General reviews of Indian Ocean Albacore (*Thunnus alalunga*)

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1. Fisheries (refer to Figs. 1-3)

Fisheries on albacore tuna started in the first half of the 1950s by Japanese longline fishing vessels. Later, longline fishing vessels of Taiwan and the Republic of Korea made entry in 1954 and 1966, respectively. Since the start of operation, catch by longline fisheries had gradually increased, remaining below 10,000 tons by 1960. Afterwards, catch increased by 1985, fluctuating between 10,000 tons and 30,000 tons. Taiwan conducted driftnet fisheries for six years from 1986 to 1992, harvesting approximately 20,000 tons and pushing the overall harvest to the 30,000 ton level.

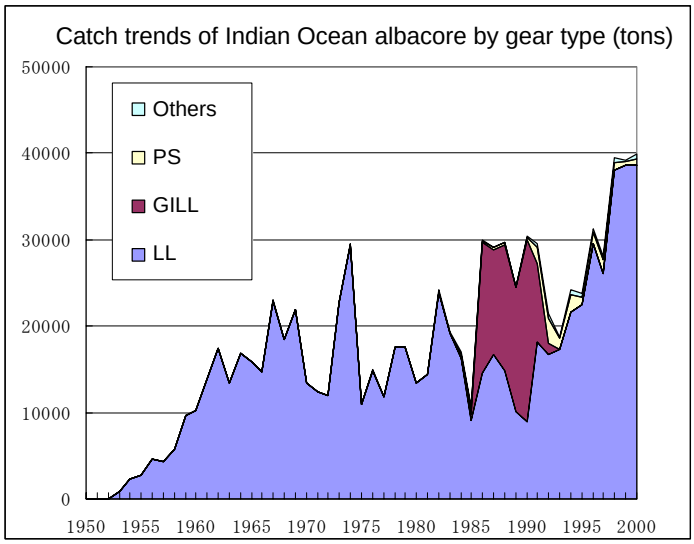

Fig. 1 Catch trends of Indian Ocean albacore by gear type (refer to the updated figures to 2003 in IOTC-WPTMP-04-01 by the IOTC Secretariat).

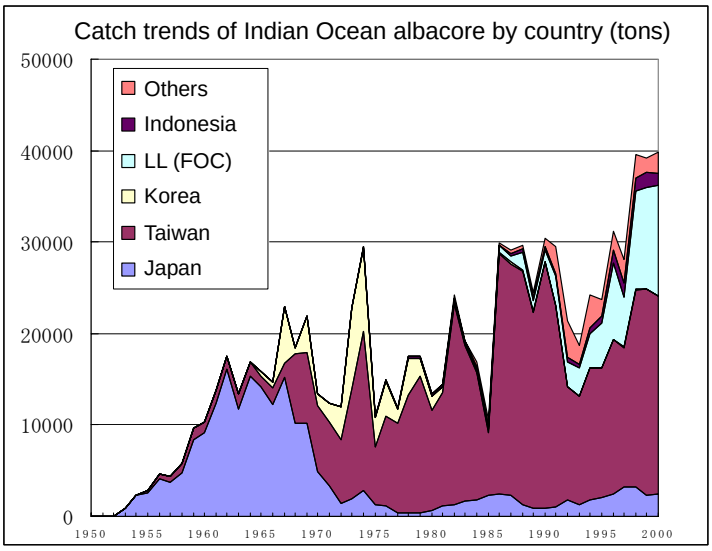

Fig. 2 Catch trends of Indian Ocean albacore by country (refer to the updated figures to 2003 in IOTC-WPTMP-04-01 by the IOTC Secretariat).

However, the total catch decreased to below 20,000 tons in 1993, the year after gillnet fishing ended. Later, catch by longline fisheries gradually increased, with the overall catch reaching the 40,000 ton level in 1998-2000. Besides, purse seine fisheries started in the western Indian Ocean in 1984, increasing the overall catch to the maximum of 3,300 tons. Longline fisheries accounted for 83-99% of all the catch of this species, except for 6 years when gillnet fishing was conducted. Further, more than 70-80% of the catch by longline fishing in recent years has been taken by Taiwanese longline fisheries.

