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Analysis of the sexed size data of billfishes from the Taiwanese offshore and coastal fisheries [1]

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Abstract

Sexed size data of swordfish, striped marlin, blue marlin, black marlin and sailfish were collected from the catches of Taiwanese offshore longline, offshore gillnet and coastal harpoon fisheries landed at three fishing ports during 1997 to 2005. These data were analyzed and the length distributions, length-weight relationships and sex ratio at observed lengths were described in this report. The results showed that the females grew to a larger body length than the males. The length-weight relationships were not significantly different between the females and the males. In addition, the proportion of females increased with body length for all billfishes.

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*). For the Taiwanese offshore fishery, billfishes were mostly caught by offshore longline, followed by offshore gillnet and coastal harpoon fisheries (Sun et al., 2005). The catches of blue marline and swordfish were obviously larger than the other species, and were primarily taken as by-catches by offshore longline. For black marlin, catches were made by coastal harpoon as well as offshore longline. Also, offshore gillnet catches of sailfish were similar to those taken by offshore longline. Comparatively, the catches of striped marlin were slightly less than those of the other billfishes. The size data provides basic information for stock assessments. In this report, the preliminary size data analyses were completed using the five species of billfishes caught by the Taiwanese offshore fishery.

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Data Collection

The sexed size data were collected from the landings of the Taiwanese offshore longline, offshore gillnet and coastal harpoon fisheries at the following three fishing ports: Tungkang, Nanafao and Shinkang (Fig. 1). The data of swordfish were collected from all three fishing ports from September 1997 to September 2001. The data collected from Sinkang fishing port were from July 2004 to July 2005 for striped marlin and black marlin, and from July 1997 to July 2005 for sailfish. For blue marlin, the data were collected from Tungkang fishing port from January to December 2001 and from Shinkang fishing port from July 2004 to June 2005. 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

Sex-specific body length (LJFL) frequency distributions ordered by 5 cm intervals and sample sizes for the five billfishes collected during the whole sampling periods are shown in Fig. 2. Generally, the females grew to larger body lengths than the males for all the billfishes. Female swordfish, blue marlin and black marlin grew to the length of 300 cm or more. In addition, length distributions of the female billfishes had a larger range than those of the males. Most of the male billfishes' lengths occurred in a range between 150 cm and 200 cm, except for the swordfish whose lengths mostly occurred in the range from 100 cm to 170 cm. Fig. 3 shows the yearly length distributions and sample sizes for the five billfishes.

Length-weight relationships for the female and male billfishes are shown in Fig. 4. The length exponents of swordfish, striped marlin and blue marlin exceeded three, indicating that body weights were more than proportional to the cube of length. The weight of black marlin was very close to the cube of length. The length exponent of sailfish was slightly less than three, which showed that sailfish was more slender than the other billfishes. The likelihood ratio test (Huelsenbeck and Bull, 1996) was applied to demonstrate whether the length-weight relationships differed between sexes. The length-weight relationships were not significantly different ($p>0.05$) between the females and males for all the billfishes. For sailfish, Chiang et al. (2002) indicated that the length-weight relationships differed between females and males by analysis of covariance. The results of this report deviated from Chiang et al. (2002), which might be due to the use of the updated data and a different statistical analysis method. Sexes pooled data were also used to conduct the length-weight relationships (Fig. 4).

Figure 5 shows the sex ratios at length intervals of 5 cm for the billfishes. The sex ratio used in this report was defined as the proportion of female samples to the total samples of females and males. For swordfish, blue marlin, black marlin and sailfish, the sex ratios revealed very significant patterns, where sex ratios increased for lengths larger than 150 cm. Wang et al. (2003) developed an equation to represent the increment of sex ratio with length for swordfish. All samples having lengths larger than 210 cm for swordfish, 280 cm for blue marlin, 270 cm for black marlin and 230 cm for sailfish were females. Although the sample size of striped marlin was much less than the other billfishes, the sex ratio of striped marlin females to males also showed an increasing pattern at longer lengths.

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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.

