play an important role in the Tern Island management decision. The law requires that the agency (in this case, the refuge branch of the FWS) initiate consultation with the endangered species office of the FWS and with NMFS because the management decision for Tern Island may affect endangered monk seals and/or threatened green turtles or indirectly the endangered wildlife on other refuge islands. Although no "critical habitat" for either the seal or turtle has been formally designated as yet, proposals for defined CH boundaries are under review. Formal designation of CH for either or both species will include both land and water areas within specified boundaries. It is important to note that the Section 7 restrictions apply to any action "authorized, funded, or carried out by (a Federal) agency". Under the present interpretation of jurisdiction at FFS, any alternative requiring access to refuge waters or islands would require FWS authorization, thereby placing FWS under the direct influence of Section 7. Also, any State or private action (i.e., establishment or operation of a fishing station, or fishing within the refuge) that includes any Federal involvement (i.e., federal loans) would also require consultation by the involved Federal agency. The prohibition in the Act against "taking" (which includes harassment) would also effect the legality of actions undertaken by any agency or individual.

- (i) National Environmental Policy Act of 1969 (42 U.S.C. Sections 4321-4347)

(See Section 2 of this report for a discussion of the relevance of NEPA to this study).

- (j) Marine Mammal Protection Act of 1972 (16 U.S.C. Section 1361 et seq.)

This Act states a Congressional finding that certain marine mammals may be in danger of extinction and establishes a policy to protect the mammals, their "rookeries, mating grounds, and areas of similar significance" from adverse action of man. Both the Secretaries of Commerce and Interior, depending on the species of mammal, have responsibility for enforcing the statute and promulgating regulations (See 50 CFR Part 216 and Part 18).

The statute prohibits the "taking" of marine mammals and defines "taking" similarly to the Endangered Species Act, to include any harassment or attempt to do so. Not only is the "taking" of marine mammals illegal under the Act, but also illegal is the importation of any fish which was caught in a manner prohibited by regulations whether or not there was a taking or marine mammals incident to the fishing. Illegal acts under the statute make the offender subject to forfeiture of his vessel, cargo, and civil penalty not more than \$25,000. The Act was partially amended by the Fishery Conservation and Management Act of 1972 to extend the jurisdiction of the United States over marine mammals to 200 nautical miles from the coasts (baselines), the same as for fishery jurisdiction.

The Act does allow "taking" of Marine Mammals by permit from the Secretary of Commerce, after consultation with the Marine

Mammal Commission and its Committee of Scientific Advisors.

Much controversy has arisen over the granting of such permits to allow the taking of porpoise in connection with commercial tuna fishing. The granting of this permit was initially prohibited by a federal court because the Secretary had not made the necessary scientific findings required by the Act (Committee for Humane Legislation, Inc. v. Richardson, 414 F. Supp. 297 (1976)), but was later granted by a federal Court of Appeals when the "quota" of porpoises had been properly adjusted (540 F. 2d 1141 (1976)).

The Act further provides that its provisions completely preempt all state regulation of marine mammals, unless a state adopts a regulatory scheme acceptable to the Secretary, in which case provision is made for funding of the state's regulatory program.

Major Effect: The absolute moratorium on "taking" would apply of course to the Hawaiian Monk Seal and cetaceans of the refuge, and would include any action that could be interpreted as harassment of the species (50 CFR Part 216.15). It is difficult to imagine any circumstances under which the Secretary would permit such "taking" in the NWHI.

The Act, in effect, also extends the jurisdiction of FWS to the 200 mile boundary from the Refuge land areas (baselines) although some challenge could be expected to this extension unless there was an administrative declaration that such boundaries constituted the "significant areas" for protection of the monk seal.

(k) Marine Protection, Research and Sanctuaries Act (16 U.S.C. Sections 431-1434, 33 U.S.C. Section 1401-44)

The larger portion of this statute has been codified with statutes controlling the pollution of waters and is commonly referred to as the Ocean Dumping Act. It provides for a permit system, to be administered in part by the Secretary of the Army through the Corps of Engineers, for any dumping of "dredged material". Permits for material other than "dredged material" are granted by the Administrator of the Environmental Protection Agency.

The remainder of the statute authorizes the Secretary of Commerce to designate certain coastal areas as "marine sanctuaries: after consultation with other federal officials, agencies and the approval of the President. The statute authorizes the promulgation of regulations and provides for civil penalties not to exceed \$50,000 for violation of those regulations.

The regulations (15CFR,Part 922) delegate to the Administrator of NOAA the authority to receive nominations for marine sanctuaries and to make and enforce regulations for each sanctuary. The sanctuaries are defined to mean "waters" extending to the edge of the Continental Shelf and "their connecting waters."

Only two areas have been designated as marine sanctuaries under this act, neither of which are in Hawaii.

Major Effect: The ocean dumping provisions will require any disposal of material from Tern Island to obtain a permit from either EPA or Corps of Engineers, depending upon the nature of the material. Either would be a "federal action: that could interact with other statutes,

such as NEPA or the Endangered Species Act.

More significant is the potential for part or all of the HINWR to be designated as a Marine Sanctuary. The dispute with the State of Hawaii over the waters of the Refuge and the question of location of a refuge boundary could be settled, albeit at the price of shared jurisdiction with NOAA, by such a designation. If regulations are adopted for such a sanctuary that stress the necessity of protecting the rare species and habitat, this designation could preclude commercial fishing options within protected waters, much as the current refuge regulations do today.

(1) Coastal Zone Management Act of 1972 (16 U.S.C. 1451 et seq.)

This statute establishes federal policies and goals for the management and development of the nation's "coastal zone" and provides a program to encourage the coastal states to develop management plans in conformity with the federal standards. Upon acceptance of such plans by the Office of Coastal Zone Management (NOAA, Department of Commerce), states will then have the authority to regulate, usually by a permit system, all uses in the state-designated coastal zone. Federal lands are excluded from state control under the CZM act; however, Section 307 of the Act provides that all federal actions that affect the coastal zone must conform "to the maximum extent practicable" with the state management plans. Federal regulations to achieve this consistency have been promulgated and a process is established by which conflicts between federal actions and an approved state CZM plan can be resolved.

Major Effect: The following section on State of Hawaii Laws provides details of Hawaii's CZM program. The current state boundaries for the

coastal zone include the entire state, and by some interpretation, the waters of the HINWR (lands excluded as federally owned). Strictly construed, all management alternatives affecting the coastal zone would have to conform with the policies of the state CZM program. Ordinarily, because of the refuge status of French Frigate Shoals, this should cause no problems. In fact, this area would properly be designated as an "area of particular concern" where special management measures would be adopted. However, the State CZM specifies no priority among its conflicting policies governing plans for the coastal zone. Among these policies is the encouragement of coastal development that will aid the economic development of the state. Therefore it is conceivable that the state of Hawaii could invoke the federal consistency requirements of the Act after the selection of a management alternative which would deny commercial fishing. Given the clear intent of the federal statute to preserve areas such as the HINWR, it is doubtful whether such a dispute would survive the above-mentioned process for resolution.

(m) Fishery Conservation and Management Act of 1976 (16 U.S.C. Sections 971, 1362, 1801, 1811-1813, 1821-1825, 1851-1861, 1881, 1882; 18 U.S.C. Sections 1972, 1973).

This statute has several sections that are especially relevant to the HINWR. First, it extends the jurisdiction of the United States over waters 200 miles from the territorial sea baselines (coastline) not only for fisheries management, but also for regulation by the Marine Mammal Protection Act (sections 1362-15); second, it exempts "highly migratory species" from the statute; third, it defines all species of precious coral as "continental shelf fishery resources" within the juris-

diction of the Act; fourth, it prohibits all foreign fishing within the fishery conservation zone (unless permitted by an approved fishery management plan); and fifth, it establishes the Regional Fishery Management Councils which have the authority to regulate the types and quantities of fishery harvest within their jurisdiction (The Western Pacific Fishery Management Council includes Hawaii, American Samoa and the Marianas).

Major Effect:

Although this statute is now almost three years old, there has been little practical effect on the Western Pacific region because management plans for the area have not yet been adopted or enforced. Further, the exemption of "highly migratory species" has now been defined by regulation to include all tunas (specifically mentioned are aku and ahi). Since expansion of the fishery is a major controversy in the HINWR, the Act may prove to be particularly relevant in determining which fisheries are economically attractive.

The State of Hawaii has several methods of input into the prospective management plans, but it is interesting to note that the federal regulations provide for consideration of both State fishing regulations and the state CZM plan and provides for discretionary adoption of state or other local government fishing management measures (laws and/or regulations).

The Act does not automatically preempt state regulation of fishing within the 3 mile limit. However, the Secretary can accomplish such preemption after a hearing, and after making a formal determination that a state has failed to act to carry out a fishery management plan. The provision may have application to refuge waters if current FWS regulations (which now prohibit fishing) are changed.

(n) Intervention on the High Seas Act (33 U.S.C. Sections 1471-84)

This statute gives the Coast Guard the authority, under an international treaty, to take measures on the high seas to prevent potential oil pollution of the "coastline or related interests of the United States." Specifically mentioned in this statute are such interests as fish, shellfish, and "other living marine resources." The Coast Guard is authorized to use all public and private efforts to prevent such harm, including the destruction of the vessel or its cargo. Interference with these Coast Guard activities is made a criminal offense, but the United States has also waived its sovereign immunity and declared a court action can be brought in the Court of Claims for "excessive measures."

Major Effect

This statute provides the Coast Guard basic authority to protect the HINWR from all types of "catastrophic" oil pollution, as it had by its proposed "area to be Avoided" designation, since the sinking of the IRENES CHALLENGE. The statute does not provide for any other types of procedure to deal with oil pollution except in the cases where there is a clear abnormal circumstance. It is doubtful under this statute whether the Coast Guard has the authority to intervene where it might suspect other activities, such as bilge pumping, would produce oil pollution. Other regulations, of course, prevent this activity within refuge waters. The effect, therefore, is to put FWS on notice to notify the Coast Guard for the control of a potential oil spill through an accident.

(o) Act for Preservation of Antiquities (16 U.S.C. 431-433)

This statute gives the President the authority to designate as national monuments those lands he considers of historic or scientific

value. This authority has been upheld by the United States Supreme Court to include such designation for purely scientific purposes, as in the case of the designation of the Devil's Hole for the protection of the endangered Devil's Hole pupfish (Cappaert v United States, 96 S.Ct. 2062 1976).

More recently, President Carter used this authority to designate 17 separate tracts of Alaskan land as National Monuments to protect those tracts from state control or commercial development when Congressional authority over those lands expired (Presidential Proclamations No. 4611 through 4627, December 1, 1978).

Major Effect

Although speculative, at least one environmental commentator has suggested this authority of the President is most suitable for designation of the HINWR as a national monument for the protection of the monk seal. (Ref 72).

(p) Federal Water Pollution Control Act, As Amended by Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

This statute effectively prohibits any type of discharges into waters of the United States unless permitted by a specified authority. All types of discharges, except those specified in Section 404 of the Act, are regulated by a National Pollutant Discharge Elimination System. This would include any type of sewage outfall, referred to in the Act as a "point source" discharge. The Act further provides that the administration of the NPDES permits can be taken over by the states, provided each state implement a plan acceptable to the Administrator of the Environmental Protection Agency. Section 404 of the Act regulates all discharges of "dredge or fill" material and allows it only when permitted by the

Secretary of the Army, acting through the Corps of Engineers. These permits can also be administered by the states, upon approval of an administrative plan.

The relevant NPDES system is administered by the State of Hawaii, Department of Health, and is more completely discussed in the following section on State Regulations. It is important to note, however, that issuing of any permit is for a limited period of time (five years) and is subject to the objection of the Regional Administrator of the Environmental Protection Agency, thus bringing some federal oversight in the process.

The permit program of Section 404 of the Act is administered by the Pacific Ocean Division, Corps of Engineers. "Dredge or fill" material has been defined by federal regulation and statute to include almost anything placed in the water and most commonly includes any type of construction material placed in the water or removed from the water, such as sand, gravel, concrete, steel, dirt, etc. The process of getting a permit can include public hearings and the preparation of an EIS if there is, in the opinion of the District Engineer, sufficient public interest in the particular action being permitted or if the action of granting the permit will meet the guidelines of NEPA as a "major federal action significantly affecting the human environment."

