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OVERVIEW OF TAIWANESE OBSERVERS PROGRAM FOR LARGE SCALE TUNA LONGLINE FISHERIES IN PACIFIC OCEAN FROM 2002 TO 2006

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SUMMARY

For collecting fisheries data for scientific purposes, Taiwan started to deploy observers on distant water fishing vessels since 2002. Observers were trained to collect fisheries data and biological samplings. The data recorded include the fishing activities, catch number and weight, species identification, bycatch species, status and biological samples for some species.

This report provides a general overview of the Taiwan observer program and summary of data collected. From 2002 to 2006, 23 trips on large scale tuna longline fishing vessels were observed in the Pacific Ocean. The observations days were 1590, with an average coverage rate of 3.5% by trips. More than 20 species were recorded, and 98,055 fishes were sampled. The catch composition varied by areas. In tropical area, over 50% of catch were bigeye. In temperate waters, the albacore accounted over 87% in the northern area, and 71% in the southern area. In addition, length frequency of major species and the sighting and incidental catch of ecological species were recorded, and biological samplings were collected for biological research.

1. INTRODUCTION

Large Scale Tuna Longline Fisheries

The Pacific Ocean is one of the earliest fishing grounds exploited by Taiwanese tuna fishery, with the involvement of three types of fisheries, large scale tuna longline fisheries, small scale tuna longline fisheries, and purse seiners. Currently, Taiwan's large scale longline (LTLL) vessels can be divided into two fleets in accordance with the target species: those operate mainly in tropical area targeting on bigeye tuna, and those operate in subtropical and temperate waters targeting on albacore. Vessels targeting on bigeye tuna usually conduct a year round operation, and transship their catches at sea to carriers and receive fuel and supplies during transshipment.

Most LTLL vessels targeted on albacore for supplying to canneries in Pago Pago in the early stages of development. Before 1995, the catch of albacore in the south region was higher than north region. Constrained by opportunities of fishing agreements for access to waters of the coastal States in the South Pacific, the Taiwanese fishing efforts were driven to the North region and drastically increased thereafter. The vessels fish for northern albacore seasonally from September to next March, and shift to the South Pacific fishing for southern albacore from April to August.

In recent years, more vessels targeted on tropical species for Japanese frozen sashimi market. The major fishing grounds of LTLL vessels were located in the central Pacific region, with a total number of 133 vessels operating in 2002 and increased to 142 in 2003. However, owing to the bigeye quota restriction, perceiving of the overcapacity of the fleet, the Fisheries Agency decided to carry out fleet reduction program to reduce the fishing vessels, offering to buyback a large number of LTLL. The number of LTLL decreased to 117 in 2006. The number of LSLLs between 2002 and 2006 are listed in Table 1.During 2002-2006, the dominant species were bigeye, albacore and yellowfin tuna. The average annual catch of bigeye was around 17,300 ton, accounting for about 35% of the total catch, while the average annual albacore tuna was around 16,300 t, accounting for another 33%, and the average annual yellowfin catch was around 8,000 t, accounting around 16%. The annual catch was listed in Table 2.

Observer Program

Noting the importance of fisheries dependent data for scientific purposes, Chinese Taipei launched a pilot observers program on distant water fisheries since 2002. In the first year, there were only 5 observers for all oceans. In line with the government's policy in establishing an observers program in a global basis, and availability of budgets to support the increase of observers, the number of observers employed gradually increased and reached 56 in 2007. The annual budget was US$ 166 thousand in 2002 and increased to US$ 1,978 thousand in 2007(Table 3), covering such expenses as the salary of observers, food, travel fees, sampling facilities, communication costs and administrative fees, etc.

For smoothly implementing the observer program, the fishing vessel owners, captains and crews are requested to cooperate and assist the observers for conducting their missions, which include allowing the observers to access to the satellite telephone, fax machine, internet and any other communication facility independently and assisting observers to collect samples on designated target and non-target species, etc. Captains or crews are obligated to answer questions of observers in relation to their work.

2. PROGRAMS ARRANGEMENT

Vessel selection

Due consideration was taken on the requirement of the measures in place by various RFMOs when deploying observers. Stratification was made in fleet types (such as bigeye fleet and albacore fleet). At the outset, taking observers on board was in a voluntary basis. As an incentive, additional quota was provided to those vessels which has catch quota limit. Later, ballot would be applied to the entire fleet, in a rotation basis.

In 2006, it became mandatory for fishing vessels to accept an observer onboard. There will be no additional quota for observed vessels. However, if the vessel would be cooperating with Fisheries Agency for special experiment, additional quota could be considered on case-by-case basis.

Missions

To implement the scientific missions, three weeks training course are designed for observers. There are five major parts which included the understanding of the relevant fisheries management policy and regulations, knowing the facility of fishing vessels, learning how to record catch information, practicing the techniques of biological sampling and knowledge of the "Health and Safety" onboard.

While onboard, observers shall record the following information,

(1) Basic information of the vessels: the vessel's name, tonnage, vessel length, number of crew, the type of communication system, etc.

(2) Daily fishing activities information: gear characteristics, set and retrieval time, environmental conditions, bait types, total number of hooks, total number of baskets, hooks per baskets, etc.

(3) Catch information: identification and record catch species, measurement of length and weight for first sixty fishes, the number and weight of each catch species. In addition, the sex should be recorded for some species (billfishes and sharks).

