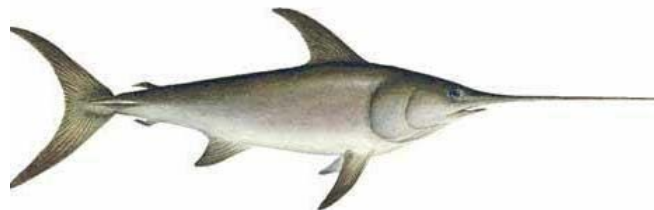
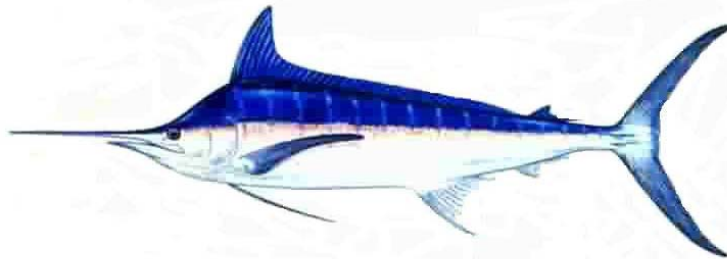




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Russell Ito
NOAA NMFS PIFSC
2570 Dole St., Honolulu, Hawaii, USA, 96822

William Walsh
Joint Institute for Marine and Atmospheric Research
University of Hawaii
2570 Dole St., Honolulu, Hawaii, USA, 96822



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Russell Y. Ito
Pacific Islands Fisheries Science Center
National Marine Fisheries Service, NOAA
Honolulu, Hawaii 96822 U.S.A.

William A. Walsh
University of Hawaii
Joint Institute for Marine and Atmospheric Research
Pelagic Fisheries Research Program
Honolulu, Hawaii 96822 U.S.A.

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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 the U.S. fisheries in the North Pacific Ocean. These are striped marlin (*Kajikia audax*), blue marlin (*Makaira nigricans*), shortbill spearfish (*Tetrapturus 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. 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 category for marlins. These fisheries opportunistically target marlins on a seasonal basis. The Hawaii handline fishery represents the third category, with small incidental catches of marlin.

Longline logbook data suggest that blue marlin landings taken by both longline and troll fisheries (Fig. 1), was typically the largest component of the marlin landings

(Table 2) followed by striped marlin, landed primarily by the longline fishery (Fig. 2) and landings of shortbill spearfish ranking third. However, a study investigating misidentification of marlins show striped marlin was usually the largest component of the longline landings in numerical terms 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. Floats attached to the mainline 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 15-30 (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 in the evening and haul the following morning, use mackerel or mackerel-like bait, attach chemical lightsticks to the branchlines, and set only 2-5 hooks between floats. Because swordfish gear is set relatively shallow, a line thrower is not needed. Most of the Hawaii-based longline fleet targeted tunas from 1987 to 1990 then switched to targeting swordfish in the 1990s. The longline fishery switched back to targeting tunas in 2000 due to restrictions on the shallow set segment of the longline 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 127 vessels active in 2009.

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° N latitude and from 130° to 175° W longitude in 2009. The total range exploited since 1991 extends from 5°S to 50° N latitude and from 130° W to 175° E longitude. Effort by the Hawaii-based longline fishery has been on an increasing trend from 1994 with 39.2 million hooks set in 2009. Most of the hooks were deployed on the high seas (65%), the Main Hawaiian Islands (MHI) Exclusive Economic Zone (EEZ) (24%) and in the Northwestern Hawaiian Islands (9%).

Longline landings of striped marlin rose rapidly from 1987, peaked in 1991, decreased slowly to a record low in 2000, and varied substantially thereafter (Table 3). The preliminary estimate for striped marlin landings in 2009 was 259 t, down 39% from 2008. Blue marlin landings grew from 1987, reached a peak in 1995, then exhibited a slow decline subsequently with the preliminary estimate of landings at 362 t in 2009, up 4% from the previous year.

Plots of the geographic distributions in 2009 show that the highest catches (in number of fish) for striped marlin were between 10°N to 30° N latitude and 150° W to 170° W longitude (Fig. 3). The highest blue marlin catches occurred southwest of the main Hawaiian Islands between 10°N to 20° N latitude and 155° W to 170° W longitude (Fig. 4). There was seasonality in marlin catches. Striped marlin catches were typically highest in the first and fourth quarters while blue marlin catches were usually highest in the second and third quarters.

