A Review of Taiwan's Blue Marlin Fisheries in the Pacific Ocean, 1958-2010[1]

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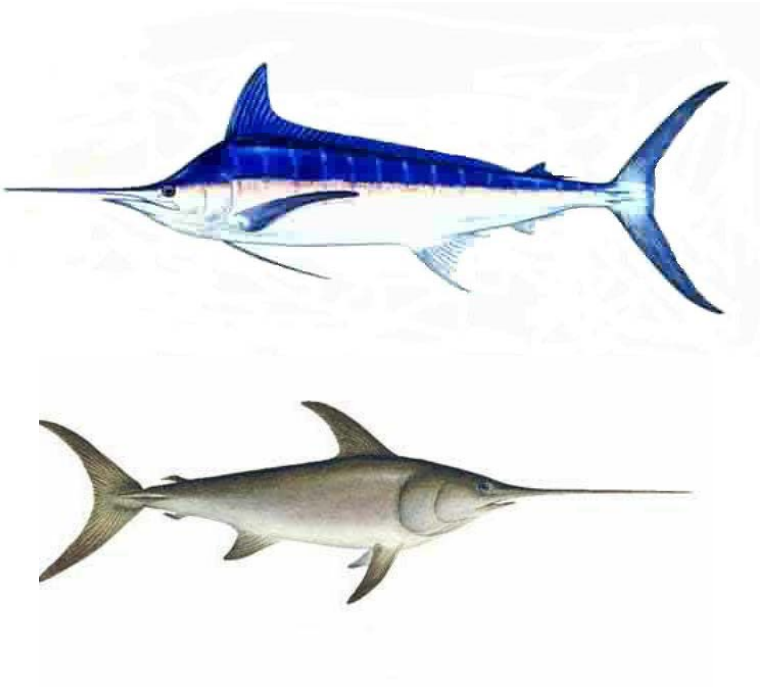

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A review of Taiwan's blue marlin fisheries in the Pacific Ocean, 1958-2010*

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Abstract

Catch-effort data (1964-2010) and length data (2005-2010) of blue marlin from the Taiwanese distant-water longline fishery and catch-effort data (2007-2010) for the Taiwanese offshore longline fishery in the Pacific Ocean were collected in this study, as well as annual catches from various offshore and coastal fisheries in waters off Taiwan during 1958-2010. The Taiwanese distant-water tuna longline fleets operate throughout the Pacific Ocean in the 1990s and 2000s, while offshore longline vessels operated in the North Pacific Ocean. However, most of blue marlin was caught in tropical Pacific Ocean for these two fisheries, as a result of high abundance and thus high catch-rates in tropical waters. The largest proportion of blue marlin catch comes from the offshore longline fishery in Taiwan, with a catch of 3,553 mt for 2010. The catch of blue marlin from the Taiwanese distant-water longline fishery is 1,490 mt in 2010. However, small catches of blue marlin are also taken by various offshore and coastal fisheries, such as gillnets, harpoons, and set nets.

Keywords: catch, effort, longline, gillnet, harpoon, set net

Introduction

Blue marlin (*Makaira nigricans*) is a highly migratory species distributed throughout tropical, sub-tropical, and temperate waters of the Pacific Oceans (Molony, 2008). A single stock of blue marlin in the Pacific Ocean has been assumed based on genetic analyses (Graves and McDowell, 2003) and fishery catch-rates (Kleiber et al., 2003). This assumption is also supported by the results of tagging experiments that have demonstrated that blue marlin migrate long distances and throughout the Pacific basin (Hinton, 2001).

Blue marlin are the largest of the billfishes, attaining up to 450 cm in length and over 900 kg in weight, and are the most popular gamefish because of their size and fighting ability (Molony, 2008). They exhibit, however, sexual dimorphism in size,

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with males reaching a maximum size of 200 cm in length while females can grow to more than this (Wilson et al., 1991; Hinton, 2001). The sizes-at-maturity of blue marlin also differ between males and females (Sun et al., 2009).

Annual catches, catch-effort data and length samples of blue marlin in the pacific Ocean caught in Taiwanese fisheries were collected from the Oversea Fisheries Development Council (OFDC, Taiwan), and summarized by fishery in this study. This review of Taiwan's blue marlin fisheries in the Pacific Ocean is important and necessary when conducting stock assessments for this population and implementing fisheries management for sustainable use of this resource.

The blue marlin fisheries in Taiwan

The blue marlin fisheries in Taiwan, for the Pacific Ocean, are composed primarily of the distant-water longline, offshore longline, offshore and coastal gillnet, coastal harpoon, and coastal set net fisheries. In contrast, very small catches of blue marlin were taken from other fisheries, e.g. coastal longline and other net fisheries (Fig.1). Most of blue marlin was caught in Taiwanese offshore tuna longline fishery, followed by the distant-water tuna longline fishery. Catches of blue marlin from the offshore longline fishery ranged between 3,210 and 4,524 mt in recent ten years (2001-2010), while catches from the distant-water longline fishery are between 495 and 1,678 mt (Fig. 1). Catches of blue marlin from the coastal gillnet fishery were high in the 1980s, with a maximum catch at 973 mt in 1987, but decreased from the mid-1990s. In recent five years (2005-2010), catches from this fishery accounted for only 12 to 30 mt. Small amounts of blue marlin catches were reported for various fisheries other than longline and gillnet fisheries in Taiwan, such as harpoon and set net fisheries (i.e. other fisheries in Fig. 1).

