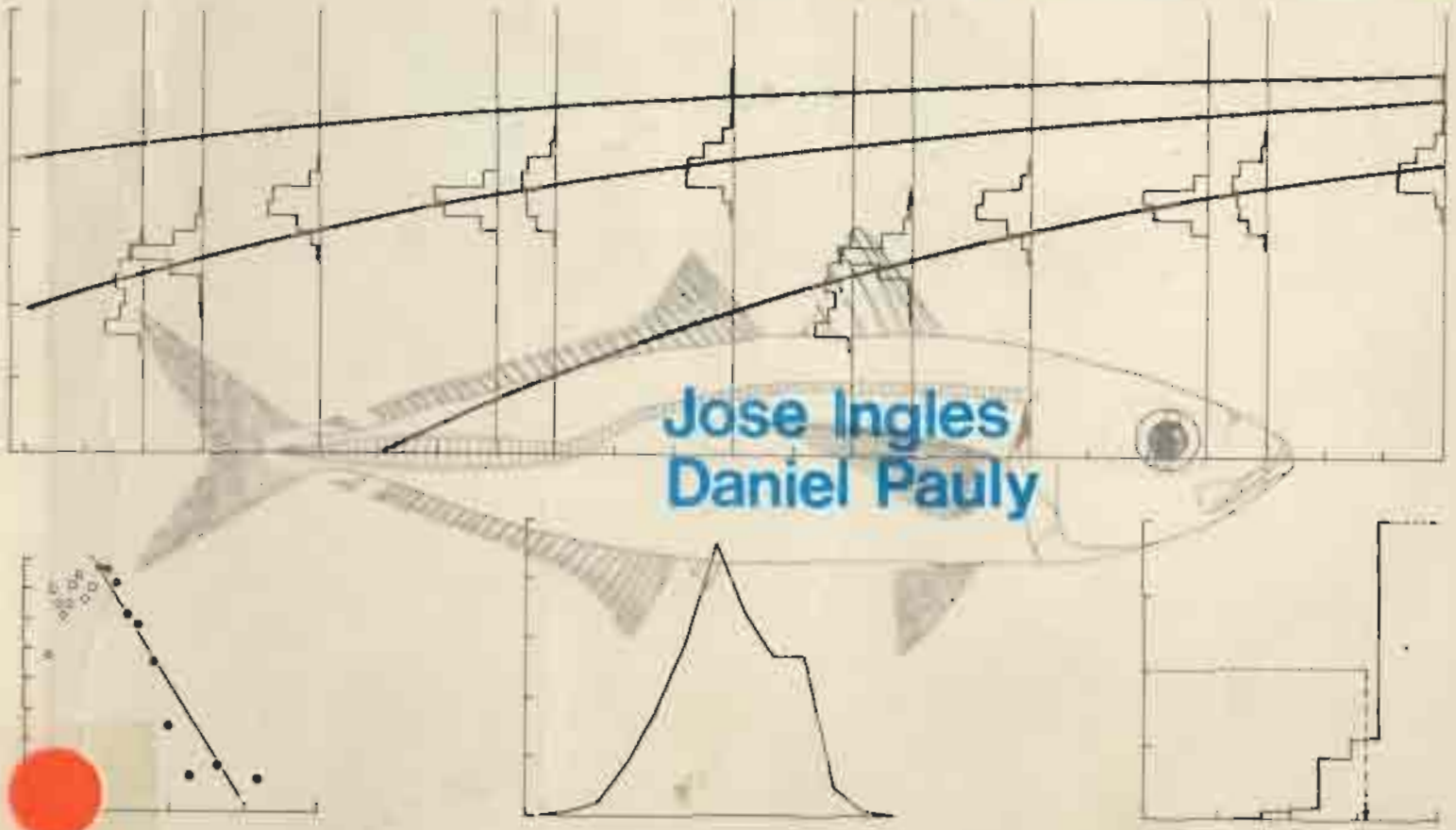
ICLARM Technical Reports 13

An Atlas of the Growth, Mortality and Recruitment of Philippine Fishes



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1984

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QUEZON CITY, PHILIPPINES

INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT
MANILA, PHILIPPINES

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Published jointly by the Institute of Fisheries Development and Research, College of Fisheries, University of the Philippines in the Visayas, Diliman, Quezon City, Philippines and the International Center for Living Aquatic Resources Management, MCC P.O. Box 1501, Makati, Metro Manila, Philippines

Ingles, J. and D. Pauly. 1984. An atlas of the growth, mortality and recruitment of Philippine fishes. ICLARM Technical Reports 13, 127 p. Institute of Fisheries Development and Research, College of Fisheries, University of the Philippines in the Visayas, Quezon City, Philippines and International Center for Living Aquatic Resources Management, Manila, Philippines.

ISSN 0115-5547
ISBN 971-1022-12-5

ICLARM Contribution No. 219.

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Abstract

This atlas presents the results of a detailed analysis of length-frequency data collected from 1957 to 1981 throughout the Philippines, covering 23 families, including 34 genera and 56 species representing 112 stocks of commercially exploited teleost fishes. The raw data, covering 0.9 million single fish measurements were compiled by the authors from a number of different sources, particularly the files of the Philippine Bureau of Fisheries and Aquatic Resources.

The results are presented in the form of 112 plates, providing for each stock: an outline drawing of the fish discussed, with name and sampling location and date, a graphic representation of the length-frequency data with superimposed growth curve, a length-converted catch curve as used for estimating total mortality, a recruitment pattern used to infer the seasonality of spawning and recruitment, and a graph where probabilities of capture are plotted against length to estimate mean length at first capture (L_c).

Also, a legend is provided giving, for each stock, the numerical values of the estimates of growth, mortality and exploitation rate (L_∞, K, Z, M and E), the source of the data used, brief comments on the biology of the fish in question, and reference to a source of further information.

Introduction

This atlas presents estimates of the vital statistics of commercially important Philippine fishes, obtained exclusively through analysis of length-frequency data.

The scope and aim of the atlas are as unique as the methodology upon which it is based. What is attempted here is to present information relevant to the fisheries management of tropical fish using the type of data that is most commonly collected from tropical fisheries, i.e., length-frequency data, as exemplified in Table 1. The methods used were developed explicitly for application to tropical fish: the ELEFAN programs (for *E*lectronic *LE*ngth *F*requency *AN*alysis), more specifically the ELEFAN I and II programs. These programs can be used, given suitable length-frequency data files (prepared by the ELEFAN 0 program), to obtain estimates of growth parameters, estimates of total, natural and fishing mortality, and a representation of the seasonality of recruitment into a stock.

The basic ideas behind these programs have been described elsewhere (Pauly and David 1980, 1981; Pauly 1982) and detailed user's instructions with complete listings (in Microsoft BASIC) made available (Pauly et al. 1980, 1981). Here discussion is limited to some problems that have arisen in the systematic application of these programs and some solutions implemented after the bulk of the work was completed.

Data suitable for the kind of analysis performed here have been, and continue to be collected in large quantities, if often haphazardly, in most tropical countries. This atlas shows what can be done with such data.

The aim of this atlas is to provide parameter estimates for the assessment of multispecies stocks in Southeast Asian

Table 1. A typical set of length-frequency data (pertaining to *Secutor ruconius,* p. 89) as used in this atlas.[a]

Class limits (cm)[b] Lower	–	Upper	Class midlength (cm)[c]	Jan.	Feb.	May	July	Aug.	Sept.	Dec.
1.20	–	1.59	1.4	–	–	–	–	1	–	–
1.60	–	1.99	1.8	–	–	–	–	2	–	–
2.00	–	2.39	2.2	–	–	31	1	9	2	–
2.40	–	2.79	2.6	–	–	23	21	20	1	–
2.80	–	3.19	3.0	–	–	20	70	34	10	–
3.20	–	3.59	3.4	–	–	84	253	55	41	–
3.60	–	3.99	3.8	–	–	361	363	30	30	–
4.00	–	4.39	4.2	–	–	647	660	67	38	–
4.40	–	4.79	4.6	4	–	339	844	199	229	11
4.80	–	5.19	5.0	28	2	161	1,032	183	167	80
5.20	–	5.59	5.4	147	21	186	655	144	78	139
5.60	–	5.99	5.8	701	124	71	285	111	49	182
6.00	–	6.39	6.2	444	265	19	83	46	14	44
6.40	–	6.79	6.6	85	136	4	23	19	5	8
6.80	–	7.19	7.0	12	37	1	5	4	1	–
7.20	–	7.59	7.4	2	7	–	1	1	1	–
7.60	–	7.99	7.8	–	1	–	1	–	–	–
8.00	–	8.39	8.2	–	–	–	1	–	–	–
				Σ1,323	593	1,947	4,298	925	666	464

[a]These data are also illustrated in Fig. 2.
[b]Note that these class limits imply that lowest possible non-negative class limit is equal to 0.2 cm (see equation (2) and text).
[c]As defined and used for ELEFAN I and II.

countries, where most of the species considered are important components of the fishery resource. The growth and mortality parameters estimated here are sufficient for performing single-species yield-per-recruit analyses (see Beverton and Holt 1966) which may be combined into a multispecies analysis using the method of Munro (1983) or that of Sinoda et al. (1979).

These methods, which provide results based on a large number of species, are largely insensitive to the uncertainties associated with single-species estimates, and are thus ideally suited for results such as those presented here.

Another use of the results in this atlas is the construction of ecosystem models, which usually require parameter estimates for a large number of species (Andersen and Ursin 1977; James and Stark 1982). The growth and other parameter estimates provided here could be used to group species into guilds and averaged within a guild. [A method for taking the mean of different sets of growth parameters is provided in Munro and Pauly (1983) and Pauly and Munro (1984).] Average growth parameters can then be used to obtain reasonable estimates of M, which, since M corresponds (in a virgin stock) to a production/biomass ratio, can then serve to estimate biomass in various box models, e.g., the ECOPATH model (Polovina 1984; Polovina and Ow 1983).

Another use for the results presented here is the detailed investigation of single, important species. For example, fisheries scientists working on *Decapterus macrosoma* will find in this atlas a number of estimates of vital processes (growth, mortality, recruitment) which may enable them to draw inferences on the variability of these processes.

It is hoped that readers will agree that reducing *available* length-frequency data is a highly cost-effective way of acquiring information on fish stocks, and that this atlas will serve as a model for future work of this kind in the Philippines and elsewhere in the tropics.

SOURCES

The length-frequency data used in the completion of this atlas were collected from 1957 to 1981 throughout the Philippines (Fig. 1) by a vast number of researchers, notably staff of the Philippine Bureau of Fisheries and Aquatic Resources (BFAR).

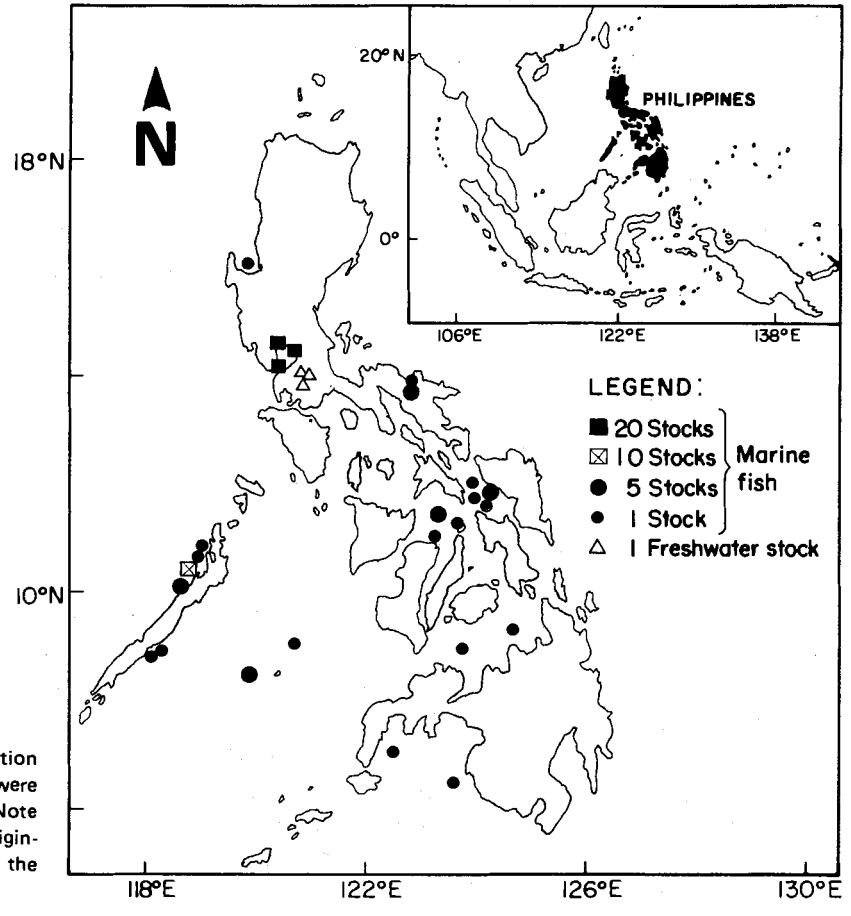

Fig. 1. Geographic distribution of stocks for which data were analyzed for this atlas. Note large number of stocks originating from Manila Bay and the northern Palawan area.

Data were examined which *in toto* amounted to well over 1.2 million single fish measurements. However, only a subset of these was retained, amounting to 0.9 million single fish measurements. Data sets were rejected that were too incomplete or in which the identity of the fish measured could not be established. As the reader will notice, some fairly complete data sets were nevertheless included in which the species identification is questionable (plates 19 and 83-86).

Table 2 gives a summary of the sources of the data included here. Most of the data stem from the files of the Research

Table 2. Sources of length-frequency data on Philippine fishes included in this atlas.

Rank	Sources	No. of stocks
1	Bureau of Fisheries and Aquatic Resources, Manila (raw data files)	42
2	Formal publications and reports	24
3	M.Sc. theses (University of the Philippines and Kiel University, Federal Republic of Germany)	20
4	College of Fisheries/Institute of Fisheries Development and Research, University of the Philippines in the Visayas, project reports	18
5	FAO/UNDP South China Sea Programme, Manila, working papers	4
6	Bureau of Fisheries and Aquatic Resources, Manila, project reports	4

Division of BFAR. Analyzed were length-frequency data sets fulfilling the following criteria:

- the data pertained to a fish that was identified to the species level,
- location and sampling times (months at least) were indicated on the raw data sheets, and
- the data gave a reasonable fit when processed with ELEFAN I.

The last criterion requires further comments. ELEFAN I is structured to produce growth information if such information

is embedded in a data set. A very poor fit obtained by ELEFAN I suggests that:

- the fish in question do not grow according to the von Bertalanffy Growth Formula (VBGF) as used in ELEFAN I, or more likely,
- the sampled fish consist of a mixture of misidentified species, or were sampled with highly selective gear.

The data used were from raw data sheets, frequencies by length class, histograms, or linear series of single measurements. Thus, some manipulation and grouping of length classes were sometimes needed to make the data suitable for analysis by ELEFAN. For fishes reaching adult sizes of 15 cm or less, the class intervals used were 0.5 cm and 0.6 cm; for fish reaching 40 cm, the classes were 0.8 cm and 1.0 cm; for larger fish 2 cm and 5 cm classes were used.

Data regrouping procedures have resulted in relatively small numbers of length classes (7 to 29) in the data sets analyzed. The central part of this range (12-20) is the most appropriate for analysis with the ELEFAN method; it also corresponds, not by coincidence, to the range of class numbers suggested by Sokal and Rohlf (1969) for drawing and interpreting histograms.

One problem encountered is that not all fishery biologists use a scale which begins with zero when measuring fishes. Denoting $L\downarrow$ and $L\uparrow$ as the lower and upper limit of given length class (see Table 1), respectively, and $\Delta L = L\uparrow - L\downarrow$, the smallest length class(es) (with ${}_s L\downarrow$ and ${}_s L\uparrow$ as lower and upper limits) can be described by:

$$ {}_s L\downarrow = 0 \qquad \ldots 1) $$

or

$$ {}_s L\downarrow = \Delta L/2 \qquad \ldots 2) $$

The ELEFAN programs used for the analysis of the compiled data assume that (1) applies. In cases where (2) applies and where the raw data could not be corrected, the results (L_∞ values) were adjusted appropriately.

The dates used in conjunction with the various monthly samples were obtained as follows:

- when all sampling for one month took place during one day and the date was reported, that date was used;
- when a composite sample was obtained by pooling several subsamples representative of a given *part* of a month, a "mean" date was calculated from the dates of the subsamples;
- when a composite sample was obtained by pooling several subsamples representative of a given month, the 15th was used as the date of the composite sample;
- when only the month, but not a date, was given for a sample, the 15th was assumed to be the sampling date.

All length frequencies used in this atlas are presented, with superimposed growth curve, as percentages. These length-frequency data are also available in tabulated form (Ingles and Pauly 1982), which should help authors interested in refining some of the estimates presented, or in checking other methods against those used here.

The results are represented such that each page represents one "stock", with one "stock" defined here as a group of cohorts of a given species, sampled during a certain period at a certain location. This "stock" definition is slightly at variance with the standard one, which assumes the temporal integrity of a stock, and uses more than simply "location" to ensure spatial integrity.

The 112 "stocks" presented were arranged chronologically within species, and the species alphabetically within genera, as were the genera within families. The families, finally, were arranged according to Greenwood et al. (1966).

A separate reference to a paper with additional information is provided for each stock. These references, which may refer to taxonomic, biological or fishery-related information, were included to provide the reader with an entry to the literature on the various groups. Collectively, the 112 references also demonstrate that, contrary to a widely-held opinion, quite a few papers have been written on tropical fishes, and that judicious use of the information embedded in this literature could greatly contribute to accelerating the assessment of tropical fisheries resources.

Methods

The ELEFAN I program, run on a Radio Shack microcomputer (Model I, 16K) was used to estimate, for each set of length-frequency data, the value of the parameters L_∞ and K of a growth equation of the form

$$L_t = L_\infty (1 - e^{-K(t - t_o)}) \quad \ldots 3)$$

that is of the VBGF (von Bertalanffy 1938), where

- L_t is the mean length at age t
- L_∞ is the asymptotic length, that is the mean length the fish of a given stock would reach if they were to grow indefinitely
- K is a growth constant which may be conceived as a "stress factor"
- t_o is the "age of the fish at zero length" *if* they had always grown in the manner described by the equation (note that t_o is generally negative).

No attempt was made to estimate the values of the parameter t_o, because it cannot be estimated from the length-frequency data alone, and because it is not needed for most assessments (see below). With t_o remaining unknown, all growth curves given refer to *chronological* time: they indicate what *size* the fish of a given cohort had at a certain *time* but do not indicate the *absolute ages* of the fish, i.e., they do not give the *age* corresponding to a given *size*.

No attempt was made to investigate seasonal growth oscillation, although such oscillations occur in tropical waters and ELEFAN I could have picked them up. The quantity and quality of the data processed were too high and too low, respectively, to justify this effort.

To estimate the set of growth parameters which best "fits" a set of growth parameters, ELEFAN I does the following:

1. "restructures" the length-frequency sample(s) that have been entered, such that small but clearly identifiable peaks are attributed a number of "points" similar to peaks based on a larger number of fishes. The procedure used here essentially consists of calculating running average frequencies (over five length classes), dividing each length-frequency value by the corresponding running average frequency, then subtracting 1 from the quotient. A few other minor adjustments are then made to prevent certain types of samples from generating biases;
2. calculates the maximum sum of points "available" in a (set of) length-frequency sample(s), where "available points" refer to points which can possibly be "accumulated" by one single growth curve (see below). This sum is termed "available sum of peaks" (ASP);
3. "traces" through the (set of) length-frequency sample(s) sequentially arranged in time, for any arbitrary "seed" input of L_∞ and K, a series of growth curves started from the base of each of the peaks, and projected backward and forward in time to meet all other samples of the sample set and/or the same sample repeated again and again;
4. accumulates the "points" obtained by each growth curve when passing through peaks (positive points) or through the troughs separating peaks (negative points);
5. selects the curve which, by passing through most peaks and avoiding most troughs best "explains" the peaks in the (set of) sample(s) and, therefore, accumulates the largest number of points. This new sum is called "explained sum of peaks" (ESP);
6. increases or decreases the "seeded" values of L_∞ and K until the ratio ESP/ASP reaches a maximum, and outputs the growth parameters corresponding to this optimum ratio.

The validity of the procedure outlined here rests on the following assumptions:

1. that the sample(s) used represents the population investigated;
2. that the growth pattern in the population is the same from year to year;
3. that the VBGF describes the average growth of the investigated stock;

4. that all fishes in the (set of) sample(s) have the same length at the same age, and that, therefore, differences in length can be attributed to differences in age.

Of these four assumptions, the first is a sampling problem and need not be discussed here. Assumptions 2 and 3 appear to be realistic, and they are in fact made—explicitly or not—every time the growth parameters of fish are calculated on the basis of annual markings on skeletal parts.

The last of these assumptions does not strictly apply, since it is known that fishes having the same age may have different lengths. Simulations show, however, that this assumption—which is essential to the operation of the program—does not generate marked bias.

The reader is reminded that the growth curve which has been superimposed on the length-frequency data is the single growth curve which gave the best fit, not the *only one* that could have been fitted. Thus in most cases, or more precisely, in all cases where two cohorts recruit annually to the stocks, a second growth curve could have been fitted to the data by shifting the original growth curve by about five to seven months (Fig. 2).

Some of the growth curves (notably in plates 88, 89) generate "ages" that appear too high due to the values of L_∞ being too low because the samples were not representative of the stock (e.g., from migration out of the sampling area). In most cases, growth curves and parameter values appear reasonable and generally compare well with values available in the literature.

The length-converted catch curves are generally straight, justifying the computation of a single value of Z for all sizes (ages) in the exploited phase.

The ELEFAN I program used to fit the growth curves presented has been modified since the bulk of the work in this atlas was completed. It is expected, therefore, that any reader attempting to reproduce the results using length-frequency data in Ingles and Pauly (1982) and a recent version of ELEFAN I would find slightly different growth parameter values to give the best fit. These small differences will not detract from the overall usefulness of this atlas (see postscript).

The ELEFAN II program has four main subroutines, all of which require growth parameter estimates (as generated by

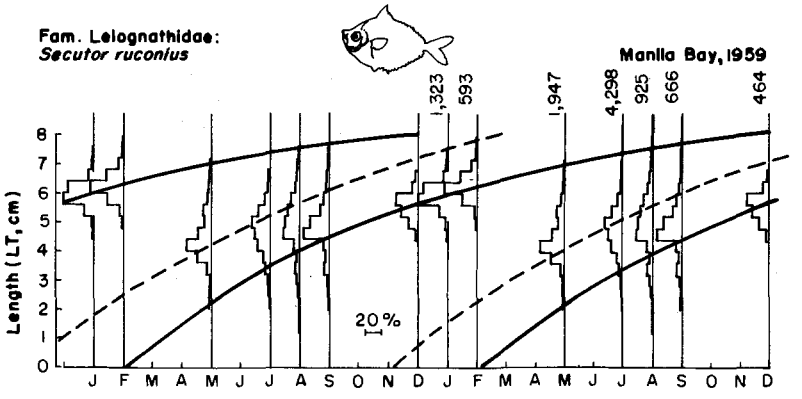

Fig. 2. Example of a growth curve fitted by ELEFAN I (solid line), with second growth curve (broken line) obtained by shifting solid line until remaining major peaks are "hit" by the curve. Secondary growth curves are not given in this atlas, although the presence of a second cohort is apparent in most cases.

ELEFAN I) and the same length-frequency data used for growth parameter estimation. These routines are:

1. the estimation of total mortality (Z) from the straight right arm of a length-converted catch curve (Pauly 1984a);
2. the estimation of natural mortality (M) from the built-in empirical relationship (Pauly 1980):

$$\log_{10} M = -0.0066 - 0.279 \log_{10} L_\infty + 0.6543 \log_{10} K + 0.4634 \log T \quad \ldots 4)$$

3. the derivation of a "selection pattern", i.e., of a graph giving probabilities of capture by length, based on the method described in Pauly (1983, 1984b);
4. the derivation of a "recruitment pattern", i.e., of a graph showing the seasonality of recruitment into the stock investigated; these graphs are derived based on the method outlined in Pauly (1982).

The first of these routines usually provides estimates of Z that are within 1% of the true values when the length-frequency data used are representative of the population investigated (Pauly 1984b). As with the latest version of this program, the version of ELEFAN II used pooled the various samples of a data set into one single sample, such that the effect of seasonal recruitment pulses on the length-converted catch curves was evened out as far as possible. However, the early version of ELEFAN II differed from the latest version in that each

sample of a data set was given the same weight before pooling (through re-expression in percentages); in newer versions, after expression as a percentage, each sample is weighted by the square root of the original sample size (see Pauly 1984b).

Estimates of Z were obtained which appear reasonable in most cases, the only major exception being the catch curves based on length-frequency data collected in 1979-80 in the Samar Sea and Carigara Bay area (plates 23, 57, 61, 70, 82, 92, 93 and 108). In most of these, the assumption of "constant recruitment" inherent in catch curves was clearly violated, because fishing effort, due to a trawl ban was drastically reduced during the sampling period, with the result that more young fish entered the fishing grounds than usual (Saeger 1981). This phenomenon, which is now being investigated in greater detail, apparently resulted in a "tilting" of the catch curves and a concomitant overestimation of total mortality and exploitation rates.

The estimates of M obtained from equation (4) using a mean water temperature set at 27°C throughout were subtracted from the values of Z obtained from the length-converted catch curves to obtain approximate values of fishing mortality ($F = Z - M$), which were used to compute exploitation rates ($E = F/Z$). The latter may be used to assess stocks, in the absence of catch and effort data, if the generalization of Gulland (1971) is accepted that the optimum fishing mortality in an exploited stock should be approximately equal to natural mortality or

$$E_{opt} \approx 0.5 \qquad \ldots 5)$$

Because of the uncertainties inherent in the various estimates used to compute the values of E, no attempt should be made to assess a *single* stock using the technique outlined here. On the other hand, a predominance of estimates of values of $E > 0.5$, in a *number of stocks* should be suggestive of overexploitation.

The selection patterns presented were obtained from the left, ascending arm of the length-converted catch curves, using the analytical method described in Pauly (1984a, 1984b), which is run automatically everytime a length-converted catch curve is derived by ELEFAN II (Pauly et al. 1981). Throughout, the computations were run with a straight, backward projection of the descending right arm of the curve. This leads to estimates of mean size at first capture (L_c) very close to those that would have been obtained, had a more elaborate method been used to estimate the probabilities of capture (see Pauly 1984b).

The method by which recruitment patterns are derived from a set of length-frequency data and growth parameter values has been described in Pauly (1982) and Pauly and Navaluna (1983); it is also part of the user's instruction for ELEFAN II (Pauly et al. 1981). Recruitment patterns are generated by a backward projection, using the growth parameter at hand, of the available length-frequency data.

Typically, recruitment patterns have the bell shape of a normal distribution when recruitment occurs as a single event. When annual recruitment occurs as two major events (more than two are unlikely; see Pauly and Navaluna 1983), this results in a strongly asymmetric graph with a single mode, or in a bimodal pattern. Composite recruitment patterns as obtained by ELEFAN II can be decomposed into their component distributions and inferences can be drawn on the seasonality of the recruitment and on the relative strength of different recruitment pulses. This was done, using the data presented in this atlas, by Pauly and Navaluna (1983). The reader is invited to read their paper for details.

Fig. 3 gives a frequency distribution of the 112 values of exploitation rates that were obtained here. As might be seen, the plot is skewed to the right, toward values of $E > 0.5$, suggesting that, as a whole, Philippine fish stocks tend to be subjected to a very strong fishing mortality, a fact further emphasized by comparison with the two low values of E reported by Cabanban (1984) from (underexploited) marine parks based on the same methodology.

For most stocks, the recruitment patterns suggest that two "pulses" of recruits are generated each year, as also reported by Pauly and Navaluna (1983).

Little needs saying, finally on the selection patterns. The estimates of L_c are in almost all cases close to those one would have expected, given the sampling areas and gears used to sample the fish in question.

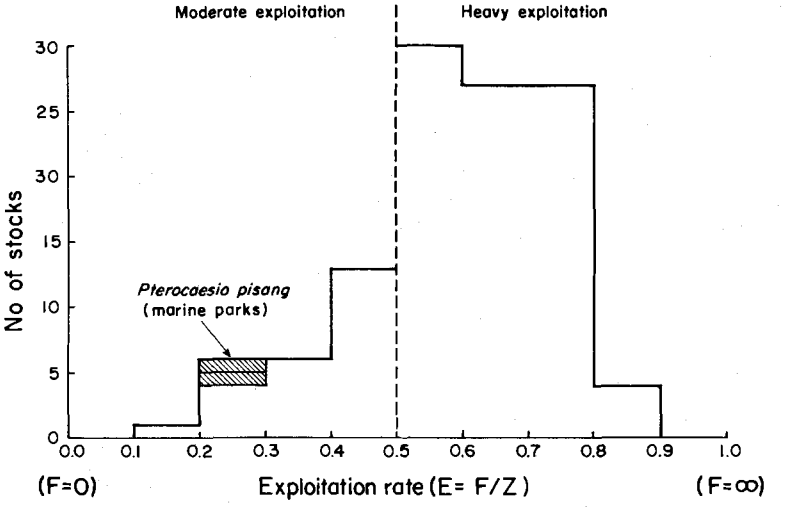

Fig. 3. Frequency distribution of the exploitation rate (E = F/Z) of the Philippine fishes represented in this atlas. Two values, pertaining to the fusilier, *Pterocaesio pisang,* and estimated by Cabanban (1984) using the same methodology as used in this atlas were added. It will be noted that these two values which refer to underexploited marine parks, are relatively low, as would be expected. The figure suggests that Philippine stocks are as a whole severely overfished. Dotted line, E = 0.5, represents the Gulland (1971) generalization that optimum fishing mortality should equal natural mortality.

Explanation of the graphs

Graphs of length-frequency data with superimposed growth curves, length-converted catch curves, recruitment pattern and selection pattern, are given for each "stock" recognized here in plates 1-112, p. 15-126. An index to the 112 stocks is provided on p. 10-13.

The upper graph in each plate gives length-frequency histograms, which are shown as percentages rather than absolute numbers, for months in which data were available. The number of fish in each monthly sample is shown beside each histogram. The sequence of histograms is repeated to show how ELEFAN I uses the data repetitively. Best-fit lines of growth resulting from ELEFAN's analysis are superimposed for one cohort (two cohorts are recruited each year in the majority of fish species investigated). The projection back to zero of the growth curve does not necessarily provide the time at hatching of the fish, because t_o cannot usually be assumed equal to zero.

The lower left graph in each plate is a length-converted (to age) catch curve from the length-frequency data. Relative age is given since the growth curves provide only relative, not absolute, age (t_o is not known). Black dots are those used in calculation of the straight line, the slope of which is an estimate of Z. Open dots represent fish not fully selected by the gear used in the fishery; and / or not used in mortality estimates.

The central lower graph in each plate is the pattern of annual recruitment into the fishery as obtained from ELEFAN II. The data are expressed as percentage of annual recruitment by month.

In most species the graphs suggest that two annual pulses of recruitment have occurred; fewer species show one (bell-shaped curve); the remainder are somewhat ambiguous, the result of insufficient data.

The lower right graph presents the probability of capture of fish by length class as estimated from ELEFAN II. From the histogram the length at first capture (L_c) has been determined by a cumulative method (broken lines).

Parameters determined from these graphs (L_∞, K, L_c, Z, M and E) are provided beneath each plate together with a reference to literature on the species concerned.

