Observations on South Pacific albacore spawning as indicated by gonad indices

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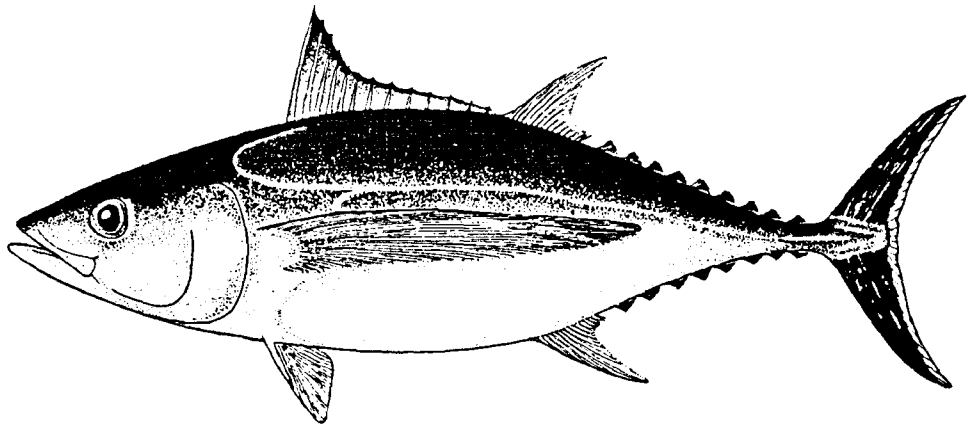

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3. DATA COLLECTED

3.1 Caledonie Toho longline samples

This component began in May 1990. Samples of chilled albacore caught primarily in the New Caledonia EEZ (15-25°S., 155-170°E) and landed in Noumea for the local market and export to Japan. Fish are sampled by TBAP staff once a week as the three to four vessels fleet unloads its catch. A sample of up to 100 albacore is also measured during each unloading day.

Availability of albacore to sample in this fishery depends on the market and season in Japan. During the austral winter, from June to September, almost all albacore above 16 kg in weight, which usually accounts for 90% of the catch, are exported to Japan because of their high fat content. Sampling during these three months is often limited to fish below 90 cm in fork length that are diverted to the local market, or when the vessels unload quantities in excess to Japanese demand. The reverse fortunately happens during the austral summer, allowing for adequate sampling of large albacore that are approaching or are in spawning condition.

Sampling records for the 84 female and 159 male albacore examined in Noumea are presented in Table 1. It is anticipated that sampling will be completed in May at the end of the 1992 austral summer. The data set will therefore span a period of two years, which should be adequate to determine spawning seasonality in New Caledonia waters.

3.2 MV Lofa samples

The Lofa sampling component began in January 1990, with the assistance of the Tongan Fisheries Division. To date, five trips of the vessel in Tongan waters (13-25°S, 178-172°W) have been covered. Sampling is carried out by the crew when time permits after the fish have been landed. The radio operator, who was trained in sampling procedures by a TBAP staff member, supervises all stages of collection, labelling and recording of gonad data. Table 2 details the numbers of fish that have been sampled during the first four trips. A further 78 females and 26 males were examined, and four pairs of gonads collected during the fifth trip (April - July 1991), but the complete data set for the trip was not available at the time of writing. Unfortunately, no gonad weight data were collected from September 1990 to mid-February 1991 because the scale being used was broken and could not be replaced for some time. The project will continue until the end of the 1992 austral summer, thus filling the above mentioned gap in the data set.

3.3 Other sampling projects

A sampling protocol modelled on those used in Noumea and on the Lofa was prepared for the Cook Islands Ministry of Marine Resources in October 1991, so that Ministry staff could collect gonads from albacore caught while handlining near local fish aggregation devices. No gonads have been collected as yet.

Port sampling operations at the PAFCO cannery in Levuka have recently been re-established, and plans are currently being made to initiate gonad sampling in Papeete, French Polynesia. it is hoped that this additional sampling will facilitate future assessment of the spatial and temporal trends in spawning periodicity.

4. ANALYSIS OF DATA

Fig. 1 shows the length frequency distributions of the albacore that have been examined and sexed. Although the sample sizes are not large, it appears that male and female albacore exhibit differences in size structure. In both the Caledonie Toho and Lofa samples, few females have ever been measured over 100 cm in length whereas both male samples exhibit a pronounced mode centered on 100-102 cm. This apparent dimorphism warrants further research, and should be considered in any ageing or mortality studies undertaken.

