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Non-Target Species Interactions with the Tuna Fisheries of the Western and Central Pacific Ocean

WCPFC-SC6-2010/EB-IP-8

Oceanic Fisheries Programme[1]

[1] Secretariat of the Pacific Community, Noumea, New Caledonia

TABLE OF CONTENTS

Introduction 1

Observer Data 1

Major Finfish Species and Species Groups Caught by Longliners and Purse Seiners in the Western and Central Pacific Ocean 3

Longline Fisheries 6

Purse-seine Fisheries 7

Key conclusions 12

INTRODUCTION

The Western and Central Pacific Ocean (WCPO) tuna fisheries are amongst the largest, most complex and valuable fisheries resources in the world. In 2008, the most recent year with confirmed statistics, the annual catch exceeded 2.4 million tonnes (Williams and Terawasi, 2009), comprised over 50% of the total global tuna catch and was valued at over USD 5 billion dollars. Although albacore, bigeye, skipjack and yellowfin tunas have dominated annual catches from the WCPO, the fisheries also interact with non-tuna taxa, such as billfishes and sharks, which are important components of the retained catches and a range of other species with no commercial value (e.g. turtles, birds).

The Western and Central Pacific Fisheries Commission (WCPFC) is the Regional Fisheries Management Organisation for the tuna fishery with responsibilities for not just managing the catch of target species but also non-target species. Estimates of the catch of non-target species have been provided regularly to the WCPFC since 2005 (Molony 2005, SPC 2006, 2007, 2008). This report syntheses the current information on the interaction of WCPO tuna fisheries with non-target species to assist with informing discussion within the Ecosystem and Bycatch Specialist Working Group at the 2010 regular meeting of the WCPFC Scientific Committee.

OBSERVER DATA

The species and species groups caught in the WCPO can be determined from observer data held by the SPC Oceanic Fisheries Programme that were collected onboard longliners since 1992 and purse seiners since 1994. Tables 1 and 2 show the number of observer trips covered by data held by the OFP for longliners and purse seiners respectively.

The number of trips onboard purse seiners have been relatively consistant through time, both for trips fishing mainly unassociated schools and trips fishing schools associated with floating objects (primarily logs, drifting FADs and anchored FADs). In the early years of the time series, the majority of trips were taken on United States vessels, but the coverage of other fleets, particularly those fishing under the FSM Arrangement, has improved over time. Since 2002, a large number of observer trips has been taken in the waters of Papua New Guinea.

The number of trips taken on offshore longliners based in Pacific island countries and fishing in the tropics or targeting albacore in sub-tropical waters, and on vessels in the domestic fleets of Australia and New Zealand, has been relatively consistent. However, data held by the OFP for trips taken on longliners based in Hawaii cover only the period from 1994 to 2004; while the fleet has continued to operate since 2004, data have no longer been provided to the OFP. The distant-water fleets of Japan, Korea and Chinese Taipei account for a high proportion of longline effort in the WCPO, but the number of trips covered by observer data held by the OFP, other than for Japanese vessels fishing in the waters of Australia or New Zealand, is minimal. The Japanese longline fleet ceased fishing in the Australian Fishing Zone in 1998. The discontinuities in the observer data covering the fleet based in Hawaii and the Japanese vessels fishing in the AFZ should be born in mind when interpreting time series of catch rates of finfish determined from the observer data.

Table 1. Number of trips taken by observers onboard longliners covered by data held by the SPC Oceanic Fisheries Programme, by sector

Year	Australia Domestic	Australia Japanese	Distant-Water Albacore	Distant-Water Yellowfin & Bigeye	Hawaii	New Zealand Domestic	New Zealand Japanese	Offshore Albacore	Offshore Tropical Deep	Offshore Tropical Shallow	Shark	Total
1992	0	59	0	0	0	2	6	1	1	0	0	69
1993	0	86	0	0	0	0	17	1	2	6	0	112
1994	0	62	0	0	46	1	7	1	3	15	0	135
1995	0	41	0	1	48	3	8	7	5	18	3	131
1996	0	34	1	0	53	5	0	13	7	13	2	126
1997	0	31	0	0	37	7	8	10	19	20	3	132
1998	0	2	2	1	50	11	5	6	11	24	4	112
1999	0	0	1	0	38	4	6	12	11	13	10	85
2000	0	0	0	1	111	9	4	5	20	14	4	164
2001	0	0	0	0	229	21	4	5	4	3	10	266
2002	0	0	0	2	279	10	4	32	69	8	5	404
2003	6	0	0	1	264	5	4	48	49	6	1	383
2004	34	0	0	0	213	16	0	52	47	11	11	373
2005	11	0	0	3	0	12	2	53	41	0	6	122
2006	51	0	0	5	0	14	3	74	67	4	3	218
2007	19	0	0	0	0	14	3	49	53	12	4	150
2008	0	0	0	0	0	17	2	70	17	11	3	117
2009	0	0	0	0	0	0	0	90	4	5	1	99
Total	121	315	4	14	1,368	151	83	529	430	183	70	3,198

Table 2. Number of trips taken by observers onboard purse seiners covered by data held by the SPC Oceanic Fisheries Programme, by main type of school association per trip

Year	Unassociated Schools	Associated Schools	Total
1994	14	11	25
1995	32	30	62
1996	52	57	109
1997	47	62	109
1998	78	85	163
1999	21	54	75
2000	35	55	90
2001	56	69	125
2002	84	128	212
2003	91	144	235
2004	141	224	365
2005	164	246	410
2006	191	256	447
2007	169	239	408
2008	151	169	320
2009	53	63	116
Total	1,379	1,892	3,271

Figures 1 and 2 show the distribution of observed effort relative to total effort in the longline and purse-seine fisheries in the WCPFC Statistical Area. While the coverage of observer data collected on purse seiners is more or less geographically representative, except for the lack of data covering Indonesia and the Philippines, the coverage for longliners is not, primarily because of the lack of data covering the distant-water fleets.

MAJOR FINFISH SPECIES AND SPECIES GROUPS CAUGHT BY LONGLINERS AND PURSE SEINERS IN THE WESTERN AND CENTRAL PACIFIC OCEAN

The major finfish species and species groups caught by longliners and purse seiners covered by observer data held by the OFP are listed in Tables 3 and 4, ranked by the amount of observed catch. Non-target species account for only 0.89% of the observed purse-seine catch (assuming that the unidentified tunas were target species), whereas for the longline fleets that are covered by the data, non-target species account for about half of the observed catch, with sharks accounting for 29.7%. The relatively large proportion of southern bluefin in the observed catch of longliners reflects the fact that much of the observer coverage of Japanese longliners fishing in Australia and New Zealand has been of trips targeting southern bluefin.

Figure 1. Distribution of longline hooks set and hooks observed in the WCPFC Statistical Area, 1992–2007

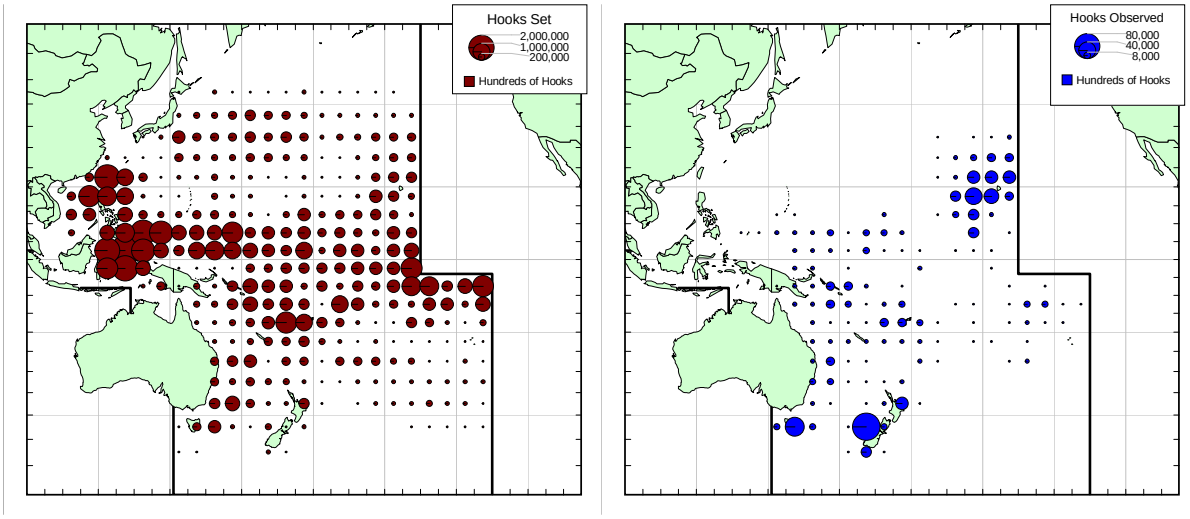


Figure 2. Distribution of purse-seine days fished or searched and days observed, 1994–2008

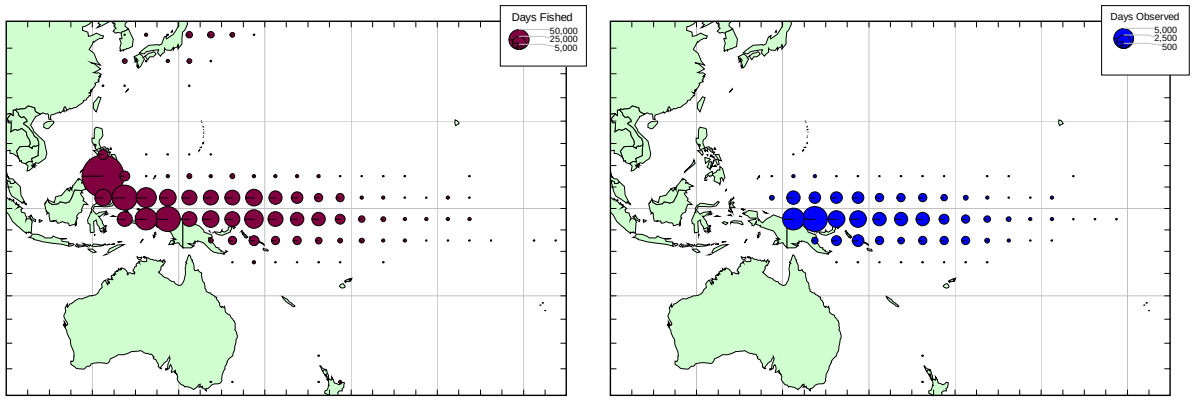


Table 3. Major finfish species and species groups caught by longliners in the Western and Central Pacific Ocean, ranked by total observed catch, 1994–2009

Species or Species Group	Scientific name	Observed Catch	
		Tonnes	%
Blue shark	Prionace glauca	9,216	19.5%
Bigeye tuna	Thunnus obesus	7,381	15.6%
Albacore	Thunnus alalunga	5,945	12.6%
Yellowfin tuna	Thunnus albacares	5,560	11.8%
Southern bluefin tuna	Thunnus maccoyii	4,468	9.5%
Swordfish	Xiphias gladius	2,792	5.9%
Silky shark	Carcharhinus falciformis	1,644	3.5%
Opah	Lampris guttatus	1,330	2.8%
Striped marlin	Tetrapturus audax	1,200	2.5%
Mako sharks	Isurus spp	1,047	2.2%
Escolars	Gempylidae	805	1.7%
Blue marlin	Makaira nigricans	799	1.7%
Oceanic whitetip shark	Carcharhinus longimanus	666	1.4%
Common dolphinfish	Coryphaena hippurus	565	1.2%
Ocean sunfish	Mola mola	499	1.1%
Porbeagle	Lamna nasus	450	1.0%
Wahoo	Acanthocybium solandri	408	0.9%
Pomfrets	Bramidae	346	0.7%
Skipjack tuna	Katsuwonus pelamis	323	0.7%
Shortbill spearfish	Tetrapturus angustirostris	289	0.6%
Lancetfishes	Alepisaurus spp	264	0.6%
Butterfly kingfish	Gasterochisma melampus	223	0.5%
Shark suckers	Remora spp	213	0.5%
Oilfish	Ruvettus pretiosus	207	0.4%
Thresher sharks	Alopias spp	181	0.4%
Black marlin	Makaira indica	149	0.3%
Indo-Pacific sailfish	Istiophorus platypterus	117	0.2%
Hammerhead sharks	Sphyrna spp	106	0.2%
Other sharks and rays	Elasmobranchii	719	1.5%
Other fish	Osteichthyes	590	1.2%
Total		47,193	100.0%

Table 4. Major finfish species and species groups caught by purse seiners in the Western and Central Pacific Ocean, ranked by observed catch, 1994–2009

Species or Species Group	Scientific Name	Observed Catch	
		Tonnes	%
Skipjack tuna	Katsuwonus pelamis	812,882	64.95%
Yellowfin tuna	Thunnus albacares	349,719	27.94%
Bigeye tuna	Thunnus obesus	59,574	4.76%
Rainbow runner	Elagatis bipinnulata	4,131	0.33%
Triggerfish	Balistidae	1,023	0.08%
Whale shark	Rhincodon typus	939	0.07%
Mackerel scad	Decapterus macarellus	931	0.07%
Silky shark	Carcharhinus falciformis	900	0.07%
Frigate and bullet tuna	Auxis thazard & Auxis rochei	787	0.06%
Common dolphinfish	Coryphaena hippurus	512	0.04%
Blue marlin	Makaira nigricans	365	0.03%
Mantas	Mobulidae	284	0.02%
Black marlin	Makaira indica	234	0.02%
Albacore	Thunnus alalunga	161	0.01%
Wahoo	Acanthocybium solandri	155	0.01%
Oceanic whitetip shark	Carcharhinus longimanus	120	0.01%
Tunas (unidentified)	Thunnini	18,270	1.46%
Other scombrids	Scombridae	192	0.02%
Other sharks and rays	Elasmobranchii	177	0.01%
Other billfish	Istiophoridae	120	0.01%
Other fish	Osteichthyes	760	0.06%
Total		1,251,474	100.00%

Longline Fisheries catch composition

To examine the differences in species caught by the various longline fisheries, the observer data from 1996 onwards (excluding data from the Aust., NZ, and Hawaii observer programmes) was grouped into four combinations of geographic area and depth of set: (1) Western South Pacific (WSP) Albacore is 10°S to 25°S, (2) Western Tropical Pacific (WTP) Deep is 10°N-10°S and west of 180° and > 10 Hooks Between Floats (HBF), (3) WTP Shallow is 10°N-10°S and west of 180° and <= 10 HBF and (4) Shark targeted sets. There was considerable variation in the species composition by group (Figure 3). The target tuna species (albacore, bigeye, skipjack, yellowfin) comprised 74% of the number of individuals observed in the WSP Albacore group, 66% of the observations for the WTP Deep group and 43% of the WTP Shallow group.

One hundred and ninety non-target species have been observed to interact with the WSP Albacore group. The most commonly observed non-target species were mahi mahi (17%), wahoo (12%), blue shark (10%), longsnouted lancetfish (9%), escolar (5%), great barracuta (4%), opah (4%),

shortbilled spearfish (3%), silky shark (3%) oceanic whitetip shark (2%), pelagic stringray (2%), blue marlin (2%), swordfish (2%), oilfish (2%), striped marlin (2%), sailfish (1%), short finned mako (1%) sickle pomfret (1%) and snake mackerel (1%). All other species comprised observation frequencies of < 1%.

One hundred and forty non-target species have been observed to interact with the WTP Deep group with blue shark (12%), silky shark (11%), wahoo (8%), mahi mahi (7%), blue marlin (6%), pelagic stringray (4%), bigeye thresher (4%), sailfish (3%), pelagic thresher (3%), great barracuda (3%), shortsnouted lancetfish (3%), longsnouted lancetfish (3%), lancetfish (3%), oceanic whitetip shark (3%), swordfish (3%), pomfret (2%), opah (2%), oilfish (2%), striped marlin (2%), snake mackerel (2%), black marlin (2%), escolar (2%), barracuda (1%), short finned mako (1%), sickle pomfret (1%), longfinned mako (1%) and shortbilled spearfish (1%) the most commonly observed. All other species comprised observation frequencies of < 1%.

Ninety seven non-target species have been observed to interact with the WTP shallow group. The most commonly observed non-target species were blue shark (22%), silky shark (15%), blue marlin (8%), swordfish (8%), pelagic stringray (5%), oceanic whitetip shark (5%), mahi mahi (3%), wahoo (3%), sailfish (3%), black marlin (2%), bigeye thresher (2%), striped marlin (2%), oilfish (2%), escolar (2%), barracuda (2%), lancetfish (2%), shortfinned mako (2%), snake mackerel (1%), great barracuda (1%), pelagic thresher (1%), shortbilled spearfish (1%), longsnouted lancetfish (1%) and crocodile shark (1%) with all other species comprising observation frequencies of < 1%. The longline data to the east of 180 degrees longitude was excluded as the sample size of 296 sets available for analysis was too small for meaningful comparison.

The most commonly observed species from shark targeted sets were silky shark (55%), oceanic whitetip shark (6%), yellowfin tuna (5%), grey reef shark (3%), swordfish (3%), great barracuda (2%), sailfish (2%), blacktip shark (2%), hammerhead shark (2%), silvertip shark (2%), blue shark (2%), blue marlin (2%) galapogos shark (1%), balcktip reef shark (1%), bronze whaler shark (1%), scalloped hammerhead shark (1%), mahi mahi (1%) and bigeye (1%). The number of observations of seabirds, turtles and marine mammals was <1% for each group.

Purse-seine Fisheries catch composition

The purse-seine fisheries operating between 10°N and 10°S were split into unassociated and associated (log, drifting FAD, anchored FAD) sets. There was considerable variation in the species composition between associated and unassociated sets (Figure 4). The target species comprised 98% `for log associated sets and 99% for all other set types.

On log associated the most commonly observed non-target species were rainbow runner (41%), mackerel scad (12%), oceanic triggerfish (11%), silky shark (6%), mahi mahi (4%), frigate tuna (3%), blue marlin (1%), black marlin (1%), bullet tuna (1%), black triggerfish(1%), manta rays (1%), wahoo (1%), kawakawa (1%), mackerel (1%) and other sharks (1%). On anchored FAD associated sets the most common non-target species observed were rainbow runner (41%), frigate tuna (12%), silky shark (8%), mackerel scad (6%), mahi mahi (6%), bullet tuna (5%), oceanic triggerfish (4%), kawakawa (4%), manta rays (2%), blue marlin (2%), black marlin (1%), oceanic whitetip sharks (1%) , barracudas (1%), wahoo (1%), black triggerfish(1%), and other sharks (1%). On drifting FAD associated sets the most common non-target species observed were rainbow runner (45%), silky shark (8%), oceanic triggerfish (8%), mackerel scad (7%), mahi mahi (6%),

blue marlin (3%), wahoo (3%), albacore (3%), bullet tuna (2%), black marlin (2%), other sharks (2%), manta rays (1%), frigate tuna (1%), oceanic whitetip sharks (1%) , swordfish (1%), and kawakawa (1%).

On unassociated sets the most common non-target species observed were silky shark (19%), blue marlin (14%), manta rays (11%), black marlin (9%), rainbow runner (8%), saury (7%), albacore (4%), mackerel scad (4%), bullet tuna (4%), frigate tuna (3%), barracudas (3%), kawakawa (2%), striped marlin (2%), mahi mahi (2%), oceanic triggerfish (1%), sailfish (1%) and amberjacks (1%).

Figure 3. Catch composition of the various categories of longline fisheries operating in the WCPO.

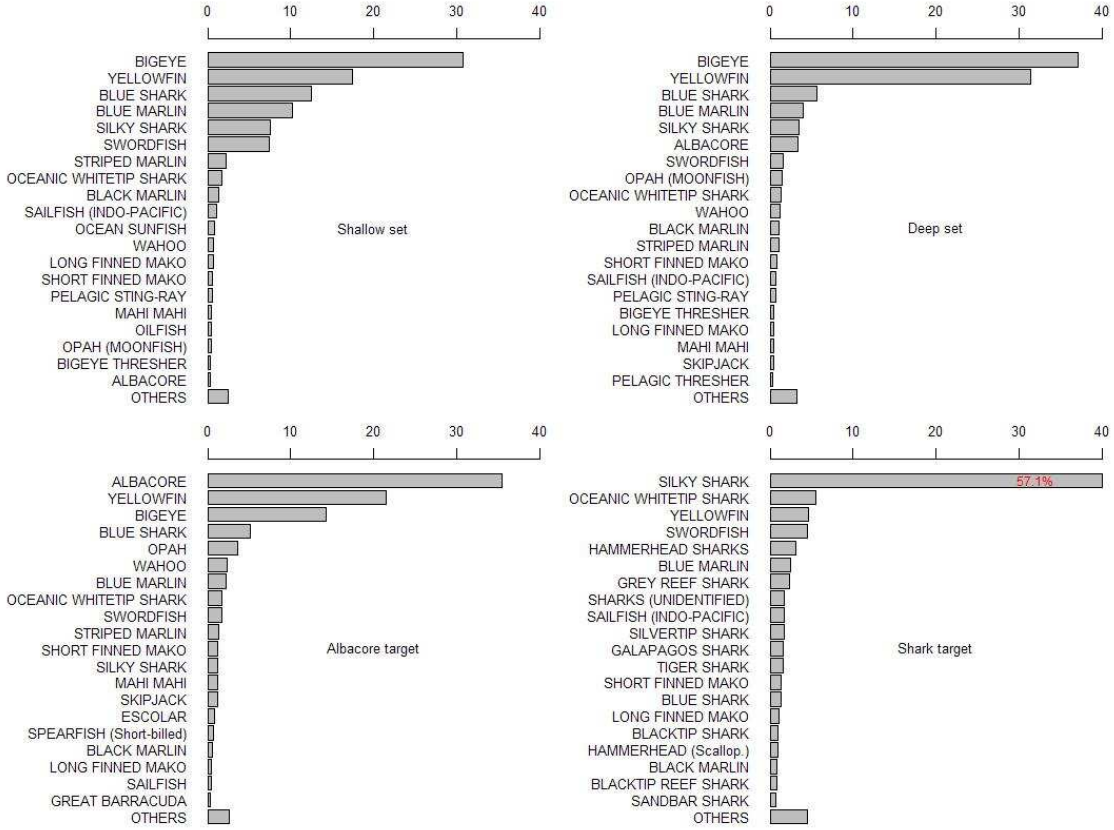
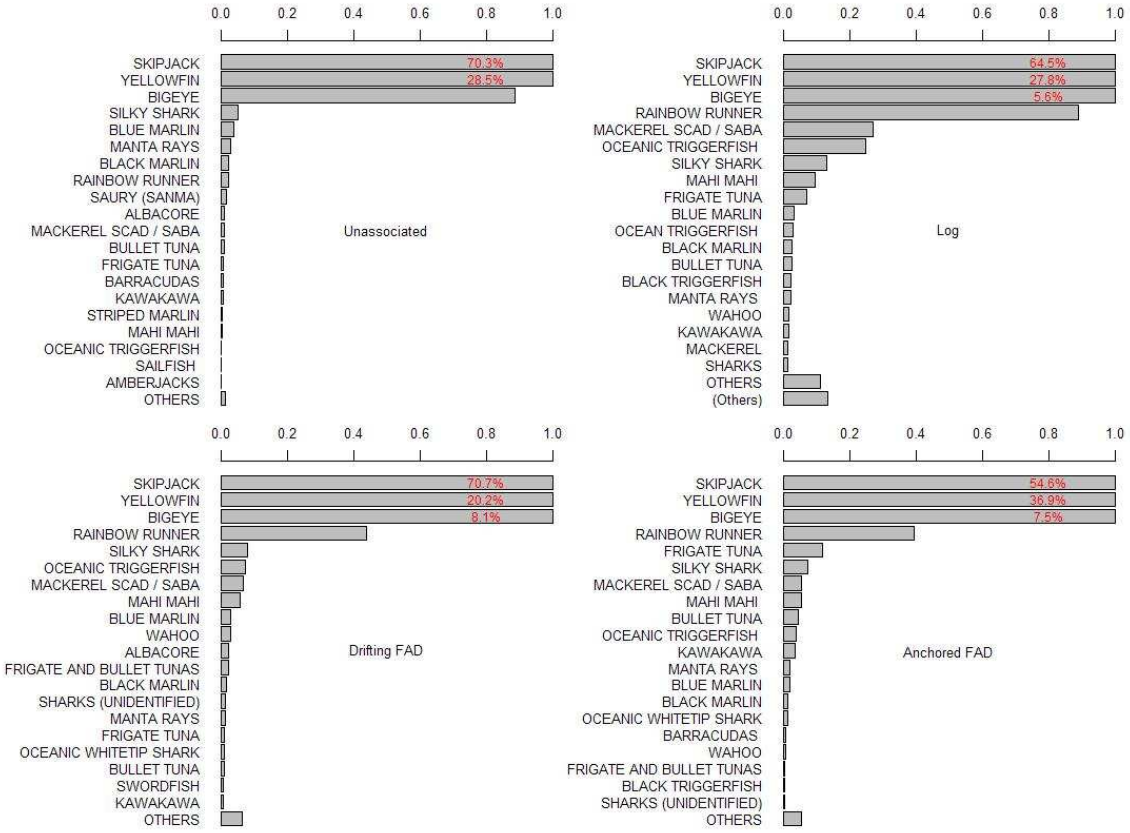


Figure 4 Catch composition of the various categories of purse-seine fisheries operating in the WCPO.



