5.0 HISTORY OF DATA COLLECTION, MANAGEMENT AND RESEARCH

5.1 State and Territorial Licensing and Data Collection Programs

There are no State or Territorial restrictions (e.g., seasons, bag limits, size limits, or gear restrictions) on fishing for billfish or for the other pelagic fishes in the management unit. There are, however, certain licensing and reporting requirements in Hawaii. Hawaii regulations require a person to obtain a "Commercial Marine License" in order to sell any fish caught; and all such licensed fisherman must file a monthly report listing all fishing trips taken during the month and all fish caught, whether any of the fish are sold or not. Recreational and subsistence fishermen who do not sell any of their catch are not required to obtain licenses nor to report their catches. Charterboat operators, however, are required to obtain a "Commercial Marine License" and to submit monthly trip and catch reports. Specialized catch reports are required for longline (flagline) vessels and skipjack tuna (aku) baitboat vessels in Hawaii along with an annual "Commercial Marine License".

Neither commercial, recreational, or subsistence fishermen are required to obtain fishing licenses in the Territory of Guam or to report their catches. Presently, there are two principal sources of data in Guam which contain some catch/effort information on billfish and the other management unit species: (a) commercial fish wholesalers, and (b) the offshore creel survey conducted by the Guam Division of Aquatic and Wildlife Resource (DAWR). The largest and oldest of the fish wholesalers is the Guam Fishermen's Cooperative (Coop) which has been collecting data on its fish purchases from fishermen since July 1979 and submitting this information to the Western Pacific Fishery Information Network (WPACFIN) on a voluntary basis. The Southwest Fisheries Center (SWFC) of the NMFS developed the concept of the Fishery Information Network (FIN) to provide a central source of region-wide fisheries data. WPACFIN is a component of the FIN system and it is administered by the Honolulu Laboratory of the NMFS. During 1984, two additional wholesalers in Guam started submitting their purchase data to the WPACFIN on a similar basis. The DAWR has conducted an intercept creel survey (sample) data collection program for offshore (boat-based) fisheries since the 1970's. Sample catch and effort data on the management unit species and tuna can be obtained from this data base. The offshore creel sample data are expanded into island-wide estimates of catch and effort by fishing method or gear type used.

The Territory of American Samoa does not have any licensing requirements for either commercial, subsistence, or recreational fishermen. Other than data on the Samoa-based foreign longline fishery for tuna which are maintained by the Southwest Fishery Center (SWFC) of the NMFS, virtually all of the fisheries data on the management unit species for American Samoa come from the Office of Marine and Wildlife Resources (OMWR), American Samoa Government. The OMWR relies upon voluntary catch reports and back-up interviews with commercial fishermen to obtain catch and effort information on the management unit species. Because

this data base is a result of a sampling program, the sample data are expanded to get estimates of total commercial landings of the management unit species. The OMWR has also taken "standardized" troll fishing trips in Samoan waters since 1975 to ascertain the seasonality of abundance of pelagic species and to compute measures of their relative abundance. The OMWR generally gets involved in organizing and operating several fishing tournaments held by the American Samoa Gamefishing Association. Estimates on catch-per-unit-effort (CPUE) can be derived from these tournament data but inferences on the seasonal and annual abundances of the management unit species in the waters of American Samoa are difficult to make from these data sets because of the "spotty" nature of the tournament data sets.

5.2 Preliminary Fishery Management Plan (PMP)

The PMP is the only Federal endeavor affecting fishing for billfish, mahimahi, wahoo, and oceanic sharks in the island areas served by the Council. The PMP applies only to foreign longline fishing in the FCZ around Hawaii, American Samoa, Guam, the Northern Mariana Islands, the U.S. possessions, and the mainland West Coast (except Alaska).

The PMP became effective on April 1, 1980 (Federal Register, Vol. 45, No. 46, March 6, 1980, pages 14581-14588). Any foreign vessel desiring to engage in longline fishing in the FCZ must possess a permit, whether billfish and associated species would be retained or not. The PMP established retention and non-retention zones for billfish within the FCZ of each regulatory area (Table 5.1). National allocations for individual species of billfish must be taken in areas beyond the non-retention zones. All billfish caught by foreign vessels within the non-retention zones must be returned to the sea without removing the fish from the water. Billfish hooked and released in the non-retention zones are not counted against national allocations.

The TALFF (total allowable level of foreign fishing) for each species in the management unit and area of the FCZ is shown in Table 5.2. A zero TALFF for any particular billfish species in a particular area of the FCZ means that a fish of that species hooked in the FCZ of that area must be returned to the sea by cutting the leader or line without removing the fish from the water. The "Reserve" component may be granted to foreign fishermen but only if domestic catches of that species do not meet expected levels. Once TALFF and the "Reserve" are taken for any species in the management unit in a FCZ area, that species becomes a prohibited species and cannot be retained anywhere in the FCZ of that area.