The Clean Water Act provides for both criminal and civil penalties for unpermitted discharges and for injunctive relief to prohibit current or planned actions that will result in discharges (Section 309). The Act also grants, in Section 505, the right for citizen suits against any person, including the United States, where there is an allegation of a discharge violation or inaction by the Administrator of the Environmental

Protection Agency.

Major Effect

The present discharge of treated sewage from Tern Island is allowed by permit issued under the Clean Water Act (NPDES). The current permit, issued by the EPA in 1978 specifies a quantity of discharge that could be increased under some management options. Therefore administrative action would be necessary to modify or re-issue this permit. Further, many of the management alternatives could require some type of dredging or filling (dock, channel modification) which would additionally require a Department of Army (Section 404) permit. Either or both of these permits would be federal actions that could interact with other federal laws, such as NEPA or the Endangered Species Act and thus require an EIS or the consultation process under the Endangered Species Act.

The provision granting standing for citizen suits under the Clean Water Act can additionally expect to trigger legal action by environmental groups if they are in disagreement with the FWS choice of management alternatives.

(q) Rivers and Harbors Act of 1899 (33 U.S.C. 401 et. seq.)

The Army Corps of Engineers is authorized by this statute to regulate the construction of any obstruction to navigation in the navigable waters of the United States and this regulation has taken the form of a permit program which grants "Section 10" permits for such construction. There is no procedural difference in the granting of a Section 10 permit as compared to a Section 404 permit under the Clean Water Act. Section 10 has traditionally been applied to the construction of docks, wharves, pilings and the installation of submerged pipelines, outfalls, etc. The

jurisdiction of the Corps of Engineers under Section 10 is limited to "navigable waters" which is, in many cases, less extensive than their jurisdiction under the Clean Water Act. In practice, however, since the construction of Section 10 structures almost always involves the "discharge of dredge or fill material", such actions are also regulated by Section 404 and a permit applicant is required to follow the same procedure for either permit (see 33 CFR Parts 322 through 325).

Major Effects

Any person, state or federal agency that is planning an activity that will create any obstruction to navigation, other than the maintenance of an existing structure, will be required to obtain a Section 10 permit. The failure to obtain such a permit is a violation of the act and makes the violator liable for criminal penalties and/or fines.

In the consideration of Tern Island alternatives, strict compliance with Section 404 requirements of the Clean Water Act will satisfy Section 10 requirements.

(r) Federal Aid in Wildlife Restoration Act (16 U.S.C. Section 669)

This statute provides funding for wildlife restoration projects to states which submit to the Secretary of Interior, and get approval for, comprehensive plans for a wildlife restoration project which recognizes both conservation and recreational values. Included in the possibilities for funding is the acquisition of lands by the state, administration, and research costs.

Major Effect

The provisions of this statute should only have limited effect on the HINWR and only if there is some type of decision which may give the

State of Hawaii partial jurisdiction in this area. Such a decision would probably require the consent of the Secretary of the Interior, and, in that event, funding should be considered under this Act as an aid to the State of Hawaii.

3. Pertinent State Statutes and Regulations

(a) Natural Areas Reserve System (H.R.S., Ch. 195); Marine Life Conservation Program (H.R.S., Ch. 190)

The statute involving marine areas declares all waters of the State of Hawaii to be a "marine life conservation area" and prohibits fishing or the taking of any marine animal unless in accordance with DLNR regulations. DLNR is mandated to make rules and regulations to govern the taking and conservation of marine species. DLNR can, and has, established special marine life conservation districts, in which consumptive uses are generally prohibited.

The statute involving the "natural areas reserve system" makes a statement of policy to establish such a system to preserve "as relatively unmodified as possible" certain areas for both the enjoyment of future generations and to serve as "baselines" for measurements of changes in the Hawaiian environment.

DLNR and the Natural Area Reserves System Commission are given the authority to administer and make recommendations for acquisition of land and guidelines of regulations. No specific mandates are given in the statute nor are funds authorized specifically for any purpose.

Effects

These statutes, taken together, form the state equivalent of a "marine sanctuary" and/or a "research natural area." However, neither designation has been applied to lands or waters in the HINWR so there is apt to be no effect on the decision for management alternatives at Tern Island. Either designation could be applied as an alternative form of resource protection for lands or waters under state jurisdiction.

(b) Hawaii Endangered Species Act (H.R.S., Ch. 195-D4 through 195-D10); Monk Seal Act (H.R.S. Ch. 188-55); Regulation 36, Board of Land and Natural Resources.

The two State laws mentioned here provide protection similar to the federal Endangered Species Act. The State list of endangered species includes only birds and mammals, and with few exceptions is virtually identical to the federal list. One exception significant to this discussion is the omission of the green turtle from the State list. The State act provides a mechanism for coordination with federal programs and between federal agencies.

The Monk Seal Act makes it unlawful to "molest, kill, capture or possess" any Hawaiian Monk Seal or part thereof, and gives the seal the status of a "protected animal." Criminal penalties are provided for violations.

Regulation 36 (BLNR) established penalties for taking or disturbing of green turtles or their nests, except with a BLNR permit.

Effects

As stated earlier, federal legislation completely preempts state regulations, so there is no management alternative which would be affected significantly by these state statutes. Recent listing of the green turtle as a "threatened" species makes the permit system under State Regulation 36 illegal. Uncertainty regarding federal/state jurisdiction does not affect the authority of the FWS and other federal agencies to enforce laws that preempt these statutes.

(c) State Sanctuaries or Wildlife Refuges

The State, acting through the BLNR, is empowered to acquire and/or

set aside lands and waters for protection of wildlife and habitats. In cooperation with the FWS (then Bureau of Sport Fisheries and Wildlife) the State established a wildlife refuge in the NWHI in 1952. Boundaries were identical to the HINWR, although Kure Island was also made part of the State refuge. Regulation 7 (BLNR) also established a State Seabird Sanctuary for protection of indigenous seabirds and their nesting habitat. A total of 33 islets within the main islands are included.

Effects

Federal laws implementing migratory bird treaty acts preempt state regulations over seabird species, and FWS management authority preempts State authority over the HINWR.

The State Seabird Sanctuary could be expanded to include any islands (including Tern) over which the State was able to assume jurisdiction, although under the present situation, then State statutes have little relevance to the Tern Island management decision.

(d) Environmental Protection Act (H.R.S. Ch. 343-1 through 7); State Environmental Policy (Ch. 344)

These statutes are modeled on NEPA, but depart in significant aspects that weaken their effectiveness considerably as compared to NEPA.

The State law provides both an overall policy and a more detailed set of guidelines that specify 10 separate areas of consideration. Agencies are required to "consider" these guidelines and, as in the policy areas of the State Coastal Zone Management Program, there is potential for conflict among guidelines that vary from the "protection of endangered species" to the "encouragement of industries...in harmony with the environment."

The statute provides for types of actions that require an EIS to include actions that "will probably have significant effect" on the quality of the environment.

The State has provided, however, regulations to correspond somewhat to the federal CEQ guidelines (Environmental Quality Commission Regulations) but a wide degree of agency discretion is allowed by these regulations.

In a recent Hawaii Supreme Court case challenging the adequacy of a State EIS (Life of the Land v Ariyoshi, 11 ERC 1940, April 26, 1978) the court did look to some degree to federal cases for statutory interpretation, but held that a cost/benefit analysis of alternatives was only a discretionary, but not mandatory, agency requirement.

Effect

State planning procedures are specifically exempted from the EIS requirement and the statute also provides procedures to accept a federal EIS as satisfying State requirements. FWS decisions for Tern Island may be brought, indirectly, under State EIS requirements by the "federal consistency" requirements of the CZM Act, since such decisions technically affect the State "Coastal Zone." Submission of the federal EIS should satisfy this statute.

(e) Coastal Zone Management Act (H.R.S., Ch. 205A)

The State of Hawaii Coastal Zone Management Program is the state implementation of the federal statute (CZM Act of 1972) intended to encourage states to protect coastal zone resources in accordance with congressional standards.

The state program, although basically implemented by the above-mentioned statute, actually depends on this statute to establish a

framework and basic policies for the program, which, in turn, has produced a program document that has identified laws, regulations and authorities to implement these policies. By executive order of the Governor, all state agencies have been mandated to conform regulations and policies to the program, and, as mentioned in the federal section, approval of this program by Office of Coastal Zone Management, NOAA, has implemented that part of the federal statute which mandates "federal consistency" of the federal agency action with the state plan.

Significant for the HINWR is the definition in federal regulation of "coastal zone" to include the territorial sea, thus the states gain a degree of influence over such areas adjacent to federal lands. However, "refuges" are also specifically defined by federal regulation to be areas of "national interest" and each state is therefore mandated to recognize this fact in their programs.

The federal statute and regulations also mandate procedures for identifying and designating "areas of particular concern" for special regulation or protection, suggesting, among others, a conservation intent. The state program has identified the several marine conservation districts and Kakaako (urban renewal) as such areas.

Effect

Program approval by OCZM took place in September, 1978, and therefore, the state program is untested. Several commentators have noted potential problems with the state program that will undoubtedly produce conflict, such as the role of counties in management vis-a-vis DPED (lead agency) and the lack of priority among conflicting program policies. In particular, conflict in policies for resource conservation and economic development is anticipated to affect management options in the NWHI.

The program has the potential for providing the strongest influence of any state statute over a HINWR management decision, but given the "national interest" in the refuge, such influence would not be sustained by the Secretary of Commerce if contra a decision to preserve refuge values. Further, since the state statute provides for citizen suit, any state decision to compromise or mal-influence the refuge would surely be challenged by citizen groups.

(f) Leeward Islands Fishing Act (H.R.S., Ch. 188-37 to 39)

This statute declares that the State has authority to adopt, through DLNR, regulations to control fishing in the "Leeward Islands" which are defined as "islands, reefs" and shoals from French Frigate Shoals to Kure Island. Such authority is granted to DLNR where "the action will not deplete stocks of fish or shellfish" in the area.

A second section of the statute establishes a permit system for such fishing which can include a fishing season and methods of fishing that are prohibited elsewhere in Hawaii.

Regulations of DLNR (Regulation 10) specifically permit open season on lobsters and mullet and permit the use of fish traps if a permit is first obtained. Violations are made misdemeanors.

Effect

This statute and regulations show a recognition by the State of different circumstances in the NWHI for fishing and seem to encourage the exploitation of them by allowing commercial fishermen more freedom. However, refuge status continues to preempt State fishing regulations within designated reefs.

(g) State Historic Preservation Act (H.R.S. Ch. , Act 104, May 13, 1976)

This is the complementary statute to the federal counterpart, which depends heavily on input from and coordination with the State Historic Preservation Officer.

This office, within DLNR, is empowered to do research, plan for, and assist other state agencies in, the preservation and acquisition of historic properties.

The State also declares itself the owner of historic property on State land, specifically including "under waters owned or controlled by the State."

Effect

The State has not registered or identified any sites within the HINWR, but if there is any future State action in this area, this statute requires the written concurrence of DLNR that no historic properties will be affected.

(h) Water Pollution Control (H.R.S., Ch. 342-31 through 43); Hazardous Substances (H.R.S., Ch. 188-21)

As discussed in the section on federal statutes, the Environmental Protection Agency has approved the State of Hawaii, acting through the Department of Health, to administer the National Pollution Discharge Elimination System (NPDES) permits for all discharges into the waters of Hawaii.

Therefore, although these statutes establish the basic prohibitions against unpermitted discharges, the actual operative control is accomplished by Department of Health regulations, Chapter 37, "Water Pollution Control." These regulations set the standards, in accordance

with the federal Clean Water Act and EPA regulations, for discharges and permits.

Federal court decisions have held that such permit requirements must be complied with by federal agencies. Also significant is the prohibition against a transfer of a NPDES permit and the establishment of water quality standards that specify certain quantifiable standards for the waters in particular areas of the State, which cannot be violated by a permit.