(4) Bycatch information: many bycatch species were released before taken onboard. If those bycatch species were dead taken onboard, observers are requested to take some biological samples for further researches.

(5) Biological samples: otoliths, stomach contents, muscle and vertebra were collected for some species. Weighing of the whole shark and shark fin for obtaining shark fin ratio estimation.

Data summarization

Every observer is provided with a laptop with electronic observer data system, for daily entry of

observation data. After the observer completes his mission and returns home, there will be a debriefing between observer and observers' manager. Then the data will be checked twice by other observers off duty. Upon completion of the checking, the data will be submitted to statistician for analysis. The data will be released to managers and scientists when requested.

3. Data Summary

Trips information

A total of 23 trips were deployed in Pacific Ocean from 2002 to 2006. The observation days were 65 in 2002 and increased to 735 in 2006. Total of 1590 fishing days were recorded, with the total efforts of 5,348 thousand hooks, ranging from 186 thousand hooks in 2002 to 2,511 thousand hooks in 2006. The overall coverage rate was 3.5 % by trip. It was 0.8 % in 2002 and increased to 8.6 % in 2006. The average observer days for a trip were 70 days. The detail information was listed in Table 4. It shows increasing trend in observer efforts, days, and trips from 2002 to 2006.

Observation areas

In the Pacific Ocean, there are three fishing grounds, which is the tropical area (15N-15S) for bigeye tuna fishing vessels, north area (15N-45N) and south area (15S-40S) for albacore fishing vessels. The observation areas are showed in Figure 1. Over 60% of the observation area was in the tropical areas, with only 33% in north area and the remaining in south area.

Catch composition

Catch in numbers and composition were summarized in Table 5 and Figure 2. More than 20 species were recorded, including 9 tuna and tuna-like species, 8 shark species, and 2 species of other fishes. Among them, six species were of commercial valuable, including bigeye, albacore, yellowfin, skipjack, blue shark, and swordfish. These species covered more than 90 % of the total catch, 53.2% of albacore, 21.8% of bigeye, 7.3% of yellowfin, 1.6% for swordfish, 2.8% for skipjack, 2.1% for blue shark. The diversity of shark species is quite high in the tropical area.

The three major tuna species catch composition by 5*5 degree is shown in Figure 3. It is obvious that the species compositions varied by areas. In north area, 86.7 % were albacore, 3.7% bigeye, 1.4 % blue sharks. In tropical area, 49.5% were bigeye, 16.1% yellowfin, 8.5% albacore and 3.1% swordfish. In south area, albacore accounted for 70.9 %, 4.6% bigeye and 4.5% yellowfin.

Average nominal CPUE distribution of four bycatch species, swordfish, blue marlins, black marlins and blue shark were shown in Figure 4 to Figure 7. Blue marlin was more concentrated in tropical area. Black marlin, swordfish and blue shark have boarder distribution, with higher CPUE for blue shark.

Length Frequency

Observers recorded length and weight for target species and bycatch species if possible. During the observer trips, around 58000 samples were measured, included 28216 albacore, 16021 bigeye, 5281 albacore, 1608 swordfish and 2119 blue shark. The length frequencies of albacore, bigeye tuna, yellowfin tuna, swordfish and blue shark are shown in Figure 8-12.

The length frequency of albacore ranged from 50 cm to 120 cm and averaged 91.6 cm with mode at 96 cm. We separated the length frequency to north stock and south stock. The modes were 96 cm and 98 cm for north and south stock respectively. It showed the average size was smaller in north area. The length frequency of bigeye ranged from 65 cm to 205 cm and averaged 120.5 cm, the mode was 116 cm. The length frequency of yellowfin tuna ranged from 68 cm to 250 cm and averaged 122.4 cm. The mode was 114 cm. The length frequency of swordfish ranged from 53 cm to 280 cm and averaged 150.8 cm. The modes were 105 cm and 150 cm. The length frequency of blue shark ranged from 86 cm to 335 cm and averaged 221.83 cm. The mode was 240 cm.

Ecological species interaction and incidental catch

Many ecological related species, such as seabirds, sea turtles, cetacean, are known to have interaction

with tuna longline fisheries. The observers recorded the species sighted as shown in Table 5 and Figure 13-15. Eight species of seabirds, four species of sea turtles and more than four cetaceans are sighted. However, because most of the ecological related species were sighted from far distance, some species could not be identified.

In addition, the incidental catch also became important tasks for observers. During the trips, 82 sea turtles, 293 albatross and other seabirds, 3 cetaceans were incidentally caught. The bycatch locations were shown in Figure 16-18. It showed the seabird was bycatch in north of 30N north, 160E to 140W. The sea turtles were bycatch in tropical area, especially in 0-10N, 130-150W. The cetaceans were incidental catch in very limited area with small numbers.

Biological and other researches

Biological studies were done using the biological samples collected by observers. Specific experiments required observers' cooperation, which included the following,

(1) The stock structure of bigeye in three oceans through DNA analysis

A thorough understanding of the bigeye tuna population structure is necessary for the effective management of this highly migratory marine species. The study is to elucidate the existence of these bigeye tuna population stocks inferred from mtDNA control region polymorphisms. Tissue samples of bigeye tuna were collected mainly from Western Pacific, central Pacific and eastern Pacific oceans. The population structure of bigeye tuna in the Pacific Ocean was investigated using sequence data of the mitochondrial control region.