Nominal catch per unit effort (CPUE) was measured as number of fish per 1000 hooks. The CPUE for the two marlin species exhibited declines over time. Striped marlin CPUE on tuna targeted trips peaked at 2.2 in 1992 and trended downward to 2000, then remained low with CPUE at a record low 0.20 in 2007 and 2009 (Fig. 5). Blue marlin CPUE exhibited an apparent peak of 0.68 in 1991 (see Species Identifications, below), dropped off sharply in 1992, declined slowly subsequently to a record low 0.08 in 2007, and remained low at 0.11 in 2009 (Fig. 6).

There are no agreed upon reference points by the Regional Fishery Management Organizations with respect to overfishing or overfished for striped and blue marlin but the International Scientific Committee Billfish Working Group has evidence that the striped marlin stock is depleted or rapidly approaching depleted and the stock has been experiencing excessive fishing mortality .

The weight frequency histogram for longline caught striped marlin showed a bimodal distribution. The mean weight for striped marlin was 31.0 kg in 2009 (Fig. 7A). The blue marlin weight frequency distribution was unimodal with a mean weight 84.0 kg in 2009 (Fig. 7B).

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 that 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.

The number of troll fishers peaked at 2,367 in 1999, declined to a minimum of 1,837 fishermen in 2005, and was 2,079 in 2009. The duration of a troll trip is one day. Since this fishery employs small vessels, most trips remain within 50 miles from shore, inside the 200 mile EEZ.

Blue marlin landings usually made up more than 80% of the troll marlin landings. Blue marlin landings peaked at 434 t in 1996, declined to a record low 128 t in 2007, and increased to 179 t in 2009 (Table 4). Striped marlin made up 6% of the landings at 11 t in 2009.

Hawaii Handline Fishery

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

The number of handline fishers peaked at 693 in 1987, declined to a low of 375 fishermen in 2006, and increased to 550 in 2009. The duration of a handline trip is typically one day for the day handline fishery and one night for the night 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 higher peaking at 9 t in 1997.

The weight frequency histogram for troll and handline caught striped marlin showed a bimodal distribution (Figure 8A). The mean weight for striped marlin was 41.7 kg in 2009. The blue marlin weight frequency distribution was unimodal with a mean weight 104.4 kg in 2009 (Figure 8B).

2. DATA SOURCES

Category I: Annual Catch Data

Category I data for the longline, troll, and handline fisheries are collected by federal (NOAA Fisheries), state (Hawaii), and Pacific Island (Guam and CNMI) agencies. Federal logbook, market sample, and State of Hawaii Division of Aquatic Resources (DAR) commercial fish catch and commercial marine dealer data were used to estimate annual catches (Table 6).

In some instances, data sets were combined to estimate annual catches. For example, estimates for the Hawaii-based longline fishery used number of fish from logbooks and mean fish weights from the market sample and commercial marine dealer data to calculate the weight of longline landings. Catch summaries and estimates do not include discards. The coverage and duration for each of the data sets vary. Raising factors were applied to the weight of processed catch to increase nominal weight to an

estimated whole weight. Data were extrapolated when necessary to represent full coverage and complete landing estimates. Category I data summaries are accessible on the internet at <http://www.pifsc.noaa.gov/fmsd/>

Species Identifications

NOAA Fisheries PIFSC is devoted to improving the accuracy of longline logbook data. A longstanding problem in monitoring the Hawaii-based longline fishery 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 (“Analysis of logbook accuracy for blue marlin (*Makaira nigricans*) in the Hawaii-based longline fishery with a generalized additive model and commercial sales data” by W.A. Walsh, R.Y. Ito, K.E. Kawamoto, and M. McCracken, 2005, *Fisheries Research* 75:175–192) and a technical memorandum that dealt with the five istiophorid species (“Corrected Catch Histories and Logbook Accuracy for Billfishes (Istiophoridae) in the Hawaii-based Longline Fishery” by William A. Walsh, Keith A. Bigelow and Russell Y. Ito, 2007). This TM 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 (Figure 9). Either or both can be obtained as a ‘pdf’ upon request from the PIFSC.

Category II: Spatial Catch and Effort Data

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

Category III: Biological (size composition) Data

Biological measurements were obtained for the Hawaii longline, troll, and handline fisheries. Weight frequency distributions for striped marlin and blue marlin were produced from DAR Commercial marine dealer data.