Discarding

The average discarding of the target tuna in the longline fisheries is approximately 5% for yellowfin, bigeye and albacore and 20% for skipjack. Discarding (including live release) of other billfishes is approximately 11%, 54% for other teleosts, 49% for sharks and rays, 73% for seabirds, 94% for marine mammals and 96% for turtles. Approximately 50% of the landed yellowfin, bigeye and albacore are dead and 77% of landed skipjack are dead. The percentage dead on landing for billfish, other teleosts, sharks and rays, seabirds, marine mammals and turtles are 55%, 46%, 21%, 86%, 7% and 33% respectively. Species specific discard and mortalities are presented in Appendix Table A1. The percentage of discarded sharks which are finned is provided in Appendix Table A2. The shark finning percentage for pelagic thresher, long finned mako, blacktip shark, great hammerhead, silvertip shark, grey reef shark, scalloped hammerhead, silky shark, sanbar shark, porbeagle shark, blacktip reef shark, oceanic whitetip shark, hammerhead sharks, galapogos shark was >50%.

Turtles (from EB-WP-07 WCPFC-SC5)

'Life status' has been recorded for 96% of the 262 individual turtles encountered: 41% of these were 'dead' or 'barely alive', while 55% were alive (27% were alive and 'healthy', 12% were alive and 'Injured/stressed', 16% were alive with condition 'Not specified'). Observers have covered most longline fleets throughout the SPC Statistical Area with at least one trip, although overall coverage at <1% is very low. Fleets for which observer data are most lacking, especially in regards to marine turtle, are the Chinese, Japanese, Korean, Spanish, Chinese Taipei and Vanuatu distant-water longline fleets and the offshore fleets of Chinese Taipei; these fleets collectively account for ca. 65-70% of the WCPFC Convention Area tuna catch. Other fleets do collect observer data but due to national restrictions these data are not available for regional analyses. Observations clearly show that tropical areas have higher incidence of turtle encounters than temperate areas (3% vs. <1%). Species composition changes with latitude, with leatherback/loggerhead turtle encounters being more prevalent in sub-tropical to temperate waters, while species encountered in tropical/sub-tropical waters include Olive Ridley, green, loggerhead, hawksbill, flatback and leatherback turtles. Leatherbacks are also observed in deep-set longline fisheries. Interactions with turtles is higher for all shallow sets than for any deep sets (>4.5% vs. <2.4%). The current level of coverage provided by observer data on purse-seine vessels, while spatially representative and much higher than for longline, is not sufficient to provide statistically robust estimates of total marine turtle encounters in WCPO purse seine fisheries. This situation is expected to change as the purse seine fleet moves towards 100% coverage.

Species Diversity (see Proceeding of the National Academy of Sciences, 107: 9707-9711)

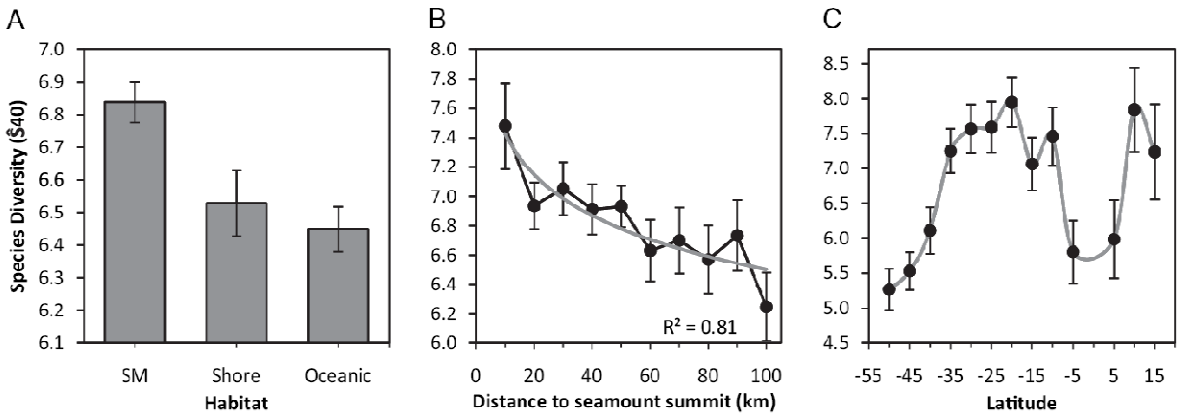
Species diversity was examined using rarefraction techniques to account to account for differences in fishing effort (number of hooks) among longline sets. The expected number of species ($\hat{S}40$), standardized to 1000 hooks per longline set, was rarefied for subsamples of 40 individuals from the total number of individuals in the sample. GLM techniques were used to standardize rarefied richness and to evaluate whether the influence of significant explanatory variables. The explanatory variables included in the model were year as a proxy for temporal variability, moon phase as the relationship between lunar periodicity and catch rates has been demonstrated for a wide variety of commercially exploited species, geographical area, fleet type, distance to the closest feature, and fishing effort. The Akaike's Information Criterion (AIC) was used to compare the model fits using different relationships with distance to feature, with log-transformed having the better fit. The model used was:

$$\hat{S}_{40} \sim Year + moon\ phase + month + lat5 + long5 + flagfleet + \mathrm{Log}(distance\ to\ feature) \cdot feature + \mathrm{ns}(hooks, df=10)$$

Moon phase was divided into 8 categories from New to Full. The geographical areas used in the standardization were squares of 5 degrees latitude and longitude. Vessels were categorized based on a combination of their flag and fleet type. Effort was measured as the number of hooks in each longline set. The species being targeted, and the depth and time of a set can influence the non-target species caught. Information on these variables was not contained within the database and fleet type and number of hooks was used as a proxy measures for these variables.

Rarefied pelagic diversity was significantly higher in seamount habitats than in coastal or oceanic waters (Figure 4A) and was found to be nonlinearly related to the distance to seamount, with diversity higher close to the summits (Figure 4B). Rarefied diversity was higher at intermediate latitudes (10-35°S and 10-15°N; Figure 4C). Regions with higher pelagic diversity included Indonesia, Palau, Federated States of Micronesia and Marshall Islands in the Northern hemisphere and Tonga, New Caledonia, and Norfolk Island in the Southern Hemisphere.

Figure 4. Mean expected species diversity (±95% confidence limits) rarefied from 40 individuals (^S40) as a function of (A) the main habitat [seamount (SM), shore and oceanic], (B) distance to seamount summit where the fitted logarithmic regression is also shown (shaded line), and (C) 5 ° latitude.



Catch Rates

Nominal catch rates of target and non-target species determined from observer data collected onboard longliners and purse seiners are presented in Appendix Figures A1 and A2. For longliners, the catch rates have been estimated for six combinations of geographic area and depth of set: (1) shallow sets north of 10°N (labelled "Hawaii, Shallow Sets", since observer data held by the OFP for the area north of 10°N cover only the Hawaii-based fleet); (2) deep sets north of 10°N ("Hawaii, Deep Sets"); (3) shallow sets from 10°N to 10°S; (4) deep sets from 10°N to 10°S; (5) all sets from 10°S to 25°S; and (6) all sets south of 25°S. For purse seiners, the catch rates have been estimated for associated and unassociated sets.

For longliners, each page in Figure A1 presents line plots of nominal catch rates for a particular species for each combination of geographic area and depth of set, with the most northern areas at the top of the page and the most southern at the bottom. Since certain species are not distributed in all latitudes, some of the plots include catch rates that are all zero, but the plots have been included for the sake of completeness. The mean catch rate was estimated as the total catch divided by the total effort within each stratum. Mean catch rates for strata with less than 50,000 hooks are not shown. The scale of the ordinate ("Y") axes have been allowed to vary among the plots for a given species so that trends can be examined regardless of the scale. The error bars in each plot represent plus or minus two standard errors of the estimate of the mean catch rate; the standard errors were determined from sets, which are not independent, and so the errors bars underestimate the uncertainty. For purse seine, the standard errors were determined from trips and the error bars almost certainly overestimate the uncertainty.

The estimates of mean catch rates may be subject to species identification errors, particularly in the early years of the time series. For example, observers may not have routinely identified sharks to the species level during the early years of the observer programmes and then subsequently were encouraged to do so by their supervisors. As a result, the mean catch rates for the species group "Other sharks and rays" tend to decline, while mean catch rates for some shark species may increase.

When interpreting trends in longline catch rates in the area south of 25°S, the almost complete cessation of fishing by the Japanese fleet in the AFZ after 1997 should be born in mind. Also, the number of trips taken by observers on Japanese vessels in the waters of New Zealand dropped to zero in 2004 and only two or three trips were taken during 2005–2008. Trends in estimates of purse-seine catch rates may have been affected by the large increase in the number of trips taken by observers in Papua New Guinea since 2002. Some of these and other difficulties in the interpretation of nominal catch rates would be addressed through the standardisation of catch rates.

KEY CONCLUSIONS

Species diversity in the WCPO varies in association with habitat features and latitudes. Rarefied pelagic diversity was significantly higher in seamount habitats and was higher at intermediate latitudes (10-35°S and 10-15°N). Regions with higher pelagic diversity included Indonesia, Palau, Federated States of Micronesia and Marshall Islands in the Northern hemisphere and Tonga, New Caledonia, and Norfolk Island in the Southern Hemisphere.

There are differences in the catch composition between longline and purse-seine fishery with a higher proportion of non-target species caught. Over 98% of the catch on purse –seine sets are the target species (including juvenile yellowfin and bigeye) whereas on longline sets the target species comprise 74% (WSP-albacore), 66% (WTP-Deep) and 43% (WTP-Shallow) of the observations.

Non target species composition varies between purse-seine and longline with higher observations of sharks on longline sets in comparison to purse-seine sets which were dominated by surface teleosts such as rainbow runner, mackerel scad and mahi mahi.

Non-target species catch was highest on log sets for purse-seine and WTP-shallow sets for longline.

The number of reported interactions between marine mammals, seabirds and turtles are insufficient for more complex analyses. The percentage dead on landing for seabirds, marine mammals and turtles are 86%, 7% and 33% respectively.

The most important gap in the data required to examine catches of non-target species in the WCPO is observer data covering the distant-water longline fleets, for which coverage by data held by the OFP is minimal.

The declines observed in catch rates for porbeagle shark, oceanic whitetip shark and silky shark warrants further investigation to determine whether this reflects changes in observer patterns, fisheries behaviours or a decline in abundance.

Table A1. Discarding and condition percentages from observer records in the WCPO held by SPC

		Discarding (%)					Dead (%)				
Common_Name	Scientific_Name	North 10°N	WSP-Albacore	WTP Deep	WTP Shallow	Shark	North 10°N	WSP-Albacore	WTP Deep	WTP Shallow	Shark
Tuna											
ALBACORE	Thunnus alalunga	2	6	5	0	0	63	56	75	0	33
YELLOWFIN	Thunnus albacares	9	5	6	2	10	50	43	51	45	51
BIGEYE	Thunnus obesus	6	6	3	2	9	28	33	31	20	47
SKIPJACK	Katsuwonus pelamis	35	8	44	11	0	93	90	91	87	25
WAHOO	Acanthocybium solandri	5	3	14	14	6	87	83	83	69	64
SOUTHERN BLUEFIN TUNA	Thunnus maccoyii	33	11	0		0	33	20	100		100
BUTTERFLY TUNA											
KINGFISH	Gasterochisma melampus		36	100	0			65	33	100	
PACIFIC BLUEFIN TUNA	Thunnus orientalis	0	19	15			0	47	67		
SLENDER TUNA	Allothunnus fallai		96	50		0		50	0		21
BULLET TUNA	Auxis rochei		0	0	0	25		25	14	0	25
ATLANTIC BLUEFIN TUNA	Thunnus thynnus		11					35			
KAWAKAWA	Euthynnus affinis		43	0	0			57	0	100	
DOGTOOTH TUNA	Gymnosarda unicolor		100	0		100		0	0		0
LONGTAIL TUNA	Thunnus tonggol					0					33
Billfishes											
SWORDFISH	Xiphias gladius	44	13	29	13	5	54	60	62	67	70
STRIPED MARLIN	Tetrapturus audax	7	4	5	4	2	57	36	52	22	32
SHORTBILLED SPEARFISH	Tetrapturus angustirostris	8	10	38	3	0	75	73	67	41	25
BLUE MARLIN	Makaira nigricans	3	11	5	3	2	57	57	54	38	44
SAILFISH (INDOPACIFIC)	Istiophorus platypterus	19	7	29	4	13	65	74	79	35	54
BLACK MARLIN	Makaira indica	5	45	6	0	7	85	60	73	35	53
Sharks and Rays											
BLUE SHARK	Prionace glauca	96	30	12	19	2	4	7	8	7	16
SILKY SHARK	Carcharhinus falciformis	47	10	7	35	3	22	26	23	27	22
PELAGIC STINGRAY	Dasyatis violacea	95	98	99	99	100	2	3	5	8	0

OCEANIC WHITETIP SHARK	Carcharhinus longimanus	84	10	11	7	0	23	25	20	14	12
BIGEYE THRESHER	Alopias superciliosus	75	52	12	43	1	21	26	37	30	38
SHORT FINNED MAKO	Isurus oxyrinchus	55	26	12	90	0	21	24	28	5	26
SMOOTH SKIN DOGFISH	Centroscymnus owstoni		100					11			
PELAGIC THRESHER	Alopias pelagicus	40	69	6	6	2	39	34	53	36	49
CROCODILE SHARK	Pseudocarcharias kamoharai	98	98	62	50	100	3	5	18	32	0
SCHOOL SHARK	Galeorhinus galeus		6					21			
GREY REEF SHARK	Carcharhinus amblyrhynchos		11	0		1		29	30		30
GALAPAGOS SHARK	Carcharhinus galapagensis	100	0	59	100	0	0	17	12	0	16
SCALLOPED HAMMERHEAD	Sphyrna lewini	89	15	65		1	38	50	31		25
LONG FINNED MAKO	Isurus paucus	38	12	3	89	1	12	19	28	11	8
SILVERTIP SHARK	Carcharhinus albimarginatus	0	8	14	0	2	11	45	54	0	29
BLACKTIP SHARK	Carcharhinus limbatus		6	14	0	1		30	51	100	21
BLACKTIP REEF SHARK	Carcharhinus melanopterus		0	17	100	6		57	32	0	47
THRESHER	Alopias vulpinus	25	59	6	55	0	75	22	37	20	0
PORBEAGLE SHARK	Lamna nasus		28					36			
BRONZE WHALER SHARK	Carcharhinus brachyurus	100	56	5	100	0	0	11	22	0	44
RAYS	Dasyatis spp	100	100	89		100	0	1	13		0
TIGER SHARK	Galeocerdo cuvier	80	52	64	100	0	50	3	17	0	4
GREAT HAMMERHEAD	Sphyrna mokarran		6	33	100	3		67	67	100	18
GIANT MANTA	Manta birostris		99	100		100		0	0		17
SANDBAR SHARK	Carcharhinus plumbeus	89	13	50	100	0	0	25	0	50	14
CHILEAN DEVIL RAY	Mobula tarapacana		100	100		100		0	0		0
GREAT WHITE SHARK	Carcharodon carcharias		0	33		45		0	0		57
CENTROSCYMNUS COELOLEPIS	Centroscymnus coelolepis		100					3			
VELVET DOGFISH	Scymnodon squamulosus	95	100	100			14	10	100		
DUSKY SHARK	Carcharhinus obscurus		96					10			
SMOOTH HAMMERHEAD	Sphyrna zygaena	82	21			0	33	70			64

BASKING SHARK	Cetorhinus maximus		28			0		17			11
MANTA RAY	Mobula japanica		100	100	100	100		46	0	0	0
PLUNKET SHARK	Centroscymnus plunketi		100					11			
COOKIE CUTTER SHARK	Isistius brasiliensis	100	71	90			0	14	0		
WHITETIP REEF SHARK	Triaenodon obesus		0			0		0			18
SEAL SHARK BLACK SHARK	Dalatias licha		94					0			
AUSTRALIAN BLACKTIP SHARK	Carcharhinus tilstoni		78					11			
BIGNOSE SHARK	Carcharhinus altimus	100	100	0	100	0	100	0	0	0	
SALMON SHARK	Lamna ditropis	100					60				
WINGHEAD SHARK	Eusphyra blochii		0					33			
BROADSNOUTED SEVENGILL SHARK	Notorynchus cepedianus		50					0			
BULL SHARK	Carcharhinus leucas		0	0				0	0		
BAXTERS LANTERN DOGFISH	Etmopterus spp		100					0			
BIGEYE SAND SHARK	Odontaspis noronhai					0					0
BIRDBEAK DOGFISH	Deania calcea		100					0			
KNIFETOOTH DOGFISH	Scymnodon ringens		100					0			
SHORTNOSE SPURDOG	Squalus megalops		100					0			
SPINNER SHARK	Carcharhinus brevipinna		0					50			
Other Teleosts											
LONGSNOUTED LANCETFISH	Alepisaurus ferox	100	99	99	93	70	86	70	80	93	80
MAHI MAHI	Coryphaena hippurus	7	3	18	6	4	42	27	35	27	21
SICKLE POMFRET	Taractichthys steindachneri	5	11	60	100		14	17	35	50	
RAYS BREAM	Brama brama	0	41	68	100		0	9	18	100	
ESCOLAR	Lepidocybium flavobrunneum	10	21	76	25	22	7	16	28	45	28
SNAKE MACKEREL	Gempylus serpens	97	95	64	55	92	46	49	60	52	50
MOONFISH OPAH	Lampris guttatus	3	23	49	40	50	35	25	46	40	0
GREAT BARRACUDA	Sphyraena barracuda	13	14	25	1	13	18	28	44	22	25
BIGSCALED POMFRET	Taractichthys longipinnis		61	71		0		15	32		0

SHORTSNOUTED LANCETFISH	Alepisaurus brevirostris	99	99	97	100	100	94	59	82	75	75
OILFISH	Ruvettus pretiosus	41	56	73	60	23	14	18	33	40	33
DEALFISH RIBBON FISH	Trachipterus trachipterus		100					84			
RUDDERFISH	Centrolophus niger		89					9			
SLENDER SUNFISH	Ranzania laevis	96	85	88		100	51	81	36		0
OCEAN SUNFISH	Mola mola	97	98	48	55		15	9	16	0	
BLUE GRENADIER	Macruronus novaezelandiae		84					79			
DAGGER POMFRET	Taractes rubescens	88		96			20		12		
BLACKFIN BARRACUDA	Sphyraena genie		11	17	0	4		25	46	0	26
OMOSUDID	Omosudis lowei	85	100	100	100		89	99	100	100	
ROUDI ESCOLAR	Promethichthys prometheus	100	53	100			100	37	0		
BLACK MACKEREL	Scombrolabrax heterolepis	94	96	0			57	56	100		
BARRACUDA	Sphyraena putnamae		2	0		1		51	83		39
BARRACOUTA	Thyrsites atun		95	83	0	33		51	40	50	0
RAINBOW RUNNER	Elagatis bipinnulata	26	8	29	33	0	64	61	79	100	44
BARRACUDA	Sphyraena jello		34	63		4		29	50		25
FLATHEAD POMFRET	Taractes asper	71	59				29	20			
RAZORBACK SCABBARDFISH	Assurger anzac	71	99				33	17			
CRESTED OARFISH	Lophotus lacepede	83	78	100			49	44	100		
MANOWAR	Cubiceps spp		97					63			
CRESTFISHUNICORNFISH	Lophotus capellei		57	100				35	50		
OCEANIC PUFFER	Lagocephalus lagocephalus	100	100	100			16	13	0		
BLACK GEMFISH	Nesiarchus nasutus		89	100				46	100		
GEMFISH	Rexea solandri	0	85	20		0	0	57	40		0
BLACK SNOEK	Thyrsitoides marleyi		92					72			
FROSTFISH	Lepidopus caudatus		77	0				12	100		
HAPUKU	Polyprion oxygeneios		60					14			
BRILLIANT POMFRET	Eumegistus illustris	31	0	13			29	40	38		
FALSE FROSTFISH	Paradiplospinus gracilis		97					19			
BASS GROPER	Polyprion americanus		100					24			

GIANT YELLOWTAIL	Seriola lalandi	0	72					32			
SPANISH MACKEREL	Scomberomorus commerson		0	4	0	0		100	87	100	0
HAKE	Merluccius australis		59					71			
PRICKLY FANFISH	Pterycombus petersii		88					29			
SNAPPERS	Lutjanidae		0			0		14			50
SPOTTED FANFISH	Pteraclis velifera		100					50			
ORANGEFRECKLED FLATHEAD	Ratabulus diversidens		0					33			
SHARPTAIL MOLA	Masturus lanceolatus		100	0	0			0	17	0	
GREATER AMBERJACK	Seriola dumerili		0					56			
POMPANO DOLPHINFISH	Coryphaena equiselis	25					75				
YELLOWEDGE GROUPER	Epinephelus flavolimbatus			100					50		
ALASKA POLLOCK	Theragra chalcogramma		100		100			40		100	
BLUE MACKEREL	Scomber australasicus		100					50			
DEALFISH	Desmodema polystictum		50					0			
UNICORN LEATHERJACKET	Aluterus monoceros		0			0		67			0
HECTORS LANTERNFISH	Lampanyctodes hectoris		100					20			
SAND SILLAGO	Sillago ciliata		20					100			
SHARK MACKEREL	Grammatorcynus bicarinatus					20					60
NEEDLEFISHES	Tylosurus spp			0					100		
TAPERTAIL RIBBONFISH		75					25				
ACANTHOPAGRUS BUTCHERI	Acanthopagrus butcheri		0					67			
BIGEYE TREVALLY	Caranx sexfasciatus					0					0
BLACK TRIGGERFISH	Melichthys niger		50	100				0	100		0
FALSE MORAY	Kaupichthys hyoproroides		100					67			
OARFISH	Regalecus glesne	100					67				
LONGFIN YELLOWTAIL	Seriola rivoliana		100	0				0	0		
BLUEBANDED WRASSE	Xiphocheilus typus		0					50			
COBIA	Rachycentron canadum		0					0			
DRUMMER)	Kyphosus cinerascens			50					50		

EMPORER RED SNAPPER	Lutjanus sebae			0		0			100		0
SCRIBBLED LEATHERJACKET	Aluterus scriptus		0		100		100			0	
MOONFISH	Mene maculata		0				100				
MORID COD	Mora moro		100				50				
MORWONG	Nemadactylus spp		100	100			0	100			
PILOT FISH	Naucrates ductor		50				50				
PUFFERFISH	Sphoeroides spp		100				100				
RIBBONFISH	Agrostichthys parkeri		50				50				
SCALLOPED RIBBONFISH	Zu cristatus	100				50					
SOUTHERN RAYS BREAM	Brama australis		0				100				
YELLOWTAIL SCAD	Atule mate		100	100			0	100			
WELLINGTON FLYING SQUID	Nototodarus sloani		100				0				
AUSTRALIAN SALMON	Arripis trutta		100				100				
BANDED WRASSE			100				0				
BLUENOSE	Hyperoglyphe antarctica		100				20				
COMMON WAREHOU	Seriolella brama		0				0				
COTTONMOUTH JACK	Uraspis secunda	0				0					
DEEPWATER RED SNAPPER	Etelis carbunculus			0					0		
EUROPEAN SPRAT	Sprattus sprattus		0				100				
FLATBACK TURTLE			100				100				
GIZZARD SHAD	Konosirus punctatus		0				100				
KIMBERLEY GRUNTER	Syncomistes kimberleyensis		0				100				
LOUVAR	Luvarus imperialis	100				100					
ARAFURA EEL	Lumiconger arafura		0				100				
PENCIL CARDINAL	Epigonus denticulatus		100				100				
PRICKLY ANGLERFISH			100				0				
REMORA	Remora spp		100				100				
SCISSORTAIL			100				0				
SHARK SUCKER	Remora remora		100				0				

SLIMY MACKEREL	Scomber japonicus	100					100				
SQUARETAIL			100								
STARRY TRIGGERFISH	Abalistes stellaris		0					100			
TARAKIHI	Nemadactylus macropterus		0					0			
TREVALLY	Pseudocaranx dentex		100					100			
YELLOWTAIL HORSE MACKEREL	Trachurus novaezelandiae		100					100			
BIGTAIL SNAILFISH	Osteodiscus cascadiae										
Marine Mammal											
NEW ZEALAND FUR SEAL	Arctocephalus gazella		100					4			
FALSE KILLER WHALE	Pseudorca crassidens	100		100			13		0		
SHORTFINNED PILOT WHALE	Globicephala macrorhynchus	100	100	100	100		0	25	0	0	
COMMON DOLPHIN	Delphinus delphis		100					67			
BOTTLENOSE DOLPHIN	Tursiops truncatus	100		100					0		
HUMPBACK WHALE	Megaptera novaeangliae	100	100				0	0			
MELONHEADED WHALE	Peponocephala electra		100			100		0			
HARBOUR SEAL	Phoca vitulina			0					0		
RISSOS DOLPHIN	Grampus griseus		100					0			
SOUTH AFRICAN FUR SEAL	Arctocephalus pusillus							0			
TOOTHED WHALES NEI (BLACKFISH)	Odontoceti									0	
Seabirds											
WANDERING ALBATROSS	Diomedea exulans		96					53			
LAYSAN ALBATROSS	Phoebastria immutabilis	100					67				
FLESHFOOTED SHEARWATER	Puffinus carneipes		92					85			
NEW ZEALAND WHITE CAPPED MOLLYMAWK	Thalassarche cauta		97					80			
BLACKFOOTED ALBATROSS	Phoebastria nigripes	100					100				
BLACKBROWED MOLLYMAWK	Thalassarche melanophrys		95					71			