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Index to families, genera, species and stocks

Continued

Family	Species	Fishing ground	Year	N	Page
Sillaginidae					
	Sillago sihama	Manila Bay	1978-1979	4,652	38
Carangidae					
	Decapterus macrosoma	Manila Bay	1957-1958	3,349	39
	Decapterus macrosoma	Manila Bay	1958	9,781	40
	Decapterus macrosoma	Palawan	1957	4,705	41
	Decapterus macrosoma	Palawan	1957-1958	25,021	42
	Decapterus macrosoma	Palawan	1958	13,528	43
	Decapterus macrosoma	Palawan	1958-1959	34,836	44
	Decapterus macrosoma	Palawan	1959	8,108	45
	Decapterus macrosoma	Palawan	1960	625	46
	Decapterus macrosoma	Palawan	1965	1,949	47
	Decapterus macrosoma	Palawan	1965-1966	3,079	48
	Decapterus macrosoma	Palawan	1966	339	49
	Decapterus macrosoma	Palawan (A)	1968	16,919	50
	Decapterus macrosoma	Palawan (B)	1968	11,985	51
	Decapterus russelli	Manila Bay	1958-1959	13,462	52
	Decapterus russelli	Manila Bay	1959	7,026	53
	Decapterus russelli	Palawan	1958	11,091	54
	Decapterus russelli	Palawan	1959	7,092	55
	Decapterus russelli	Palawan	1968	9,116	56
	Elegatis bipinnulatus	Moro Gulf	1975-1976	128	57
	Selar crumenopthalmus	Manila Bay	1978-1979	2,287	58
	Selaroides leptolepis	Manila Bay	1978-1979	4,440	59
	Selaroides leptolepis	Visayan Sea	1976-1977	1,389	60
Menеidae					
	Mene maculata	Manila Bay	1978-1979	2,160	61
Leiognathidae					
	Gazza minuta	Honda Bay, Palawan	1977-1978	854	62
	Gazza minuta	San Miguel Bay	1979-1980	511	63
	Leiognathus bindus	Manila Bay	1958	6,286	64
	Leiognathus bindus	Manila Bay	1959	2,074	65
	Leiognathus bindus	Manila Bay	1960	1,002	66
	Leiognathus blochii	Manila Bay	1957	615	67
	Leiognathus blochii	Manila Bay	1958	1,401	68
	Leiognathus blochii	Manila Bay	1959	931	69
	Leiognathus blochii	Manila Bay	1959-1960	956	70
	Leiognathus brevirostris	Samar Sea	1979-1980	29,662	71
	Leiognathus daura	Manila Bay	1957	4,074	72
	Leiognathus daura	Manila Bay	1959	6,140	73

Continued

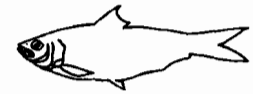
Family	Species	Fishing ground	Year	N	Page
	Leiognathus daura	Manila Bay	1959-1960	1,301	74
	Leiognathus equulus	Samar Sea	1979-1980	9,660	75
	Leiognathus leuciscus	Manila Bay	1957	1,754	76
	Leiognathus leuciscus	Manila Bay	1958	1,872	77
	Leiognathus lineolatus	Manila Bay	1957	1,530	78
	Leiognathus lineolatus	Manila Bay	1958	3,326	79
	Leiognathus lineolatus	Manila Bay	1959	1,685	80
	Leiognathus splendens	Manila Bay	1957-1958	58,090	81
	Leiognathus splendens	Manila Bay	1958	67,005	82
	Leiognathus splendens	Manila Bay	1959-1960	33,879	83
	Leiognathus splendens	Samar Sea	1979-1980	95,253	84
	Secutor insidiator	Manila Bay	1957	3,835	85
	Secutor insidiator	Manila Bay	1959	1,253	86
	Secutor insidiator	Manila Bay	1960	181	87
	Secutor ruconius	Manila Bay	1957	38,051	88
	Secutor ruconius	Manila Bay	1959	10,217	89
	Secutor ruconius	Manila Bay	1960	1,820	90
Nemipteridae					
	Nemipterus japonicus	Manila Bay	1978-1979	3,665	91
	Nemipterus nematophorus	Lingayen Gulf	1980	1,290	92
	Nemipterus nematophorus	Visayan Sea	1976-1977	1,477	93
	Nemipterus ovenii	Visayan Sea	1976-1977	3,276	94
Gerridae					
	Pentaprion longimanus	Carigara Bay	1979-1980	6,174	95
	Pentaprion longimanus	Samar Sea	1979-1980	3,454	96
Pomadasyidae					
	Pomadasys argyreus	Manila Bay	1958	2,014	97
	Pomadasys argyreus	Manila Bay	1959	18,476	98
	Pomadasys argyreus	Manila Bay	1960	15,217	99
	Pomadasys argyreus	Manila Bay	1961	7,727	100
Sciaenidae					
	Dendrophysa russelli	San Miguel Bay	1980-1981	779	101
	Otolithes ruber	San Miguel Bay	1958-1961	1,444	102
	Otolithes ruber	San Miguel Bay	1980-1981	1,629	103
	Pennahia anea	Manila Bay	1978-1979	4,354	104
	Pennahia macropthalmus	San Miguel Bay	1980-1981	498	105

Continued

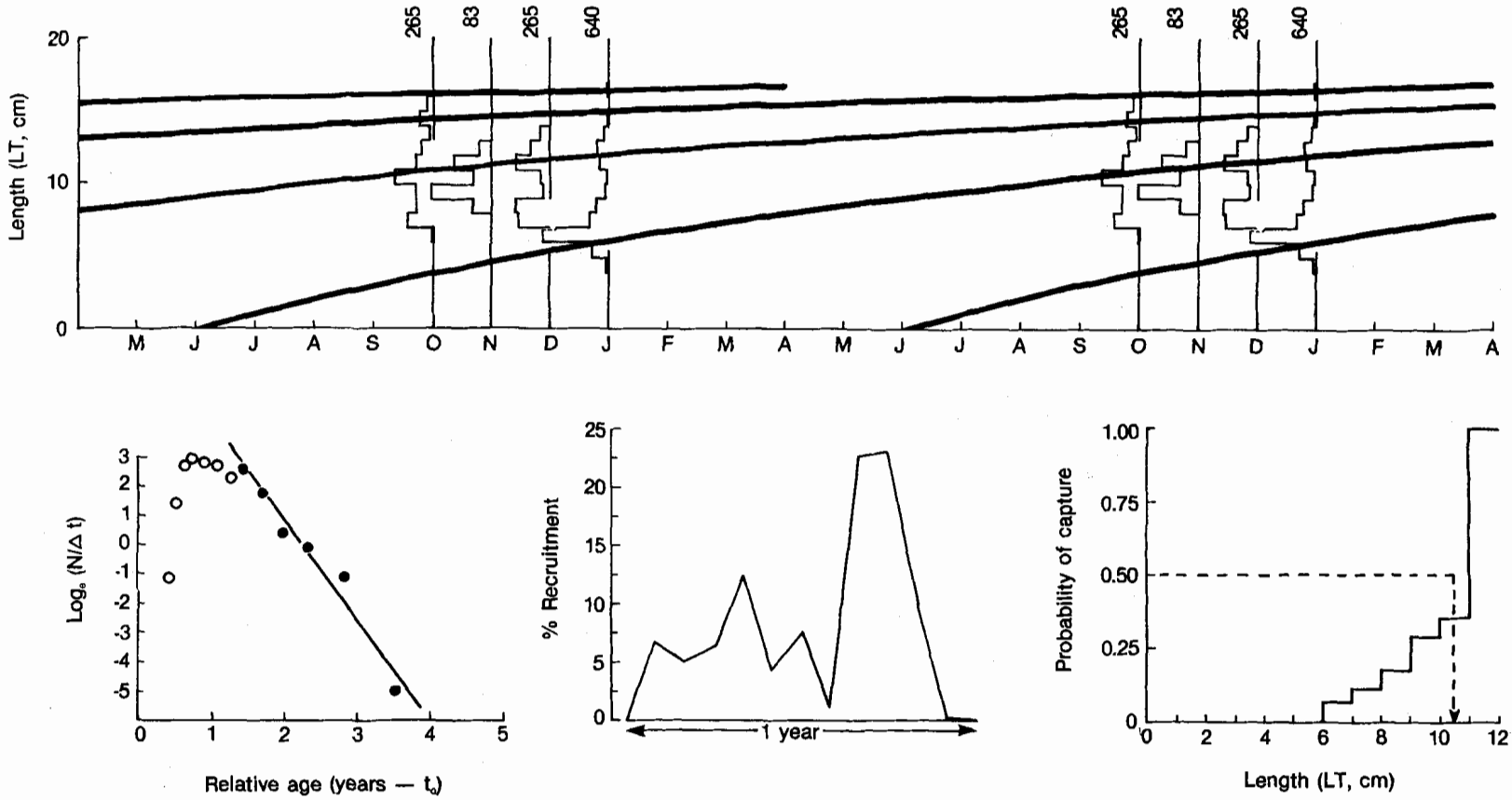
Family	Species	Fishing ground	Year	N	Page
Mullidae					
	Upeneus moluccensis	Samar Sea	1977-1980	8,594	106
	Upeneus sulphureus	Samar Sea	1979-1980	48,547	107
	Upeneus sulphureus	San Miguel Bay	1980-1981	787	109
	Upeneus vittatus	Manila Bay	1978-1979	3,816	109
Scatophagidae					
	Scatophagus argus	Manila Bay	1978-1979	1,977	110
Mugilidae					
	Liza subviridis	Manila Bay	1978-1979	6,104	111
Gobiidae					
	Glossogobius giurus	Cardona, Laguna de Bay	1958	2,191	112
	Glossogobius giurus	Taguig, Laguna de Bay	1958	1,577	113
Trichiuridae					
	Trichiurus lepturus ♀	Manila Bay	1960-1961	3,711	114
	Trichiurus lepturus ♂	Manila Bay	1960-1961	3,128	115
	Trichiurus lepturus	Manila Bay	1978-1979	11,993	116
Scombridae					
	Auxis thazzard	Bohol Sea	1980	1,518	117
	Auxis thazzard	Moro Gulf	1975-1976	1,048	118
	Katsuwonus pelamis	Bohol Sea	1980	1,118	119
	Katsuwonus pelamis	Sulu Sea	1975-1976	1,908	120
	Rastrelliger brachysoma	Manila Bay	1978-1979	2,966	121
	Rastrelliger brachysoma	Samar Sea	1979-1980	2,970	122
	Rastrelliger kanagurta	Palawan	1965	431	123
	Scomberomorus commerson	Visayan Sea	1976-1977	444	124
	Thunnus albacares	Sulu Sea	1975-1976	813	125
Cynoglossidae					
	Cynoglossus puncticeps	Manila Bay	1978-1979	2,571	126

Plate 1

Fam. Clupeidae:
Sardinella fimbriata



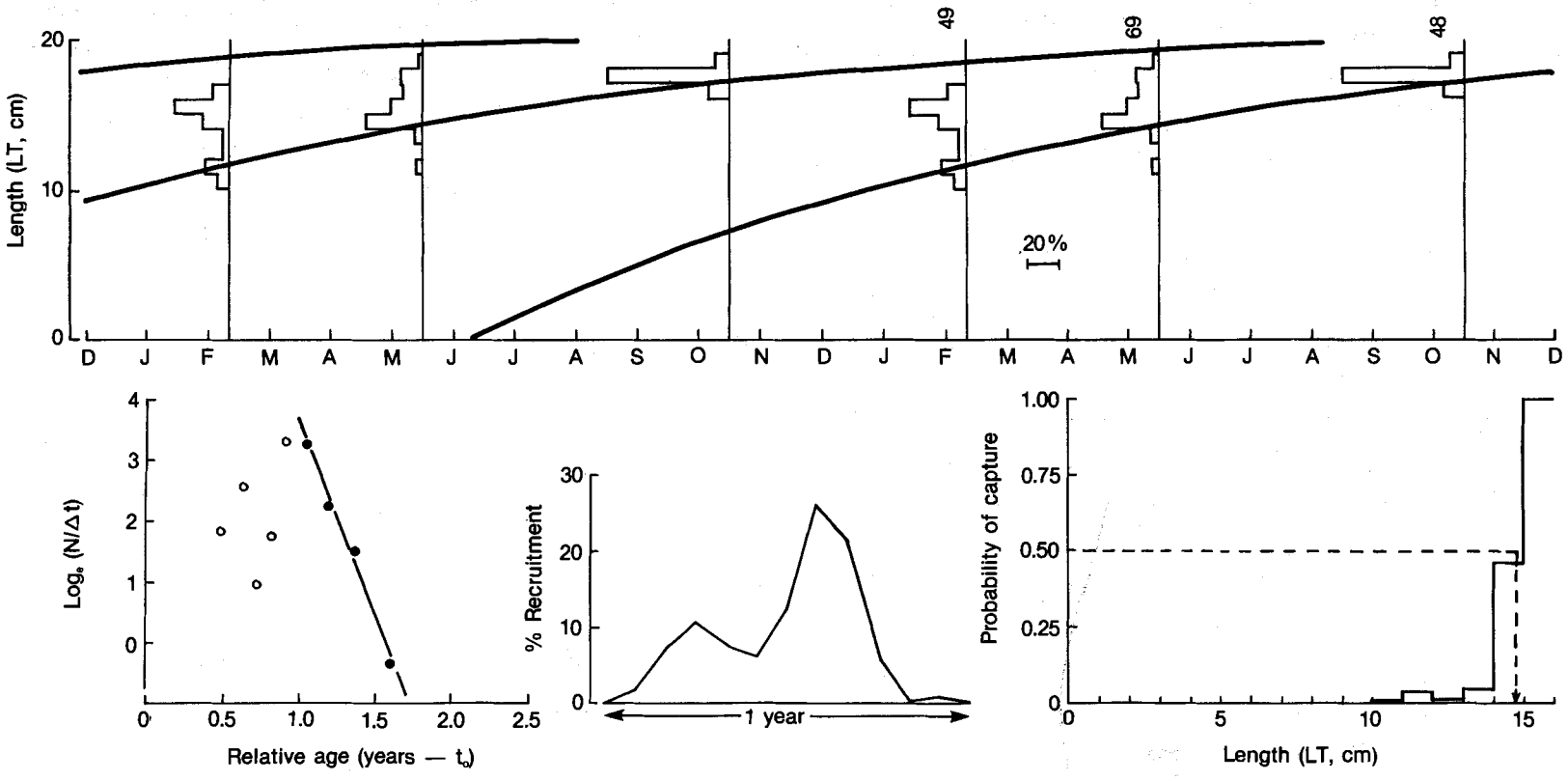
Manila Bay, 1959



The length-frequency data analyzed here on the fringescale sardinella ("tamban", "lao-lao") which originated from the Research Division, BFAR, Manila, suggest the growth parameters: L_∞ = 18 cm, K = 0.70; also the following statistics were computed: L_c = 10.4 cm, Z = 3.38, M = 1.63 and E = 0.52. Annual recruitment probably occurred as one major pulse, with intermittent recruitment outside the main season. For a review of Philippine data on this and related sardine species see Ronquillo, I.A. 1960. Synopsis of biological data on Philippine sardines *(Sardinella perforata, S. fimbriata, S. sirm, S. longiceps).* Species Synopsis No. 13, p. 453-495. *In* H. Rosa and G.I. Murphy (eds.) Proceedings of the World Scientific Meeting on the Biology of Sardines and Related Species, Rome, Italy, 14-21 September 1959. FAO, Rome. Vol. 2.

Fam. Clupeidae:
Sardinella fimbriata

Palawan, 1965

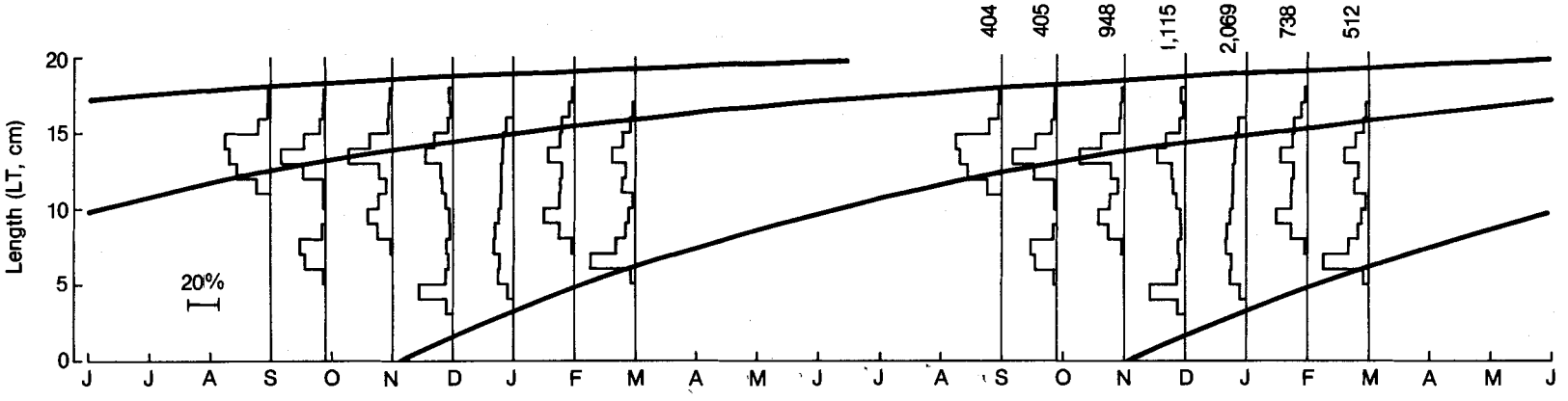


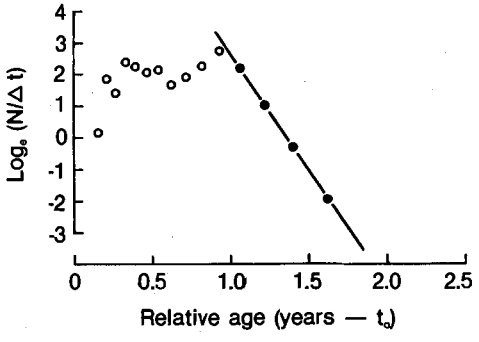
The set of data on the fringescale sardinella available here, which originates from the Research Division, BFAR, Manila, led to the following parameter estimates: L_∞ = 22 cm, K = 1.15, L_c = 14.7 cm, Z = 6.56, M = 2.12 and E = 6.56. The small sample sizes limit the reliability of these results, however. Annual recruitment occurred in two unequal pulses. This confirms the main results of Anicete, B.Z. and J.V. Yapchiongco. 1960. Certain aspects of the biology of the fimbriated sardine *Sardinella fimbriata* (Cuvier and Valenciennes). Nat. Appl. Sci. Bull. (Manila) 17(3/4): 237-282.

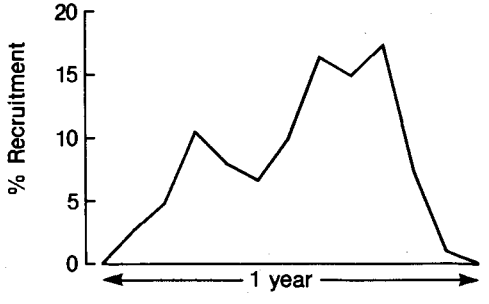
Plate 3

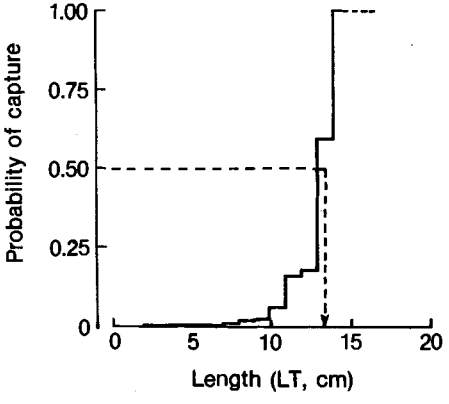
Fam. Clupeidae:
Sardinella longiceps

Manila Bay, 1978-1979





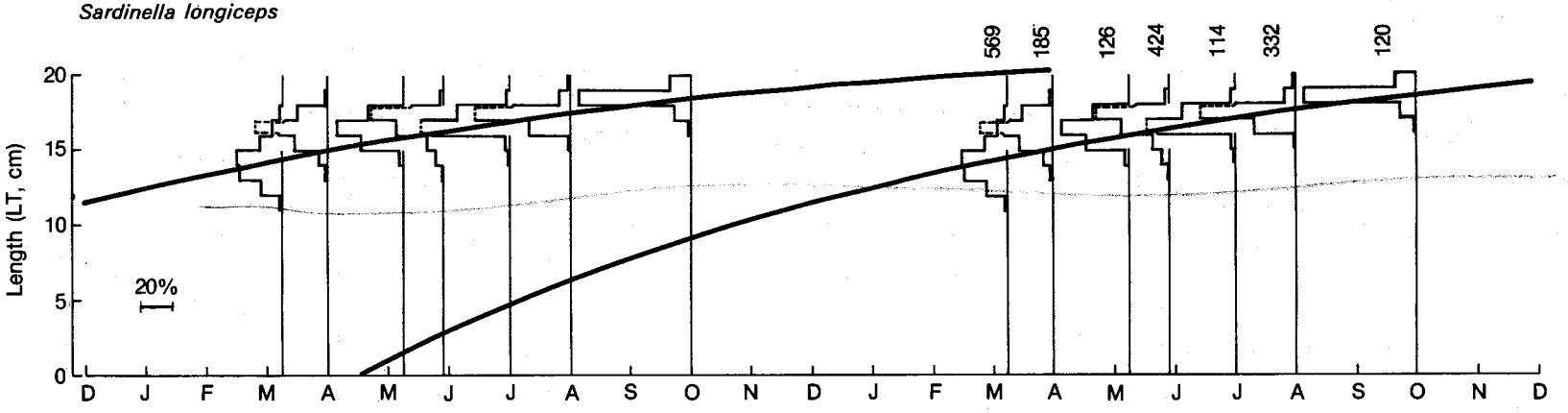


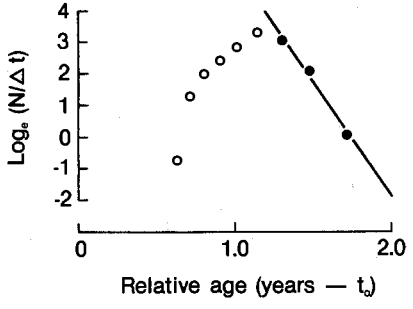


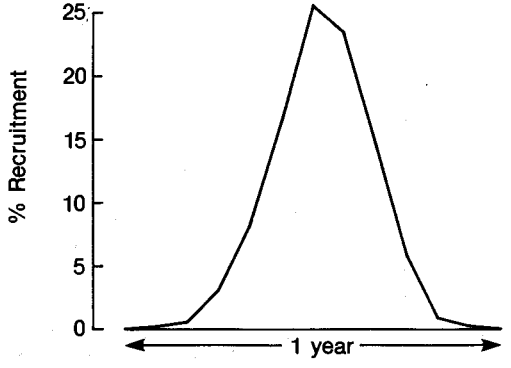
The Indian oil sardine ("tamban lison") is reported to reach 23 cm at most. The data used here stemmed from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines, as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. They suggest the growth parameters L_∞ = 21 cm and K = 1.10; other statistics are L_c = 13.5 cm, Z = 7.37, M = 2.10 and E = 0.72. Annual recruitment occurred in the form of two pulses of unequal strength. Miscellaneous data on *S. longiceps* may be found in Dwiponggo, A. 1972. The fishery for and preliminary study on the growth rate of "lemuru" (oil sardine) at Muntjar, Bali Strait. Proc. Indo-Pac. Fish. Counc. 15(3): 221-240.

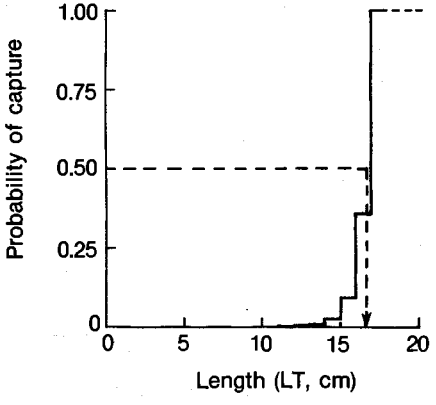
Fam. Clupeidae:
Sardinella longiceps

Palawan, 1965



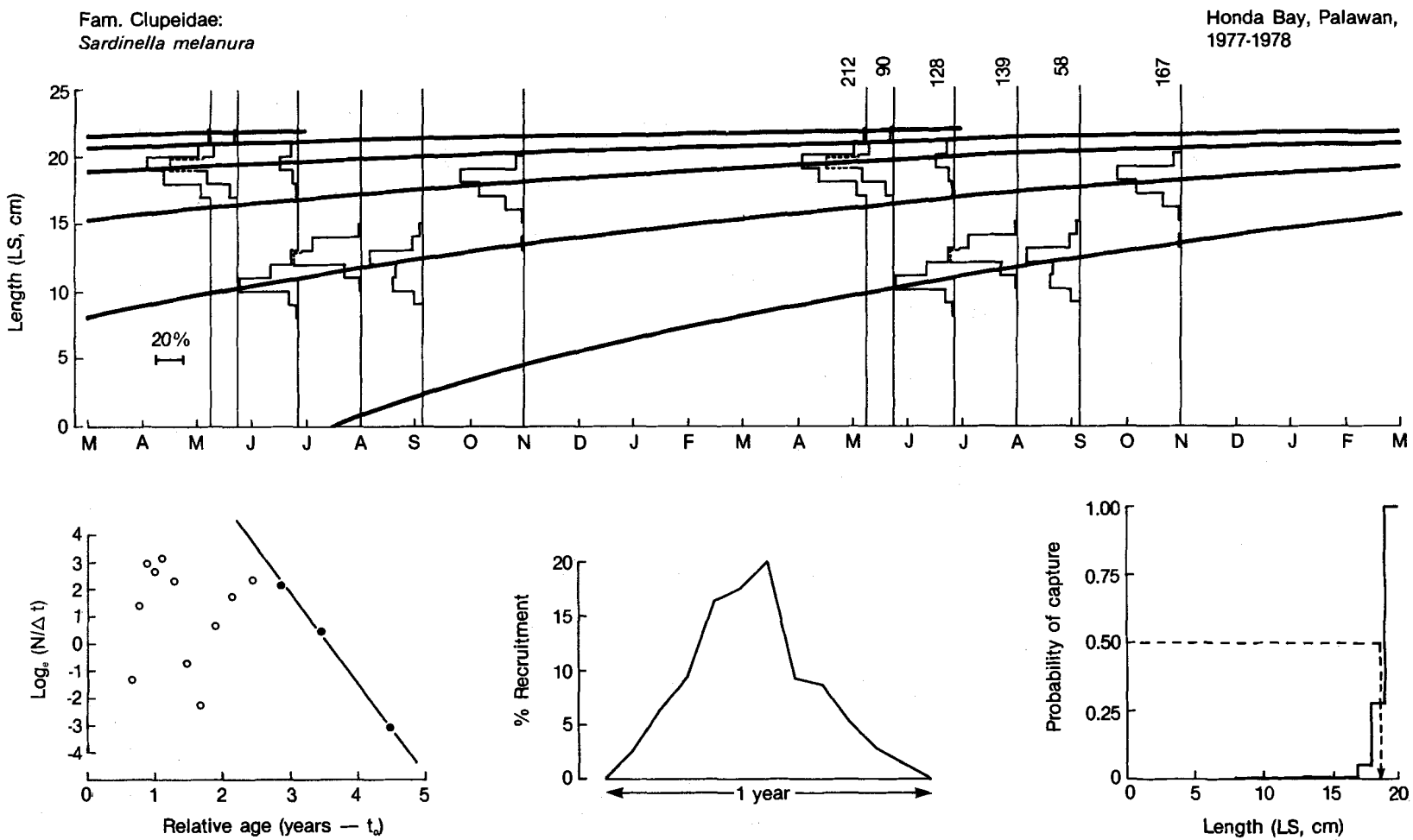






The set of length-frequency data on Indian oil sardine used here stems from the Research Division, BFAR, Manila. It suggests the statistics: L_∞ = 23 cm, K = 1.10, L_c = 16.8 cm, Z = 7.26, M = 2.05 and E = 0.72. Only one single pulse of recruitment is distinguishable. An hypothesis attempting to explain the recruitment variability of the Indian oil sardine is given in Antony Raja, B.T. 1972. Possible explanation for the fluctuation in abundance of the Indian oil sardine, *Sardinella longiceps* Valenciennes. Proc. Indo-Pac. Fish Counc. 15(3): 241-252.

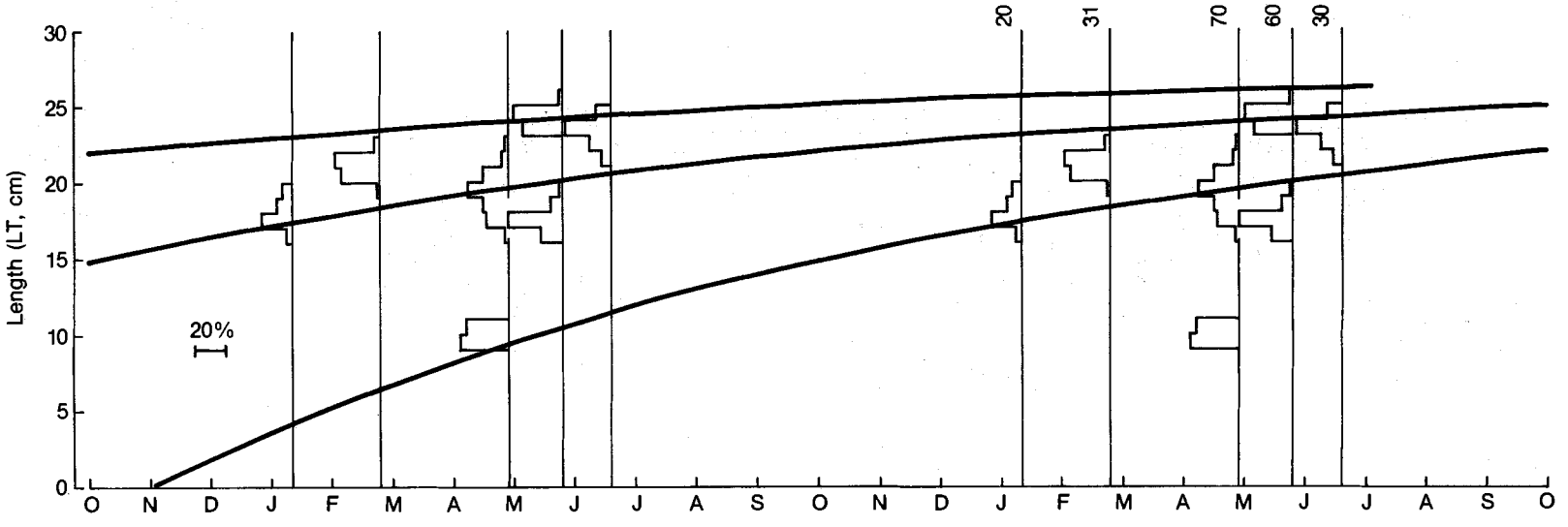
Plate 5

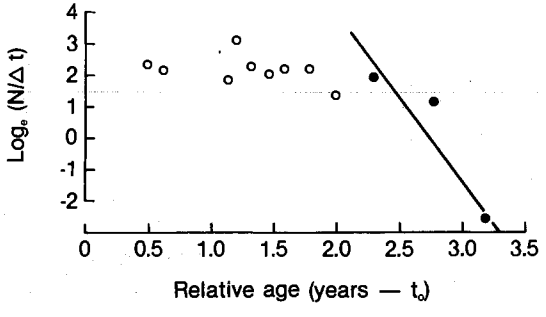


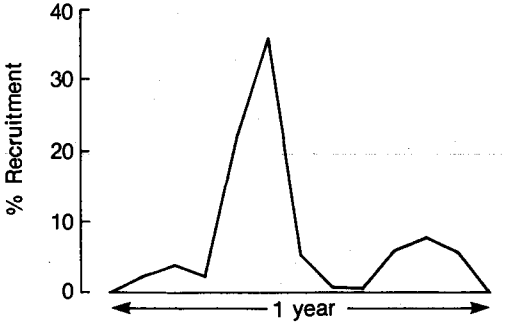
The blacktip sardinella is represented here by length-frequency data taken from Schroeder, R. Notes on the biology of commercially important fishes of Honda Bay, Palawan. Unpublished MS on file at Research Division, BFAR, Manila. The following statistics were estimated from the data: L_∞ = 22.5 cm, K = 0.70, L_c = 18.8 cm, Z = 3.36, M = 1.53 and E = 0.54. Annual recruitment had occurred in two major pulses of unequal strength. Some information on the biology of *S. melanura* is given in Whitehead, P.J.P. 1974. Clupeidae. *In* W. Fischer and P.J.P. Whitehead (eds.) FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71). Vol. 1. (var. pag.) FAO, Rome.

