# EXPERT CONSULTATION ON THE STOCK ASSESSMENT OF TUNA IN THE INDIAN OCEAN

MAURITIUS

22-27 JUNE 1988

***

## SEYCHELLES RESEARCH OBSERVER PROGRAM

***

G. LABLACHE*

and

B. KARPINSKI**

***

JUNE 1988

---

* SEYCHELLES FISHING AUTHORITY, P.O. Box 449, Mahe, Seychelles
** ORSTOM, P. O. Box 570, Mahe, Seychelles

## 1. INTRODUCTION

The commercial exploitation of tuna by purse-seiners in the Western Indian Ocean began in November 1982, when four French purse seiners from the Western Atlantic started fishing operations. In November 1983 a fishing licence agreement was negotiated with the Spanish Government for 15 purse seiners and in January 1984 with the European Community for 18 purse seiners. This was closely followed by private agreements with French, Spanish and Ivory Coast Companies. Hence by December 1984 at the peak purse seine fishing activity, 49 vessels were fishing in the Western Indian Ocean based in Port Victoria, Seychelles.

At present around 40 purse seiners are still active in the region and Victoria still remains the major transhipment centre. Tuna catches for 1986 and 1987 totalled 143,000 tonnes (9334 days at sea) and 163,000 tonnes (9072 days at sea) respectively of which over 90% were transhipped in Seychelles. (SFA 1987).

Since the beginning of the fishery, logbooks are submitted by fishing captains and transhipment data are obtained from stevedoring companies and through port sampling. In order to supplement available biological knowledge on the fishery, a research observer programme was started in November 1985 by the Seychelles Fishing Authority (SFA). Since then, SFA has received assistance from ORSTOM involving training of observers and technical aspects of the programme. The programme is based on foreign fishing vessels licensed in Seychelles and up till now has been limited to purse-seiners only.

## 2. OBJECTIVES

The program objectives are as follows:

a) to recruit and train local technicians in data collection and compilation techniques on board foreign purse seiners operating from the Seychelles.

b) to assemble information required for reliable indices of stock abundance and fishing effort for stock assessment purposes.

c) to collect biological information on the various tuna species for stock assessment purposes.

d) to collect environmental data so as to identify favourable conditions for the concentration of tuna.

e) to design and implement a micro-computer-based data processing system for data assembled by the program to be used in conjunction with already existing SFA data processing systems.

## 3. MATERIALS AND METHODS

### 3.1 Personnel

Since the beginning of the programme, five observers have been recruited and trained. Four observers remain to date, of which one is the supervisor and three others make regular trips at sea.

A preliminary planning of the trips are made at the beginning of the year so as to have an equal coverage of the different fishing companies. The programme was first started on French vessels and was progressively implemented on other vessels. Trips on some vessels are sometimes not possible due to limitations in accommodation.

Training of observers usually last one month and their work performance are assessed after three to four trips, after which their initial training is completed.

### 3.2 Work program

When at sea the observer collects information on a routine basis namely:

i) Environmental data

The following observations are recorded at noon each day and for every set:

- weather, wind (direction and speed)
- sea surface temperature, sea current (speed and direction) water transparency, sea state and water samples for salinity measurements.

ii) Vessel activity for each day spent at sea

Vessel activity data is recorded:

- time spent travelling to and from fishing grounds or port,
- searching time
- time spent around driftwood or Fish Aggregating Devices (FADs)
- time inactive due to poor weather, mechanical breakdown or other reasons.
- time spent setting the net.

iii) Sighting

Every sighting made, such as driftwood, birds, tuna schools or mammals, is described on Form A (Annex I), as well as the date, time and position. The size of the school, fish species and behaviour is also noted. If the school is not fished, reasons are given.

iv) Fishing operations

For each set, Form B (Annex II) is completed giving the following details:

- time skiff is launched, time the net is closed, beginning of fish brailing operations and time skiff is retrieved on board
- catch by species and by-catch, if any
- if catch is nil, reasons are stated.

v) Biological data

The length and weight of a sample of an average of 100 fish, is taken for each positive set.

After each trip, observers are required to make a report of their trip, describing their activities at sea, fishing trends and working conditions on board.

The data collected after each trip is first checked by the supervisor, and then entered on a data-base program on an IBM micro-computer, by the observer and verified by the supervisor. On average each observer spends 25 working days on shore after each trip, during which data entry is done and since 1987 biological sampling (length, weight, sex and maturity stage) on yellowfin is carried out at the local cannery.

3.3 Materials

Eight different forms are used in their daily work at sea. The observer's equipment consist of the following:

- a measuring board
- a caliper
- a digital thermometer
- an anemometer
- a sampling bottle
- a spring balance (0-100kg)
- a manual including identification sheets for tuna, tuna-like fish, billfish and cetaceans.

Other information are obtained from the vessel's bridge instruments such as the satellite navigator, echosounder, sonar and ship's thermometer.