SOOTY SHEARWATER	Puffinus griseus		94					82			
CAMPBELL IS BLACKBROWED MOLLYMAWK			100					100			
GREY PETREL	Procellaria cinerea		100					100			
GREY HEADED ALBATROSS	Thalassarche chrysostoma		100					100			
WHITECHINNED PETREL	Procellaria aequinoctialis		100					100			
SHORTTAILED SHEARWATER	Puffinus tenuirostris		0					100			
WEDGETAILED SHEARWATER	Puffinus pacificus		33					86			
WESTLAND PETREL	Procellaria westlandica		40					100			
CAPE PIGEON	Daption capense		25					20			
SOUTHERN ROYAL ALBATROSS	Diomedea epomophora		100					75			
GREATWINGED PETREL	Pterodroma macroptera		0					100			
BLACK PETREL	Procellaria parkinsoni		100					100			
BULLERS ALBATROSS	Thalassarche bulleri		0					50			
SOUTHERN GIANT PETREL	Macronectes giganteus		100					100			
ATLANT YELLOWNOSED ALBATROSS	Thalassarche chlororhynchos		0					100			
LIGHTMANTLED SOOTY ALBATROSS	Phoebetria palpebrata		100					100			
SALVINS ALBATROSS	Thalassarche salvini		100					100			
Turtles											
OLIVE RIDLEY TURTLE	Lepidochelys olivacea	100	71	74	100	100	70	29	76	8	0
GREEN TURTLE	Chelonia mydas	100	82	94	100	100	100	18	67	22	0
LEATHERBACK TURTLE	Dermochelys coriacea	100	100	100	100	100	0	4	25	0	0
HAWKSBILL TURTLE	Eretmochelys imbricata		75	71	100	100		50	83	50	50
LOGGERHEAD TURTLE	Caretta caretta	100	100	100		100	0	0	50		0
FLATBACK TURTLE	Natator depressus		100			100		50			0

Table A2. Percentage of discarded shark which are finned

Row Labels	Discarded Not finned	Discarded Finned	Total Discarded	Percentage of discarded shark which are finned
BULL SHARK		2	2	100
PELAGIC THRESHER	180	1236	1416	87.28813559
LONG FINNED MAKO	53	360	413	87.16707022
BLACKTIP SHARK	22	113	135	83.7037037
GREAT HAMMERHEAD	8	40	48	83.33333333
SILVERTIP SHARK	20	96	116	82.75862069
GREY REEF SHARK	14	53	67	79.10447761
SCALLOPED HAMMERHEAD	29	75	104	72.11538462
SILKY SHARK	1390	3179	4569	69.57758809
SANDBAR SHARK	16	33	49	67.34693878
PORBEAGLE SHARK	116	233	349	66.76217765
BLACKTIP REEF SHARK	42	76	118	64.40677966
OCEANIC WHITETIP SHARK	1164	1802	2966	60.75522589
HAMMERHEAD SHARKS	62	95	157	60.50955414
GALAPAGOS SHARK	17	23	40	57.5
BROADSNOUTED SEVENGILL SHARK	1	1	2	50
BIGEYE THRESHER	1999	1863	3862	48.23925427
SMOOTH HAMMERHEAD	13	12	25	48
BRONZE WHALER SHARK	169	153	322	47.51552795
SHORT FINNED MAKO	1171	885	2056	43.04474708
BLUE SHARK	40637	24814	65451	37.91233136
THRESHER	244	130	374	34.75935829
TIGER SHARK	111	40	151	26.49006623
MAKO SHARKS	25	7	32	21.875
BASKING SHARK	8	2	10	20
BIGNOSE SHARK	6	1	7	14.28571429
THRESHER SHARKS NEI	217	23	240	9.583333333
GREAT WHITE SHARK	34	2	36	5.555555556
SHARKS UNIDENTIFIED	378	22	400	5.5
CROCODILE SHARK	618	34	652	5.214723926
VARIOUS SHARKS NEI	24	1	25	4
COOKIE CUTTER SHARK	26	1	27	3.703703704
SCHOOL SHARK	42	1	43	2.325581395
PELAGIC STINGRAY	5340	5	5345	0.09354537
RAYS SKATES AND MANTAS	62		62	0
AUSTRALIAN BLACKTIP SHARK	7		7	0
GROUND SHARKS	9		9	0
CENTROSCYMNUS COELOLEPIS	69		69	0
PLUNKET SHARK	37		37	0
SMOOTH SKIN DOGFISH	2273		2273	0
DOGFISH	5		5	0

BIRDBEAK DOGFISH	1	1	0
DOG FISHES	5	5	0
SHORTNOSE SPURDOG	1	1	0
DUSKY SHARK	46	46	0
SALMON SHARK	5	5	0
MANTA RAYS (UNIDENTIFIED)	226	226	0
GIANT MANTA	109	109	0
MANTA RAY	37	37	0
CHILEAN DEVIL RAY	86	86	0
MOBULA NEI	3	3	0
REQUIEM SHARKS NEI	1	1	0
SEAL SHARK BLACK SHARK	16	16	0
BAXTERS LANTERN DOGFISH	1	1	0
SHARKS RAYS SKATES ETC NEI	5	5	0
RAYS STINGRAYS MANTAS NEI	148	148	0
VELVET DOGFISH	67	67	0
RAYS (TORPEDINIDAE NARKIDAE)	354	354	0
RAYS (DASYATIDIDAE)	93	93	0
KNIFETOOTH DOGFISH	1	1	0

Figure A1. Nominal catch rates of target and non-target species determined from observer data collected onboard longliners in the Western and Central Pacific Ocean

Albacore

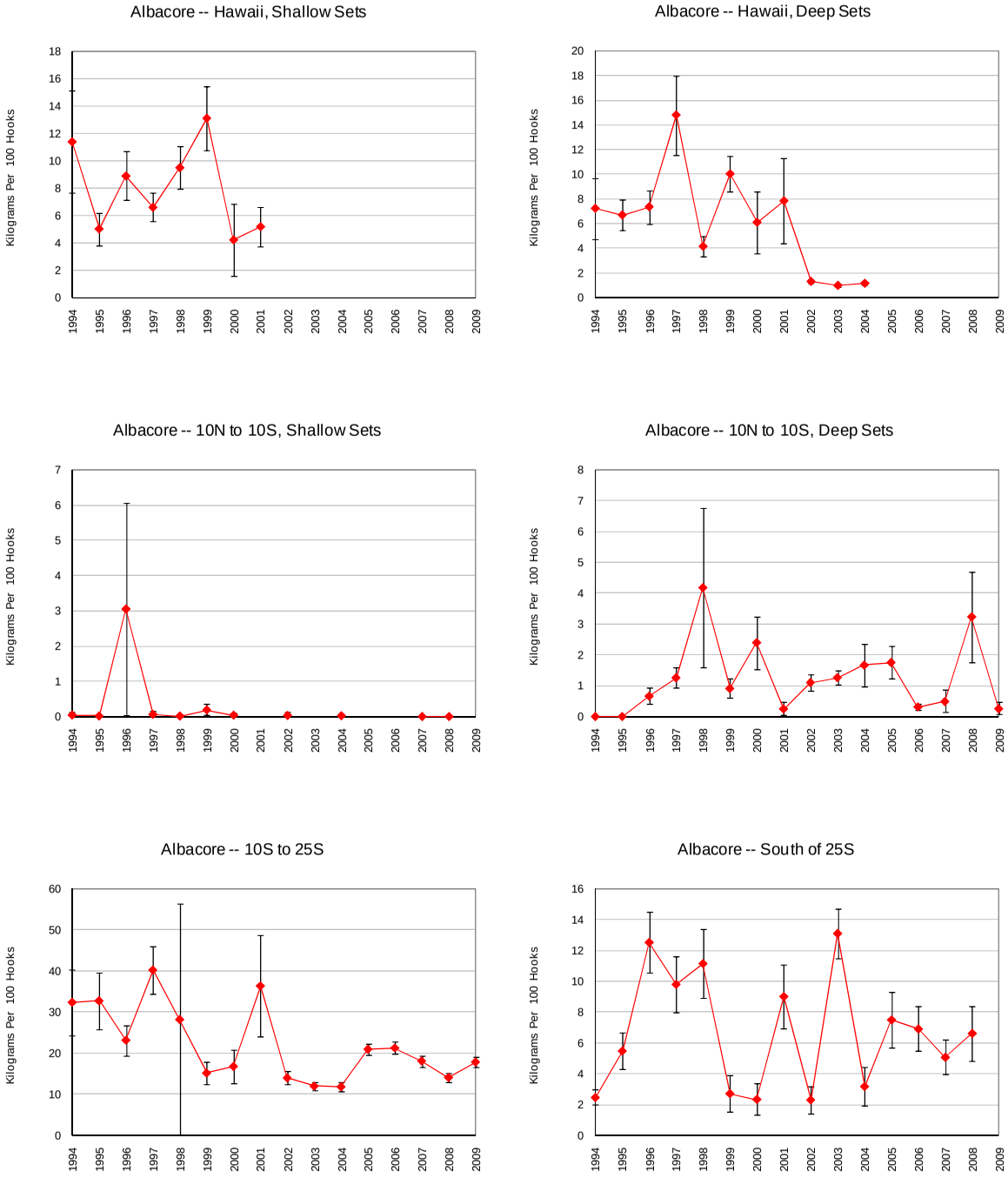
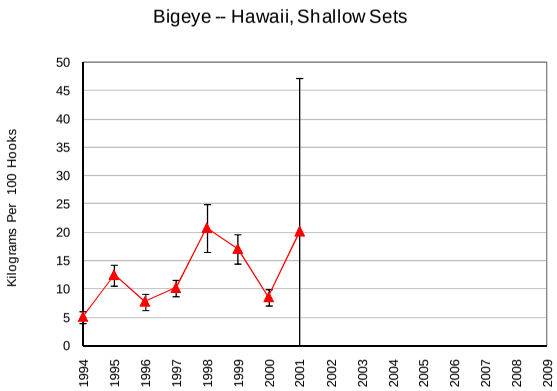
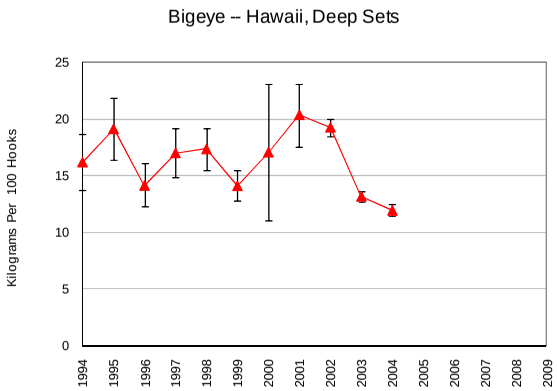
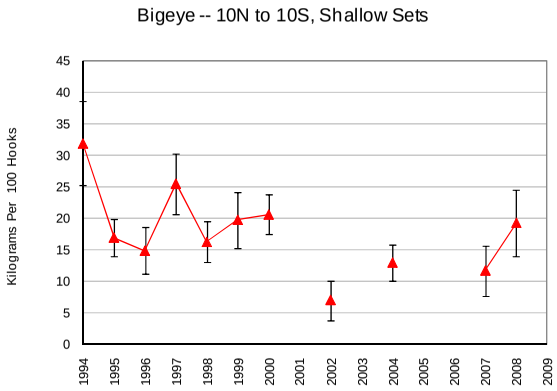
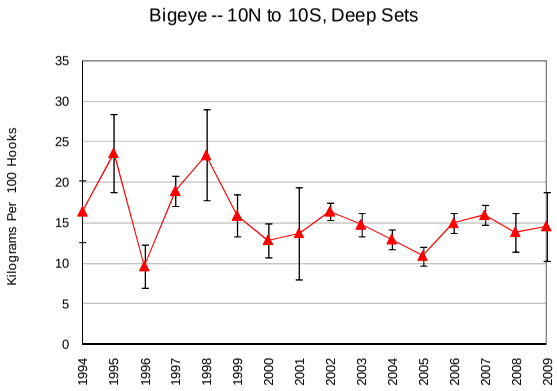


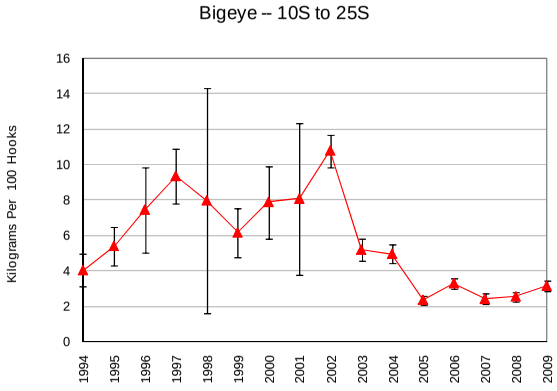
Figure A1 (continued) — Bigeye











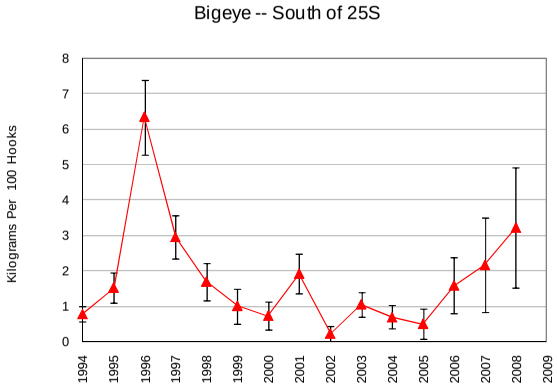
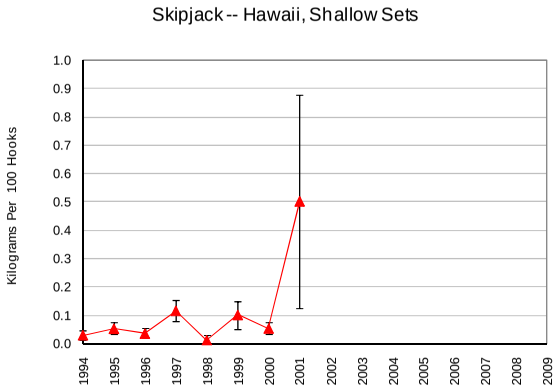
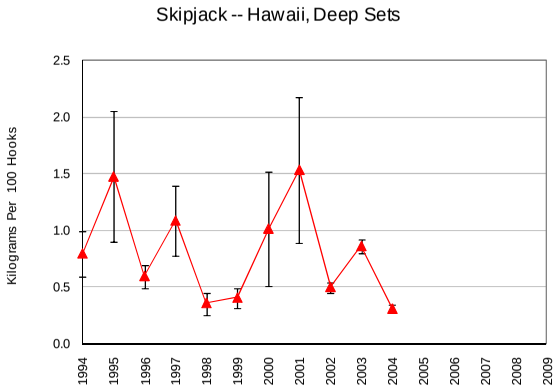
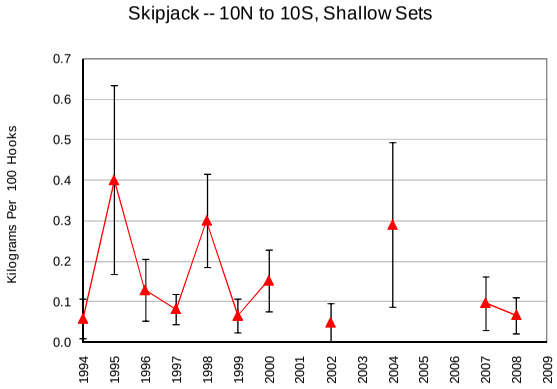
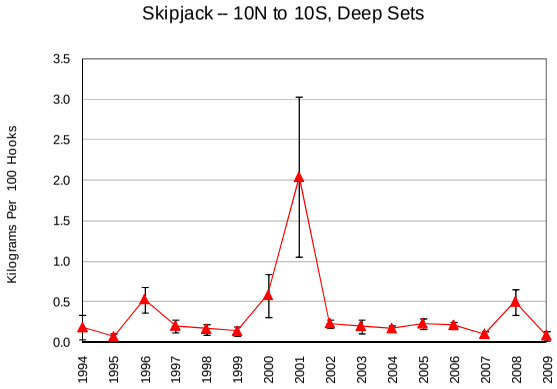


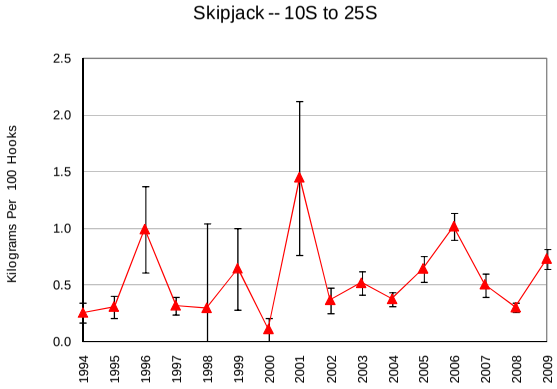
Figure A1 (continued) — Skipjack











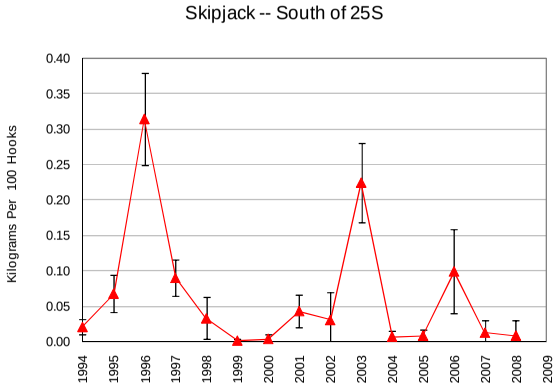
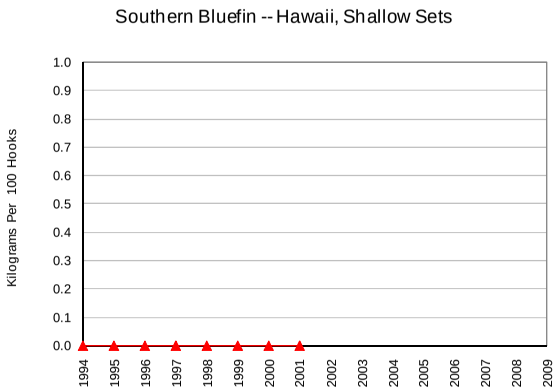
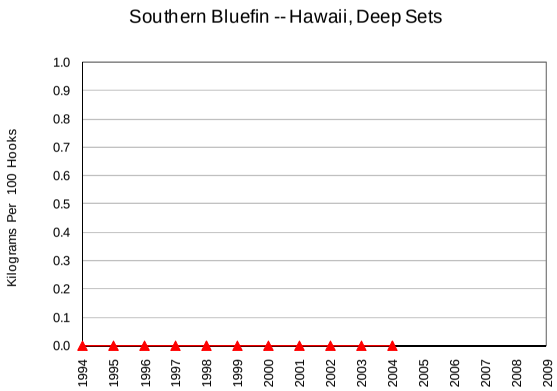
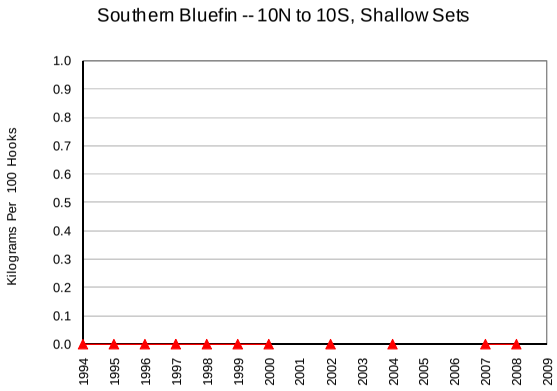
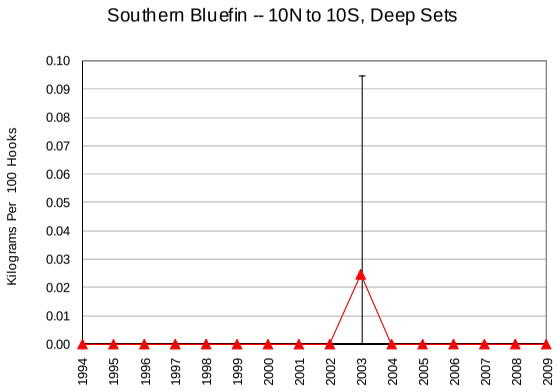


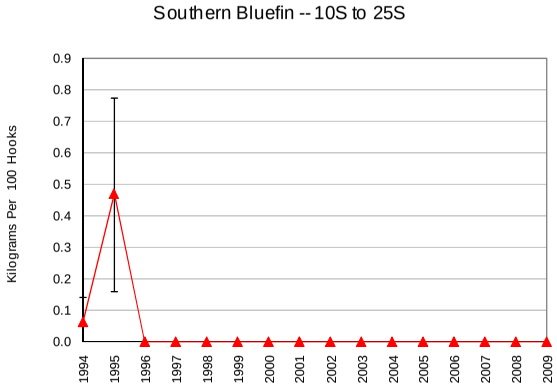
Figure A1 (continued) — Southern Bluefin