2. Biology

2.1 Morphology

The body is fat in a spindle shape, and fully covered with scale. The pectoral fin is conspicuously long and slender and is shaped like a ribbon. Its tip reaches further back than the lower part of base of the second dorsal fin. The number of gill rakers is 30 or less, and dorsal surface of body is blackish blue and stomach surface is silver white (Plate 1).

Plate 1 Indian Ocean albacore (courtesy from Koji Uosaki, NRIFSF)

2.2 Length and weight relationship

The following relational expression between body weight (W: kg) and body length (fork length, L: cm) has been reported.

Lee and Kuo (1988)

Male $W = (3.383 \times 10^{-5})L^{2.8676}$

Female $W = (4.183 \times 10^{-5})L^{2.8222}$

2.3 Growth

According to the studies on scales by Huang *et al* (1990), Indian Ocean albacore have been confirmed up to the age of 8. The following three growth formulae have been reported.

L: fork length (cm), t: age

(a) Huang et al (1990) : based on scale

$$L_{t(cm)} = 128.13\left(1 - e^{-0.162[t-(-0.897)]}\right)$$

(b) Lee and Liu (1992) : based on vertebrae

$$L_{t(cm)} = 75.5\left(1 - e^{-0.1019[t-(-2.0668)]}\right)$$

(c) Hsu (1991) : based on size frequency distributions

$$L_{t(cm)} = 136\left(1 - e^{-0.159[t-(-1.6849)]}\right)$$

2.4 Natural mortality

Two reports are available on natural mortality of Indian Ocean albacore.

(a) Lee *et al.* (1990)

M=0.206 estimated by the method of Pauly (1990).

(b) Lee and Liu (1992)

M=0.2207 estimated from Z=q*F+M using longline fishing data

3. Ecology

3.1 Distribution

Indian Ocean albacore is distributed from 5 ^{o}N to 40^{o}S. The high density water is the mid-latitudinal area, as compared with that for bigeye and yellowfin centering on the equatorial area. The area from 5 ^{o}N to 25 ^{o}S is the distribution area for adult fish, in which spawning area exists in the area from 10 ^{o} S to 25 ^{o} S and feeding water from 30 ^{o} S to 40 ^{o}S, with the high fish school density. The southern and northern boundaries of distribution slightly differ seasonally.

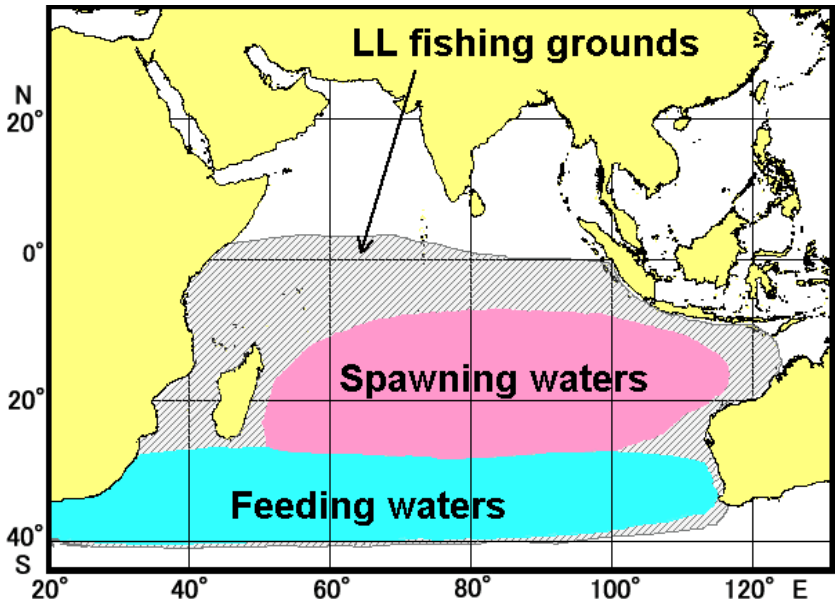

Fig. 3 Distribution of spawning waters, feeding waters and tuna longline fishing ground of Indian Ocean albacore.