During 1980, the first year the the PMP was in effect, a total of 912 permits were issued to Japanese, Taiwanese, and Korean longline vessels to fish in the FCZ of the Western Pacific Region. None of these vessels chose to fish in FCZ waters even though they each paid a nominal permit fee. The number of permits issued to foreign longline vessels dropped to 592 in 1981. Each of

to 121, and during 1983 foreign longline vessels did not apply for permits to fish in the FCZ of the Pacific Ocean at all (Table 5.3). Since then, longline vessels from Taiwan and Korea have once again applied for and received permits to fish in the FCZ. Forty-three permits were issued to Taiwanese vessels in 1984. The number of permits granted to Taiwanese and Korean vessels more than doubled to 103 in 1985. Through June of 1986, ninety-two permit applications were were received from Korean and Taiwanese longline vessels for fishing in the FCZ of the Pacific Ocean, presumably in the FCZ around American Samoa. Some of these vessels are large (up to 494 gross tons). The permit applications demonstrates a continuing interest of foreign longliners to fish in the FCZ, and fishing by these vessels in non-retention zones would result in a waste of billfish and other management unit species. However, there has not been any legal foreign longlining in the U.S FCZ of the entire Western Pacific Region to date under the regulations of the PMP. There have been three seizures of foreign longline fishing vessels for illegal fishing in the FCZ of the Western Pacific Region. Two vessels were seized for fishing without permits and one permitted vessel was sized in American Samoa for failing to comply with the regulatory requirements of the PMP.

TABLE 5.3

NUMBER OF PERMITS ISSUED TO FOREIGN LONGLINE VESSELS
TO FISH IN THE U.S. FCZ OF THE PACIFIC OCEAN,
1980 THROUGH 1986

Nationality	1980	1981	1982	1983	1984	1985	1986*
Japan	789	464	53	-	-	-	-
Taiwan	92	108	68	-	43	84	53
Korea	31	20	-	-	-	19	39
TOTAL	912	592	121	0	43	103	92

* As of June, 1986

SOURCE: NMFS, Western Pacific Program Office.

Foreign fishing permit applications are not issued for any specific area in the FCZ around Hawaii, Guam, American Samoa, the Commonwealth of the Northern Mariana islands, U.S. island possessions in the Pacific, or the U.S. West Coast. Rather, permit applications and the permits themselves are lumped together for the FCZ of the Pacific Ocean.

For calendar year 1986, a permit application fee of $167 is charged to each foreign vessel. If a nation chooses to accept an allocation for any of the management unit species, an irrevocable letter of credit must be established to cover the poundage fees for at least 25% of the previous year's total allocations at the rate structure shown in Table 5.4. The poundage fee is a price that foreign vessels pay for the privilege of retaining the management unit species. Foreign fees are required by the Magnuson Act to return to the United States the cost of carrying out the provisions of the Act in at least the same proportion as foreign vessels share in the total harvest from the FCZ. Foreign fishing vessels may also be subject to a surcharge of up to 20% on fees paid in order to capitalize the Fishing Vessel and Gear Damage Compensation Fund. If the Fund is sufficiently capitalized, NMFS may reduce or waive the surcharge. NMFS has waived the surcharge for 1986 fees.

So far, no nation has requested allocations for any of the management unit species, thus, all permit holders entering the FCZ to fish would be fishing under full nonretention rules in all areas at all times. None of the management unit species could be retained.

This revised FMP will supercede the provisions of the PMP in the U.S. FCZ of Hawaii, Guam, American Samoa, and U.S. island possessions in the Pacific. Foreign longlining in the FCZ of the Commonwealth of the Northern Mariana Islands (CNMI), as well as off the U.S. West Coast, will continue to be regulated under the provision of the PMP. The FMP will be amended regarding foreign and domestic fishing for the management unit species in the FCZ of the CNMI after the Secretary of Commerce appoints Council members from this area who, in turn, will nominate fishermen to serve on the pelagic species Advisory Panel. The decision to alter the PMP or to develop a FMP covering the FCZ off the U.S. West Coast lies with the Pacific Council.

