U.S. Commercial Fisheries for Marlins in the North Pacific Ocean[1]

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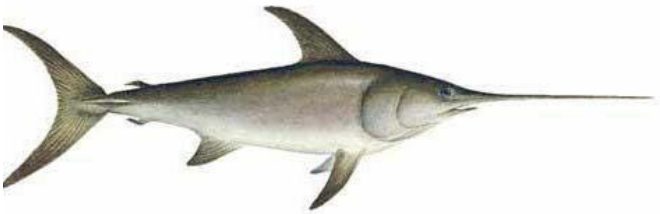

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U.S. COMMERCIAL FISHERIES FOR MARLINS IN THE NORTH PACIFIC OCEAN

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INTRODUCTION

This report summarizes historical trends and recent developments for U.S. commercial fisheries taking marlins (Istiophoridae) in the North Pacific Ocean. Marlins are also targeted and taken incidentally by recreational fisheries but there is no mandatory data collection program for these fisheries. Therefore, only the U.S. commercial fisheries are discussed herein.

At least five species of marlins are exploited commercially by U.S. fisheries in the North Pacific Ocean. These are striped marlin (*Kajikia audax*), blue marlin (*Makaira nigricans*), shortbill spearfish (*Tetrapterus angustirostris*), sailfish (*Istiophorus platypterus*), and black marlin (*Istiompax indica*). The first two species predominate in the commercial landings (tonnage).

1. FISHERIES AND CATCHES

U.S. commercial fisheries for marlins in the North Pacific Ocean can be categorized according to three distinct gear types: longline, troll, and handline. The largest is the longline fishery, which for the purposes of this report refers solely to the Hawaii-based longline fishery (Table 1). This fishery takes marlins as incidental catch on sets targeting tuna or swordfish. Troll fisheries in Hawaii, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI) constitute the second largest catches of marlins. These fisheries opportunistically target marlins on a seasonal basis. The Hawaii handline fishery represents the third category, with small incidental catches of marlin.

Estimates from federal longline logbook data and State of Hawaii Division of Aquatic Resources (HDAR) fish catch and marine dealer data suggest that blue marlin landings from both longline and troll fisheries (Fig. 1) were typically the largest component of the marlin landings (Table 2), followed by striped marlin, landed primarily by the longline fishery (Fig. 2), and shortbill spearfish ranking third. However, a 1995–2003 study investigating misidentification of marlins showed that during the study period striped marlin was usually the largest component of the longline landings in both numbers and weight followed by blue marlin and shortbill spearfish (Walsh et al. 2007).

Hawaii-based Longline Fishery

The longline gear consists of a single monofilament mainline about 30 to 80 km in length with floats attached to the mainline to support the gear in the water column. Branchlines with baited hooks are attached to the mainline between the floats. Gear configurations and operational techniques differ according to target species (i.e., tunas, *Thunnus* spp., and swordfish, *Xiphias gladius*). Vessels targeting tunas usually set the longline gear in the morning and haul in the afternoon, use saury or sardine for bait, set 25 or more hooks between floats, and employ a line thrower. The latter creates slack in the mainline and causes the gear to sag between floats as it sinks and results in a "deep-set". In contrast, vessels targeting swordfish typically set gear after dusk and haul the following morning, use mackerel or mackerel-like bait, attach chemical lightsticks to the branchlines, and typically set 4-5 hooks between floats. Because swordfish gear is set relatively shallow, a line thrower is not needed. This technique is referred to as "shallow-set" longline fishing. The deep-set longline sector accounts for majority of the effort and marlin landings for this fishery.

The Hawaii-based longline fishery has operated under a limited entry program since 1994. This program capped participation at 164 vessels although the number of active vessels has never reached this limit. Vessel participation ranged from 37 to 141 vessels since 1987, with 128 vessels active in 2011 (tuna and swordfish sectors combined).

Two other important characteristics of this fishery are its geographic range and total annual hook deployment. The Hawaii-based longline fishery ranged from the equator to 40^{o} N latitude and from 125^{o} W to 175^{o} longitude in 2011. The total range exploited since 1991 extends from 5^{o} S to 50^{o} N latitude and from 130^{o} W to 175^{o} E longitude. Effort by the Hawaii-based longline was a record 41.7 million hooks set in 2011. The deep-set sector of the longline fishery accounted for 96% of the total number of hooks set.

Based on logbook data, longline landings of striped marlin rose rapidly from 1987, peaked in 1991, decreased slowly to a low of 152 t in 2010 and increased to 294 t in 2011, up 93% from the previous year. Blue marlin landings increased from 1987, reached a peak in 1995, then exhibited a slow decline through 2000 and varied considerably in subsequent years. The preliminary estimate of blue marlin landings was 329 t in 2011, an increase of 16% from 2010.

Plots of the geographic distributions in 2011 show that the highest catches (in number of fish) for striped marlin were between 10^{o}N to 30^{o} N latitude and 155^{o} W to 170^{o} W longitude (Fig. 3). The highest blue marlin catches occurred southwest of the main Hawaiian Islands between 10^{o}N to 20^{o} N latitude and 160^{o} W to 170^{o} W longitude (Fig. 4).

There was seasonality in marlin catches. Striped marlin catches were typically highest in the first and fourth quarters of the year while blue marlin catches were usually highest in the second quarter of the year.

