LJFL and EFL relationships for the billfishes caught by the Taiwanese offshore and coastal fisheries [1]

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Abstract

The relationships between lower jaw fork length (LJFL) and eye fork length (EFL) were described for blue marlin, black marlin, striped marlin, sailfish and swordfish from eastern Taiwan waters. Specimens were sampled from the catches of Taiwanese offshore and coastal fisheries during June 2004 to July 2005. Our attempt was to provide the relationships between LJFL and EFL for billfishes in Taiwan waters in order for researchers and managers to convert LJFL and EFL metrics for comparison with size data collected in other areas where different metrics were used.

Introduction

The billfish catches of Taiwanese offshore and coastal fisheries were made up of swordfish (*Xiphias gladius*), striped marlin (*Tetrapturus audax*), blue marlin (*Makaira mazara*), black marlin (*Makaira indica*) and sailfish (*Istiophorus platypterus*). Blue marlin is mainly captured by offshore longline fishery, and lesser amounts of catch are taken by the surface fisheries such as offshore gillnet, coastal set net and coastal harpoon. Like blue marlin, striped marlin is also predominantly captured by offshore longline fishery, and small amounts are caught by coastal gillnet fishery. The catches of swordfish, however, are mostly taken by offshore longline fishery. In contrast, the catches of black marlin taken by gillnet and harpoon fisheries are roughly equal to that of longline fisheries. But, the catches of sailfish caught by offshore gillnet were as many as those of offshore longline fishery (Sun, et al., 2005).

Bills or jaws of marlins were usually cut off right after capture; data of lower jaw fork length (LJFL) were often not available while we measured the body size at the fish market. The objective of this report is to provide the relationships between LJFL

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and EFL for billfishes in Taiwan waters in order for researchers and managers to convert LJFL and EFL metrics for comparison with size data collected in other areas where different metrics were used.

Materials and Methods

Size data including low jaw fork length (LJFL, cm) and eye fork length (EFL, cm), and sex identified by appearance of gonad for each specimen were recorded at the Shinkang Fish Market of eastern Taiwan (Fig. 1) between July 2004 and June 2005 for blue marlin, black marlin, and striped marlin. The linear regression equation ($LJFL = a \times EFL + b$, where a and b are parameters) was implemented for females and males, respectively. If there is no significant difference between females and males, the relationship between LJFL and EFL was calculated again by using all data of both sexes to obtain the pooled linear regression equation. The LJFL-EFL relationships for swordfish and sailfish were adopted from Sun, et al. (2002) and Chiang, et al. (2004), respectively.

Results and Discussions

Both LJFL and EFL data for 213 female and 209 male blue marlins, 1,920 female and 252 male black marlins, and 117 female and 146 male striped marlins have been measured. The minimum, maximum, and average sizes by sex are shown in Table 1. For blue marlin, black marlin, and striped marlin, body size of females are apparently larger than males. However, the average size of black marlin is smaller than that of blue marlin, but larger than that of striped marlin for both sexes. The linear regression equation between LJFL and EFL of three marlins by sex are shown in Fig. 2. No significant differences existed between females and males for blue marlin, black marlin, and striped marlin (ANCOVA, $P > 0.05$), LJFL and EFL data of each sex were combined and the pooled relationships between LJFL and EFL for each species of billfish are shown as follows:

For blue marlin:

Female: LJFL = 1.0831 EFL + 9.0296, with $r^2 = 0.97$ and $n = 213$

Male: LJFL = 1.0899 EFL + 7.3668, with $r^2 = 0.98$ and $n = 209$

Pooled: LJFL = 1.0915 EFL + 7.2158, with $r^2 = 0.99$ and $n = 422$

For black marlin:

Female: LJFL = 1.1169 EFL + 5.474, with $r^2 = 0.98$ and $n = 1,920$

Male: LJFL = 1.1007 EFL + 7.8563, with r^2 = 0.98 and n = 252
Pooled: LJFL = 1.1169 EFL + 5.466, with r^2 = 0.98 and n = 2,172