5.3 Source of Data

5.3.1 Data on Domestic Fisheries

Hawaii - Aggregate monthly data on reported commercial landings of the management unit species and ex-vessel sale revenues are available from the Hawaii Department of Land and Natural Resources, Division of Aquatic Resources for 1948 through June 1985. Catch and trip reports of licensed fishermen in Hawaii covering the management unit species are maintained in the NMFS Southwest Fishery Center (SWFC), Honolulu Laboratory data base through June 1984. Skillman et. al., (1984) presented cross tabulations of reported commercial catches of the management unit species among domestic fishing gear types and by distance zones from shore around the Hawaiian islands covering the period from January 1976 to April 1981.

TABLE 5.1

RETENTION AND NON-RETENTION ZONES FOR BILLFISH
WITHIN EACH REGULATORY AREA OF THE FCZ UNDER THE PMP

Regulatory Area	Billfish Retention Zones	Billfish Non-Retention Zones
West Coast	None	Between 12 and 200 nautical miles
Guam and Northern Mariana Islands	(1) Beyond 50 nautical miles from Guam, Rota, Tinian, Aguijan, and Saipan, and (2) Beyond 12 nautical miles of the remaining islands of the Northern Mariana Islands	Between 12 and 50 nautical miles from Guam, Rota, Tinian, Aguijan, and Saipan No non-retention zone
Hawaii and Midway Islands	(1) Beyond 100 nautical miles from the islands of Hawaii, Kahoolawe, Kauai, Lanai, Maui, Molokai, Niihau, and (2) Beyond 50 nautical miles from the remaining islands of the State of Hawaii and Midway Islands	(1) Between 12 and 100 nautical miles form the islands of Hawaii, Kahoolawe, Kauai, Lanai, Maui, Molokai, Niihau, and Oahu, and (2) Between 12 and 50 nautical miles from the remaining islands of the State of Hawaii and Midway Islands
American Samoa	Beyond 12 nautical miles from American Samoa	No non-retention zone
U.S. Possessions	Beyond 12 nautical miles from any other possession of the United States in the Central and Western Pacific Ocean	No non-retention zone

these permit holders also declined to fish in the FCZ. During 1981, there were four requests by vessels which held permits to enter the FCZ of the Western Pacific Region for fishing purposes. In each case, the vessel was instructed to pick up a U.S. observer prior to commencing fishing operations. All four vessels declined to pick up an observer and chose not to fish in the FCZ. During 1982, the number of permits granted to foreign longline vessels dropped

TABLE 5.2

1986 TALFF AND RESERVE FOR PACIFIC BILLFISH, MAHIMAHI, WAHOO AND OCEANIC SHARKS BY AREA OF THE FCZ UNDER THE PMP
(Metric Tons)

Species	Quotas	Area of the FCZ				
		West Coast	Hawaii (Including Midway)	Guam and N. Mariana	American Samoa	U.S. Pacific Isl. Possessions
Swordfish	TALFF	0	78.9	3.5	2.4	28.1
	Reserve	0	8.8	0.4	0.0	0.0
Blue Marlin	TALFF	0	0.0	0.0	34.9	76.3
	Reserve	0	8.6	23.9	0.0	0.0
Black Marlin	TALFF	0	0.0	0.5	5.3	6.2
	Reserve	0	0.0	0.1	0.0	0.0
Striped Marlin	TALFF	0	139.8	4.2	7.8	46.6
	Reserve	0	15.5	0.5	0.0	0.0
Sailfish/ Spearfish	TALFF	0	17.4	4.1	2.2	14.3
	Reserve	0	1.9	0.5	0.0	0.0
Sharks	TALFF	0	1000.5	31.9	101.6	651.4
	Reserve	0	111.1	0.0	0.0	0.0
Wahoo	TALFF	0	0.0	0.0	2.0	0.0
	Reserve	0	0.0	0.0	0.0	0.0
Mahimahi	TALFF	0	0.0	0.0	2.0	0.0
	Reserve	0	0.0	0.0	0.0	0.0

SOURCE: 51 Federal Register, No. 20, page 3790-3791; January 30, 1986.

The Japanese Fisheries Agency (1982) prepared an unpublished paper for the International North Pacific Fisheries Commission describing the operations of Japanese drift-gillnet vessels and their catches of billfish and tuna for 1973-1981. An earlier paper translated from the Japanese from Suisan Sekai (1978) presents a compact but very interesting and revealing account of the activities of the Japanese billfish drift-net vessels and the conflicts they have generated.

There is information available on catches of the management unit species and tuna made by foreign purse seine vessels in the FCZ of the Western Pacific Region. Iizuka and Watanabe (1983), however, persent an account of the Japansese "southern-water" purse seine fishery for 1973-1982 together with the species composition of the catches. (Section 6.12.2)

5.3.3 Biological Data Sources

Honda (1983) compiled a bibliography of materials relating to the management unit species in the western and central Pacific originating from the SWFC and other agencies. Most biological information on the management unit species used in the preparation of this FMP was gleaned from the many sources listed in the References. The best basic biological and distributional information on billfish are available in the proceedings of an international billfish symposium held in Hawaii in 1972 (Shomura and Williams - 1975). Stock assessment information is available in a summary of a meeting on tuna and billfish held in Japan in 1979 (NMFS and Far Seas Fisheries Research Laboratory - 1980).

