

# An update on landing and sex-specific size composition data of striped marlin and swordfish in the Taiwanese offshore and coastal fisheries<sup>1</sup>

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# An update on landing and sex-specific size composition data of striped marlin and swordfish in the Taiwanese offshore and coastal fisheries<sup>1</sup>

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## Abstract

The historical annual catch for striped marlin and swordfish were described in this report. Sex-specific size composition data of striped marlin and swordfish were collected from the catches of Taiwanese offshore longline, offshore gillnet and coastal harpoon fisheries landed during 1997 to 2006 at three main fishing ports in Taiwan. The length distribution, length-weight relationship and sex ratio at observed lengths were analyzed in this report. The results showed that the females of both striped marlin and swordfish grew to a larger body length than the males. The length-weight relationships were not significantly different between the sexes. The proportion of females increased with body length for both billfish species.

## Introduction

In the waters around Taiwan, the catches of billfishes consisted of swordfish (*Xiphias gladius*), striped marlin (*Tetrapturus audax*), blue marlin (*Makaira mazara*), black marlin (*Makaira indica*) and sailfish (*Istiophorus platypterus*). They were mostly caught in the offshore longline, followed by offshore gillnet and coastal harpoon fisheries (Sun et al., 2005, Wang et al 2005). The catches of blue marlin and swordfish were obviously higher than the catch of other species, and were primarily taken as by-catches in the offshore longline fishery. The catches of striped marlin were slightly lower than those of other billfishes. The size composition data provide basic information for stock assessment (Hilborn and Walters 1992). In this report, we describe the historical annual catch and update the sex-specific size composition data

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for swordfish and striped marlin caught in the Taiwanese offshore fisheries

## Data Collection

The historical annual catch data (1964-2005) were provided by the Taiwan Overseas Fisheries Development Council (OFDC). The sex-specific size composition data were collected from the landings of the Taiwanese offshore longline, offshore gillnet and coastal harpoon fisheries at the three major fishing ports: Tungkang, Nanfangao and Shinkang (Fig. 1). The swordfish data were collected at all three fishing ports from September 1997 to September 2001 and from August 2004 to September 2006. The data of striped marlin were collected at Shinkang fishing port from July 2004 to October 2006. The size data including lower jaw fork length (LJFL, cm) and body weight (kg) were measured for each sample. The sex identified by the appearance of gonads was simultaneously recorded for each sample.

## Results and Discussions

The historical data of striped marlin and swordfish from the offshore longline and all gears combined, are plotted over the years of 1964-2005 (Fig. 2). For striped marlin, the annual total landing fluctuated between 354 and 828 mt during 1964-1983. The landed catch increased sharply and reached a maximum level of 1300 mt in 1984. Since then the annual catch declined and fluctuated between 165-694 mt during 1985-2002. In the recent three years (2003-2005), the annual catch remained stable at a low level of about 166-173 mt. For swordfish, the annual catch increased steadily over the time from 360 mt in 1964 to the historically high level of 4038 mt in 2005.. The catch data used in this report were preliminary, and the staff of OFDC are currently working with the Fishery Agency of Taiwan (FA) in updating the data.

The updated sex-specific body length (LJFL) data were sorted by 5 cm of intervals. The size frequency distribution and sample sizes for striped marlin and swordfish collected during the sampling periods are shown in Fig. 3. In general the female billfishes grew to larger body lengths than the males, and the length distributions of female billfishes had a larger range than those of the males. Female swordfish grew to the length of 290 cm. The lengths of most male striped marlin fell within a range of 150 cm to 200 cm, and for the swordfish the lengths were mostly observed in the range from 100 cm to 170 cm. The results are similar to those of Wang et al. (2005).

Sex specific length-weight relationships for the striped marlin and swordfish are shown in Fig. 4. The power exponents of swordfish and striped marlin in the

length-weight relationships exceeded three, indicating the allometric growth of these species. The likelihood ratio test (Huelsenbeck and Bull, 1996) was applied to evaluate whether the length-weight relationships differed between the sexes. The length-weight relationships were not significantly different (ANCOVA;  $p > 0.05$ ) between the females and males for these two species. The sex-pooled length-weight relationships were also shown in Fig. 4.