The offshore longline fishery

Blue marlin are primarily taken as bycatches in Taiwanese distant-water and offshore tuna longline fisheries targeting tunas in the Pacific Ocean (Sun and Yeh, 2008). The catches of blue marlin from the offshore longline fishery increased gradually from less than 1,000 mt in the 1960s to a maximum of 4,617 mt in 1987 and 4,524 mt in 2001, but decreased afterward with a catch of 3,553 mt in 2010 (Fig. 1). The fishing effort of the offshore longline fishery decreased slightly in recent years (2008-2010), while the catches of blue marlin from this fishery showed an increasing trend. The nominal CPUE of blue marlin for this fishery increased from 0.338 to 0.540 (number caught per 1000 hooks) (Fig. 2).

The offshore longline vessels change their fishing grounds and target species based on fishing season and market price. Most of them operate beyond the exclusive economic zone (EEZ) of Taiwan (Fig. 3). Vessels with freezing equipment extended their fishing grounds to more distant waters operating in a similar pattern as the distant-water longline vessels. However, most of blue marlin was caught in waters off Taiwan (Western Pacific Ocean, WPO) by this fleet, and high catch-rates occur in the tropical WPO (Fig. 3).

The distant-water longline fishery

The distant-water longline vessels refer to those larger than 100 GRT and the length over all (LOA) greater than 24 meters, which mostly operate in waters of foreign EEZ and high seas. The Taiwanese distant-water tuna longline fleets mainly operated in the South Pacific Ocean during the 1960s to 1970s (1964-1979). However, this fleet extended the fishing grounds to whole Pacific Ocean in the following two decades (1980s and 1990s). During 2000 to 2010, the Taiwanese distant-water longline vessels operated throughout the Pacific Ocean (Fig. 4).

Distributions of blue marlin catches from this fishery were shown by decade in Fig. 5. Despite the extension and shifts of fishing grounds for the distant-water tuna longline fishery, most of blue marlin was caught in tropical waters of the Pacific Ocean, because blue marlin prefer to inhabit tropical warm waters of temperature above 26°C (Block et al. 1992). However, there is a increasing trend in catches of blue marlin from this fishery after 2000 (Fig. 5), due to the increasing effort especially in tropical waters.

The catch-rates (CPUE) of blue marlin for this fishery were low during the initial development stage of the fishery (1960s and 1970s; Fig. 6). However, we can see a pattern that high catch-rates of blue marlin occur in tropical waters of the Pacific Ocean (plots of 1980s and 1990s in Fig. 6). It is also evident that the catch-rates were getting higher in the 2000s (2000-2010) than before, because these vessels changed targeting practices from albacore tuna (*Thunnus alalunga*) to bigeye tuna (*Thunnus obesus*). In general, blue marlin are much more abundant in the tropical WPO. Therefore, blue marlin CPUEs become higher when the distant-water longline vessels shifted their fishing grounds to tropical waters since 2000 (Fig. 6).

Size data

Length-frequency distributions of blue marlin caught by the Taiwanese distant-water longline fleets in the Pacific Ocean were shown by year for 2005-2010 (Fig. 7). The

sample sizes of length samples for blue marlin ranged from 3,831 to 17,705. It is obvious that only one single mode appears in the length-frequency distributions (Fig. 7). The mean lengths of the size samples also remain relatively stable during this period (ranging between 171.9 and 176.6 cm LJFL, lower jaw fork length). However, we suggest that sex information of the size data should be collected in the future because blue marlin is a well-known sexually dimorphic species (Sun et al., 2009) and thus the stock assessment model developed for blue marlin should be sex-structured and fitted with sex-specific length composition data (Kleiber et al., 2003).

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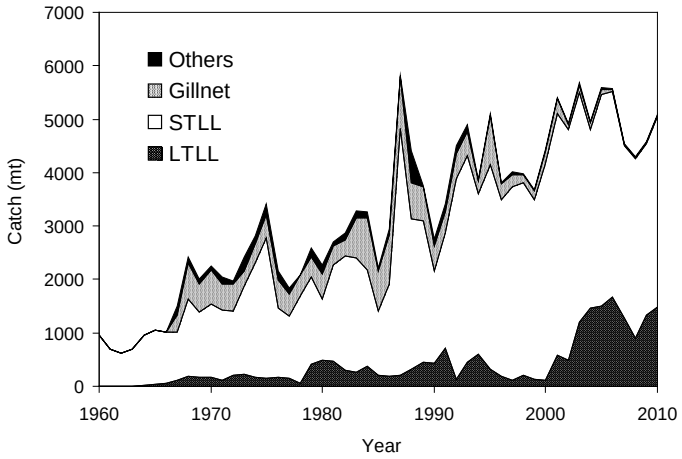


Fig. 1. Annual catches of blue marlin from the Pacific Ocean by fishery in Taiwan. LTLL: the distant-water longline fishery; STLL: the offshore longline fishery; Gillnet: the offshore and coastal gillnet and other net fisheries; Others: all the other fisheries.