An excellent synopsis of biological information on dolphin fishes (mahimahi) is available in a FAO fisheries report (Palko, et. al., 1982). Very limited biological information on wahoo is available in an unpublished fisheries resource atlas of the Northwestern Hawaiian Islands (Uchida, et. al., 1984). Several studies on the biology of oceanic sharks are listed in the References section.

5.4 Research

Discussions held in the early 1970's at a NMFS-sponsored workshop at the NMFS Tiburon Laboratory and at a special session of the 22nd Annual Tuna Conference at Lake Arrowhead, California identified a need for a symposium to bring together the available information on billfish. The culmination of these discussions was an International Billfish Symposium, co-sponsored by the NMFS and the Hawaiian International Billfish Tournament (and subsequent founding body for the Pacific Gamefish Foundation). The Symposium was held during August 9-12, 1972 at Kailua-Kona, Hawaii (Shomura and Williams, eds., 1975). Research papers contributed at the Symposium outlined the state of knowledge on species

indentification, life histories, and the distribution of billfish and their fisheries. Discussions on these papers pointed out major gaps in the understanding of billfish biology and population dynamics, particularly with regard to age and growth, mortality rates and stock structure. In an attempt to fill some of the gaps identified at the Symposium, the Southwest Center of the NMFS and the Council co-sponsored a Pacific Billfish Stock Assessment Workshop in 1977 (Shomura, ed., 1980). Assessments of the various billfish stocks in the Pacific presented in the Workshop Proceedings have been used extensively in the preparation of this revised FMP.

In the past, the NMFS with cooperation from fishing clubs, tournament directors and others had taken length, weight, sex and stage of maturity measurements from billfish caught in Hawaiian waters for many years. However, the NMFS stopped its involvement in these endeavors in 1980 when the Pacific Gamefish Foundation (based in Kailua-Kona, Hawaii) started the regular collection of these data from blue and striped marlin. There have been four attempts to tag and release marlin in Hawaii. Marlin flesh is a highly valued food item in Hawaii. As a result, most marlin which are caught in Hawaii are not released but are sold. Since only a few marlin have been tagged and released in Hawaii, the rates of recapture and tag return have been very low, and subsequently, no meaningful data for analyses regarding their migratory patterns and distribution have resulted so far. This, however, is bound to change since the Hawaiian International Billfish Tournament and the associated Kona Hawaiian Billfish Tournament have announced new rules concerning the tag and release of billfish caught during 1986 tournaments. Under the recently announced rules, a team will be awarded 200 points for any qualifying billfish caught according to the new tag and release provisions.

Other research on marlin has been completed since the Council first proposed a billfish FMP (August, 1981) while some is still continuing. The Pacific Gamefish Foundation, with Council funding, had originally undertaken research concerning a biochemical (genetic) analysis of the population structure of blue and striped marlin in the central and western Pacific. The published results of the first phase of this project indicate that, at least for blue marlin, several stocks may exist for this species in the central and western Pacific (Shaklee, Brill and Acerra, 1983). If further results from this project substantiate their earlier findings, not only for blue but also for striped marlin as well, then there would be a much greater potential for actually conserving and managing these two species by controlling both foreign and domestic fishing in the FCZ, than if there is but one stock of each of these species in the Pacific as the research on statistical correlations of catch rates between the foreign and the domestic fisheries derived by Wetherall and Yong (1983) and Skillman and Kamer (1985) seem to suggest.

The history of biological research on mahimahi, wahoo, and oceanic sharks in the central and western Pacific is exceptionally lean and largely devoid of practical application for fisheries management. Hendrix (1983) examined the growth, development, and mortality of mahimahi reared in laboratory tanks in Honolulu. Hida (1973) examined the stomach contents of mahimahi and from this he inferred the distribution and biology of their prey. Iversen (1957) made some biological observations on wahoo from the vicinity of the Line Islands (now

TABLE 5.4

POUNDAGE FEES* ($ PER METRIC TON) BY SPECIES

Species	1984+	1985++	1986+++
Blue Marlin	$234	$ 314	$ 707
Striped Marlin	585	428	660
Black Marlin	234	516	707
Swordfish	366	514	832
Sailfish/Spearfish	234	514	707
Mahimahi	312	1,428	1,965
Wahoo	312	571	786
Sharks	156	286	44

* Poundage fees are not broken down by FCZ area; instead, they are lumped together for the U.S. FCZ of the Pacific Ocean.