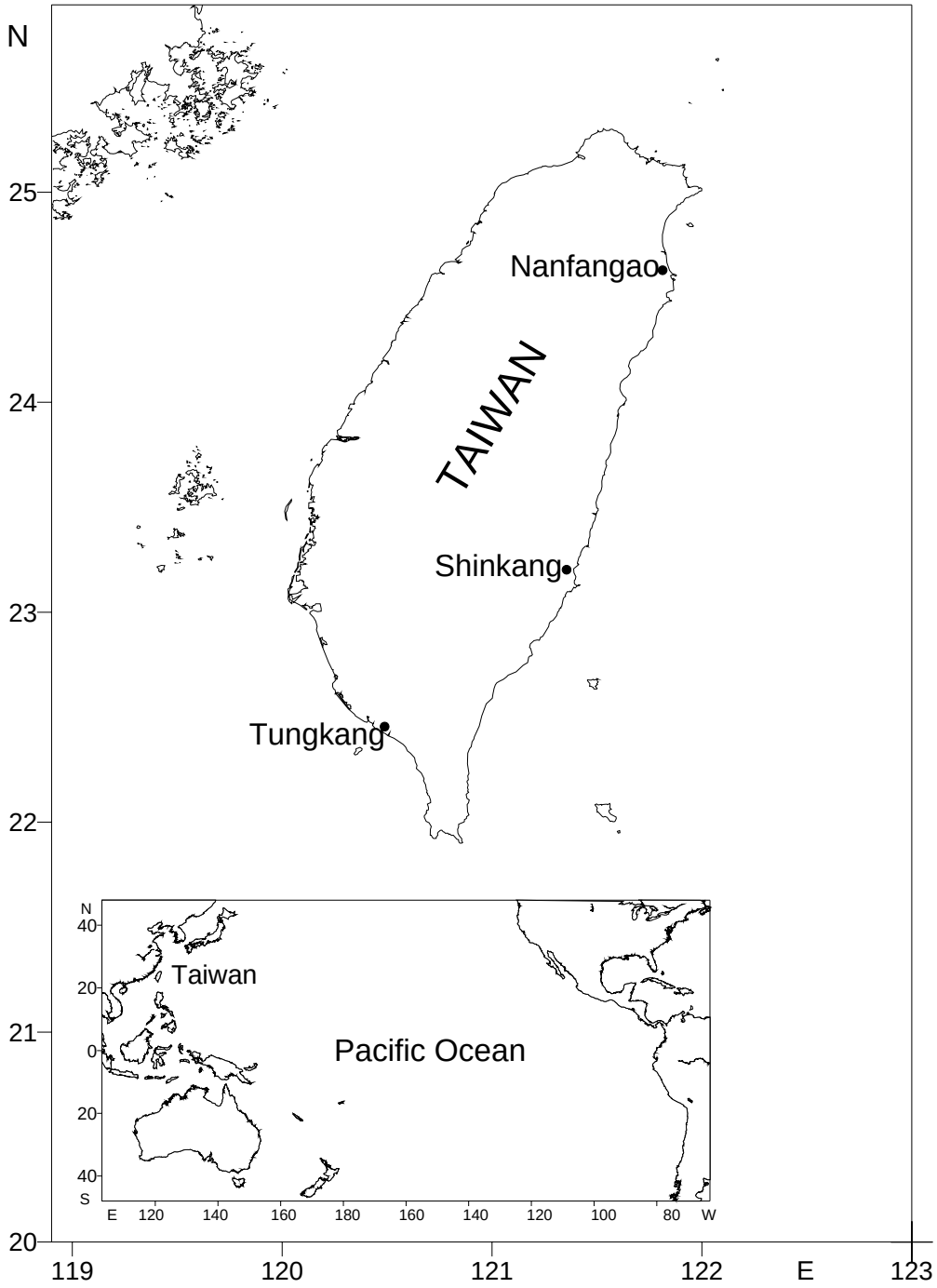


Fig. 1. Three fishing ports in Taiwan where the size data of billfishes were colleted.