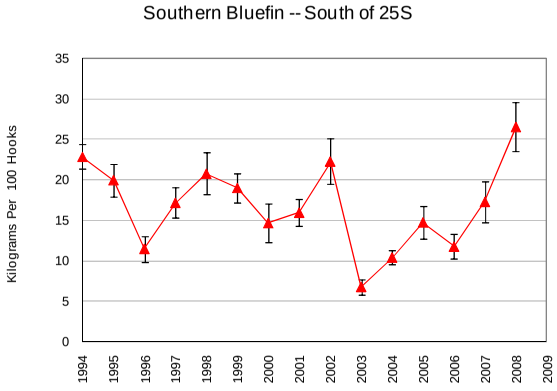


Figure A1 (continued) — Yellowfin

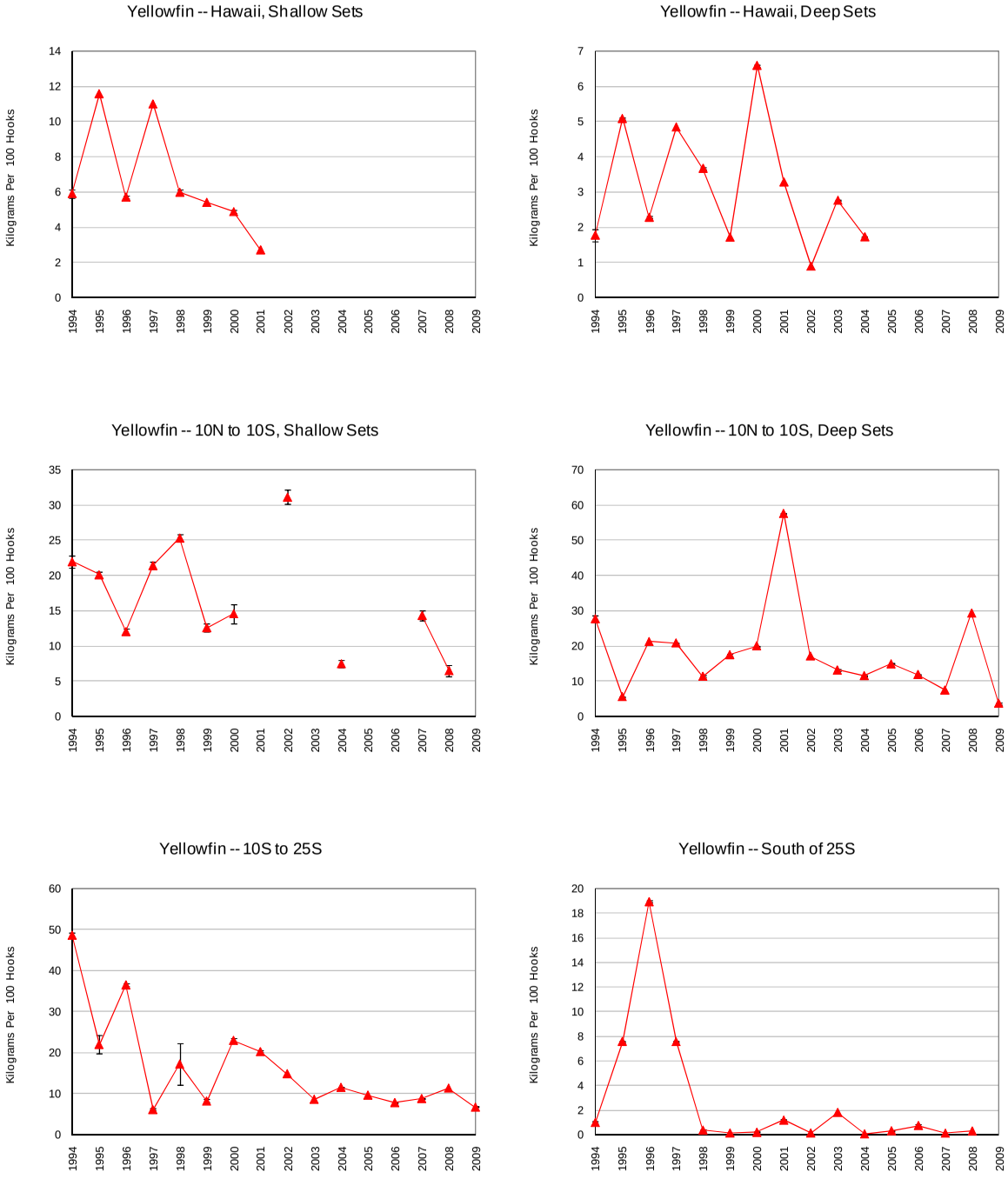
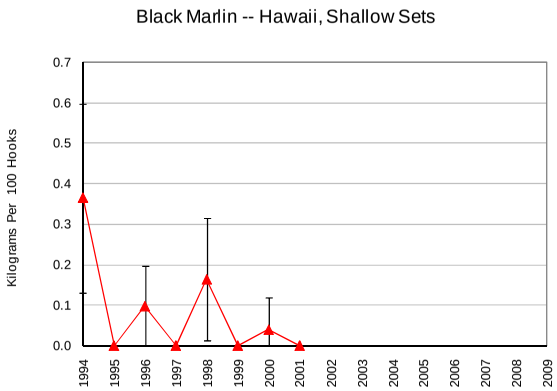
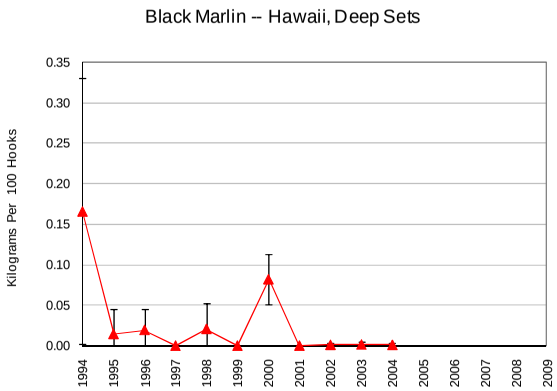
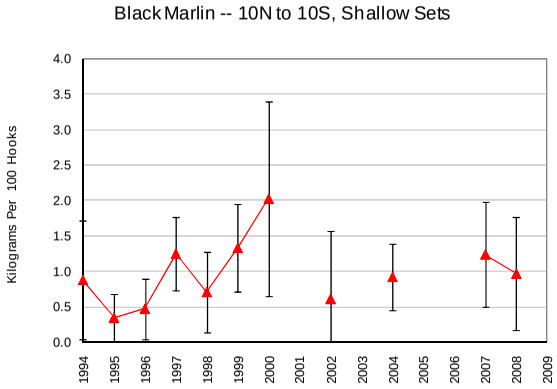
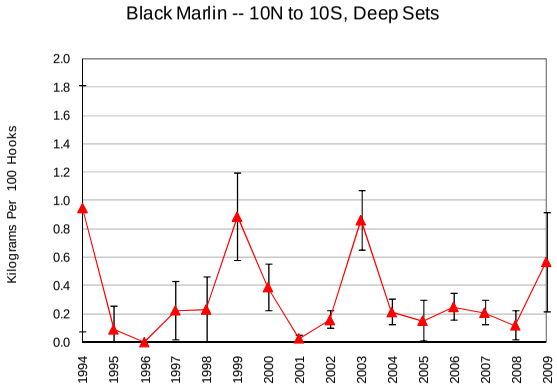


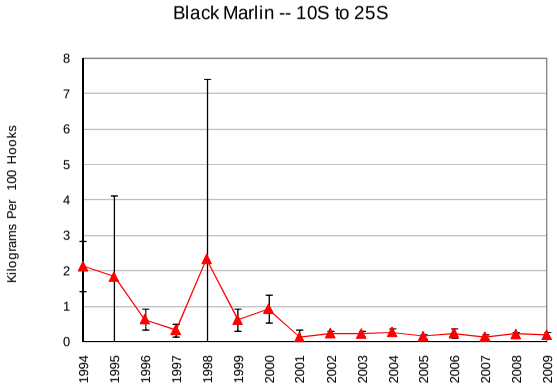
Figure A1 (continued) — Black Marlin











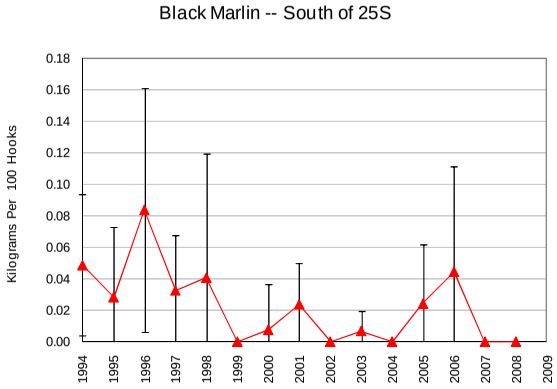
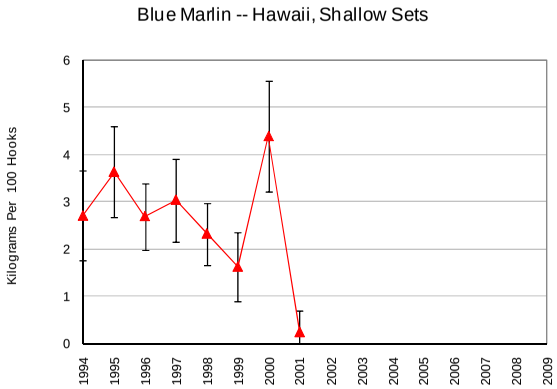
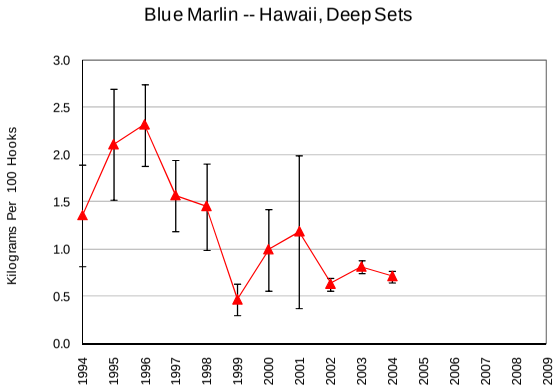
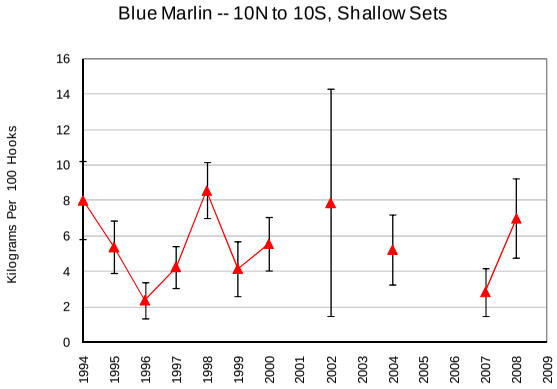
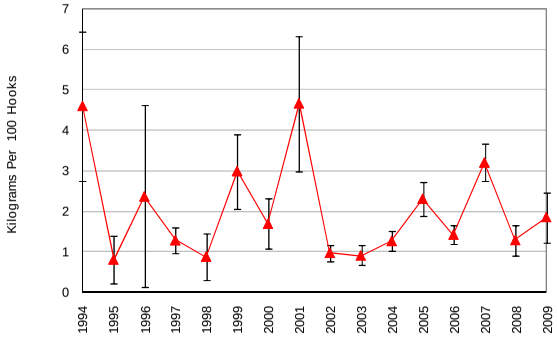


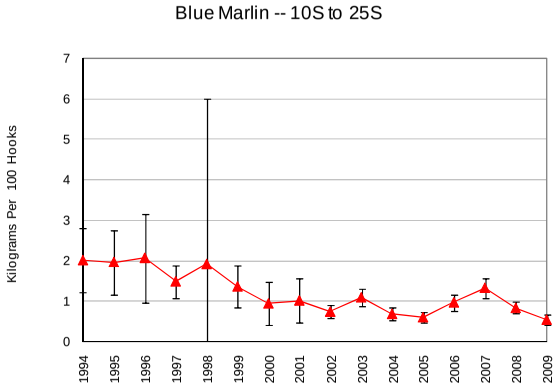
Figure A1 (continued) — Blue Marlin











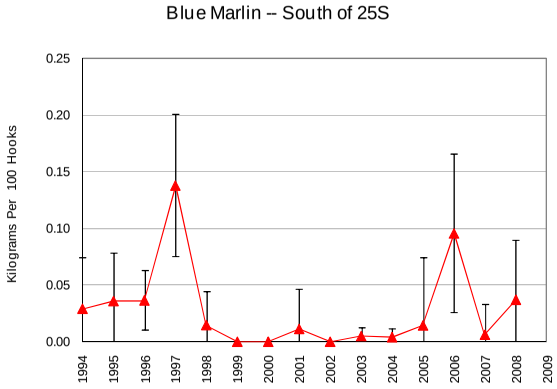
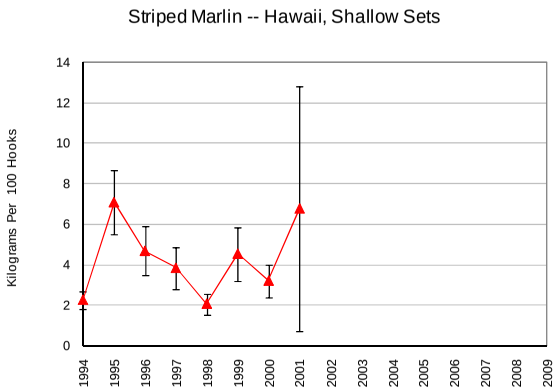
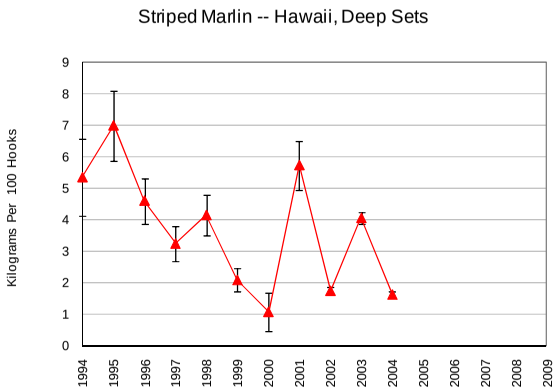
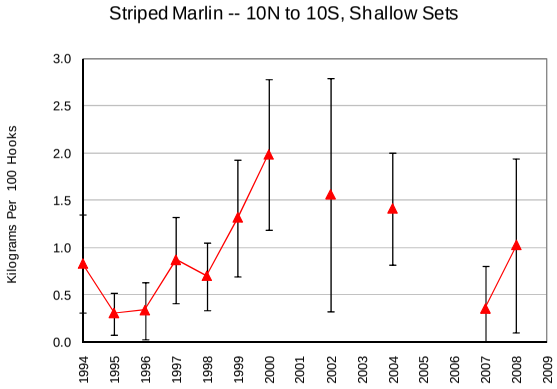
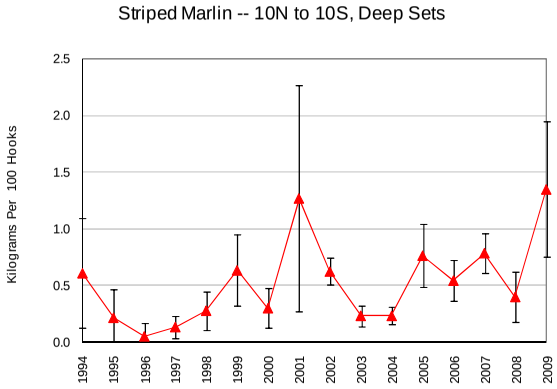


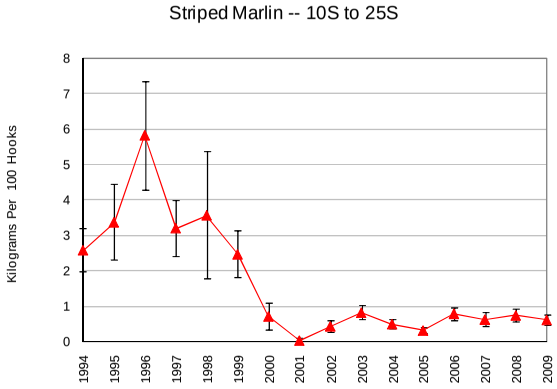
Figure A1 (continued) — Striped Marlin











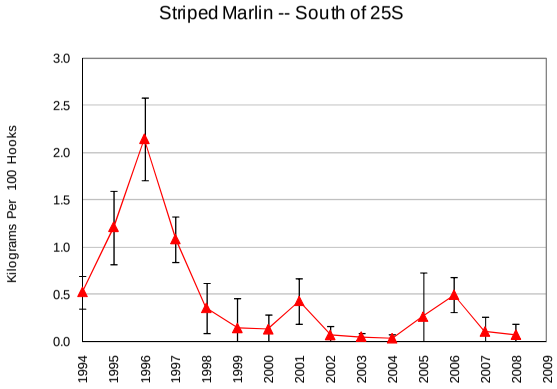
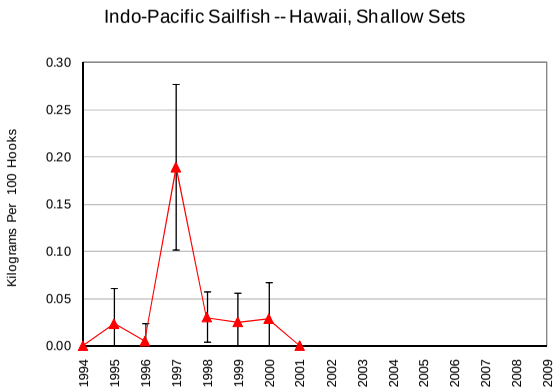
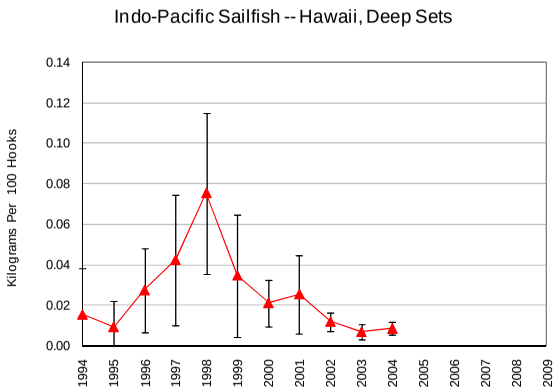
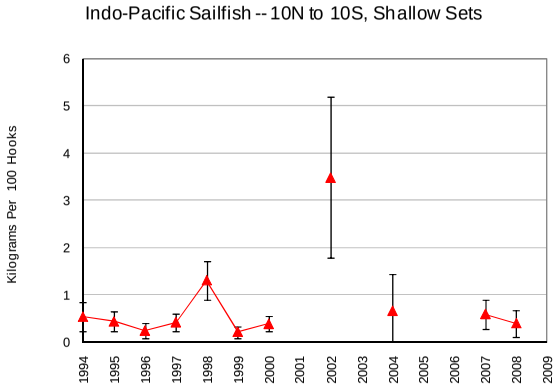
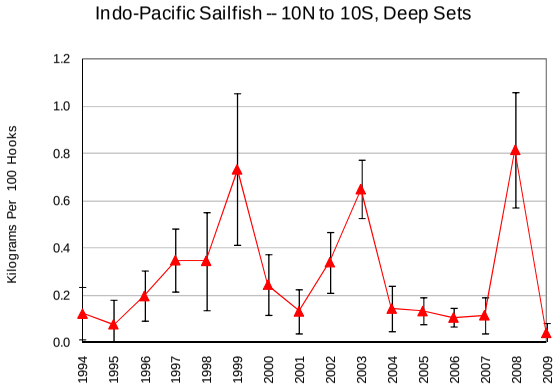


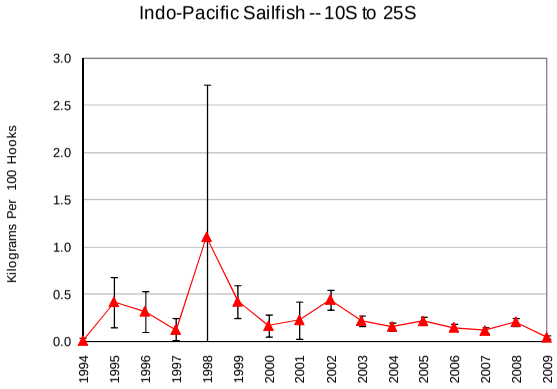
Figure A1 (continued) — Indo-Pacific Sailfish











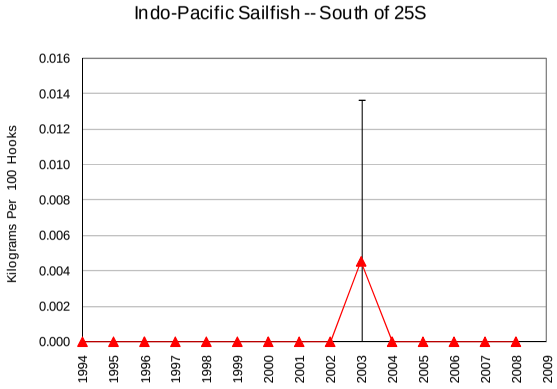
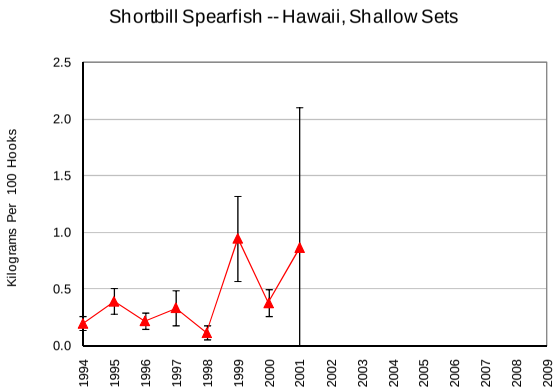
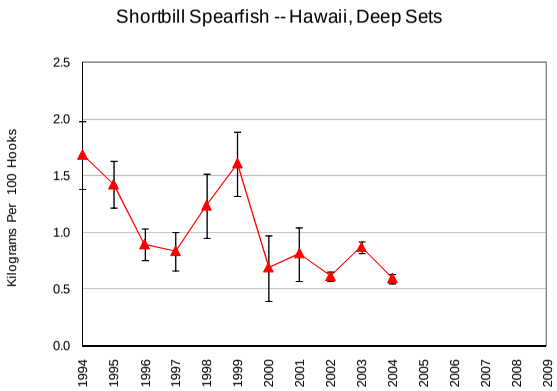
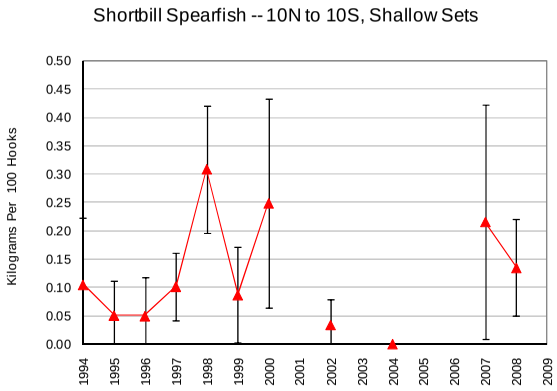
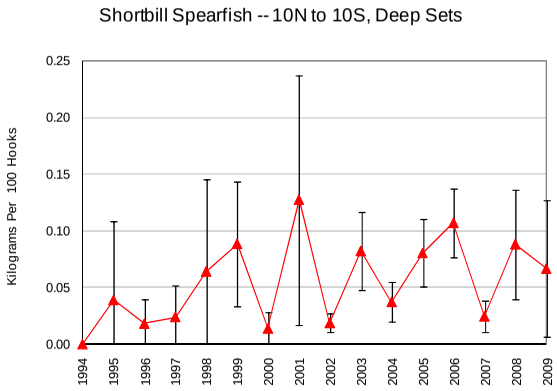


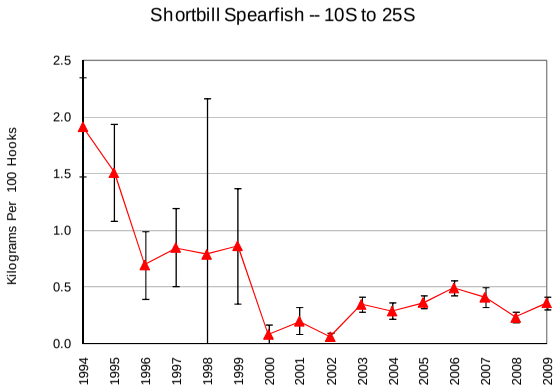
Figure A1 (continued) — Shortbill Spearfish











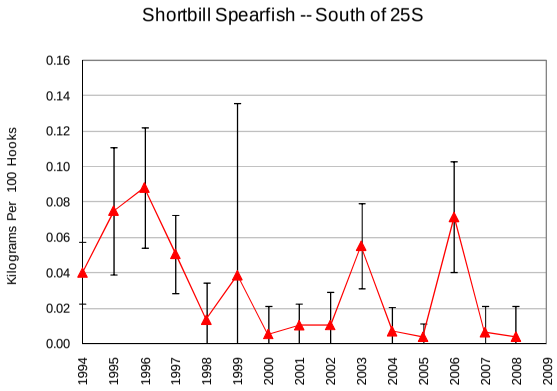
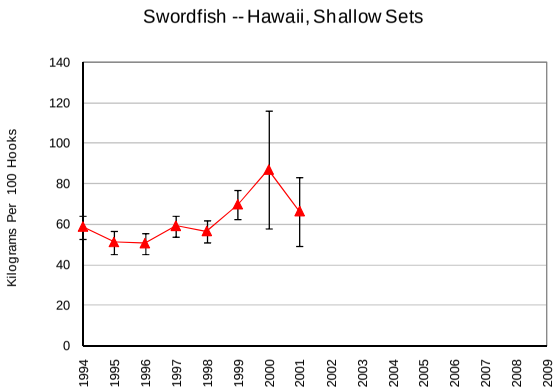
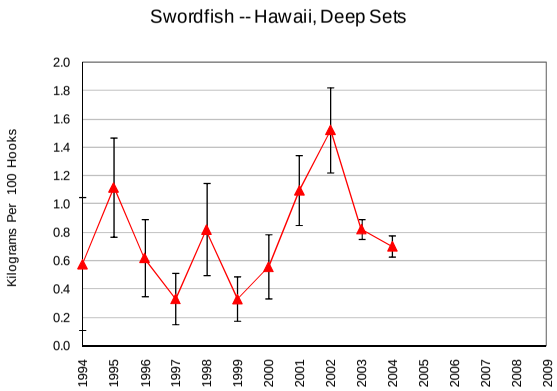
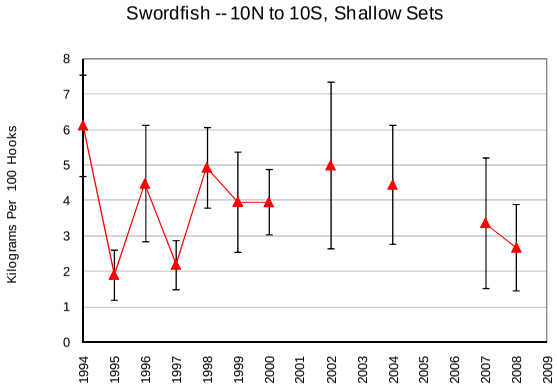
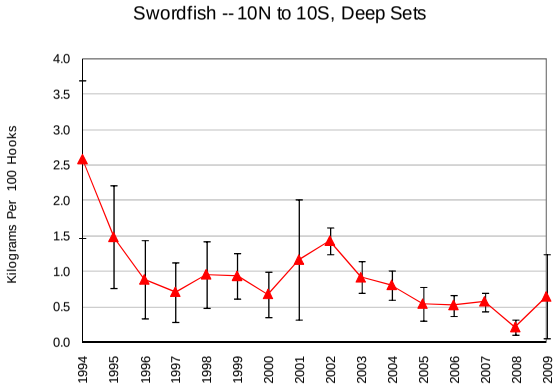