Nominal catch per unit effort (CPUE: number of fish per 1000 hooks) for the two marlin species exhibited declines from the early 1990s. Striped marlin CPUE on tuna targeted trips peaked at 2.2 in 1992 and exhibited a significant decline to 2000, remained low through 2006. CPUE continued to decrease further to a record low of 0.10 in 2010 but increased to 0.40 in 2011 (Fig. 5). Blue marlin CPUE exhibited a peak of 0.68 in 1991, decreased sharply in 1992, declined slowly to a record low 0.08 in 2007, and remained low at 0.11 in 2011.

The weight-frequency histogram for striped marlin caught by the Hawaii-based longline fishery, derived from records of commercial fish landings (see data sources below), showed a unimodal distribution with a strong peak at the 11-15 kg increment in 2011 (Fig. 6A). The mean weight for striped marlin was 21.7 kg. The blue marlin weight-frequency distribution was unimodal with a peak at the 61-70 kg increment in 2011 (Fig. 6B). The mean weight for blue marlin was 84.4 kg.

Hawaii, Guam, and CNMI Troll Fisheries

The troll fisheries in Hawaii, Guam, and CNMI are hook and line fisheries that use relatively small boats. The gear consists of rods and reels and artificial lures. Lures are typically made of resin or chrome metal heads dressed with colored rubber skirts. Live bait bridled to hooks is also used to catch marlins and other pelagic fishes. This fishery targets tunas, marlins and other pelagic species such as mahimahi (*Coryphaena spp.)* and wahoo *(Acanthocybium solandri*).

The number of troll fishers peaked at 2,367 in 1999, declined to a minimum of 1,837 fishermen in 2005, and was 2,078 in 2011. The duration of a typical troll trip is one day. Since this fishery employs small vessels, most trips remain within 50 miles from shore, well inside the 200 mile U.S. EEZ.

Blue marlin landings comprised 84% of the troll marlin landings. Blue marlin landings peaked at 434 t in 1996, declined to a record low 128 t in 2007, and were 193 t in 2011 (Table 4). Striped marlin made up 10% of the landings at 16 t in 2011.

Marlin CPUE for the Hawaii troll fishery was measured as kilograms of fish per day. Blue marlin CPUE was higher than striped marlin CPUE in the Hawaii troll fishery. Hawaii troll CPUE for blue marlin and striped marlin exhibited similar declining trends as in the Hawaii-based longline fishery (Figs. 5 and 7)

Hawaii Handline Fishery

The Hawaii handline fishery, which targets tunas, includes day and night components known as the “palu ahi” and “ika shibi” fisheries, respectively. The daytime handline fishery employs “palu” (chum in Hawaiian) to evoke a feeding frenzy in an aggregation of juvenile “ahi” (tuna in Hawaiian) and hook the catch with a handline. The nighttime handline fishery has two sets of gear, one used to catch the “ika” (squid in Japanese) for bait and the other for catching large “shibi” (tuna in Japanese).

There were 505 handline fishers in 2011. The duration of a handline trip is typically one day for the daytime handline fishery and one night for the nighttime handline fishery. As with the troll fisheries, most handline trips remain within 50 miles from shore inside the EEZ although some handline fishers operate offshore by seamounts and weather buoys and make trips longer than one day.

The handline fishery landed small amounts of striped and blue marlin. The highest striped marlin landings were 2 t in 2001 (Table 5). The highest blue marlin landings were 9 t in 1997.

The weight-frequency histogram for troll and handline caught striped marlin showed a unimodal distribution (Figure 8A). The mean weight for striped marlin was 21.7 kg in 2011. The blue marlin weight-frequency distribution was also unimodal with a mean weight of 100.5 kg in 2011 (Figure 8B).

2. DATA SOURCES

Category I: Annual Catch Data

Category I statistics refer to the total catch of fish (in weight and/or number of fish), defined as the quantity of fish removed from the population, whether or not the fish are retained by the vessel. However, in this report, “catch” estimates refer only to the quantity of fish kept and landed; the portion of the catch that is discarded or released after capture is not included because standards for calculating and reporting these quantities have not yet been developed. Category I data for the longline, troll, and handline fisheries are collected by Federal (NOAA Fisheries Service), State (Hawaii), and Pacific Island (Guam and CNMI) agencies and used by staff of the NOAA Pacific Islands Fisheries Science Center (PIFSC) to compute annual Category I catch statistics. Various sources of data are used depending on the geographic area and gear of interest (Table 6). As noted, the coverage of the data (percent of catch reported) and time period of data collection vary among data sources.

In some instances, data sets are combined to estimate annual landings. For example, estimates of landings by the Hawaii-based longline fishery involve Federal logbook data, market sample data, and State of Hawaii Division of Aquatic Resources (HDAR) commercial marine dealer data. The numbers of fish kept, as recorded in longline logbooks, are multiplied by the mean weights of landed fish, estimated from the PIFSC market sample data or the HDAR dealer data.

For troll and handline fisheries in Hawaii, landings in weight are estimated from HDAR fish catch and marine dealer data. For troll fisheries in Guam and CNMI, landings in weight are derived from expanded creel survey data.

Estimated landings are reported here in terms of whole weight. When necessary, raising factors were applied to the recorded weight of processed catch to estimate whole weight of the fish (Table 7). Likewise, when the coverage of sample data was incomplete, it was extrapolated to represent full coverage to estimate total landings.