\+ 49 Federal Register, Page 595; January 5, 1984.

++ 50 Federal Register, Page 460; January 4, 1985.

+++ 51 Federal Register, Page 208; January 3, 1986.

The NMFS National Marine Recreational Fishing Statistical Survey (MRFSS) collected sample data on marine recreational fishing in 1979-1981 in Hawaii as well as in American Samoa, Guam and the CNMI, and preliminary estimates of recreational catches of inshore and offshore marine species are available. However, the "raw" sample data derived from this survey were examined by the Honolulu Laboratory of the NMFS to determine whether the sample sizes were sufficiently large enough for deriving area-wide estimates of total catches of the management unit species made by recreational fishermen. The sample sizes are apparently not large enough to yield accurate estimates of recreative catches of the management unit species. To date, final estimates of recreational catches of the management unit species from the MRFSS are unavailable.

The Council has collected purchase data on each of the management unit species from major wholesale fish dealers in Hawaii covering the years 1979 through 1983. Data were sought from these sources because reasonably complete data on commercial catches of the management unit

species were not available from the Hawaii Division of Aquatic Resources for analyses by the Plan Development Team at this time. The Council, the NMFS, and the State of Hawaii and the Territories of Guam and American Samoa have cooperated in developing an inventory of fishing vessels in each island area in order to establish a "universe" of fishing vessels from which future surveys or samples can be drawn.

American Samoa - Estimates of landings of the management unit species are available from the Office of Marine and Wildlife Resources, American Samoa Government via the SWFC's Western Pacific Fishery Information Network (WPACFIN) for 1982-1984. Preliminary estimates of recreational catches are available from the MRFSS as mentioned previously.

Guam - Estimates of landings of the management unit species derived from the offshore creel surveys are available from the DAWR, Government of Guam for 1980-1985 and preliminary estimates of recreational catches are available from the MRFSS for 1979-1981. Dealer purchases of the management unit species are avialble from the WPACFIN system for 1980-1984.

5.3.2 Data on Foreign Fisheries

Catch and effort statistics are available on the Japanese tuna longline fishery for the years 1962-1979, the Korean tuna longline fishery for 1966-1970, the Taiwanese tuna longline fishery for 1967-1974, and for the foreign tuna longline fishery based in American Samoa for 1960-present. Some of these data are available by 1° squares of longitude and latitude while others are by 5° squares; some are also available on a daily basis while some have been summarized by month. All of these data sets are maintained by the SWFC.

Yong and Wetherall (1980) summarized and tabulated available information on estimated nominal effort and catch of billfishes and tunas in the foreign longline fishery conducted within the FCZ of the Western Pacific Region during the period 1965-1977. Foreign longliners only rarely maintain records of incidental catches of mahimahi, wahoo and oceanic sharks. The estimates of billfish and tuna catches presented by Yong and Wetherall (1980) are incomplete. They do not include data on operations of Korean longline vessels other than those based at American Samoa. Korean longliners have been known to operate in all areas of the FCZ, and while some catch and effort data are available, Yong and Wetherall declined to include them in their report because of unresolved problems with the accuracy of the data. In addition, the catch and effort records examined by Yong and Wetherall did not include Taiwanese longliners under 50 gross tons or any Japanese longliners and baitboats under 21 gross tons. Estimates of tuna catches made by Japanese baitboats (pole-and-line vessels) in the U.S. FCZ were also derived by Yong and Wetherall (1980) for the years 1970-77.

part of the nation of Kiribati) some 1,500 miles south of the Hawaiian archipelago. Matsumoto (1967) studied the morphology and distribution of larval wahoo in the central Pacific Ocean. Kramer (1985) presented very limited information on what is known about the life history of wahoo with emphasis on wahoo caught from the Northwestern Hawaiian Islands. Strasburg (1957) provided general background information on sharks of the central Pacific, and in a longer paper Strasburg (1958) discussed what is known about the distribution, abundance, and habits of pelagic sharks in the central Pacific Ocean.