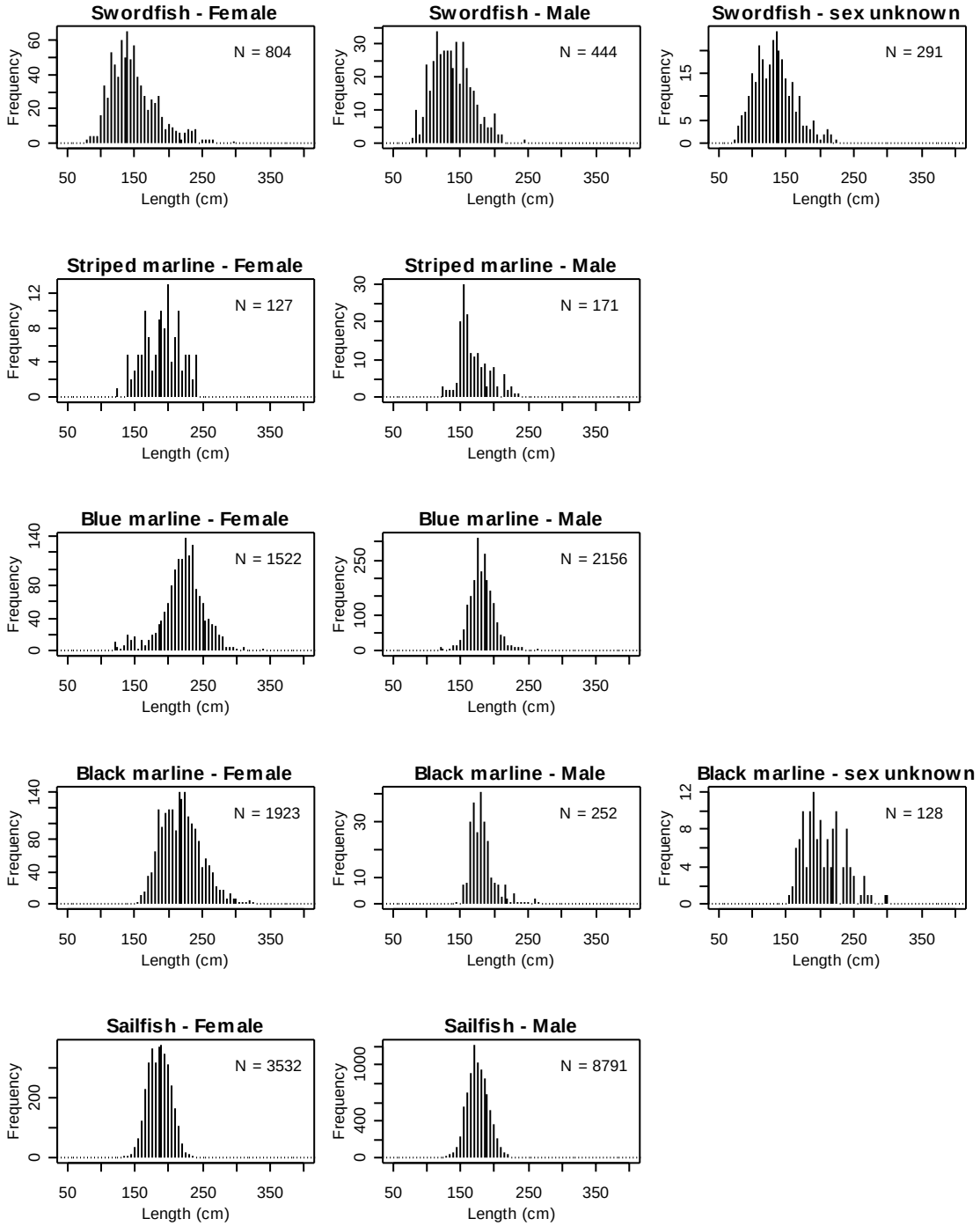


Fig. 2. Length (lower jaw fork length) frequency distributions by 5 cm intervals for the billfishes caught by the Taiwanese offshore and coastal fisheries.