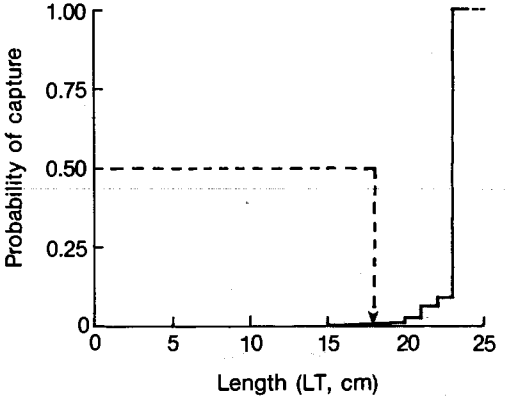
Fam. Clupeidae:
Sardinella sirm

Palawan, 1959



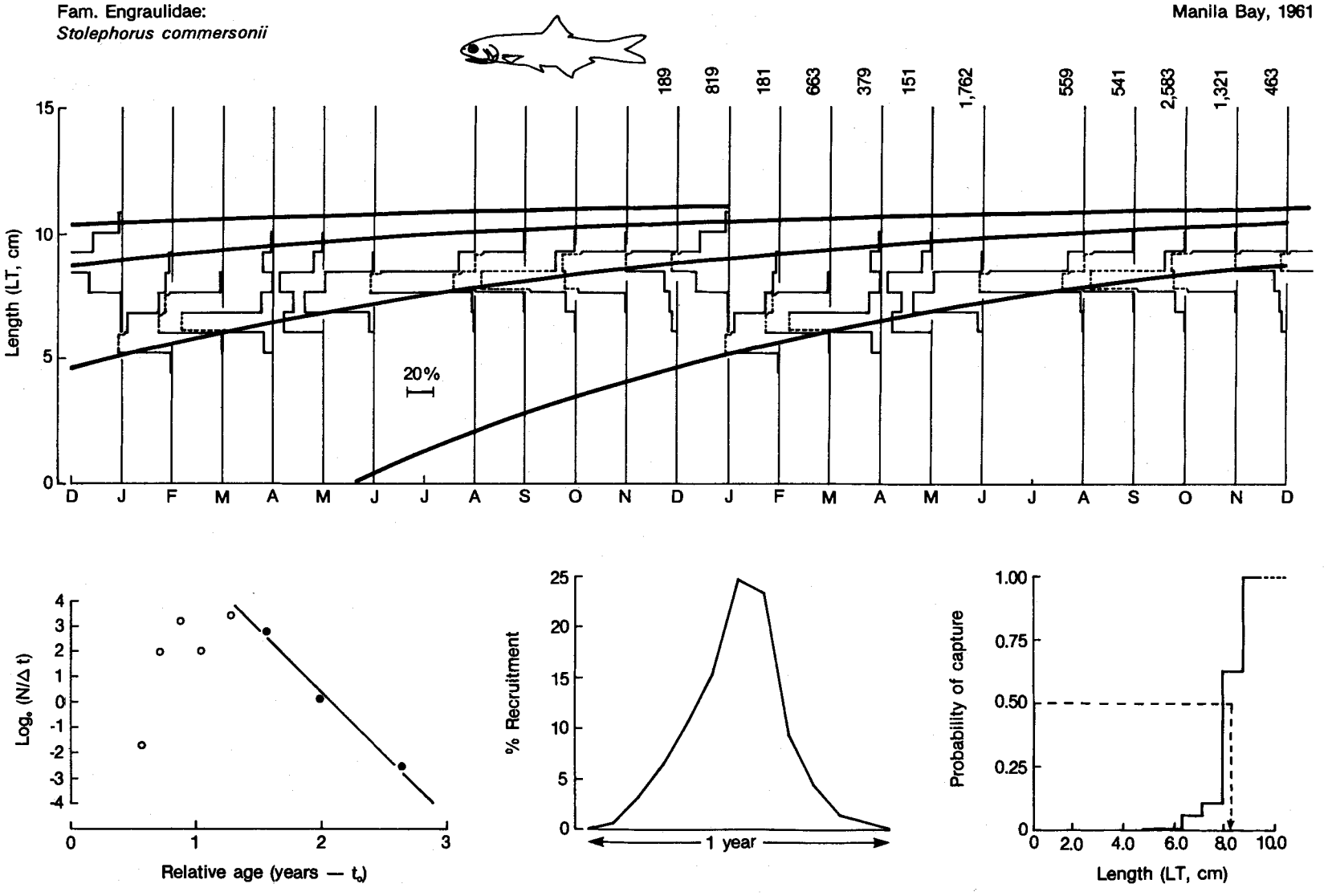




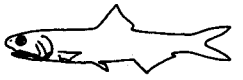


Only limited data were available on the spotted sardinella ("tunsoy"); they stem from the Research Division, BFAR, Manila and suggest the following statistics: L_∞ = 27.3 cm, K = 0.86, L_c = 17.9 cm, Z = 5.36, M = 1.66 and E = 0.69. Annual recruitment was dominated by a short strong pulse. Additional data on the biology of this fish may be found in Burhanuddin, M. Hutomo, S. Martosewojo and A. Djamali. 1974. [Some biological aspects of lemuru, *Sardinella sirm* (Waldbaum) around Panggang Island] Oseanologi di Indonesia 2: 17-25 (in Indonesian, with English abstract).

Plate 7

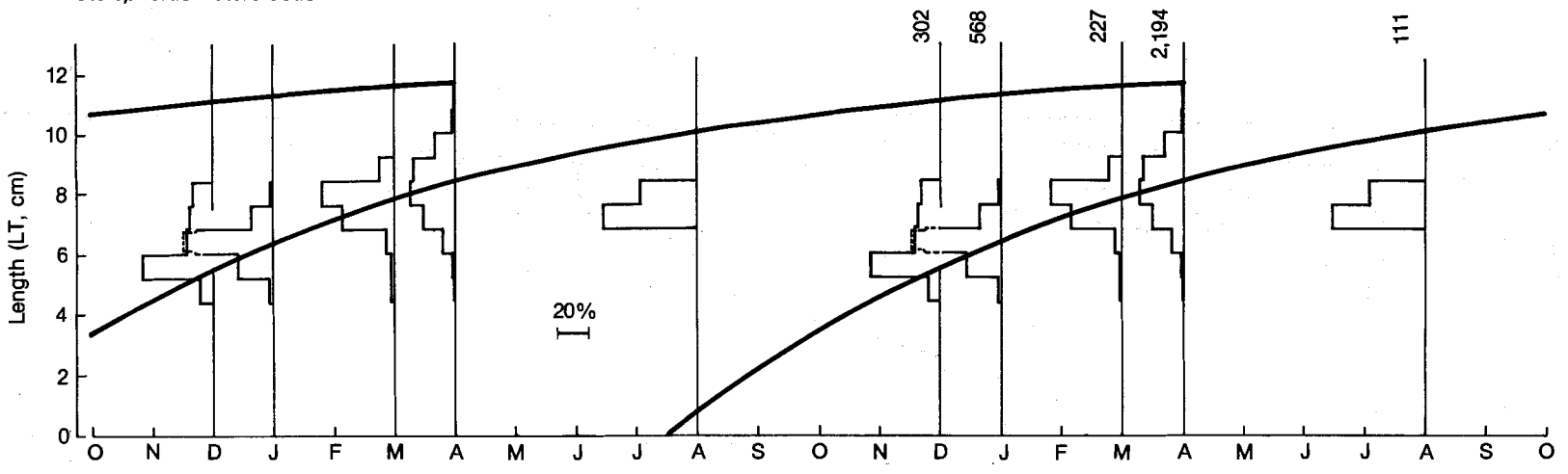


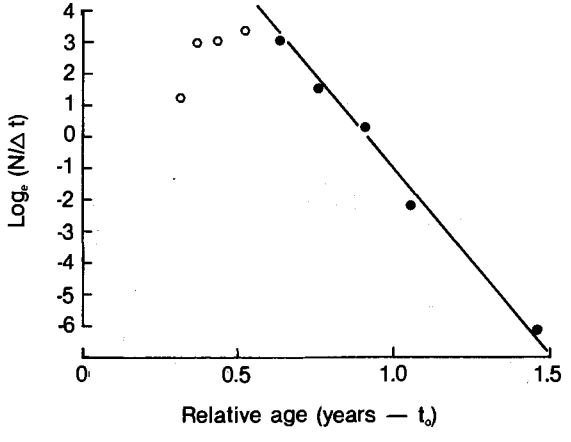
The length-frequency data on Commerson's anchovy ("dilis") that are presented here were obtained from the Research Division, BFAR, Manila. They led to the following parameter estimates: L_∞ = 11.3 cm, K = 0.96, L_c = 8.07 cm, Z = 4.94, M = 2.28 and E = 0.54. Recruitment probably occurred in one protracted pulse. Miscellaneous data on this and related species in the Philippines are given in Tiews, K. 1970. On the biology of anchovies (*Stolephorus* Lacépède) in Philippine waters. Proc. Indo-Pac. Fish. Counc. 13(2): 20-48.

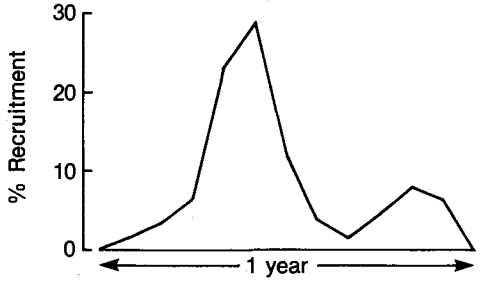


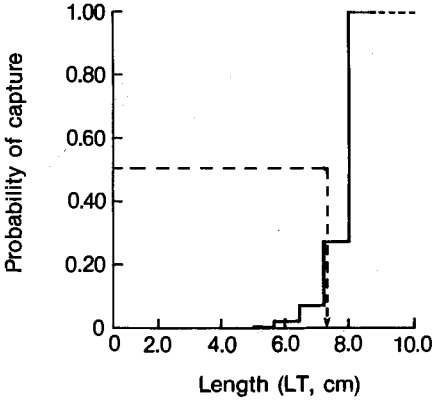
Fam. Engraulidae:
Stolephorus heterolobus

Manila Bay, 1958

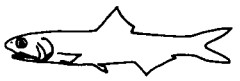






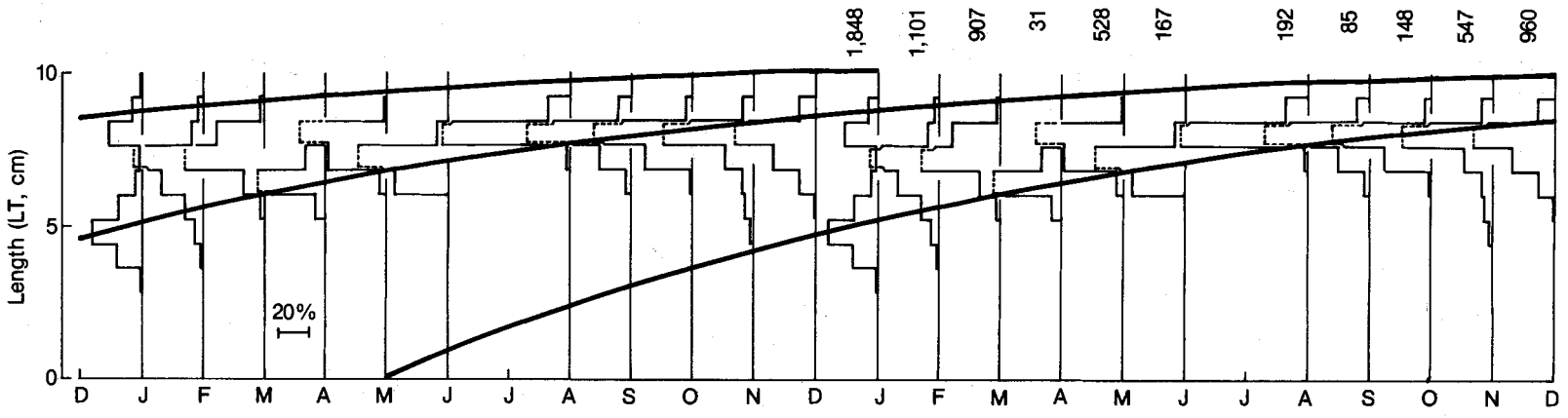


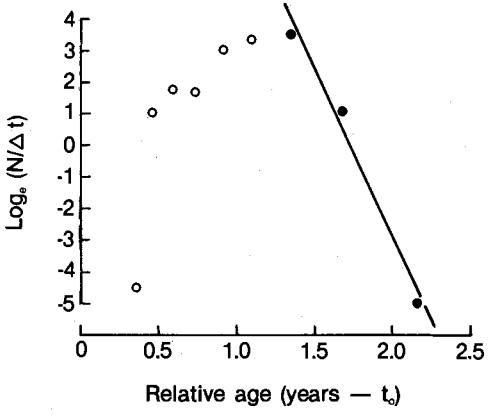
The length-frequency data on shorthead anchovy analyzed here were obtained from the Research Division, BFAR, Manila. They suggest L_∞ = 12.1 cm, K = 1.60, L_c = 7.4 cm, Z = 11.82, M = 3.10 and E = 0.74. Annual recruitment occurred in two well-separated pulses. Further data on *S. heterolobus* may be found in Muller, R.G. 1977. Some aspects of the population biology of *Stolephorus heterolobus* from Palau, p. 119-126. *In* R.S. Shomura (ed.) Collection of tuna baitfish papers. U.S. Dept. of Comm. NOAA Tech. Rep. NMFS Circ. No. 408.

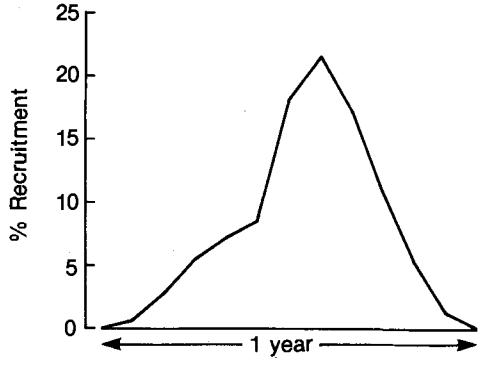


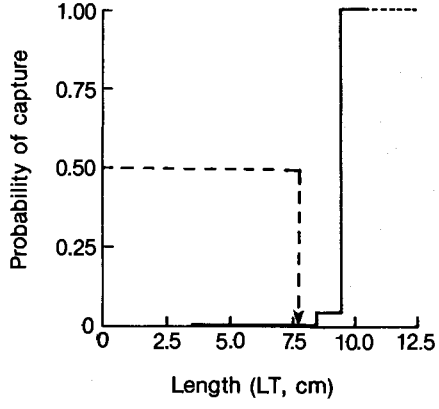
Fam. Engraulidae:
Stolephorus heterolobus

Manila Bay, 1961

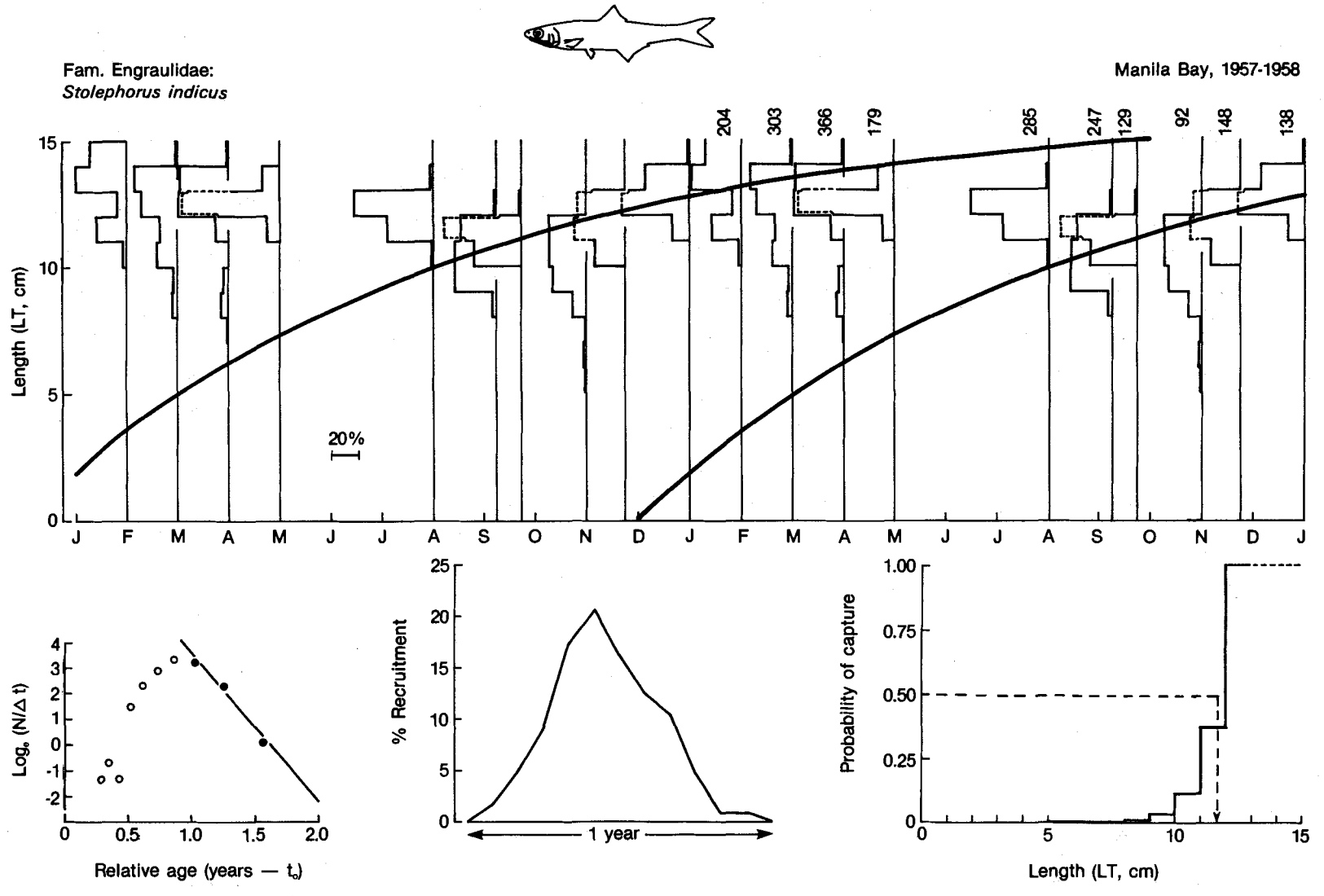






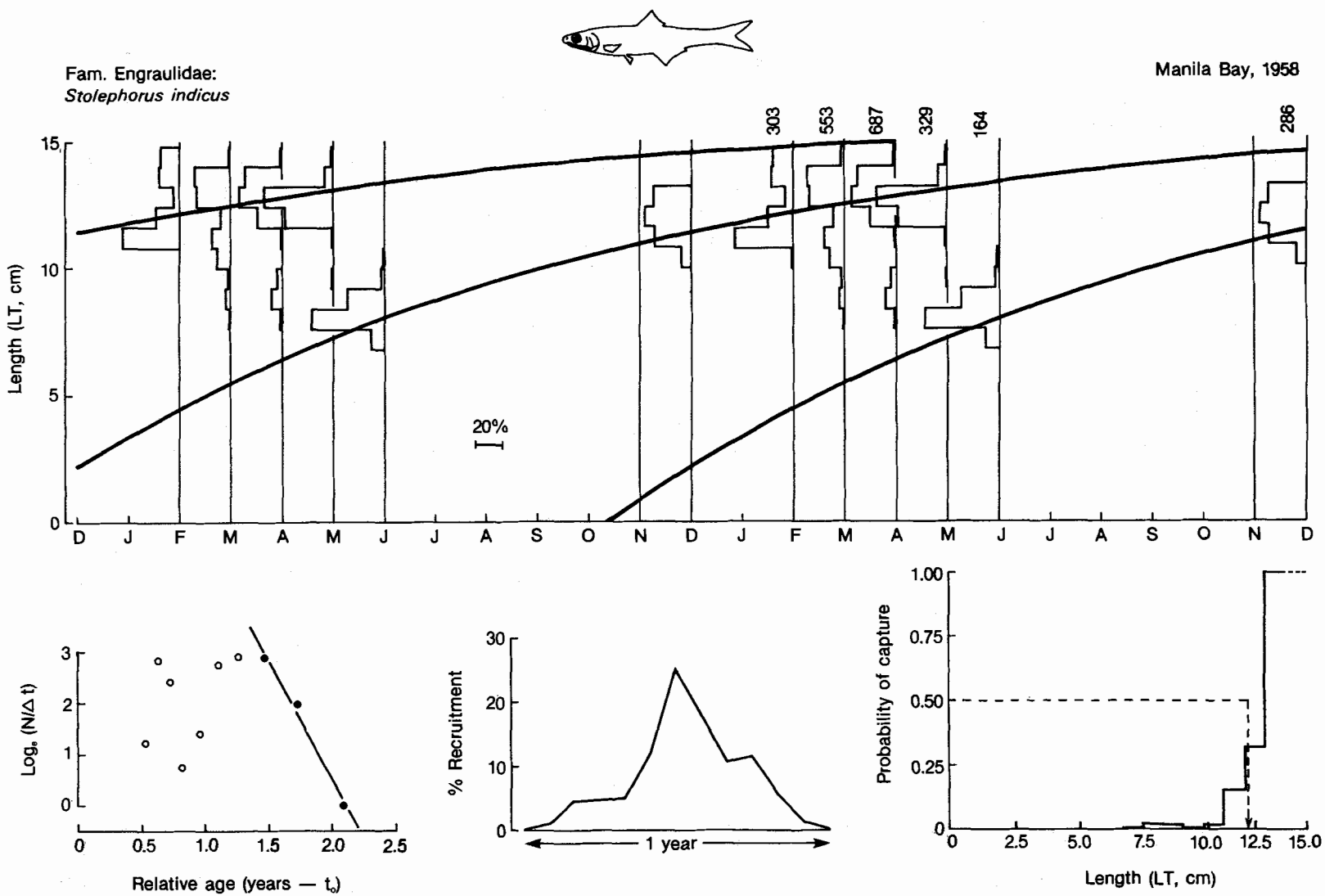


This set of length-frequency data on the shorthead anchovy was obtained from the Research Division, BFAR, Manila. It led to the following estimates: L_∞ = 11.4 cm, K = 0.95, L_c = 7.58 cm, Z = 10.69, M = 2.29 and E = 0.79. Annual recruitment occurred in two pulses of unequal strength. A comprehensive account of the biology of this, and closely allied anchovies may be found in Dalzell, P. 1984. The population biology and management of bait-fish in Papua New Guinea Waters. Report 84-05. 59 p. Fisheries Research and Survey Branch, Dept. of Primary Industry, Port Moresby.



The Indian anchovy is represented here by length-frequency data taken from Tiews, K., I.A. Ronquillo and L.M. Santos. 1971. On the biology of anchovies (*Stolephorus* Lacépède) in Philippine waters. Philipp. J. Fish 9(1/2): 92-123. The estimated parameter values are: L_∞ = 16.3 cm, K = 1.42, L_c = 11.7 cm, Z = 5.81, M = 2.67 and E = 0.54. The recruitment pattern appeared to consist of two recruitment pulses of unequal strength. A yield-per-recruit assessment of this and two other stolephorid species may be found in Pauly, D. 1982. History and status of the San Miguel Bay fisheries, p. 95-124. *In* D. Pauly and A.N. Mines (eds.) Small-scale fisheries of San Miguel Bay, Philippines: biology and stock assessment. ICLARM Technical Reports 7, 124 p. Institute of Fisheries Development and Research, College of Fisheries, University of the Philippines in the Visayas, Quezon City, Philippines; International Center for Living Aquatic Resources Management, Manila, Philippines and the United Nations University, Tokyo, Japan.

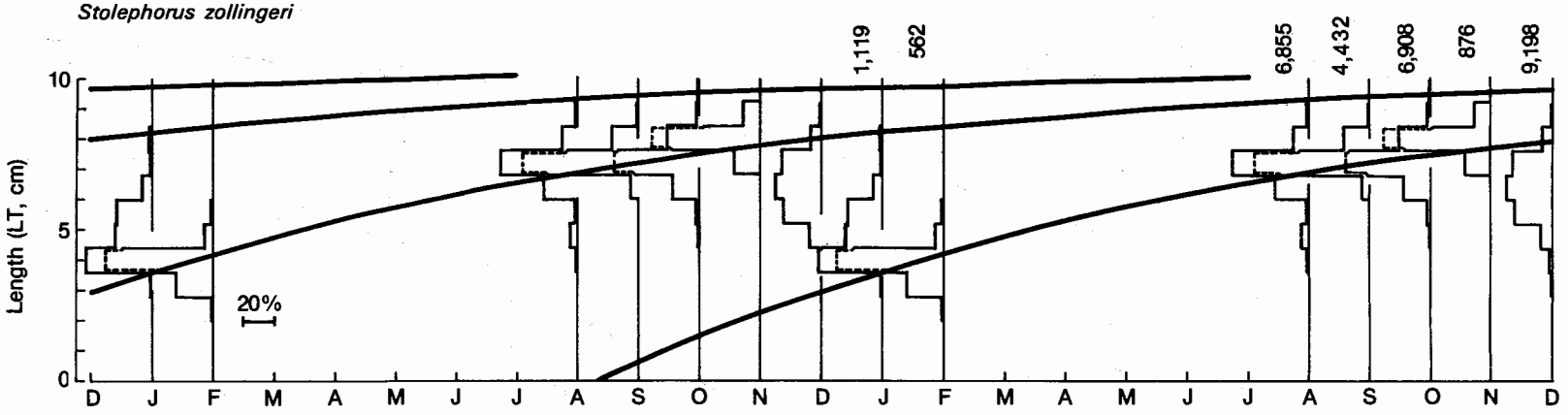
Plate 11

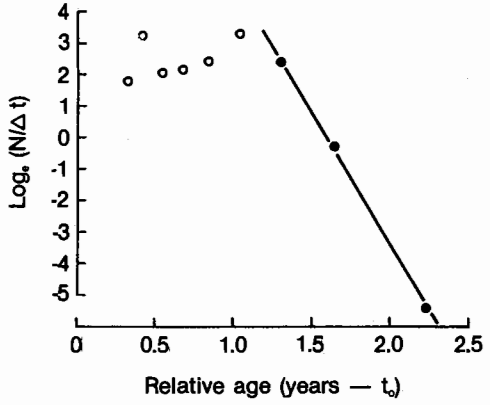


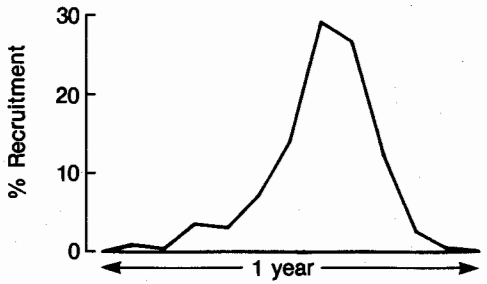
The length-frequency data on the Indian anchovy used here stem from Tiews, K., I.A. Ronquillo and L.M. Santos. 1971. On the biology of anchovies (*Stolephorus* Lacépède) in Philippine waters. Philipp. J. Fish. 9(1/2): 92-123. They suggest the parameter values L_∞ = 15.7 cm, K = 1.08, L_c = 12.2 cm, Z = 4.53, M = 2.23 and E = 0.51. Growth parameters for the Indian anchovy and other stolephorid species are derived in Tham, A.K. 1967. A contribution to the study of the growth of members of the genus *Stolephorus* Lacépède in Singapore Strait. Proc. Indo-Pac. Fish. Counc. 12(2): 1-25.

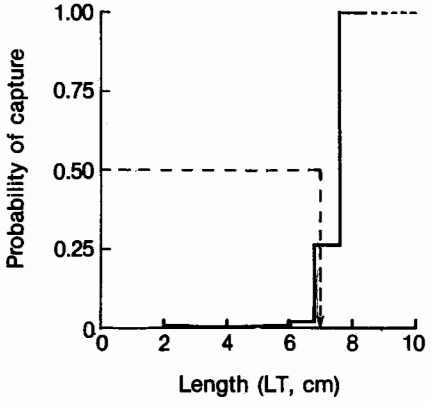
Fam. Engraulidae:
Stolephorus zollingeri

Manila Bay, 1957



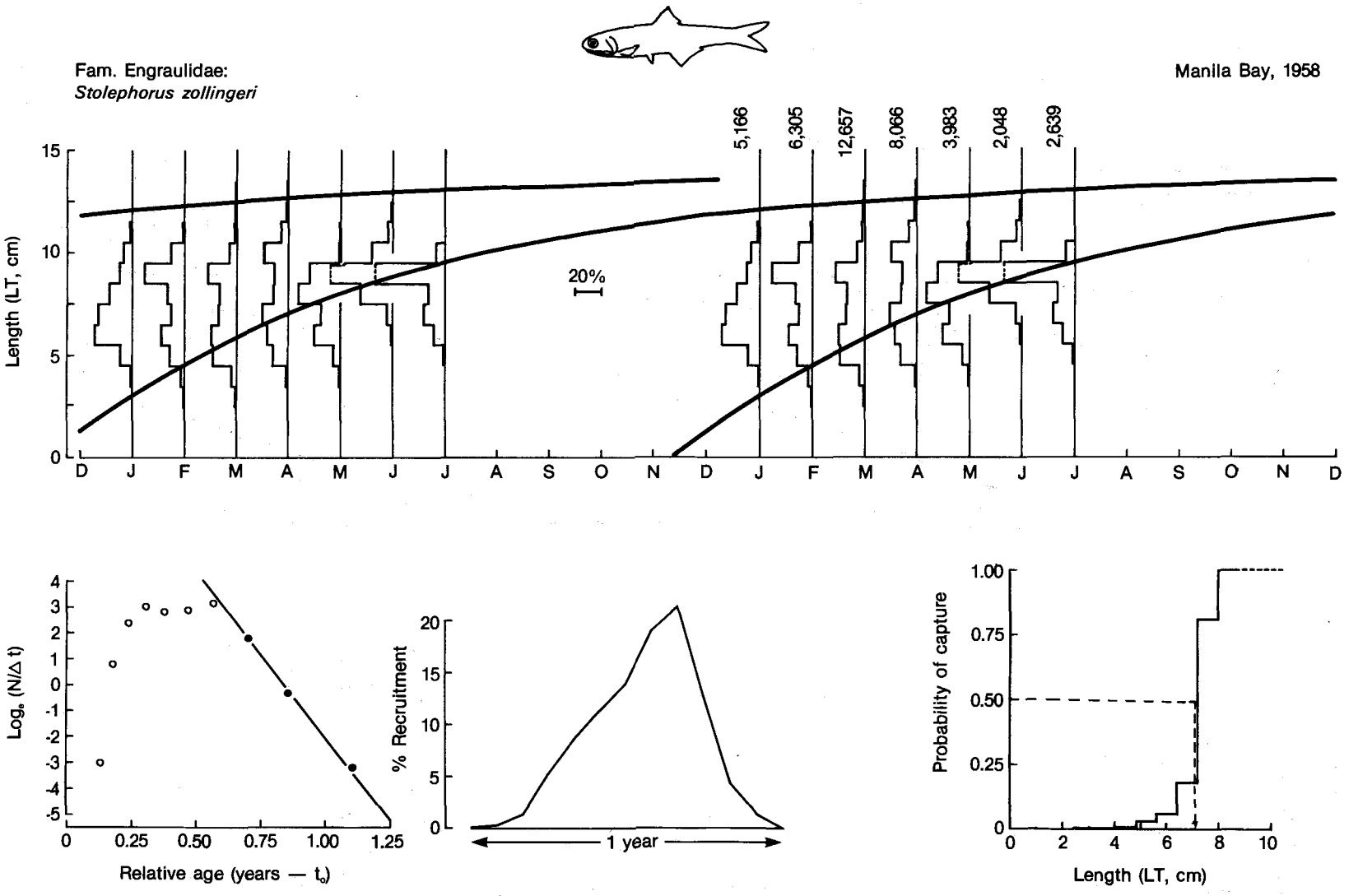






The buccaneer anchovy, renamed *S. buccaneeri* Strasburg, 1960, is represented here by length-frequency data from the Research Division, BFAR, Manila. They led to the following parameter estimates: L_∞ = 10.1 cm, K = 1.10, L_c = 7.48 cm, Z = 8.41, M = 2.55 and E = 0.70. Annual recruitment consisted of two seasonal pulses, one much larger than the other. A discussion of the biology and taxonomy of stolephorids, including *S. buccaneeri* is given in Tham, A.K. 1974. *Stolephorus* resources of the South China Sea. Proc. Indo-Pac. Fish. Counc. 15(3): 182-191.