Table 1.--U.S. commercial marlin landings* (metric tons) from the North Pacific Ocean by gear type, 1987-2009.

| 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 | 698 | 153 | 1 | 852 |
| 2008 | 1,013 | 208 | 1 | 1,222 |
| 2009 | 745 | 339 | 0 | 1,084 |

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

Table 2.--U.S. commercial marlin landings* (metric tons) by species from the North Pacific Ocean, 1987-2009.

| Year | Striped marlin | Blue marlin | 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 | 391 | 148 | 24 | 852 |
| 2008 | 440 | 529 | 226 | 27 | 1,222 |
| 2009 | 293 | 648 | 113 | 31 | 1,084 |

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

Table 3.—The Hawaii-based longline fishery marlin landings* (metric tons) from the North Pacific Ocean, 1987-2009.

| 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 | 262 | 148 | 12 | 698 |
| 2008 | 426 | 348 | 226 | 13 | 1,013 |
| 2009 | 259 | 362 | 113 | 11 | 745 |

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

Table 4.—The U.S. troll fishery marlin landings* (metric tons) from the North Pacific Ocean, 1987-2009.

| 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 | 11 | 179 | 0 | 9 | 199 |

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

Table 5.—The U.S. handline fishery marlin landings* (metric tons) from the North Pacific Ocean, 1987-2009.

| 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 |

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

Table 6.—Data sources 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

Figure 1.—Landings of blue marlin by U.S. fisheries in the North Pacific Ocean, 1987-2009.

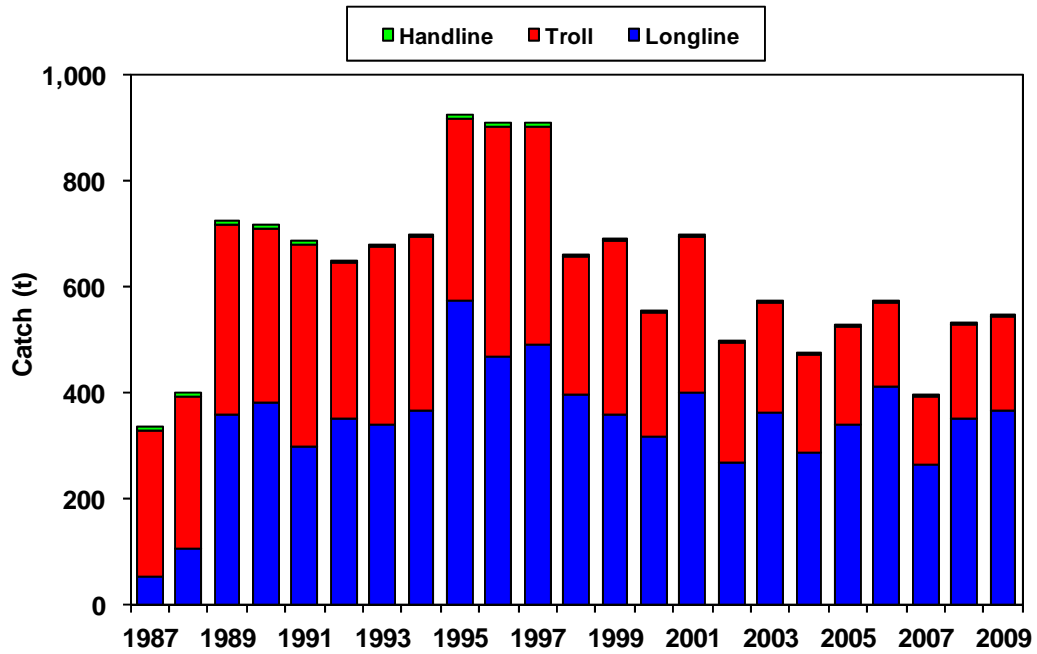


Figure 2.—Landings of striped marlin by U.S. fisheries in the North Pacific Ocean, 1987-2009.