Effect

The requirement for federal conformity, authorized in the Clean Water Act, to state standards, makes this statute and regulations a significant factor to consider in any management decision.

A decision for an alternative which increases the current sewage outfall from Tern Island may result in the opposition of the Department of Health, which has recently shown independence from other state policy decisions. Further, FWS is required to obtain an NPDES permit to operate the sewage outfall in lieu of the Coast Guard unless there is a decision for abandonment.

The absolute prohibition against petroleum discharges is analogous to federal statute, but preempted by federal law.

Table 2.

Applicability of Various Federal and State Statutes and Regulations

Table Legend:

- A.....Most likely will require EIS as "major federal action"
- B.....Most likely will affect endangered/threatened species
- C.....Statute not applicable, under reasonable interpretation
- D.....Statute should be considered and evaluation reported
- E.....Coordination/consultation required with other federal agency
- F.....Coordination/consultation required with state agency
- G.....Permit/license/approval required from other agency
- H.....Alternative encouraged by statute, policies, regulations
- I.....Alternative prohibited by statute, policies, regulations
- J.....Other agency administers/enforces statute
- K.....Private parties given cause of action for litigation
- l.....Statute pre-empted by federal statute/program

(Note: The information provided in this table is based upon an interpretation of pertinent statutes and regulations in relation to alternative management scenarios presented in Section 5 of this report. The accuracy of this interpretation is highly dependent upon potentially impacting actions, as portrayed in Table 1. Modification of one or more of these actions as part of any of the management options could affect the legal interpretation in Table 2.

TABLE 2.

| FEDERAL STATUTES | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
|-------------------|----------------|------------------|-------------------|--------------------------------|---------------------|---------------|--------------|--------------------|-----------|----------------|-------------|----------------|----------------|
| | ABANDON ISLAND | OUTPOST FACILITY | MIDLEVEL RESEARCH | MIDLEVEL (FULL-LEVEL) RESEARCH | RECREAT./ EDUCATION | INSHORE FISH. | TRAP FISHING | AHI, ET AL FISHING | AKU FISH. | ALBACORE FISH. | SPORT FISH. | AQUARIUM FISH. | PRECIOUS CORAL |
| NEPA | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK | ABJK |
| END. SP. ACT | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH | BEH |
| MARINE MAMMAL | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH | EGH |
| PROTECT. ACT. | CDE | CDEH | CEH | CEH | CEH | CEH | CEH | CEH | CEH | CEH | CEH | CEH | CEH |
| WILDERNESS ACT | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH |
| RES. NATURAL AR. | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF | DEF |
| NATL. HISTORIC | C | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ | ABCJ |
| PRES. ACT | C | C | C | C | C | C | C | C | C | C | C | C | C |
| CLEAN WATER ACT | C | C | C | C | C | C | C | C | C | C | C | C | C |
| RIVERS & HARBORS | C | C | C | C | C | C | C | C | C | C | C | C | C |
| MARINE PROTECT. | C | C | C | C | C | C | C | C | C | C | C | C | C |
| RES. & SANCT. | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ |
| FLW COORD. ACT | DK | DK | DK | DK | DK | DK | DK | DK | DK | DK | DK | DK | DK |
| NAT. WILDLIFE | | | | | | | | | | | | | |
| REFUGUE ACT | ABDEI | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH |
| MIG. BIRD TREATY | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH | DEH |
| CZM ACT | DFJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK | DFGJK |
| FISHERY CONSERV. | | | | | | | | | | | | | |
| ZONE ACT | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ | CDEJ |
| INTERVENT. ON | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ |
| HIGH SEAS ACT | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ | CJ |
| ACT FOR PRESERV. | | | | | | | | | | | | | |
| DP ANTIQUITIES | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ | CDHJ |
| LANDMTR. CONSER. | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH | DH |
| FED. AID TO FISH. | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI |
| WILDLIFE RESTOR. | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI | DFI |
| LACEY ACT | C | C | C | C | C | C | C | C | C | C | C | C | C |

TABLE 2. (CONTINUED)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|--------------------------------|----------------|------------------|-------------------|---------------------|--------------------|---------------|------------|-----------------|-----------|----------------|-------------|----------------|-----------------|
| STATE STATUTES AND REGS. | ABANDON ISLAND | OUTPOST FACILITY | MIDLEVEL RESEARCH | FULL-LEVEL RESEARCH | RECREAT/ EDUCATION | INSHORE FISH. | TRAP FISH. | AMPHIB AL FISH. | AKU FISH. | ALBACORE FISH. | SPORT FISH. | ADDARIUM FISH. | PRECIOUS CORAL. |
| ENV. PROTECT. ACT | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL | DKL |
| END. SPEC. ACT | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL |
| MONK SEAL ACT | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL | HJL |
| GREEN TURTLE REG. | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL | GHJL |
| MARINE LIFE CONSERVATION D. | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL |
| NATURAL AREAS | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL |
| RESERVE SYSTEM | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL | CHJL |
| CZM PROGRAM | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK | DFGK |
| HIST. PRESERV. | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG | DFG |
| LEEWARD IS. | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL |
| FISHING REG. | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL | CEL |
| LEEWARD IS. | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL |
| MILDLIFE REF. | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL | DHJL |
| WATER POLLUTION CONTROL ACT | C | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ | DFGJ |
| OIL & HAZARDOUS SUBSTANCES ACT | C | E | DJ | DJ | DJ | C. | DJ | DJ | DJ | DJ | DJ | DJ | DJ |

SOCIOECONOMIC CONSIDERATIONS

INTRODUCTION

Traditionally, socioeconomic analysis begins with a description of baseline conditions and is followed by a comparison of anticipated impacts relating from implementation of various project alternatives. In the case of the Tern Island management decision, strict adherence to this process would be virtually impossible, given the lack of pertinent data and the combined effect of many interrelated factors that influence the socioeconomic evaluation. Traditional cost/benefit analysis would also be unusually difficult, and to some extent misleading, in view of the many intangible values that must be considered in assessment of alternative management plans for Tern Island.

A socioeconomic profile for this assessment defies simple description as the "public" that would be potentially affected by various management decisions extends beyond the boundary of the State. It is possible, however, to focus in on those persons likely to be most directly affected by implementation of various management alternatives. Determination of the predictability of socioeconomic impacts is complicated by the unsettled nature of other related management decisions, each of which must be considered in development of a framework for the Tern Island decision. Furthermore, there is considerable difficulty in establishing a direct causative link between various parameters and the Tern Island decision, because the failure to establish a "support station" at Tern Island would not absolutely preclude at least partial fulfillment of objectives for any of the 13 management options considered here. In other words, a Tern Island station is not absolutely necessary to allow expanded consumptive or non-consumptive use of FFS or neighboring areas.

This discussion is further complicated by the wide variety of opinion regarding the economic feasibility and the potential socioeconomic impacts associated with several management alternatives under consideration. As is usually the case, this disparity of views stems largely from the lack of pertinent data, both with respect to the firm definition of the various management options and their anticipated socioeconomic impacts. The lack of data was reflected in the interview process and in the evaluation of published information. Much of the ongoing efforts of researchers involved in NWHI studies are directed at answering the most relevant socioeconomic questions, and to this extent an evaluation at this time is somewhat premature.

The framework for a socioeconomic analysis in this report will involve an evaluation of several major questions that affect the interpretation of available data and information to be gathered during ongoing studies.

What costs will be involved in the implementation of various management options?

It is apparent that an accurate description of anticipated costs of various management options must await a more definitive description of facilities that each would entail, but a partial picture can be obtained by review of the various actions (Table 1) that may be implemented. Estimates of costs would be highly speculative at this time, particularly those relating to investments in new boats, main island support facilities, and long-term maintenance of island structures.

Implementation of an abandonment option would entail the least direct expenditure, unless major salvage efforts were undertaken. It is doubtful that economic benefits accruing from removal of major structural facilities (buildings, oil tanks, water tanks) would outweigh the costs involved, although much of the usable equipment (generators, vehicles, radio equipment, etc.) could be removed economically. Abandonment without salvage of usable equipment, or a decision not to make use of existing facilities, could be considered a significant economic loss, particularly in light of the fact that the station was rehabilitated at a cost of nearly \$200,000 in 1972-1973. Additional undefined economic losses would result from the abandonment option because of benefits that would be foregone by failure to implement other management options at the island. These would include fishery resources that were not exploited commercially as well as economic benefits generated by other options. These losses would be reduced significantly by the extent to which the objectives (fishing, research, education, etc.) could still be realized in the area without a support facility at Tern Island.

As defined in this report, the outpost, mid-level and full-level research facilities would each involve retention of existing Coast Guard facilities, although in the case of the outpost option, costs would be limited to that necessary to keep the facility in a restorable condition. Direct costs for operation of the mid-level or full-level research station would be directly comparable to Coast Guard expenditures. Unfortunately, we were unable to obtain these figures during the course of our interviews with the Coast Guard. Costs associated with manpower to operate the stations would increase proportionately with these three

options, ranging from a minimum of two persons to an estimated 5-6 persons for the full-level station. Additional refuge enforcement personnel may also be required for the mid-level and full-level stations. Personnel would be required that possessed the specialized skills necessary for operation and maintenance of equipment and facilities. Other significant costs associated with these options include those associated with maintenance of the runway for small aircraft use, air and ship transportation of personnel and supplies, maintenance of the seawall, possible maintenance dredging, maintenance and periodic rehabilitation of structures and equipment, supplies (fuel, food, etc.) and purchase and maintenance of new equipment (i.e. boats, motors, smaller generators, wind and solar equipment, lab equipment). The FWS has tentatively estimated that annual costs of an outpost type research facility would be approximately \$70,000. In view of the long-term maintenance requirements, it is likely that this may be significantly underestimated. The recreation/education option for Tern Island, as defined, would be a component of one or more other management options, so in itself would not bear the full expense of station operation. Costs would involve transportation (chartered aircraft, boats, etc.), on-island support equipment, charges for use of living facilities, and other supplies.

Costs associated with implementation of the various fishery options at Tern Island would vary considerably depending upon whether or not two or more options were developed in concert with each other or with one of the non-consumptive use options. Costs would also vary with different requirements for construction of additional onshore facilities (docks, freezers, coolers, ice plants, processing facilities, storage,

etc.). Additional power, water or ice requirements would also entail additional costs for purchase, shipment and maintenance of necessary equipment. Those fishery options requiring air shipment of catch by large aircraft (if permitted by regulation), would involve proportionately greater costs in runway and seawall maintenance and in aircraft charter costs.

Anticipated costs that would be involved in expansion of the fishery fleet to exploit newly available resources would vary radically when different management options are compared. Establishment of facilities at Tern Island that would allow relatively short-range boats to viably fish the nearby waters would involve considerably less cost than would expansion of the long-range fishery fleet, at an estimated cost of 0.5 million to 1.5 million dollars per vessel. Costs incurred in fleet expansion would also depend upon the as yet unknown yield of the accessible fishery resources. Conceivably, existing Hawaiian or mainland boats could harvest what resources are available, with possible future expansion of the fleet.

It has been noted that significant expansion of the fishery can not be expected to occur, regardless of the availability of previously unexploited resources, without substantial improvements in the shoreside infrastructure, including processing and marketing facilities in the main islands.(Ref. 63). These developments would incur major, as yet undefined costs, but would be critical to expansion of the industry.

Who will bear the costs?

Several of those persons interviewed in this study questioned the economic viability of various management options in view of the anticipated

high development and maintenance costs.

Projected estimates of potential fishery yields, although based on very limited data, would appear to justify significant input of industry funding or governmental development grant support, if data derived from ongoing studies substantiate these early estimates. However, in view of the anticipated costs involved in development of a support station at Tern Island, it is virtually certain that a comparative economic evaluation of the viability of fishery expansion, with and without the support facility, would be necessary before major governmental or industry funding was forthcoming. It has been noted that "financial institutions still consider fishing operations to be high risk ventures" (Ref 63), and the investment climate is not likely to change significantly without a more substantial data base. Funding of the experimental Midway albacore fishery came only as a result of substantial data on potential yield, including the proven economic viability of an ongoing foreign fishery.