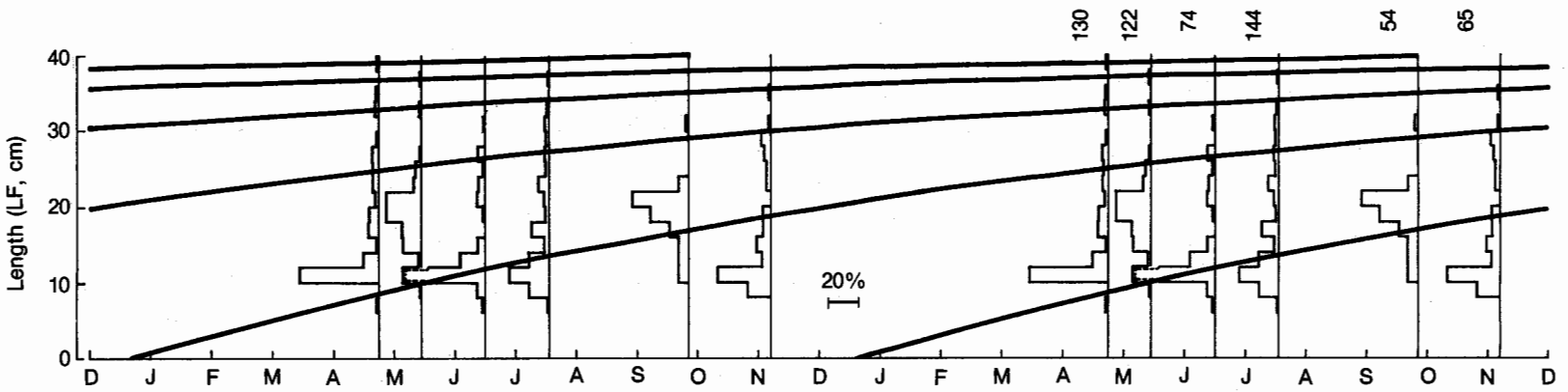
Plate 13

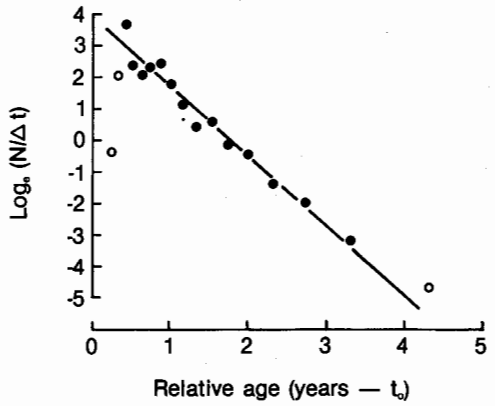


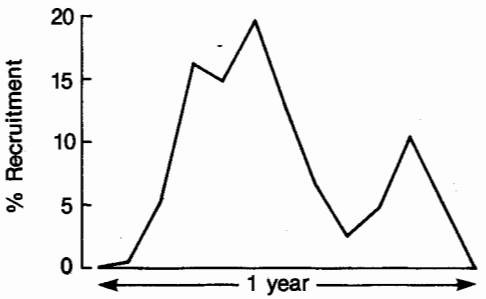
The buccaneer anchovy *S. buccaneeri* (= *S. zollingeri*) is represented here by length-frequency data from the Research Division, BFAR, Manila, which led to the estimation of the following parameter values: L_∞ = 10.6 cm, K = 1.85, L_c = 7.2 cm, Z = 12.00, M = 3.53 and E = 0.71. The recruitment pattern appeared to consist of two pulses of unequal strength. The taxonomic status of and other information on *S. buccaneeri* are reviewed in Nakamura, E.L. 1970. Synopsis of biological data on Hawaiian species of *Stolephorus,* p. 425-446. *In* J.C. Marr (ed.) The Kuroshio, a symposium of the Japan current. East-West Center Press, Honolulu.

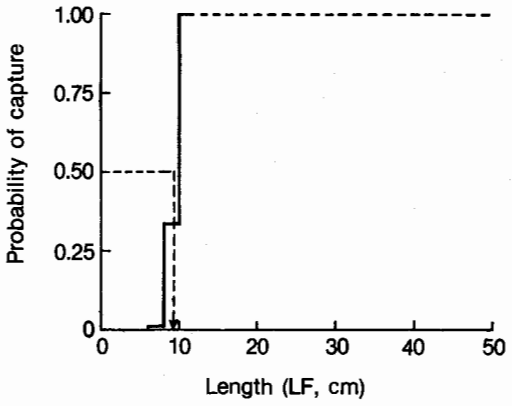
Fam. Synodontidae:
Saurida tumbil

Visayan Sea, 1976

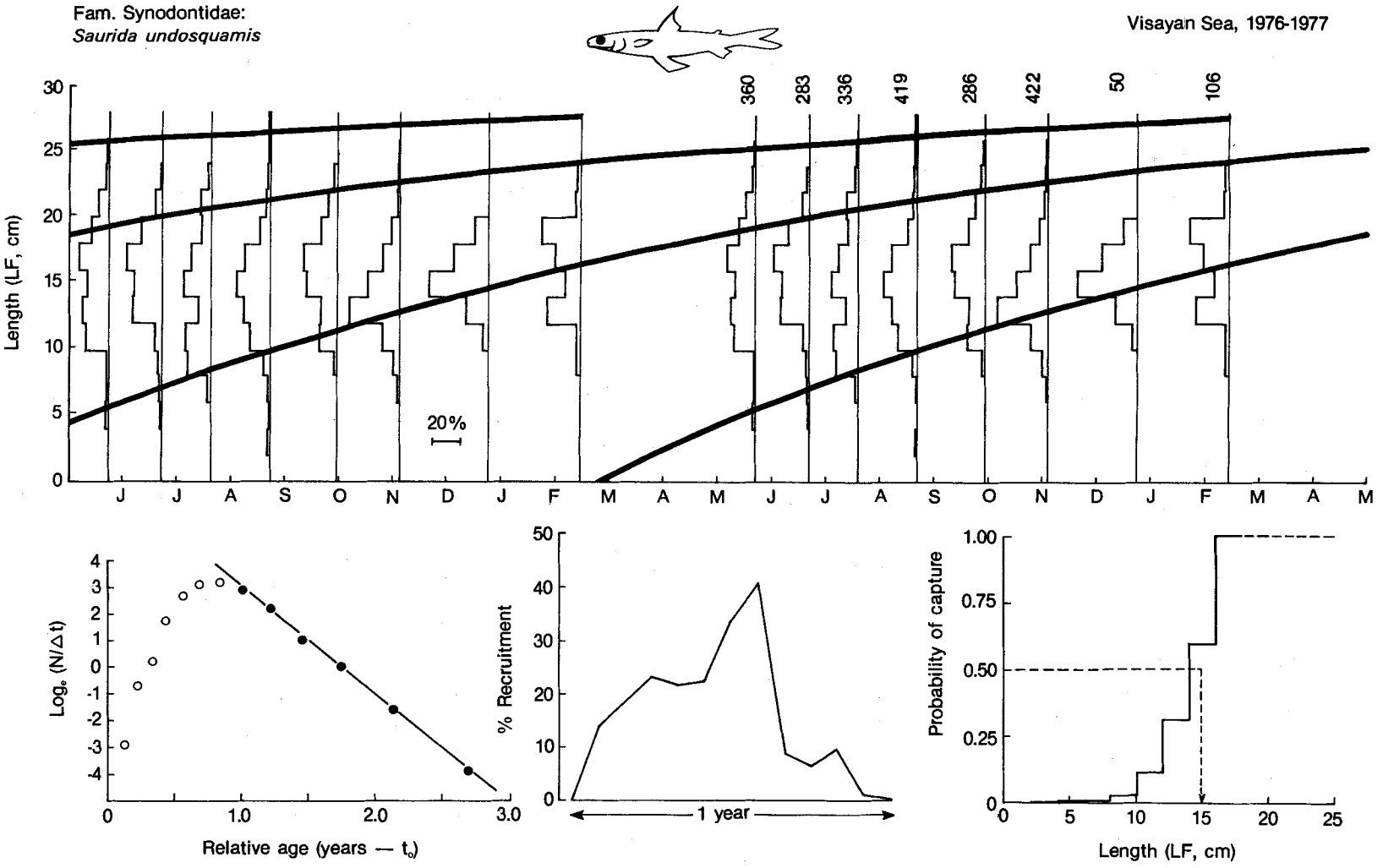




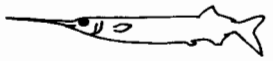




The length-frequency data on greater lizardfish analyzed here were collected in the frame of the Philippine Council for Agriculture and Resources Research (PCARR) Project 129 "Trawl fishery investigations on traditional and non-traditional fishing grounds in the Philippines". The parameter estimates obtained from these data are as follows: L_∞ = 41 cm, K = 0.70, L_c = 9.6 cm, Z = 2.22, M = 1.30 and E = 0.42. Annual recruitment appeared to occur in two pulses of unequal strength. Aspects of the population dynamics of greater lizardfish are given in Shindo, S. 1972. Notes on the study on the stock of greater lizardfish, *Saurida tumbil* in the East China Sea. Proc. Indo-Pac. Fish. Counc. 13(3): 298-305.

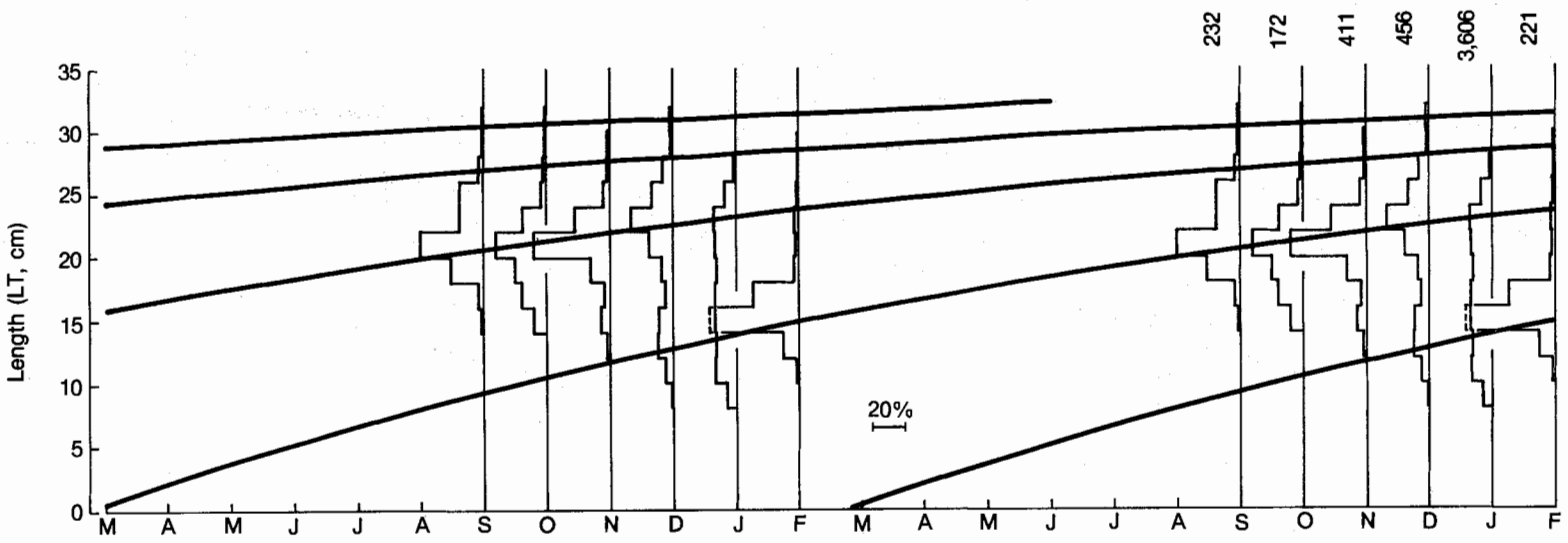


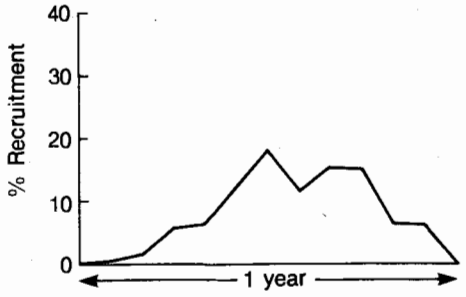
The set of length-frequency data on brushtooth lizardfish presented and analyzed here was collected in the course of PCARR Project 129 "Trawl fishery investigations on traditional and non-traditional fishing grounds in the Philippines". The following parameter values were estimated: L_∞ = 30.5 cm, K = 0.80, L_c = 15.0 cm, Z = 4.07, M = 1.54 and E = 0.62. Annual recruitment probably consisted of two pulses of unequal strength. A detailed analysis of length-frequency data on this fish is presented in Sinoda, M. and S. Intong. 1978. Size-frequency distribution of lizardfish, *Saurida undosquamis* in the inner Gulf of Thailand. Bull. Jap. Soc. Sci. Fish. 44(1): 1-6.

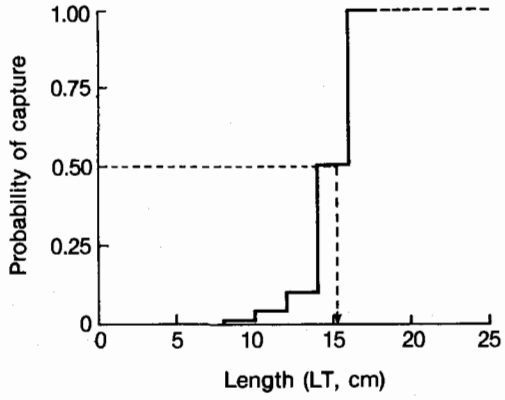


Fam. Exocoetidae:
Hemiramphus georgii

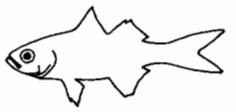
Manila Bay, 1978-1979





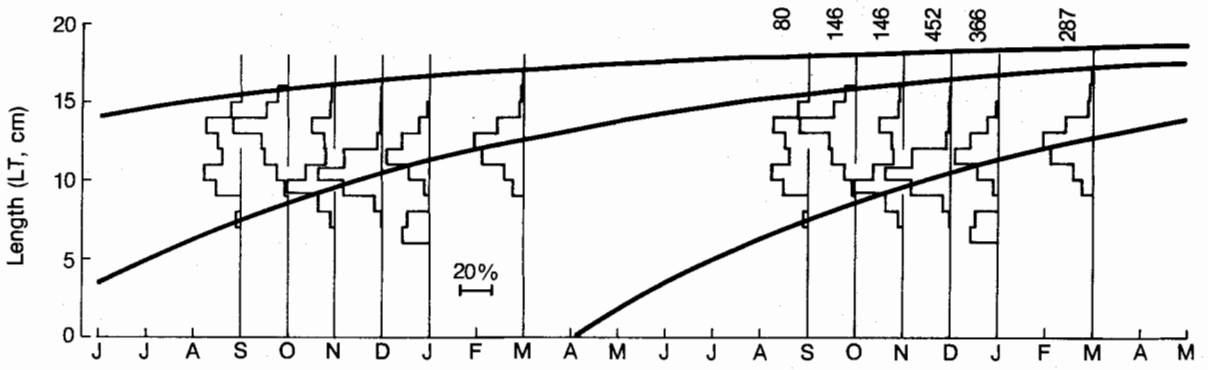


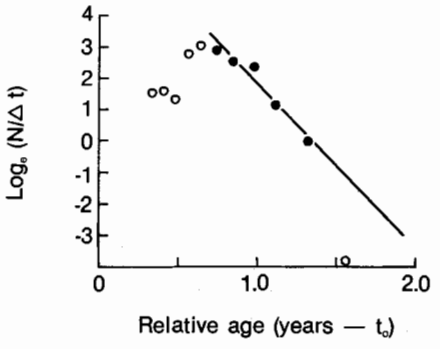
The length-frequency data presented here on long bill garfish ("buging") were collected by Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines, as estimated from analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. They gave the following parameter estimates: $L_\infty = 34.5$ cm, $K = 0.60$, $L_c = 15.3$ cm, $Z = 2.32$, $M = 1.23$ and $E = 0.47$. The shape of the recruitment pattern does not allow for inferences on the seasonality of recruitment. For a taxonomic review of the Philippine hemirhamphids see Herre, A.W.C.T. 1944. A review of the halfbeaks or Hemirhamphidae of the Philippines and adjacent waters. Standford Univ. Publ., Biol. Ser. 9(2): 39-86.

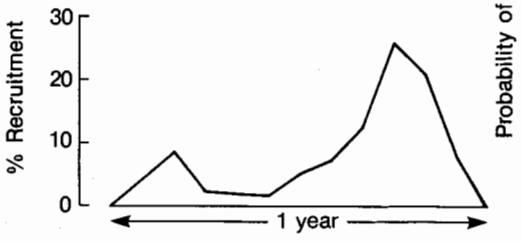


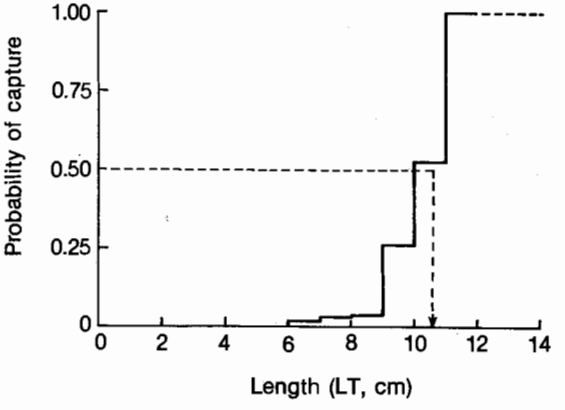
Fam. Centropomidae:
Ambassis gymnocephalus

Manila Bay, 1978-1979





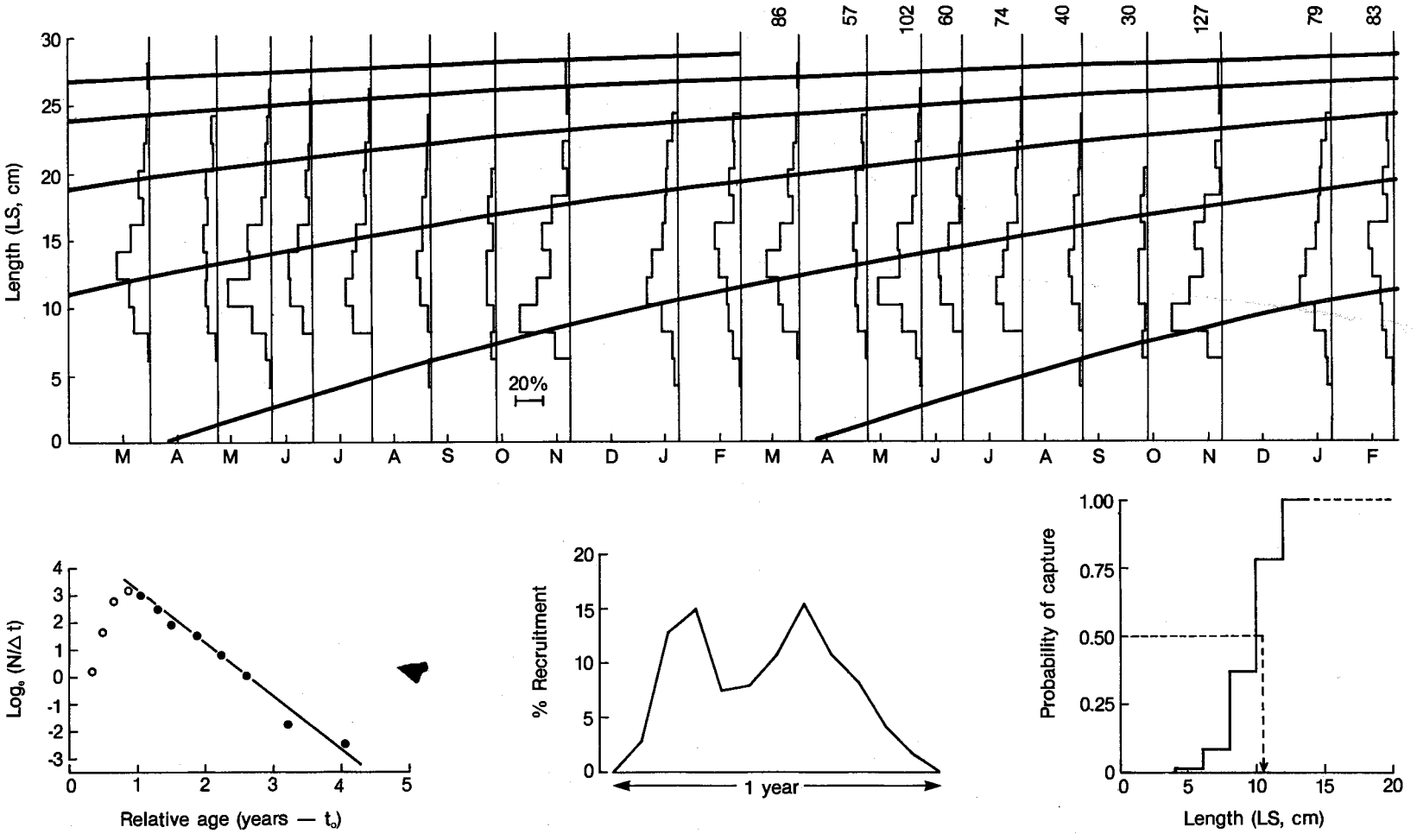




The length-frequency data on bare headed perchlet ("langaray, bangan") presented here were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. They suggest the parameter estimates L_∞ = 19.5 cm, K = 1.20, L_c = 10.6 cm, Z = 5.24, M = 2.27 and E = 0.57. Annual recruitment occurred in two well-separated pulses. As this species is reported to reach only "4 inches" the possibility of misidentification cannot be excluded. The taxonomy of Philippine glassfish is discussed in De Beaufort, L.F. 1932. Ambassidae from the Philippines. Philipp. J. Sci. 49(1): 91-96.

Fam. Serranidae:
Epinephelus sexfasciatus

Visayan Sea, 1976-1977

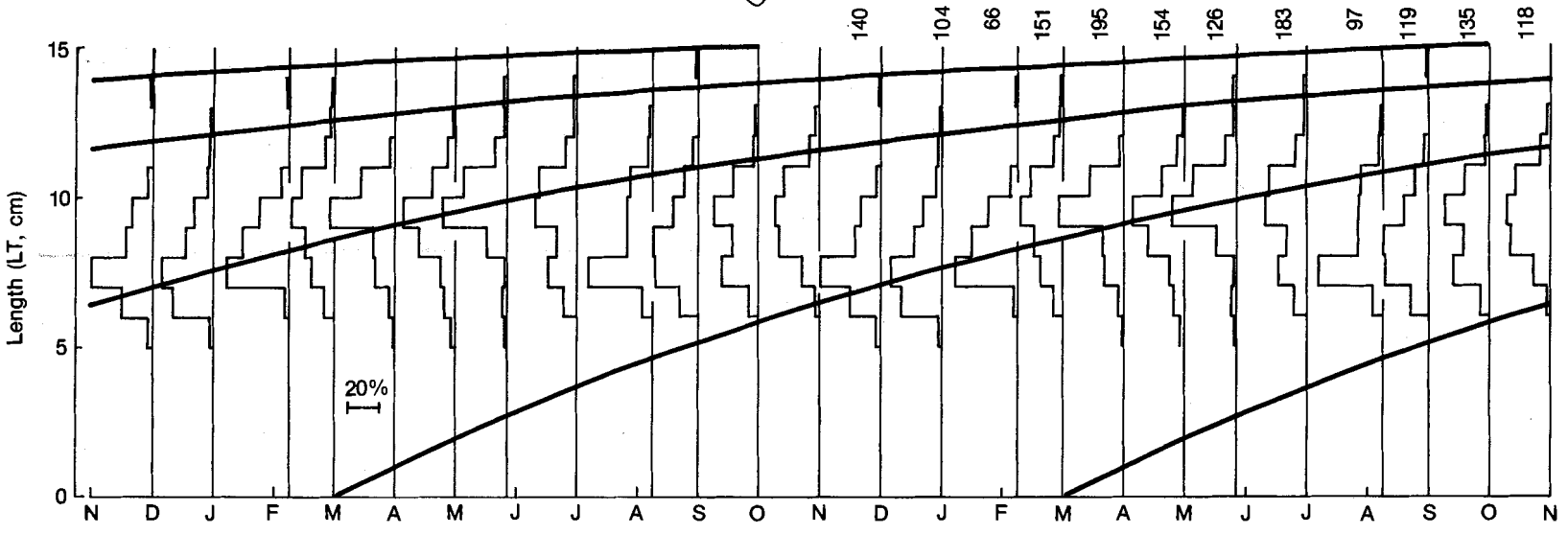


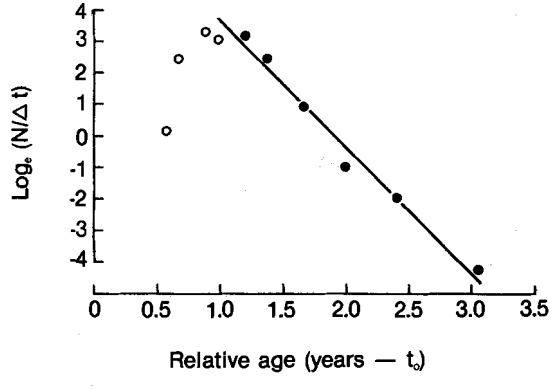
The length-frequency data presented here on six-banded rock-cod ("lapu-lapu") were obtained from PCARR Project 129 "Trawl fishery investigations on traditional and non-traditional fishing grounds in the Philippines". They led to the parameter estimates L_∞ = 30.9 cm, K = 0.51, L_c = 10.7 cm, Z = 1.95, M = 1.14 and E = 0.42. Annual recruitment seems to have occurred in two well separated pulses. This pattern of recruitment confirms what is known of the seasonality of spawning in *E. sexfasciatus,* as shown in Pauly, D. and J. Ingles. 1981. Aspects of the growth and mortality of exploited coral reef fishes, p. 89-98. *In* E.D. Gomez, C.E. Birkeland, R.W. Buddemeyer, R.E. Johannes, J.A. Marsh, Jr., and R.T. Tsuda (eds.) Proceedings of the Fourth International Coral Reef Symposium, Manila, Philippines, Vol. 1.

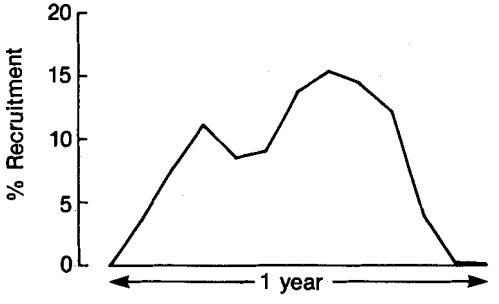
Plate 21

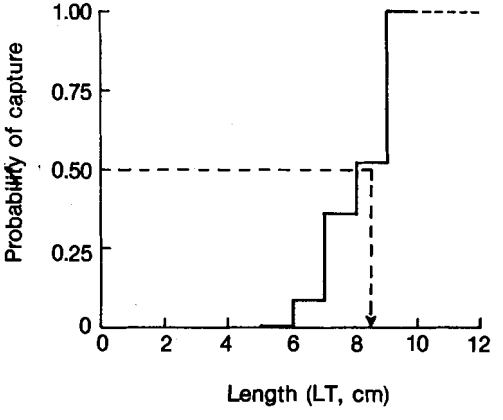
Fam. Theraponidae:
Therapon plumbeus

Laguna de Bay, 1957





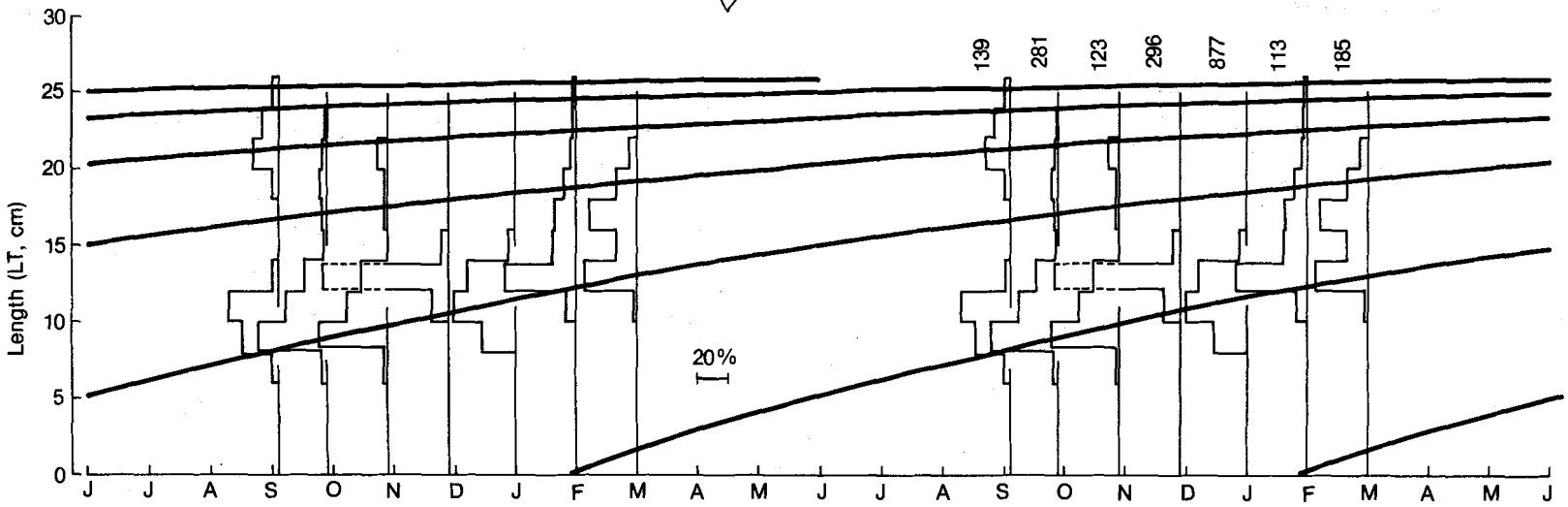


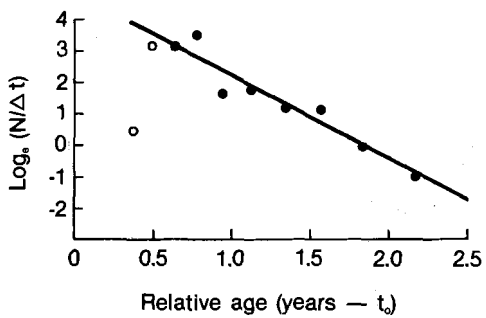


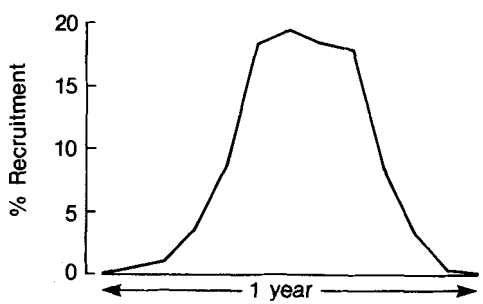
The length-frequency data on grunts ("ayuñgin") presented here were originally published in Yapchiongco, J.V. and G. Enriquez. 1963. Notes on certain aspects in the biology of *Therapon plumbeus* (Kner). Philipp. J. Sci. 92(3): 265-289. The following parameter estimates were extracted from them: L_∞ = 16.0 cm, K = 0.78, L_c = 8.50 cm, Z = 3.98, M = 1.80 and E = 0.55. Annual recruitment consisted of two distinct pulses. A detailed description of this freshwater fish is given in Herre, A.W. 1930. Notes upon *Datnia plumbea,* or ayuñgin, a Philippine theraponid. Copeia 3: 76-77.