Species Identifications

A longstanding problem in monitoring the Hawaii-based longline fishery at the NOAA PIFSC has been the accuracy of species identifications for the istiophorid billfishes. This problem has primarily affected logbook data, but some fishery observers, particularly newly-hired individuals, have also erred in species identifications. A long-term project to correct these problems has been completed. Its principal output consisted of one paper emphasizing blue marlin that was published in a peer-reviewed scientific journal that dealt with the five istiophorid species (Walsh et al. 2005). A subsequent document showed the overall marlin counts in the Hawaii-based longline logbook data were reasonably accurate but blue marlin was overlogged by 18% while striped marlin was underlogged 11% during the study period (Walsh, W.A. et al. 2007)(Figure 9). This pdf document can be obtained from the PIFSC website at:

http://www.pifsc.noaa.gov/tech/NOAA_Tech_Memo_PIFSC_13.pdf

Category II: Spatial Catch and Effort Data

Area fished, catch and effort are the required data elements for Category II data reporting. The Hawaii-based longline, Hawaii troll, and Hawaii handline fisheries were the only fisheries with Category II data. Logbook, observer, and fish catch reports contained the necessary data elements to generate catch and effort by area summaries. The largest Category II data set is the Hawaii-based longline logbook data.

Category III: Biological (size composition) Data

Biological measurements were obtained for the Hawaii longline, troll, and handline fisheries. Raising factors were applied to samples if the fish was processed to yield an estimated whole weight. Weight-frequency distributions for striped marlin and blue marlin were produced from HDAR Commercial marine dealer data.

3. REFERENCES

Walsh, W. A., R. Y. Ito, K. E. Kawamoto, and M. McCracken,
2005. Analysis of logbook accuracy for blue marlin (*Makaira nigricans*) in the Hawaii-based longline fishery with a generalized additive model and commercial sales data. *Fisheries Research* 75:175–192

Walsh, W. A., K. A. Bigelow and R. Y. Ito
2007. Corrected Catch Histories and Logbook Accuracy for Billfishes (Istiophoridae) in the Hawaii-based Longline Fishery. NOAA Technical Memorandum NMFS-PIFSC-13, 33 p.

Table 1.--U.S. commercial marlin landings estimates* (metric tons) from the North Pacific Ocean by gear type, 1987-2011.

Year	Longline	Troll	Handline	Total
1987	368	324	9	701
1988	675	362	7	1,044
1989	1,100	404	6	1,510
1990	973	373	6	1,352
1991	1,029	444	6	1,479
1992	947	351	5	1,303
1993	910	422	6	1,338
1994	787	385	4	1,176
1995	1,295	424	5	1,724
1996	1,000	504	8	1,512
1997	983	467	10	1,460
1998	945	305	3	1,253
1999	963	387	6	1,356
2000	666	269	3	938
2001	886	368	4	1,258
2002	650	269	3	922
2003	1,155	255	2	1,412
2004	859	243	4	1,106
2005	1,064	220	2	1,286
2006	1,194	193	2	1,389
2007	696	153	1	850
2008	1,013	208	1	1,222
2009	737	198	1	936
2010	555	179	2	736
2011	837	223	2	1,062

* Based on estimated whole weight and does not include discards.

Table 2.--U.S. commercial marlin landings estimates* (metric tons) by species from the North Pacific Ocean, 1987-2011.

Year	Striped marlin	Blue marlin	Shortbill spearfish	Other marlins	Total
1987	303	334	43	21	701
1988	559	398	65	22	1,044
1989	636	721	128	25	1,510
1990	565	715	50	22	1,352
1991	703	684	60	32	1,479
1992	498	648	46	111	1,303
1993	540	678	54	66	1,338
1994	360	696	59	61	1,176
1995	595	921	139	69	1,724
1996	474	908	89	41	1,512
1997	391	909	100	60	1,460
1998	404	659	134	56	1,253
1999	393	689	214	60	1,356
2000	215	549	123	51	938
2001	395	693	120	50	1,258
2002	256	495	136	35	922
2003	567	569	241	35	1,412
2004	411	471	186	38	1,106
2005	531	524	207	24	1,286
2006	632	569	161	27	1,389
2007	289	390	147	24	850
2008	440	529	226	27	1,222
2009	269	538	111	18	936
2010	171	433	109	23	736
2011	310	524	200	28	1,062

* Based on estimated whole weight and does not include discards.

Table 3.— Hawaii-based longline fishery marlin landings estimates* (metric tons) from the North Pacific Ocean, 1987-2011.

Year	Striped marlin	Blue marlin	Shortbill spearfish	Other marlins	Total
1987	272	51	43	2	368
1988	504	102	65	4	675
1989	612	356	128	4	1,100
1990	538	378	50	7	973
1991	663	297	60	9	1,029
1992	459	347	46	95	947
1993	471	339	54	46	910
1994	326	362	59	40	787
1995	543	570	139	43	1,295
1996	419	467	89	25	1,000
1997	352	487	100	44	983
1998	378	395	134	38	945
1999	364	357	214	28	963
2000	200	314	123	29	666
2001	351	399	120	16	886
2002	226	264	136	24	650
2003	538	359	241	17	1,155
2004	376	283	186	14	859
2005	511	337	207	9	1,064
2006	611	409	161	13	1,194
2007	276	261	147	12	696
2008	426	348	226	13	1,013
2009	259	357	111	10	737
2010	152	283	109	11	555
2011	294	329	200	14	837

* Based on catch in number of fish (from logbooks) and estimated whole weight. Does not include discards.

Table 4.— U.S. troll fishery marlin landings estimates* (metric tons) from the North Pacific Ocean, 1987-2011.