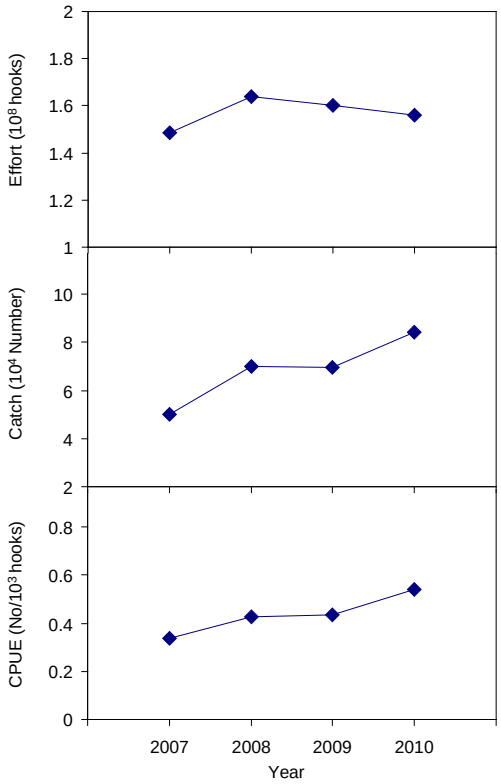


Fig. 2. Fishing effort of the Taiwanese offshore longline fishery and the catch and CPUE of blue marlin caught in this fishery.

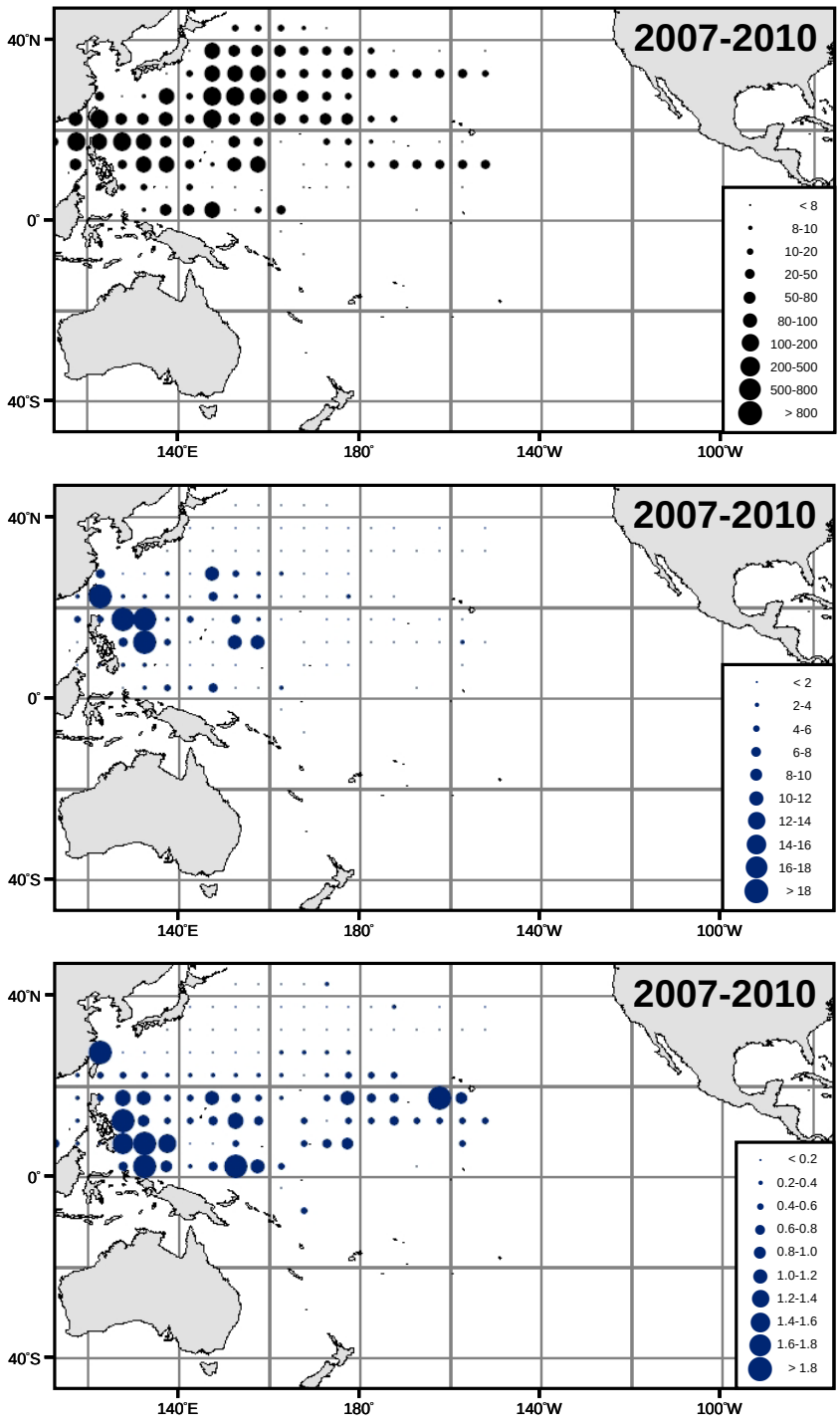


Fig. 3. Distribution of fishing effort (10^5 hooks, upper panel) for the Taiwanese offshore longline fishery and the catch (1000 fish, middle panel) and CPUE (number per 1000 hooks) of blue marlin caught in this fishery.