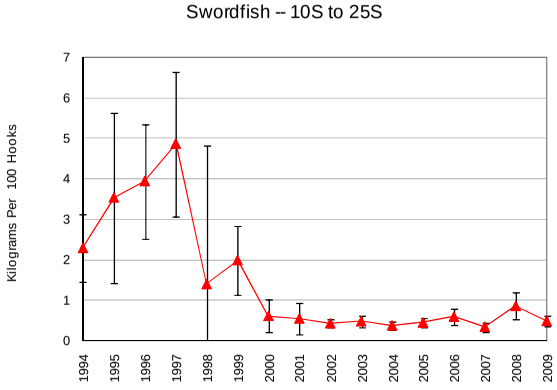
Figure A1 (continued) — Swordfish











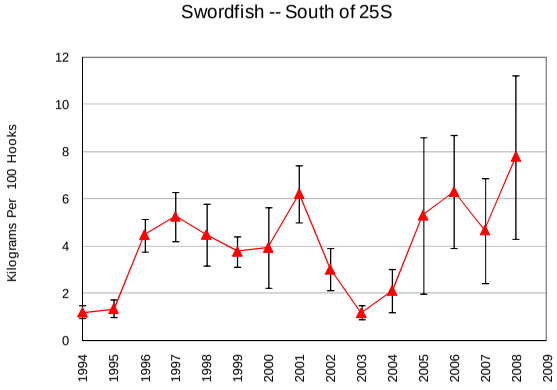
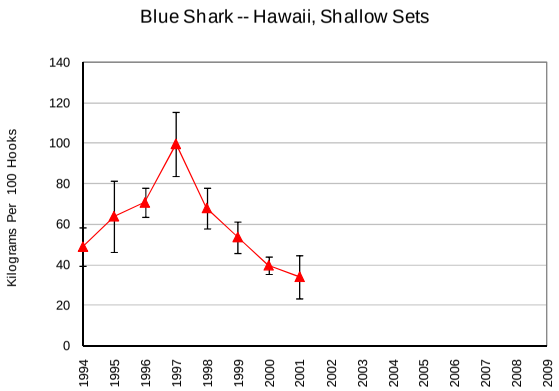
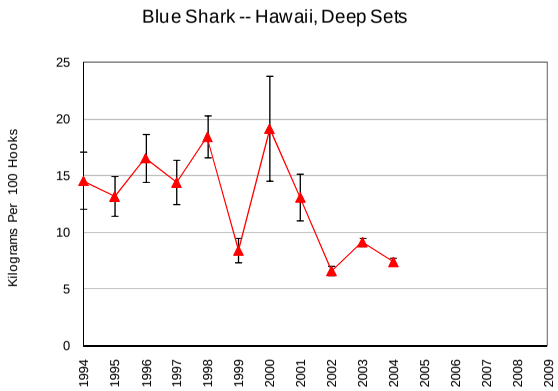
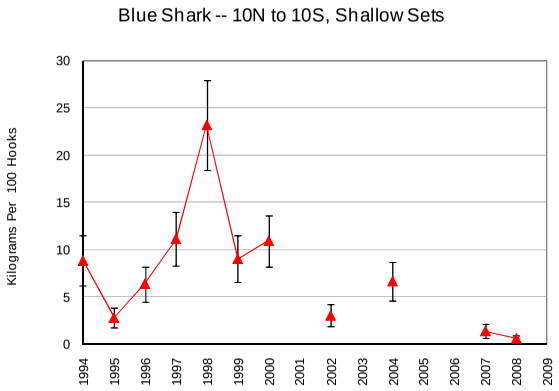
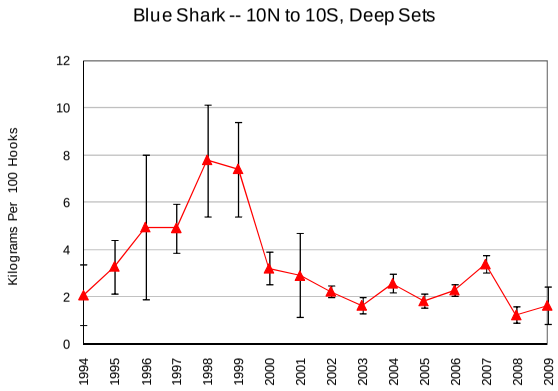


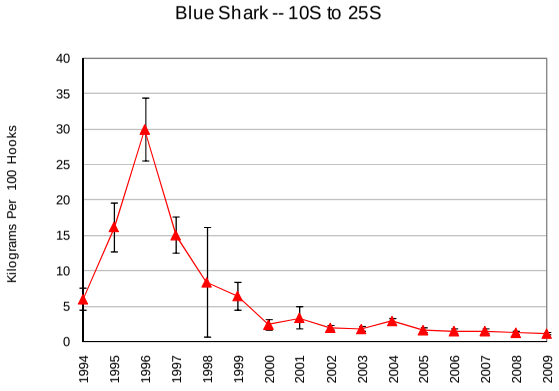
Figure A1 (continued) — Blue Shark











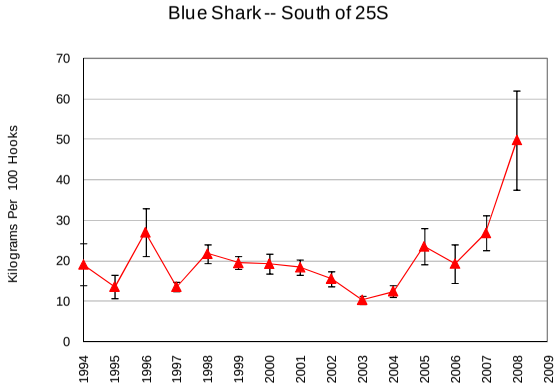
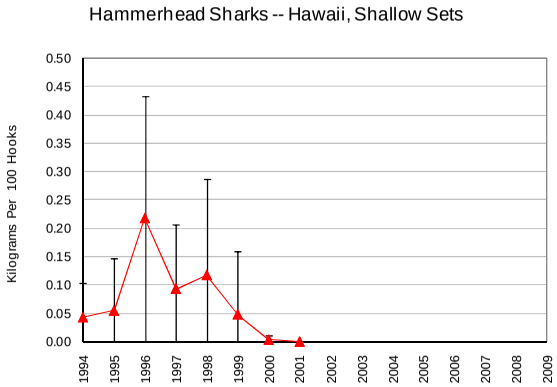
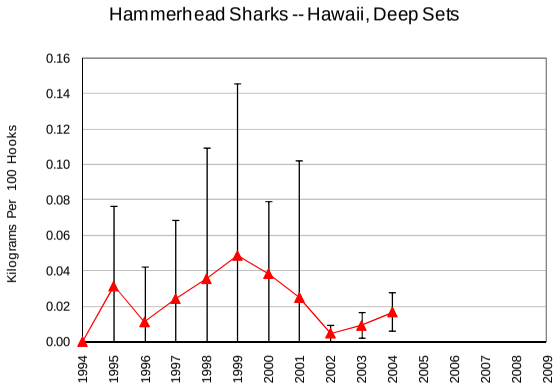
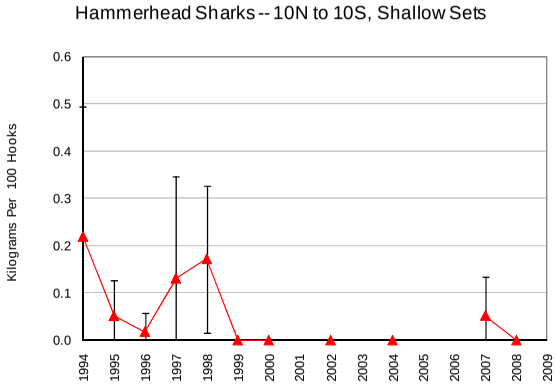
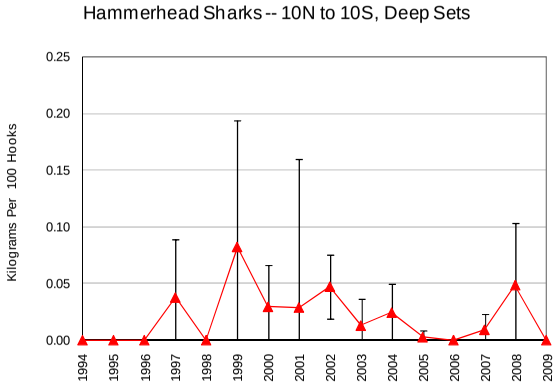


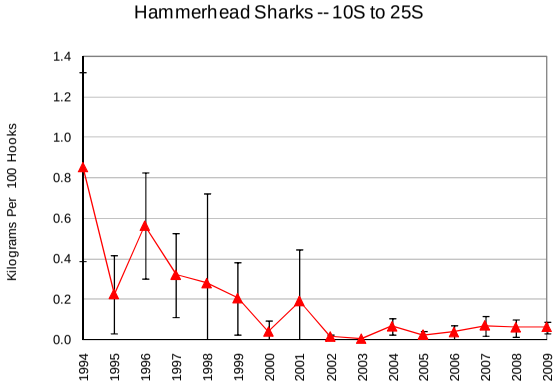
Figure A1 (continued) — Hammerhead Sharks











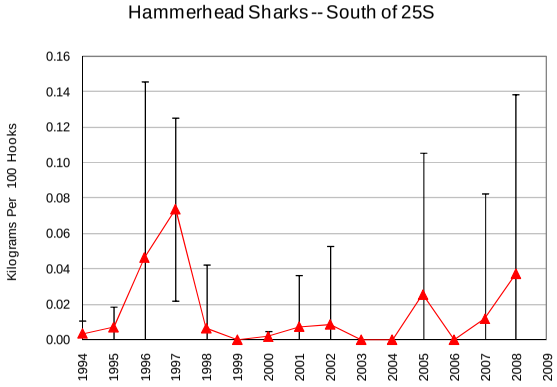
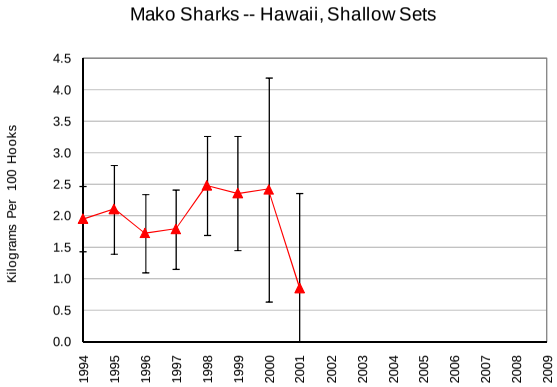
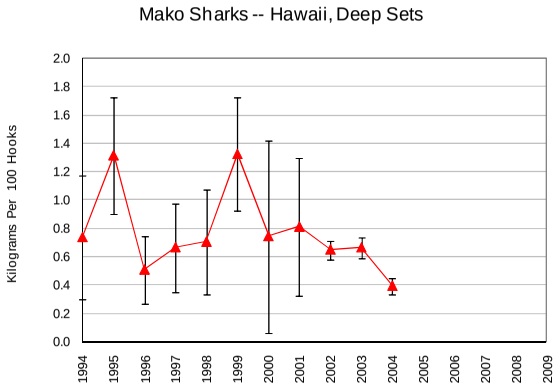
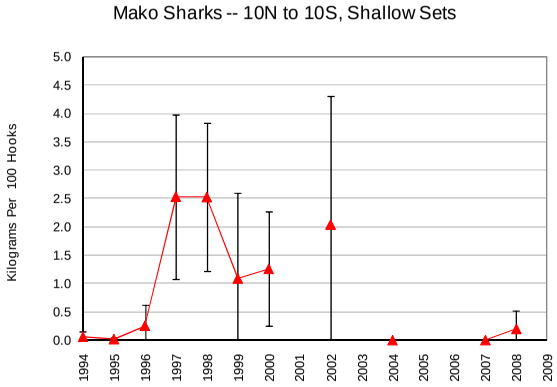
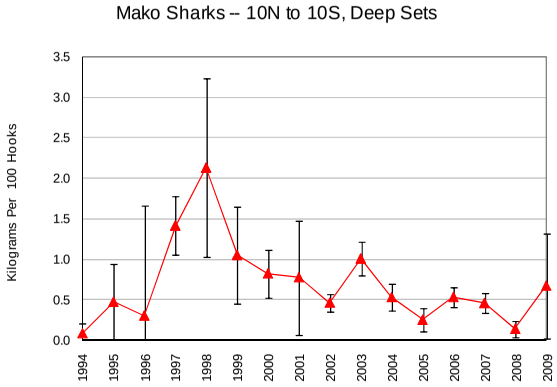


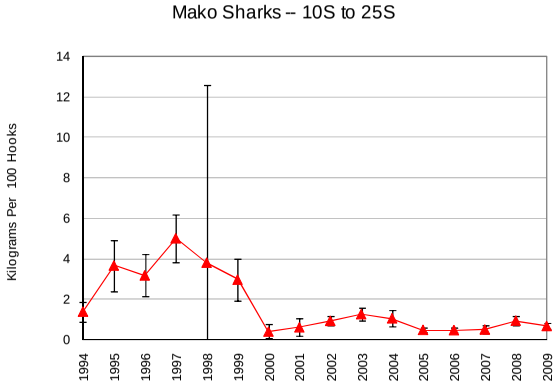
Figure A1 (continued) — Mako Sharks











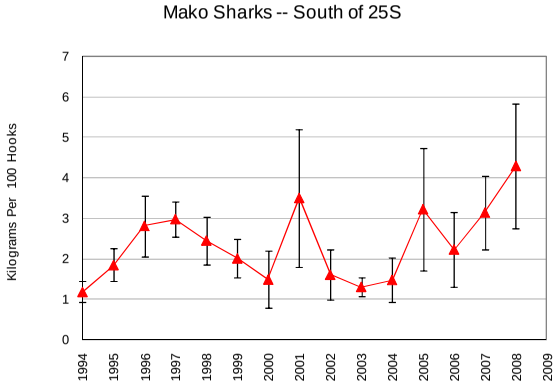
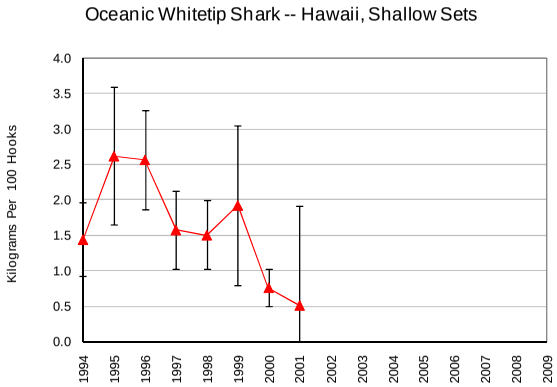
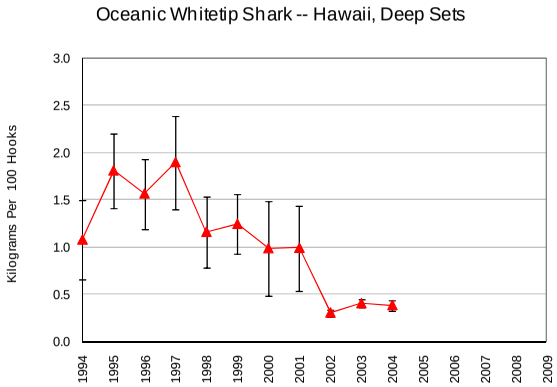
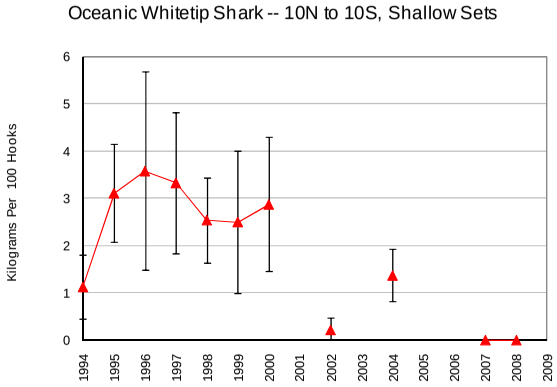
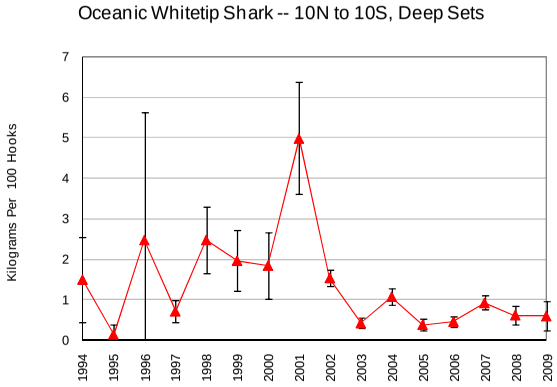


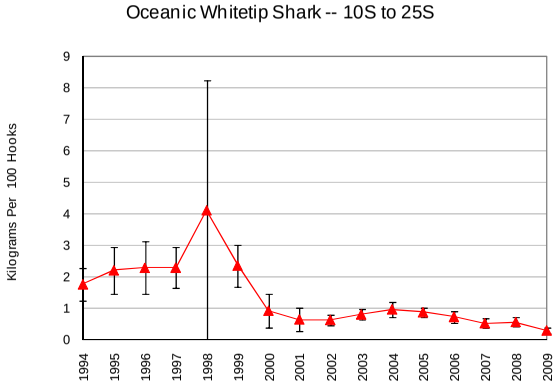
Figure A1 (continued) — Oceanic Whitetip Sharks











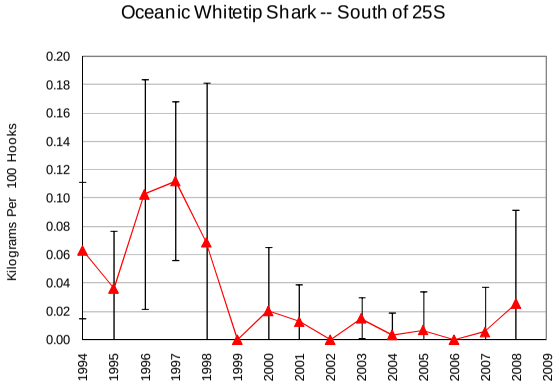
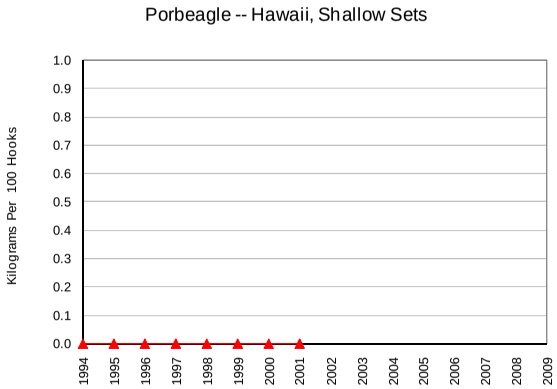
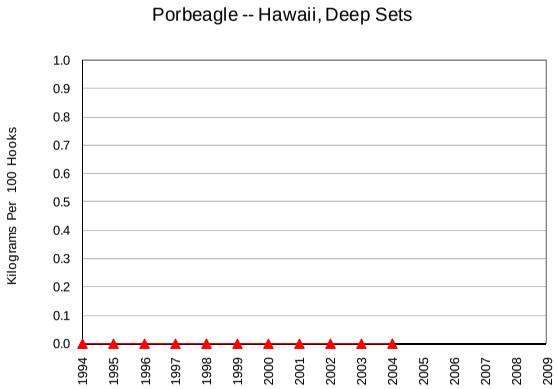
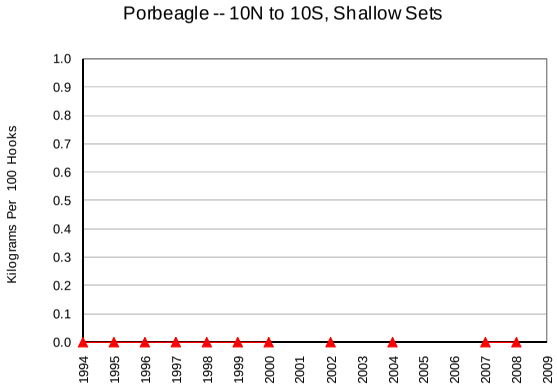
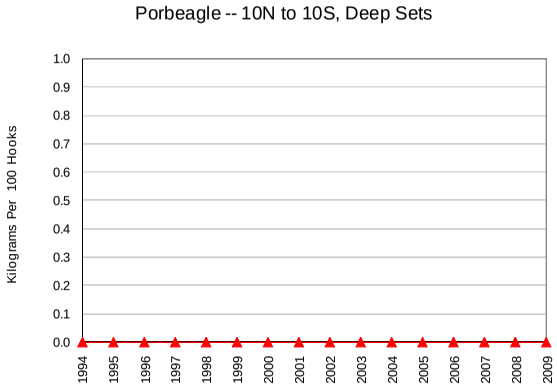


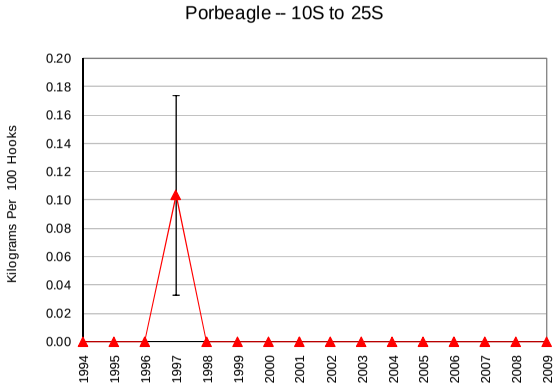
Figure A1 (continued) — Porbeagle











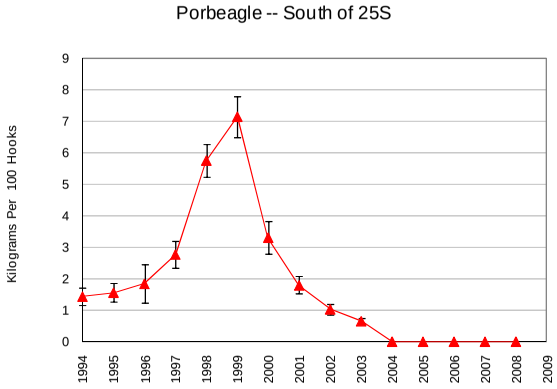
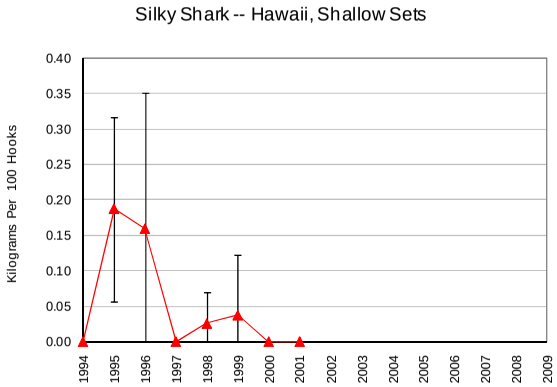
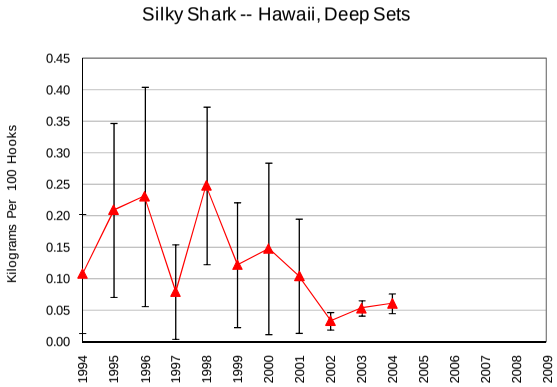
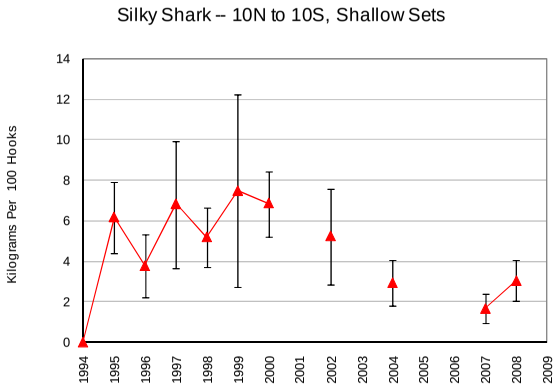
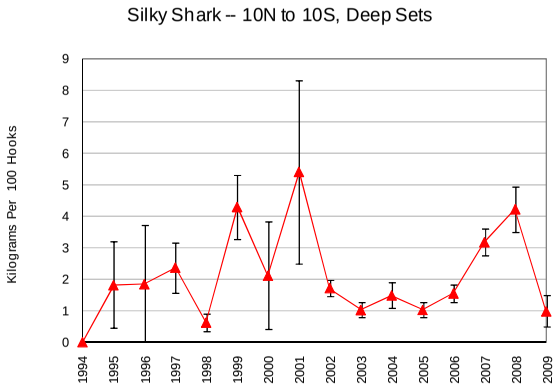