(2) Estimation the seabirds bycatch

According to the observers data collected, the preliminary incidental catch of seabirds in Pacific Ocean was estimated. It showed the incidental catch was the highest in the areas between 25-40 N and 165 W to 165 E and areas between 25-35 S and 165-180W. In comparison, the incidental catch was low in tropical area. Black-footed albatrosses and Laysan albatrosses were the major incidental catch species in the northern area.

(3) The studies on the reduction of catch loss caused by cetacean using the acoustic pinger in distant-water longline fishery

To reduce the fishery loss due to dolphin and to protect cetaceans from being caught, this study applied the bio-acoustic method to expel cetaceans from fishing gears.

(4) Experimental analysis on the reduction rate of sea turtle bycatch in tuna longline by using circle hooks

Two commercial fishing vessels were chosen to carry out the experiments of circle hooks in Pacific Ocean.

Some results of the experiments are under analysis.

4. SUMMARY

Observer data are fundamental for both management and scientific purposes. The stock might be affected by oceanography, year, season, and migration dynamics. While certain observer coverage would be necessary to collect reliable data. In addition, the biological samples collected by observers would contribute greatly to estimation of the biological parameters. As Chinese Taipei processed observer program for more than 6 years and invested tremendous manpower and budget continuously, some challenges were emerged. Some of these challenges are practical problems and some are constitutional or conceptual conflicts. The challenges we are now coping with are:

(1) Data collection priority

The operation time is long for longline vessels, even more than fourteen hours. If there are too many items needed, the overloading works might affect the data quality. It would be necessary to set

the priority for data collected items to ensure the data quality.

(2) Re-education for observers

Since the observers might not have the specialties in biology. Observer program was designed to collect data of the target species; observers do not have the competence of distinguishing seabird species correctly. With such constraints, more than half of the seabirds under observation were unknown species. The training of observers would be very important, especially for bycatch species. It showed, the senior observers would be more competence to identify those species after many trips experience and re-education. We believe the re-training and well designed debriefing could improve the ability of observers as well as the data.

Table 1 Number of Large Scale Tuna Longline fishing Vessels in Pacific Ocean, 2002-2006

Year	No. of vessels
2002	133
2003	142
2004	137
2005	133
2006	117

Table 2 Catch of major tuna and tuna-like species caught by LTLL fishery in WCPFC Convention Area, 2002-2006

Species Year	Northern ALB	Southern ALB	BET	YFT	SWO	BUM	BAM	SKJ	MLS	Total
2002	7,055	12,796	8,741	4,953	1,274	231	8	143	386	35,587
2003	6,454	14,105	7,540	4,981	1,038	807	3	283	395	29,152
2004	4,061	13,307	16,888	9,018	2,382	1,226	5	672	695	42,705
2005	3,990	9,468	10,083	5,755	1,057	1,196	54	438	404	32,445
2006	3,848	6,365	7,841	3,583	863	1,255	19	207	304	24,285

Table 3 Number of observers and annual budget for observer program, 2002-2006.

Year	No.	Budget(US$)
2002	5	166,545
2003	6	180,212
2004	9	325,939
2005	16	333,333
2006	31	745,212
2007	56	1,978,879
Total	123	3,730,120

Table 4 Number of vessels covered, observed days and hooks in Pacific Ocean, 2002-2006.

Year	Total	Days	Hooks
2002	1	65	185,855
2003	3	183	652,520
2004	4	316	1,021,017
2005	5	291	977,844
2006	10	735	2,511,182
Total	23	1,590	5,348,418

Table5 Numbers of Catch species and catch composition by areas

Species	Whole Pacific	North Area (N of 15N)	Tropical Area (15N-15S)	South Area (S of 15S)
TUNA				
Albacore	53.2%	86.7%	8.5%	70.9%
Bigeye	21.8%	3.7%	49.5%	4.6%
Yellowfin	7.3%	0.4%	16.1%	4.5%
Skipjack	2.8%	1.5%	4.0%	3.4%
BILLFISHES				
Swordfish	1.6%	0.5%	3.1%	1.1%
Striped Marlin	0.5%	0.4%	0.6%	0.4%
Blue marlins	0.9%	-	2.2%	0.1%
Black marlines	0.0%	-	0.0%	0.0%
Sailfish	0.0%	-	0.1%	0.0%
Other Billfishes	0.3%	0.0%	0.6%	0.5%
SHARKS				
Blue Shark	2.1%	1.4%	3.4%	0.7%
Silky shark	0.8%	-	2.0%	0.0%
Scalloped hammerhead shark	0.0%	-	0.0%	0.0%
Smooth hammerhead shark	0.0%	-	0.0%	0.0%
Shortfin Mako	0.3%	0.3%	0.2%	0.3%
Whitetip shark	0.1%	-	0.3%	0.0%
Thresher shark	0.0%	-	0.1%	0.0%
Long-tailed shark	0.2%	-	0.4%	0.0%
Great White shark	0.0%	0.1%	0.0%	0.0%
Other sharks	0.3%	0.0%	0.8%	0.0%
OTHER FISHES				
Dolphinfish	0.6%	0.7%	0.5%	0.8%
Sunfish	0.0%	0.0%	0.0%	0.0%
Other Fishes	7.0%	4.3%	7.4%	12.7%