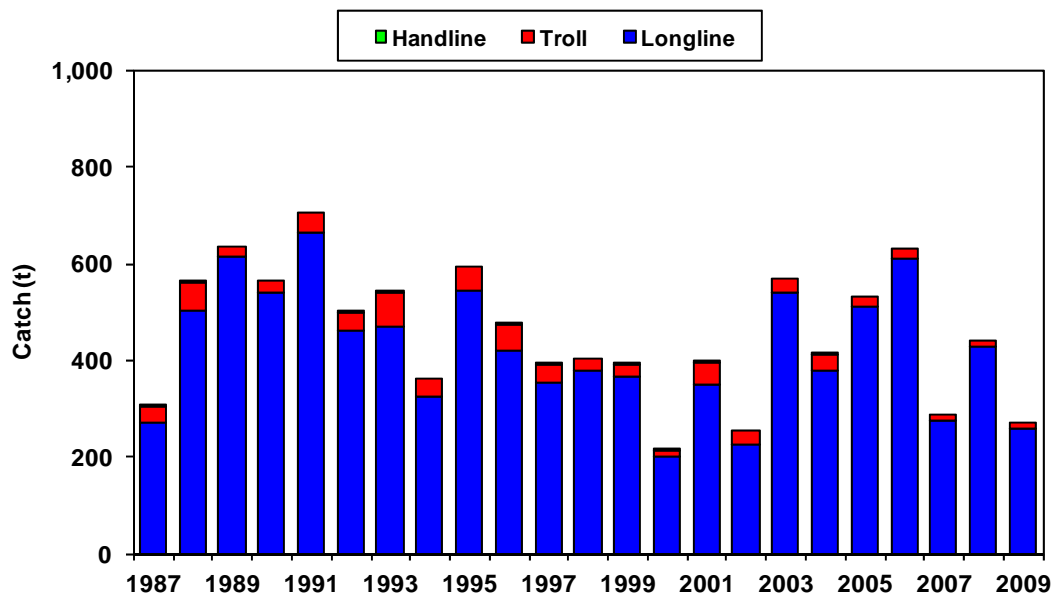
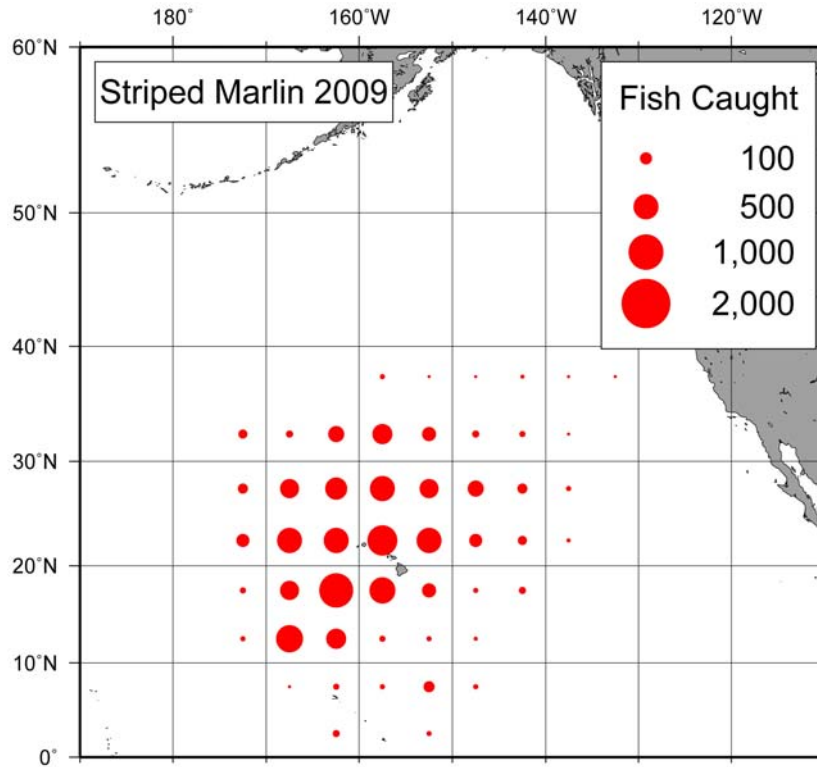
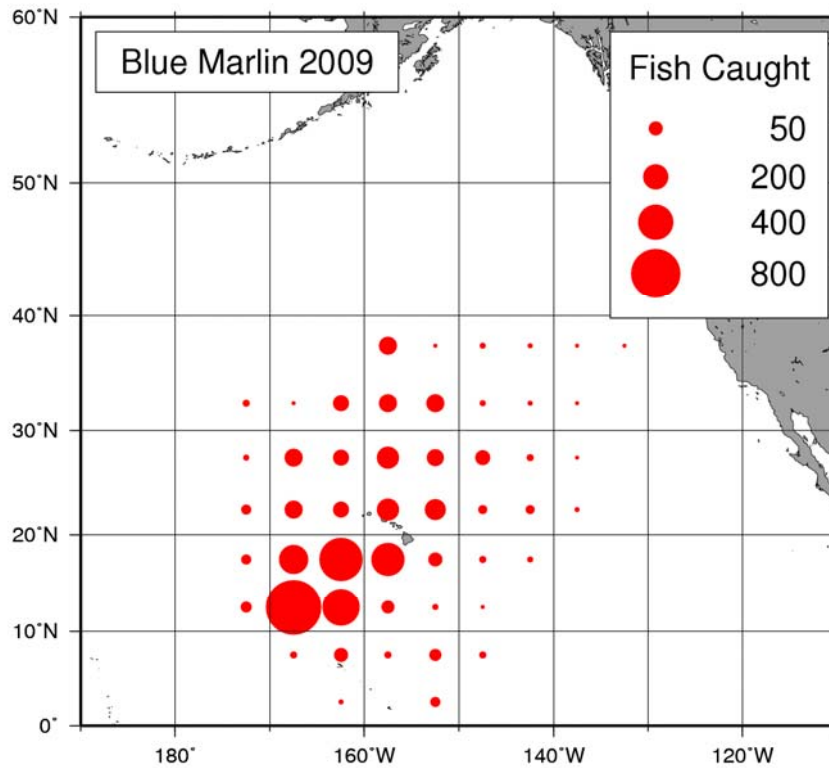