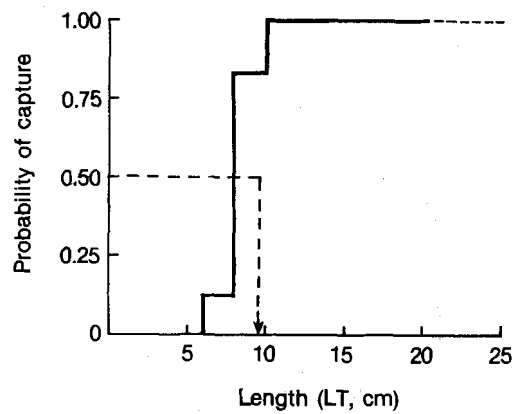
Fam. Theraponidae:
Therapon theraps

Manila Bay, 1978-1979



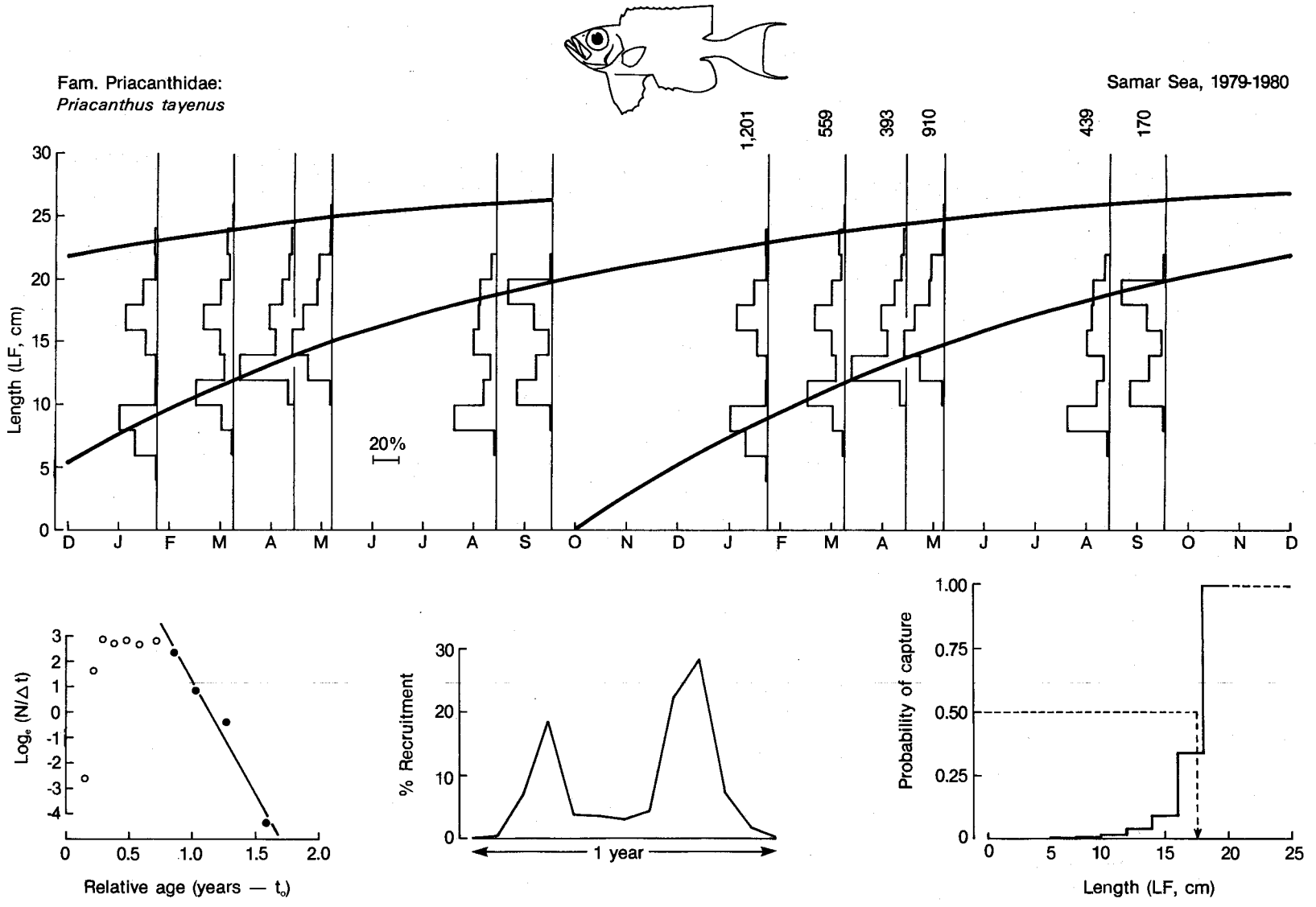






The length-frequency data on banded grunter ("babansi") presented here were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. These data suggest the following parameter estimates: $L_\infty = 34.0$ cm, $K = 0.61$, $L_c = 9.6$ cm, $Z = 3.49$, $M = 1.25$ and $E = 0.64$. Annual recruitment seems to have occurred in one broad pulse. A figure and some biological information on *T. theraps,* including morphological adaptations of its gas bladder which allow it to grunt very audibly are given on p. 225-228. *In* H.C. Delsman and J.D.F. Hardenberg. 1934. De indische zeevisschen en zeenvisscherij Visser & Co., Batavia-Centrum, Jakarta. (in Dutch)

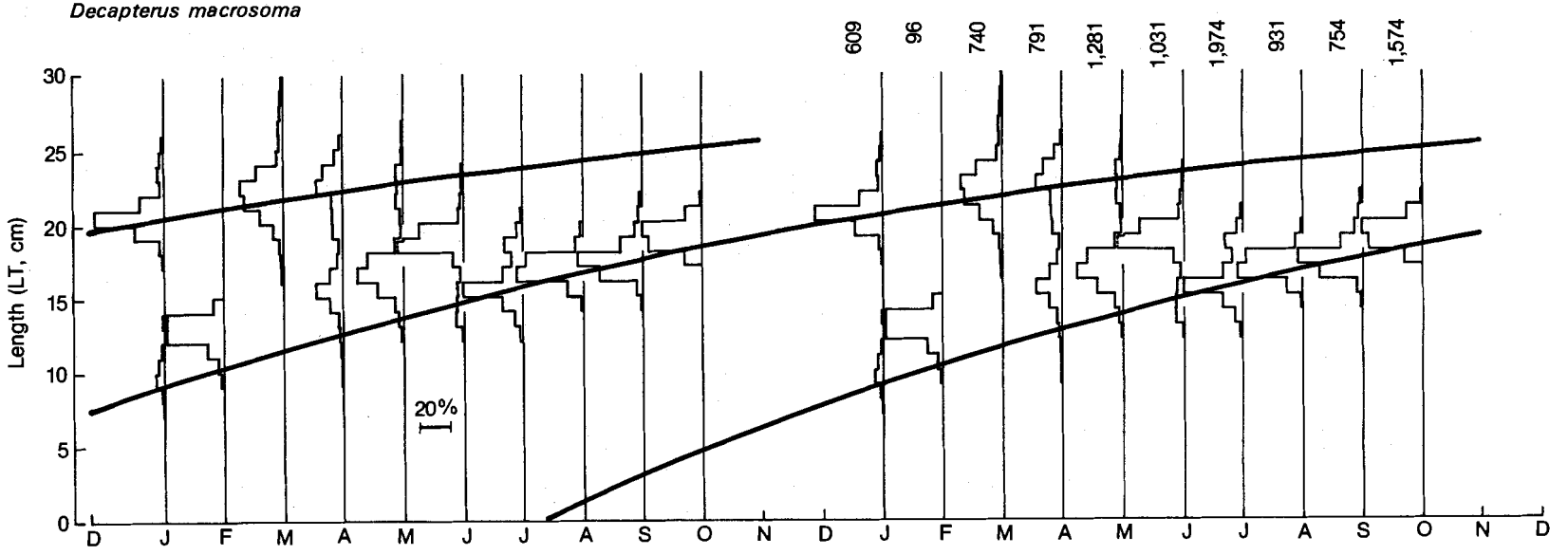
Plate 23

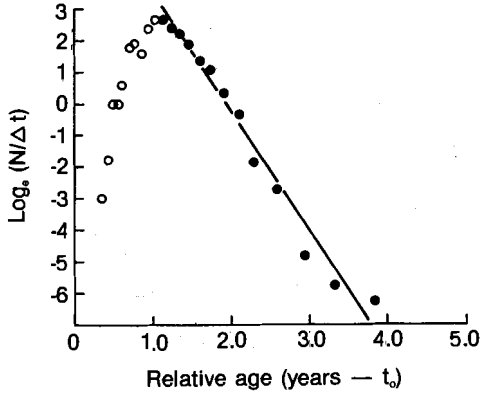


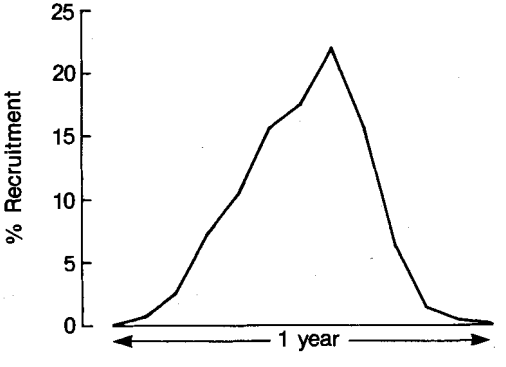
The length-frequency data presented here on purple-spotted bigeye ("dilat") were obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resource survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following parameter estimates were obtained: L_∞ = 29.0 cm, K = 1.25, L_c = 17.5 cm, Z = 8.95, M = 2.09 and E = 0.77. Annual recruitment consisted of two well separated pulses. The results of tagging experiments of *P. tayenus* in the Gulf of Thailand (growth, movements) are given in Chomjurai, W. and R. Bunnag. 1970. Preliminary tagging studies of demersal fish in the Gulf of Thailand, p. 517-523. *In* J.C. Marr (ed.) The Kuroshio: a symposium of the Japan current. East-West Center Press, Honolulu.

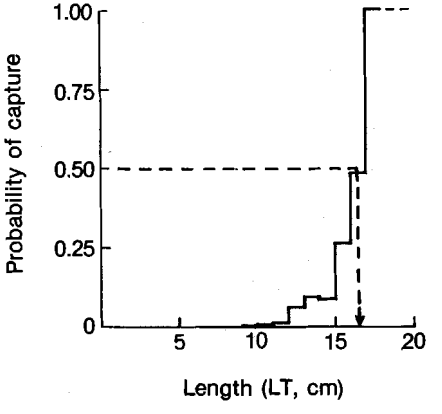
Fam. Carangidae:
Decapterus macrosoma

Manila Bay, 1958





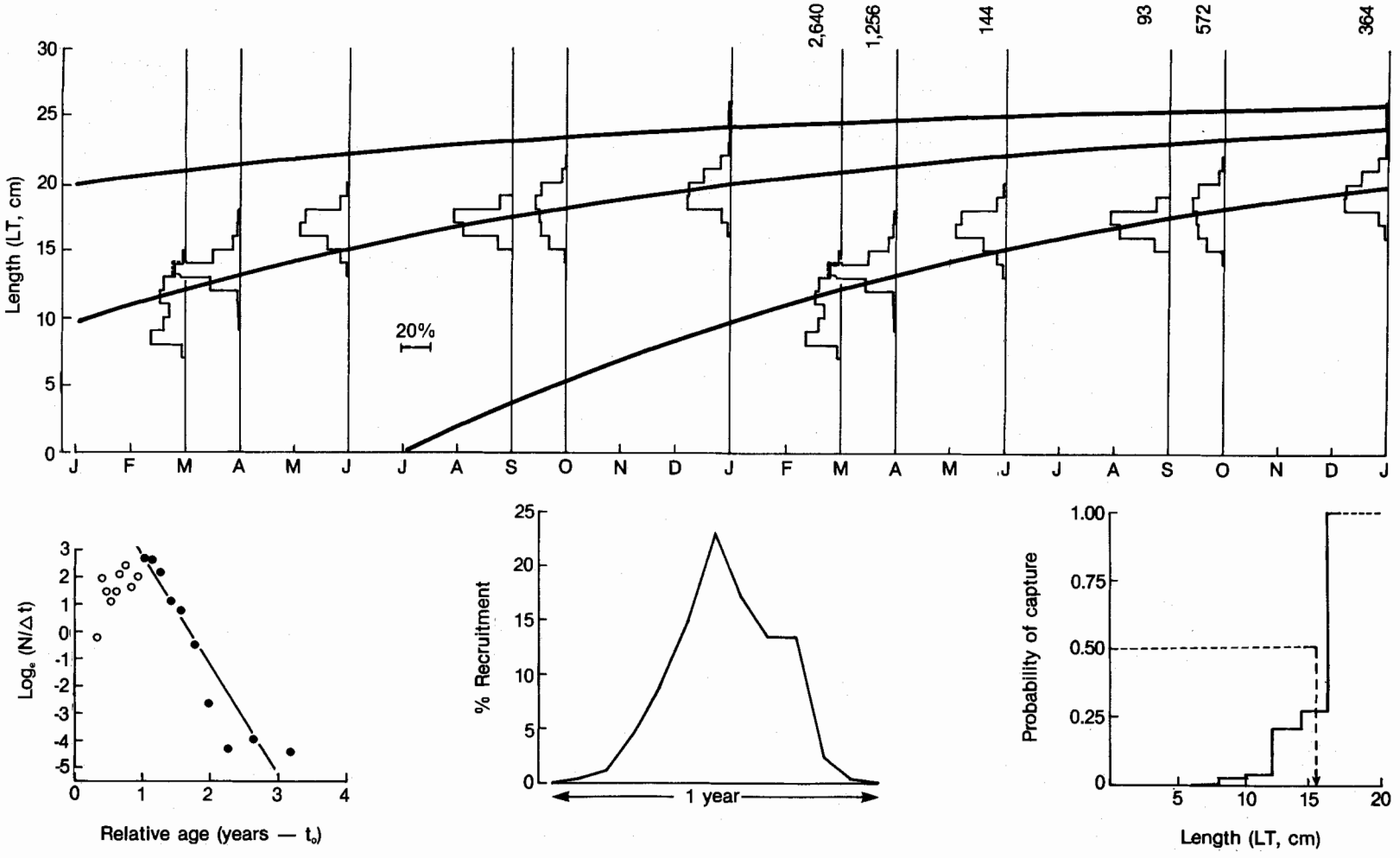




The length frequencies on *D. macrosoma* presented here were obtained from the files of the Research Division, BFAR, Manila. These data led to the following parameter estimates: L_∞ = 31.5 cm, K = 0.71, L_c = 16.5 cm, Z = 3.80, M = 1.41 and E = 0.63. Recruitment seems to have occurred in one long pulse. A review of catch and effort data in the roundscad fisheries of Southeast Asia is given in SCSP. 1978. Report of the workshop on the biology and resources of mackerels (*Rastrelliger* spp.) and round scads (*Decapterus* spp.) in the South China Sea. SCS/GEN/78/17. 70 p. South China Sea Fisheries Development and Coordinating Programme, Manila.

Fam. Carangidae:
Decapterus macrosoma

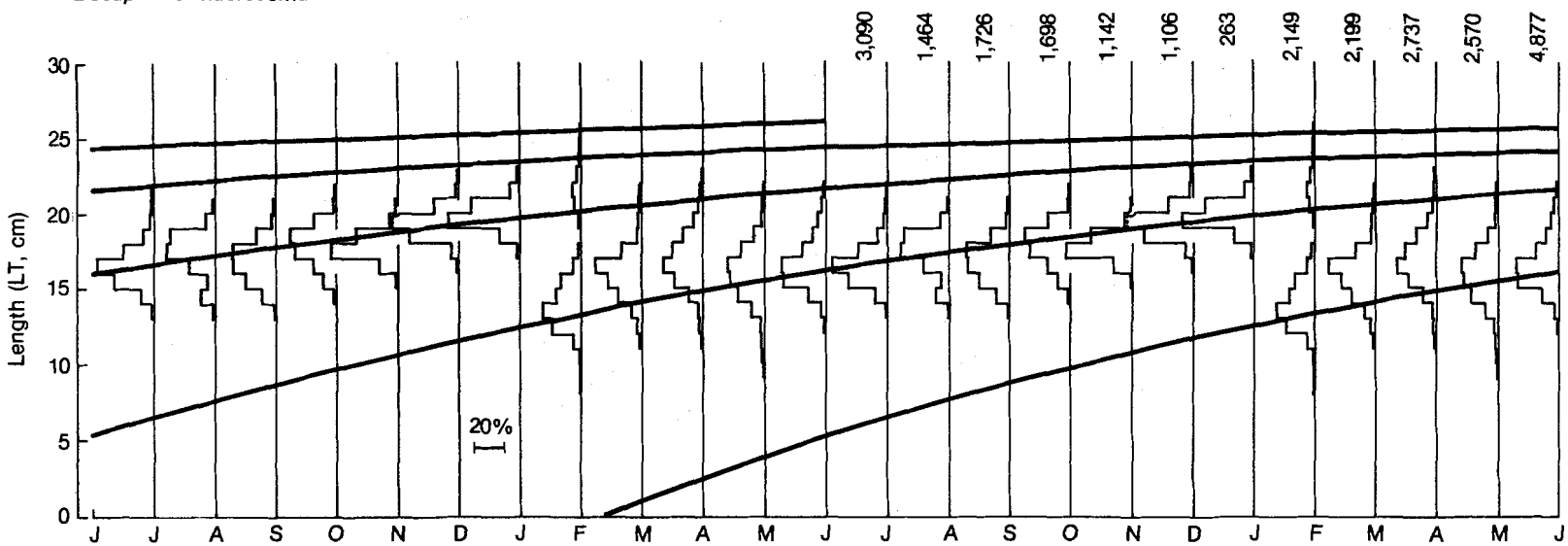
Palawan, 1957

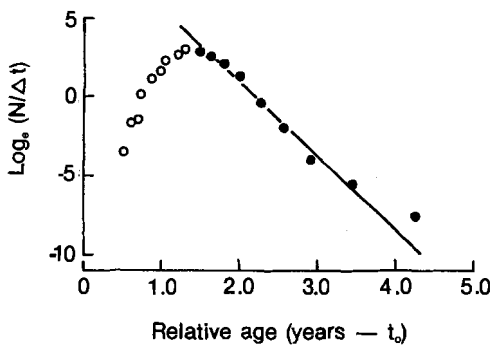


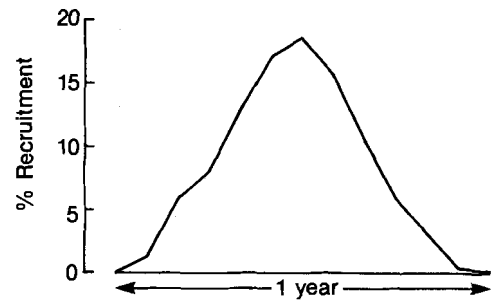
The length-frequency data analyzed here stem from the files of the Research Division, BFAR, Manila. The following parameter estimates were derived from them: L_∞ = 27 cm, K = 0.90, L_c = 15.3 cm, Z = 4.01, M = 1.72 and E = 0.57. The bulk of the annual recruitment seems to have originated from one long pulse. Ecological information on the habitat of roundscads, as well as a comprehensive discussion of their biology is given in Ronquillo, I.A. 1974. A review of the roundscad fishery of the Philippines. Proc. Indo-Pac. Fish. Counc. 15(3): 351-375. (Also issued in 1973, Philipp. J. Fish. 11(1/2): 86-126.)

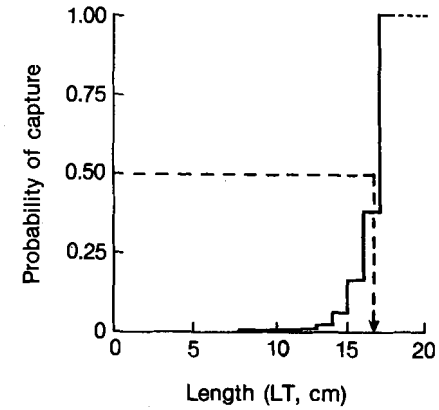
Fam. Carangidae:
Decapterus macrosoma

Palawan, 1957-1958



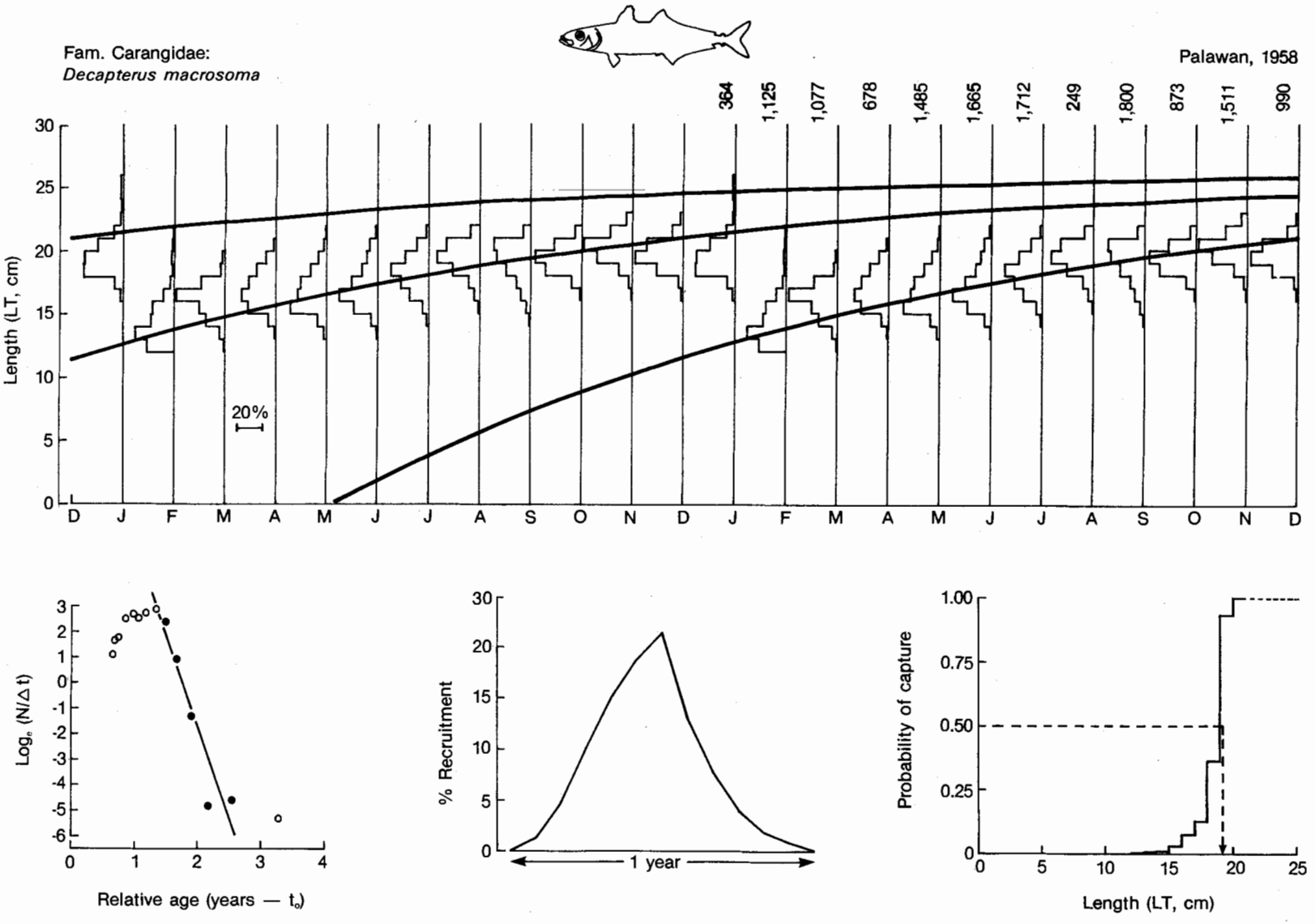




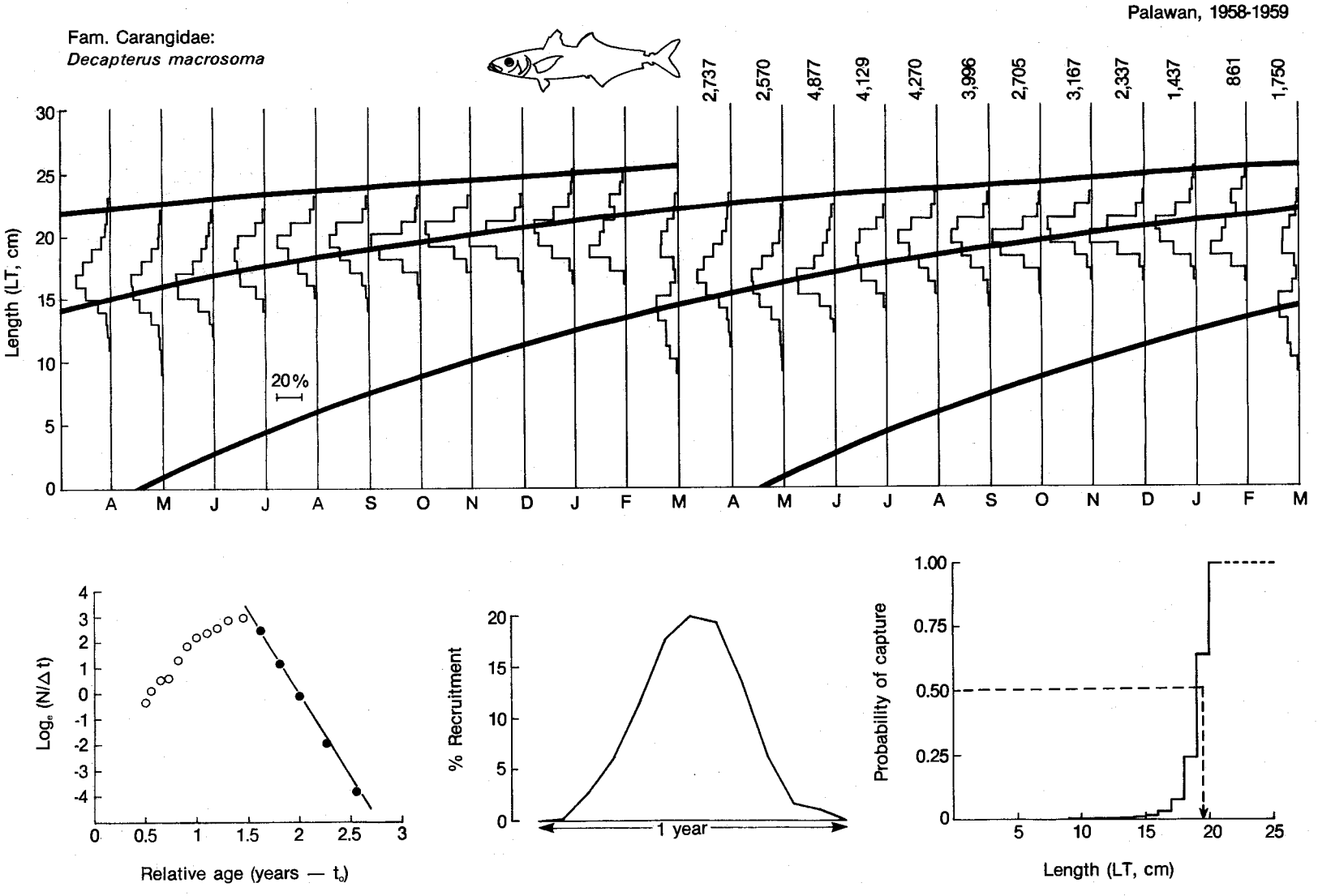


The source of the length-frequency data presented here is: Tiews, K., I.A. Ronquillo and P. Caces-Borja. 1971. On the biology of roundscads (*Decapterus* Bleeker) in Philippine waters. Philipp. J. Fish. 9(1/2): 45-71. The parameters estimated are: L_∞ = 26.8 cm, K = 0.71, L_c = 16.7 cm, Z = 4.71, M = 1.47 and E = 0.69. Recruitment seems to have occurred once per year, over a protracted period. Additional data on roundscads and on the Philippine roundscad fishery may be found in Ronquillo, I.A. 1970. Status of the roundscad (*Decapterus* spp.) catch by purse seine, p. 417-423. *In* The Kurushio II. Saikon Publ. Co. Ltd., Tokyo. (Also issued in 1974, Philipp. J. Fish. 12(1/2): 101-112.)

Plate 29

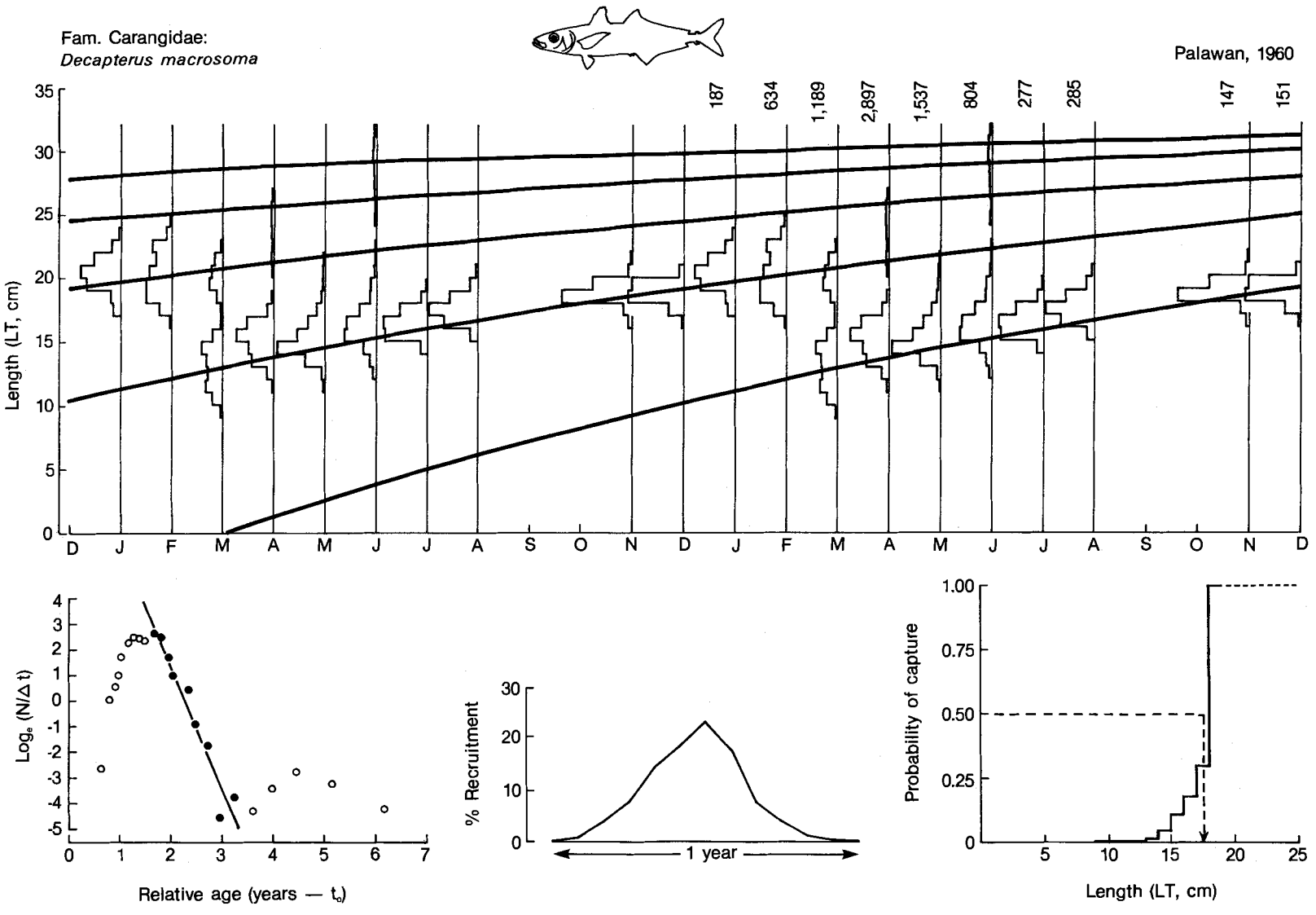


The length-frequency data used here were culled from the files of the Research Division, BFAR, Manila; the following parameter estimates were obtained from them: L_∞ = 26.5 cm, K = 1.00, L_c = 19.2 cm, Z = 6.89, M = 1.85 and E = 0.73. Annual recruitment seems to have occurred in a single protracted pulse. Catch and effort data on roundscads from various areas of the Philippines are presented in SCSP. 1978. Report of the BFAR/SCSP program on the fishery resources of the Pacific coast of the Philippines. SCS/GEN/78/19. 48 p. South China Sea Fisheries Development and Coordinating Programme, Manila.



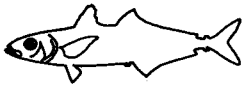
This set of length-frequency data was obtained from Tiews, K., I.A. Ronquillo and P. Caces-Borja. 1971. On the biology of roundscads (*Decapterus* Bleeker) in Philippine waters. Philipp. J. Fish. 9(1/2): 45-71. The following parameter values were estimated: $L_\infty = 27.8$ cm, $K = .825$, $L_c = 19.5$ cm, $Z = 6.46$, $M = 1.61$ and $E = 0.75$. Annual recruitment seems to have been brought about in a single protracted pulse. Notes on the biology, migration and behavior of roundscads, particularly in relationship to fish lures, have been presented by Soemarto. 1960. Fish behaviour with special reference to pelagic shoaling species: lajang (*Decapterus* spp.). Proc. Indo-Pac. Fish. Counc. 8(3): 89-93.