For striped marlin
Female: LJFL = 1.1502 EFL + 2.4908, with r^2 = 0.97 and n = 117
Male: LJFL = 1.0869 EFL + 12.239, with r^2 = 0.97 and n = 146
Pooled: LJFL = 1.1178 EFL + 7.7696, with r^2 = 0.98 and n =263

For sailfish: (adopted from Chiang, et al., 2004)
Female: LJFL = 1.1416 EFL + 2.5217, with r^2 = 0.99 and n = 446
Male: LJFL = 1.1198 EFL + 5.8186, with r^2 = 0.98 and n = 720

For swordfish: (adopted from Sun, et al., 2002)
Pooled: LJFL = 1.0647 EFL + 7.7911, with r^2 = 0.99 and n = 565

Besides catches and fishing effort, size data are also essential information for stock assessment and management. However, the total length (TL) and LJFL of billfishes can not be obtained at times since fishermen remove the bills and jaws of billfishes while at sea. Through the equation, EFL could be converted into LJFL and compared with other size samples that LJFL are available. In addition, the gonads and internal organs such as stomachs and gills occasionally are taken off before landing, so the data of round weight (RW) of billfishes can not be obtained at fish market. Therefore, data of round weight and dressed weight (DW) should be collected in the future to carry out the relationship between RW and DW for converting DW into RW.

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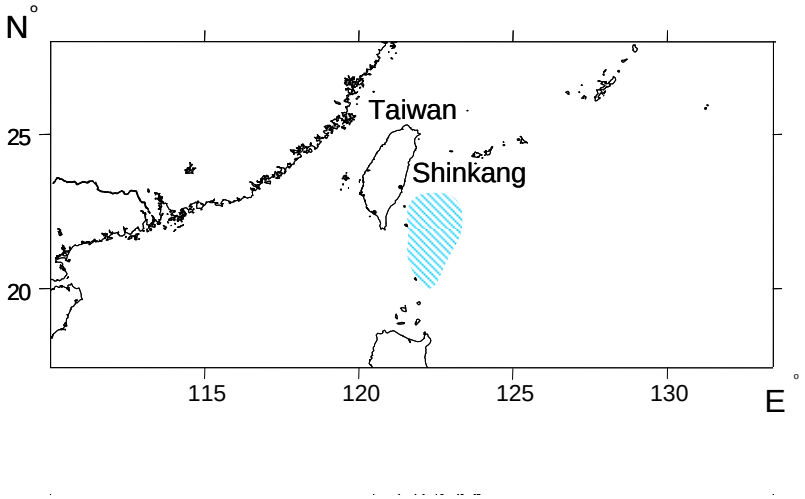

Fig. 1. The fishing ground and fishing port where the size data were collected.