(A) Swordfish

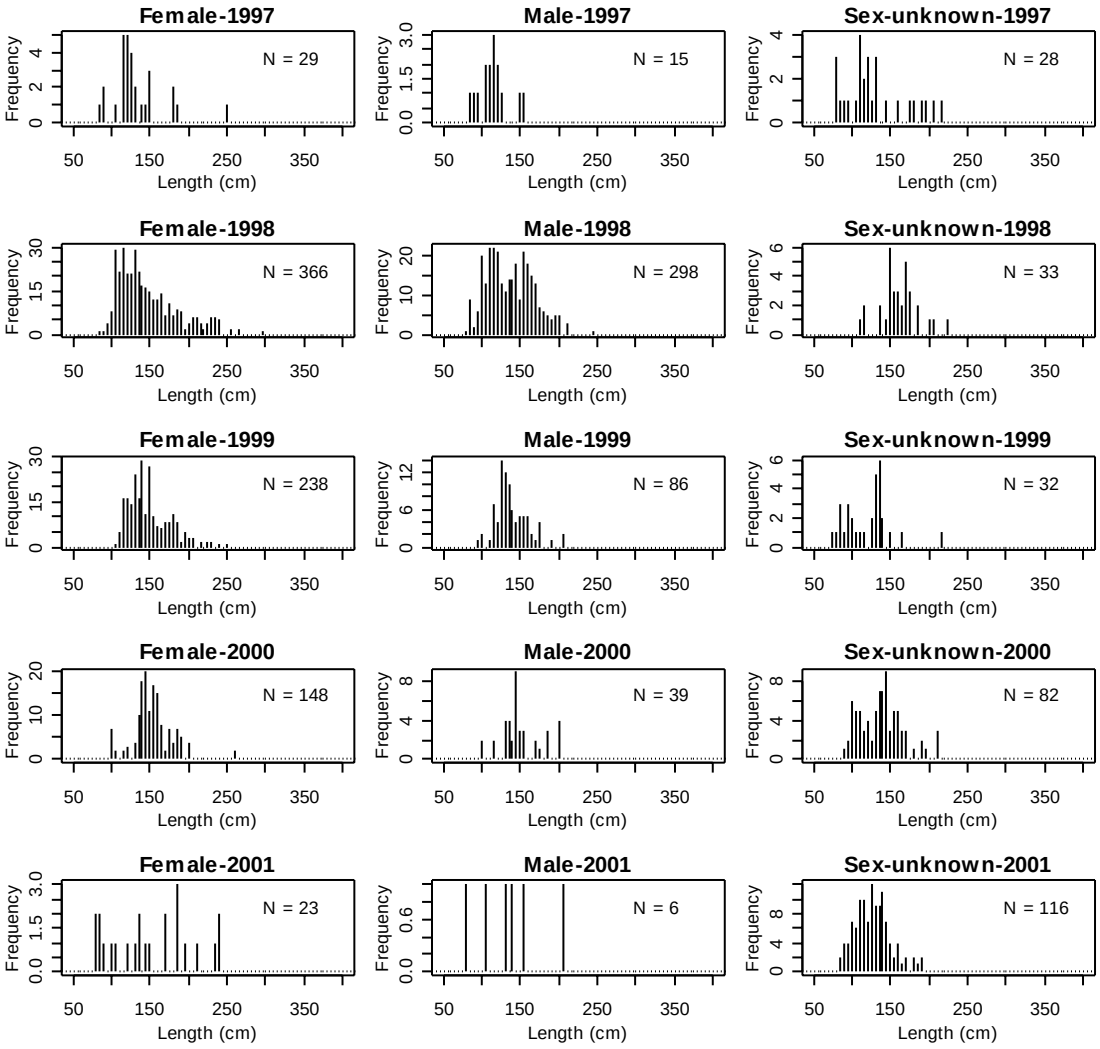
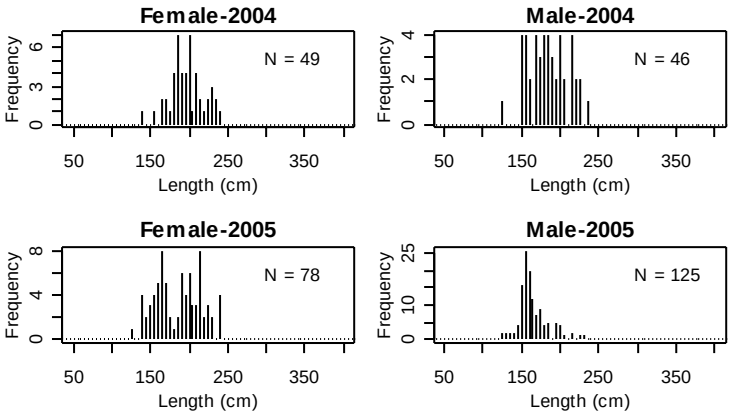
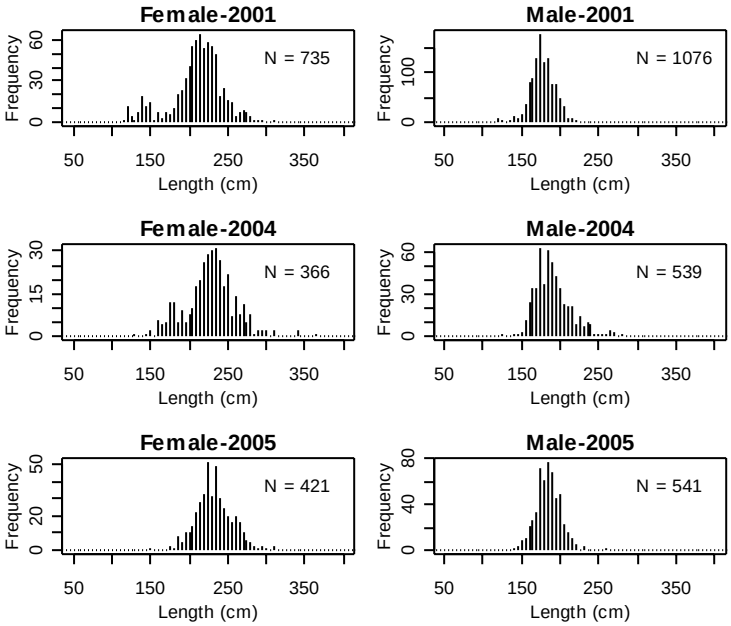