Year	Striped marlin	Blue marlin	Shortbill spearfish	Other marlins	Total
1987	30	275	0	19	324
1988	54	290	0	18	362
1989	24	359	0	21	404
1990	27	331	0	15	373
1991	40	381	0	23	444
1992	38	297	0	16	351
1993	68	334	0	20	422
1994	34	330	0	21	385
1995	52	346	0	26	424
1996	54	434	0	16	504
1997	38	413	0	16	467
1998	26	261	0	18	305
1999	28	327	0	32	387
2000	14	233	0	22	269
2001	42	292	0	34	368
2002	30	228	0	11	269
2003	29	208	0	18	255
2004	34	186	0	23	243
2005	20	185	0	15	220
2006	21	158	0	14	193
2007	13	128	0	12	153
2008	14	180	0	14	208
2009	10	180	0	8	198
2010	19	148	0	12	179
2011	16	193	0	14	223

* Based on estimated whole weight and does not include discards.

Table 5.— U.S. handline fishery marlin landings estimates* (metric tons) from the North Pacific Ocean, 1987-2011.

Year	Striped marlin	Blue marlin	Shortbill spearfish	Other marlins	Total catch
1987	1	8	0	0	9
1988	1	6	0	0	7
1989	0	6	0	0	6
1990	0	6	0	0	6
1991	0	6	0	0	6
1992	1	4	0	0	5
1993	1	5	0	0	6
1994	0	4	0	0	4
1995	0	5	0	0	5
1996	1	7	0	0	8
1997	1	9	0	0	10
1998	0	3	0	0	3
1999	1	5	0	0	6
2000	1	2	0	0	3
2001	2	2	0	0	4
2002	0	3	0	0	3
2003	0	2	0	0	2
2004	1	2	0	1	4
2005	0	2	0	0	2
2006	0	2	0	0	2
2007	0	1	0	0	1
2008	0	1	0	0	1
2009	0	1	0	0	1
2010	0	2	0	0	2
2011	0	2	0	0	2

* Based on estimated whole weight and does not include discards.

Table 6.—Data sources and rates of coverage for the longline, troll, and handline fisheries by category.

	Hawaii-based longline	Hawaii troll	Guam troll	CNMI troll	Hawaii handline
Category I: Annual catch data					
Market sample	~33-90%	+++	---	---	+++
Fish dealer	~50-100%	+++	---	+++	+++
Logbook	~100%	---	---	---	---
Fish catch report	---	+++	---	---	+++
Creel survey	---	---	+++	---	---
Observer	NA	NA	NA	NA	NA
Category II: Spatial catch and effort data					
Market sample	NA	NA	NA	NA	NA
Fish dealer	NA	NA	NA	NA	NA
Logbook	~100%	---	---	---	---
Fish catch report	---	+++	---	---	+++
Creel survey	NA	NA	NA	NA	NA
Observer					
Category III: Biological (size composition) data					
Market sample	~33-90%	+++	---	---	+++
Fish dealer	~50-100%	+++	---	+++	+++
Logbook	NA	NA	NA	NA	NA
Fish catch report	NA	NA	NA	NA	NA
Creel survey	---	---	+++	---	---
Observer	3-25%	---	---	---	---

*NA - not applicable, +++ - available but coverage unknown, --- - not collected

Table 7.—Conversion factors for processed fish.

Species	Condition of fish	Raising factor
Blue marlin	Shark bitten	1.11
	Gutted	1.15
	Gilled & gutted	1.25
	No head	1.28
	No head & guts	1.47
	No head, guts & tail	1.54
Striped marlin	Shark bitten	1.11
	Gutted	1.15
	Gilled & gutted	1.23
	No head	1.25
	No head & guts	1.37
	No head, guts & tail	1.41

Figure 1.—Estimated landings of blue marlin by U.S. commercial fisheries in the North Pacific Ocean, 1987-2011. Source: federal longline logbook data; HDAR fish catch and marine dealer data; CNMI and Guam creel survey data.

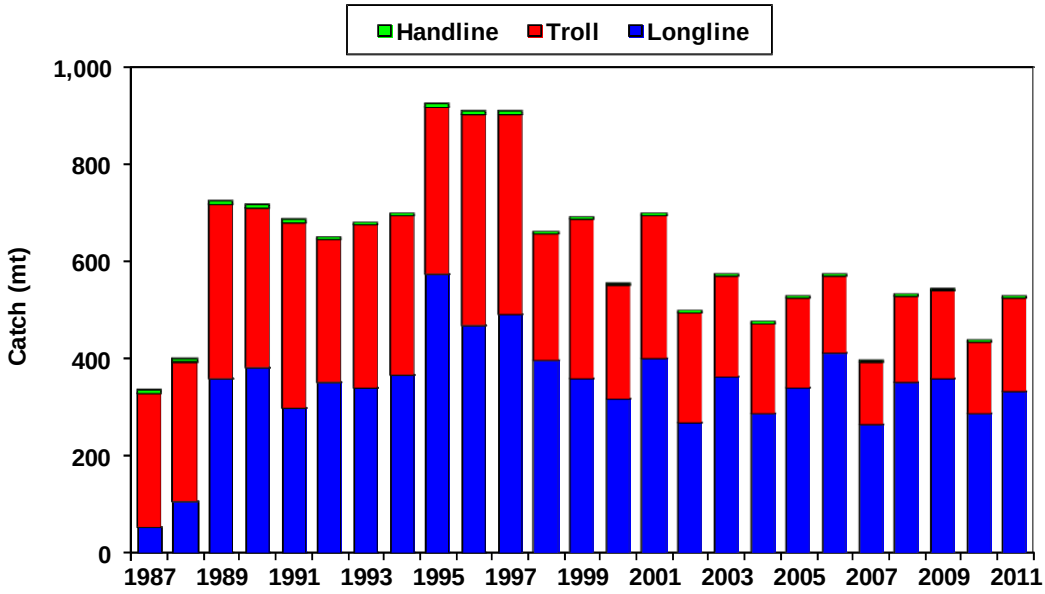


Figure 2.–Estimated landings of striped marlin by U.S. commercial fisheries in the North Pacific Ocean, 1987-2011. Source: federal longline logbook data; HDAR fish catch and marine dealer data; CNMI and Guam creel survey data.