Social and economic aspects of domestic fishing for the pelagic species in the management unit have been researched some but not very extensively. Cooper and Adams (1978) analyzed data collected in 1977 in a survey of Kailua-Kona fishermen conducted for the NMFS by Research Associates, Inc. In this study, fishing vessel owners in the Kailua-Kona area were interviewed concerning their fishing activities during 1976 (trips taken, catches, sales revenue, operating and capital costs) and the results were extrapolated to derive estimates of the total number of fishing trips taken, total catches by species and total sales revenue for the various fishery sectors that take the management unit species in the State of Hawaii as a whole. Three other SWFC Administrative Reports (NMFS 1983, 1983a, 1983b) are available on this survey. Samples, et. al., (1984) have presented a state-wide economic appraisal (1982 data) of the charter boat fishing industry in Hawaii in an attempt to update the 1976 base-year appraisal of the charter fishing industry, which was originally used to prepare this FMP. In a companion study, Samples, et. al., (1985) appraised the demographics, motivations, expenditures and fishing values of charter fishing patrons in Hawaii.

Finally, Cooper and Pooley (1983) reported on the distinguishing features of the Hawaii wholesale seafood market, and a report by Higuchi and Pooley (1985) provides estimates of the species composition of the retail seafood trade in Hawaii including some of the management unit species. Also, market information specific to mahimahi and wahoo is available from a report prepared by BT and Associates (1984), which was prepared under contract to the NMFS.

5.5 Limitations of the Data Base and Analytical Tools

The MFCMA requires FMPs to "be based on the best scientific information available" (Section 301(a)(2)). Ideally, each FMP should contain complete and accurate descriptive data on: the biology of the stocks, the fishing for the stocks, the nature and magnitude of impacts of alternative management measures on the stocks and on the fishermen; and the anticipated quantified benefits and costs of the proposed management regime relative to a "no action" alternative and to other alternative management measures considered. However, the "best scientific information available" for this FMP and the analytical tools for assessing the impacts of alternative management measures are not up to par for such an exhaustive evaluation. This is the given condition.

The difficulties and frustrations presented by this situation can be understood by examining some examples of the effect of not having complete data and predictive analytical tools for thorough assessments of impacts:

1. There is no available data base, nor can one be developed, from which to draw conclusions on foreign fishing patterns likely to emerge in response to different management approaches. This makes it generally infeasible, other than through guesswork, to estimate benefits and costs of alternative management approaches. The "analyses" and comparisons in Chapter 7 imply that foreign longliners could "lose" varying amounts of tuna under different area/season closure options. As pointed out earlier, however, tuna catch rates for longliners in and outside of the FCZ are quite similar, so what would be likely to happen as a result of closures of portions of the FCZ is that longlining effort and catch would be relocated elsewhere. There may be a slight shift in the total catch, or in the species composition of the catch, with some impact on total value of the catch and operating costs. Changes in costs of fishing or in catches, however, would most likely be small. There is, however, no statistical evidence to indicate whether shifts in effort will, in fact, occur. We do, however, know that foreign longliners have stopped fishing legally altogether in the FCZ since the PMP became effective more than six years ago. Therefore, any fishing by foreign longliners in the FCZ would be a benefit to them compared to the status quo of the PMP and a clear benefit to U.S. tuna policy.

2. If billfish or other species in the management unit are migrating toward domestic fishery areas, and if those fish are caught by foreign longliners before the fish arrive at areas used by domestic fishermen, then those fish would not be caught by U.S. fishermen. If the density or number of fish available in a domestic fishing area is increased and assuming catchability remains constant, then domestic catches would increase, and the values associated with the domestic fishery would also increase. The value increase may or may not be proportional to the catch increase depending on the timing and location of the catch and the fishery sector making the catch. Ideally, the Council should have information or analyses that present the level and values of such "transfer" effects of alternative closure options. Unfortunately, such "hard" information and predictive analyses are not available.

   The first attempt to suggest potential catch shifts of blue and striped marlin from foreign longliners to domestic longliners and trollers in the FCZ around Hawaii, depending on different closure alternatives, was made by Lovejoy (1977). The "Lovejoy model" was based on sparse information available about blue and striped marlin stock levels, seasonal migration directions of these two species, and tenuous foreign longline catch and effort patterns. A large number of assumptions had to be made concerning relative abundance, catchability coefficients, seasonal variations in abundance, among other factors. The model <u>simulates</u> the relative changes in density of blue

and striped marlin from one area to the next, leading to estimates of amounts of fish transferred from foreign to domestic fishermen over time. Assuming relatively fixed fishing areas and effort levels for recreational and commercial fisheries, estimates of changes in domestic catch associated with changes in foreign longline catch in the FCZ are derived by the model. Domestic recreational trollers' catches of blue marlin and striped marlin would increase by 2% and 7% respectively if foreign longlining were eliminated from the FCZ around Hawaii according to the estimates derived in the model. Domestic longline catches of blue marlin might be expected to rise by 2%. Catches of striped marlin on domestic longline gear would remain unaffected according to the results of the Lovejoy study.