Table 6 Ecological related species sighted

Area		Sighted species
North	Seabirds	Black-footed albatross, Laysan albatross, Giant petrel, unidentified albatrosses, unidentified sea birds
	Sea turtles	Not sighting
	Cetaceans	Blackfish(*Superfamily Delphinidae*), unidentified whale
Tropical	Seabirds	Frigatebird, unidentified sea birds
	Sea turtles	Olive Ridley turtle, Leatherback sea turtle
	Cetaceans	spinner dolphins, bottlenose dolphin, Blackfish, unidentified whale
South	Seabirds	Southern Giant Petrel, unidentified albatross, unidentified sea birds
	Sea turtles	Green turtle, Loggerhead turtle, Leatherback sea turtle
	Cetaceans	Blackfish

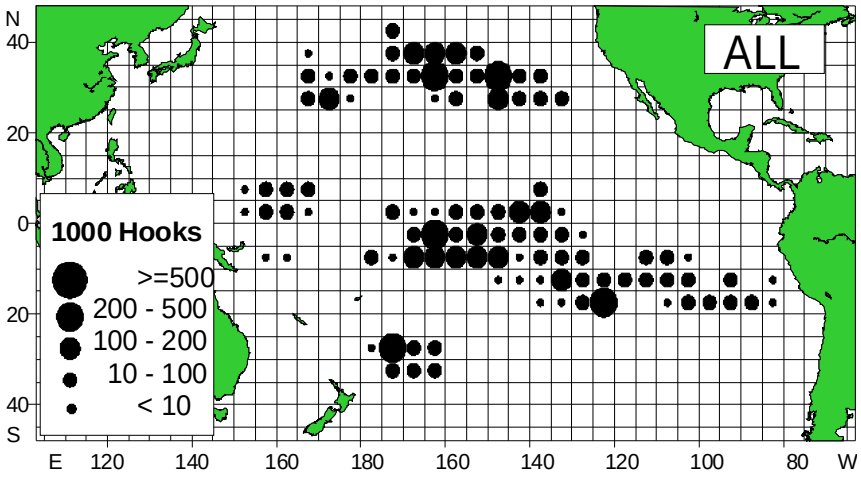


Figure 1 Distribution of observed fishing efforts, 2002-2006.

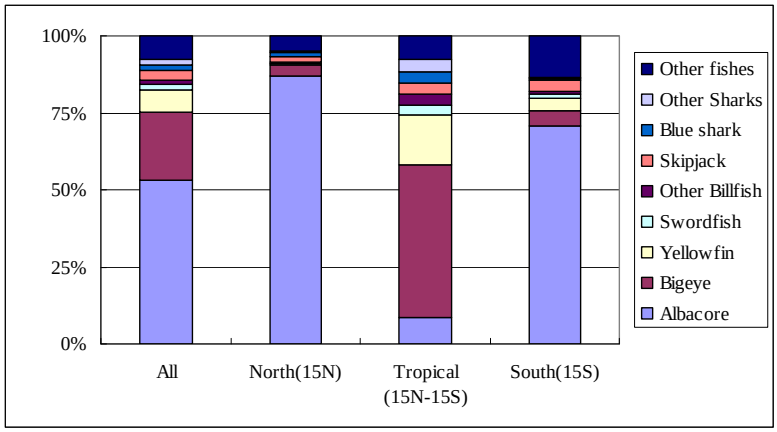


Figure 2 Species composition of observed catch by areas

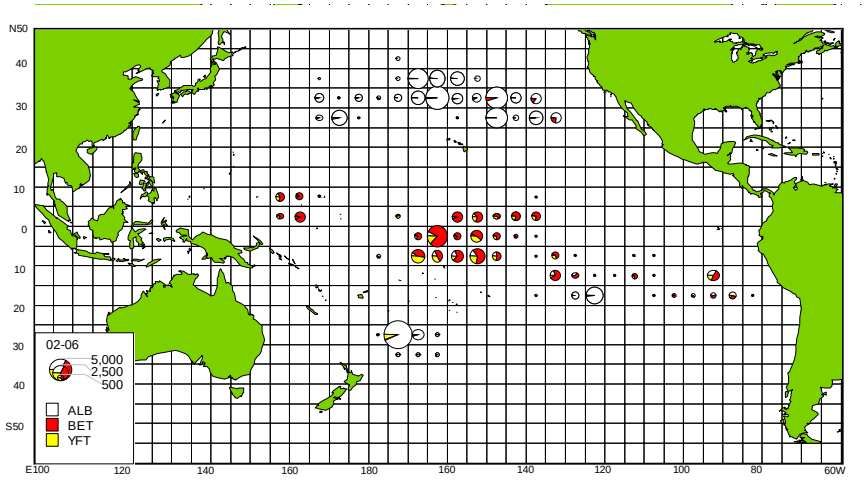


Figure 3 Distribution of the catches of albacore, bigeye and yellowfin tunas in the Pacific Ocean, in numbers, 2002-2006.