The Ocean currents run over wide spatial ranges and are considered to be the most important factor in influencing the distribution of albacore and formation of fishing grounds. The convergent fronts are formed around south of 10 ^{o}S of the equatorial countercurrent, forming the northern boundary of an abundant albacore fishing ground.

3.2 Migration

Albacore has well-developed pectoral fins and migrates extensively for feeding and spawning. There exist no studies on migration of albacore in the Indian Ocean, and migration routes and other information have not been clarified.

3.3 Stock structure

The distribution of albacore in the Pacific and the Indian Ocean can converge in the area south of Australia, and the distribution of albacore in the Indian Ocean can converge at the southern tip of Africa, intermingling in some areas (Koto, 1969). However, from the serological viewpoint, they show a considerably heterogeneous reaction, suggesting that they are different stocks (Suzuki, 1962). Further, from characteristics of the body length composition, juvenile fish and distribution, Indian Ocean albacore is considered to constitute a single stock (Hsu, 1992).

3.4 Feeding

Like other tunas, albacore mainly feed on fishes, crustaceans and cephalopods. They consume the feed organisms found in large quantities in their habitat, and prey on them mainly during daytime in a non-selective manner. Therefore, the composition of stomach contents changes substantially from area to area and season to season. In the western Indian Ocean, albacore mainly feed on *Triacanthidae, Alepisauridae, Polyipnus, Carangidae, Gempylidae and Caproidae* (Koga, 1958a).

3.5 Spawning

No detailed information is now available in the Indian Ocean. The information given below pertains to the case of the Pacific. It is considered that albacore in the western Pacific spawn when the ovary grows to 200g or over, and the minimum body length is 87cm. As males with gonad of 150g or over are deemed to be mature individuals, their minimum body length is 97cm. The diameter of an egg in the ovary grows to 0.6mm or longer during the maturity period, and the weight of ovary is commonly 100-200g. In the case of large-size adults, it grows to 20kg or over. In the case of an individual of body weight of around 20kg, the number of incubated eggs per head is 1.8 million-2.1 million (Ueyanagi, 1955).

Since more than one spawning is estimated to take place during one spawning season, the actual number of eggs spawned is estimated to be considerably larger than the number of incubated eggs. The maturity age is 5 years or over.

3. Stock status

The stock assessment of this species has been reported by the IPTP (Indo-Pacific Tuna Development and Management Programme) before 1998 and by the IOTC (Indian Ocean Tuna Commission) from 1998. The stock assessment has been carried out by production models, longline CPUE analyses and cohort analyses (VPA). In the recent stock assessment, MSY was estimated at 31,000 tons through the production model analysis carried out in 1998.

Concerns were expressed on the stock status as there were fishing pressures of a maximum of 20,000 tons by driftnet fishing by Taiwan in 1986-1991. But since catch below the MSY level continued for six years from 1992 to 1998, it was considered that fishing

pressure declined compared with the period when driftnet fishing had been conducted.

However, catch from longline fishing by Taiwan increased to over 20,000 tons from 1998. As a result, the overall catch increased close to 40,000 tons in 1998-2000 and the trend of surpassing the MSY level by about 10,000 tons continued for three years. For this reason, the stock is not considered to be in a favorable status.

4. Management

In the IOTC, a working group on temperate tuna was established to address the issue of albacore as one of the primary tasks. But to this time no meetings have been convened. As no stock assessments have been conducted, no specific managements are in place now. Because catch in excess of the MSY level continues now, there is an urgent need to convene a meeting of the working group in order to carry out stock assessment and set out specific management method. Hence, the IOTC decided at its 7th annual meeting in 2003 to convene a meeting of the temperate tuna working group in 2004 to carry out stock assessment of albacore. Reviews of detail stock assessments is available in the other document (IOTC-WPTE-04-04).

Table 1 Summary of stock status and management (As of July, 2004)

Stock level	Medium
Stock trend	Declining
Catch (1998-2002)	33,000-42,000 tons
Management goal	None
Present stock status	MSY (31,000 tons) (estimated in 1998)
Management measures	None

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