Gonad indices were calculated for Caledonie Toho females, Lofa females and males, using the formulae;

(1) $$\text{Gonad Index} = 10^4 \, W \cdot L^{-3}$$

where:

W = Total gonad weight (g)
L = Fork length (cm)

The relationship between gonad indices and fork length is presented in Fig. 2. Assuming that an index of 2.0 corresponds to the minimum level for tuna approaching spawning condition, it appears that female albacore from both the Tonga and New Caledonia EEZs are capable of spawning once they attain a length of 85 cm. This length corresponds to a total gonad weight of at least 160 g. The largest indices are seen with a 96 cm fish from the Caledonia Toho sample, with an index of 4.7 and gonad weight of 415 g, and a 89 cm fish from the Lofa samples, with an index of 5.0 and gonad weight of 350 g.

While none of the male albacore from the Lofa samples exceeded a gonad index of 2.0, there was a pronounced increase in the indices for fork lengths greater than 90 cm. The largest index attained by a male was 1.8 for a 98 cm fish, with the gonads weighting 165 g. The relationship between gonad index and reproductive condition for both males and females will be determined from histological examination of gonad samples.

The relationship between gonad indices and sampling period is shown in Fig. 3. All three components of this figure exhibit a standard sequence of presumed reproductive activity, which almost invariably peaks during the austral summer months, more specifically during the November - February period. This is followed by a decline in activity during March, and a period of inactivity between April and September. Thus the data collected so far clearly supports the theory that South Pacific albacore only spawn during the austral summer.

The differences in size of the right and left gonads of albacore are summarized in Table 3. The right gonads of both female and male albacore from the Lofa sample are on average 17.0-18.6 g larger than their left gonad. This relationship is not readily apparent with the Caledonie Toho females, where the mean difference is only 2.7 g.

One hypothesis to explain the asymmetry in gonad weight, and by inference gonad maturity, is that it allows the fish to keep one gonad in reserve for opportunistic spawning. That the greatest differences in weights of individual gonads are seen in albacore that are in spawning condition would appear to support this theory. Histological examination of the gonads by NMFS scientists should help to explain what is happening and perhaps why. A joint analyses of the data, involving the TBAP and NMFS will be made once the sampling projects and histological work are completed.

5. TABLES

Table 1. Albacore gonad sampling from Caledonie Toho longliners, May 1990 - August 1991.

Fork length range (cm)	Females numbers sexed	Females gonads weighted	Females gonads collected	Males numbers sexed	Males gonads weighted	Males gonads collected
70-79	2	1	1	3	-	-
80-89	44	42	43	29	4	4
90-99	33	32	32	58	-	-
100-109	5	5	5	69	-	-

Table 2. Albacore gonad sampling on *MV Lofa*, January 1990 - March 1991.

Fork length range (cm)	Females numbers sexed	Females gonads weighted	Females gonads collected	Males numbers sexed	Males gonads weighted	Males gonads collected
70-79	5	5	-	8	8	-
80-89	45	27	28	32	20	-
90-99	79	47	4	95	64	-
100-109	4	4	2	191	116	-

Table 3. Asymmetry in gonad weight of albacore sampled from Caledonie Toho longliners and *MV Lofa*, January 1990 to August 1991.

Gonad measurements	Females Caledonie Toho	Females *MV Lofa*	Males *MV Lofa*
Right > Left	38 (57%)	77 (93%)	206 (9%)
Right = Left	6 (9%)	6 (7%)	2 (1%)
Right < Left	23 (34%)	0	0
Right - Left ($\bar{x}$)	2.7	18.6	17
Right - Left (St. d)	33.7	11.8	16.3
Right - Left (range)	-130, +120	0-55	0-105