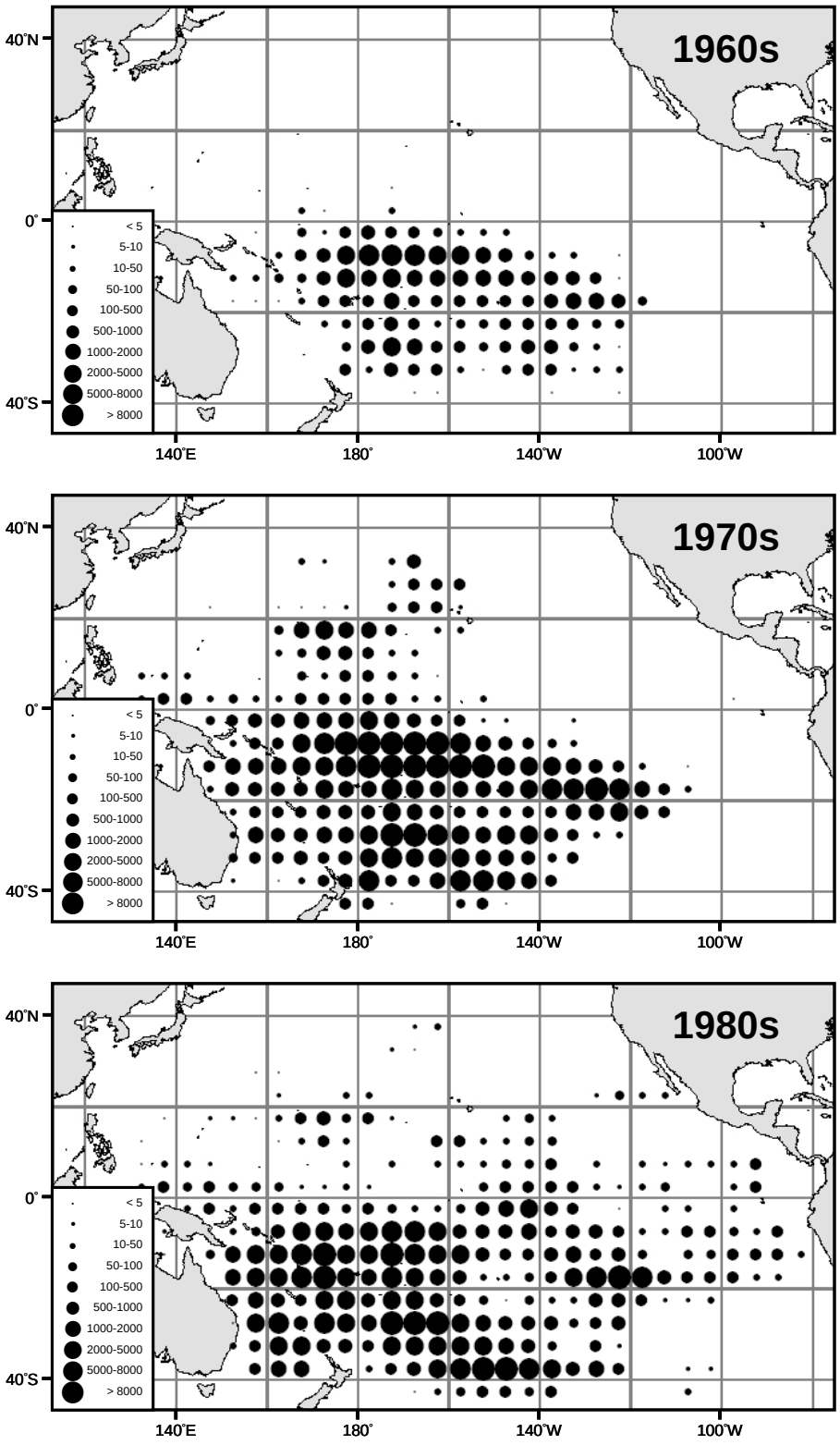


Fig. 4. Effort distributions for Taiwanese distant-water longline fleets in the Pacific Ocean by decade (unit: 10^3 hooks) and for 1964-2010 (unit: 10^4 hooks).