Figure 3.—Hawaii-based longline striped marlin catch (numbers of fish) by area, 2009.



NOAA Fisheries/Pacific Islands Fisheries Science Center
Mercator Projection Scale = 0.0625000000 inches/degree
Data as of 2010-06-25 gridded 5 deg x 5 deg x year

Figure 4.—Hawaii-based longline blue marlin catch (numbers of fish) by area, 2009.



NOAA Fisheries/Pacific Islands Fisheries Science Center
Mercator Projection Scale = 0.0625000000 inches/degree
Data as of 2010-06-25 gridded 5 deg x 5 deg x year

Figure 5.—Hawaii-based longline striped marlin CPUE* on tuna-targeted deep sets, 1991-2009.

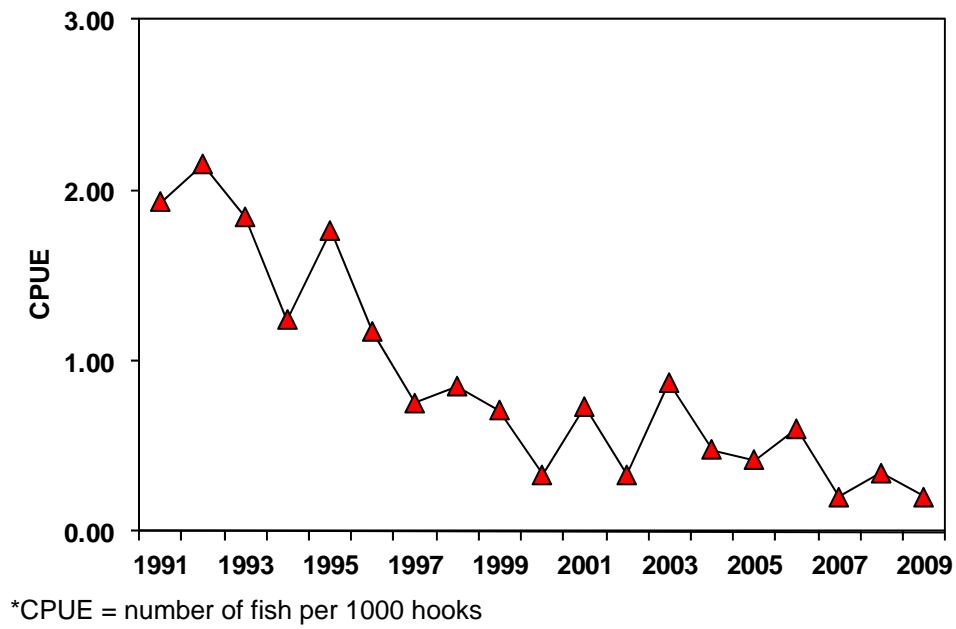


Figure 6.—Hawaii-based longline blue marlin CPUE* on tuna-targeted deep sets, 1991-2009.