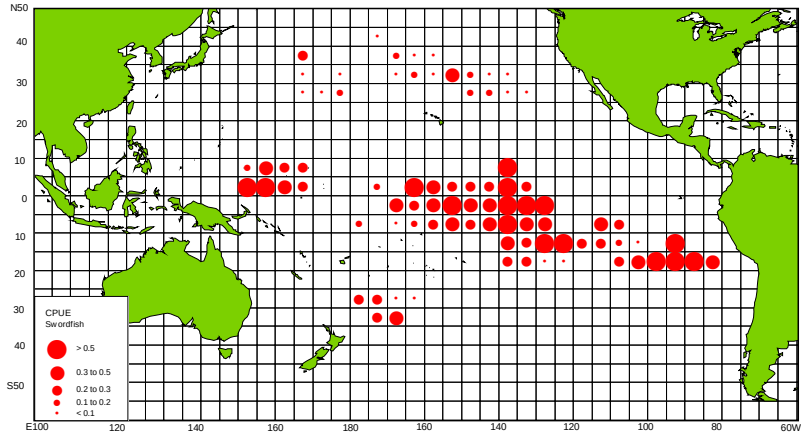


Figure 4 Nominal CPUE (No./thousand hooks) distribution of Swordfish, 2002-2006

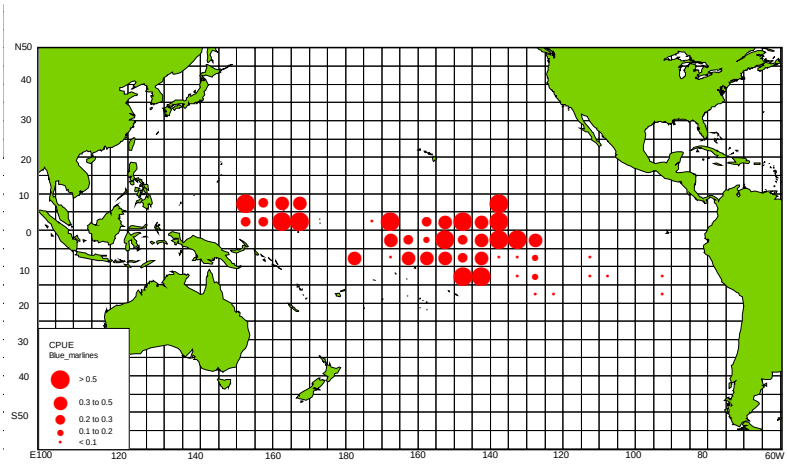


Figure 5 Nominal CPUE (No./thousand hooks) distribution of Blue marlines, 2002-2006

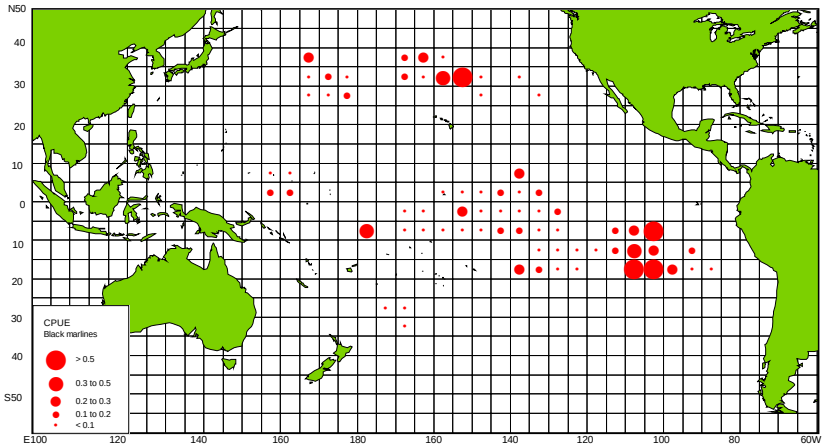


Figure 6 Nominal CPUE (No./thousand hooks) distribution of Black marlins, 2002-2006

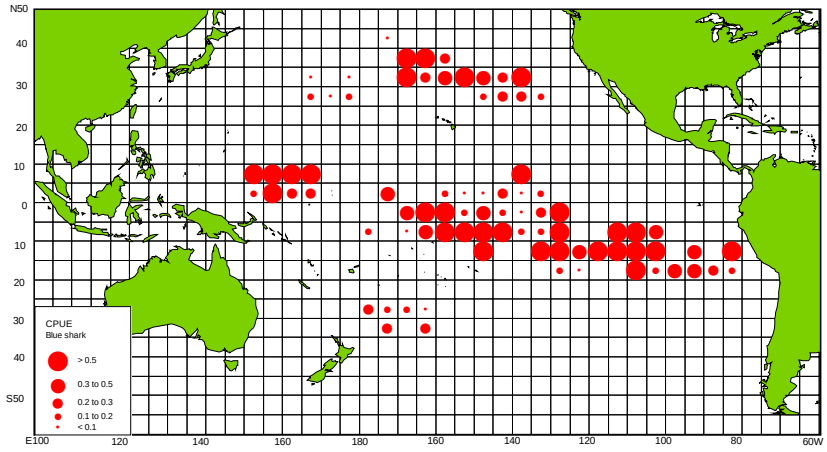
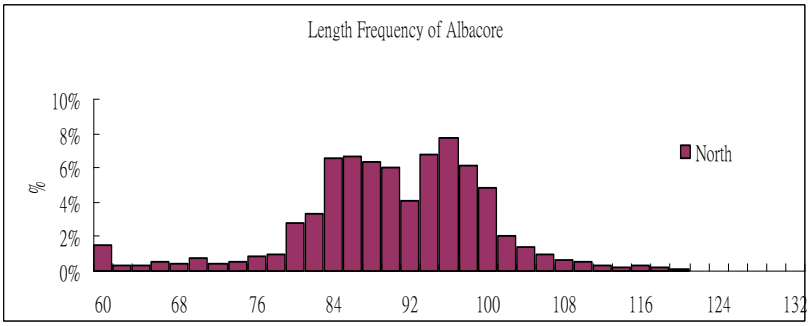