Fig. 3. Annual length (lower jaw fork length) frequency distributions by 5 cm intervals for the (A) swordfish, (B) striped marlin, (C) blue marlin, (D) black marlin, and (E) sailfish caught by the Taiwanese offshore and coastal fisheries.

(B) Striped marlin



(C) Blue marlin



(D) Black marlin

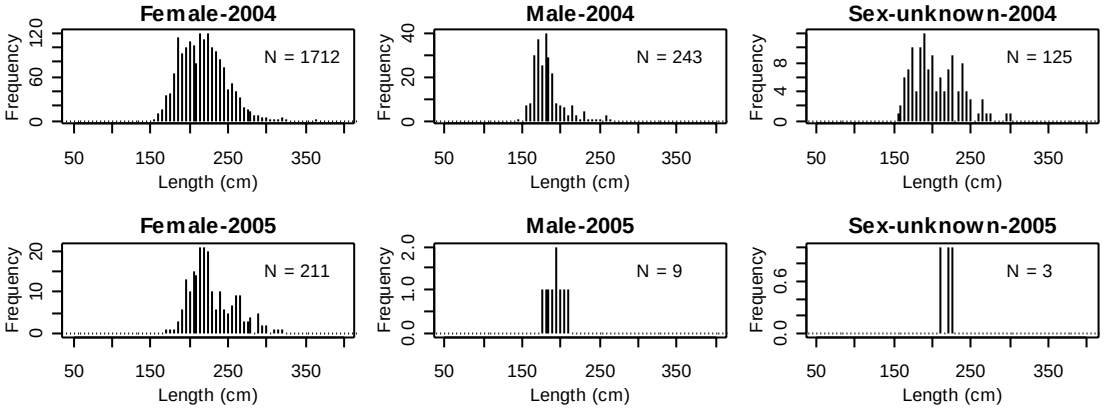


Fig. 3. Continued.