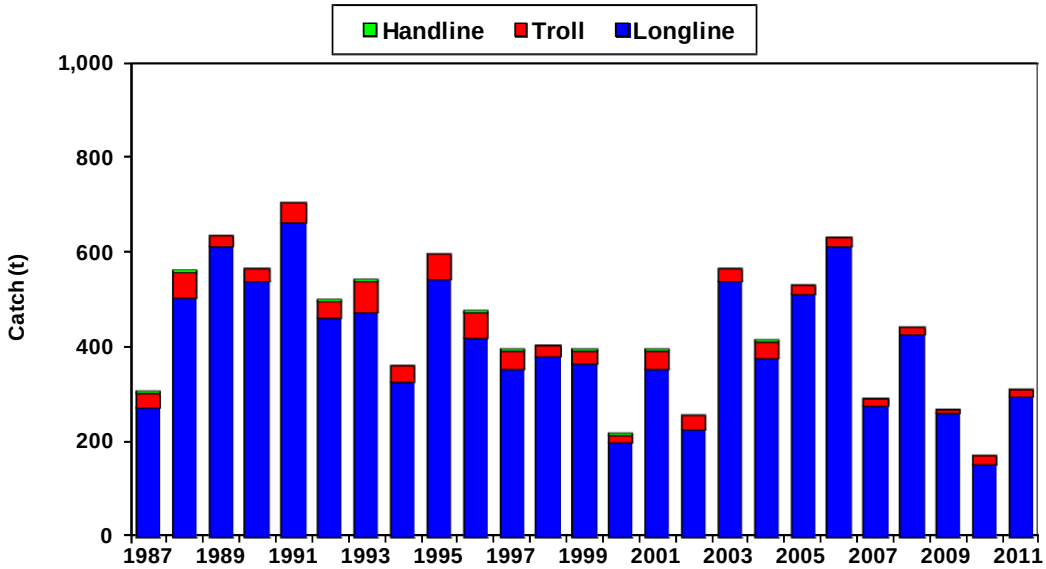


Figure 3.—Hawaii-based longline striped marlin catch (numbers of fish) by area, 2011. Source: federal longline logbook data.

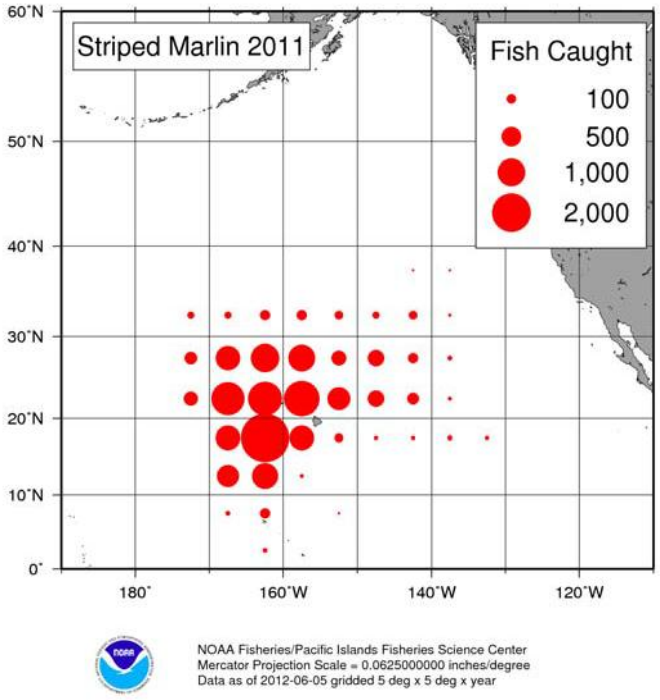


Figure 4.—Hawaii-based longline blue marlin catch (numbers of fish) by area, 2011. Source: federal longline logbook data.

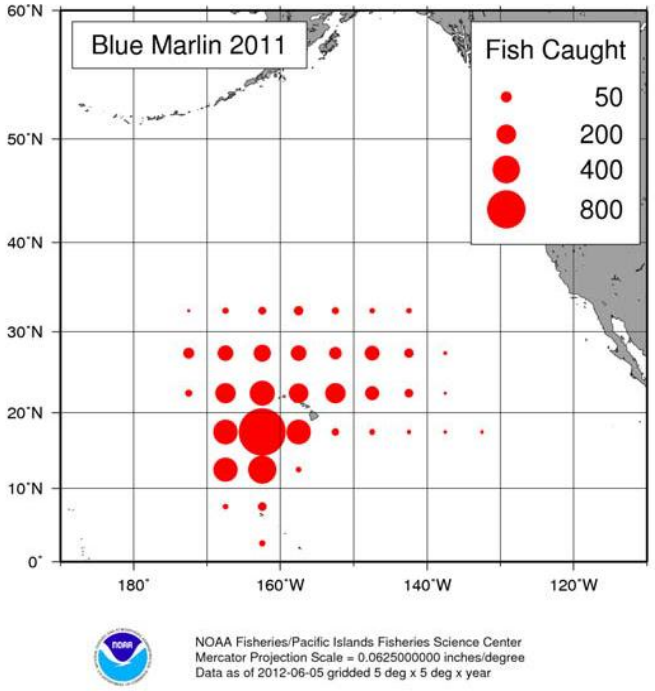


Figure 5.—Hawaii-based longline striped marlin and blue marlin CPUE on tuna-targeted deep sets, 1991-2011. Source: federal longline logbook data.