Figure 5 shows the sex ratios of fish at length intervals of 5 cm for the two species of billfishes. The sex ratio used in this report was defined as the proportion of female samples to the total samples of females and males. The sex ratio revealed a significant increasing pattern with length for both species. Almost all the samples having lengths larger than 210 cm were females for swordfish. The results were similar to those of Wang et al. (2005) although the equations that describe the relationship between sex ratio and length were different, which may result from differences in sample size.

Our laboratory at the National Taiwan University (NTU) has been conducting population dynamics and stock assessment studies for billfishes over the last several years. Currently, sex-specific size composition data and other biological information for billfishes are being collected and compiled by the Eastern Marine Biology Research Center (EMBRC) of Fisheries Research Institute in collaboration with our laboratory. A tagging program is being conducted for billfish by EMBRC. We expect that more results from these billfishes studies will be available in the near future.

### References Cited

- Chiang, W.C., C.L. Sun, and S.Z. Yeh (2004). Age and growth of sailfish (*Istiophorus platypterus*) in waters off eastern Taiwan. Fish. Bull., 102: 251-263.
- Hilborn R. and C. J. Walters. 1992. Quantitative fisheries stock assessment: choice, dynamics, and uncertainty. Chapman and Hall, New York, 570pp.
- Huelsenbeck, J.P., and J.J. Bull (1996). A likelihood ratio test to detect conflicting phylogenetic signal. Syst. Biol., 45: 92-98.
- Sun, C.L., S.Z. Yeh, S.P. Wang, W.C. Chiang, and N.J. Su (2005). A review of Taiwan's billfish fishery in the Pacific Ocean. A working paper submitted to the 1<sup>st</sup> Joint Intercessional Meeting of the Swordfish and Marlin Working Groups of ISC (the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific). August 29 to September 2, 2005, Shimizu, Japan.

Wang, S.P., C.L. Sun, and S.Z. Yeh (2003). Sex Ratios and Sexual Maturity of Swordfish (*Xiphias gladius* L.) in the Waters of Taiwan. Zool. Studies, 42: 529-539.

Wang, S.P C.L. Sun, and S.Z. Yeh W.C. Chiang, and N.J. Su and C.H.Liu (2005) Analysis of the sexed size dat of billfishes from the Taiwanese offshore and coastal fisheries., Working Groups of ISC (the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific). August 29 to September 2, 2005, Shimizu, Japan.

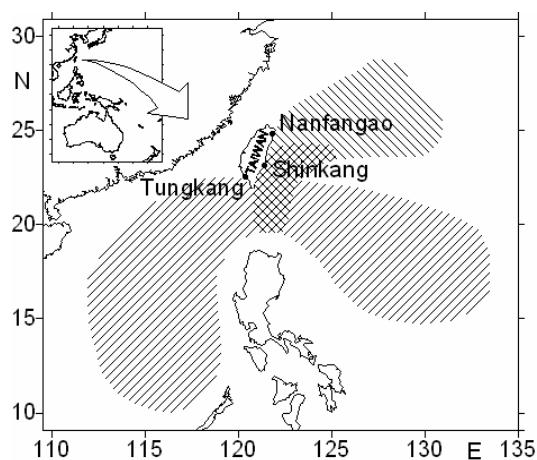


Fig. 1. Three fishing ports in Taiwan where the size data of billfishes were collected (right diagonal, left diagonal and mesh represent the fishing area for the fleets based on Tungkang, Nanfanao and Shinkang respectively).