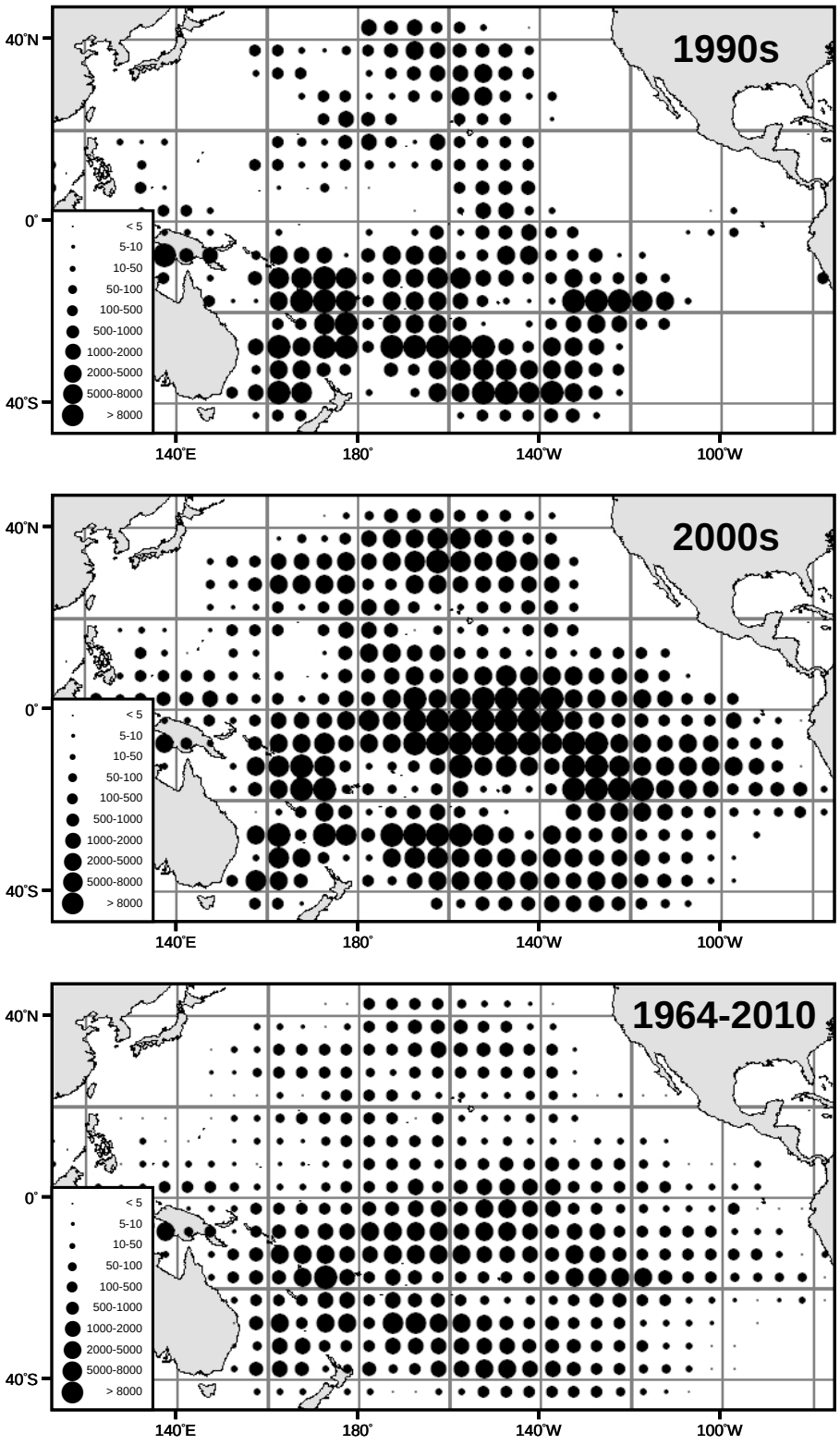


Fig. 4. Continued.