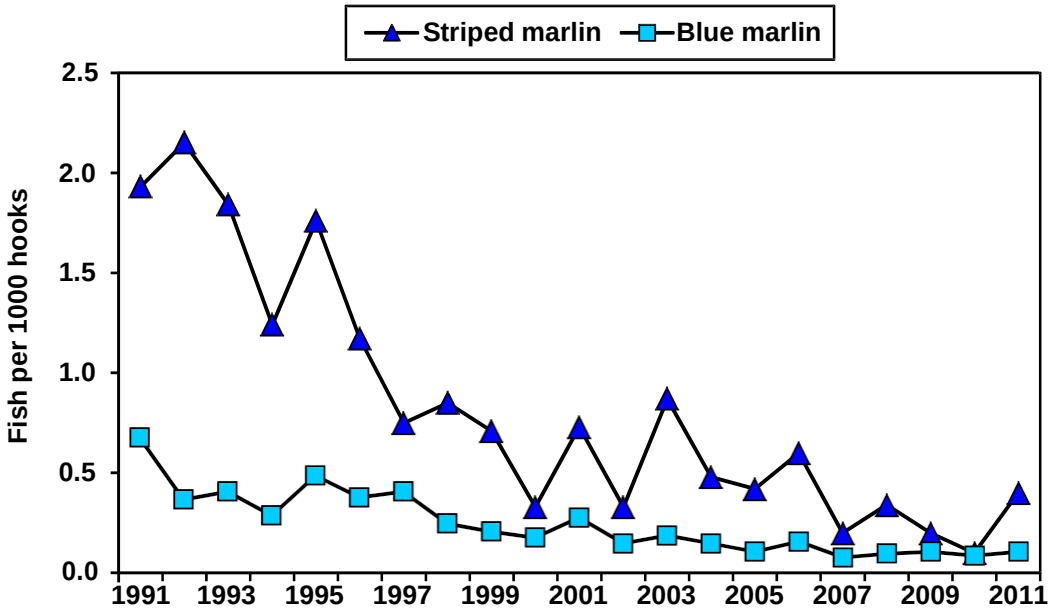
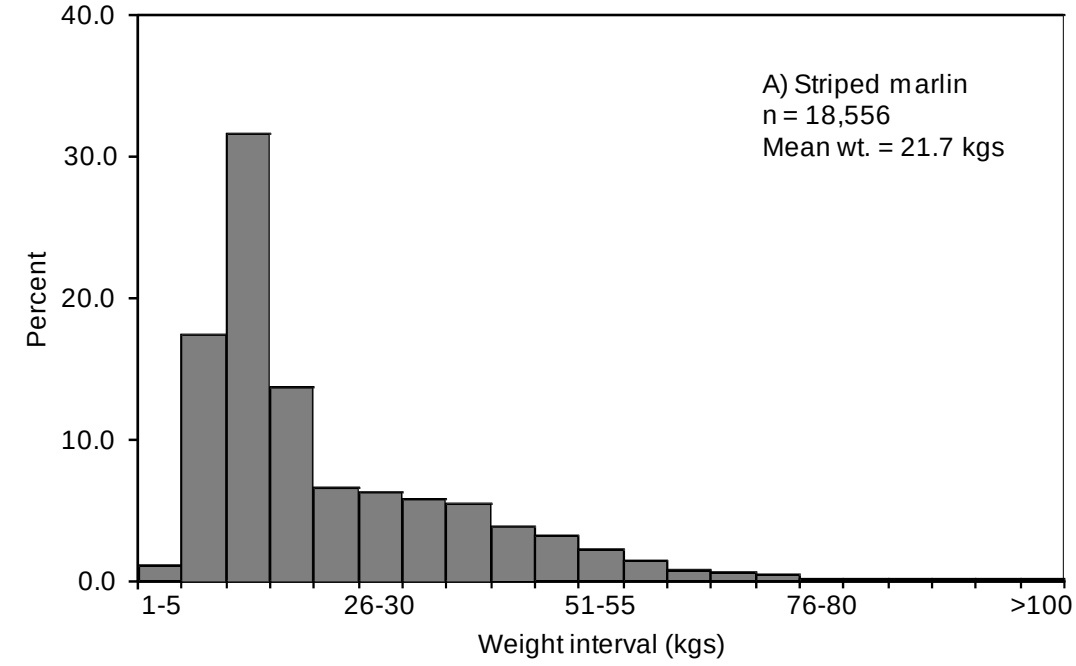


Figure 6.--Hawaii longline A) striped marlin and B) blue marlin weight-frequency, 2011.
Source: HDAR commercial marine dealer data.