Sufficient funding to sustain the non-consumptive use options at Tern Island is even more uncertain than for the fishery options. Several interviewees questioned the belief that a research station, particularly the full-level option, could be supported by grants and expenditures of investigators or cooperating institutions. It was noted that opportunities for research at other existing facilities (i.e. Eniwetak, HIMB, Kure, etc.) may be sufficient to satisfy current demand, and that an outpost facility at Tern Island could continue to accommodate a low level of research effort, characterized by intermittent short visits by individual investigators. On the other hand, it is possible that the apparent low level of demand for access to FFS for research may be due to the lack of

awareness of the facility, due to a reluctance of FWS to advertise the facility while under Coast Guard management. Certainly the potential interest of various institutional and private research organizations in Tern Island, and particularly their willingness to bear part or all the costs involved, needs to be thoroughly investigated in a thorough evaluation of various research options.

It is possible that implementation of recreation/education options for Tern Island, together with grant or institution supported research, could provide sufficient funding to support the facility. If it is determined that these alternatives are compatible with other refuge objectives, this potential for station support should be investigated.

The likelihood that various agencies with interests in Tern Island will provide sufficient funding is discussed briefly in Section 6 of this report. At this time, it is probably safe to assume that FWS will make available sufficient funding to maintain a minimum outpost facility, at least on an interim basis, until other related management questions are resolved. In the interview process, representatives of the State of Hawaii expressed a willingness to put funds and manpower into a facility at Tern Island, although it is certain that this commitment would be contingent upon opportunity to maintain the Tern Island facility to allow immediate or future exploitation of fishery resources. There was no expression of interest among representatives of other agencies, institutions or individuals interviewed in this study to commit funds to implement the various management options under consideration in this study, although some future involvement of these agencies (particularly NMFS) can be expected.

What other considerations affect this socioeconomic analysis?

As noted earlier in this report, the management decisions for Tern Island are intimately tied to other ongoing studies, currently undecided controversies and related management decisions that are likely to be made in the near future. In effect, the Tern Island decision can not be made in a vacuum, independent of these other considerations. Of greatest relevance to the decision will be 1) the outcome of the current State-Federal refuge boundary dispute; 2) final delineation (if at all) of critical habitat for the monk seal and/or the green turtle; 3) wilderness designation for refuge lands or waters; 4) final decisions regarding management plans for fishery resources within the Fishery Conservation Zone; 5) results of the ongoing Tripartite Cooperative Agreement; and 5) anticipated regulatory or legal constraints on exploitation of refuge resources.

Legal resolution of the refuge boundary dispute is likely to await the conclusion of the tripartite study, as per an agreement between the State of Hawaii and the FWS. However, it is likely that a legal decision will be pursued with vigor soon after this time. Two independent legal decisions will be involved, one relating to disputed ownership of Tern Island, and the other relating to whether or not the refuge boundary is at the high water mark (State's case) or at the presently defined over-water boundaries, including more than 300,000 acres of submerged lands in the refuge (FWS' case). A court decision which supported State ownership of Tern Island but maintained FWS refuge regulations for waters at FFS would limit exploitation. Court decisions in favor of State ownership for Tern Island and high water refuge boundaries would inevitably

result in fishery exploitation of FFS waters, constrained only by other regulatory authorities (i.e. Endangered Species Act, Marine Mammal Protection Act). Pursuit of these decisions in the court will inevitably provoke considerable social controversy and violent disagreement regarding resource management objectives.

The critical habitat proposal for the green turtle, which would have included only emergent lands in the refuge, has been withdrawn, at least for the time being. A companion proposal to include submerged areas was to be prepared by NMFS (B. Giuzentanner, pers. comm.). The critical habitat proposal for the monk seal is in a process of review and revision in light of significant debate regarding potential impacts on fishery exploitation. It is uncertain at this time what the formally proposed boundary will include, although it is virtually certain that it will involve substantial areas of nearshore habitat. Whether or not the proposal will be approved will depend upon the continued debate it provokes and the results of the analysis of impacts now required by]978 amendments to the Endangered Species Act. Included in the requirement is the necessity for an analysis of economic and other impacts likely to occur from critical habitat designation. Although critical habitat, per se, would not necessarily preclude exploitive use of waters within the boundaries, it is likely that some fishery uses would not be allowed. As is the case for the boundary dispute, this decision making process has already, and will continue to, provoke social debate on a local, national and international level.

The wilderness proposal previously reviewed in Congress included only emergent lands, excluding Tern Island. Unless efforts are reinitiated to reconsider the original proposal for a wilderness boundary identical to the refuge boundary (excluding Tern Island), it is unlikely that

designation of the emergent land wilderness area will have appreciable economic impacts on alternative management plans for Tern Island. However, social concern regarding exploitive use of refuge resources was focused to a head during the original wilderness proposal, with input received from national and international conservation organizations. It is likely that renewed consideration of the wilderness proposal in Congress will rejuvenate this debate.

Fishery management plans, and environmental impact statements, are in preparation or have been completed for various fishery resources within the Fishery Conservation Zone. These include precious coral, billfish, sharks, lobsters, bottomfish, and groundfish. These plans, as required by the Fishery Conservation and Management Act of 1976 (P.L. 94-265), will determine limits for harvest of various fisheries based on the estimates of optimum yield. The plans will also specify recommended limitations on foreign fishery harvest within the 200 mile zone. The scenario of development of a fishery support facility at Tern Island is likely to vary significantly depending upon the details of the fishery plans.

Obviously, the outcome of the tripartite study, and continued research after the termination of the cooperative study, will play a determining role in the selection and implementation of long-range resource management plans in the HINWR, including Tern Island. It is unlikely that substantial governmental or industry funding for resource exploitation will occur unless results of fishery stock surveys evidence economically viable resources, and unless ciguatera studies demonstrate that expanded marketing of NWHI fishery resources is without significant medical risk. At the same time, data from studies of potential fishery impacts on other refuge resources will probably result in

regulatory constraints, if not complete prohibition, of commercial fishing within certain refuge waters. In view of the uncertainties relating to these studies, it is impossible to predict with accuracy their long-range socioeconomic effects. It is, however, our opinion that the data available after these brief studies will be inadequate to convincingly demonstrate, with any certainty, either the long-term potential yield of the fishery resources or the absence of significant adverse potential impacts of commercial fishing on other refuge resources. In this light, it is likely that long-range management decisions, if made at the termination of this five-year study, will provoke heated debate and probably legal action.

It is anticipated that, in the absence of convincing data to the contrary, the FWS will impose strict regulations over any commercial exploitation that may be permitted within refuge waters, including development and use of possible support facilities at Tern Island. These restrictions will probably include limitations on number of boats, areas of movement, methods of fishing, timing of fishing, and the like. Periods of low level experimental exploitation are anticipated. In view of the financial commitments necessary for viable commercial exploitation, including programs in the main islands (i.e. shoreside infrastructure development, market development, etc.) it is possible that regulatory limitations and uncertainties regarding possible future restrictions will remove the incentives to investors and prevent adequate funding of the fishery expansion. It may also prove economically unfeasible for fishery development at this remote location if it is forced to occur in small increments. The adverse economic impacts will be in the form of catch foregone

on increased costs to exploit other fisheries.

What is the potential fishery yield that could be exploited through fishery station development at Tern Island?

There are insufficient data to accurately estimate the potential fishery yield that could be realized by fishery station development at Tern Island, although statements of "unlimited resources", and "vast potential" run rampant in the undocumented testimony of numerous individuals favoring exploitation of refuge resources. At least one investigator has noted that the true potential yield of many fishery resources in the NWHI will never be known until some trial commercial exploitation is allowed (Swerdloff, pers. comm.). Several investigators have noted an apparent greater abundance and larger sizes of some top level carnivore species in the NWHI, but it has not been determined whether this is due to differences in fishing effort, patterns of fish migration or differences in inherent productivity.

The major thrust of the ongoing tripartite study, and associated efforts by Sea Grant and other investigators, is to answer the question regarding potential commercial yield. Much of the ongoing work that is focused on waters within and around FFS will be directly relevant to the Tern Island management decision, but the relevant data are not yet available. The draft Hawaii Fishery Development Plan provides estimates of potential yield of various fishery resources in the NWHI, but stresses that they are "extremely tentative", and may even be misleading (Ref. 63). In view of the uncertainties surrounding these and other estimates, they will not be repeated in detail here. Suffice it to say, potential commercial yields of most fishery stocks amounting to several times

current in-State harvest are anticipated through effective exploitation. If problems regarding bait supply can be resolved, the aku fishery is viewed as the most economically viable candidate for expansion. It is currently estimated that Japanese boats take roughly three times (15,000 tons) the current Hawaiian fleet annual average for aku from waters adjacent to the NWHI..(Ref. 63) Potential for dramatic increases in yields of ahi, shrimp, lobster and bottomfishes are also believed to be possible through effective exploitation of NWHI waters.

Can the fish market absorb additional yield anticipated from effective utilization of a Tern Island facility?

The interview process in this study raised several interrelated questions that provoked considerable debate; such as: Can additional amounts of fresh fish be marketed without deflating the price to a point where the fishery is not economically viable? If air transportation of fresh fish is too expensive or not feasible for other reasons, will the public accept a quality frozen product at a high enough price to make a Tern Island station economically viable? Which species can be absorbed into the existing market and which can not? The lack of definitive answers to each of these questions has raised serious doubts among several knowledgeable individuals, including some fishermen with NWHI experience, that fishery management options for Tern Island are economically viable.

The present fresh fish market in Hawaii is one of supply and demand. In general, when the demand exceeds the supply, the price is high, and when the supply exceeds the demand, the price is low. The present supply is close enough to the demand that when two large boats sell the

same species of fish simultaneously the price usually drops. This fact is basic, and fishermen try to avoid flooded market conditions whenever possible, by staggering arrival times or by holding their catch.

Of the several persons involved in commercial fishing that were interviewed, only Mr. Frank Goto felt that the market could absorb large planeloads of fresh fish. There is some reason to believe that improvements in the distribution of the resource to the outer islands would aid in absorption of greater amounts. Also, excess fresh fish can be absorbed into the frozen fish market, although at a substantially reduced value to the fishermen. Whether or not a Tern Island station would be economically viable with most of its output going into a frozen fish market needs to be critically evaluated.

At the present time, imports from foreign and mainland markets account for approximately 60% of Hawaii's consumption of seafoods. This suggests that a greater locally-produced supply of frozen fishery products would play an important role in reducing the flow of monies out of the State. This generalization would apply to an even greater degree for the aku canning market, now dependent upon imports for approximately 80% of its supply. In contrast, the reef fish and bottom fish market could not be expanded significantly without expansion of the local and export market.

What people will be affected by a Tern Island management decision?

Identification of those people that will be directly or indirectly affected by a Tern Island management decision is not a simple task, in view of the many interrelated considerations. In simple terms, this "public" would include those who would use the facility or be prevented from use of the facility (by another management option) and those who

would be indirectly affected by a multiplier effect (i.e. those in support industries, families of fishermen or researchers, etc.). Additionally, those who would purchase fishery resources (or be prevented from purchase by unavailability) would also be affected through changes in supply and market prices.

It is an oversimplification to describe the commercial fishing industry as a directly impacted "public", as only a small portion of this group would likely exploit the NWHI resources. Conversely, the "public" should include fishermen from other locations (i.e. mainland) that might exploit NWHI resources if given the opportunity and economic incentives. The number of present full time commercial fishermen is estimated at 800, down from 3,500 immediately following World War II. (Ref.66) An estimated 150 of these work in the aku fleet. An additional estimated 1,500 fish commercial on a part-time basis. Related employment in the industry includes the cannery (estimated at 425) and others in an identified 43 fishing establishments (wholesaling and processing). Others in related industries (i.e. boats, supplies, drydocks, etc.) probably bring the total of individuals working full time in commercial fishing related work to approximately 1,400.