6. FIGURES

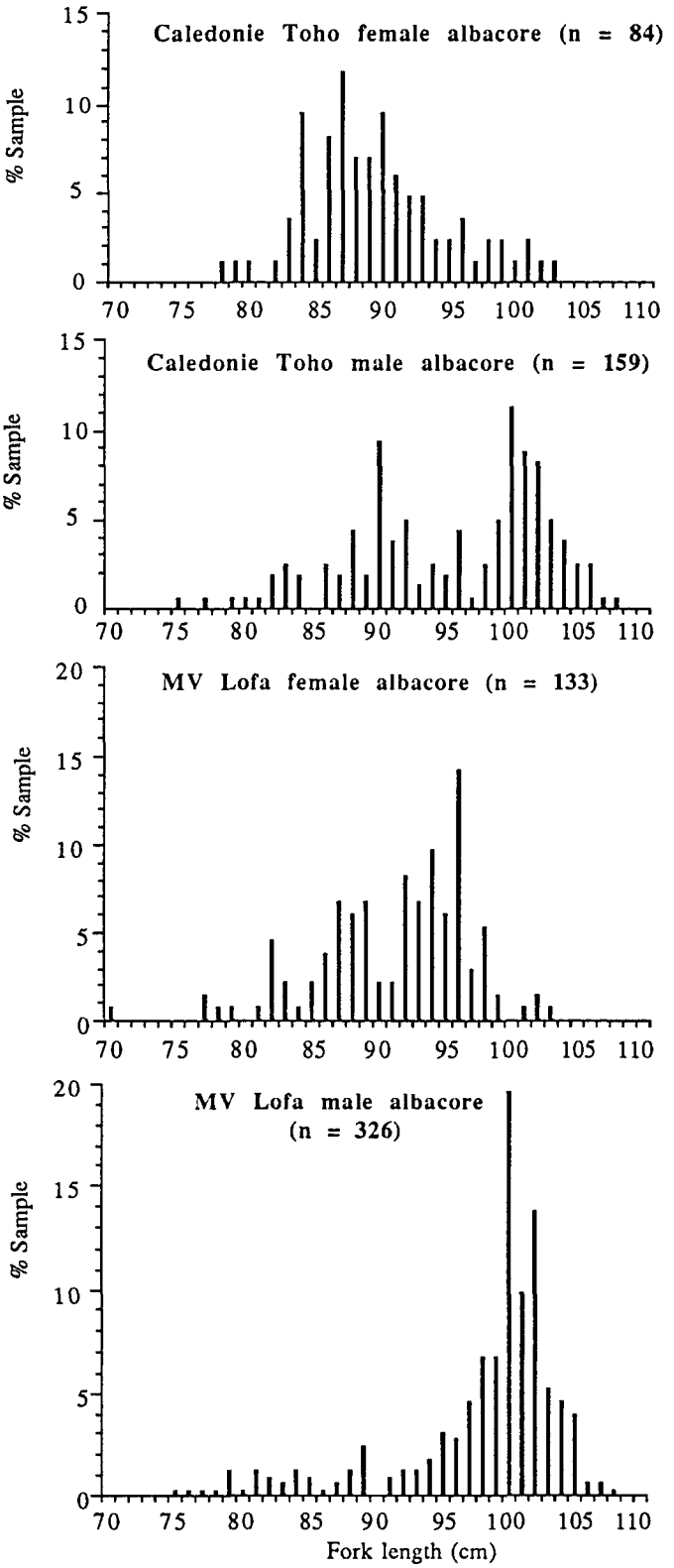

Figure 1. Length frequency distributions of albacore sampled from Caledonie Toho longliners and MV Lofa, January 1990 - August 1991.