Figure 7 Nominal CPUE (No./thousand hooks) distribution of Blue Shark, 2002-2006



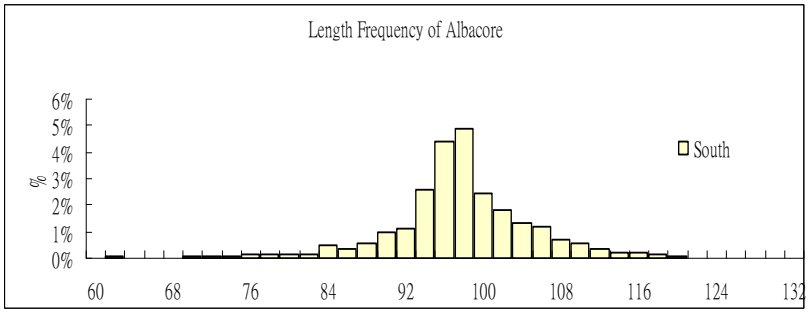


Figure 8 Length frequencies of albacore by areas

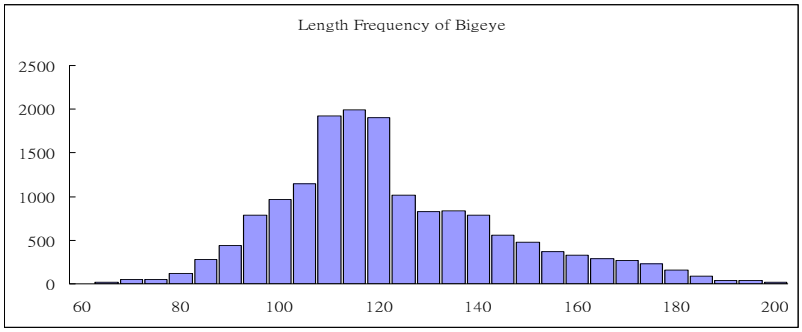


Figure 9 Length frequencies of bigeye

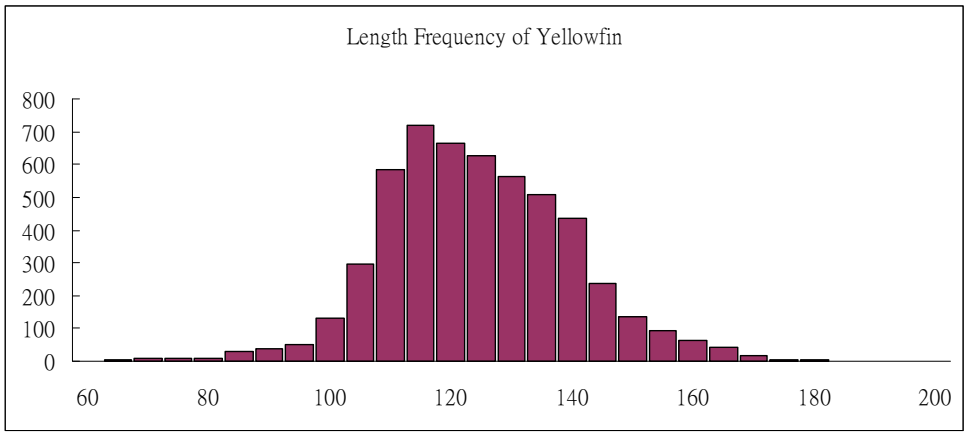


Figure 10 Length frequencies of yellowfin

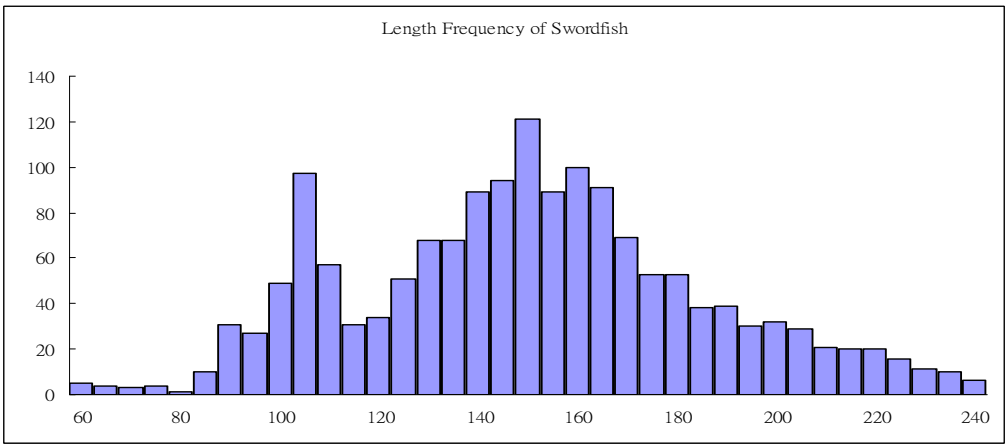