In view of the uncertainties regarding potential yields, and ability of the market to absorb this yield, evaluation of potential socioeconomic effects of an expanded fishery at FFS is equally difficult to undertake. One source estimates that 75-100 new jobs may be created for each additional yield of 7,500 tons of tuna. Another source estimates that between 450-1,300 new jobs are possible with full utilization of potential additional yields.(Ref. 66) However, in

neither case can the projected job increases be related directly to a Tern Island management decision. Although effective exploitation of fishery resources from a Tern Island station could result in substantial economic benefits to those fishermen directly involved in the exploitation (and others by a multiplier effect), it would not come without some adverse impacts on at least one other sector of the industry. Local fishermen unable to exploit the NWHI resources are likely to be adversely affected by depressed prices when the market is periodically oversupplied. It is also reasonable to expect that a significant portion of the economic benefits associated with successful exploitation of NWHI resources would accrue to mainland boats, and would enter the local economy only partially or not at all.

A management decision for Tern Island that precluded or restricted fishery opportunities would adversely affect those that could have exploited the resource, but this would be in the form of foregone catch, rather than new losses. It is anticipated that existing long-range boats will continue to harvest NWHI resources independent of the Tern Island decision, and this exploitation can be expected to increase as new long-range boats now under construction enter the commercial fleet.

The "public" directly or indirectly affected by a Tern Island management decision includes those potential non-consumptive users of a facility at the island. Selection of an alternative that precluded such use would force this "public" to go to other sites or forego this activity. However, in recent years, the demand for research and recreational/educational use of the site has been quite limited, and with the exception of those proposed activities believed to be in

conflict with refuge objectives, this demand has been satisfied. With the exception of the abandonment alternative, it appears that all the contemplated management options at Tern Island have the capability of satisfying virtually all types of non-consumptive use demands that do not conflict with other refuge management policies. Limitations on numbers of individuals that could be accommodated would be considered adverse social impacts.

It is not likely that any of the non-consumptive use options would result in major increases in employment opportunity, as even the full level research station would probably require only 5-6 support personnel. Some expansion of FWS staffing would be required for this alternative. Direct economic benefits accruing from research alternatives would be more difficult to define than for fishery options, although it is anticipated that large sums of out-of-state funds would enter the local economy for support services (food, transportation, supplies, etc.). Results of basic biological studies may have little direct definable economic benefits, at least initially, although pertinent data gathered during fishery research investigations may ultimately result in more efficient exploitation of fishery resources. Studies relating to impacts of conflicting resource uses may lead to recommendations that maximize opportunities for resource exploitation with minimal adverse social, environmental and economic impacts.

Part of the "non-consumptive" public affected by implementation of various Tern Island management options includes those persons that have an interest in resource conservation. Response to the wilderness proposals for the HINWR from around the world substantiates that

there is a widely diverse "public" concerned about the wise management of refuge resources. For those persons adamantly opposed to exploitive use in the refuge, implementation of several of the contemplated management options for Tern Island would have obvious social impacts. The "public" also includes those persons who may have access to or be exposed to the educational products (films, books, magazine articles, etc.) that result from non-consumptive educational use of a facility at Tern Island. Such use has both economic and social implications, the latter most directly related to the development of an "informed" constituency supportive of the wise management of refuge resources.

What socioeconomic resource management conflicts can be anticipated in the implementation of Tern Island management options?

The opposed forces of preservation and exploitation, of non-consumption vs. consumption, of jobs vs. resource protection, have in the past and will inevitably in the future be pitted against one another in the controversy surrounding management decisions for NWHI resources, regardless of the potential for compatible use. In the particular case relating to Tern Island, the opponents have fallen into the categories of State and Federal agencies, so larger, more complex, political considerations have come to play as well. Although those involved have sought "compromise" positions to resolve differences, and avoid this polarization, it is virtually certain that management decisions will continue to be highly controversial and violently debated in the public and political arena. This is particularly true in resource management decisions which must be made in the absence of substantive data. The primary question will remain unanswered to everyone's satisfaction: "On which party rests

the responsibility to prove that unacceptable adverse impacts will or will not occur?" The "existence value" of an undisturbed natural area will be pitted against it's "economic potential."

It should be noted that a decision for Tern Island that permitted resource exploitation would represent a significant shift in refuge management policy, at least since the beginning of continued presence of the FWS in Hawaii in 1964. It would require a change in existing refuge regulations as well. Potential conflict of such an action with pertinent laws (particularly the Marine Mammal Protection Act and Endangered Species Act) are virtually certain to precipitate legal action under provisions in these laws for citizens' suits. At the very least, social conflicts are anticipated to be significant. If resource exploitation is permitted, this concern will manifest itself in the form of restrictive regulations to insure protection of unique natural resources.

Which resource use options are economically feasible without support facilities at Tern Island?

Although the management decision for Tern Island has become a focal point for controversy regarding exploitation of NWHI resources, considerable discussion was raised in the interview process regarding the economic feasibility of realizing varying resource use objectives (including non-consumptive use) without a support station at Tern Island. It was noted by three of the four fishermen interviewed (Ohai, Naftel, Shinsato) that Tern Island was not important to their continuing exploitation of NWHI resources, as their boats were capable of long range activity independent of a land base. It was also noted that the Japanese fleet had been successfully exploiting NWHI resources, including aku, without a land

base operation. Mr. Naftel indicated that he was presently constructing a long range vessel with capability to process its own catch, and felt that this was the most efficient means to harvest NWHI resources. On the other hand, Davidson has noted that full development of fishing potential in the NWHI is probably as dependent on strategic and logistic considerations as it is on fish stocks, and stressed the need for shore-side facilities to move supplies, crews and catches. It seems apparent, in view of this obvious controversy regarding the relevance of Tern Island to the use of NWHI resources, that each of the management options should be critically evaluated to determine its dependency on such logistical support.

The abandonment option clearly involves no dependence on Tern Island. Even the outpost function could be accomplished without a Tern Island facility, as it has on various other islands in the archipelago over the last several years. A temporary field station at Laysan Island is presently performing the low-level research function, sustained by periodic ship support. Small, semi-permanent research facilities (i.e. cabins) have been contemplated for other HINWR islands in the past as well. These facilities could possibly satisfy the research demand at less long term expense.

Perhaps the most significant consideration in seeking an alternative to the Tern Island outpost facility, or any of the other more extensive facilities, would be the loss of air evacuation or emergency landing capability. Although this has been stressed as an important consideration, the history of air evacuation at Tern Island needs to be critically evaluated. We were able to find only one documented case in which a

crewman from a fishing vessel was evacuated from Tern Island, although Mr. Shinsato noted in his interview that the facility had saved the lives of three of his men. We were also able to find no evidence that the facility has ever proven to be absolutely critical in a forced landing situation. Two possible exceptions include a recorded landing of a Japanese ferry pilot in a light plane experiencing difficulty in switching fuel supply and the recent landing of an Air Force helicopter experiencing engine problems. In the latter case, parts and supplies were ferried by light plane to Tern Island to repair the helicopter, although there is no evidence that the "rescue" could not have been accomplished by boat, albeit at greater expense. There are several incidences in which boats in distress were rescued in the archipelago that involved no use of the Tern Island facility, including one rescue as recently as May, 1979.

In view of the questionable demand for a mid-level or full-level research station at Tern Island, the economic viability of other means to satisfy research needs should also be evaluated. Other existing facilities, both in the archipelago and elsewhere in the Pacific, could support at least a portion of this undefined "demand", at presumably far less initial and recurring cost. Alternatively, floating platforms (i.e. the TOWNSEND CROMWELL, or EASY RIDER) could support continuing research as they have successfully in the past.

The recreational/educational use suggested for a Tern Island facility could also be accomplished at other permanent stations or by boat throughout the archipelago. Although the runway and living quarters at the island would provide an alternative to access by boat, they are clearly not critical to such use. However, effective enforcement, at relatively low

cost, would be rendered more difficult without the permanent facility and air transportation capability. The educational objective could also be at least partially achieved through a main island program or facility, designed to disseminate information about the refuge in a meaningful way. A permanent facility to accomplish this task was suggested in the 1970 Master Plan for the HINWR but has not been implemented

Support facilities at Tern Island are not absolutely critical to any of the eight fishery options under consideration. The NWHI are already fished efficiently by long-range vessels and this use could be expanded significantly by incorporation of new boats into the fleet. In view of the considerable controversy regarding the ability of the local market to absorb air-flown fresh fish at a level adequate to sustain a Tern based fishery, the critical need for the air shipment capability has not been clearly demonstrated. At least one fisherman now using the area (Chai) noted that boats such as his with long range and large storage capability could be used to move fish from the NWHI fishing areas to Honolulu. Capability to process catch on long-range vessels would also reduce or eliminate this dependency on shore stations. The "mother ship" concept is now in operation for the albacore fishery at Midway and could be employed in the FFS area. This ship could also provide the fuel and supplies necessary to support a fleet of aku boats in the area, and to store their catch when they return from fishing. The documented ability of Japanese fishing boats to harvest aku in the NWHI without dependency on inshore bait resources suggests that the local industry should re-evaluate the economic feasibility of using offshore bait or cultured species. Restrictive regulations within refuge waters may make this

course of action necessary in any event.

Without a Tern Island support facility, the inshore fishery (by skiffs), the sport fishery and the aquarium fishery would probably not be feasible logistically or economically in the form that they are presented in this report. Some inshore skiff fishing could be undertaken from larger vessels, but it could not result in a major continuing supply of fresh fish without the air transport capability. It is unlikely that there would be substantial demand for aquarium species in the area, without logistical and air support at Tern Island, as the relatively insignificant differences between FFS and main island species (and abundance) would probably not justify the considerably greater expense of harvesting the distant resource.

The suggested Tern Island support facilities are probably of least significance to the described albacore and precious coral fishery options. In the case of albacore, the availability of support much closer to the fishing grounds (Midway) makes it unlikely that a fishery in the FFS area would be economically viable, with or without a Tern Island station. Although a Tern Island facility could provide some logistical support for harvest of precious coral at nearby Brooks Bank, there is no evidence to suggest that it could not be fished efficiently and economically without this support. The single long-range vessel now exploiting this fishery in Hawaii is not dependent on Tern Island for work in the NWHI.

Although this discussion has been directed at the feasibility of achieving fishery objectives without Tern Island support, it should be noted that the interview process raised several arguments that justify continued consideration of the economic advantages of such a facility.

Basing boats out of Tern Island would reduce time and cost enroute to and from fishing grounds. It would also provide an opportunity to more efficiently utilize existing mid-range vessels in the fleet that could not fish the NWHI without logistical support. This, in turn, would result in a greater percentage of fishery revenues remaining within the State's economy rather than going out of state to long-range mainland boats. Assuming the market could adjust to accomodate larger catches, the presently underutilized NWHI fishery resource would supply increasing demands and bolster the local economy. It has also been suggested that the present facilities at Tern Island would allow expansion of fishery harvest in the NWHI at lower initial cost than would be incurred if the industry was forced to implement a "mother ship" alternative. Such a facility would also allow a quicker response, with far less lead time in seeking support funding or constructing long-range boats.

What would be the socioeconomic effects of lumping management options?

Lumping of management options, particularly various fisheries, could provide significant economic savings in development and operation of facilities. Limited exploitation of varied species would result in less risk of resource depletion and less flooding of the Honolulu market, while at the same time facility and transportation costs could be shared. Flexibility to adjust fishing pressure to avoid flooding the market might be possible if the boats and crews involved the fishery were adaptable. This, of course, would not be possible for fisheries requiring specialized equipment or skills.

Lumping of alternatives also carries with it the risk of signifi-

cant adverse economic and social impacts. Apportionment of responsibility (and cost) for development of new facilities and continued rehabilitation would be difficult. Limitations on development potential of an individual fishery, caused by requirements to share facilities, would make the initial investments necessary for some fisheries less economically sound. Difficulties in apportionment of on-island storage facilities and transportation capability are anticipated, particularly when inevitable breakdowns of equipment occur. These problems could be alleviated to some degree if combined fisheries were centrally managed by an individual contractor.