A more recent study by Wetherall and Yong (1983) attempts to better determine the significance of foreign longline fishing in the FCZ of Hawaii on the catches and catch rates for blue marlin experienced by domestic longline fishermen in Hawaii. Closures of the FCZ to foreign longline fishing are based on a perception that foreign longline vessels compete significantly with domestic vessels in catches of the management unit species and tuna on local grounds or, in the outer reaches of the FCZ, intercept fish migrating to local grounds from distant waters. Domestic fishermen could benefit from the exclusion of foreign vessels from particular areas of the FCZ to the extent that this perception or conviction is valid. The Wetherall and Yong study examined the validity of the "transfer effect" concept but only with respect to blue marlin and their study was limited to longline gear.

The results of their study suggest that the success rate of catching blue marlin on domestic longline gear in local waters is influenced more heavily by events occurring outside of the FCZ than by foreign longline fishing within the FCZ. Year-to-year changes in blue marlin catch rates on domestic longline gear tend to reflect similar changes in the catch rates of blue marlin on foreign longline gear in the mid-Pacific. The implication here is that blue marlin taken in local waters originate elsewhere and are a part of a common, wide-ranging stock since local catch rates for blue marlin follow the same basic trends as those beyond the FCZ in the mid-Pacific. The expulsion of foreign longliners would not necessarily lead to higher local catch rates of blue marlin <u>if</u> the displaced vessels were redeployed in other regions of the blue marlin's range. Foreign longliners could still affect local catch rate by reducing the number of blue marlin migrating from those regions to local waters.

This is not, however, to say that there would be little impact on domestic catch rates of blue marlin stemming from closures of the FCZ to foreign longline fishing. The net effect of removing foreign competitors from the FCZ, or from parts of the FCZ, would depend on the relative concentrations of blue marlin in the FCZ and beyond the FCZ and their vulnerability to foreign longline gear. It is conceivable that benefits could accrue to domestic blue marlin fishermen from various exclusionary policies. However, Wetherall and Yong were

unable to predict the results of exclusionary policies with any statistical confidence. Their belief is that quantitative predictions are not yet possible because of the inadequacy of scientific understanding of blue marlin dynamics and the present inability of scientists to explain, much less forecast, changes in local abundance of blue marlin. Previous studies such as that by Lovejoy, have also stressed that, at best, only qualitative conclusions could be reached, and that even these are based more on assumptions than on established facts. As Lovejoy concluded, the most that can be said is that some benefit will accrue from excluding foreign longliners from the FCZ, provided catchability of blue marlin by foreign longliners is constant. A major conclusion reached by Wetherall and Yong as a result of their exercise is that a meaningful comparative study of alternative exclusionary policies in the FCZ is not possible and "would be out of the question" to undertake at this time.

The Wetherall and Yong "foreign/domestic blue marlin catch competition" study was extended by Skillman and Kamer (1985) to include striped marlin as well as blue marlin, and to cover domestic trolling and handline gears in addition to both foreign and domestic longline gears. Data on catch and fishing effort for each of these four fisheries were assembled covering a 17-year period (1962 through 1978). The catch-per-unit-effort (CPUE), or the catch rate, was calculated for both blue and striped marlin for each of these fisheries by month, quarter, and year. The degree of the relationship with respect to catch rates for blue and striped marlin between the Japanese longline fishery and the domestic fisheries for the species was then evaluated using correlation analyses.

Their results with respect to blue marlin were in tandem with Wetherall and Yong's finding: Since the abundance estimates (CPUEs) for both the domestic longline and troll fisheries and the Japanese longline fishery vary from year-to-year in a consistent fashion (are positively correlated), these results indicate that both local and Japanese fishermen fish a common stock of blue marlin. Changes occurring in the mid-Pacific stock as a whole are also reflected in changes in the portion of the blue marlin stock fished by local fishermen in local waters.

The situation for striped marlin is similar to that of blue marlin. Estimates of annual abundance for striped marlin for domestic longline gear, with time lags behind Japanese CPUE data in areas adjacent to the FCZ, are all positively correlated. That is, CPUE data for both fisheries change in a similar fashion. These results again suggest that the domestic and Japanese longline fisheries operate on a common stock and that changes in abundance of striped marlin to the local fishery are a reflection of comparable changes for the whole stock.