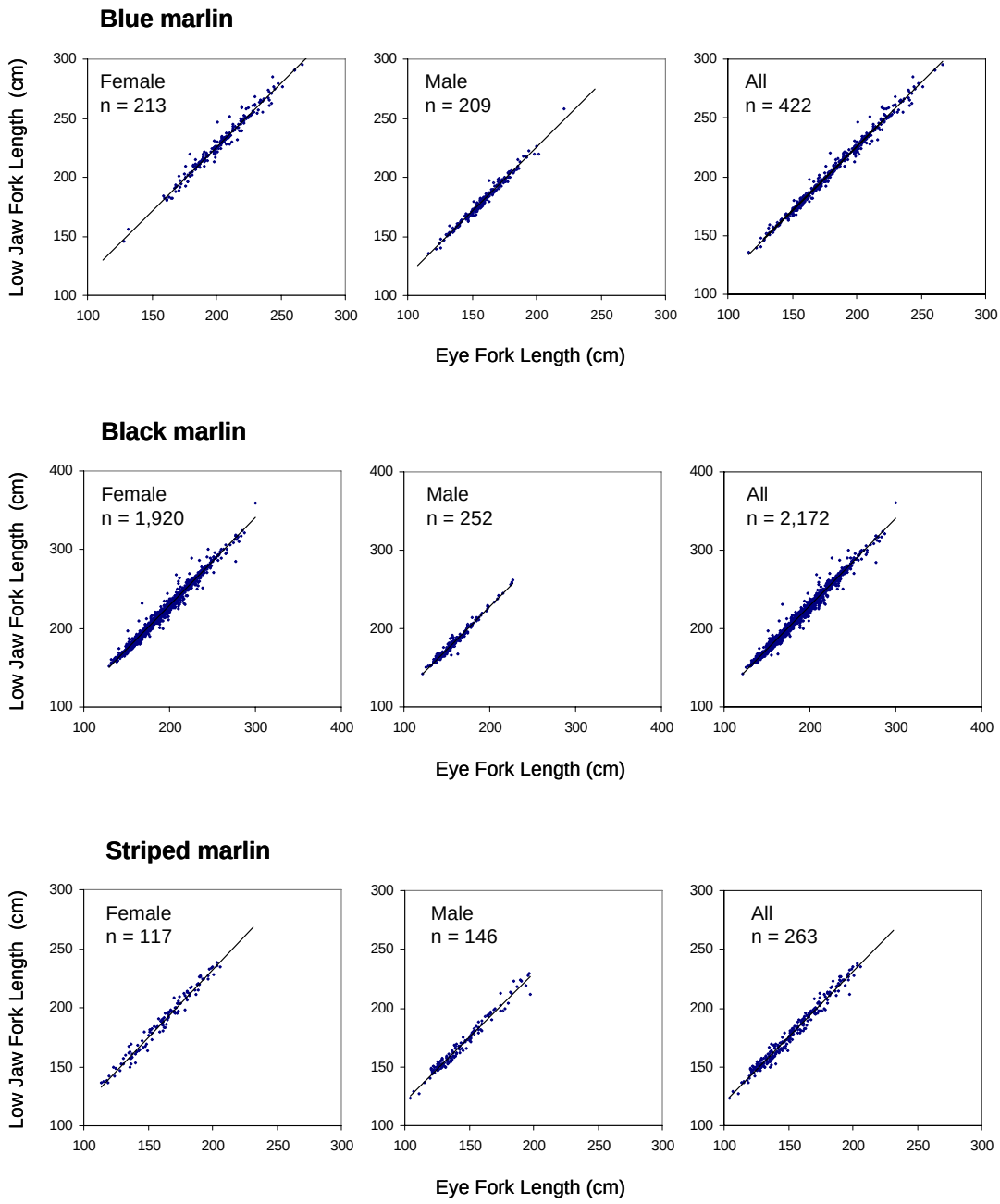

Fig. 2. Relationships between eye fork length (EFL) and low jaw fork length (LJFL) for the blue marlin, black marlin, and striped marlin caught by the Taiwanese offshore and coastal fisheries in the eastern Taiwan waters.

Table 1. The range (minimum and maximum) and average size of the blue marlin, black marlin, and striped marlin caught by the Taiwanese offshore and coastal fisheries in the eastern Taiwan waters.

		Blue marlin		**Black marlin**		**Striped marlin**	
		EFL	LJFL	EFL	LJFL	EFL	LJFL
minimum	female	112.0	146.1	129.5	151.9	115.5	121.7
	male	107.8	119.6	122.2	142.0	104.0	123.5
maximum	female	299.0	364.0	300.0	360.0	231.4	237.9
	male	245.0	265.8	226.5	261.5	197.5	230.0
average	female	195.8	231.3	188.7	216.3	162.6	187.3
	male	158.9	185.1	156.5	180.1	143.0	167.5