(E) Sailfish

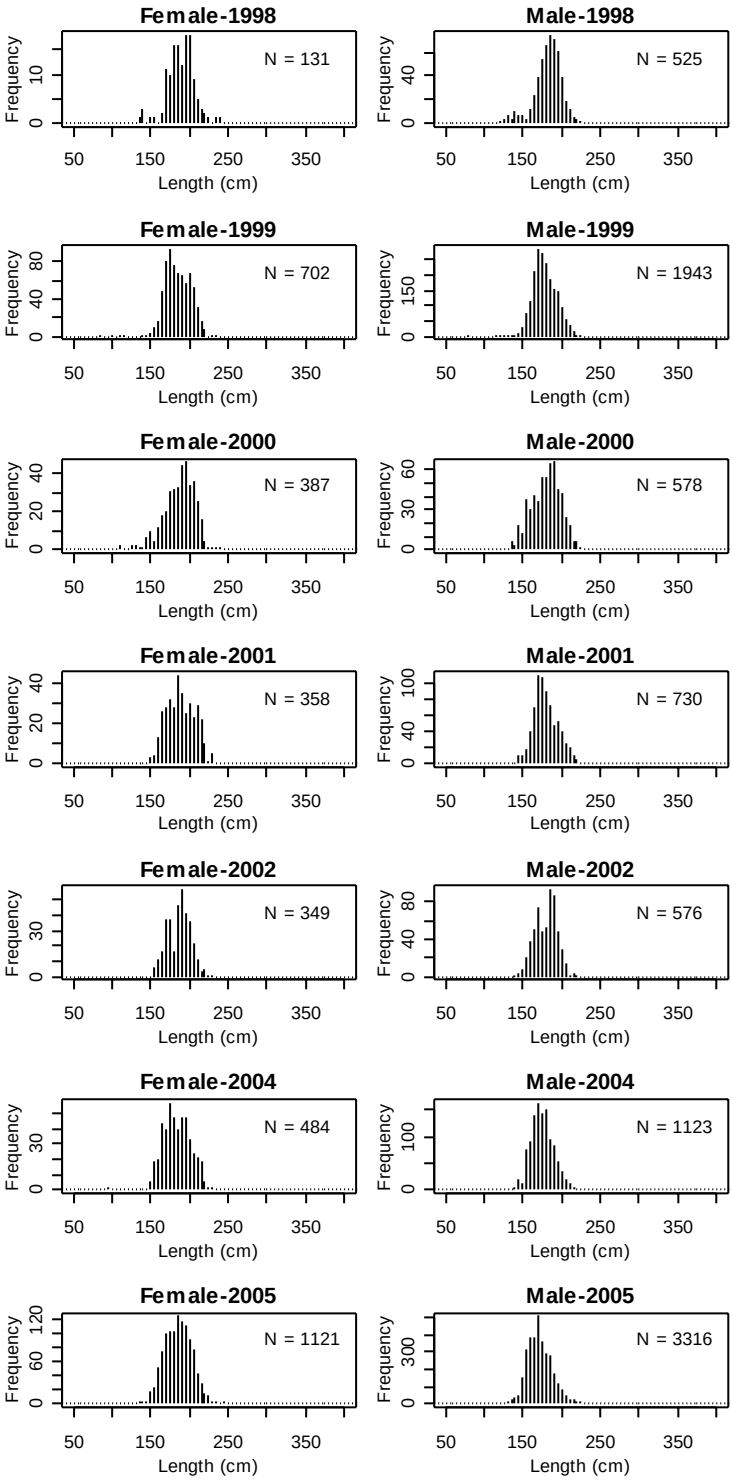


Fig. 3. Continued.