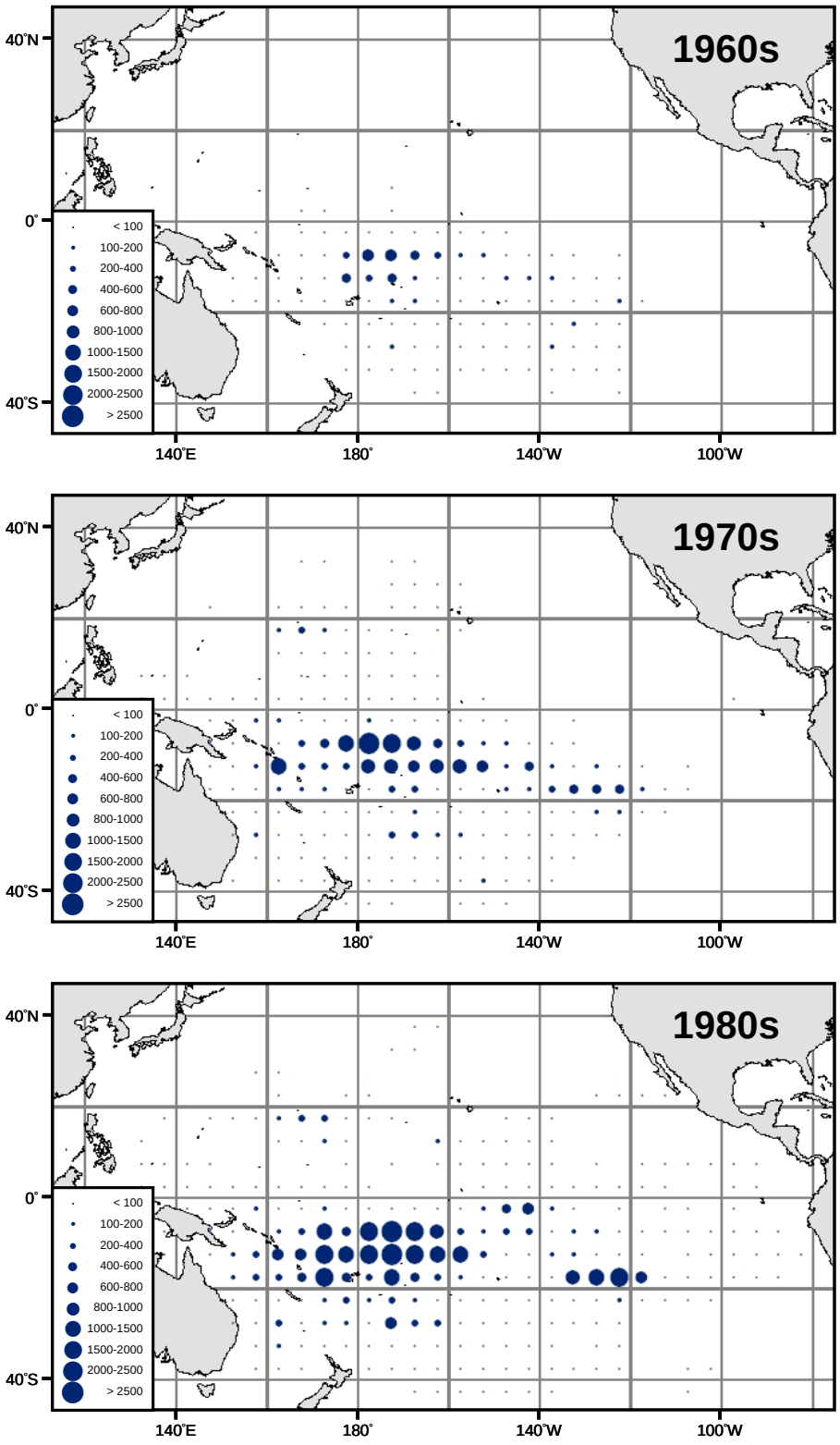
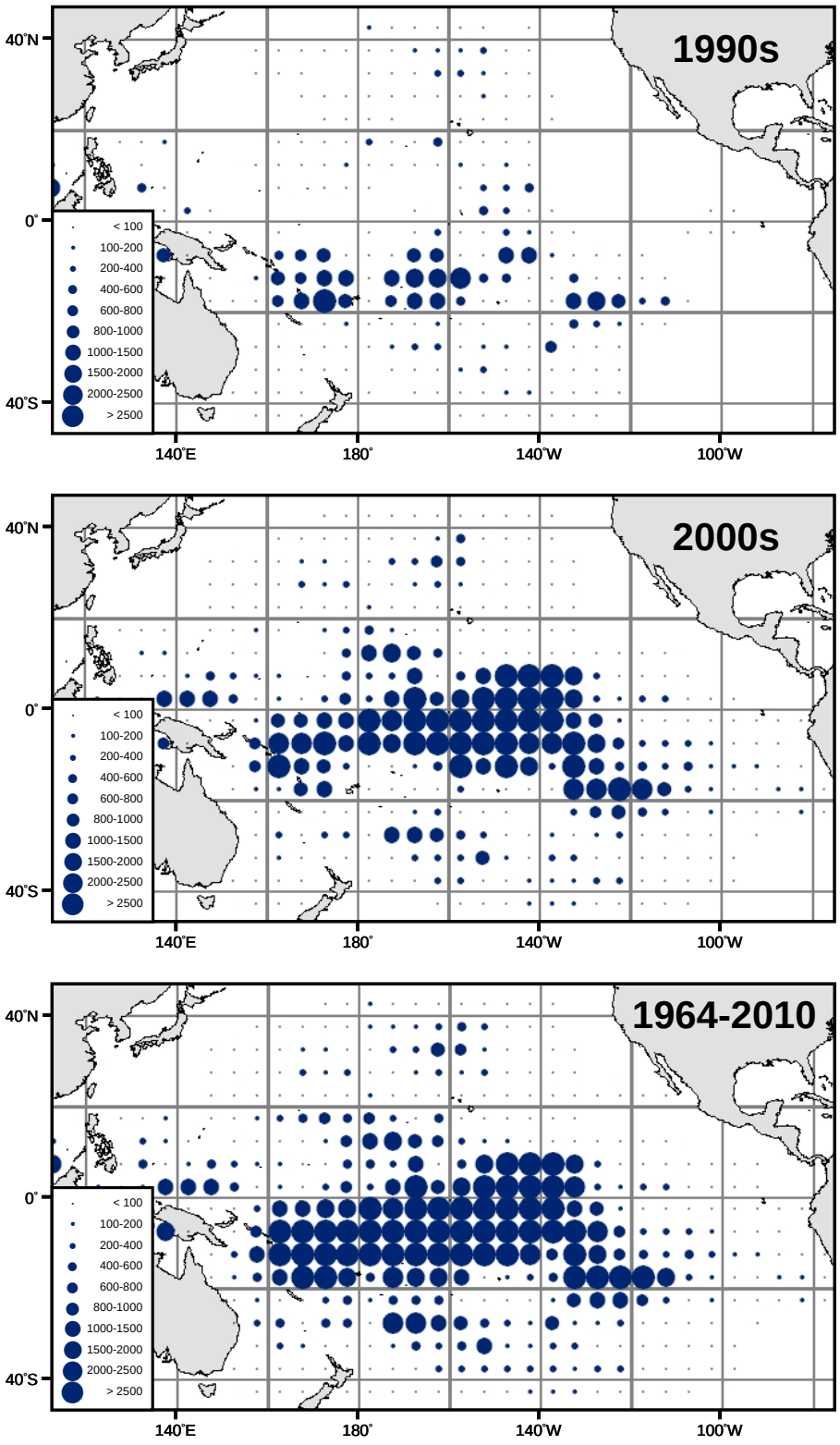


Fig. 5. Distributions of blue marlin catch (in number) caught by Taiwanese distant-water longline fleets in the Pacific Ocean by decade and for 1964-2010.