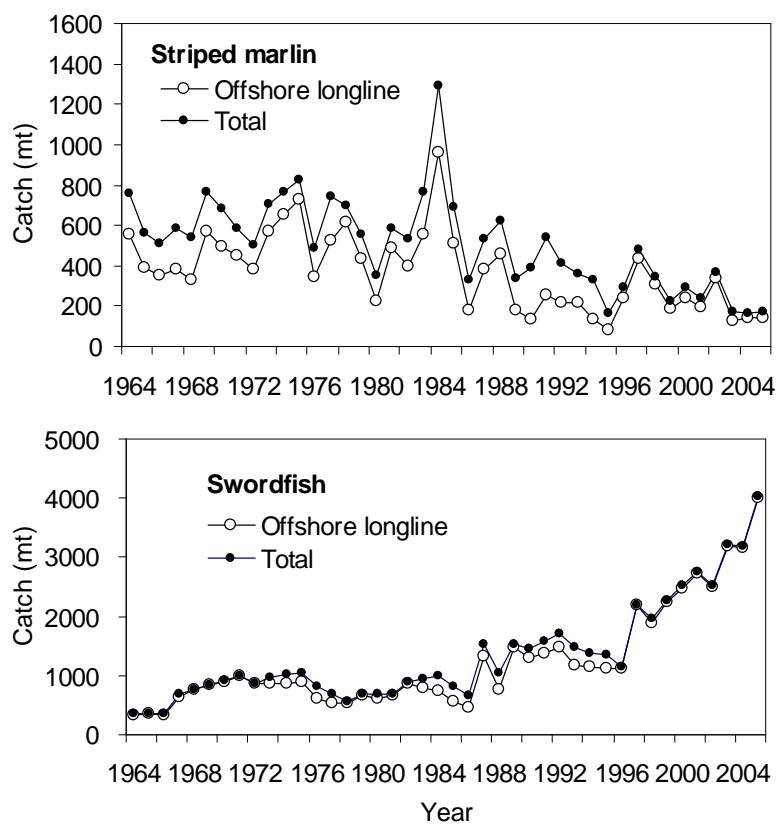


Fig. 2. Annual total catch and longline catch of swordfish and striped marlin by the Taiwanese offshore fisheries, 1964-2005.

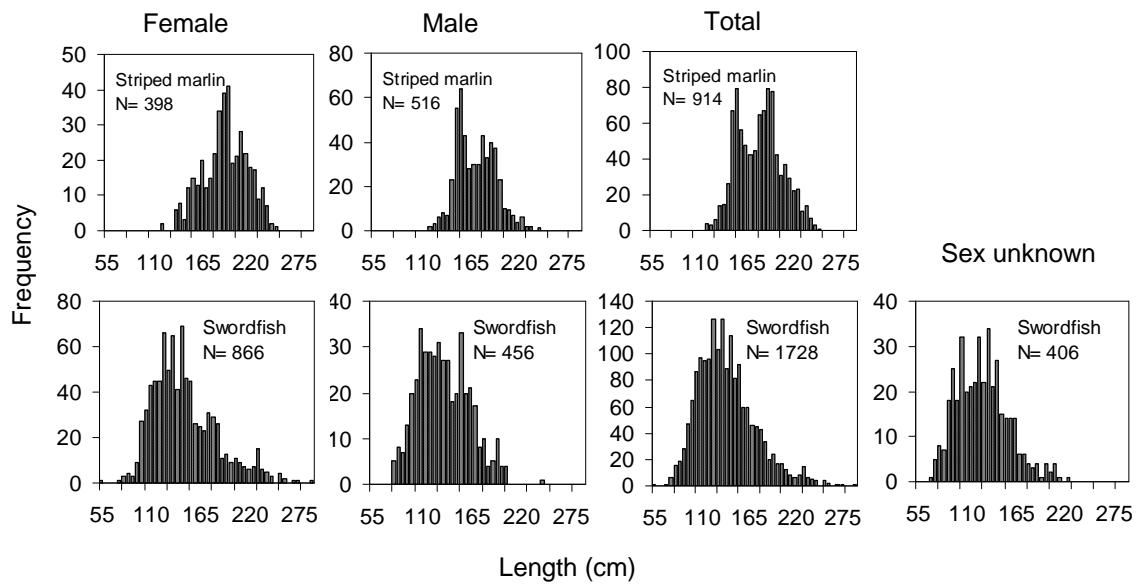


Fig. 3. Length (lower jaw fork length) frequency distributions by 5 cm intervals for the swordfish and striped marlin caught by the Taiwanese offshore and coastal fisheries.