4. RESULTS

The results presented below are summarized from a more detailed report by KARPINSKI (to be published).

Observers average 4.2 trips at sea per year. The average duration of a trip is 32 days. A total of 19 trips have been

made on French, Spanish and Russian purse-seiners since November 1985. The fishing areas covered are given in Figure 1.
During two years the following observations were made:

- 1227 tuna schools were sighted
- 4000 measurements of physical parameters were made
- 388 sets were analysed totalling 6744 tonnes of tuna
- 26 271 fish were measured.

A coverage rate of 4% for french purse-seiners (on which 74% of the trips were made) or 3% for the totality of the fleet was obtained.

## 4.1 Hydrology and meteorology

These data describe the physical environment on tuna fishing grounds. In the long term these data could be useful for determining areas favourable to tuna concentrations. The results obtained are not presented in this report though it is interesting to note that only 17% of sea data observations made correspond to rough weather condition (troughs > 1.25m).

## 4.2 Vessel activity

Purse seining activities are limited to daylight hours only, which is around 12 hours per day. The activity of a purse seiner as a function of the time spent at sea can be divided as follows:

- searching for tuna schools 39%
- drifting at night 28%
- night transit 17%
- fishing (setting the net) 9%
- day transit 4%
- drifting near a floating object 2%
- stoppage due to breakdown 1%
- stoppage due to bad weather <1%

Nearly half of the sea time of a purse seiner is therefore devoted to fishing operations i.e. searching for schools and setting the net.

## 4.3 Searching and school sightings

A total of 1227 observations on school sightings were made. On average, sightings were made every 3.75 hours spent searching. This figure is most likely under-estimated as schools are not always reported to the observers. Schools may be sighted indirectly, through "objects" indicating the presence of a school e.g. drifting logs, birds, whales, whale-sharks or the presence of other fishing vessels. All schools which are not associated with logs are called free-swimming schools. 29% of the schools sighted were reported as composed of only yellowfin, 42% skipjack and 20% as mixed tuna school or other species.

Seasonal changes in behaviour for yellowfin and skipjack schools are given in Figure 2. "Breezer" ("balbaya") type schools were found to be more frequent during the South-East Trades when rougher seas prevail. "Boiler" and "foamer" ("Sardara" and "brisant") schools are less common during this period.

This analysis takes into consideration 4 seasons which are described as follows:

NW = North-West Monsoon season (1/12 to 31/3)
AM = April-May intermonsoon season (1/4 to 31/5)
SE = South-East Monsoon season (1/6 to 14/9)
ON = October-November intermonsoon seasons (15/9 to 30/11).

4.4 Fishing operations

A set was attempted for every 3.2 schools sighted. Altogether 449 fishing sets were observed, of which 61% were positive (catch of at least one tonne) averaging 30 tonnes.

Figure 3 shows that the frequency of sets are higher on free-swimming schools associated with birds. However the fishing success is much greater on schools associated with floating objects. Fishing around drifting objects was more common during the South-East Trades season, with highest fishing success and catches obtained in July/August. Sets on free-swimming schools were more frequent during the North West Monsoon, with best fishing results obtained in October/November (North and North East of Seychelles) and April/May (skipjack fishing season in the Mozambique Channel).

Overall fishing success increases with cloudiness (see fig. 4) as well as with rougher seas (fig. 5). Figure 6 shows that fishing on log-associated schools usually takes place early in the morning before 8 a.m. whereas fishing on free-swimming schools is carried out throughout the day with slightly better success and results in the afternoon (fig. 7).

4.4.1 Duration of set

The duration of the different stages of a set collected by observers at sea are described as follows:

- total duration of set (time skiff is launched to time skiff is onboard)
- time the net is closed
- time brailing begin
- time brailing ends

These data are essential for the determination of the fishing effort index or searching time. A model for the estimation of the set duration as a function of other parameters (such as catch, environmental conditions, etc) was first tested by Marsac (1986) for the Indian Ocean purse-seine fishery.

Using observer data, the average duration of a nil set was estimated to be 140 minutes. When abnormally long sets were discarded the average duration was 110 minutes.

MARSAC (1986) obtained 120 minutes and 92 minutes based on data collected on board French/Ivory Coast and Spanish vessels respectively. It should be noted that for this present data set, all vessels (except USSR purse seiners) were fitted with opening ring net system, which works faster than the old closed ring net system.

The duration of all positive sets (excluding two sets of more than 9h40), were tested against several parameters (sea state, wind speed, percentage of skipjack in the catch, total catch and vessel size). Only total catch was found to correlate with set duration at a 5% error level:

Duration (minutes) = 1,682 catch (tonnes) + 172.51 ($r^2$ = 0.406)

or

Duration (hours) = 0.028 catch (tonnes) + 2.88

Assuming optimal set conditions, observations on set duration were grouped in nine tonnage classes defined using KENDAL statistical test as described by MARSAC (1986). Considering three sets of the least duration in each tonnage class, a regression of the mean duration against the tonnage midclass gave the following equation:

Duration (minutes) = 1,148 catch (tonnes) + 1186.63 ($r^2$ = 0.093.)