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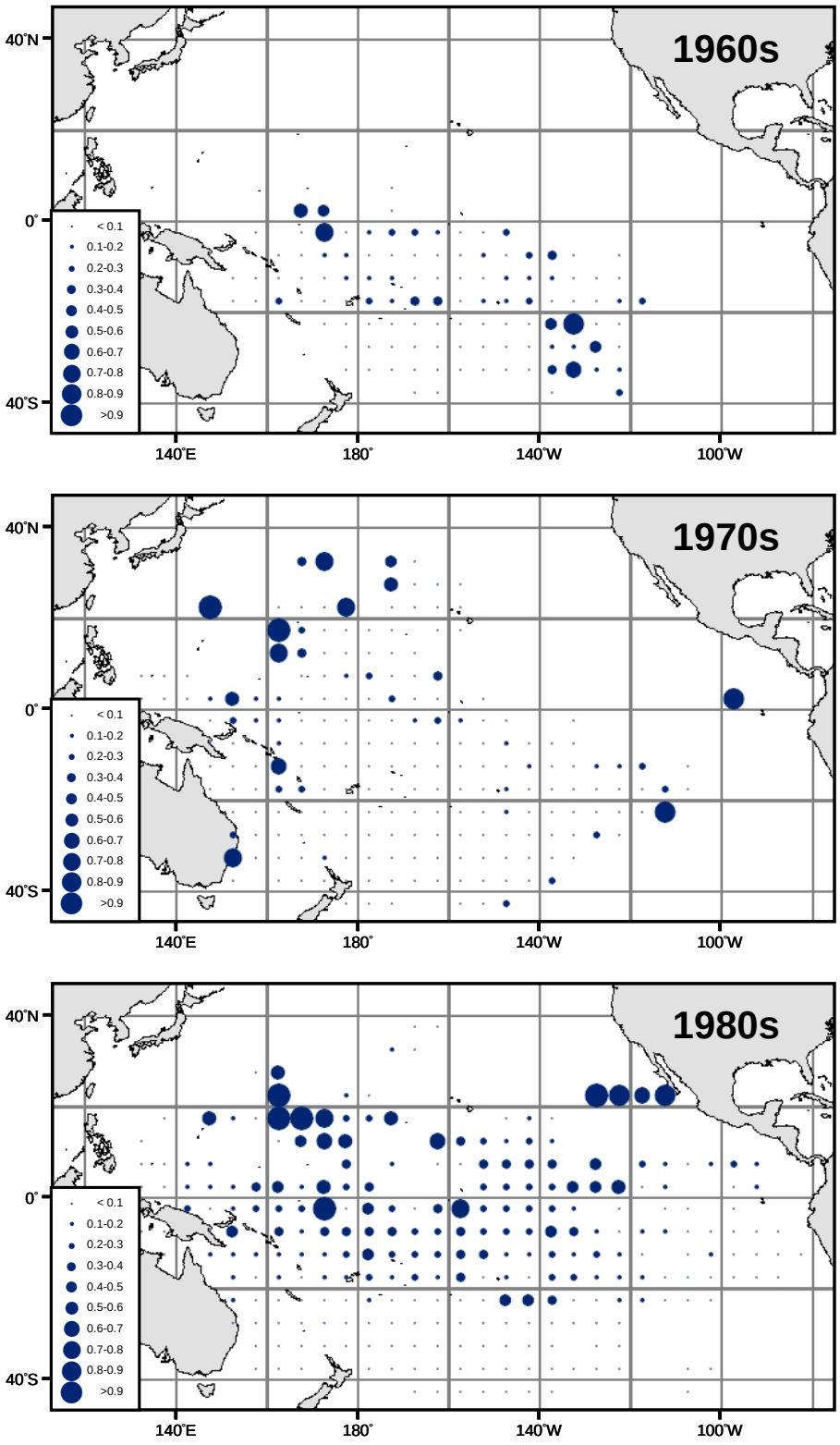
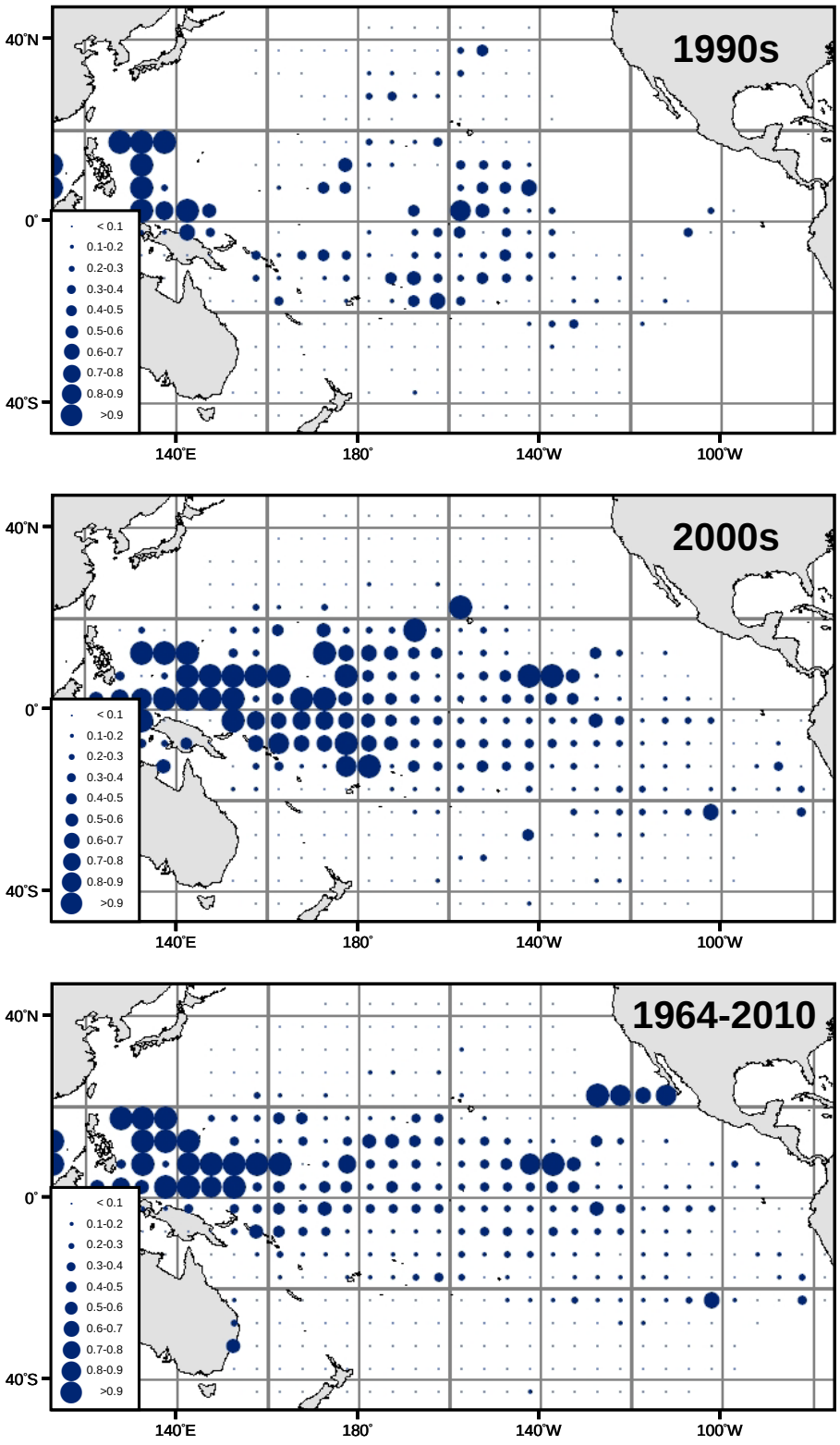