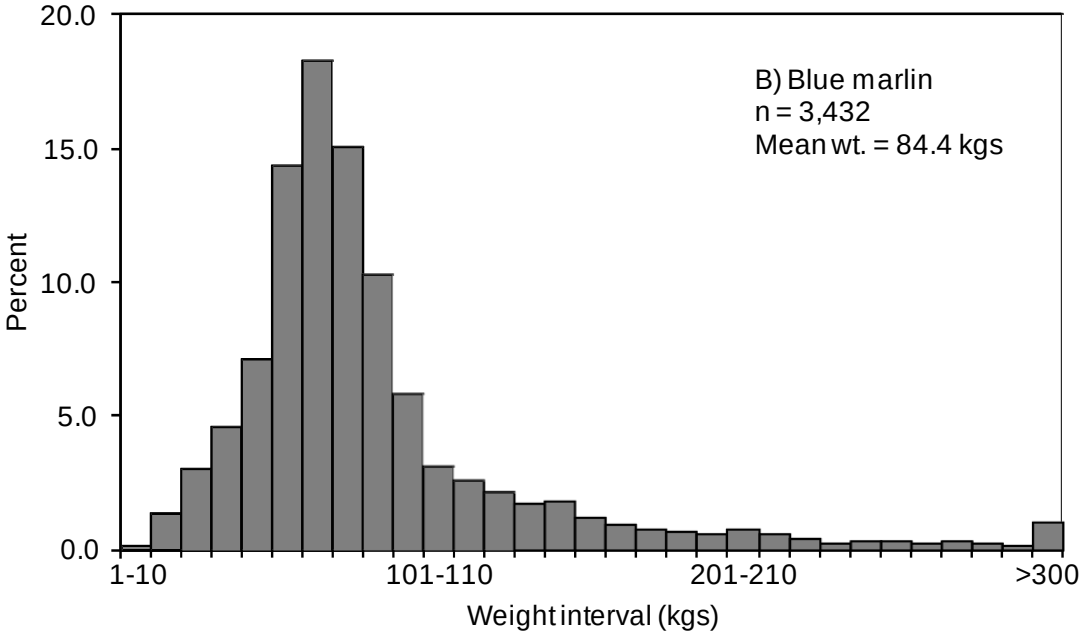


Figure 7.—Hawaii troll striped marlin and blue marlin CPUE, 1991-2011. Source: HDAR commercial fish catch data.

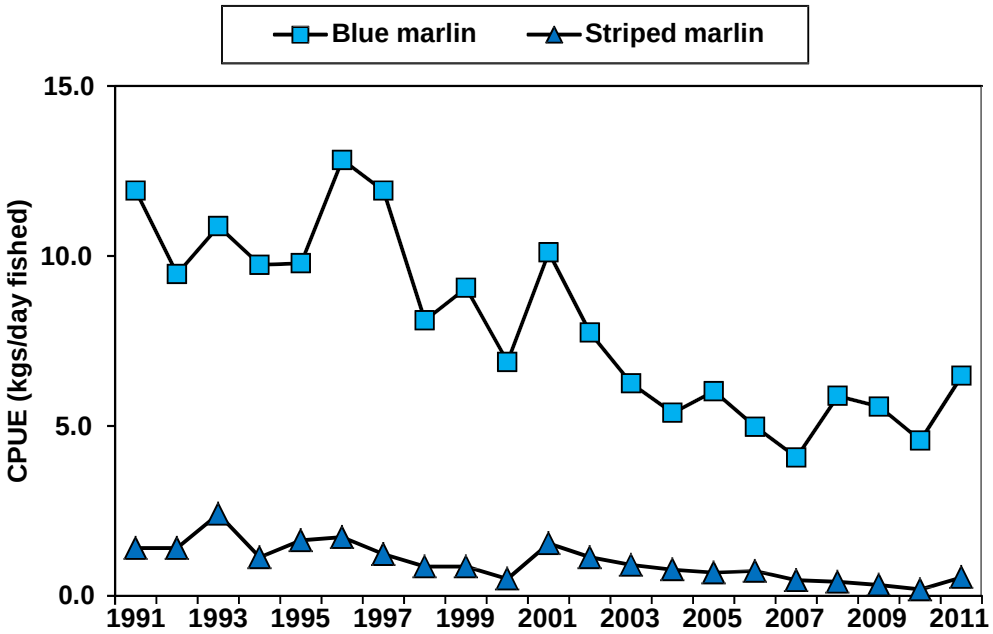
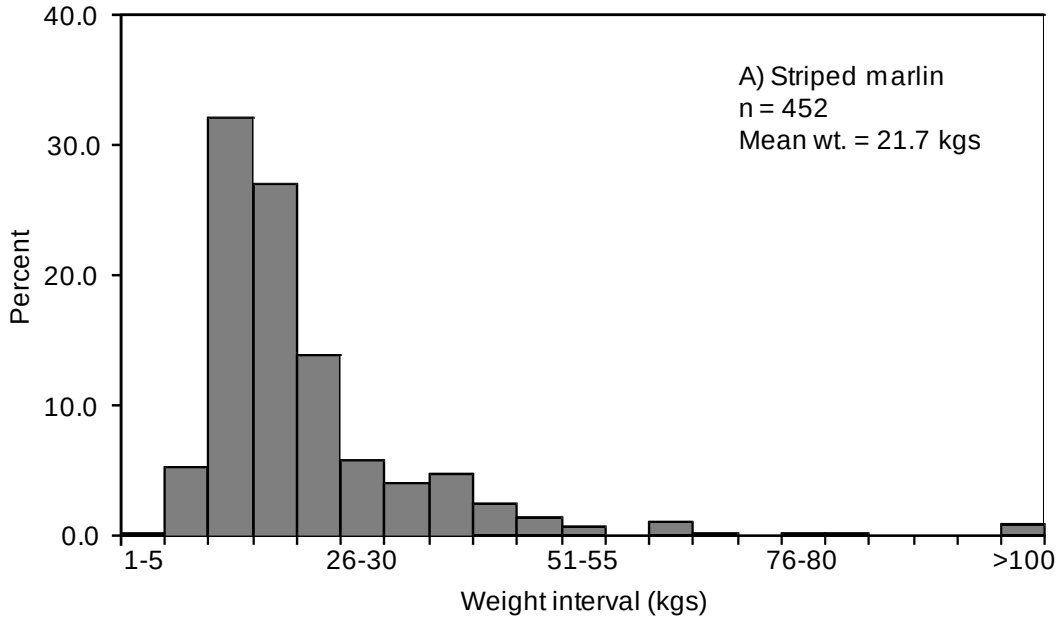


Figure 8.—Hawaii troll and handline A) striped marlin and B) blue marlin weight-frequency, 2011. Note the different horizontal scales.