In this case, the duraton of a nil set was estimated as 119 minutes compared to 110 minutes obtained by MARSAC (1986).

4.5 By-catch

The by-catch is defined as part of the catch (including tuna and other species) which are caught in the net and then thrown overboard. Whales which break through the net and whale sharks which are released from the net are not included in the by-catch.

Analysis of by-catch composition only started in July 1987 and is therefore only accounted for in 89 positive sets, totalling 3292 tonnes of tuna caught and kept in the hold. By-catch was present in 71% of the sets made, averaging 2.4 tonnes per set or 6% of the total catch. Major composition of the by-catch were as follows:

| | |
|---|---|
| Tuna (lack of hold space) | 37% |
| Tuna (under-sized or damaged) | 22% |
| Shark (Carcharhinus longimanus) | 12% |
| Rainbow runner (Egalatis bipinnulatus) | 11% |
| Dolphinfish (Coryphaena hippurus) | 5% |
| Triggerfish (Balistes sp.) | 5% |
| Billfish | 2% |
| Bonito or Kawakawa (Euthynnis affinnis) | 2% |
| Kingfish (Acanthocybium solandri) | 2% |

## 5. CONCLUSION

The overall activity of an observer can be summarized as follows

An average of 4.2 trips is made annually by each observer, each trip lasting 32 days on average. For each trip some 230 sightings are made, 20 sets are analysed and 1380 fish are measured. At the end of each trip, the observer spends on average 25 days working onshore.

During the first two years of the programme a total of 19 trips have been made, of which 14 trips took place on French purse-seiners. This represents an overall coverage rate of 3% for the totality of the fleet and 4% for the French fleet.
The programme has progressively been extended to purse-seiners of other nationality and it is expected that an equal coverage of the different fleet (by nationality and company) will be achieved.

The coverage rate of the fleet is expected to be satisfactory with a total of five observers, since purse-seiners are often grouped in similar locations.

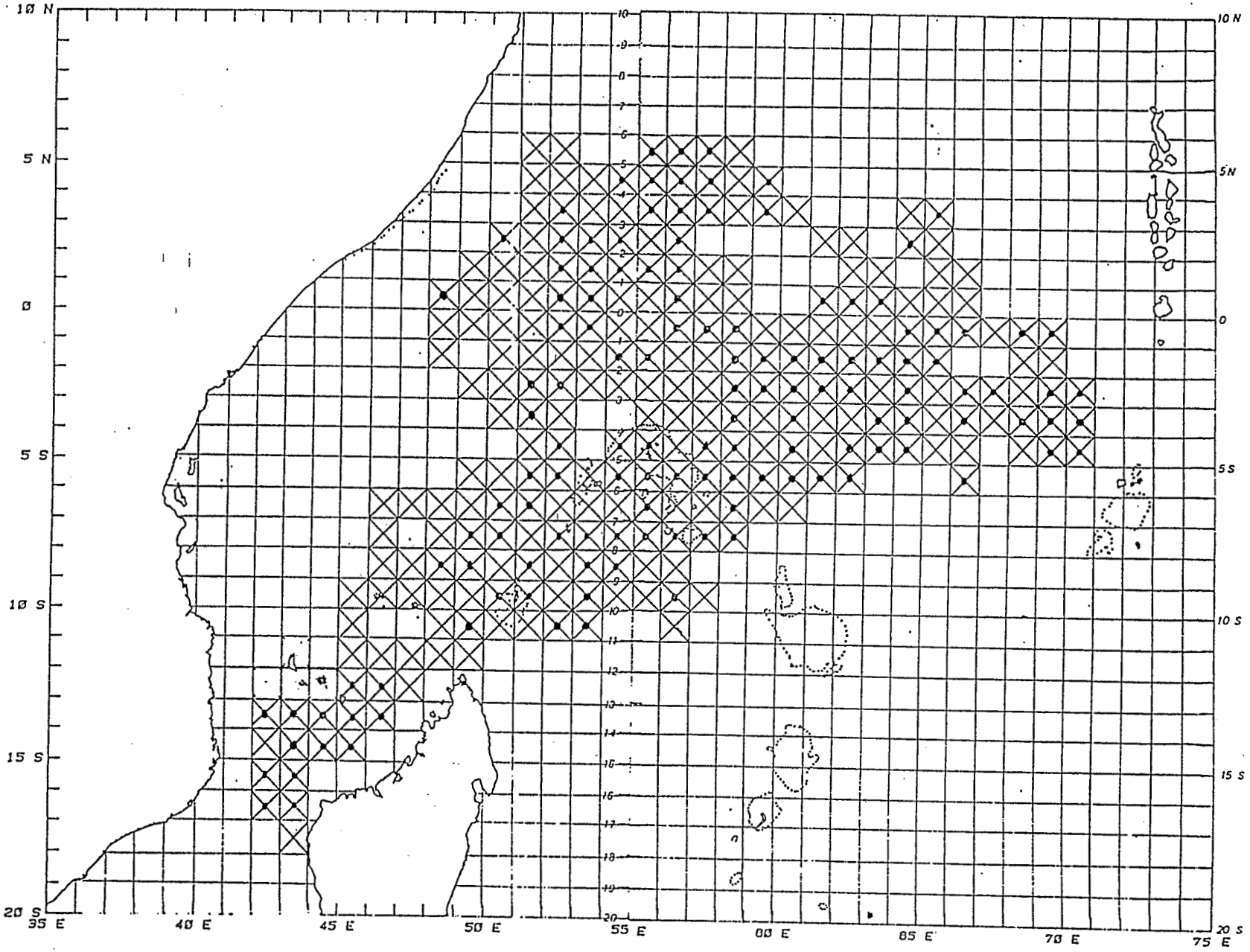
This programme has been proved beneficial to the Seychelles, not only for generating biological information but also for gaining first-hand knowledge on the fishery.