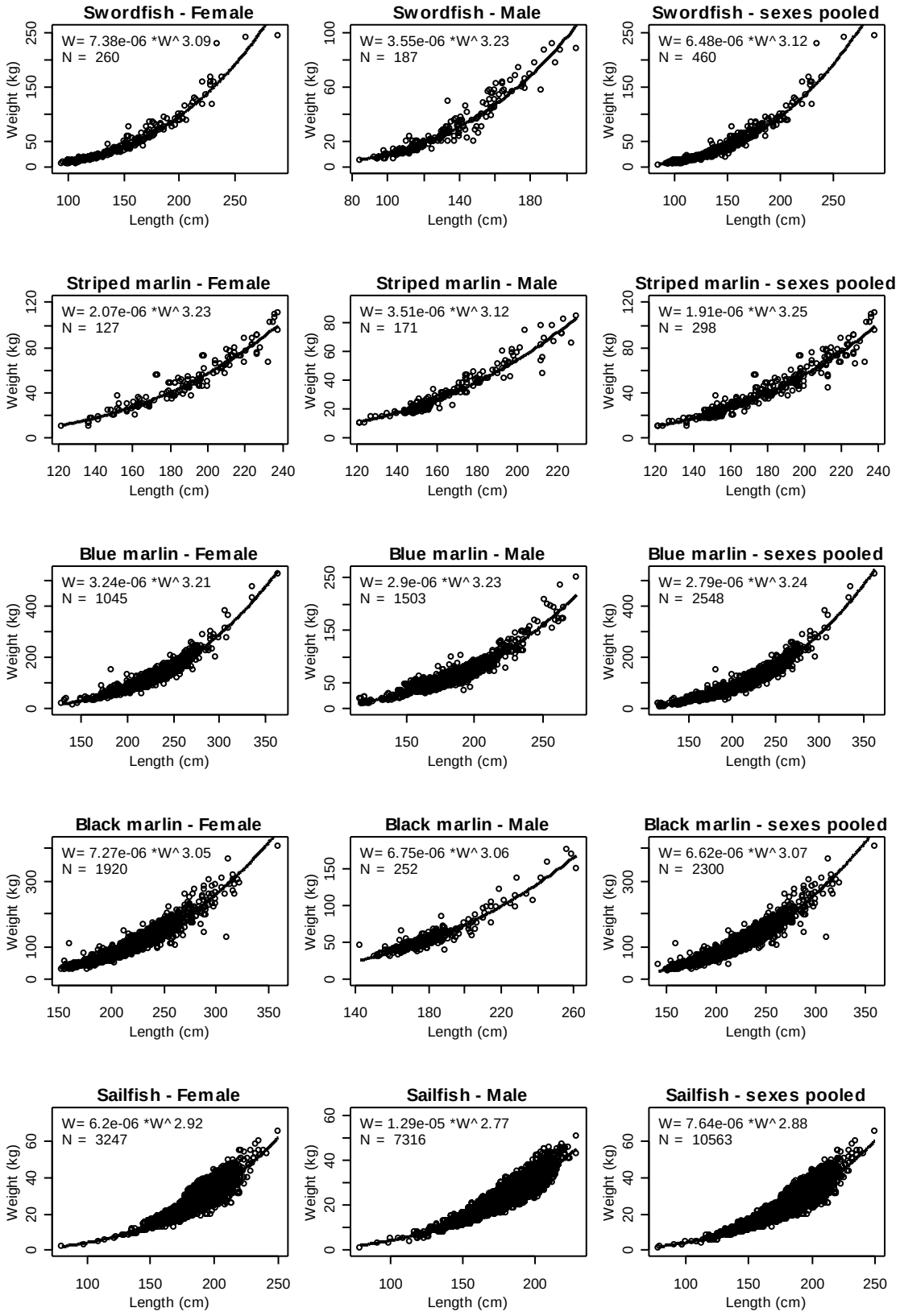


Fig. 4. Length-weight relationships for the billfishes caught by the Taiwanese offshore and coastal fisheries.