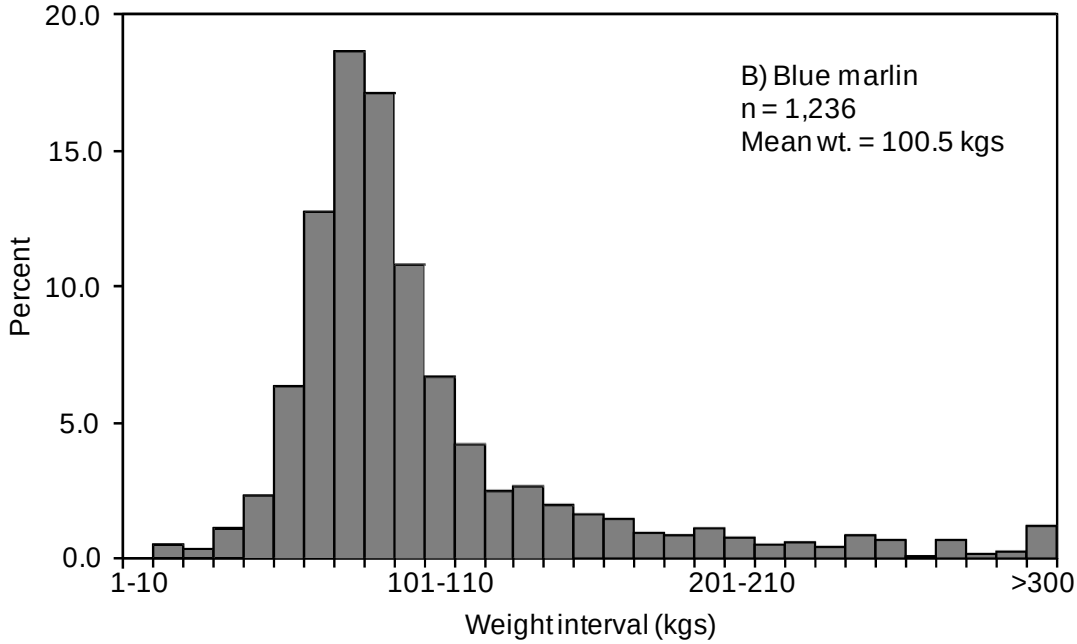
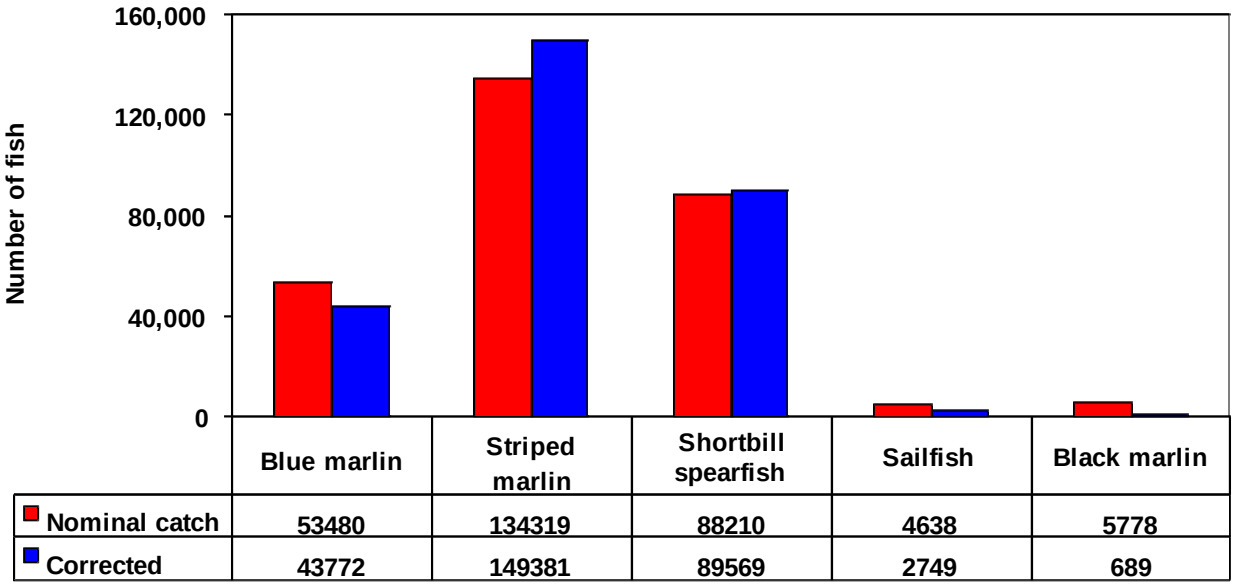


Figure 9. Nominal and corrected marlin catches for the Hawaii-based longline fishery, 1995-2003. Source: Walsh et al. 2007, Table B1.



	Blue marlin	Striped marlin	Shortbill spearfish	Sailfish	Black marlin
Nominal catch	53480	134319	88210	4638	5778
Corrected	43772	149381	89569	2749	689