## REFERENCES


1. KARPINSKI B., 1988. Analyse des données collectées lors des embarquements à bord des senneurs basés aux Seychelles (1986-1987). (to be published).

2. MARSAC F., 1986. A method to assess the set time of the purse seiners in the Indian Ocean. Expert Consultation on the stock assessment of tuna in the Indian Ocean, Colombo, Sri Lanka (4-8 Dec 1986) TWS/86/38; 1-13.

3. SFA 1987. Tuna Fishery Bulletin, Fourth Quarter 1987. Seychelles Fishing Authority.




X At least 1 observation
X At least 1 set

Fig. 1 : Fishing zone covered by observers (January 1986 to December 1987)

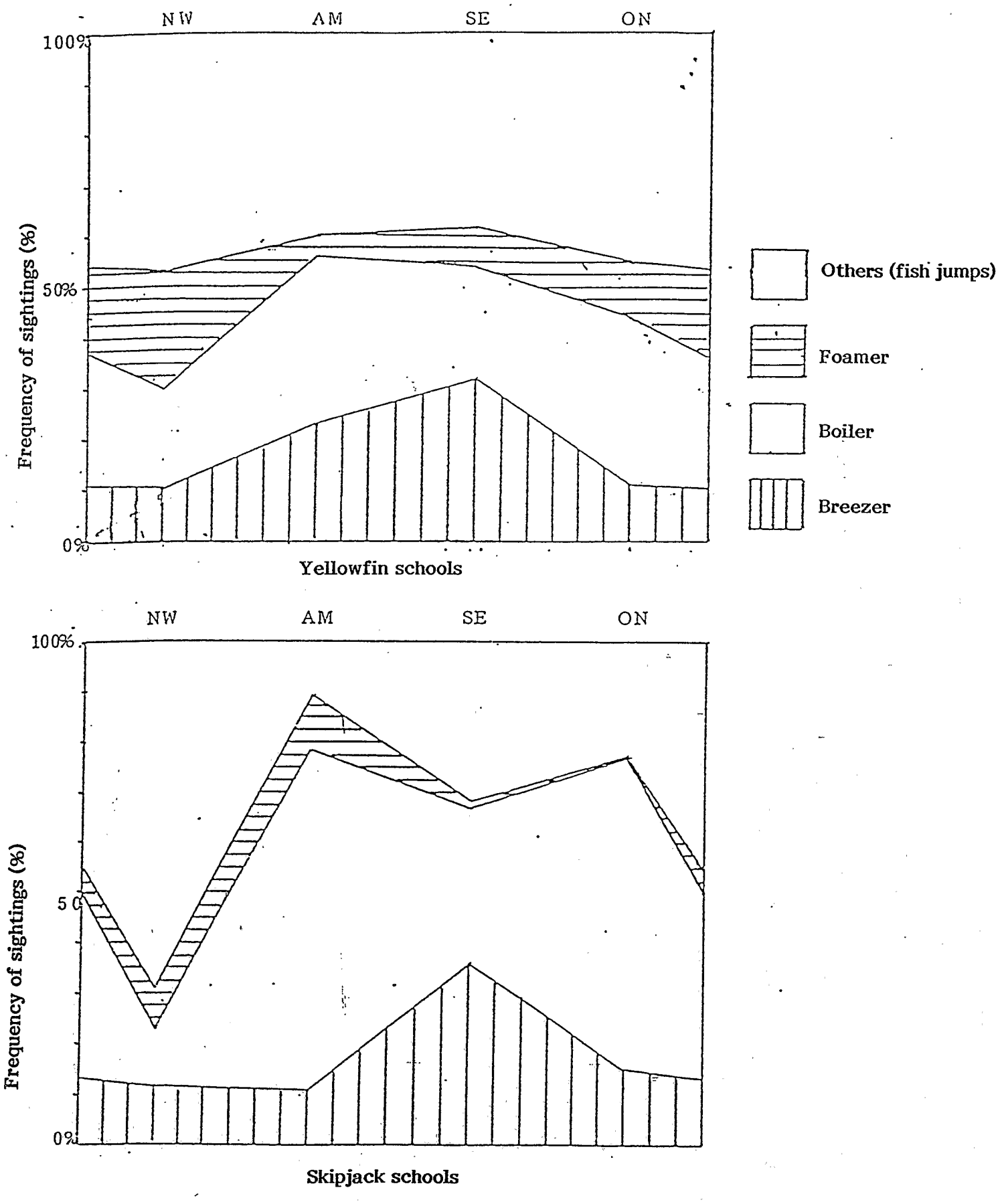



**Fig. 2 : Seasonal changes in behaviour of free-swimming schools (yellowfin and skipjack)**

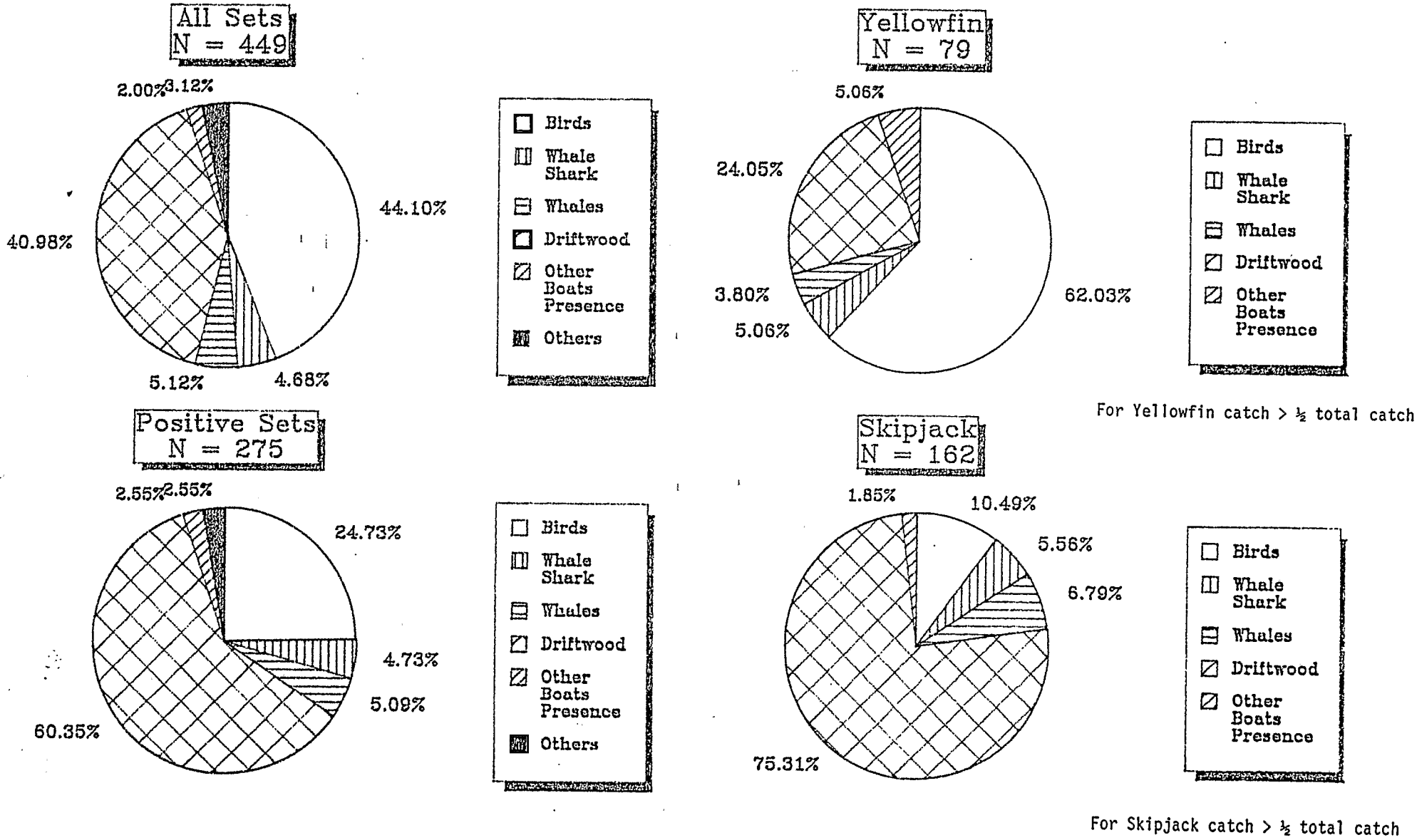



Fig. 3 : Distribution of different types of sets

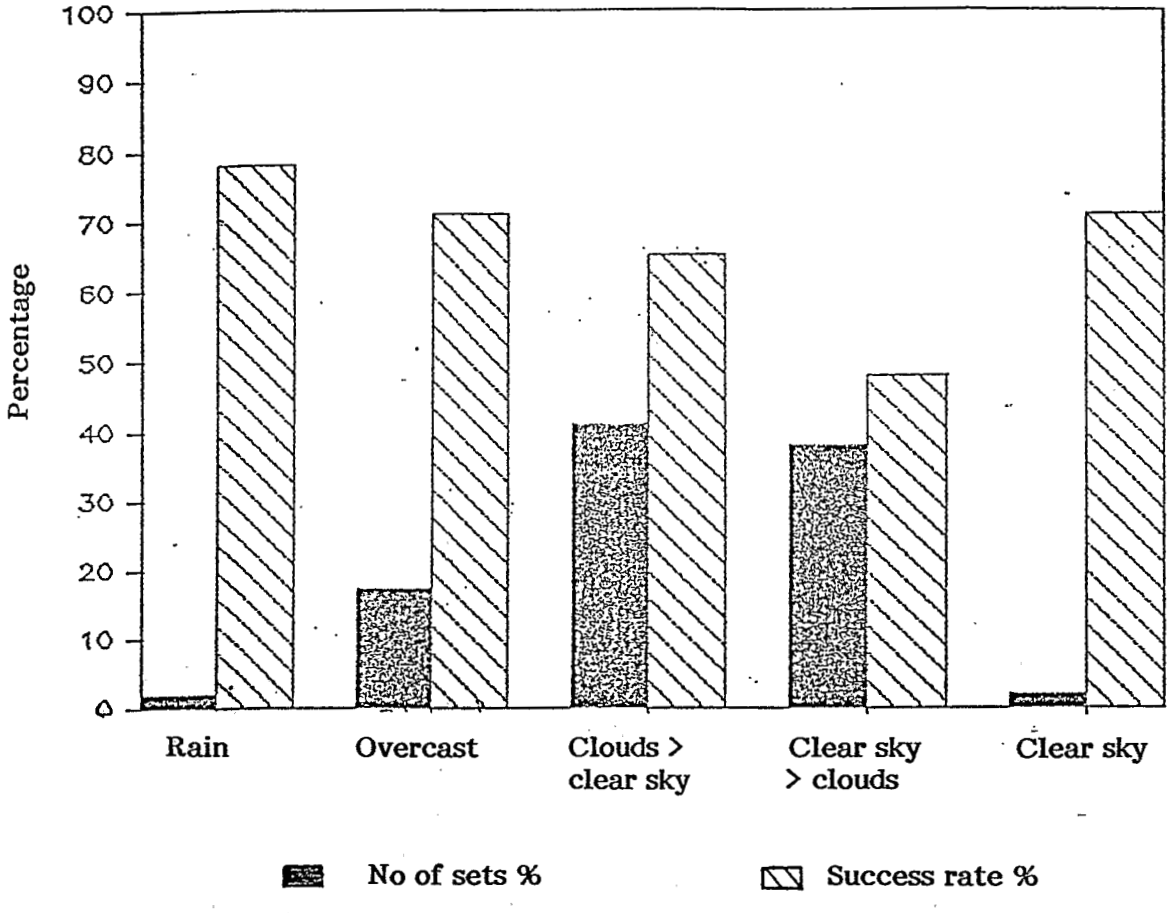