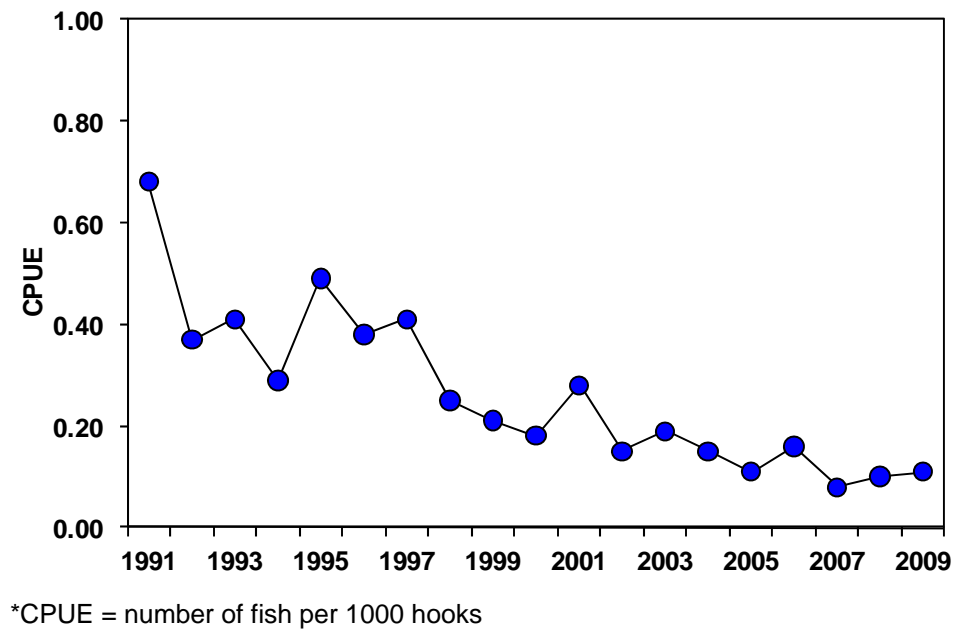


Figure 7.--Hawaii longline A) striped marlin and B) blue marlin weight-frequency, 2009.

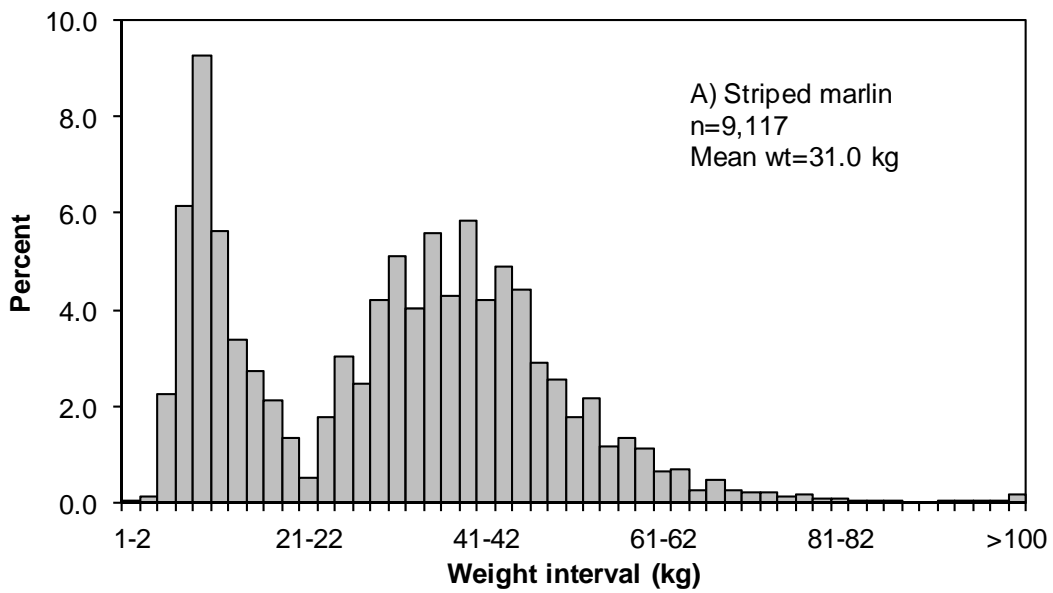


Figure 8.—Hawaii troll and handline A) striped marlin and B) blue marlin weight-frequency, 2009.