Figure 11 Length frequencies of swordfish

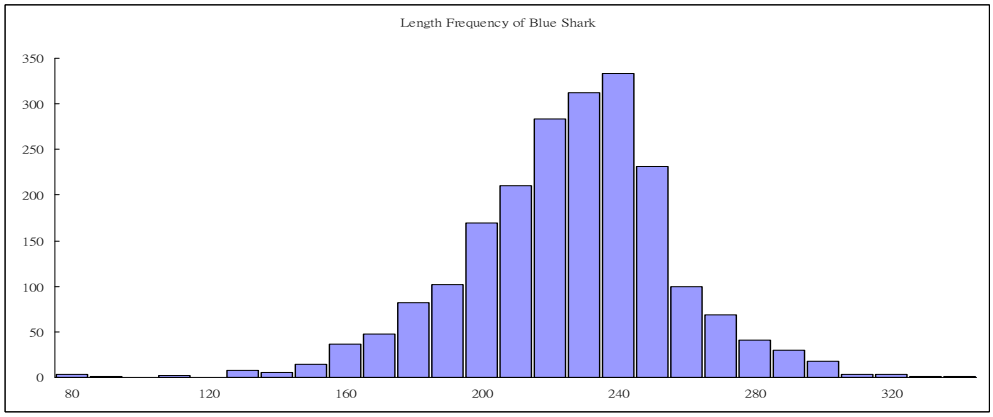


Figure 12 Length frequencies of blue sharks

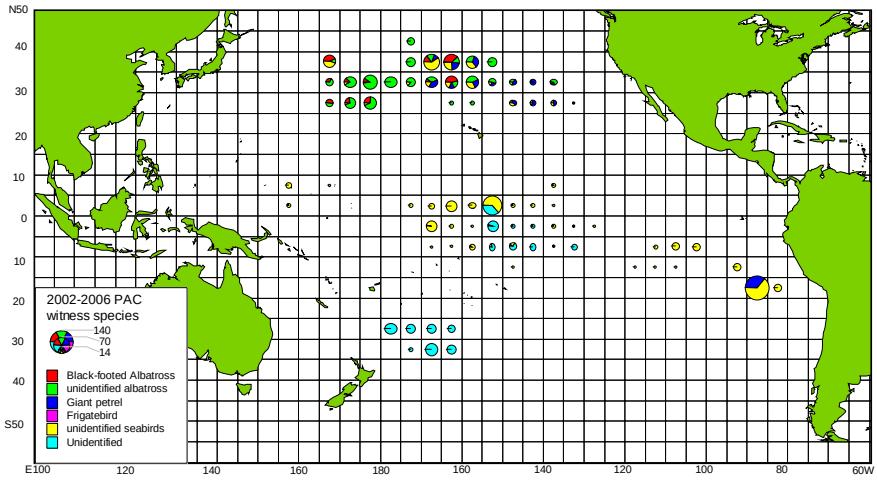
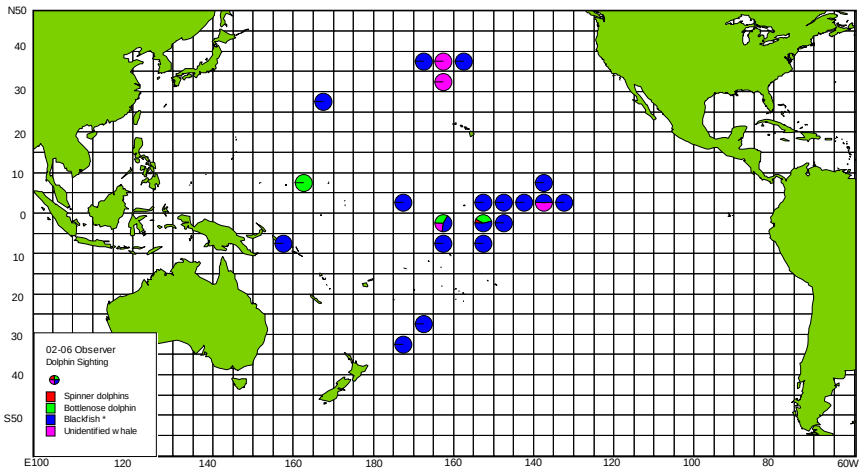


Figure 13 Distribution of Seabirds Sighted by species, 2002-2006



*Blackfish include False killer whale, Melon-headed whale, Pygmy killer whale, Short-finned pilot whale, Long-finned pilot whale