**Fig. 4 : Fishing success v/s nebulosity**

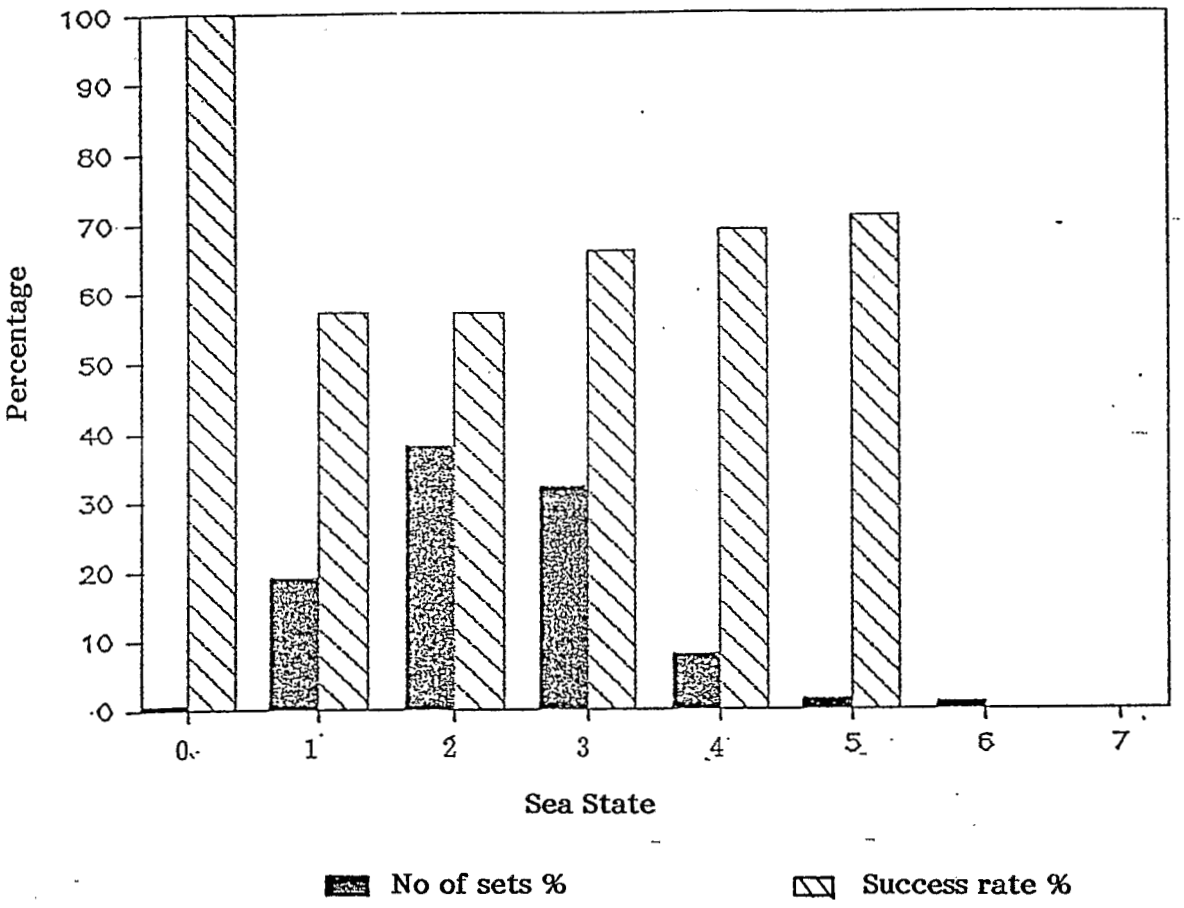



Fig. 5 : Fishing success v/s sea state

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 0 | = | No wave | 1 | = | calm (0 – 0.1 m) | 2 | = | smooth (0.1 – 0.5 m) |
| 3 | = | Moderate (0.1 – 1.25 m) | 4 | = | rough (1.25 – 2.5 m) | 5 | = | high (2.5 – 4 m) |
| 6 | = | Very high (4 – 6 m) | 7 | = | Other | | | |