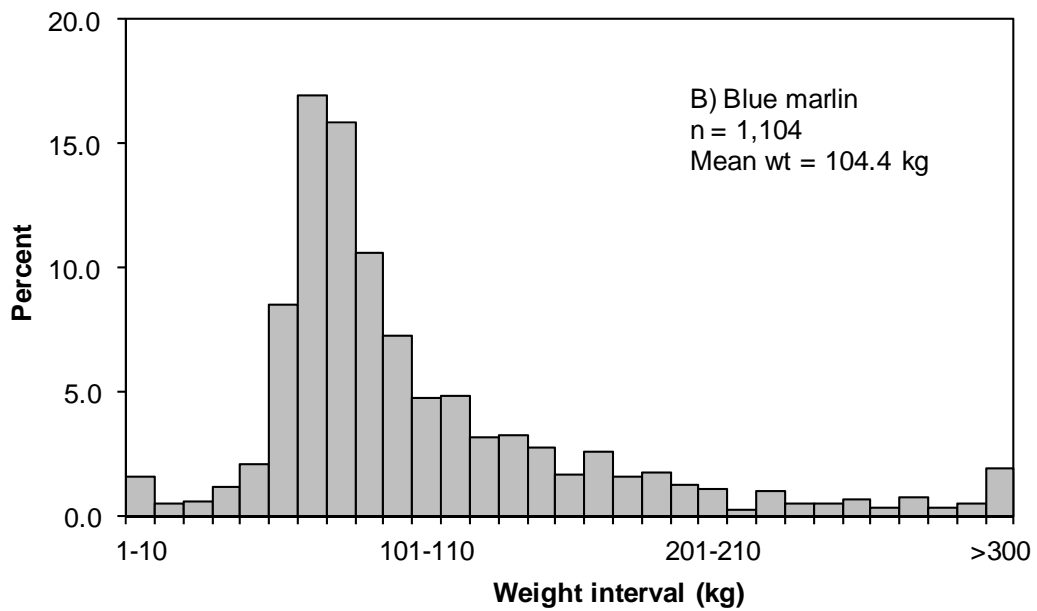
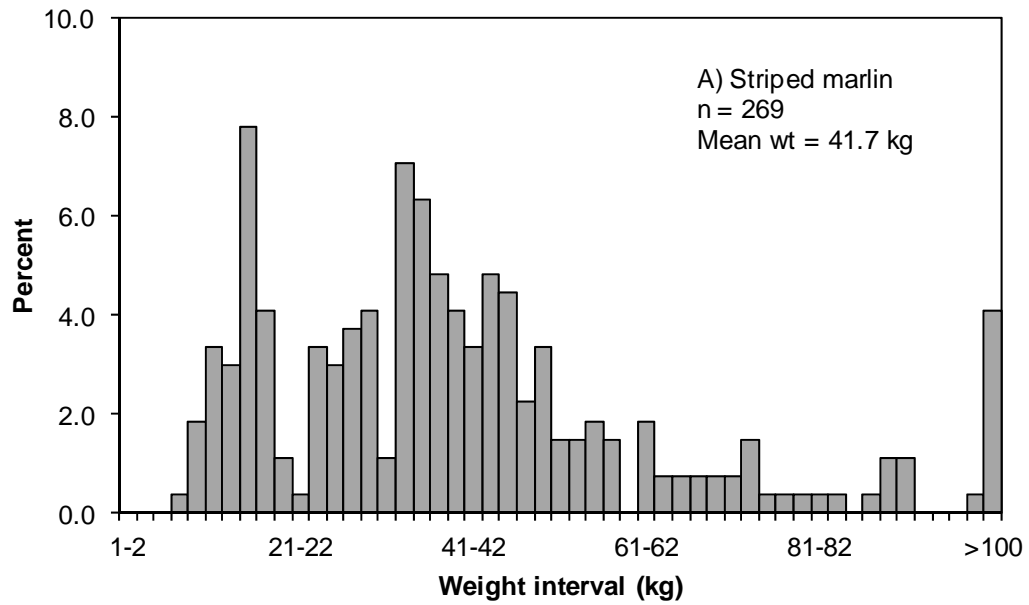


Figure 9. Nominal and corrected marlin catches for the Hawaii-based longline fishery, 1995-2003.