Plate 31

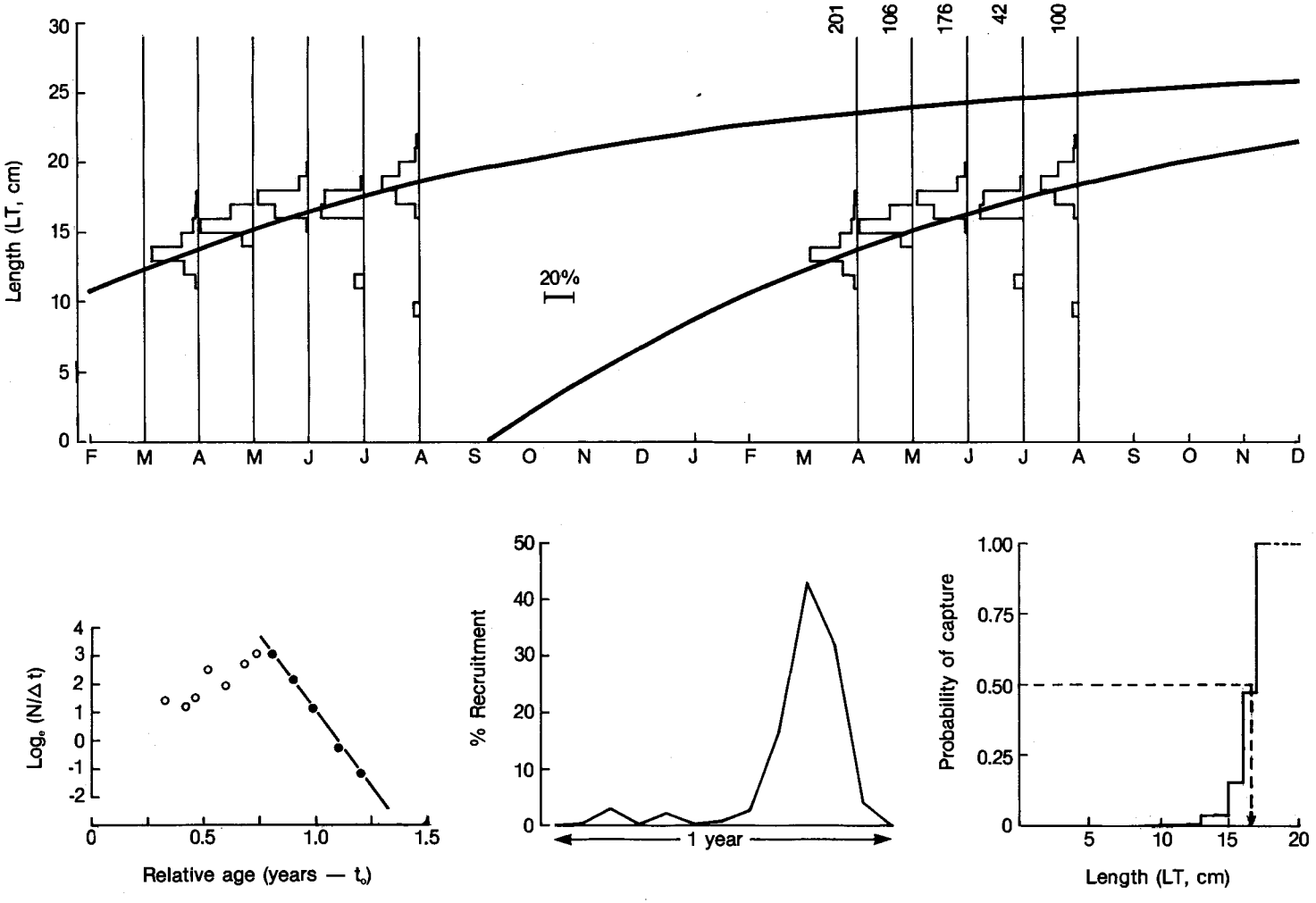


The length-frequency data presented here were obtained from the files of the Research Division, BFAR, Manila. They led to the following estimates: L_∞ = 33.0 cm, K = 0.50, L_c = 17.7 cm. The first straight segment of the length-converted catch curve suggests values of Z = 4.80, M = 1.10 and E = 0.77. Annual recruitment seems to have occurred as one long pulse. A description of the eggs of *D.* (= *"caranx"*) *macrosoma* and allied species is given in Delsman, H.C. 1926. Fish eggs and larvae from the Java Sea 5: *Caranx kurra, macrosoma* and *crumenophthalmus.* Treubia 8: 199-211 (reprinted in Delsman, H.C. 1972. Fish eggs and larvae from the Java Sea, Linnaeus Press, Amsterdam).

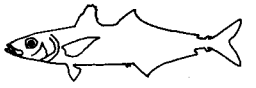
Fam. Carangidae:
Decapterus macrosoma



Palawan, 1960

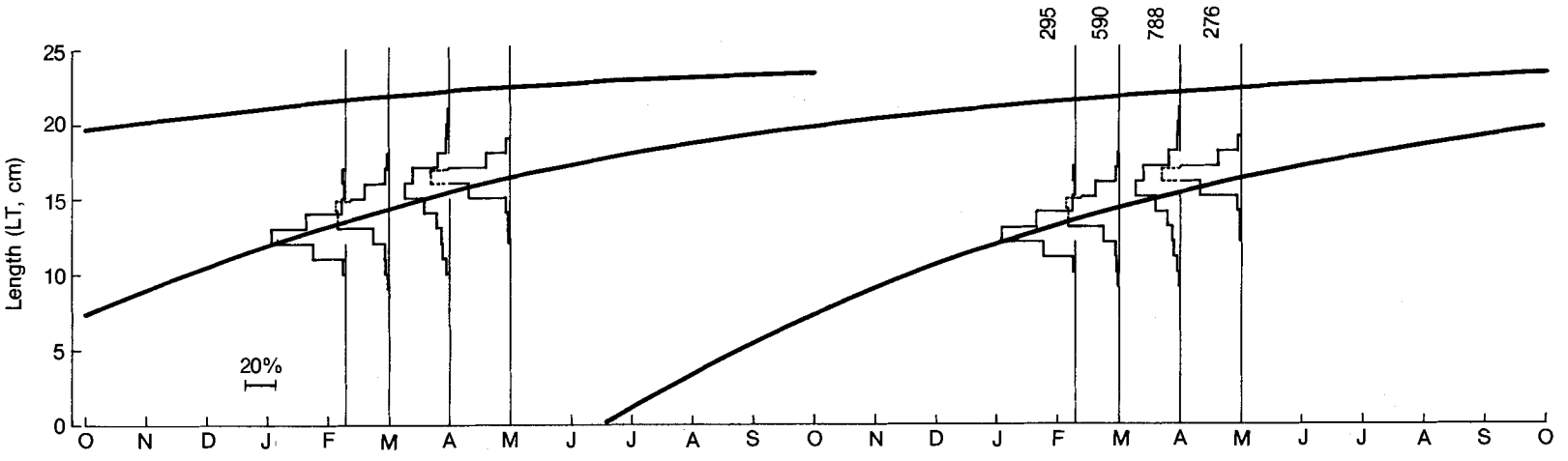


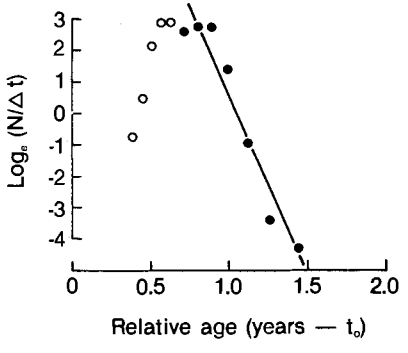
This set of length-frequency data on roundscad stems from the files of the Research Division, BFAR, Manila. It led to the parameter estimates: L_∞ = 27.5, K = 1.25, L_c = 16.6, Z = 10.5, M = 2.12 and E = 0.80. Annual recruitment seems to have occurred in one short pulse. A detailed taxonomic description of *D. macrosoma* is given by Roxas, H.A. and A.G. Agco. 1941. A review of Philippine Carangidae. Philipp. J. Sci. 74(1): 1-82.

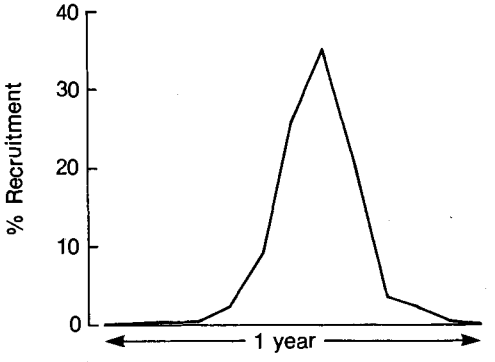


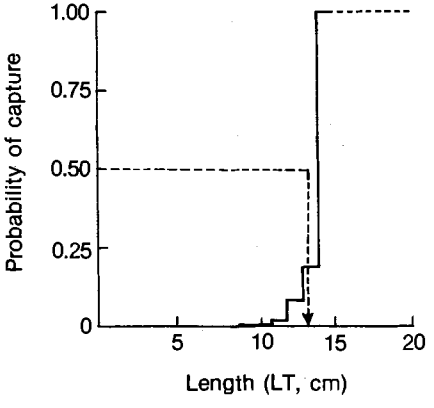
Fam. Carangidae:
Decapterus macrosoma

Palawan, 1965



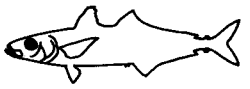




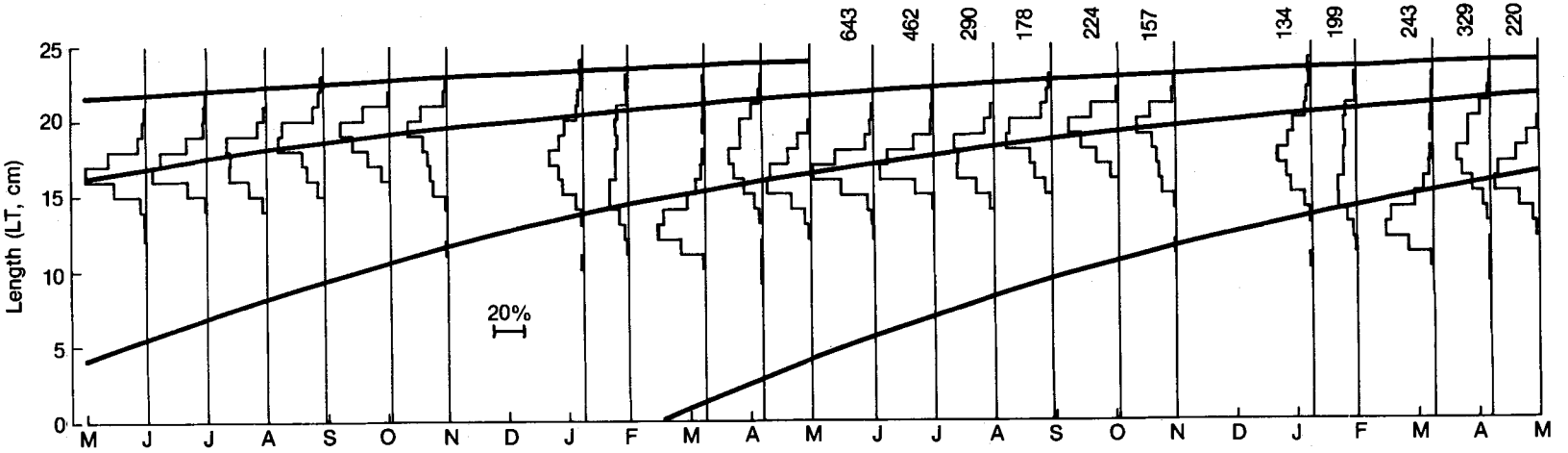


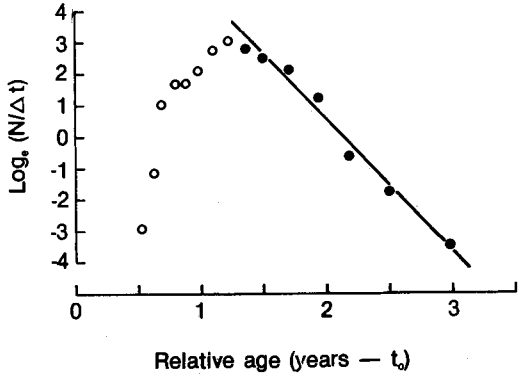
The set of length-frequency data presented here has been culled from the files of the Research Division, BFAR, Manila. The data led to the following estimates: L_∞ = 25 cm, K = 1.20, L_c = 13.9 cm, Z = 11.57, M = 2.12 and E = 0.82. Annual recruitment seems to have occurred as one relatively short pulse. Field workers have been able to distinguish only two species of *Decapterus* in the Philippines, namely *D. macrosoma/lajang* and *D. russelli.* The exact status of *D. macrosoma* is thus still open. For a list of the four nominal species of *Decapterus* and their synonymy, see p. 281-282 in Herre, A.W. 1953. Check list of Philippine fishes. Fish. Wildl. Serv. U.S. Dept. Int. Res. Rep. 20, Washington. 977 p.

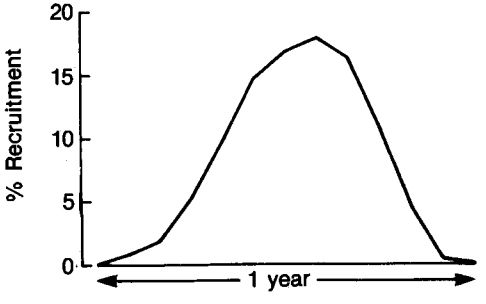
Fam., Carangidae:
Decapterus macrosoma

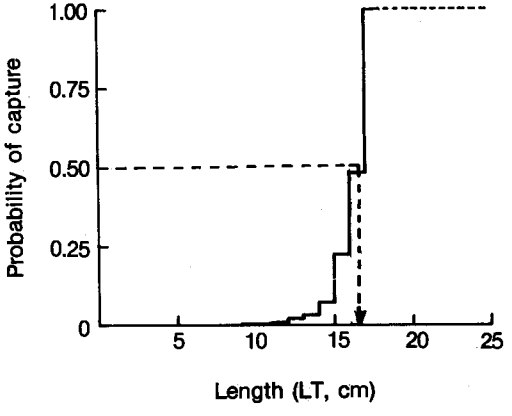


Palawan, 1965-1966





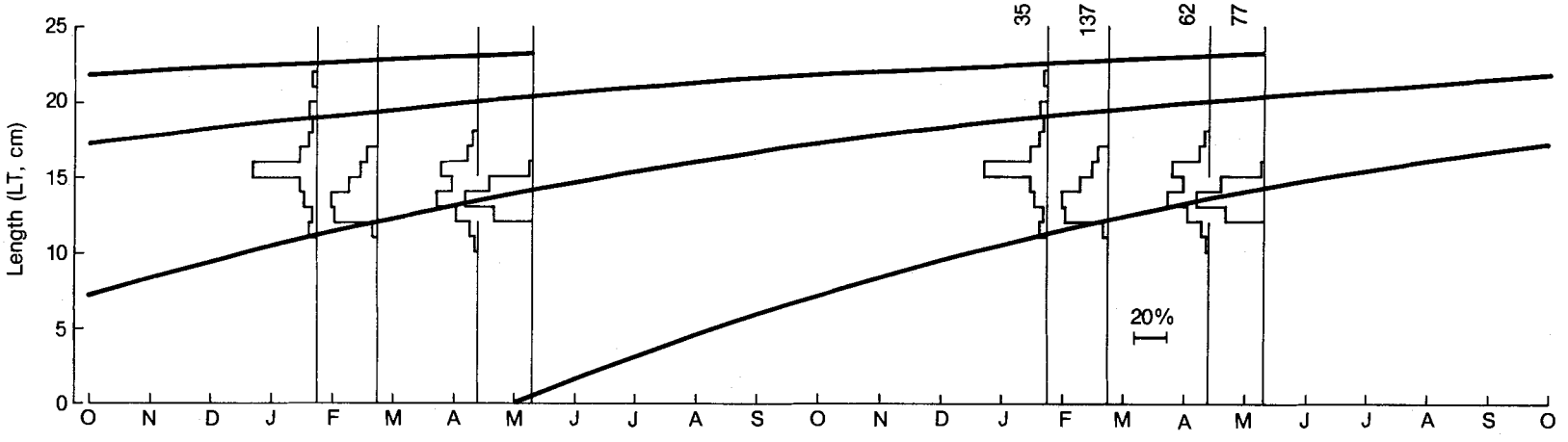


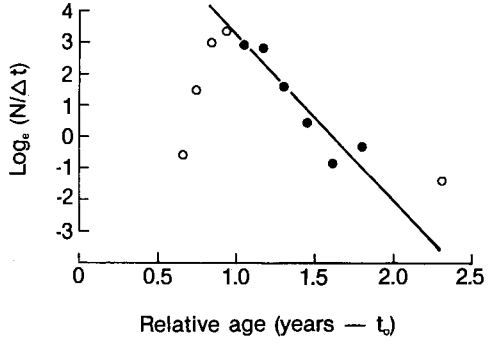


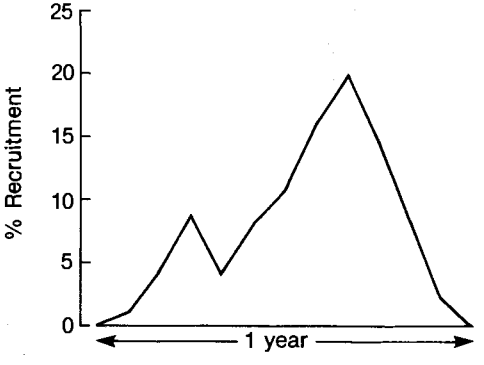
The length-frequency data analyzed here stem from the files of the Research Division, BFAR, Manila. They allowed the estimation of the following parameter values: L_∞ = 25.5 cm, K = 0.85, L_c = 16.6 cm, Z = 4.14, M = 1.68 and E = 0.59. The recruitment pattern suggests that recruitment occurred as a single protracted event. Color plates for four species of *Decapterus,* including *D. lajang* (= *D. macrosoma*?) may be found in Chan, W.L. 1968. Marine fishes of Hongkong. Part 1. Hongkong Government Press, Hongkong.

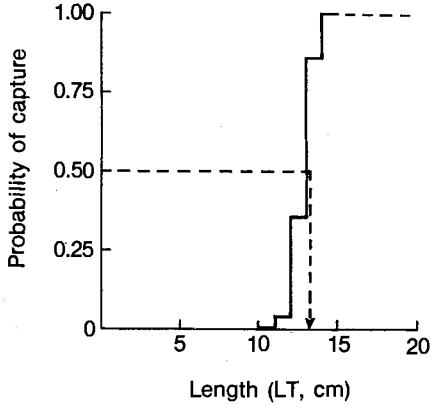
Fam. Carangidae:
Decapterus macrosoma

Palawan, 1966





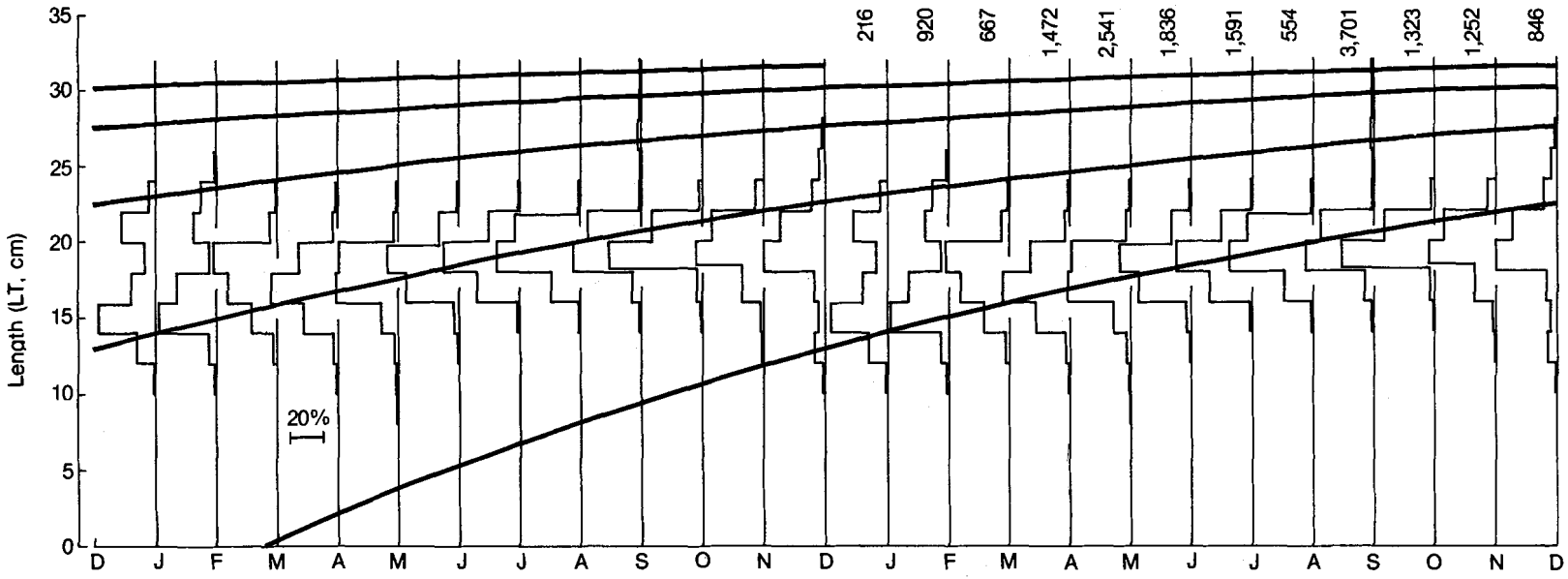


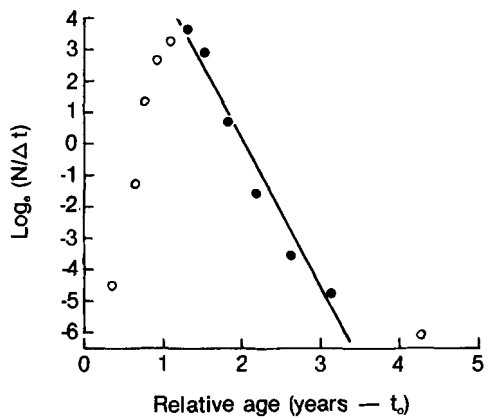


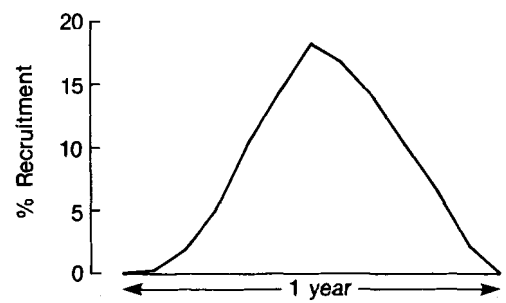
The source of the length-frequency data presented here is the Research Division, BFAR, Manila. The following parameter values were estimated from these data: L_∞ = 25.5 cm, K = 0.80, L_c = 13.3 cm, Z = 5.26, M = 1.62 and E = 0.69. Annual recruitment might have occurred as two distinct events, one much stronger than the other. Graphs and useful descriptions of four *Decapterus* species *(D. kurroides, D. macarellus, D. macrosoma* and *D. maruadsi)* are given in Rau, N. and A. Rau. 1980. Commercial marine fishes of the Central Philippines (bonyfishes). Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn.

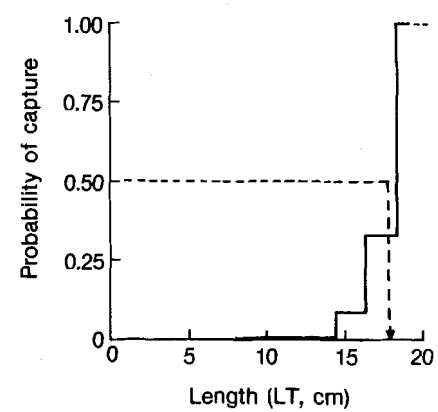
Fam. Carangidae:
Decapterus macrosoma

Palawan, 1968





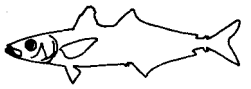




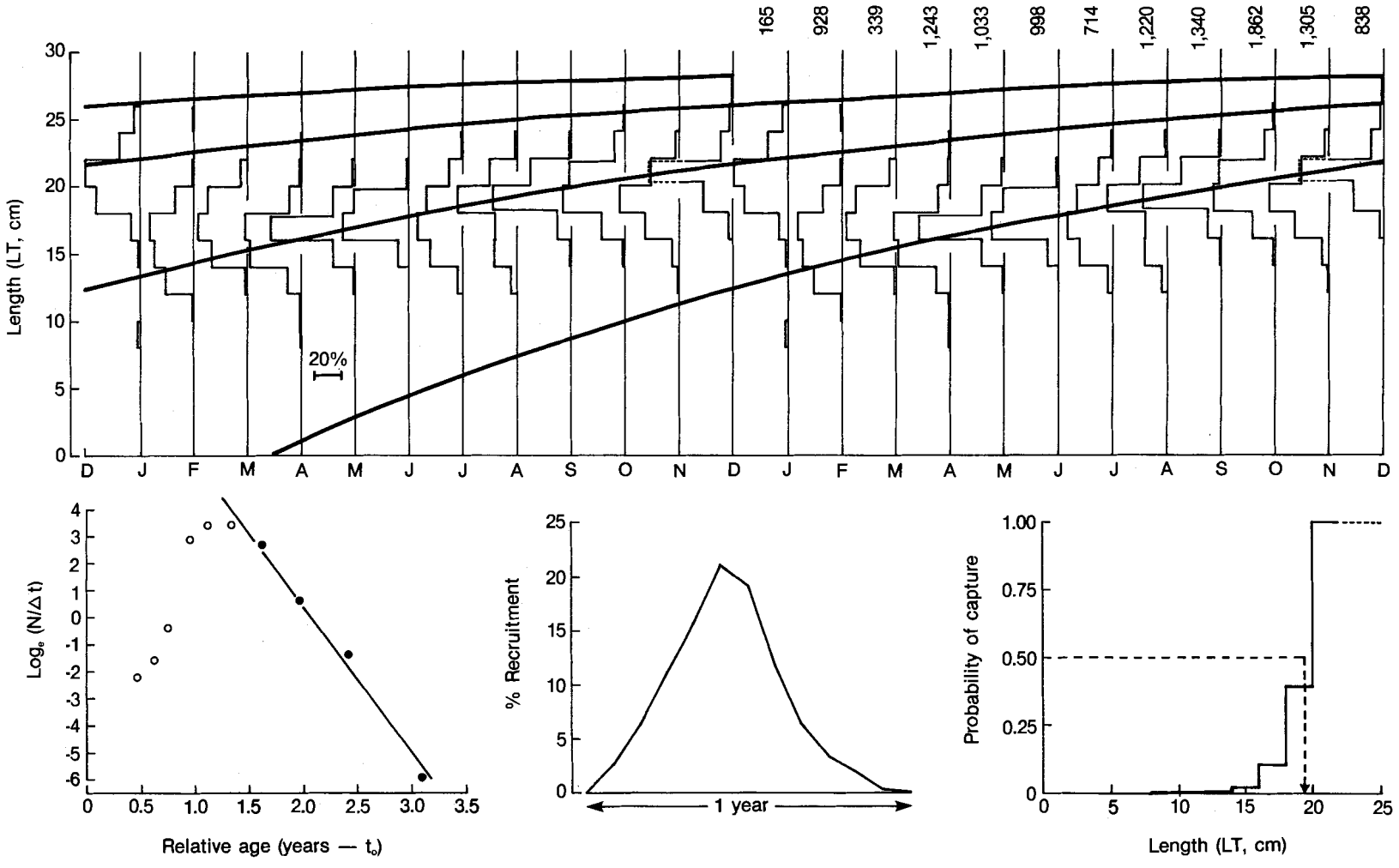
The length-frequency data analyzed here are from Magnusson, J. 1970. Deep sea fishing development. The Philippine marine fisheries biology. FAO-UNDP report to the Philippine Government. FI: SF/PHIL II. 84 p. The following parameters were estimated from the data: L_∞ = 33.0 cm, K = 0.65, L_c = 17.5 cm, Z = 3.38, M = 1.31 and E = 0.61. Annual recruitment seems to have occurred as a single protracted event. The distinctness of *D. macrosoma* from *D. lajang* is still advocated by some authors. However, most taxonomists now agree that these two names actually refer to the same species, with *D. lajang* the junior synonym. See Chan, W., F. Talbot, P. Sukhavisidh and W.F. Smith-Vaniz. 1974. Carangidae. *In* W. Ficher and P.J.P. Whitehead (eds.) FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71), Vol. 1. (var. pag.) FAO, Rome.

Plate 37

Fam. Carangidae:
Decapterus macrosoma



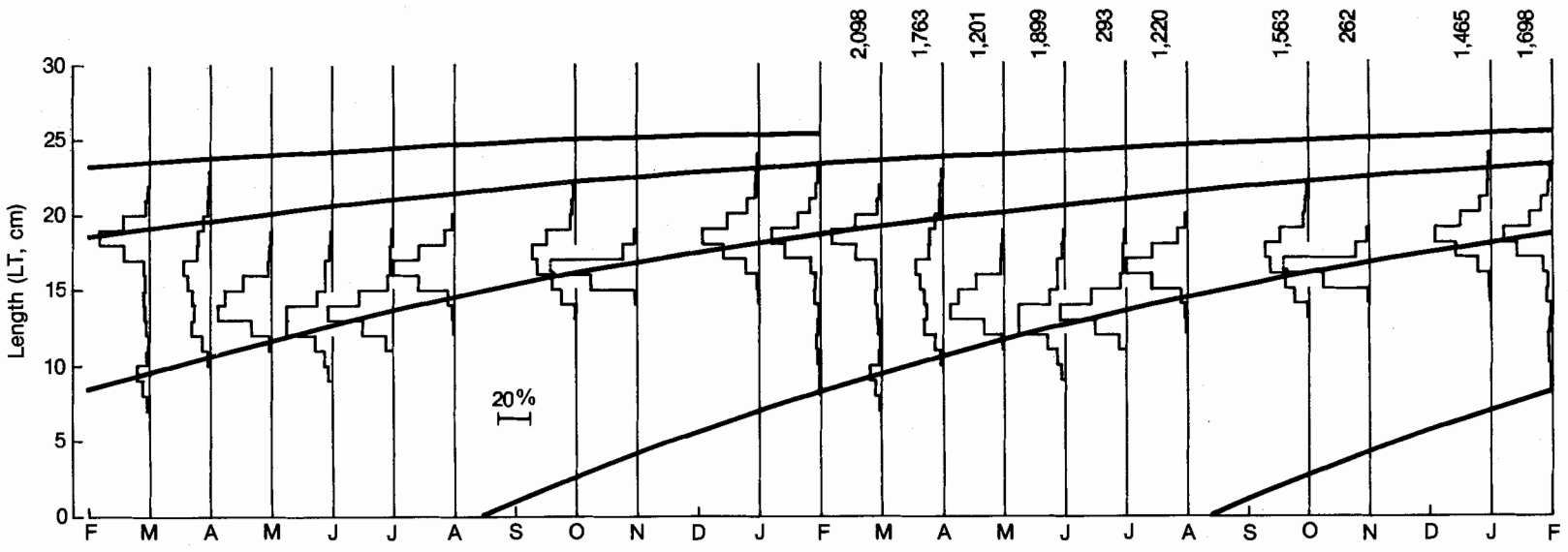
Palawan, 1968b

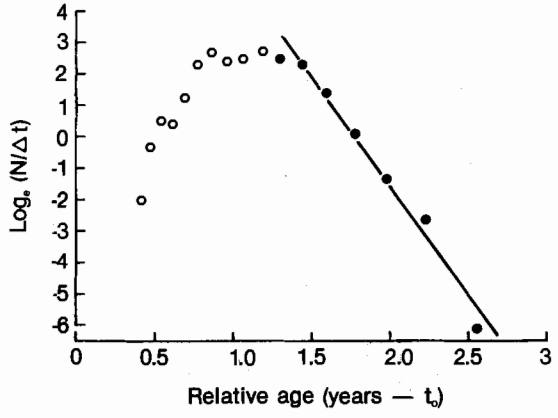


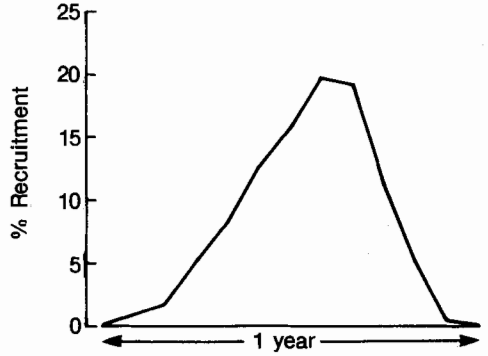
The source of the length-frequency data on *D. macrosoma* presented here is Magnusson, J. 1970. Deep sea fishing development. The Philippine marine fisheries biology. FAO-UNDP report to the Philippine Government. FI: SF/PHIL II. 84 p. The parameter estimates are L_∞ = 30.0 cm, K = 0.74, L_c = 19.5 cm, Z = 5.79, M = 1.47 and E = 0.75. Annual recruitment seems to have occurred as one long, protracted pulse. The original description of *D. macrosoma* was provided by Bleeker, P. 1851. Over eenige nieuwe geslachten en sorten van makreelachtige vischen van den Indischen Archipel. Nat. Tijdschr. Ned. Ind. 1: 341-372.