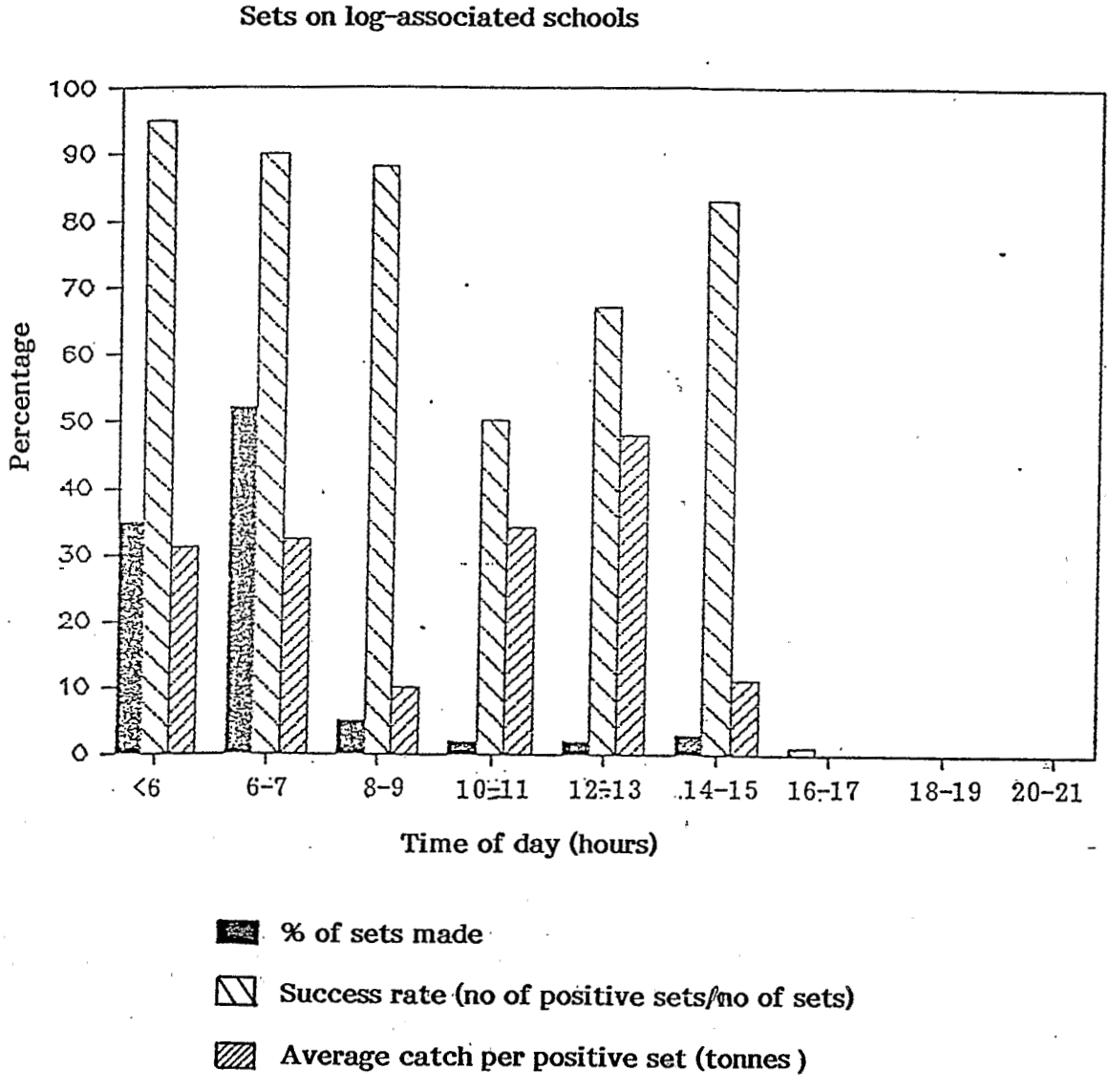



**Fig. 6 : Distribution of sets with time of day**