Figure 14 Distribution of Cetaceans Sighted by species, 2002-2006

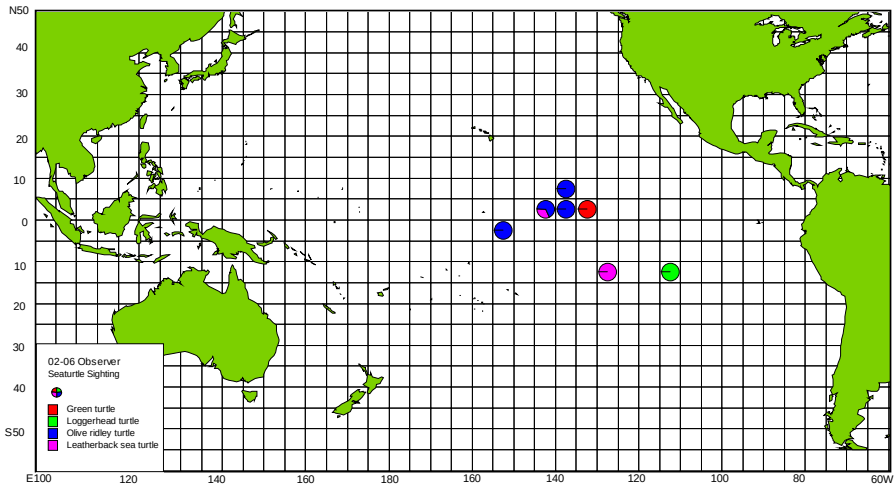


Figure 15 Distribution of Sea turtles Sighted by species, 2002-2006

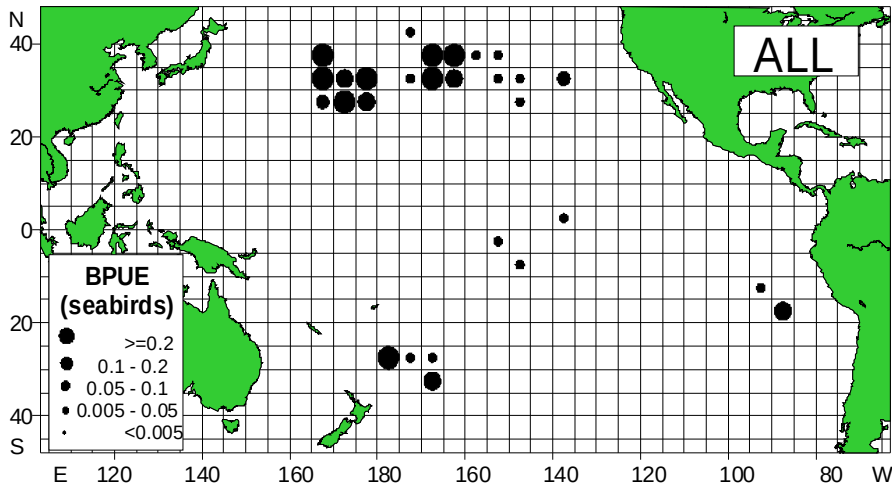


Figure 16 Distribution of sea birds incidental catch per unit effort (NO/thousand hooks), 2002-2006

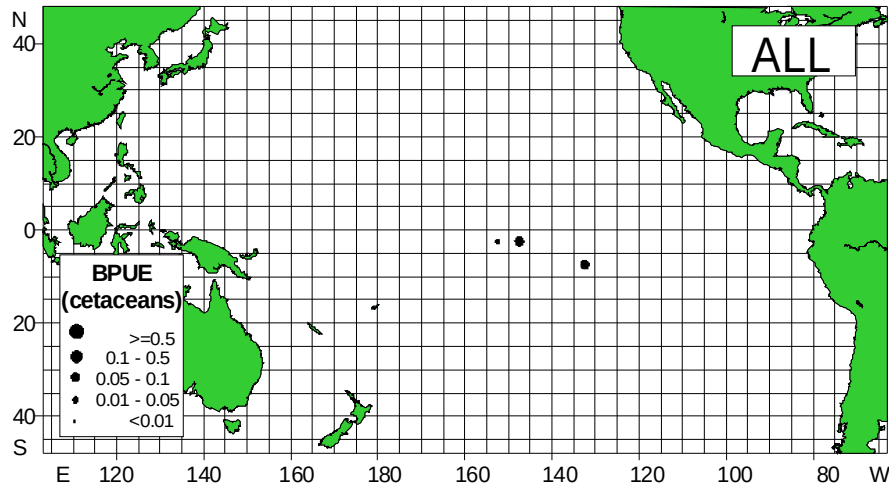


Figure 17 Distribution of cetacean incidental catch per unit effort (NO/thousand hooks), 2002-2006

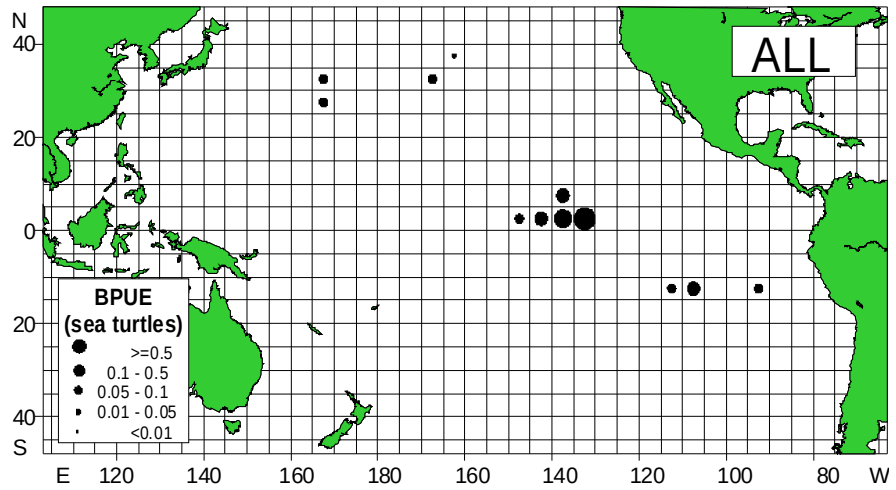


Figure 18 Distribution of sea turtles incidental catch per unit effort (NO/thousand hooks), 2002-2006