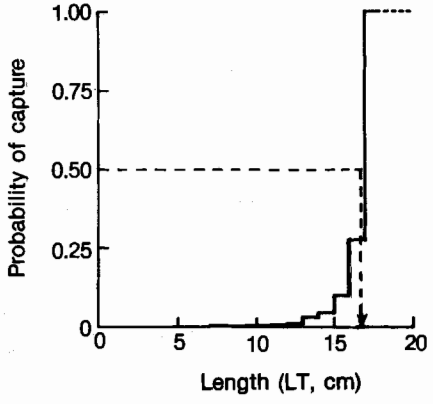
Fam. Carangidae:
Decapterus russelli

Manila Bay, 1958-1959



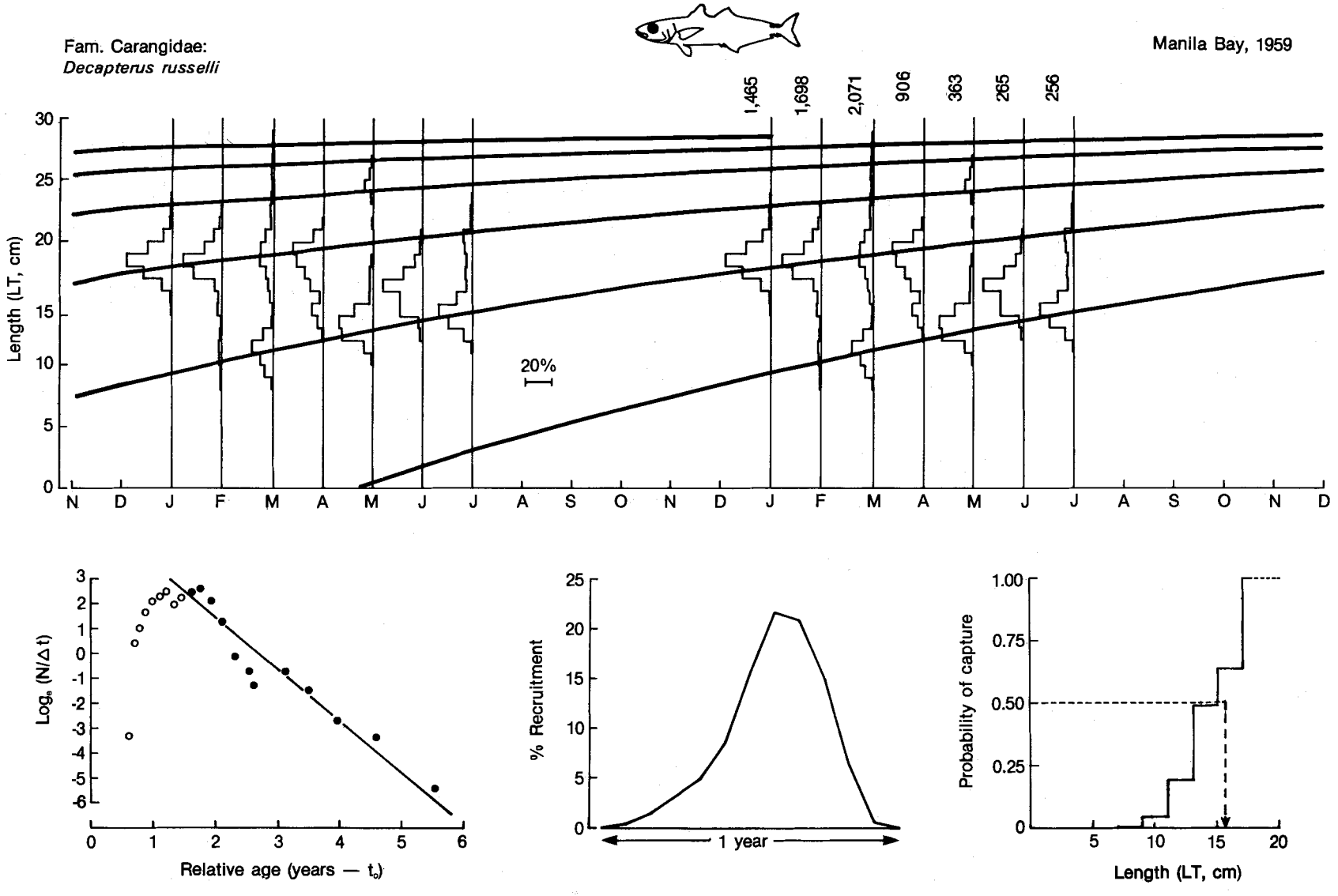




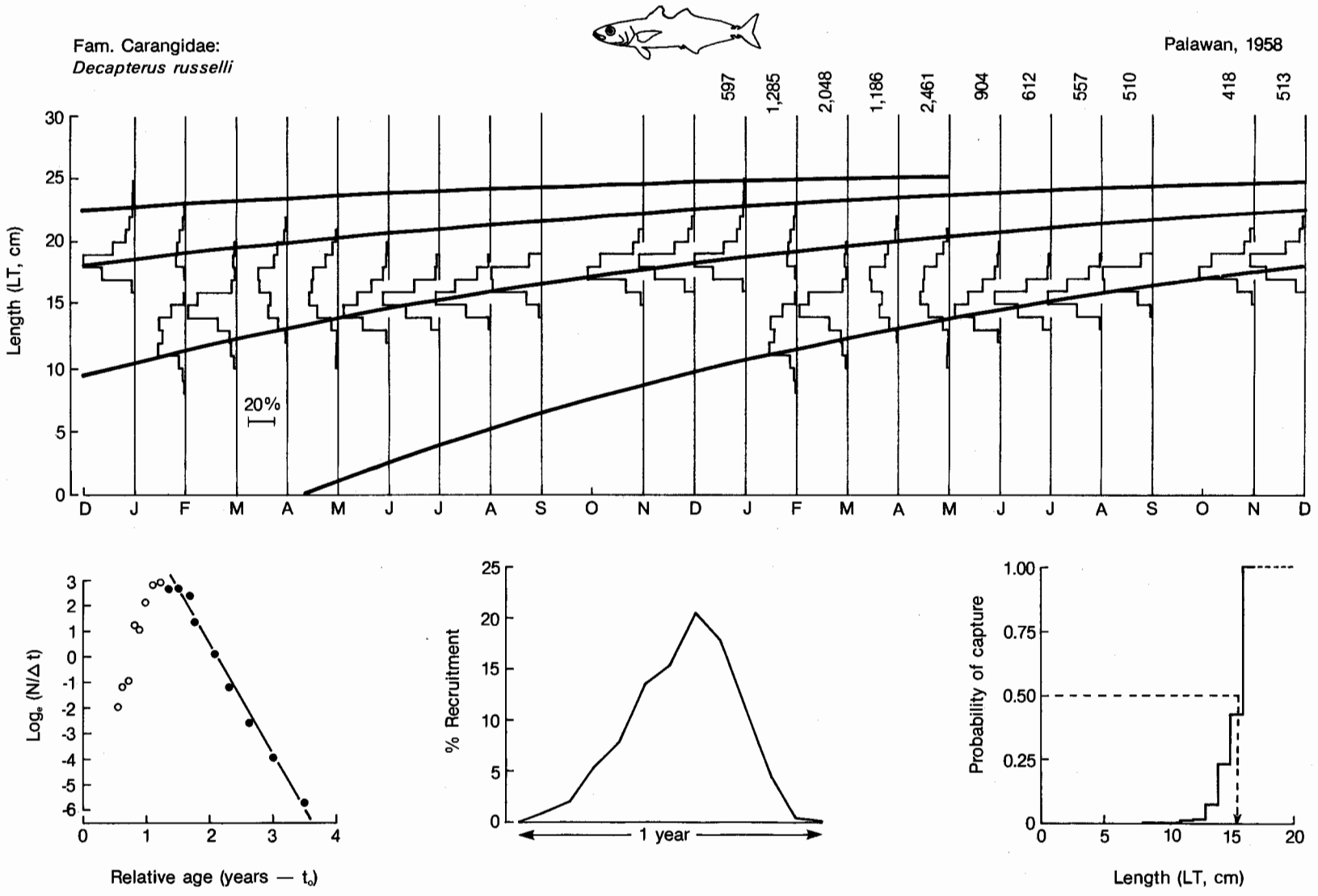


The length-frequency data presented here were extracted from Tiews, K., I.A. Ronquillo and P. Caces-Borja. 1971. On the biology of roundscads (*Decapterus* Bleeker) in Philippine waters. Philipp. J. Fish. 9(1/2): 45-71. They yielded the following parameter estimates: L_∞ = 27.0 cm, K = 0.80, L_c = 16.8 cm, Z = 6.89, M = 1.59 and E = 0.77. Annual recruitment appears to have occurred in the form of a single protracted pulse. A first attempt at estimating population parameters for *D. russelli,* based on miscellaneous information in the paper cited above, has been made by Sinoda, S. 1976. A method for the estimation of the optimum size and age of exploitable fish and its application to pelagic resources management. Singapore J. Primary Ind. 4(2): 66-72.

Plate 39

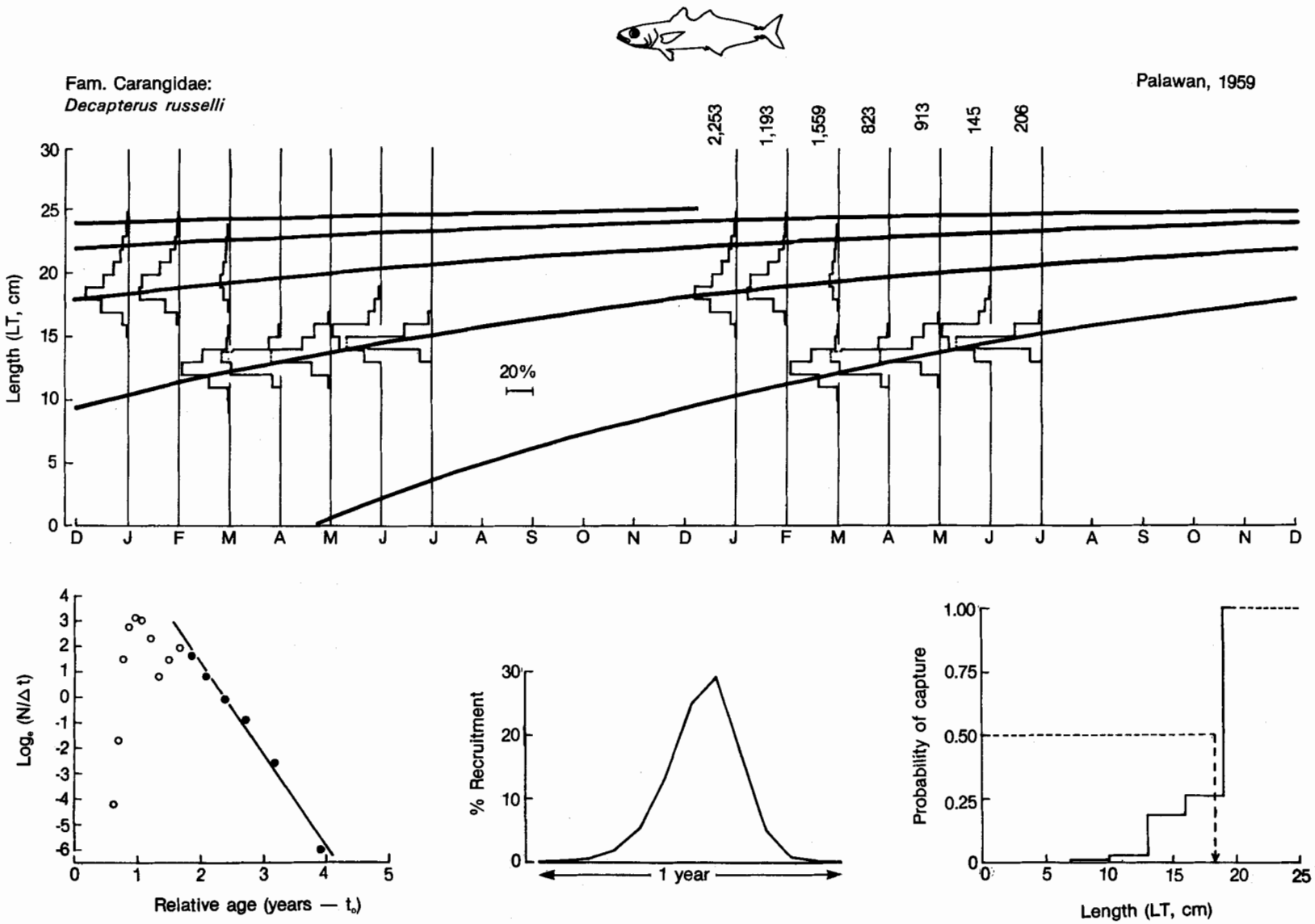


The set of length-frequency data used here stems from Tiews, K., I.A. Ronquillo and P. Caces-Borja. 1971. On the biology of roundscads (*Decapterus* Bleeker) in Philippine waters. Philipp. J. Fish. 9(1/2): 45-71. The following statistics were estimated from these data: L_∞ = 30.0 cm, K = 0.54, L_c = 15.4 cm, Z = 2.06, M = 1.19 and E = 0.42. Annual recruitment probably consisted of two pulses, one very much stronger than the other. Additional information on the growth and mortality of *D. russelli* is given in Rafail, S.Z. 1972. Studies of Red Sea fisheries by light and purse-seine near Al-Gardaga. Bull. Inst. Oceanogr. Fish. (Cairo) 2: 24-49.

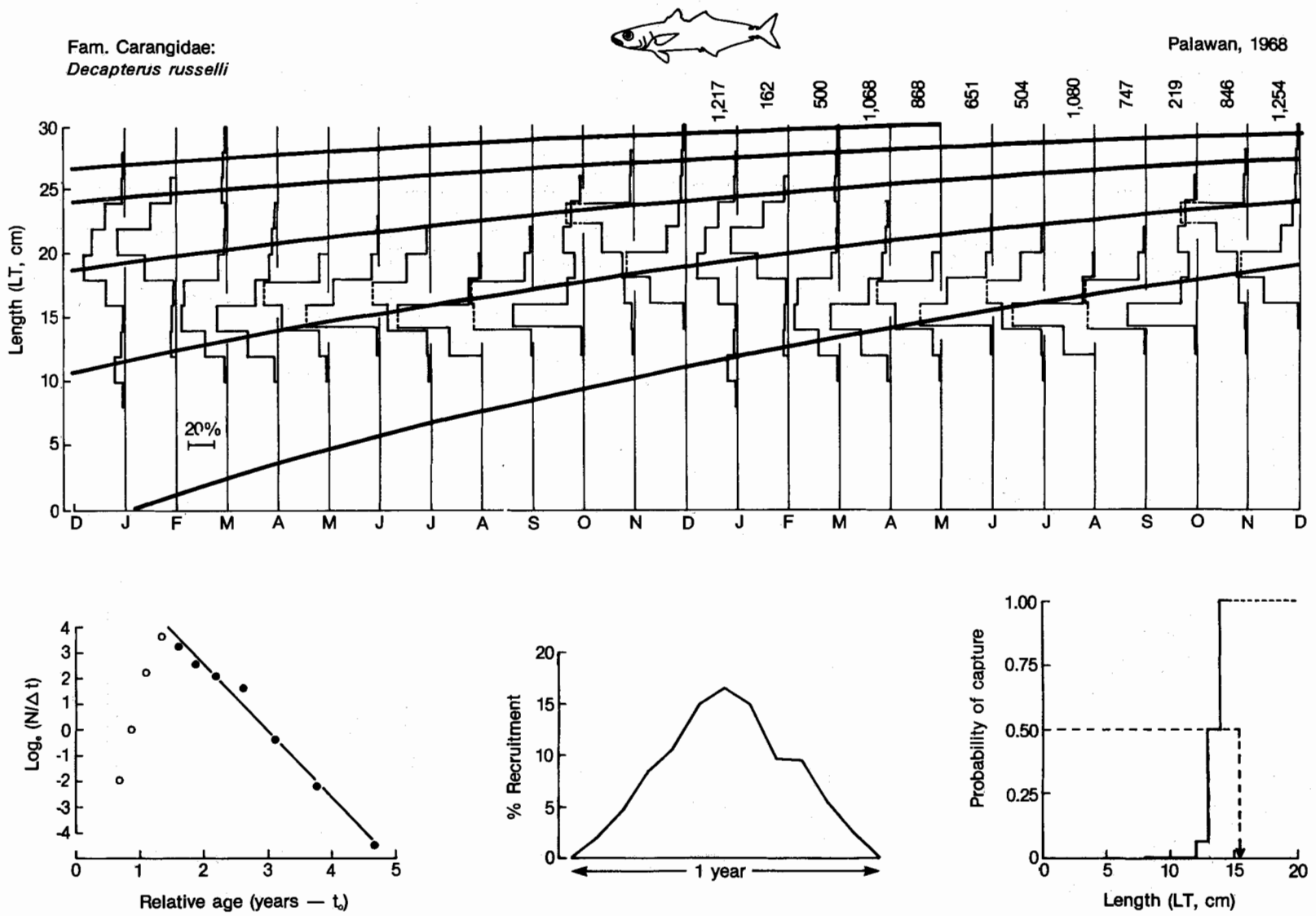


The length-frequency data analyzed here, which stem from the files of the Research Division, BFAR led to the following parameter estimates: L_∞ = 26.9 cm, K = 0.69, L_c = 15.6 cm, Z = 4.34, M = 1.44 and E = 0.67. Annual recruitment seems to have occurred in two pulses of unequal strength. A detailed account of the fishery biology of *D. russelli,* including ages based on the study of daily otolith rings, is given in Gjøsaeter, J. and M.I. Sousa. 1983. Reproduction, age and growth of the Russel's scad *Decapterus russelli* (Rüppel 1829) (Carangidae) from Isofala Bank, Mozambique. Rev. Invest. Pesq. (Maputo) 8: 83-108.

Plate 41

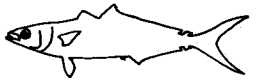


The length-frequency data presented here were extracted from the files of the Research Division, BFAR, Manila. They led to the following parameter estimates: $L_\infty = 26.0$ cm, $K = 0.73$, $L_c = 18.2$ cm, $Z = 3.69$, $M = 1.51$ and $E = 0.59$. Annual recruitment seems to have occurred in the form of one protracted pulse. An account of research on various aspects of the biology of *D. russelli* and of other fishes off Palawan and elsewhere in the Philippines is given in Tiews, K. 1958. Report to the Government of the Philippines on marine fishery resources. Philipp. J. Fish. 6(2): 107-210.



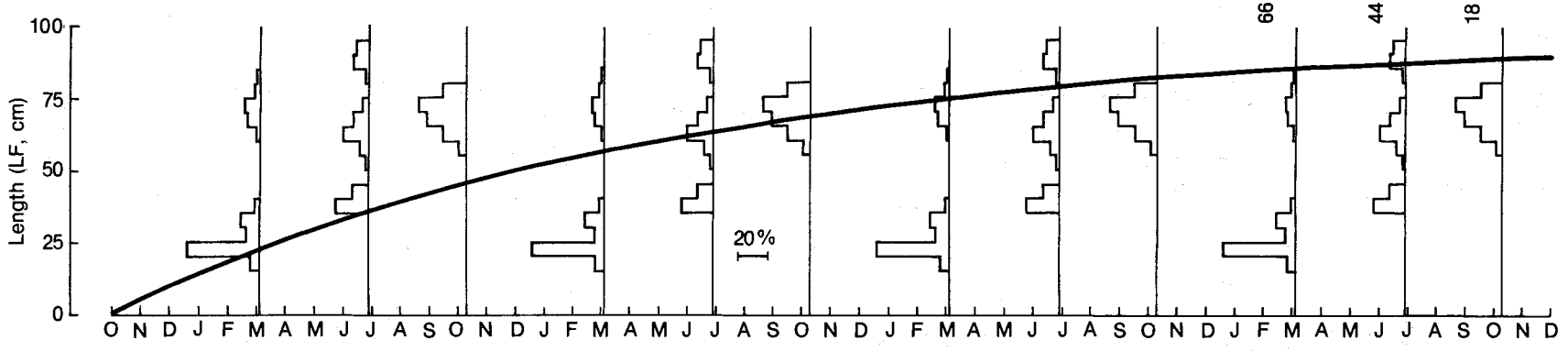
The length-frequency data presented here were obtained from Magnusson, J. 1970. Deep sea fishing development. The Philippine marine fisheries biology. FAO-UNDP report to the Philippine Government. FI: SF/PHIL II. 84 p. The following statistics were estimated from these data: L_∞ = 33.0 cm, K = 0.45, L_c = 15.4 cm, Z = 2.62, M = 1.03 and E = 0.61. Annual recruitment appears to have occurred in two pulses of unequal strength. The original description of *D. russelli* may be found in Rüppel, E. 1828. Atlas zu der Reise im Nördlichen Afrika: Fische des Rothen Meeres. Frankfurt.

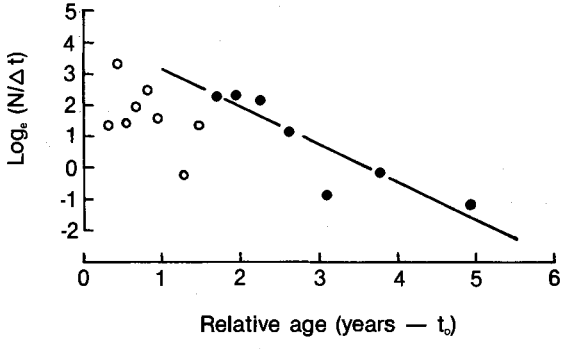
Plate 43

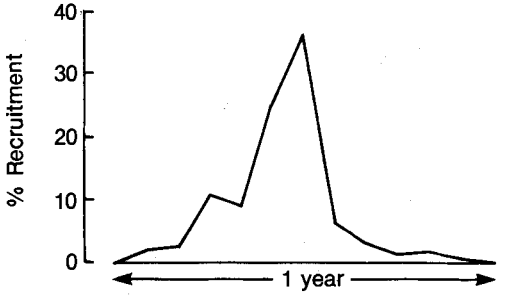


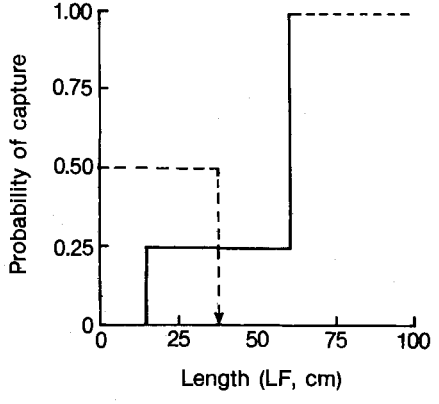
Fam. Carangidae:
Elegatis bipinnulatus

Moro Gulf, 1975-1976





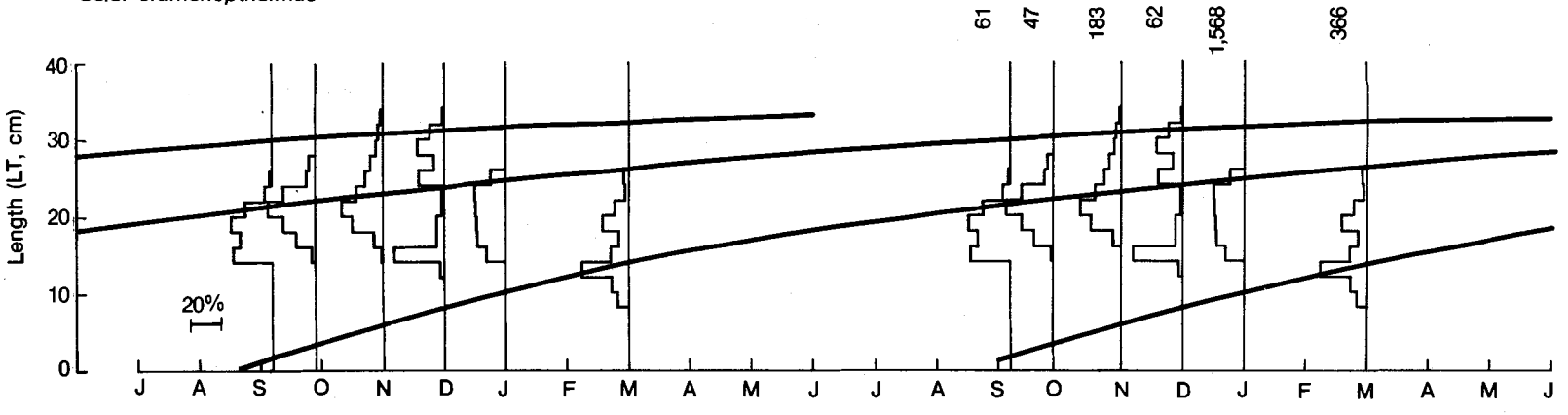


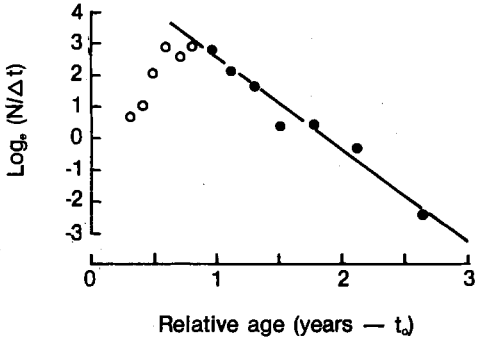


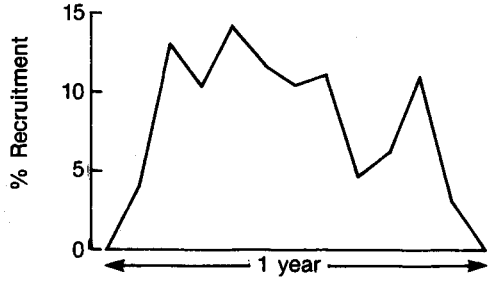
Rainbow runners ("salmon") are reported to contribute 2,500 to 3,500 tonnes annually to Philippine catches. The length-frequency data presented here were compiled from the trip reports of several exploratory surveys in the Sulu Sea conducted by the South China Sea Fisheries Development and Coordinating Programme. (Simpson, A.C. and W.R. Murdoch. 1976-1977. SCS/76/WP/48-51; SCS/77/WP/58; Murdoch, W.R. and P.S. Walczak. 1977. SCS/77/WP/56-57, 59.) The parameters estimated from these (scanty) data are: L_∞ = 97.5 cm, K = 0.60, L_c = 38.8 cm, Z = 1.19, M = 0.92 and E = 0.23. Annual recruitment seems to have been generated in two pulses of unequal strength. The limited information available on the biology and distribution of this interesting fish have been reviewed by Yesaki, M. 1979. Rainbow runner: a latent oceanic resource? Mar. Fish. Rev. 41(8): 1-6.

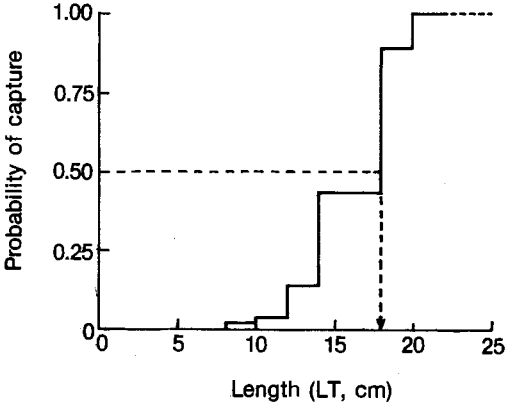
Fam. Carangidae:
Selar crumenopthalmus

Manila Bay, 1978-1979



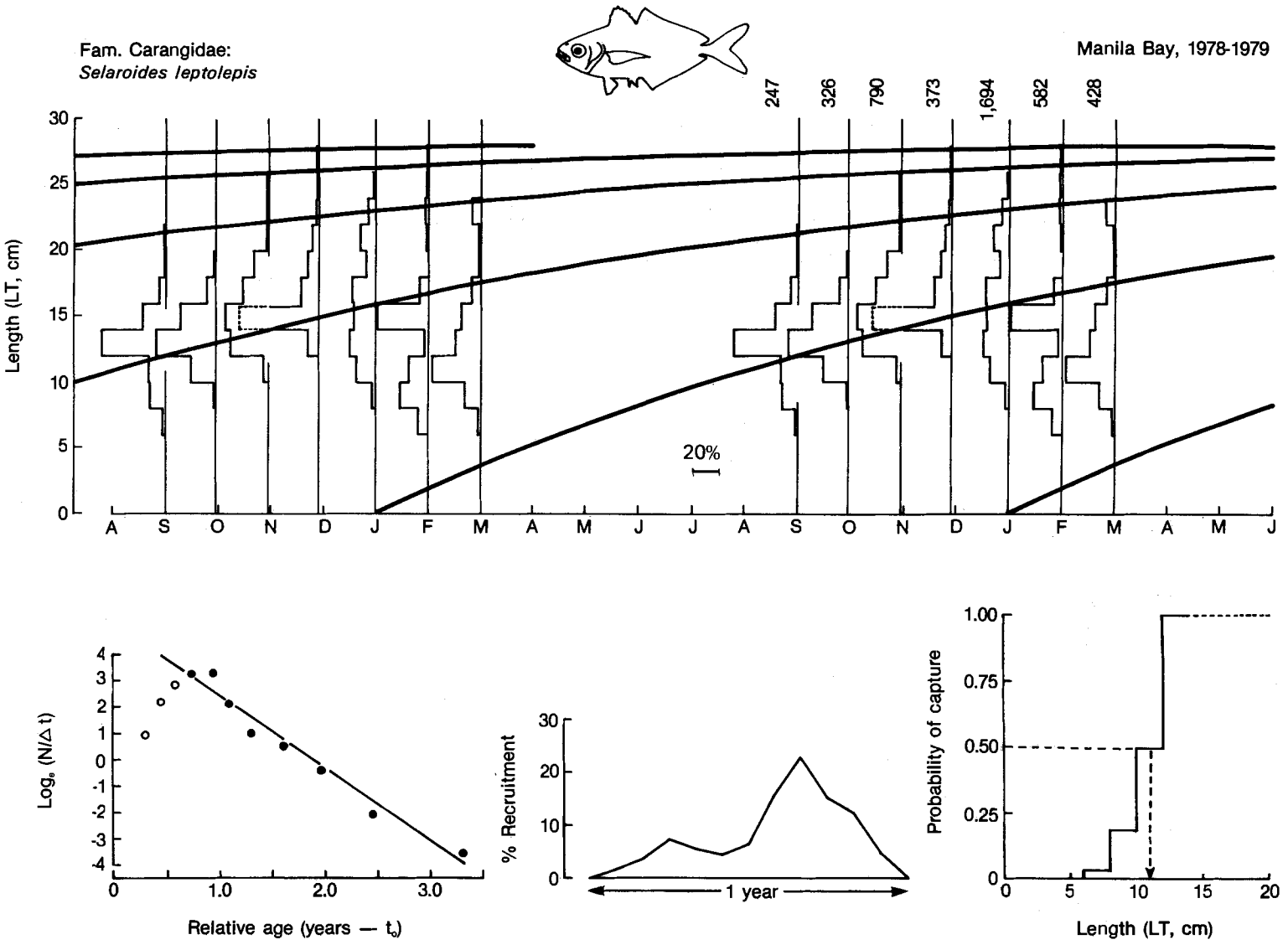






The set of length-frequency data on bigeye scad ("matang baka") presented here was obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines, as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The estimated statistics are as follows: L_∞ = 36.5 cm, K = 0.89, L_c = 17.9 cm, Z = 2.91, M = 1.57 and E = 0.46. The recruitment pattern, although somewhat jagged, suggests that annual recruitment occurred in two pulses of unequal duration and strength. Some data on the biology of this fish and a number of other species may be found in Shindo, S. and S. Chullasorn. 1980. Economically important marine fishes in the Southeast Asian waters. SEAFDEC Training Department, TRB/No. 17. 91 p.

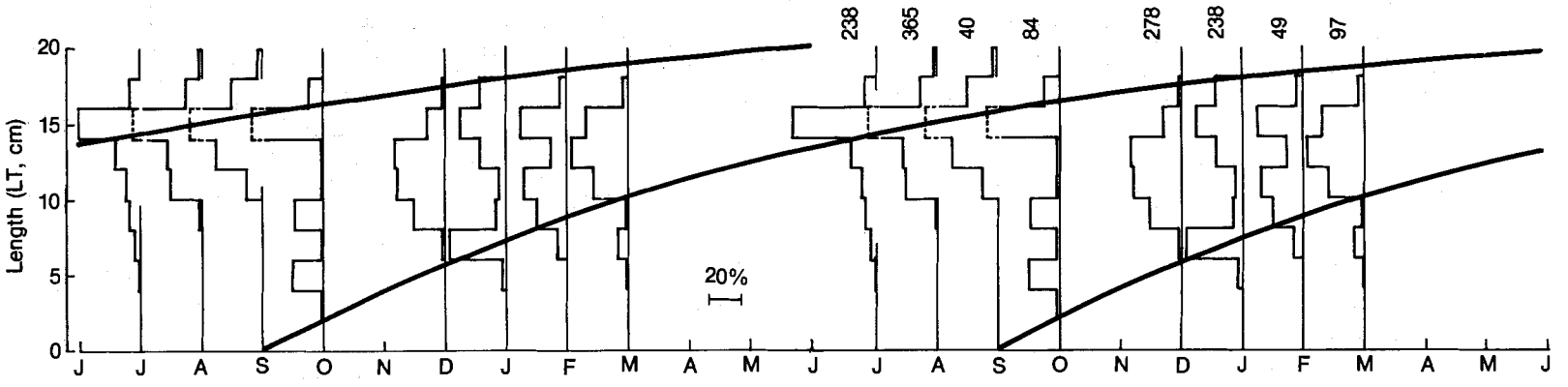
Plate 45

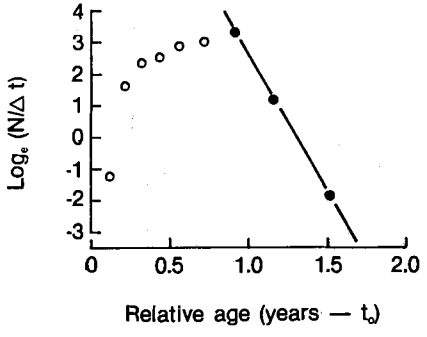


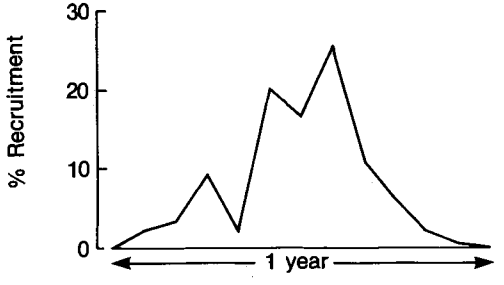
The length-frequency data on yellowstripe trevally ("salay salay") used here stem from Ziegler, B. 1979. Growth and mortality of some fishes of Manila Bay, Philippines, as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The following statistics were estimated from these data: L_∞ = 29.0 cm, K = 0.80, L_c = 11.0 cm, Z = 2.76, M = 1.56 and E = 0.44. Annual recruitment occurred in the form of two well-separated pulses of unequal strength. Estimates of natural mortality for the Gulf of Thailand stock of *S. leptolepis*, obtained from two different methods, are given in Pauly, D. 1983. Some simple methods for the assessment of tropical fish stocks. FAO Fish. Tech. Paper No. 234. 52 p.