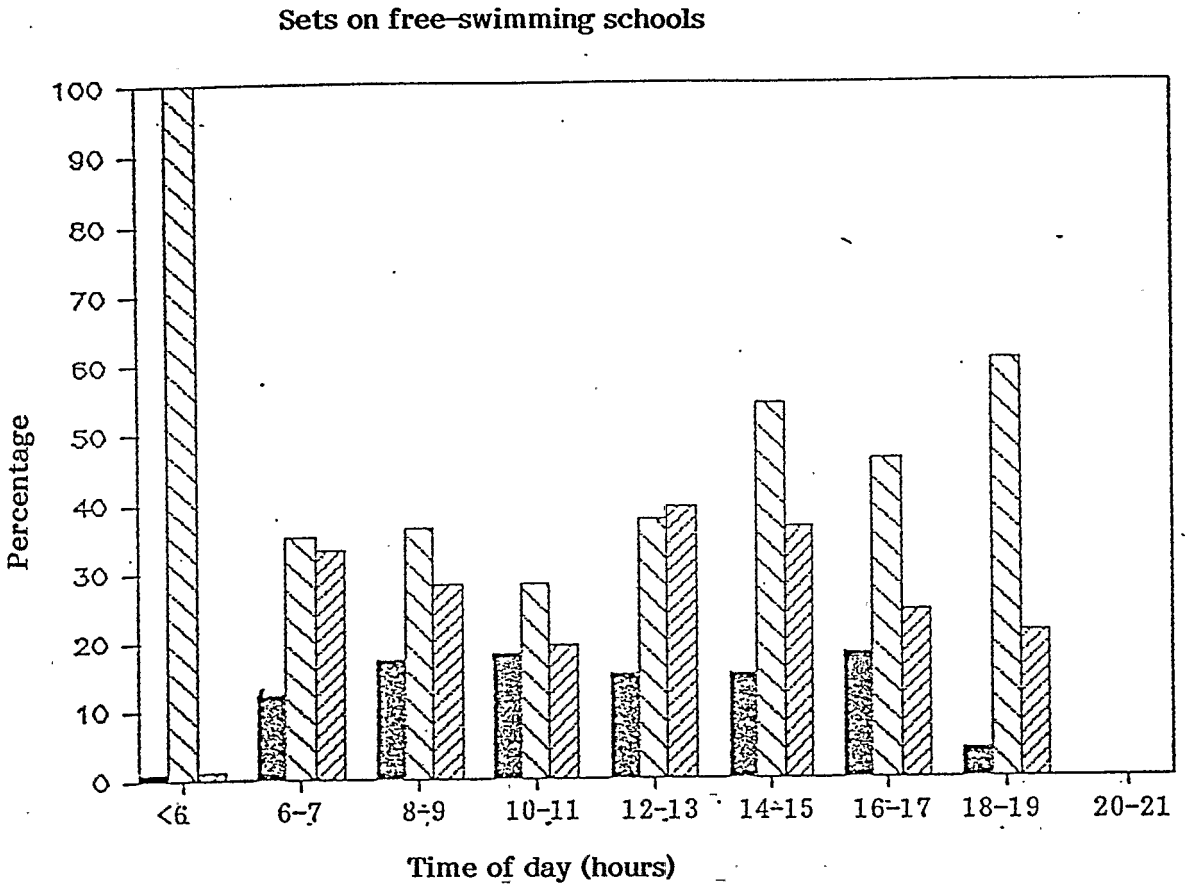



**Fig. 7 : Distribution of sets with time of day**