Fig. 6. CPUEs (number caught per 1000 hooks) of blue marlin for Taiwanese distant-water longline fishery in the Pacific Ocean by decade and for 1964-2010.



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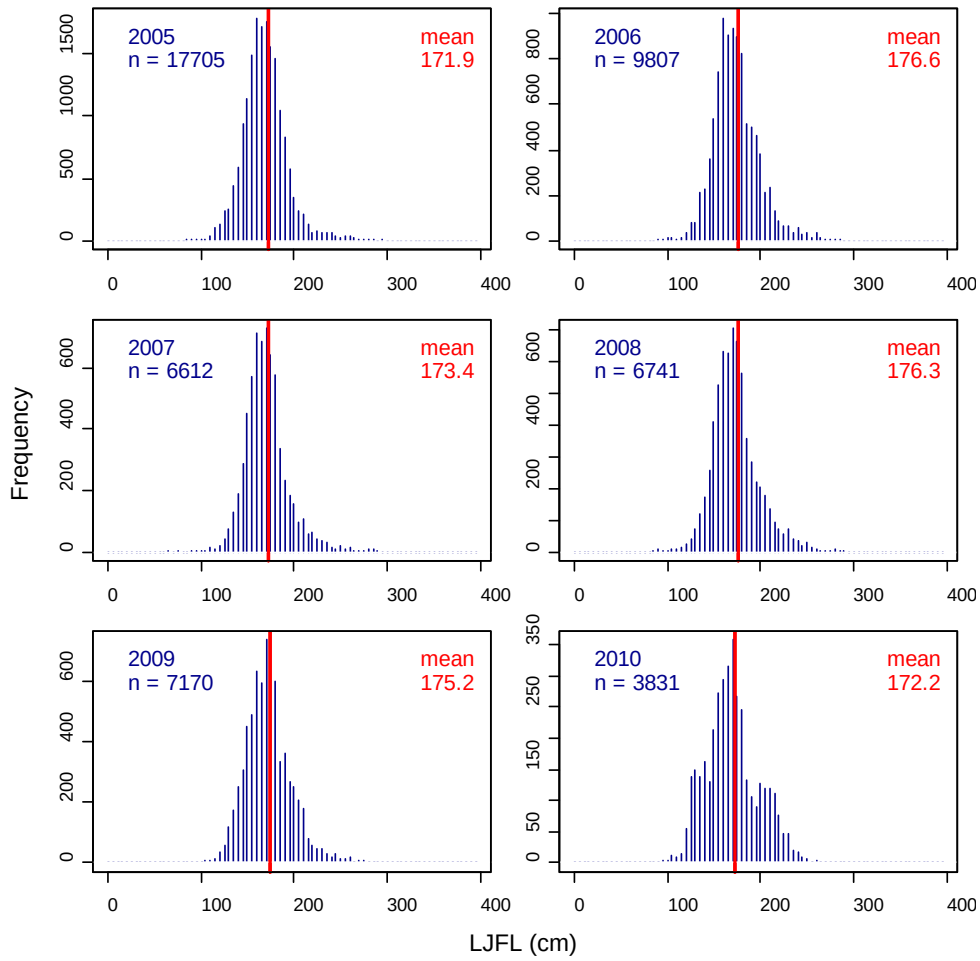

Fig. 7. Length-frequencies of blue marlin caught by Taiwanese distant-water longline fleets in the Pacific Ocean for 2005-2010. “n” denotes the sample sizes. “mean” indicates the mean length of the size samples.