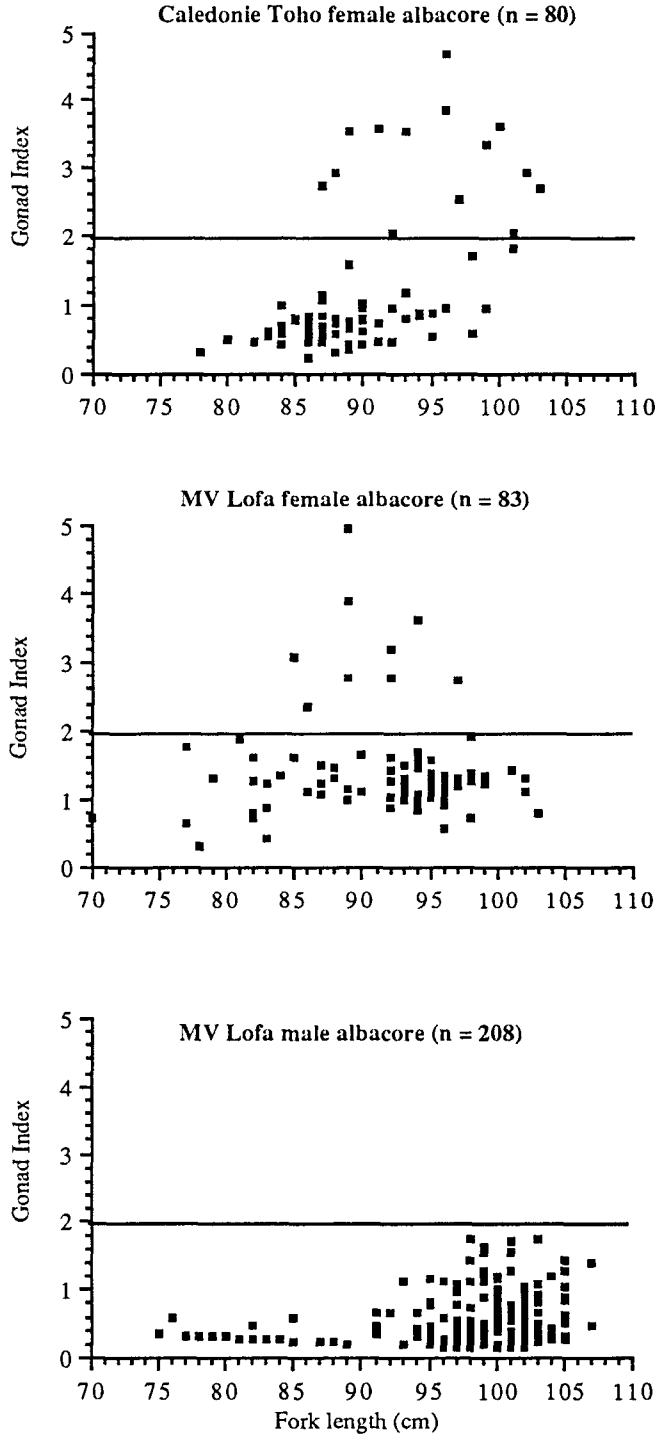

Figure 2. Gonad indices of albacore sampled from Caledonie Toho longliners and *MV Lofa*, January 1990 - August 1991.

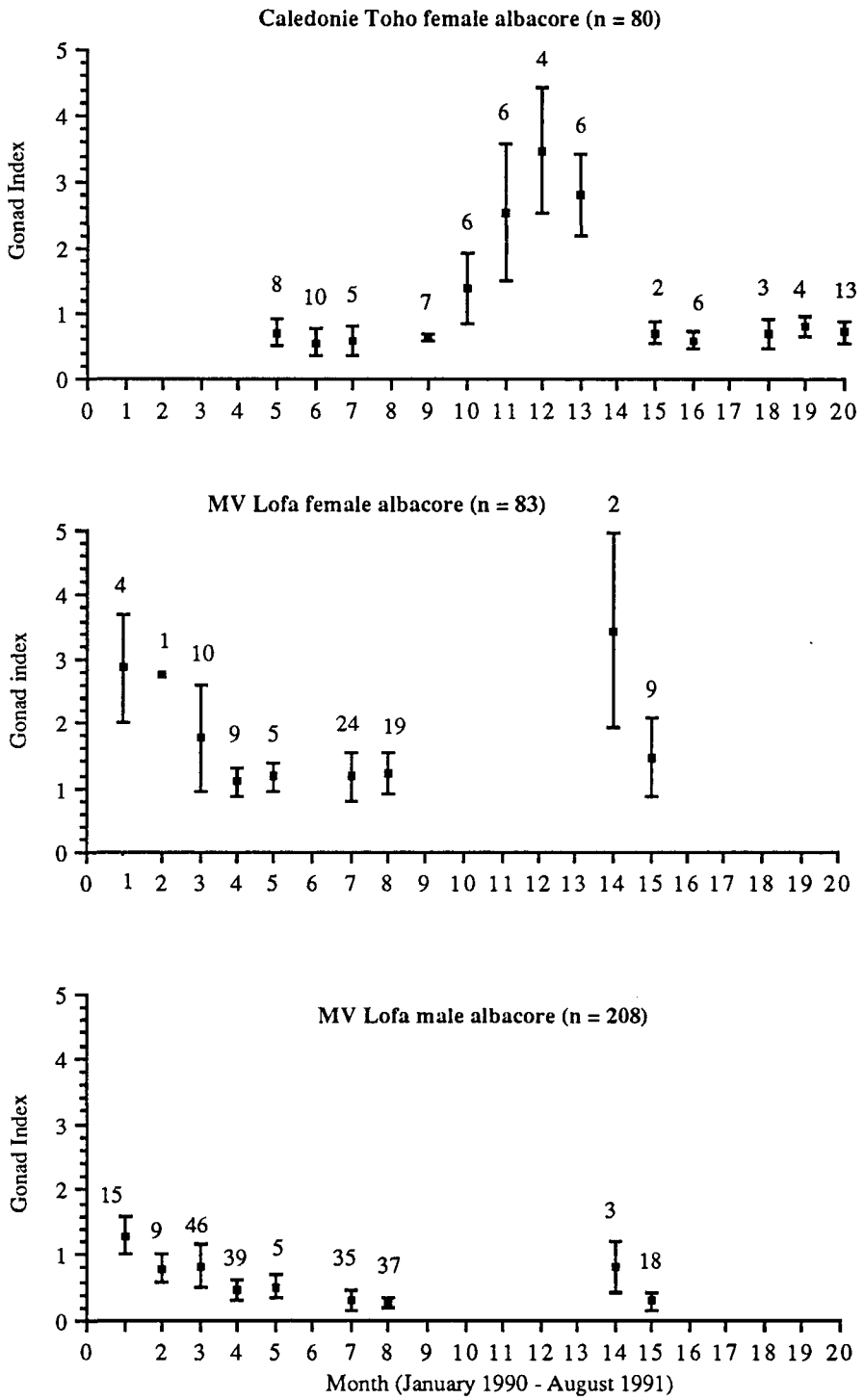

Figure 3. Mean monthly gonad indices (± 1 standard deviation) of albacore sampled from Caledonie Toho longliners and *MV Lofa*, January 1990 - August 1991.