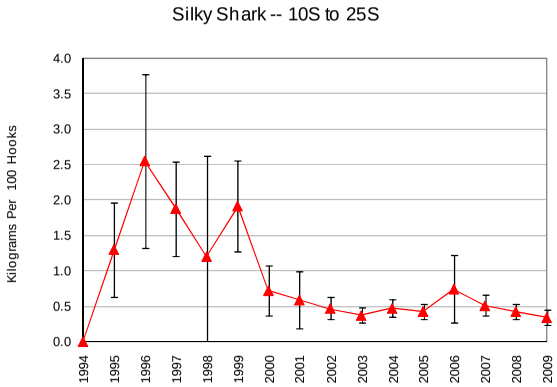
Figure A1 (continued) — Silky Shark











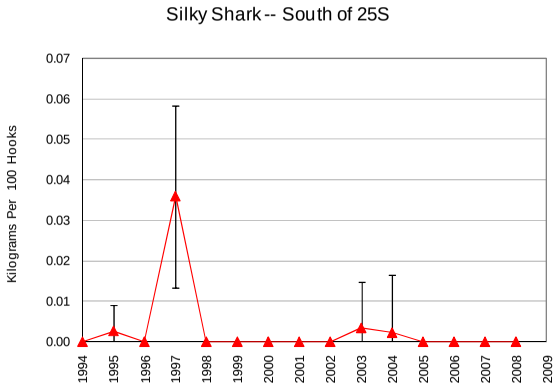
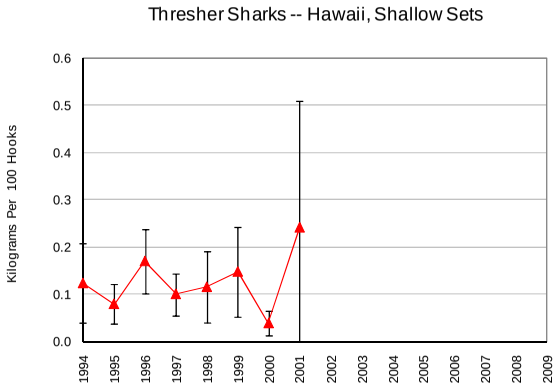
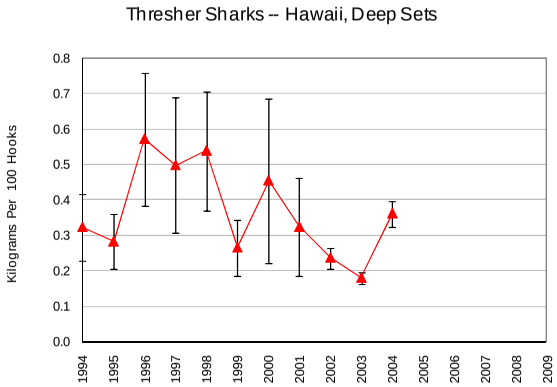
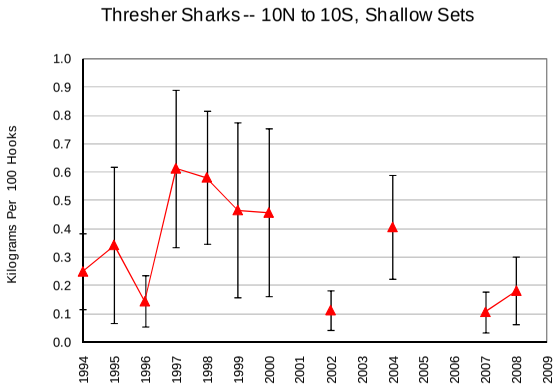
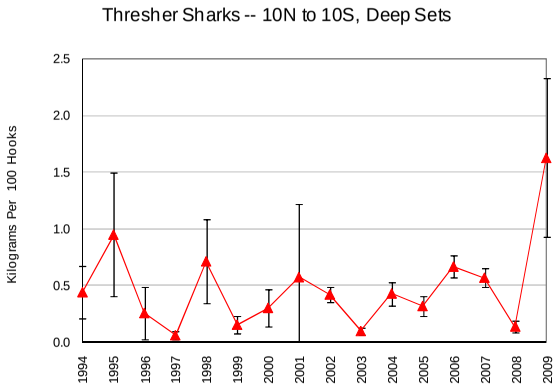


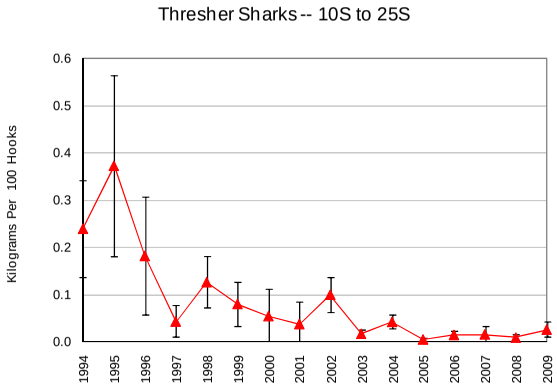
Figure A1 (continued) — Thresher Sharks











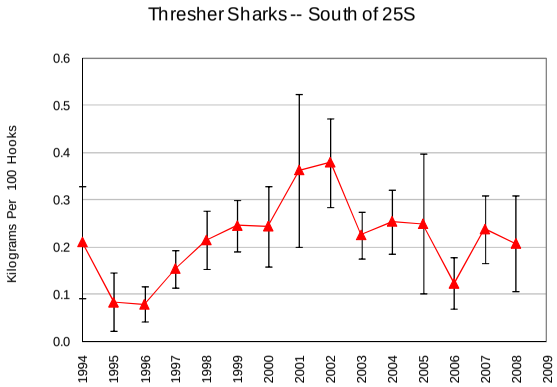
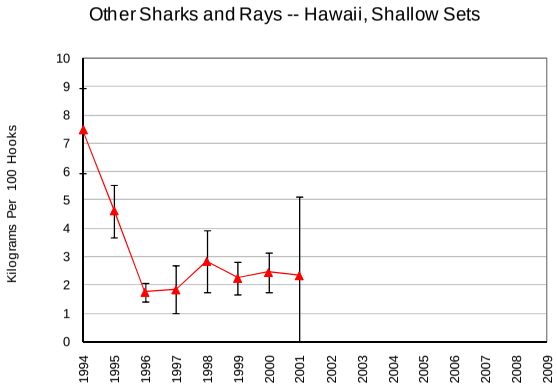
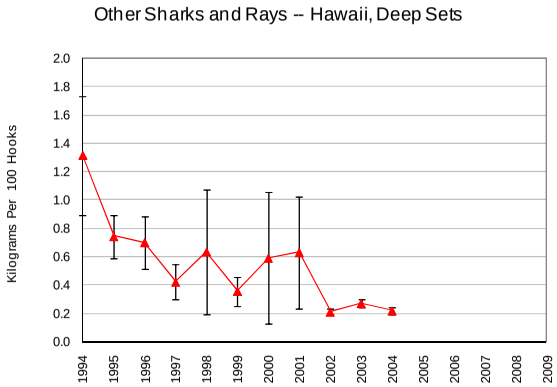
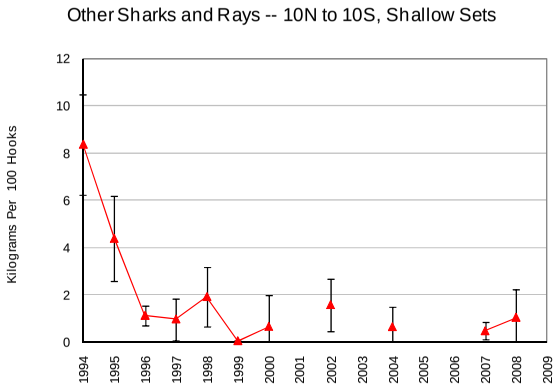
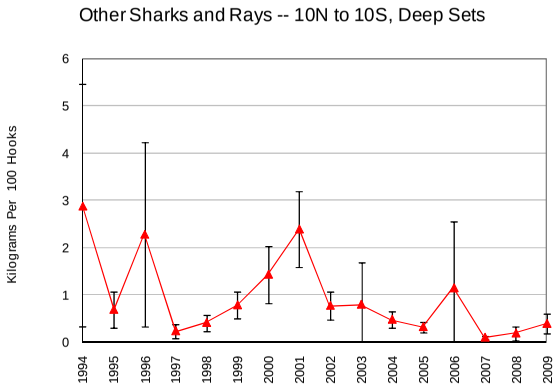


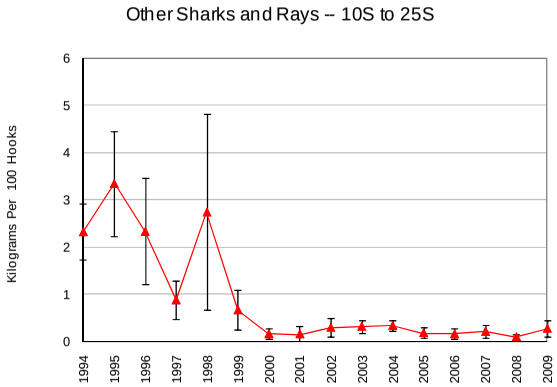
Figure A1 (continued) — Other Sharks and Rays











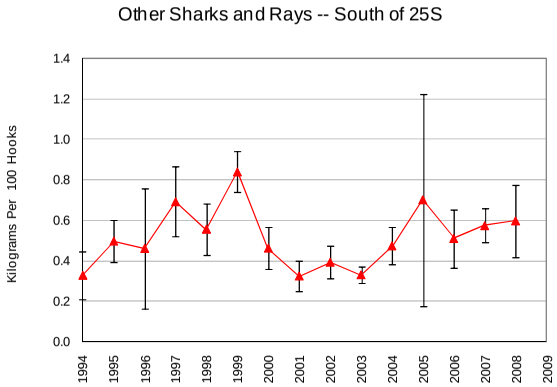
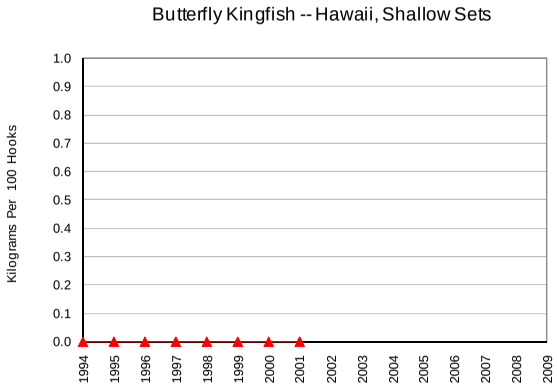
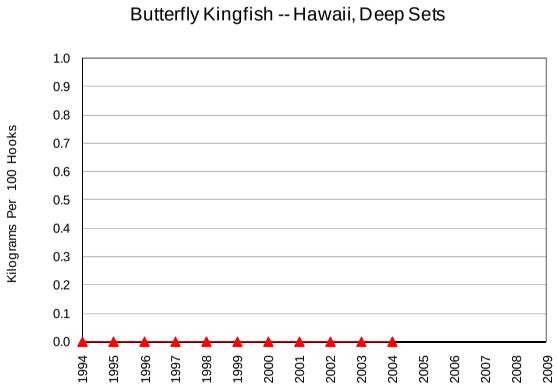
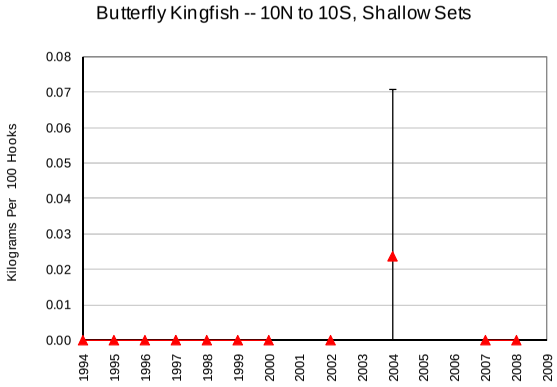
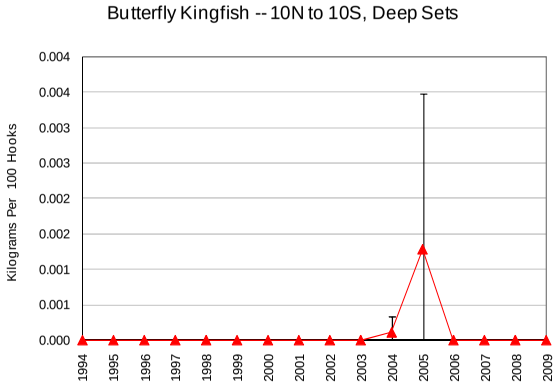


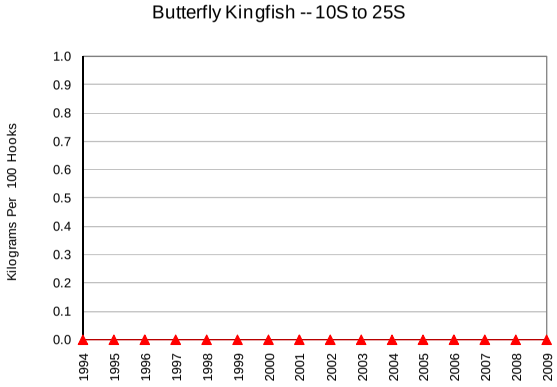
Figure A1 (continued) — Butterfly Kingfish











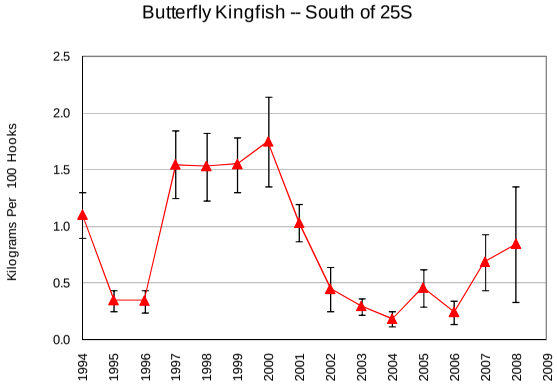
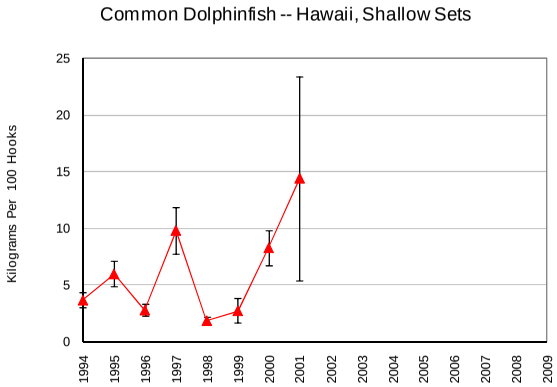
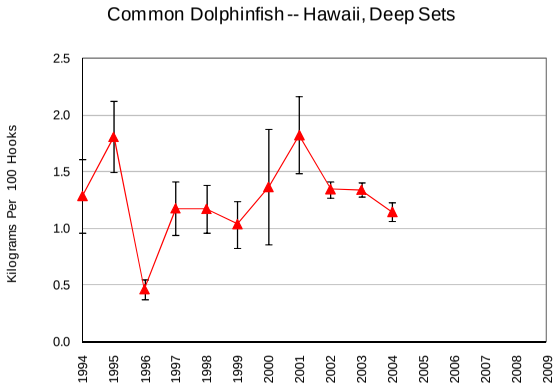
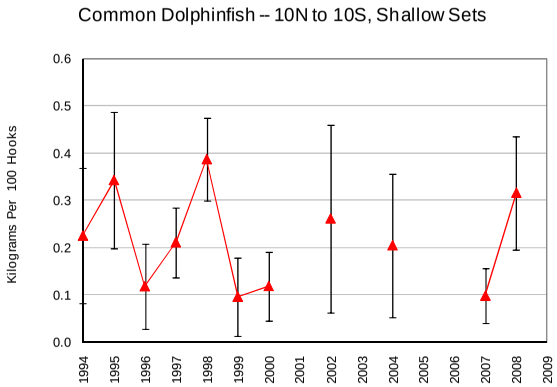
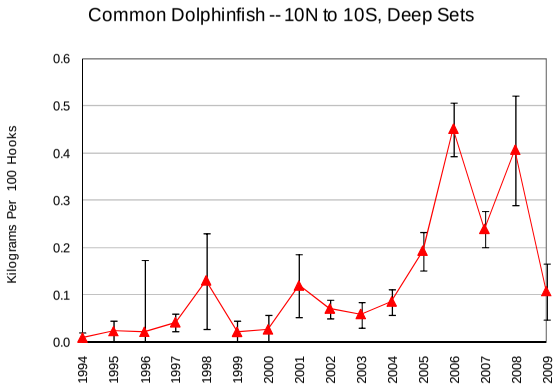


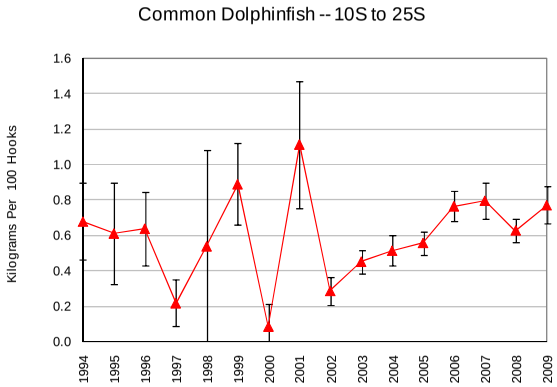
Figure A1 (continued) — Common Dolphinfish











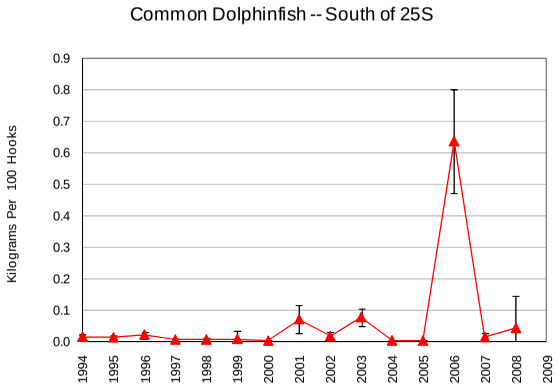
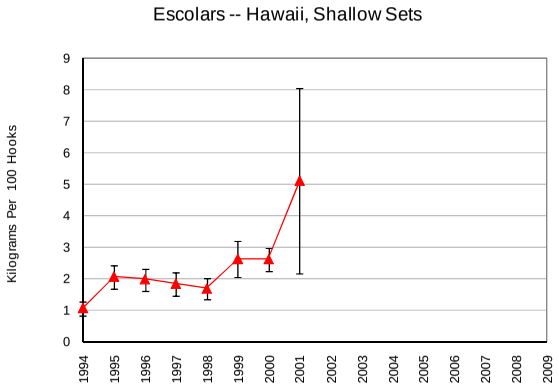
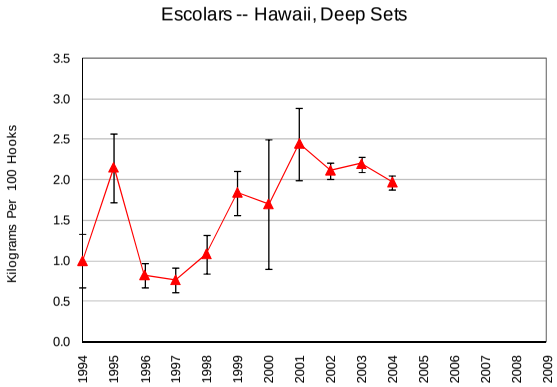
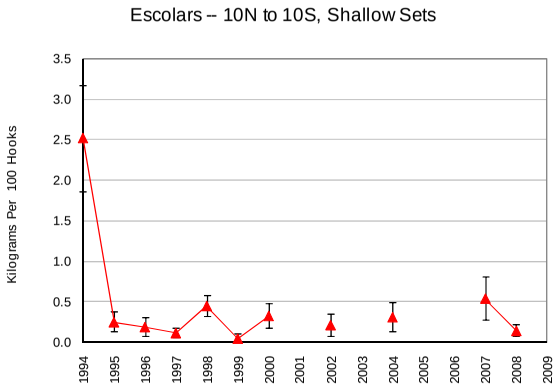
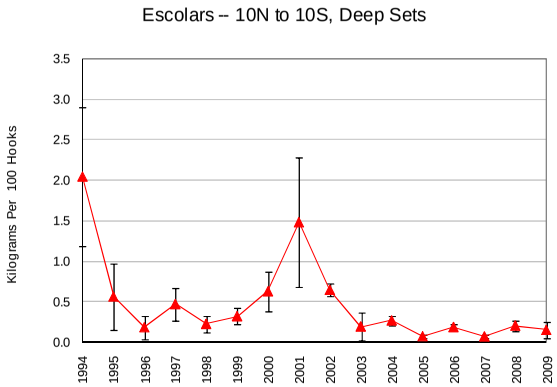


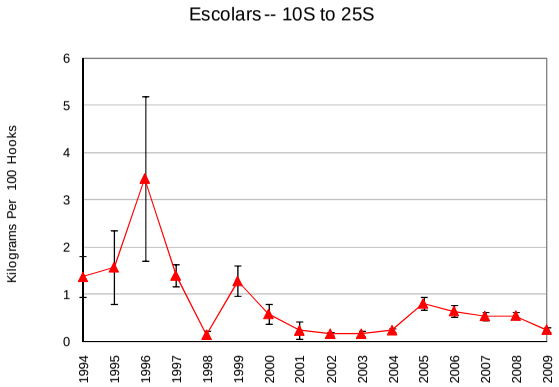
Figure A1 (continued) — Escolars











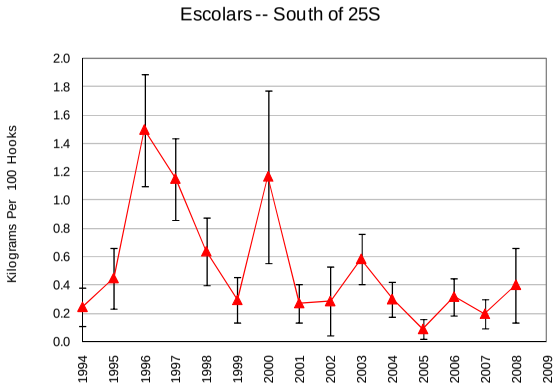
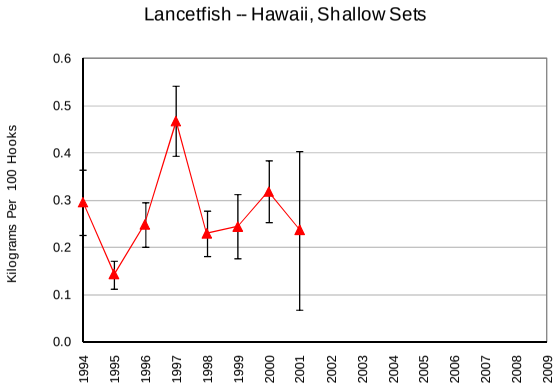
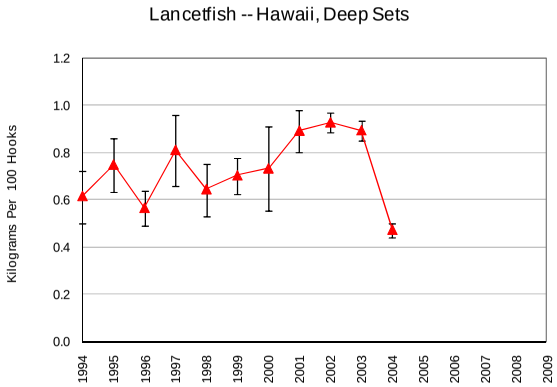
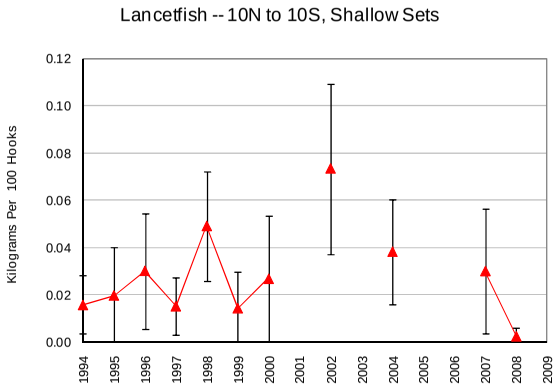
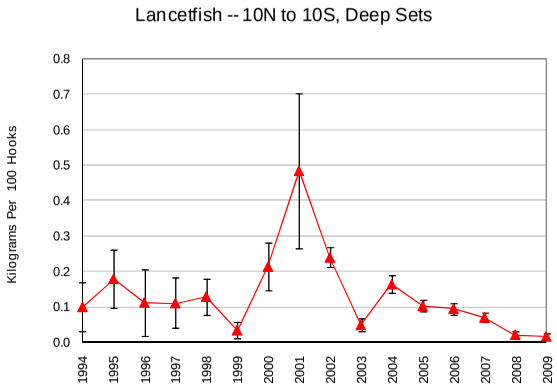