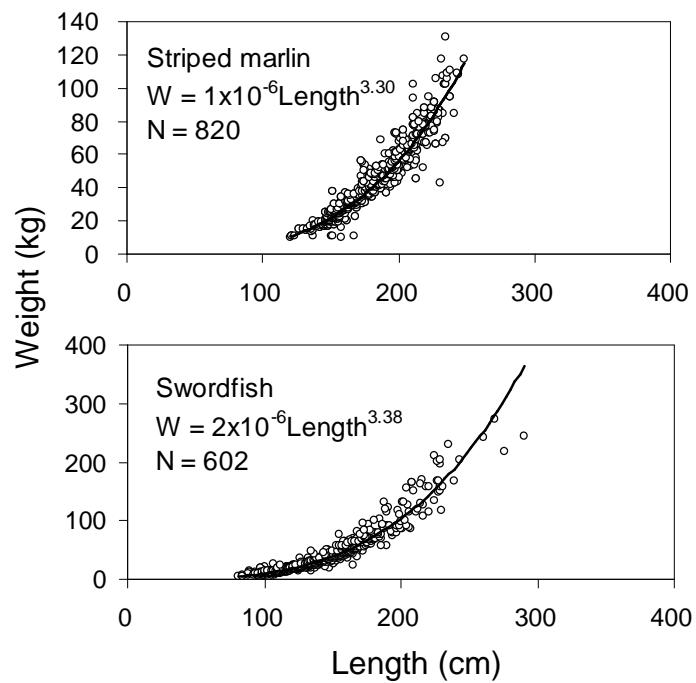


Fig. 4. Length-weight relationships for the swordfish and striped marlin caught by the Taiwanese offshore and coastal fisheries.

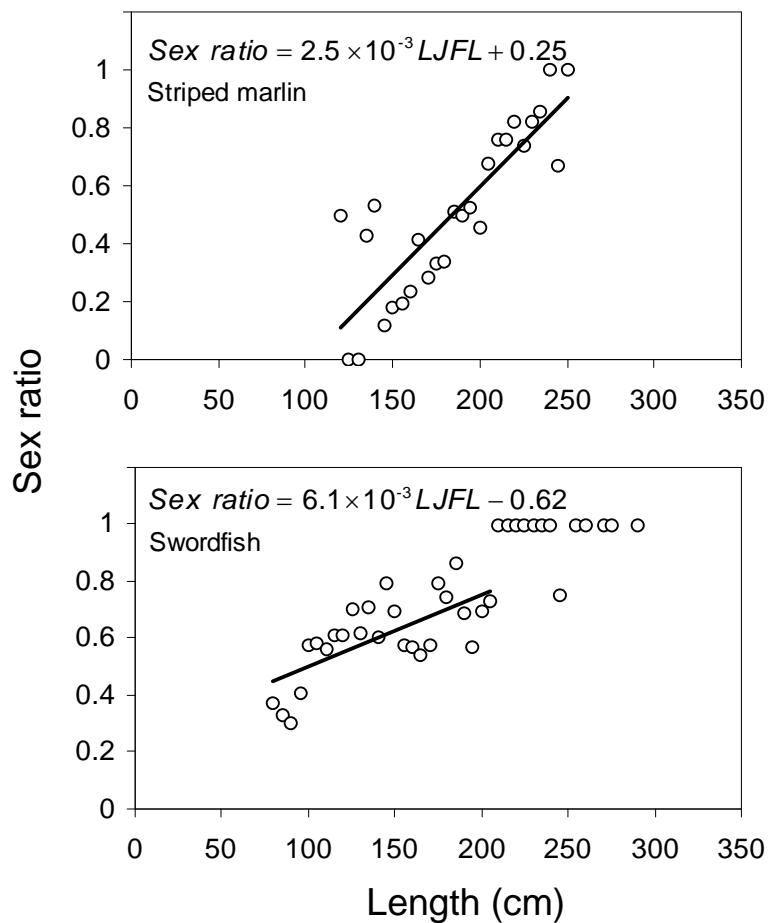


Fig. 5. Sex ratios by 5 cm length (lower jaw fork length) intervals (circles) and the relationships between sex ratios and lengths (lines) for the swordfish and striped marlin caught by the Taiwanese offshore and coastal fisheries.