Restrictions on fisheries development imposed by limited space, facilities costs and refuge regulations also raise the important social problem of apportioning opportunity to exploit the resource among the varied public that may demand to use the facility. The conflict would occur for both consumptive and non-consumptive users, and between the two groups as well. One interviewee recommended that first fishing opportunities should be given to individuals with demonstrated continuing interest in fisheries of the area (i.e. those who have attempted to fish the area in the past). It was also suggested that native Hawaiians be given first use rights (Alika Cooper, pers. comm.). Obvious social conflicts are anticipated in seeking an equitable resolution to these problems once any decision is made to expand various use-opportunities in the refuge. Social conflicts are also anticipated between consumptive and non-consumptive users in the apportionment of facilities and in the shared use of living space. For fisheries with minimal on-island requirements, this impact would be minimal.

Summary:

It is apparent from the preceding discussion that a realistic and informative evaluation of socioeconomic considerations requires far more complete data than are presently available. However, it is also apparent that serious concern regarding the economic viability of many of the management options under review is justified. The requirements for a mid-archipelago navigational aid have justified the facility since the Coast Guard moved to the island in 1952, but at no time has the station "paid for itself". The anticipated high costs of maintenance, improvements and periodic rehabilitation necessitate a critical evaluation of the ability of single or joint management options to support themselves or at the very least to justify continuing input of funds for "valued" uses (i.e. refuge management) that may not every repay their costs.

BIBLIOGRAPHY

1. Abe, M. T. (1973) The Accidental Death of a Great Number of Seabirds on the Gamo Coast, Miyagi Prefecture. *Tori* 22:58-59.
2. Agard, L. K. (1979) Testimony; Fishing Boat Association of Hawaii. S. R. #133 (1979).
3. Ahsan, A. E., J. L. Ball, Jr., and J. R. Davidson (1972) Costs and Earnings of Tuna Vessels in Hawaii. UNIHI-SEAGRANT-AR-72-01. Sea Grant College Program, University of Hawaii, Honolulu.
4. Albers, P. H. (1977) Effects on Aquatic Birds. In Fore, P. L. (editor).
5. Aldrich, J. W. (1970) Review of the Problem of Birds Contaminated by Oil and Their Rehabilitation. Bureau of Sport Fisheries and Wildlife, Resources Publication 87.
6. Amerson, A. B., Jr. (1969) French Frigate Shoals, A History: 1786-1969. Pacific Ocean Biological Survey Program Department of Vertebrate Zoology Smithsonian Institution. Washington, D. C. Unpublished.
7. Amerson, A. B., Jr. (1971) The Natural History of French Frigate Shoals, Northwestern Hawaiian Islands. *Atoll Res. Bull.* 150, 383 p.
8. Amerson, A. B., Jr., R. B. Clapp, and W. O. Wirtz II (1974) The Natural History of Pearl and Hermes Reef, Northwestern Hawaiian Islands. *Atoll Res. Bull.* 174, 306 p.
9. Amerson, A. B., Jr. (1975) Species Richness on the Nondisturbed Northwestern Hawaiian Islands. *Ecology* 56(2):435-444.
10. Anon (1977) A Compilation of Federal Laws Relating to Conservation and Development of Our Nation's Fish and Wildlife Resources, Environmental Quality and Oceanography. Printed for the use of the Committee on Merchant Marine and Fisheries. U.S. Government Printing Office, Washington. Serial #95-8:1977
11. Anon (1977) Regulations Governing Recreational Activities of Personnel at the U. S. Coast Guard LORAN Station, Tern Island, French Frigate Shoals, Hawaiian Islands National Wildlife Refuge. Effective: 1 June 1977.
12. Anon (1978) Survey and Assessment of the Living Resources of the Northwestern Hawaiian Islands. A Tripartite Cooperative Agreement. Between: National Marine Fisheries Service of U. S. Department of Commerce, Department of Land and Natural Resources of the State of Hawaii, and the Fish and Wildlife Service of the U. S. Department of the Interior.
13. Anon (1979) Senate Concurrent Resolution (#27) Requesting the Governor of the State of Hawaii to Take Immediate Action Toward the Acquisition and Return of Tern Island and Its Facilities to the State of Hawaii.

14. Apple, R. A. (1973) Prehistoric and Historic Sites and Structures in the Hawaiian Islands National Wildlife Refuge: A Survey. Prepared for U. S. Fish and Wildlife Service by Hawaii Group Office, National Park Service. 111 p.
15. Bailey, A. M. (1952) The Hawaiian Monk Seal. Mus. Pict. Denver 7:1-32.
16. Balazs, G. H. (1974) Survival Status of the Green Turtle (*Chelonia mydas*) nesting and basking colony at French Frigate Shoals, Northwestern Hawaiian Islands. Presentation to 104th Annual Meeting of the American Fisheries Society, 10 September, Honolulu, Unpublished report.
17. Balazs, G. H. (1975) Green Turtles' Uncertain Future. Defenders of Wildlife. December 1975. pp. 521-523.
18. Balazs, G. H. (1976) Green Turtle Migrations in the Hawaiian Archipelago. Biol. Conserv. 9:125-140.
19. Balazs, G. H. (1978) Survey and Assessment of the Green Sea Turtle Resource of the Northwestern Hawaiian Islands, Sea Grant Year 10 through Year 12. From: Northwestern Hawaiian Islands Fisheries Investigations Program, An Overview. Sea Grant 1978.
20. Balazs, G. H. (1978) Terrestrial Critical Habitat for Sea Turtles Under United States Jurisdiction in the Pacific Region. Elepaio 39(4):37-41.
21. Balazs, G. H. and Whitton, G. C. (1978) Bibliography of the Hawaiian Monk Seal (*Monachus schauinslandi*) Matschie 1905. University of Hawaii, Hawaii Institute of Marine Biology, Honolulu. Technical Report #35, March 1978.
22. Balazs, G. H. and G. C. Whittow (1979) Revised Bibliography of the Hawaiian Monk Seal (*Monachus schauinslandi*) Matschie 1905. University of Hawaii, Sea Grant College Program.
23. Beach, D. W. (1976) Hawaiian Monk Seal (*Monachus schauinslandi*) Management Plan. Administrative Report No. SWR/RMD-76-1. National Marine Fisheries Service, Southwest Region, Resource Management Division, Marine Mammal - Endangered Species Program, September 1976.
24. Beamish, T. (1976) Aride Island, A Desert Only in Name. Wildlife Vol. 8, #9, Sept. 1976. pp 405-408.
25. Beardsley, J. W. (1966) Insects and Other Terrestrial Arthropods from the Leeward Hawaiian Islands. Proc. Haw. Entomological Society. Vol. XIX, No. 2.
26. Board of Commissioners of Agriculture and Forestry. (1958). Regulation 20: Relating to Fishing in the Leeward Islands of the Territory of Hawaii and Authorizing Taking of Mullet and Lobster During Closed Seasons and the Use of Non-Portable Fish Traps.

27. Brock, V.E. and R.N. Uchida. (1968) Some Operational Aspects of the Hawaiian Live-Bait Fishery for Skipjack Tuna (Katsuwonus pelamis). U.S. Fish and Wildlife Service, Department of the Interior. Special Scientific Report - Fisheries No. 574.
28. Bryan, E.H. () American Polynesia and the Hawaiian Chain, Tongg Publishing Co., Honolulu.
29. Bryan, E.H. Jr. (1978) The Northwestern Hawaiian Islands - An Annotated Bibliography. U.S. Fish and Wildlife Service, Honolulu, HI.
30. Bureau of Sport Fisheries and Wildlife (1965) Hawaiian Islands Wilderness Proposal, Hawaiian Islands National Wildlife Refuge. United States Department of the Interior.
31. Bureau of Sport Fisheries and Wildlife () Hawaiian Islands Wilderness Proposal. Prepared by U.S. Department of Interior.
32. Bureau of Sport Fisheries and Wildlife (1970) Hawaiian Islands National Wildlife Refuge, Hawaii: Master Plan. U.S. Department of Interior, Fish and Wildlife Service.
33. Bureau of Sport Fisheries and Wildlife (1971) Birds of the Hawaiian Islands National Wildlife Refuge (R.L. 211 R-1: 7/21/71) Pamphlet prepared by U.S. Department of Interior, Fish and Wildlife Service.
34. Bureau of Sport Fisheries and Wildlife (1972) Review of the Problem of Birds Contaminated by Oil and Their Rehabilitation. U. S. Department of the Interior, Fish and Wildlife Service.
35. Bureau of Sport Fisheries and Wildlife (1972) Inventory Forms of Historic and Archaeologic Places. Prepared for the Northwestern Islands.
36. Bureau of Sport Fisheries and Wildlife (1973) Draft Environmental Statement: Proposed Hawaiian Islands Wilderness Area, City and County of Honolulu, Hawaii. U. S. Department of the Interior.
37. Butler, G.D. and R. Usinger (1963) Insects and Other Invertebrates from Laysan Island. Atoll Research Bull. 98. Washington, D.C.
38. Carlquist, S. (1966) Vegetation Maps of the Leeward Hawaiian Islands. Unpublished Report.
39. Clapp, R.B. (1972) The Natural History of Gardner Pinnacles, Northwestern Hawaiian Islands. Atoll Research Bull. 163, pp2-25.
40. Clapp, R.B. and E. Kridler (1977) The Natural History of Necker Island, Northwestern Hawaiian Islands. Atoll Research Bull. 206 and 207, May 1977.
41. Clapp, R.B., E. Kridler and R.R. Fleet (1977) The Natural History of Nihoa Island, Northwestern Hawaiian Islands. Atoll Research Bull. 206 and 207, May 1977.

42. Clapp, R.B. and W.O. Wirtz, III. (1975) The Natural History of Lisianski Island, Northwestern Hawaiian Islands. Atoll Research Bull. 186, 196 p.
43. Clapp, R.B. and P.W. Woodward (1968) New Records of Birds from the Hawaiian Leeward Islands. Proceedings of the U.S. National Museum, Smithsonian Institution, Washington, D.C. Vol 124, No. 3460.
44. Clarke, T.A. (1972) Exploration for Deep Benthic Fish and Crustacean Resources in Hawaii. Tech. Report 29. Hawaii Institute of Marine Biology, University of Hawaii, Honolulu.
45. Coast Guard, Fourteenth Coast Guard District (1971) Specifications for Rehabilitation of Coast Guard LORAN Transmitting Station French Frigate Shoals: Tern Island French Frigate Shoals, Hawaiian Archipelago. Honolulu, HI.
46. Coast Guard (1975) Coast Guard LORAN Station French Frigate Shoals: General Information Book.
47. Coast Guard (1979) Negative Declaration of Significant Environmental Impact for the LORAN-A Phase Out in the Hawaiian Island Chain.
48. Coast Guard (1979) Negative Declaration of Significant Environmental Impact for the Disestablishment of the LORAN-A Station at Kauai in the Hawaiian Island Chain.
49. Comitini, S. (1977) An Economic Analysis of the State of the Hawaiian Skipjack Tuna Fishery. UNIHI-SEAGRANT-TR-78-01. Sea Grant College Program, U. of Hawaii, Honolulu.
50. Council on Environmental Quality (1978) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. 43FR55978-65007 (November 29, 1978) 40CFR Parts 1500-1508.
51. Craven, J.P. (1979) Testimony before the Senate Committee on Ecology, Environment, on Recreation on Tern Island. SR 133 and SCR 27, March 7, 1979.
52. Crawford, J.M. and P.A. Shelton (1978) Pelagic Fish and Seabird Interrelationships off the Coasts of Southwest and South Africa. Biol. Conserv. (14) 85-109.
53. Cushing, D. (1976) Fisheries Resources of the Sea and their Management. Oxford University Press. London.
54. Darlington, P.J. (1970) Carabidae on Tropical Islands, Especially the West Indies. Biotropica 2(1):7-15, pp. 7-15.
55. Davidson, J.R., S. Comitini and J. Rutka. (1978) Economics of Fisheries Development and Management for the Hawaiian Archipelago, Sea Grant Year 11 through Year 13. From: Northwestern Hawaiian Islands Fisheries Investigations Program, an Overview. Sea Grant, 1978.