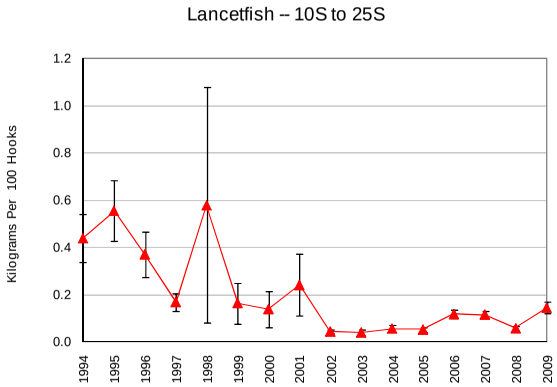
Figure A1 (continued) — Lancetfish











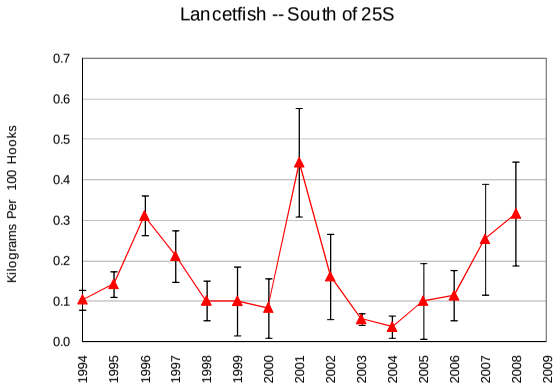
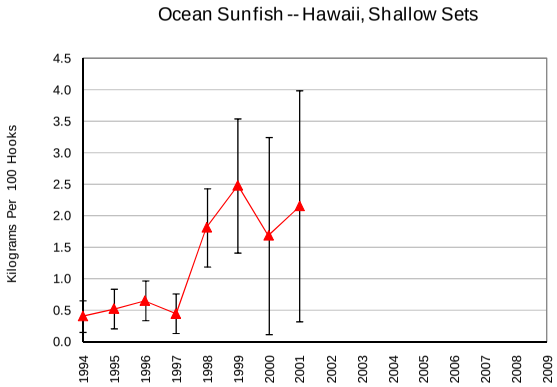
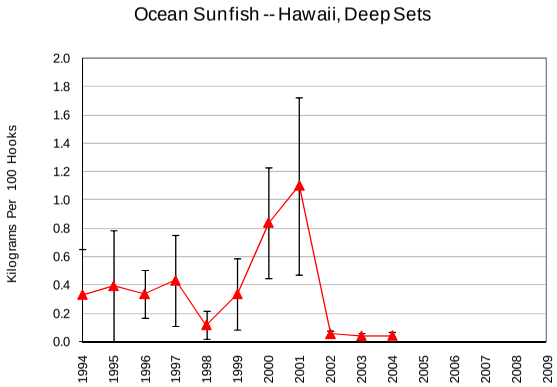
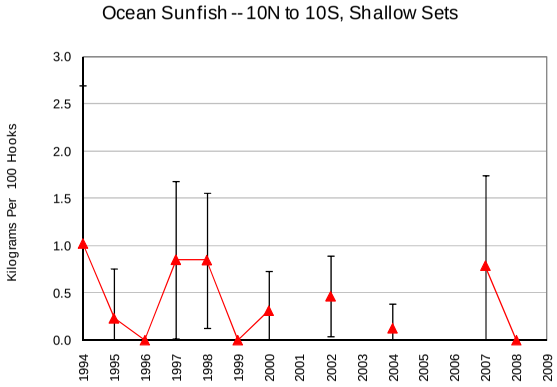
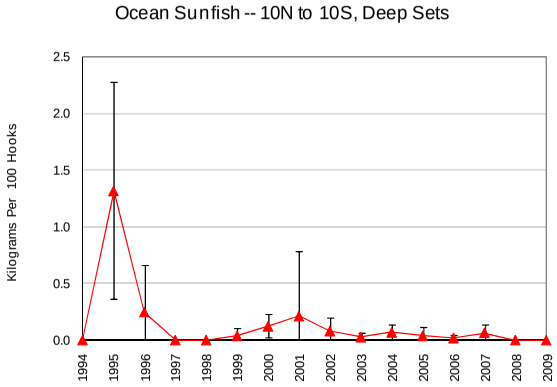


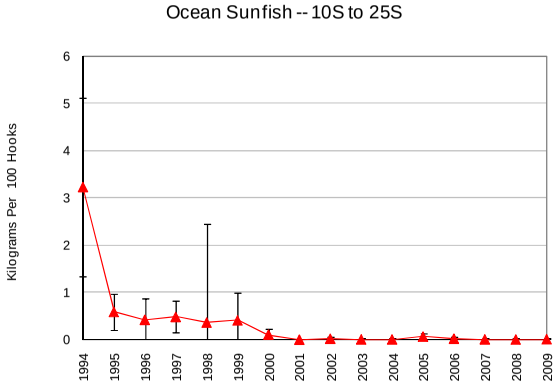
Figure A1 (continued) — Ocean Sunfish











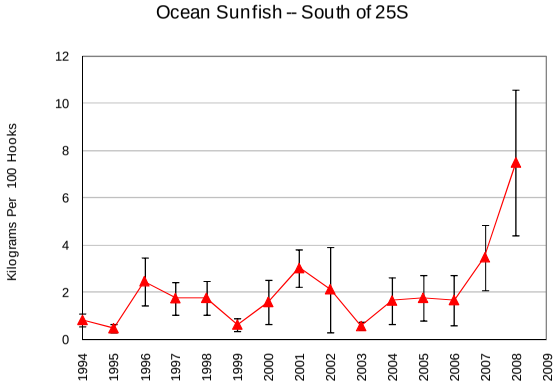
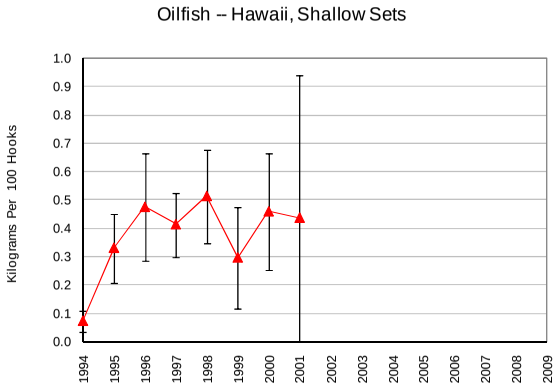
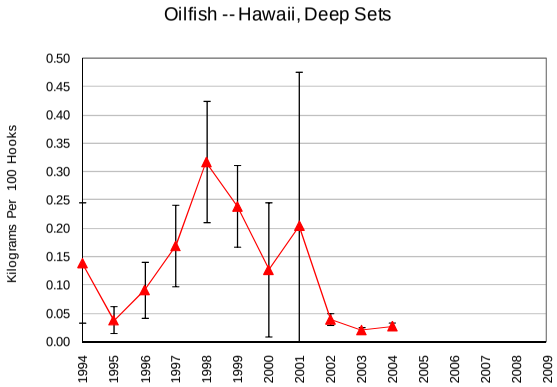
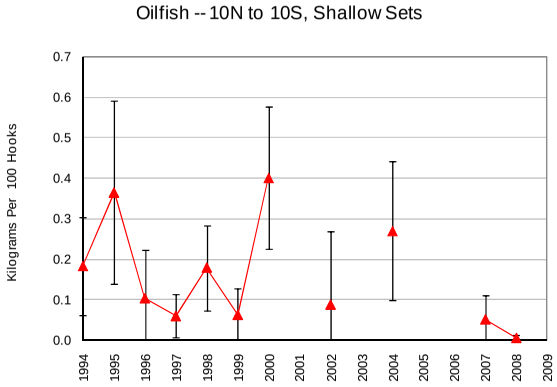
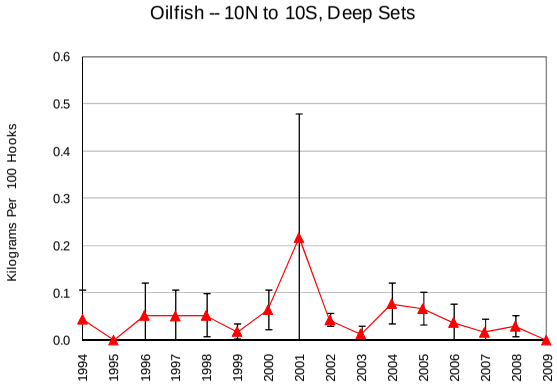


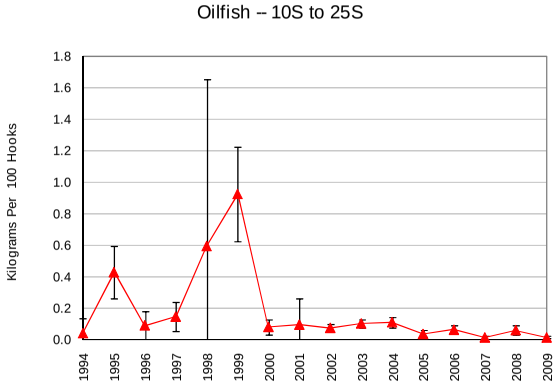
Figure A1 (continued) — Oilfish











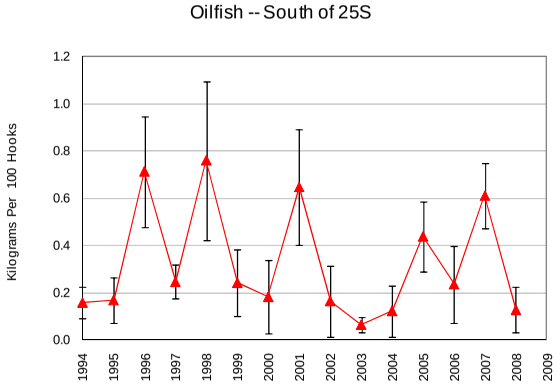
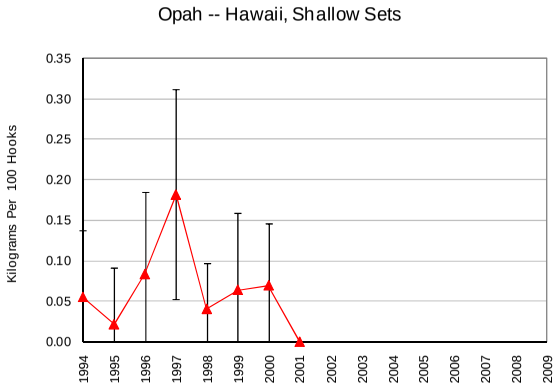
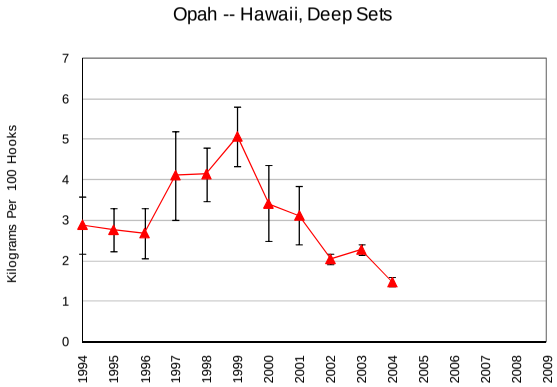
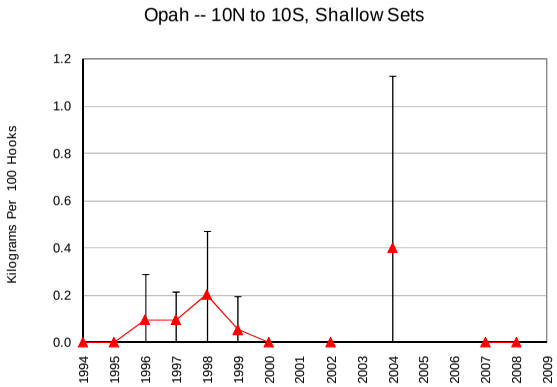
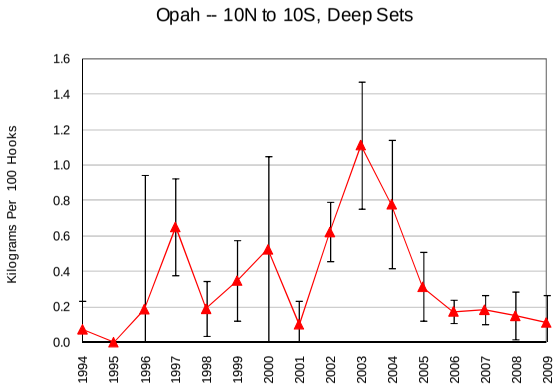


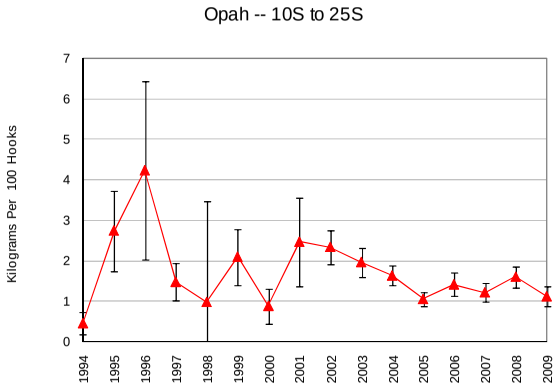
Figure A1 (continued) — Opah











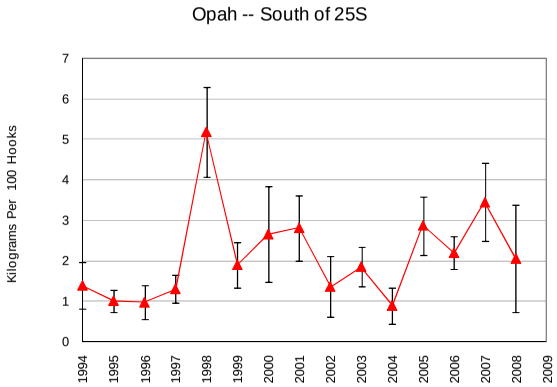
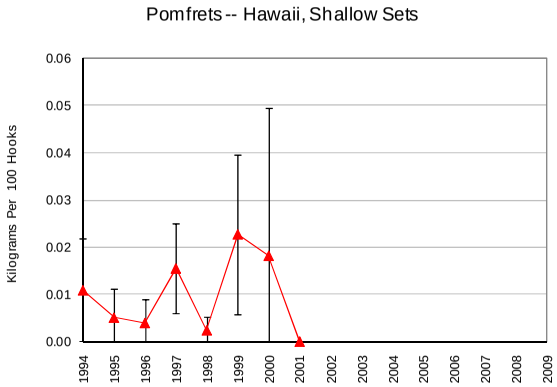
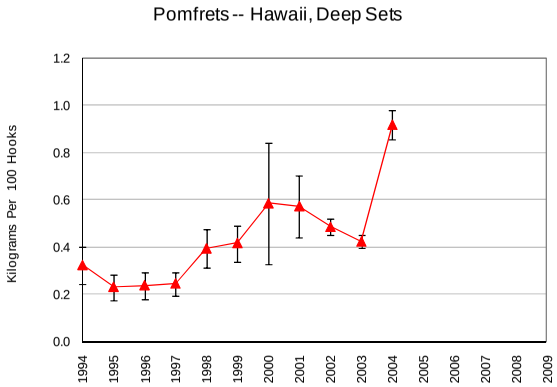
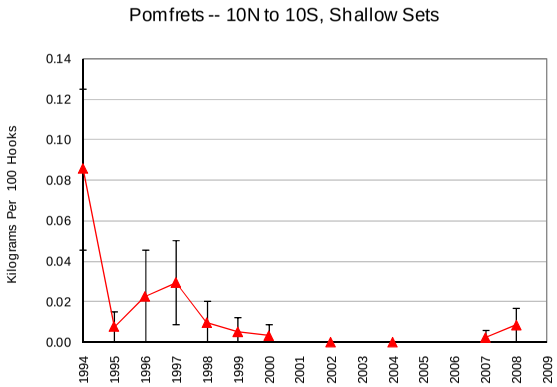
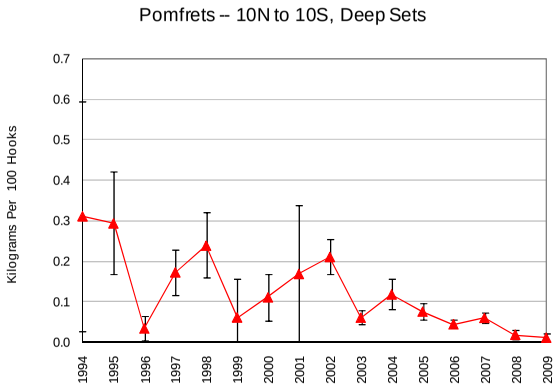


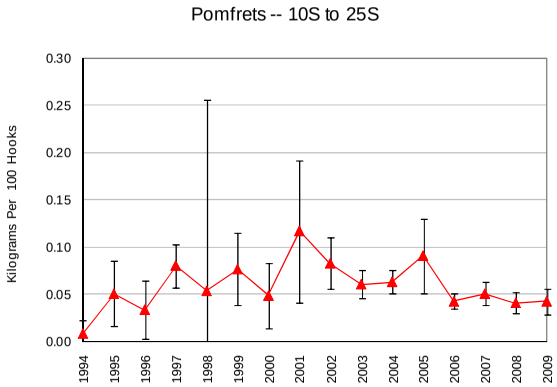
Figure A1 (continued) — Pomfrets











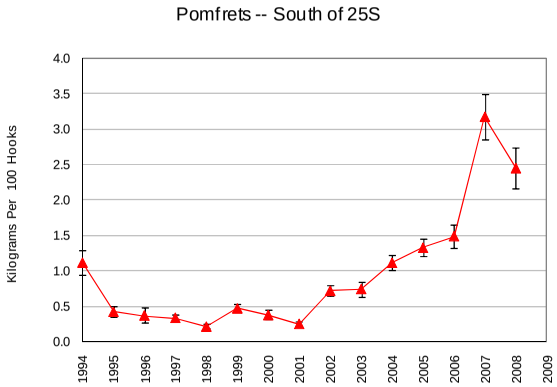
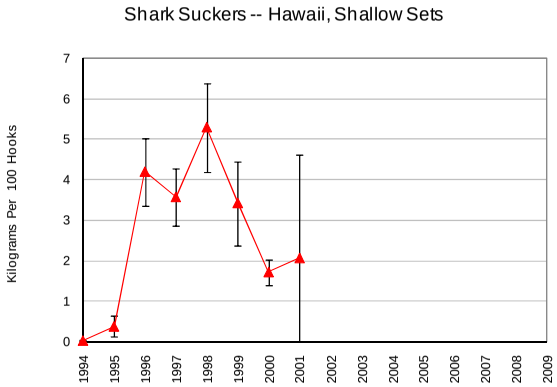
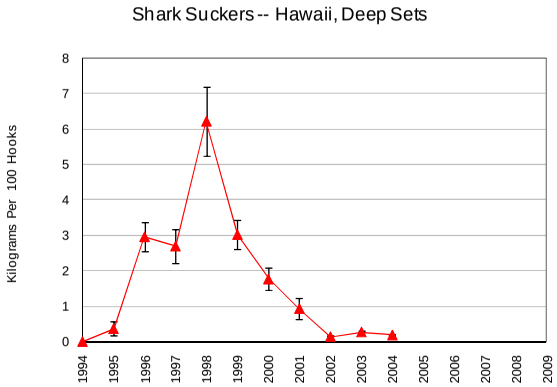
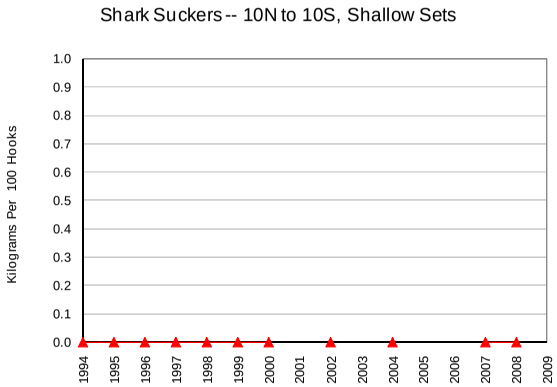
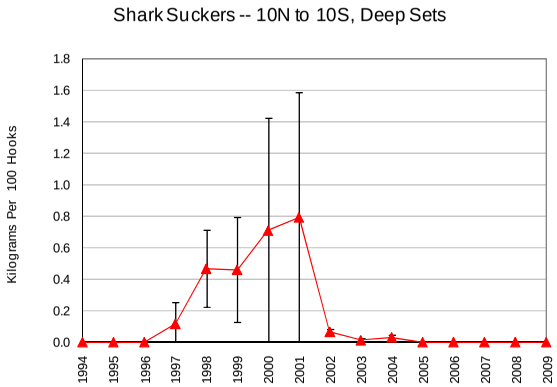


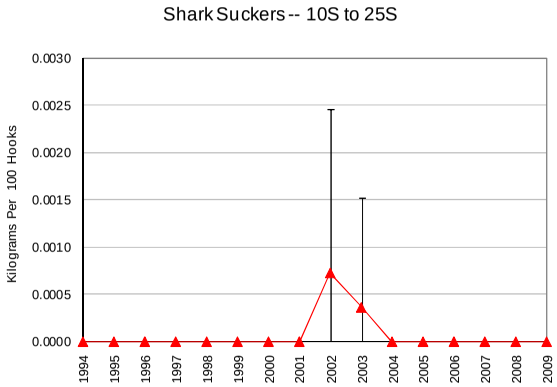
Figure A1 (continued) — Shark Suckers











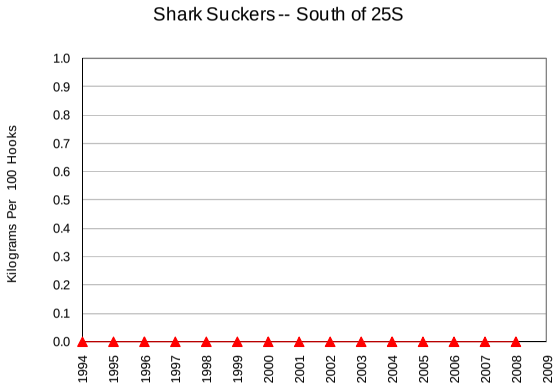
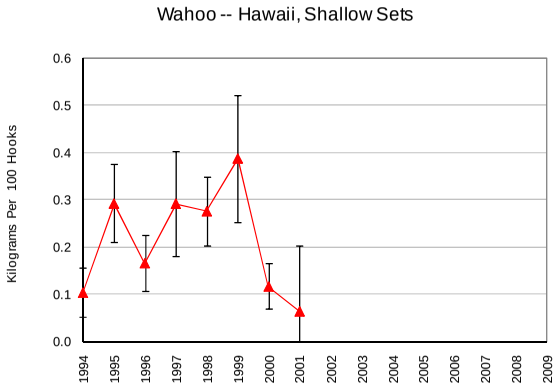
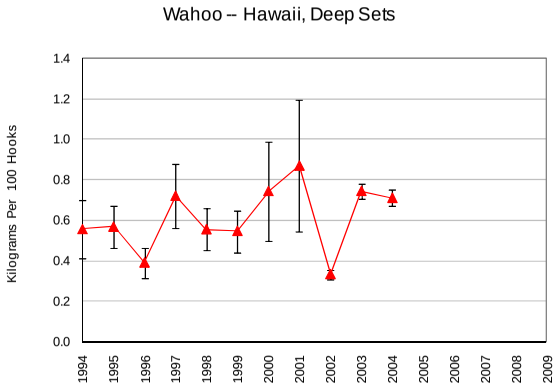
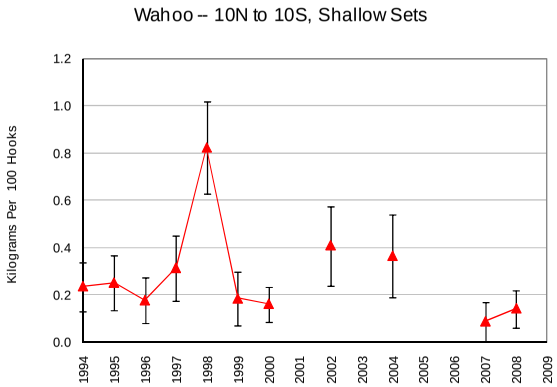
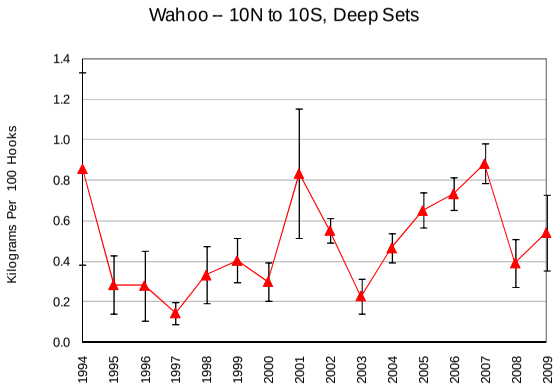