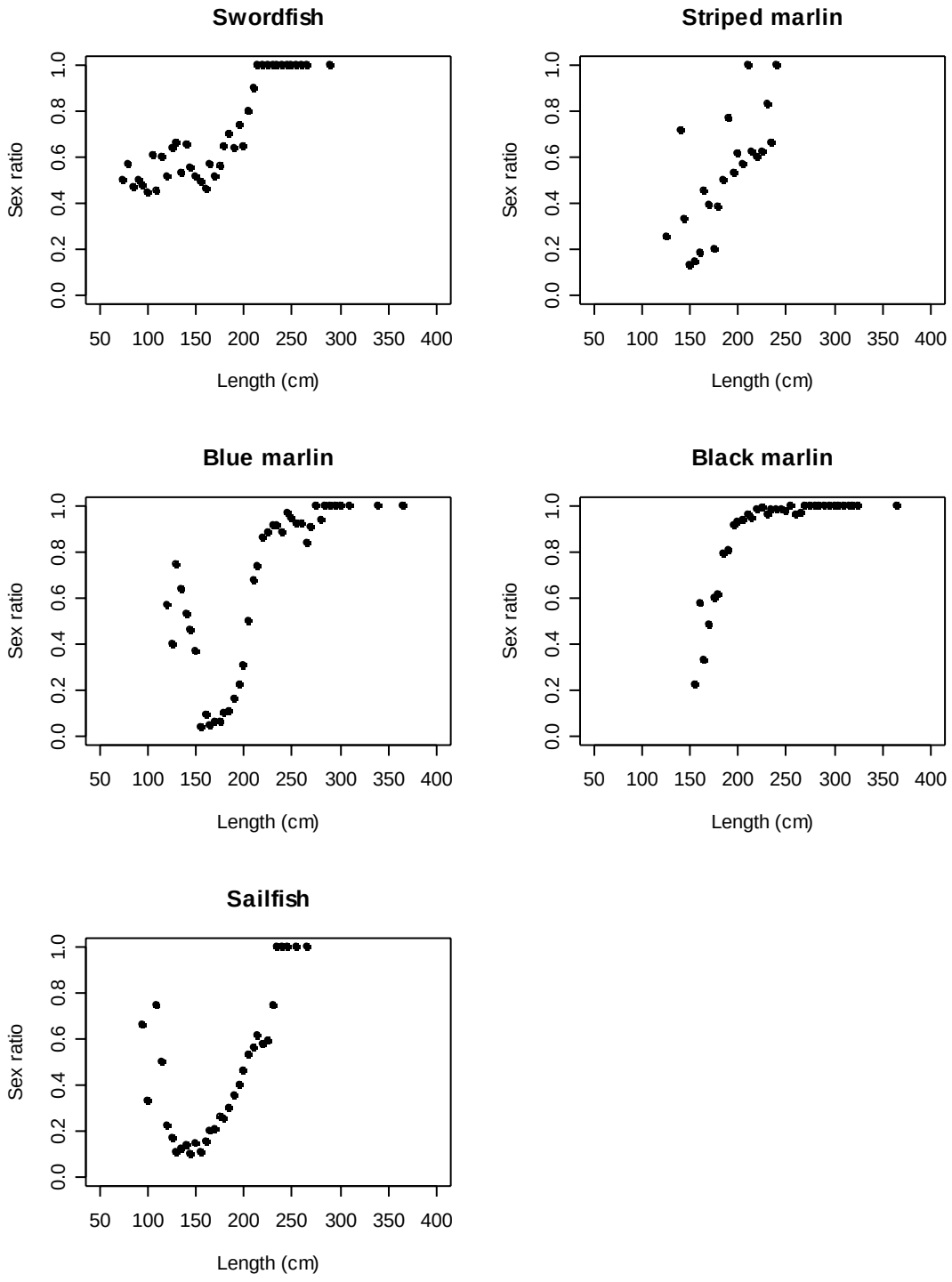


Fig. 5. Sex ratios by 5 cm length (lower jaw fork length) intervals for the billfishes caught by the Taiwanese offshore and coastal fisheries.