56. DeLong, R.L. (1976) Current Information on Hawaiian Monk Seals. Marine Mammal Division, Northwest Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Prepared for: Conference on Marine Mammals of the Sea, Group III, Seals and Marine Otters, Advisory Committee on Marine Resources Research, Bergen, Norway, 31 Aug - 9 Sept 1976.
57. DeLong, R.L. (1978) Investigation of Hawaiian Monk Seal Mortality at Laysan, Lisianski, French Frigate Shoals and Necker Island, May, 1978. Xerox report: Marine Mammal Division, NWAFC, NMFS, Seattle, WA.
58. DeLong, R.L. & R.L. Brownell (1977) Hawaiian Monk Seal Habitat and Population Survey in the Northwestern Hawaiian Islands, April 1977. Processed Report, NMFS, NWAFC, Seattle, WA. 43 p.
59. DeLong, R.L., C.H. Fiscus and R.W. Kenyon (1976) Survey of Monk Seal (Monachus schauins landi) Populations of the Northwestern (Leeward) Hawaiian Islands. National Marine Fisheries Service, Northwest Fisheries Center, Marine Mammal Division, Naval Support Activity, Seattle, WA.
60. Department of Health (1977) An Ecosystem Approach to Water Quality Standards: Report of the Technical Committee on Water Quality Standards. Technical Report No. 1, 208 Areawide Waste Treatment Management Program, State of Hawaii.
61. Department of Health and City and County of Honolulu. (1978) Water Quality Management Plan for the City and County of Honolulu. Vol. 1.
62. Department of Health. (1978) Nonpoint Source Pollution in Hawaii: Assessments and Recommendations. Report of the Technical Committee on Nonpoint Source Pollution Control. State of Hawaii.
63. Department of Land and Natural Resources (1979) Interim Report to the 1979 State Legislature, Hawaii Fisheries Development Plan.
64. Department of Planning and Economic Development (1974) Hawaii and the Sea. Prepared for the Governor's Advisory Committee on Science and Technology. State of Hawaii.
65. Department of Planning and Economic Development. (1977) Permits and Environmental Requirements for Aquaculture in Hawaii. Aquaculture Planning Program, Center for Science Policy and Technology Assessment. State of Hawaii.
66. Department of Planning and Economic Development (1977) Hawaii Tuna Fishery Development Plan. State of Hawaii.

67. Diamond, J.M. (1975) The Island Dilemma: Lessons of Modern Biogeographic Studies for the Design of Natural Reserves Biological Conservation, 7, pp. 129-146.
68. Dollar, S. (1978) Guide to Research Logistics in the Northwestern Hawaiian Islands. Working Paper No. 33. Sea Grant College Program, U. of Hawaii. Honolulu.
69. Dollar, S.J. (1979) Sand Mining in Hawaii: Research, Restrictions and Choices for the Future. Sea Grant College Program, U. of Hawaii. Technical Paper Series. UNIHI-SEAGRANT-TP-79-01.
70. Ehrhard, L.M. (1978) A Continuation of Baseline Studies for Environmentally Monitoring Space Transportation Systems at John F. Kennedy Space Center: Annual Report. Contract No. NAS 10-8986, Bioscience Operations, John F. Kennedy Space Center, p. 587-583.
71. Emory, K.P. (1928) Archeology of Nihoa nad Necker Islands. Bernice P. Bishop Museum Bulletin No. 53.
72. Environmental Law Institute (1977) The Evolution of National Wildlife Law. Prepared for the Council on Environmental Quality.
73. Everhart, W.H., A.W. Eipper and W.D. Youngs (1975) Principles of Fishery Science. Cornell Univ. Press, Ithaca, N.Y.
74. Federal Committee on Ecological Reserves (1977) A Directory of Research Natural Areas on the Federal Lands of the United States of America. Forest Service, U.S. Dept. of Agriculture.
75. Fiscus, C.H. A.M. Johnson, K.W. Kenyon (1978) Hawaiian Monk Seal (Monachus schauinslandi) Survey of the Northwestern (Leeward) Hawaiian Islands (July, 1978) Processed Report, National Marine Fisheries Service, Northwest and Alaska Fisheries Center, Seattle, WA.
76. Fish and Wildlife Service (1969) Billfishes of the Central Pacific Ocean. Circular 311. Department of the Interior.
77. Fish and Wildlife Service (1975) Final Environmental Statement: Proposed Hawaiian Islands Wilderness Area, City and County of Honolulu, Hawaii. U.S. Department of Interior.
78. Fish and Wildlife Service (1976) Public Use Regulations, National Wildlife Refuge System. Chapter 1. Department of Interior. Published in the Federal Register, Vol. 41, No. 43, pp. 9166-9172.
79. Fish and Wildlife Service (1976) Final Environmental Statement: Operation of the National Wildlife Refuge System. Department of the Interior.
80. Fish and Wildlife Service (1977) Special Use Permit, Issued October 1, 1977, from Refuge Manager to Commanding Officer, USCG LORAN A/C Station (Authorizing Monthly Trips to Islands in French Frigate Shoals to Collect Glass Fishing Floats.)

81. Fish and Wildlife Service (1978) Administration of the Marine Mammal Protection Act of 1972. U.S. Department of the Interior. Washington, D.C.
82. Fish and Wildlife Service (1978) Draft Environmental Impact Assessment: Proposed Determination of Critical Habitat for the Green Sea Turtles. U. S. Department of the Interior, Washington, D.C.
83. Fish and Wildlife Service (1979) Testimony on April 4, 1979 before the House Committee on Water, Land Use, Development and Hawaiian Affairs on Senate Concurrent Resolution No. 27. U.S. Department of the Interior.
84. Fish and Wildlife Service (1979) Final Recommendations on the Management of the National Wildlife Refuge System. U.S. Department of the Interior. Washington, D.C.
85. Fore, P.L. (Ed.) (1977) Proceedings of the 1977 Oil Spill Response Workshop. U.S. Fish and Wildlife Service, Biological Services Program (FWS/OBS/77-24)
86. Fosberg, F.R. (1966) The Oceanic Volcanic Island Ecosystem. Reprinted from Bowman, R.I. Ed., The Galapagos, University of California Press, 1966. Proceedings of the Galapagos International Scientific Project.
87. Fosberg, F.R. (1967) Observations on Vegetation Patterns and Dynamics on Hawaiian and Galapagoan Volcanoes. Reprinted from Micronesia 3:129-134, 1967.
88. Fosberg, F.R. (1967) Opening Remarks: Island Ecosystem Symposium. Micronesia 3:3-4, 1967 pp. 408-413. Presented at the 11th Pacific Science Congress, Tokyo, August, 1966.
89. Gatlsoff, P.S. (1933) Pearl and Hermes Reef, Hawaii: Hydrographical and Biological Observations. B.P. Bishop Mus. Bull. 107:1-49.
90. Grigg, R.W., S.J. Dollar and M.T. Palmgren. (1978) Reef and Shelf Benthic Ecology of the Hawaiian Archipelago. Sea Grant Year 11 thru 13 from: Northwestern Hawaiian Islands Fisheries Investigations Program, An Overview. Sea Grant 1978.
91. Gulick, A. Biological Peculiarities of Oceanic Islands. The Quarterly Review of Biology. Vol. VII, No. 4, pp. 405-427.
92. Hadden, F.C. (1941) Midway Islands. Reprint from "The Hawaiian Planters' Record," Vol. XLV, No. 3, 1941. pp. 179-221.
93. Hedgren, S. (1975) The Breeding Population of Guillemot in the Baltic Sea. Var Fagelvarld 34:43-52.

94. Helfrich, P., S.V.D. Ralston, and R.L. Burgner (1978) Development of a Biological Basis for Managing the Handline Fishery for Snapper and Grouper Population in the Hawaiian Archipelago. Sea Grant Year 12 through Year 13. From: Northwestern Hawaiian Islands Fisheries Investigations Program, an Overview. Sea Grant, 1978.
95. Hendrickson, J.R. (1969) Report on Hawaiian Marine Turtle Populations. Proceedings of the Working Meeting of Marine Turtle Specialists. IUCN Publications New Series. 20:89-95.
96. Herman, L.M. and R.C. Antinaja (1977) Humpback Whales in Hawaiian Breeding Waters. Population and Pod Characteristics. Whale Res. Inst. No. 29.
97. Higham, J.L. LJJG, USCGR (1979) Environmental Impact Assessment for the Disestablishment of the LORAN-A Station at French Frigate Shoals in the Hawaiian Island Chain. Prepared for: U.S. Coast Guard Fourteenth Coast Guard District, Honolulu, Hawaii, Marine Environmental Protection Branch.
98. Higham, J.L., LTJG, USCGR (1979) Environmental Impact Assessment for the LORAN-A Phase-Out in the Hawaiian Island Chain. Prepared for U.S. Coast Guard Fourteenth Coast Guard District, Honolulu, Hawaii, Marine Environmental Protection Branch, March 1979.
99. Hoffman, R.G. and H. Yamauchi (1972) Recreational Fishing: Its Impact on State and Local Economies. University of Hawaii, Hawaii Agriculture Exp. Stn., Dep. Pap.
100. Hubbell, T.H. (1968) The Biology of Islands. Reprinted from the Proceedings of the National Academy of Sciences. Vol. 60, No. 1, pp 22-32, May, 1968.
101. Idyll, C.P. (1973) The Anchovy Crisis. Scientific American 228(6):22-29.
102. Johnson, B.W. and P.A. Johnson (1978) The Hawaiian Monk Seal on Laysan Island: 1977. Report No. MMC-77/05. Final Report Marine Mammal Commission Contract MM7AC009, Washington, D.C.
103. June, F.C. (1951) Preliminary Fisheries Survey of the Hawaiian Line Islands Area. Part II - Notes on the Tuna and Bait Resources of the Hawaiian, Leeward, and Line Islands. Comm. Fish. Rev. 13(1):1-22.
104. Kay, E. Alison (ed.) (197) A Natural History of the Hawaiian Islands, Selected Readings. University of Hawaii Press.
105. Kenyon, K.W. (1972) Man Versus the Monk Sea. J. Mam. 53(4):687-696.
106. Kenyon, K.W. (1973) Hawaiian Monk Seal (*Monachus schauinslandi*). IUCN Pub. New Series, Supplementary Paper No. 39, pp. 88-97.

107. Kenyon, K. (1975) The Monk Seal's Cloistered Life. Defenders of Wildlife, December, 1975. pp. 497-499.
108. Kenyon, K.W. (1976) Critical Habitat of the Hawaiian Monk Seal; Including a Review of the Status of the Caribbean and Mediterranean Monk Seals. Prepared for: The U.S. Marine Mammal Commission.
109. Kenyon, K.W. and D.W. Rice (1959) Life History of the Hawaiian Monk Seal. Pacific Science. 15:215-252.
110. King, J.E. and R.J. Harrison (1961) Some Notes on the Hawaiian Monk Seal. Pacific Science 15: 282-293.
111. King, W.B. (1973) Conservation Status of Birds of Central Pacific Islands. Wilson Bulletin 85:89-103.
112. Lach, D. (1970) Island Birds. Biotropica 2(1):29-31.
113. Lovejoy, W.S. (1977) A BFISH Population Dynamics Analysis of the Impact of Several Alternative Fisheries Management Policies in the Hawaiian Fishery Conservation Zone (FC) on the Pacific Stocks and Hawaiian Sport Fishing Yields of Blue and Striped Marlin. Western Pacific Regional Fishery Management Council. 33 pp.
114. MacDonald, C.D., J.S. Stimson, and T.D. Smith (1978) Population Biology of Spiny Lobsters Throughout the Hawaiian Archipelago, Sea Grant Year 11 through Year 14. From: Northwestern Hawaiian Islands Fisheries Investigation Program, An Overview.
115. MacDonald, C.D. and B.E. Thompson (1977) The Biology and Nearshore Fishery of the Spiny Lobster, Panulirus marginatus, at Midway Islands and Oahu, Hawaii, with notes on Panulirus pencillatus. Ref. in T.Smith proposal - SeaGrant year 11.
116. Magnuson, W.G. (1965) Compilation of Federal Laws Relating to the Conservation and Development of our Nation's Fish and Wildlife Resources. Compiled under the direction of W. G. Magnuson, Committee on Commerce, United States Senate, U.S. Govt. Printing Office. Washington, D.C.
117. Marine Mammal Commission (1974) Background Information, Guidelines and Format for Submission of Proposals. Washington, D.C.
118. Mayr, E. (1965) Avifauna: Turnover on Islands. Science 150:1587-1855.
119. Moreau, J.W. (1976) Memo from Commander, Fourteenth Coast Guard District to Commanding Officer, C.G. LORAN Station French Frigate Shoals: Subject: REgulations in and around a wildlife refuge. (4 June 1976)
120. National Marine Fisheries Service (1975) Draft EIS. Listing of the Green Sea Turtle (Chelonia mydas), Loggerhead Sea Turtle (Caretta caretta) and Pacific Ridley Sea Turtle (Lepidochelys olivacea) as Threatened Species Under the Endangered Species Act of 1973. National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Washington, D.C.