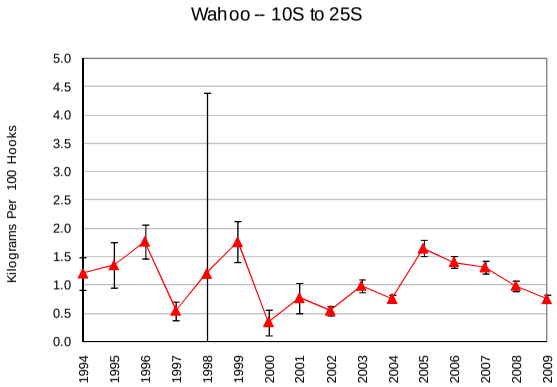
Figure A1 (continued) — Wahoo











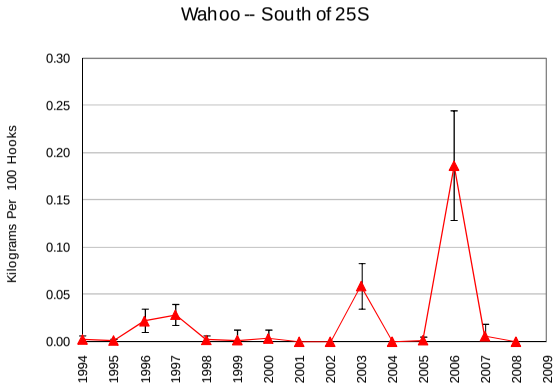
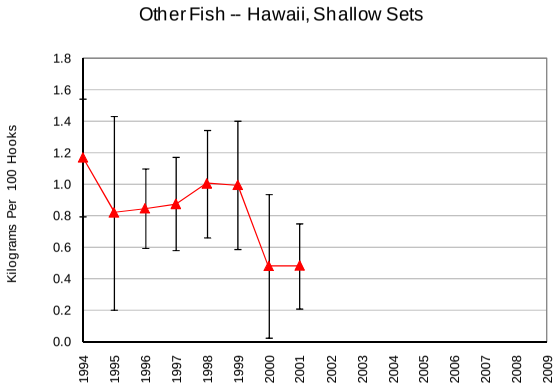
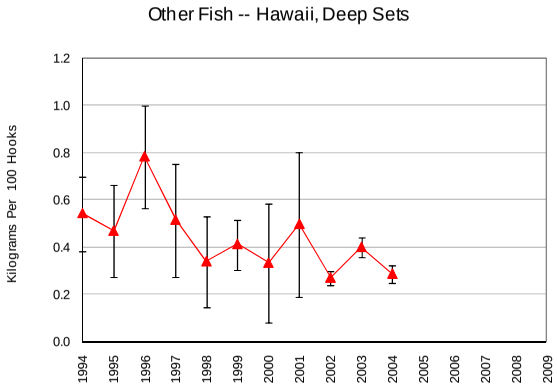
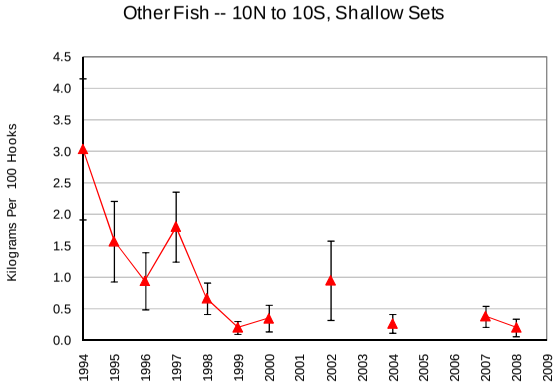
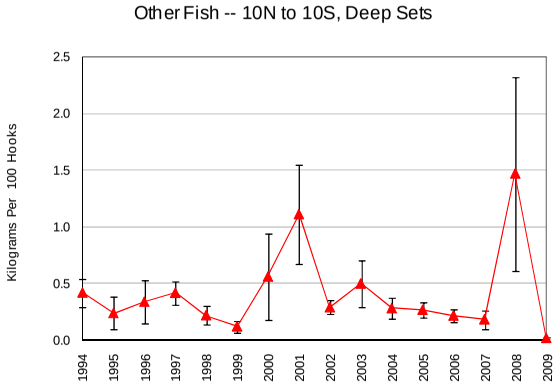


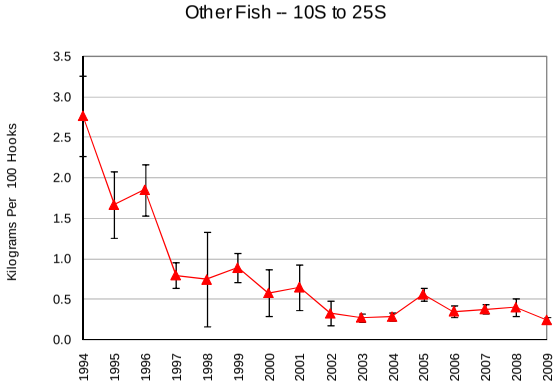
Figure A1 (continued) — Other Fish











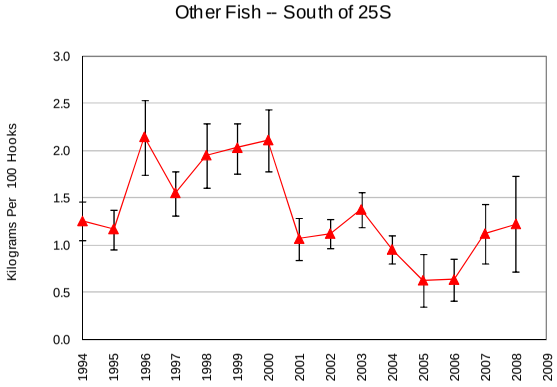


Figure A2. Catch rates of target and non-target species determined from observer data collected onboard purse seiners in the Western and Central Pacific Ocean

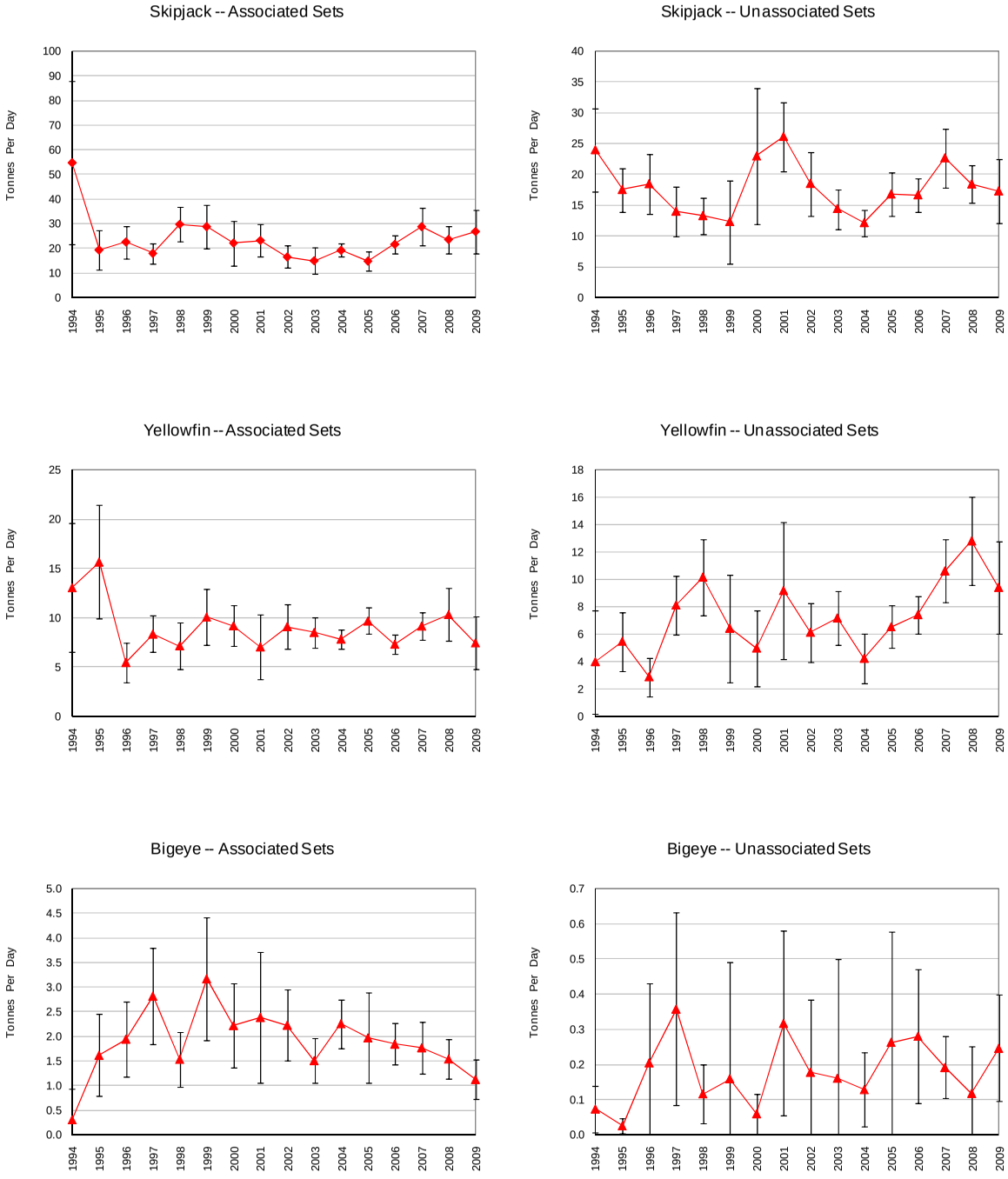
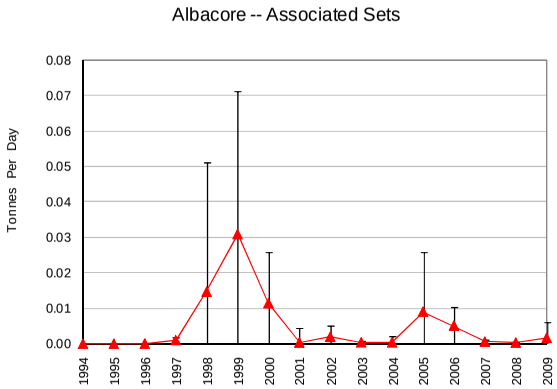
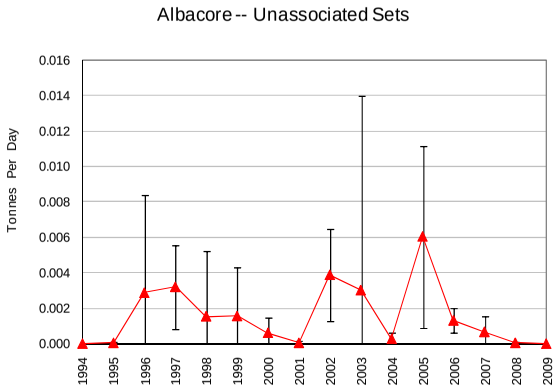
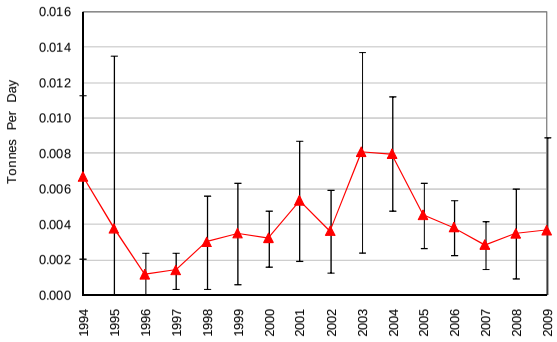
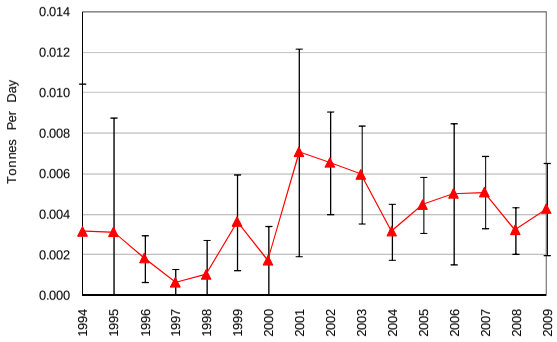


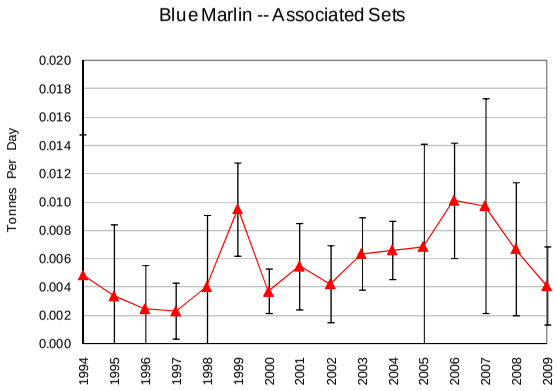
Figure A2 (continued)











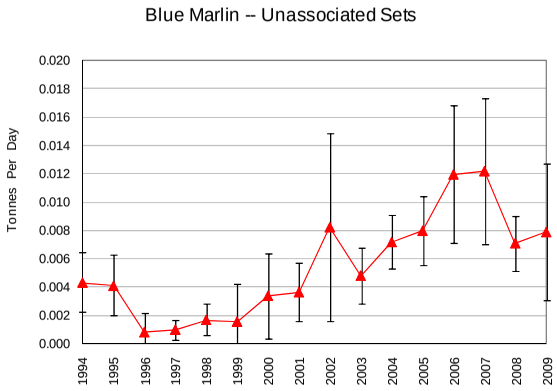
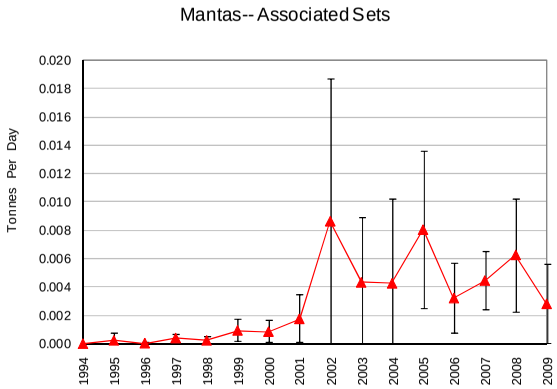
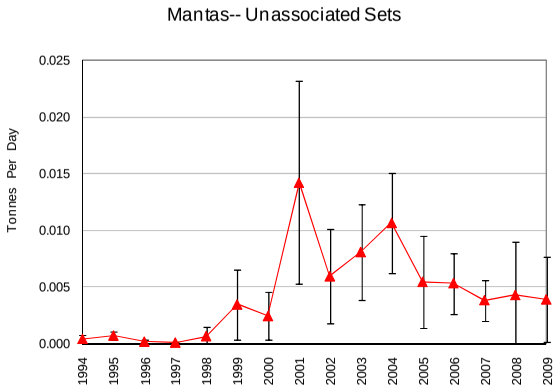
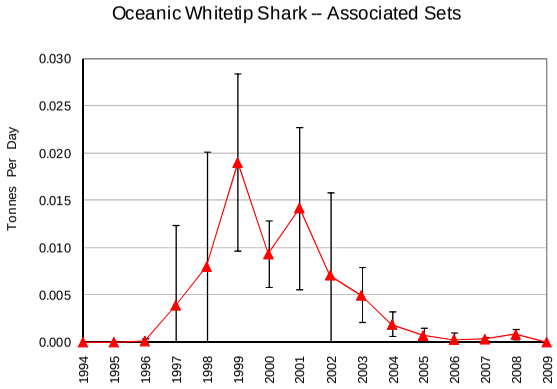
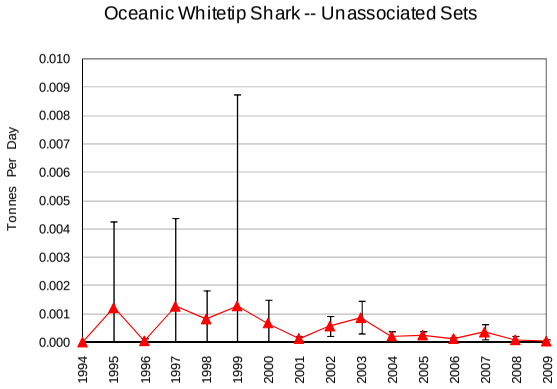


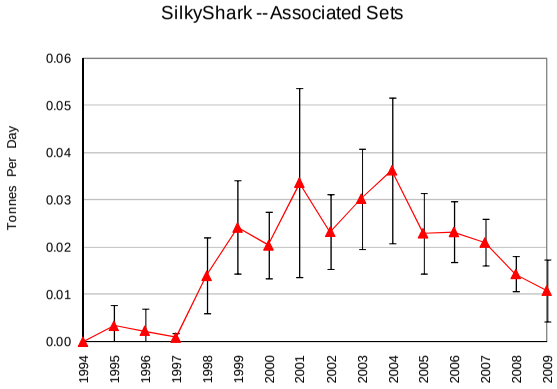
Figure A2 (continued)











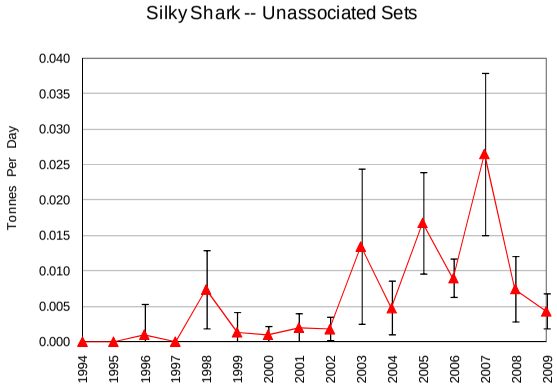
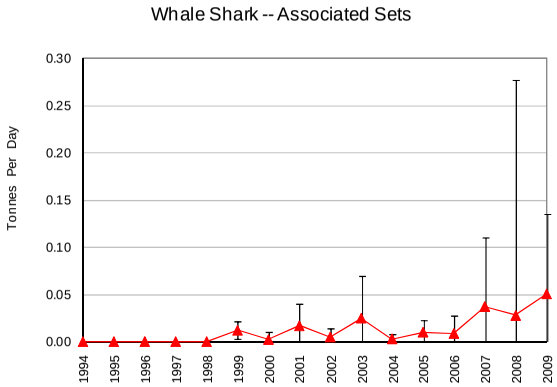
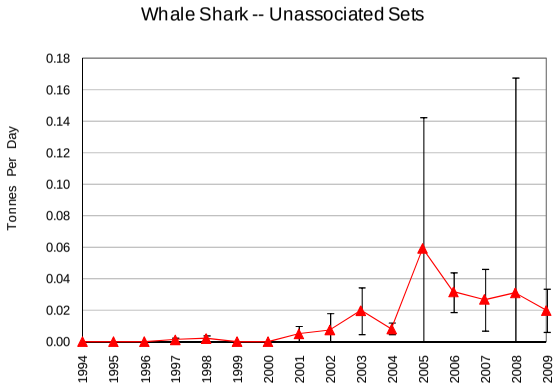
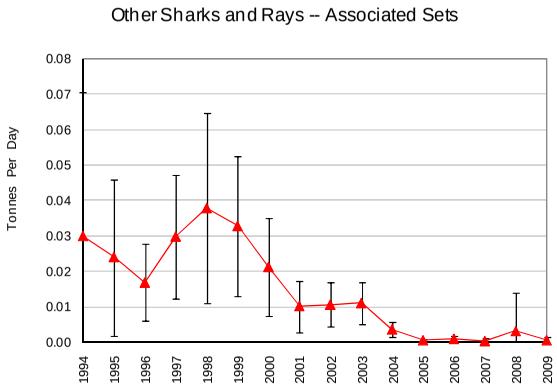
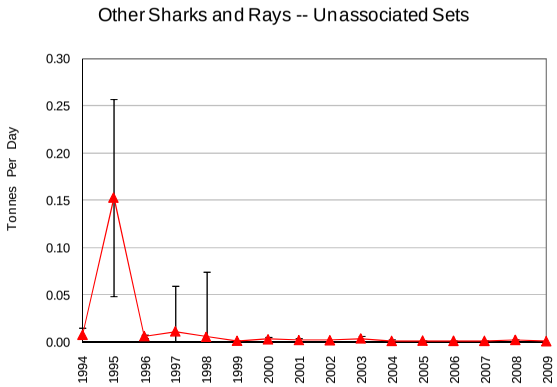


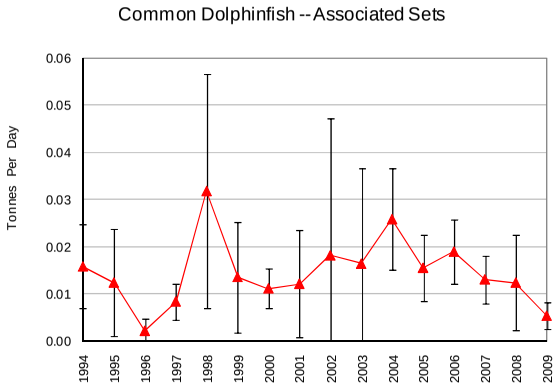
Figure A2 (continued)











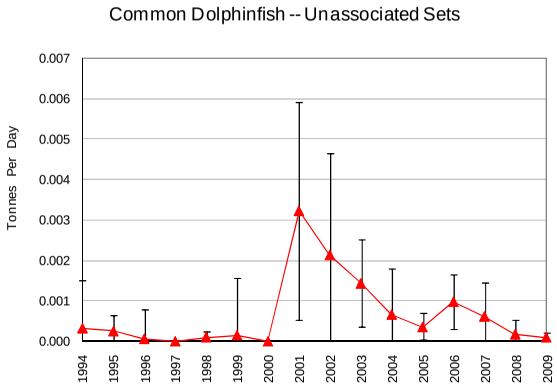
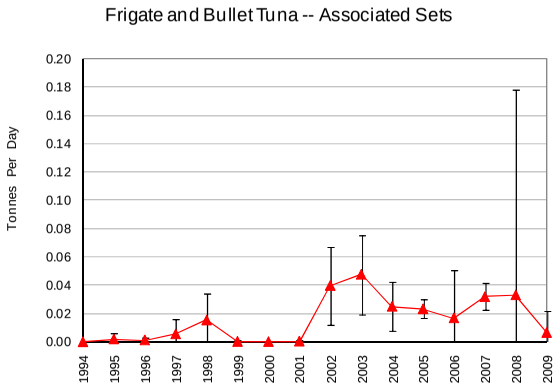
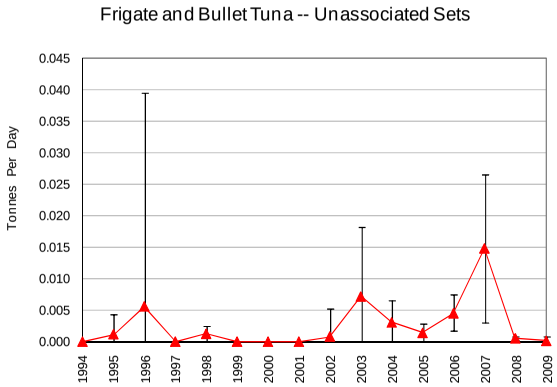
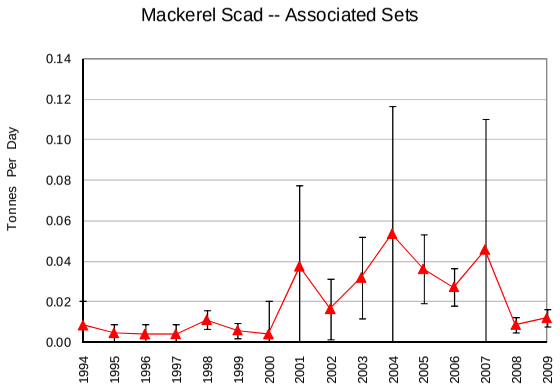
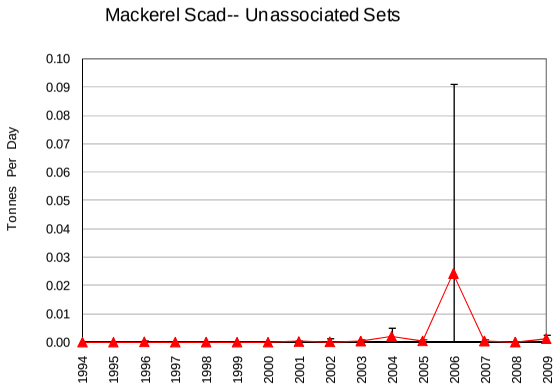


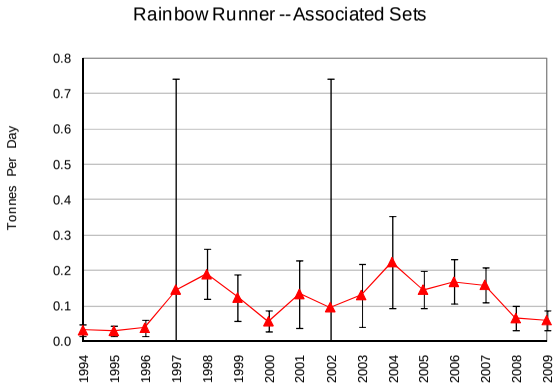
Figure A2 (continued)











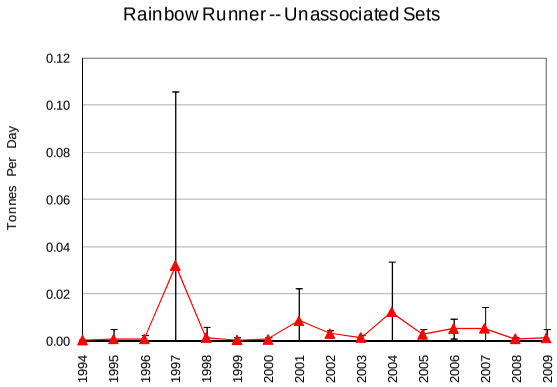


Figure A2 (continued)