Skillman and Kamer, however, also examined the relationship between Japanese longline fishing effort and the abundance (CPUE) estimates for blue and striped marlin derived from domestic gears. They in effect were looking at whether marlin mortality on foreign longline gear in the FCZ, in waters adjacent to the FCZ, and in the mid-Pacific waters is associated with marlin abundance in local waters. They found that the abundance of blue marlin in Hawaii as calculated from catch/effort statistics from the local troll and longline fisheries is negatively correlated with Japanese longline effort expended in the FCZ and adjacent areas during the same quarter of the year and in the local area one quarter previously. Thus, increases in the amount of foreign longline fishing in waters close to where the domestic fisheries operate are associated with decreases in the abundance of blue marlin available to the domestic fisheries. Likewise, decreases in the amount of foreign longline fishing in the FCZ is associated with increases in the abundance of blue marlin available to domestic fishermen. There is an apparent catch competition effect between the foreign and domestic fisheries operating in the FCZ. Skillman and Kamer have statistically confirmed the experiences of local fishermen.

The abundance estimates of striped marlin calculated from domestic longline data are also negatively correlated with Japanese longline fishing effort expended in the FCZ and in waters adjacent to the FCZ during the same quarter and in the adjacent area one to four quarters earlier. As with blue marlin, the correlation analysis for striped marlin also shows that increases in Japanese fishing effort in the FCZ and in adjacent areas around Hawaii is associated with decreases in the abundance of striped marlin available to the domestic fishery (and vice versa). A catch competition effect between the foreign longline fishery and the domestic longline fishery apparently also exists with respect to striped marlin. Their results provide confirmation that Japanese longline fishing effort in local waters and in waters adjacent to the FCZ is, in fact, associated with reduced abundance of both blue and striped marlin available to the domestic fleets. While catch competition effects do exist between the foreign and domestic fisheries for the two principal species in the management unit, Skillman and Kamer's study did not address the magnitude of the catch competition effects. Also, it was not possible to test for interactions between foreign and domestic fisheries which take mahimahi, wahoo, and sharks because catch statistics for these species are only available for domestic gear types. Nor was it possible to test for foreign/domestic fisheries catch competition effects with respect to black marlin, sailfish, and shortbill spearfish because it was not possible to derive statistically valid estimates of abundance (CPUEs) for these species for both domestic and foreign fisheries that take these species.

The Lovejoy simulation study is the only one which attempted to quantify possible magnitudes of a transfer effect stemming from alternative area closures of the FCZ surrounding Hawaii to foreign longline fishing. Over the years, the model has been subject to a

variety of criticisms questioning the validity of many untested assumptions underlying the workings of the model, and the model's results which cannot be statistically tested. Nevertheless, the Lovejoy study has been helpful in understanding qualitative or directional catch effects of area closures of the FCZ to foreign longline fishing, although the Lovejoy study is certainly not definitive in determining either the amount or value of catch transfers of blue and striped marlin from foreign to domestic fishermen which could result from different area closure options. The central conclusion which is common to the Lovejoy study, the Wetherall and Yong study, and the study done by Skillman and Kamer is that a transfer effect would in fact occur and that domestic fishermen are bound to benefit by restricting foreign longline fishing in the FCZ off Hawaii. The transfer efect is equally important in Guam and American Samoa.

3. The available information on the domestic fisheries is limited. In part, this reflects the fact that before passage of the MFCMA, it was not thought to be very important to collect complete and accurate records of catches and fishing effort. In part, this also reflects the relatively limited resources that have been and are presently available for fisheries data collection in the island areas represented by the Council.

In summary, the "best scientific informative" is of limited value in practical terms although the Plan Development Team and the SSC both certified that the best scientific information available was used in developing this revised FMP. In reviewing the draft of this plan, NMFS "Reviewers indicated that in their view, the analyses of benefits and costs needs to be improved". However, they failed to recognize that it would indeed be very difficult or impossible to accurately quantify the benefits and costs of the alternatives considered in the FMP in the absence of hard data and proofs regarding the magnitude of the relationship between foreign and domestic fisheries. There are not many proofs in the whole subject of fisheries science, and this FMP is no exception. The attempt in this revised FMP to quantitatively assess the trade-offs of different management options is recognized as having a weak statistical foundation. There too, normative judgements bearing on reasonableness, equity, and consistency should be recognized as having at least as much validity than the quantitative measures which have been incorporated in this plan.

5.6 International Management

At present, there are no international treaties or bilateral agreements to which the U.S. Government is a party for the management of billfish and the other species in the management unit in the Pacific. However, since late 1984, the U.S. Government has been negotiating with sixteen Pacific island countries aimed at developing an international agreement which would provide access to U.S. purse seine vessels to rich tuna resources in the south and western Pacific. Adoption of this FMP is not expected to affect the course of these negotiations. There is at least one bilateral agreement under which the catch

of billfish by longliners is being restricted. The Governments of Australia and Japan have reached an agreement whereby Japanese longline vessels are prohibited from fishing in black marlin and tuna grounds north of Queensland (NMFS, Market News, November, 1980).