121. National Marine Fisheries Service (1977) Cruise report, TOWNSEND CROMWELL, 77-02-75, Part V, July 4-August 17, 1977. Honolulu Laboratory, SWFC, NMFS, NOAA.
122. National Marine Fisheries Service (1977) Final Environmental Impact Statement/Preliminary Fishery Management Plan: Seamount Groundfish Fishery Resources. U.S. Department of Commerce, National Oceanic and Atmospheric Administration.
123. National Marine Fisheries Service (1978) Final Environmental Impact Statement: Preliminary Fishery Management Plan. Pacific Billfish and Oceanic Sharks. U.S. Department of Commerce, NOAA, NMFS, SWFC.
124. National Marine Fisheries Service, Southwest Region (1979) Hawaiian Monk Seal (Monachus schauinslandi) Critical Habitat Discussion Paper. Southwest Fisheries Center, Northwest and Alaska Fisheries Center, Second Draft, February 12, 1979.
125. Nelson, J.B. (1970) The Relationship between Behavior and Ecology in the Sulidae with Reference to Other Sea Birds. Oceanographic Marine Biology Annual Revue, 1979, 8:501-574.
126. Nettleship, D.N. (1976) Census Techniques for Seabirds of Arctic and Eastern Canada. Occasional Paper #25, Canadian Wildlife Service.
127. Nitta, E.T. (1977) An Evaluation and Recommendation for Modification of the Marine Mammal Commission's Proposed Designation of Critical Habitat for the Hawaiian Monk Seal (Monachus schauinslandi) Admin. Report No. SWR/RMB-77-1. National Marine Fisheries Service, Southwest Region, Resource Management Branch, Marine Mammal Endangered Species Program, March 1977.
128. Nitta, E.T. and J. Naughton (1977) Environmental Assessment Proposed Designation of Critical Habitat for the Hawaiian Monk Seal (Monachus schauinslandi) Prepared for: U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Region.
129. Nitta, E.T., J.J. Naughton, R.L. DeLong and L. Hudgins (1978) Draft Hawaiian Monk Seal (Monachus schauinslandi) Critical Habitat Discussion Paper
130. Norris, K.S. (Ed.) (1977) Report of a Workshop on Problems Related to Humpback Whales, Megaptera noveangliae, in Hawaii. Marine Mammal Commission Workshop.
131. Norris, K.S. and T.P. Dohl (in press) The Behavior of the Hawaiian Spinner Porpoise, Stenella longirostris (Schlegel, 1941).

132. Office of Coastal Zone Management (1978) Draft Environmental Impact Statement and Proposed Coastal Management Program for the State of Hawaii. National Oceanic and Atmospheric Administration and the Department of Planning and Economic Development, State of Hawaii.
133. Pacific Marine Fisheries Commission (1977) Summary of Pacific Area Input to the Eastland Fisheries Survey. National Oceanic and Atmospheric Administration.
134. Parrish, J.D., L.R. Taylor, Jr., J.H. Bailey-Brock and R.D. Brock (1978) Trophic Analysis of Shallow-Water Fish Communities in the Northwestern Hawaiian Islands: Effects of Natural and Human Predation. Sea Grant Year 12 through Year 14. From: Northwestern Hawaiian Islands Fisheries Investigations Program, An Overview.
135. Petersen, S.B. (1973) Decisions in a Market: a Study of the Honolulu Fish Auction. Unpublished Ph.D. dissertation, University of Hawaii, Honolulu.
136. Prochaska, F.J. and J.S. Williams (1976) Economic Analysis of Cost and Returns in the Spiny Lobster Fishery by Boat and Vessel Size. SUSF-SEAGRANT-76-004. Florida Sea Grant, Gainesville.
137. Ralston, S. (1978) A Description of the Bottomfish Fisheries of Hawaii, American Samoa, Guam, and the Northern Marianas, First Draft. A report submitted to the Western Pacific Regional Fisheries Management Council, December, 1978.
138. Rauzon, M., K.W. Kenyon, and A.M. Johnson (1977) Observations of Monk Seals, French Frigate Shoals, 17 February to 27 May 1977. Xerox report, Div. Coop. Research, USFWS, Anchorage, AK.
139. Repenning, C.A. and C.E. Ray (1977) Origin of the Hawaiian Monk Seal. Proc. Bio. Soc. Wash. 89(58):667-688.
140. Rice, D.W. (1960) Distribution of the Bottlenose Dolphin in the Leeward Hawaiian Waters. J. Mammalogy 41:407-408.
141. Rice, D.W. (1960) Population Dynamics of the Hawaiian Monk Seal. J. Mam. 41(3):376-385.
142. Rice, D.W. (1964) The Hawaii Monk Seal. Nat. Hist. 73:48-55.
143. Richardson, F. (1957) The Breeding Cycles of Hawaiian Sea Birds. Bernice P. Bishop Museum, Bulletin 218, Honolulu, HI.
144. Robbins, C.S. and D.W. Rice (1974) Recoveries of Banded Laysan Albatrosses and Black-footed Albatrosses. (IN: King, W.B. (ed.) Pelagic Studies of Seabirds in the Central and Eastern Pacific Ocean, Smithsonian Contrib. to Zool. No. 158.)

145. Ruehle, J. and A.M. Johnson (1977) Observations of Monk Seals and Other Wildlife on Kure Atoll, 10 February-13 May 1977. Xerox Report, Dv. Coop. Research, USFWS, Anchorage, AK.
146. Sachet, M. (1967) Coral Islands as Ecological Laboratories. Presented at the 11th Pacific Science Congress, Tokyo, August 1966. Micronesia, Vol. 3, June 1967. pp. 45-49.
147. Schaefer, M.B. (1970) Men, Birds and Anchovies in the Peru Current - Dynamic Interactions. Trans. Amer. Fish. Soc. 99(3):461-467.
148. Sekora, P.C. (1975) Refuge for Rare Species. Defenders of Wildlife, December, 1975, pp. 506-510.
149. Shaklee, J.B., and E.A. Kay (1978) Genetic Aspects of Population Structure of Four Species in the Northwestern Hawaiian Islands. Sea Grant Year 11 through Year 13. From Northwestern Hawaiian Islands Fisheries Investigations Program, An Overview.
150. Shallenberger, E.W. (1976) Report to SeaFlite and Sea Grant on the Population and Distribution of Humpback Whales in Hawaii. Mimeo.
151. Shallenberger, E.W. (1977) Activities Possibly Affecting the Welfare of Humpback Whales. Marine Mammal Commission Workshop on Humpback Whales. K.S. Norris (ed.)
152. Shallenberger, E.W. (1977) Humpback Whales in Hawaii - Population and Distribution. Mar. Tech. Soc.
153. Shallenberger, E.W. (1979) The Status of Hawaiian Cetaceans. Marine Mammal Commission Report #MM7AC028. 103 pp.
154. Shallenberger, R.J. (1977) Research Plan for Study of Seabird Resources in the Northwestern Hawaiian Islands. Unpublished Report. U.S. Fish and Wildlife Service, Honolulu.
155. Shang, Y.C. (1969) The Skipjack Tuna Industry in Hawaii: Some Economic Aspects. Economics Research Center, U. of Hawaii, Honolulu.
156. Simberloff, D.S. (1969) Experimental Zoogeography of Islands: A Model for Insular Colonization. Ecology. Vol. 50, No. 2 pp. 296-314.
157. Simberloff, D.S. and E.O. Wilson (1969) Experimental Zoogeography of Islands: The Colonization of Empty Islands. Ecology, Vol. 50, No. 2. pp. 278-295.
158. Skillman, R.E. (1976) Survey and Assessment of the Living Resources of the Northwestern Hawaiian Islands. A tripartite cooperative agreement. Unpublished manuscript.
159. Struhsaker, P. and D. C. Aasted (1974) Deepwater Shrimp Trapping in the Hawaiian Islands. Mar. Fish. Rev. 36(10):24-30.

160. Struhsaker, P. and H.O. Yoshida (1975) Exploratory Shrimp Trawling in the Hawaiian Islands. *Mar. Fish. Rev.* 37(12):13-21.
161. Taylor, L. and G. Naftel (1978) Predation of the Hawaiian Monk Seal (*Monachus schauinslandi*) by Large Sharks. Final report Marine Mammal Commission. Contract No. 7AC011.
162. Tull, C.E., P. Germain and A.W. May (1972) Mortality of the Thick-billed Murres in the West Greenland Salmon Fishery. *Nature* 237:42-44.
163. Uchida, R. N. (1967) Catch and estimates of fishing effort and apparent abundance in the fishery for skipjack tuna in Hawaiian waters, 1952-1962. *Fishery Bulletin*: Vol. 66, No. 24.
164. Uchida, R. N. (1970) Distribution of fishing effort and catches of skipjack tuna, *Katsuwonus pelamis*, in Hawaiian waters, by quarters of the year, 1948-65. U. S. Fish and Wildlife Service, Department of the Interior. Special Scientific Report - Fisheries No. 615.
165. Uchida, R. N. (1977) A Summary of Environmental and Fishing Information of the Northwestern Hawaiian Islands. SWFC Adm. Rept. No. 4H, 1977 NOAA, NMFS, SWFC, Honolulu Laboratory, Honolulu, HI.
166. Uchida, R. N., and T. S. Hida (1977) Preliminary result of lobster trapping in the Northwestern Hawaiian Islands SWFC Adm. Rept. No. 13H, Dec. 1976. NOAA, NMFS, SWFC, Honolulu Laboratory, Honolulu, HI.
167. Uchida, R. N. & R. F. Sumida (1971) Analysis of the operations of seven Hawaiian skipjack tuna fishing vessels, June-August 1967. National Marine Fisheries Service, U. S. Department of Commerce. Special Scientific Report - Fisheries No. 629.
168. University of Hawaii, Sea Grant College Program. (1978) Project Proposal: Sea Grant Institutional Program, Year 11 (1978-79).
169. Walters, J. F. (1978) Hawaii Fishing Industry's Future. *Elepaio*, 39(3): 27-30.
170. Western Pacific Regional Fishery Management Council. (1978) Draft Fishery Management Plan for the Precious Coral Fisheries of the Western Pacific Region.
171. Western Pacific Regional Fishery Management Council. (1979) Fishery Management Plan for the Spiny Lobster Fisheries of the Western Pacific Region, fourth draft, February, 1979.
172. Western Pacific Regional Fishery Management Council. (1979) Draft Environmental Impact Statement/Fishery Management Plan for the Precious Coral Fisheries of the Western Pacific Region.
173. Wiens, H. J. (1971) Atoll Environment and Ecology. Yale University Press. New Haven.
174. Wilson, E. O. and D. S. Simberloff (1969) Experimental Zoogeography of Islands: Defaunation and Monitoring Techniques. *Ecology*, Vol. 50, No. 2, pp. 267-278. Early Spring, 1969.

175. Wirtz, W. O. III (1968) Reproduction, growth and development and juvenile mortality in the Hawaiian monk seal. *J. Mam.* 49(2): 229-238.
176. Woodward, P. W. (1972) The natural history of Kure Atoll, Northwestern Hawaiian Islands. *Atoll Res. Bull.* 164, 318 p.
177. Zimmerman, E. C. (1970) Adaptive Radiation in Hawaii with Special Reference to Insects *Biotropica* 2(1) pp. 32-38.