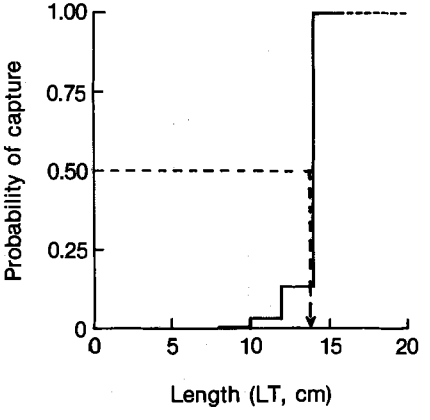
Fam. Carangidae:
Selaroides leptolepis

Visayan Sea, 1976-1977





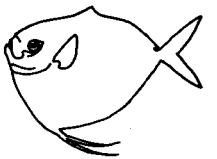




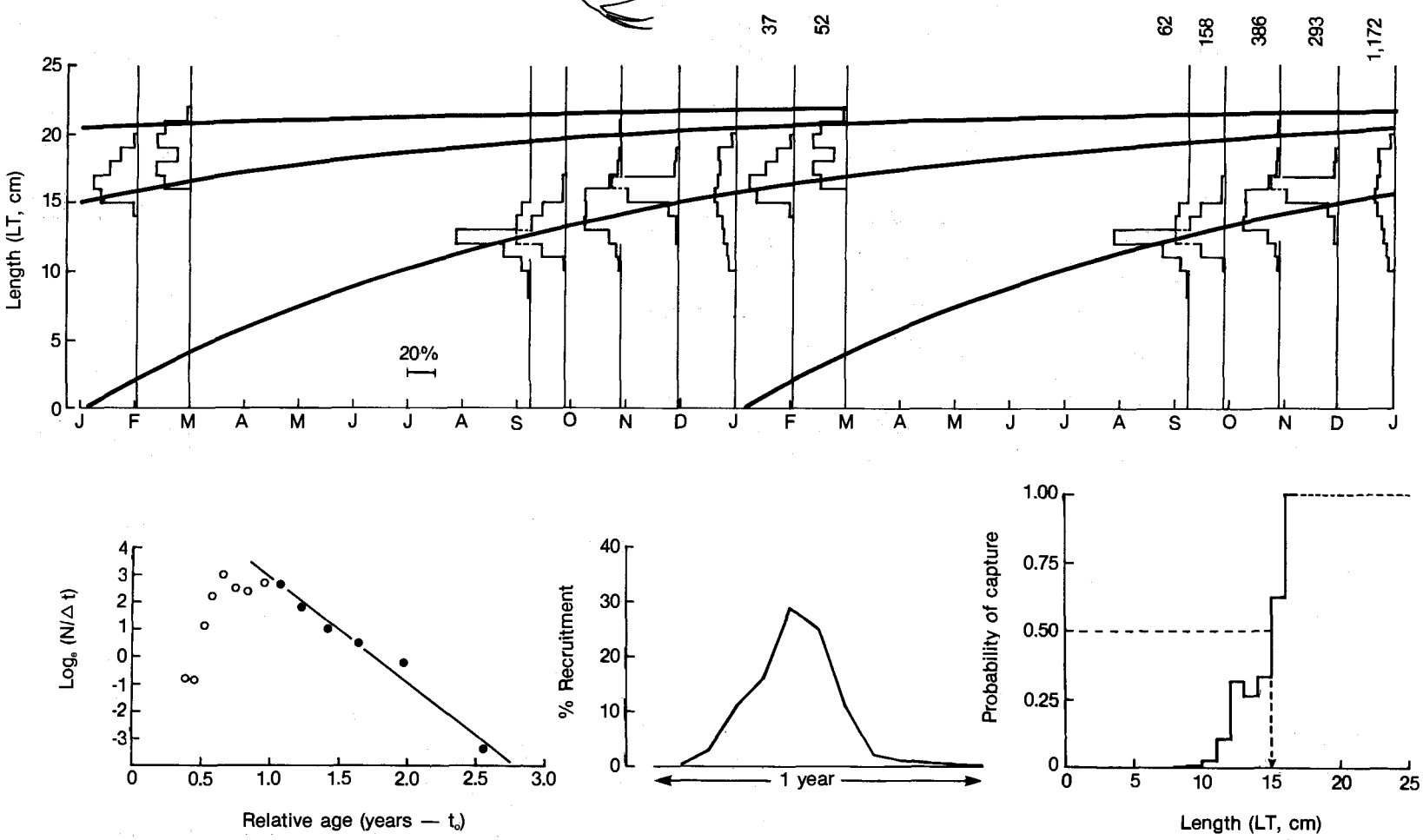
This set of length-frequency data stems from Arce, F. 1981. Distribution and relative abundance of nemipterids and carangids (Pisces: Nemipteridae and Carangidae) caught by trawls in Visayan Sea, with notes on the biology of *Nemipterus oveniides* and *Selaroides leptolepis*. University of the Philippines, Quezon City. 67 p. M.Sc. thesis. The following parameter estimates were obtained from these data: L_∞ = 23.0 cm, K = 1.15, L_c = 13.8 cm, Z = 8.64, M = 2.11 and E = 0.76. Annual recruitment seems to have occurred in two pulses of unequal strength. Additional information on the biology of this fish may be found in Naiyanetr, P. 1963. Preliminary studies on life history of pampano *(Caranx leptolepis)* in the Gulf of Thailand. Contr. Mar. Fish Lab. Bangkok No. 2. 19 p.

Plate 47

Fam. Meneidae:
Mene maculata



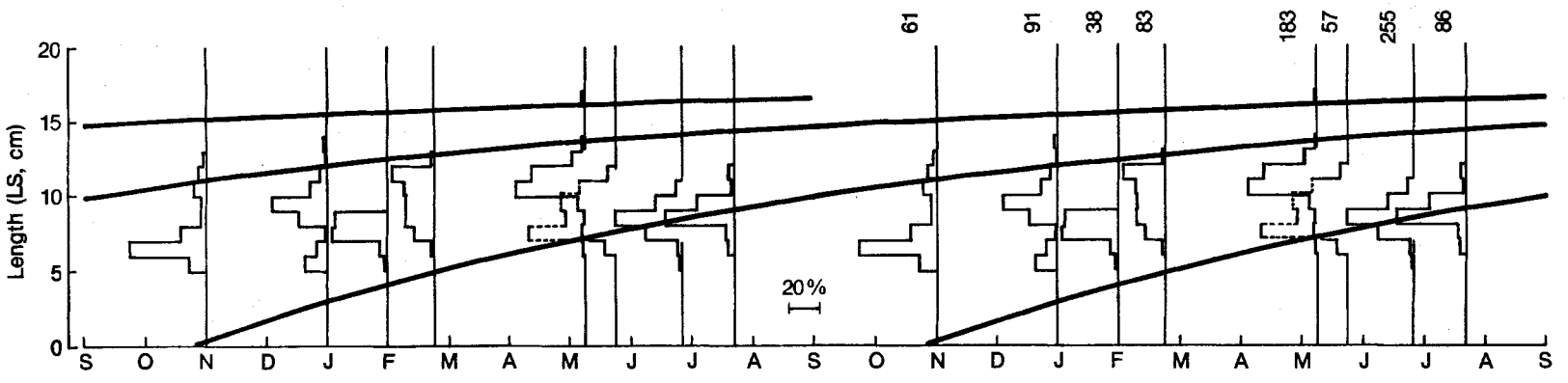
Manila Bay, 1978-1979

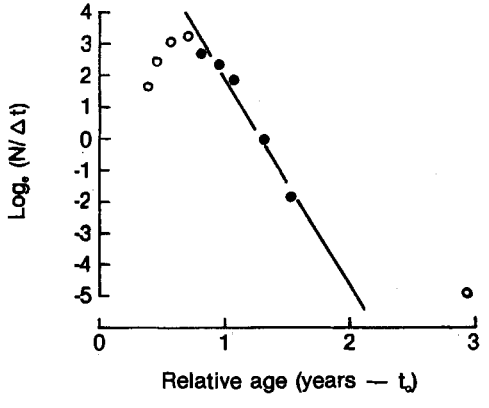


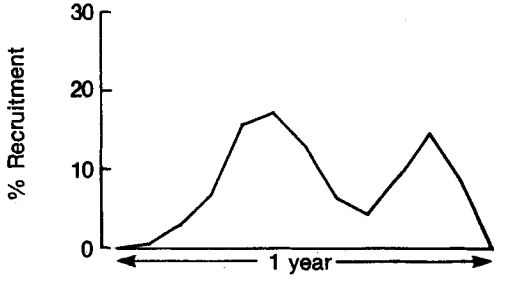
The length-frequency data used here on spotted moonfish ("chabita") were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines, as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The following statistics were estimated: L_∞ = 22.5 cm, K = 1.22, L_c = 15.0 cm, Z = 3.85, M = 2.20 and E = 0.43. The bulk of the annual recruitment seems to have originated from one major recruitment event. Literature on the biology of this fish are wanting. A good description, with figure, is given in Fowler, H.W. 1936. A synopsis of the fishes of China. Part 6. The mackerels and related fishes. Family Carangidae, continued. Hongkong Nat. 7(1): 61-80 (Reprint edition 1972, Vol. 1, Junk, The Netherlands.)

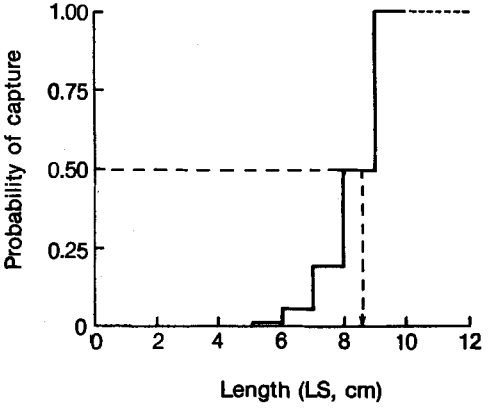
Fam. Leiognathidae:
Gazza minuta

Honda Bay, Palawan, 1977-1978





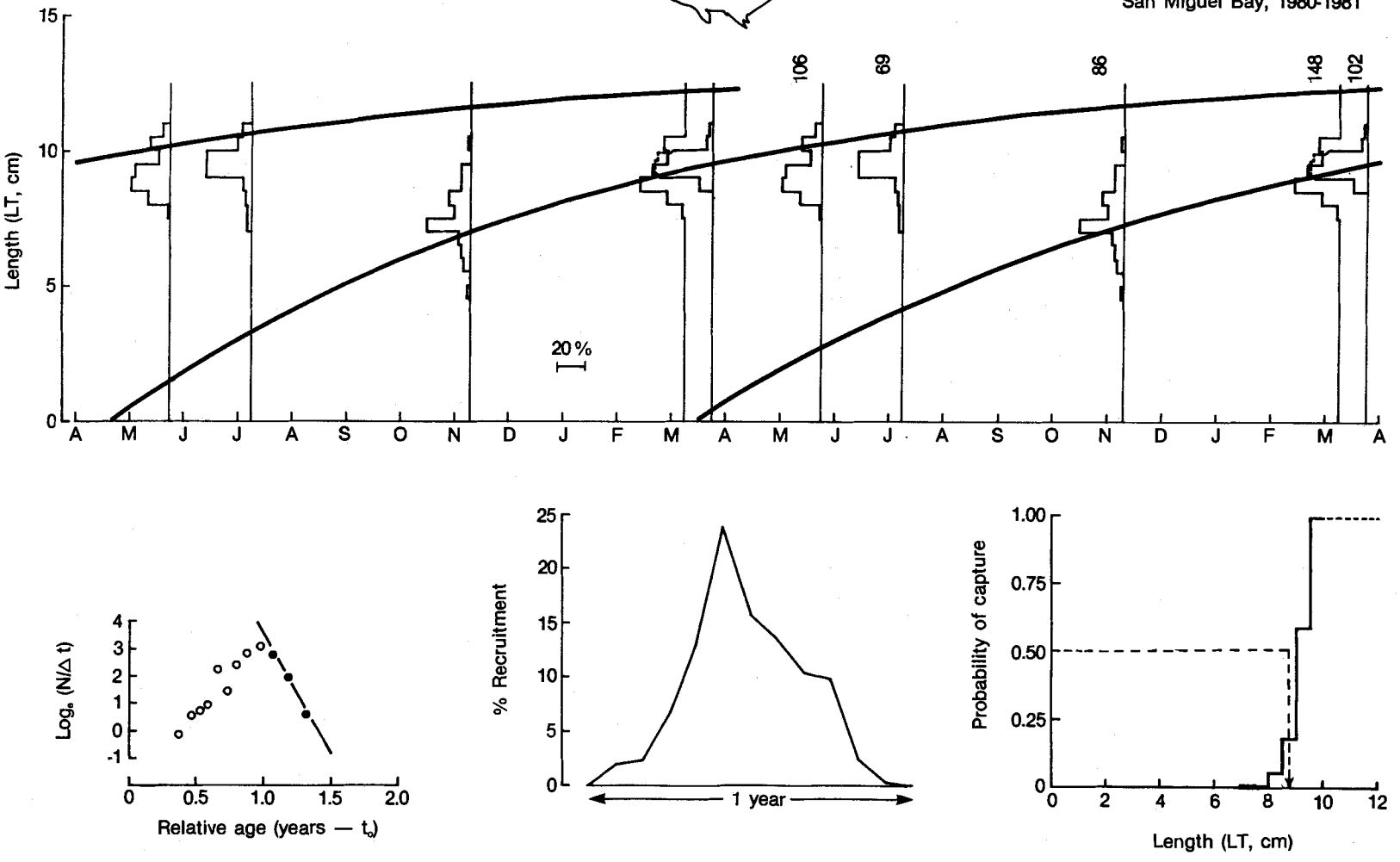




The data presented here on toothed pony fish were obtained from Schroeder, R. Notes on the biology of commercially important fishes of Honda Bay, Palawan. Unpublished MS on file at the Research Division, BFAR, Manila. They led to the following parameter estimates: L_∞ = 17.5 cm, K = 0.97, L_c = 8.6 cm, Z = 6.62, M = 2.03 and E = 0.69. Recruitment occurred in two well-separated pulses. Information on the reproduction of *G. minuta* is given in Pillai, P.K.M. 1972. Fecundity and spawning habits of some silver bellies. Indian J. Fish. 19(112): 196-199.

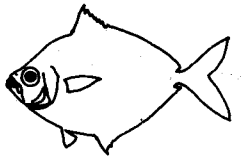
Plate 49

Fam. Leiognathidae:
Gazza minuta

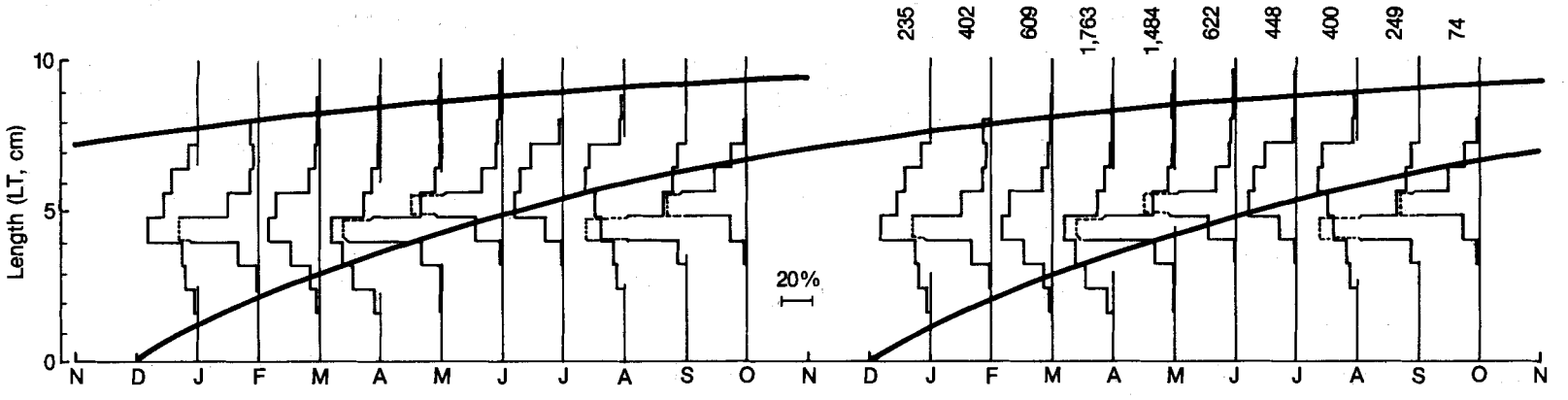


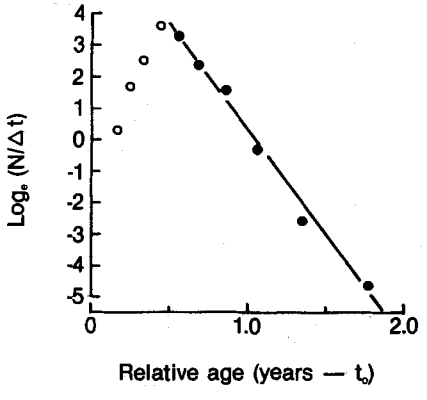
The length-frequency data analyzed here were collected in the frame of the multidisciplinary San Miguel Bay Project between the International Center for Living Aquatic Resources Management and the University of the Philippines (College of Fisheries, IFDR) and ICLARM by Mr. E. Cinco and N.A. Navaluna (pers. comm.). These data led to the following parameter estimates: $L_\infty = 14.0$ cm, $K = 1.10$, $L_c = 8.80$ cm, $Z = 8.85$, $M = 2.35$ and $E = 0.73$. Annual recruitment appears to have occurred in the form of two pulses of unequal strength. The toothed pony fish is a piscivore which preys heavily on young stolephorid anchovies. For a detailed account see Tham, A.K. 1950. The food and feeding relationships of the fishes of Singapore Straits. Colon. Off. Fishery Publ. 1(1): 35 p.

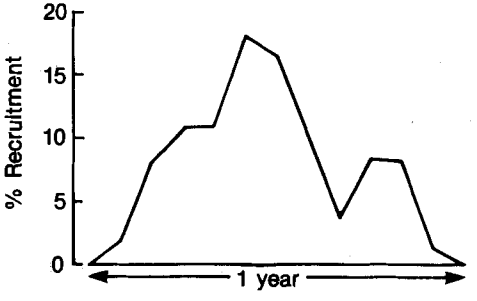
Fam. Leiognathidae:
Leiognathus bindus

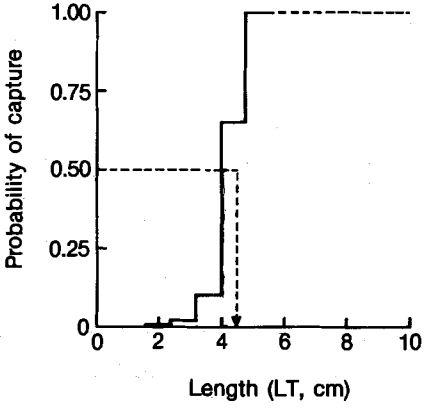


Manila Bay, 1958



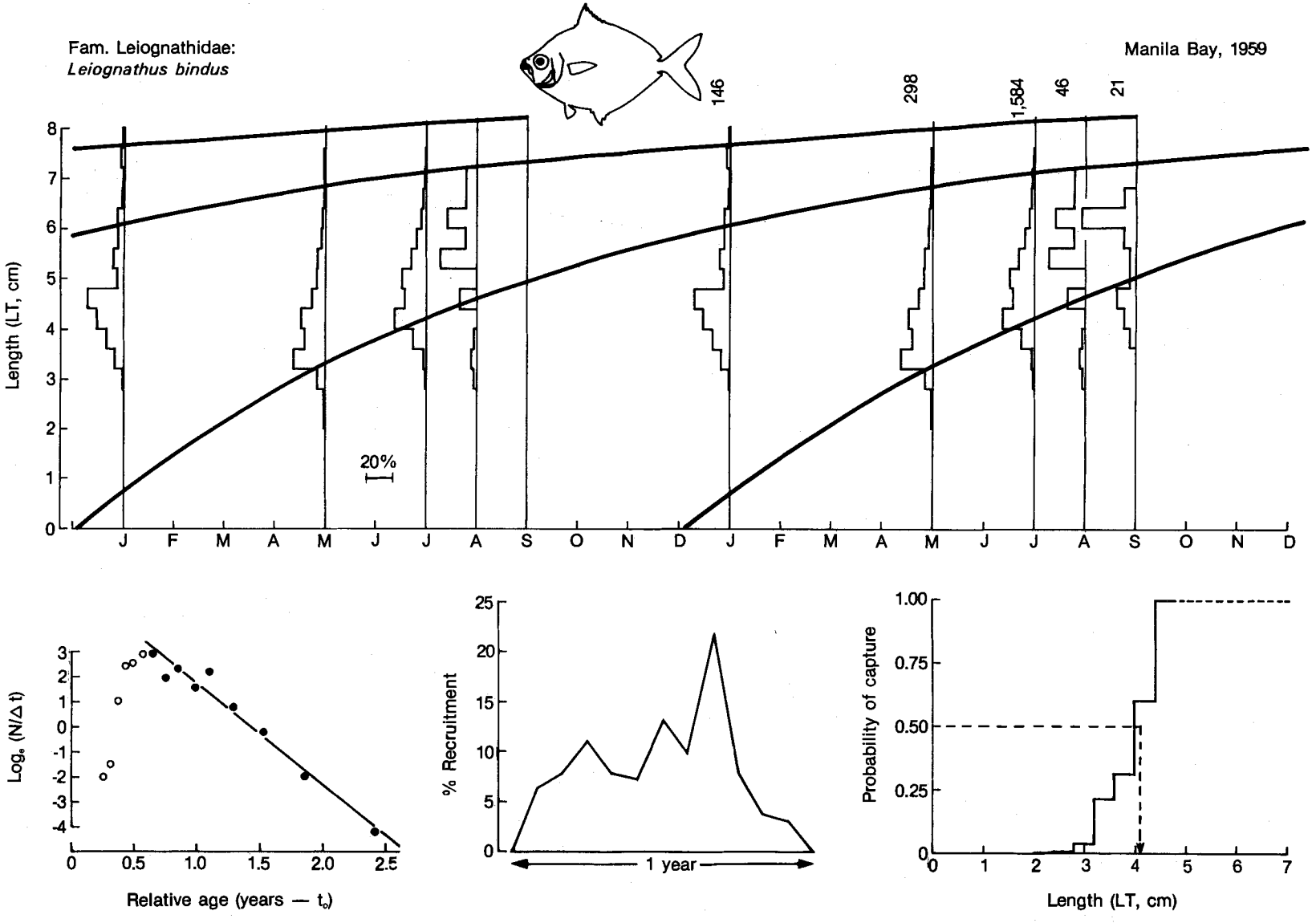




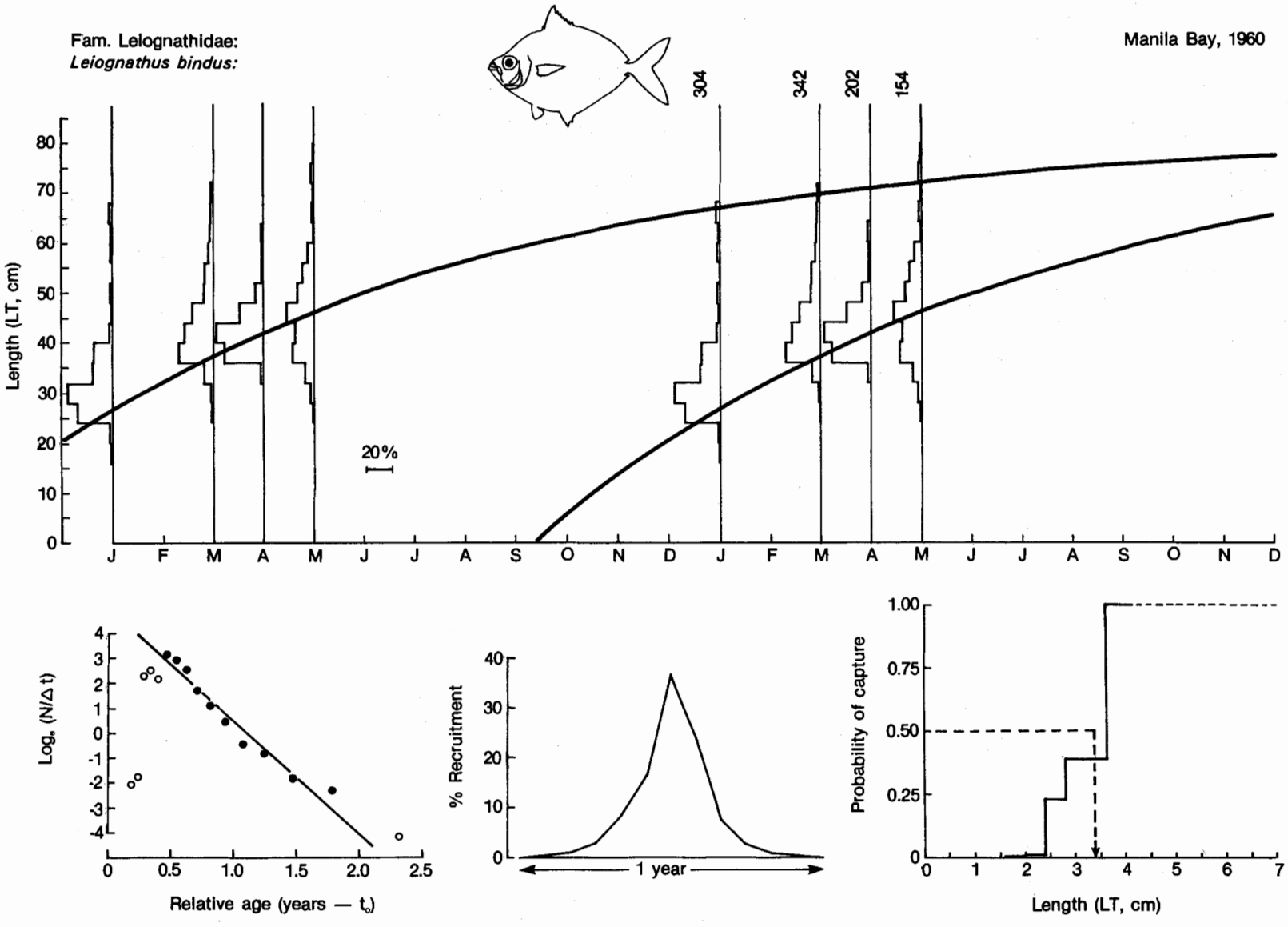


This set of length-frequency data on orangefin pony fish was read off graphs in Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. The following parameter estimates were derived: L_∞ = 10.3 cm, K = 1.25, L_c = 4.5 cm, Z = 6.70, M = 2.79 and E = 0.58. Annual recruitment may have occurred in two major pulses, one much larger than the other. Descriptions and some biological information on this and other slipmouth species are given in Kühlmorgen-Hille, G. 1974. Leiognathidae. *In* W. Fischer and P.J.P. Whitehead (eds.) FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71) Vol. 2. (var. pag.) FAO, Rome.

Plate 51

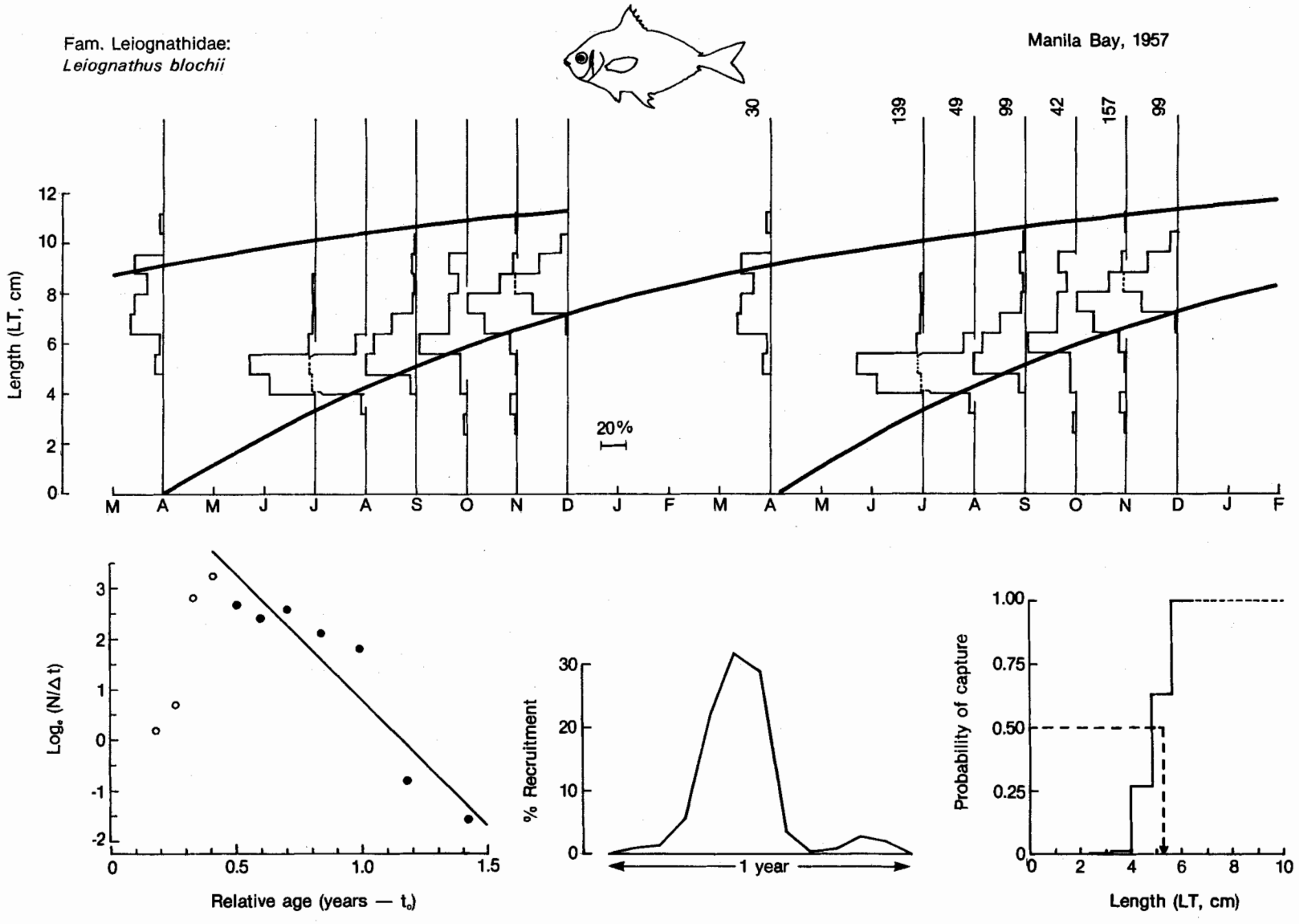


The set of length-frequency data presented here was culled from the files of the Research Division, BFAR, and it led to the following estimates: L_∞ = 8.2 cm, K = 1.25, L_c = 4.1 cm, Z = 4.00, M = 2.97 and E = 0.26. The available data suggest a very irregular pattern of recruitment, possibly consisting of two major events per year. A comprehensive account of the biology of this fish is given in Balan, V. 1967. Biology of the silverbelly, *Leiognathus bindus* (Val.) off the Calicut Coast. Ind. J. Fish. 10A: 118-134.



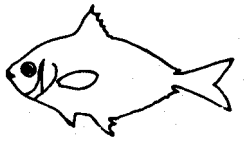
The scanty length-frequency data presented here, which stem from the files of the Research Division, BFAR, Manila suggest the following statistics: L_∞ = 8.2 cm, K = 1.30, L_c = 3.4 cm, Z = 4.58, M = 3.05 and E = 0.34. Annual recruitment seems to have been dominated by a single pulse. A brief account of the food and feeding habit of the orangefin pony fish is given in Chacko, P.I. 1949. Food and feeding habits of the fishes of the Gulf of Manaar. Proc. Indian Acad. Sci. 29B(3): 83-97.

Plate 53

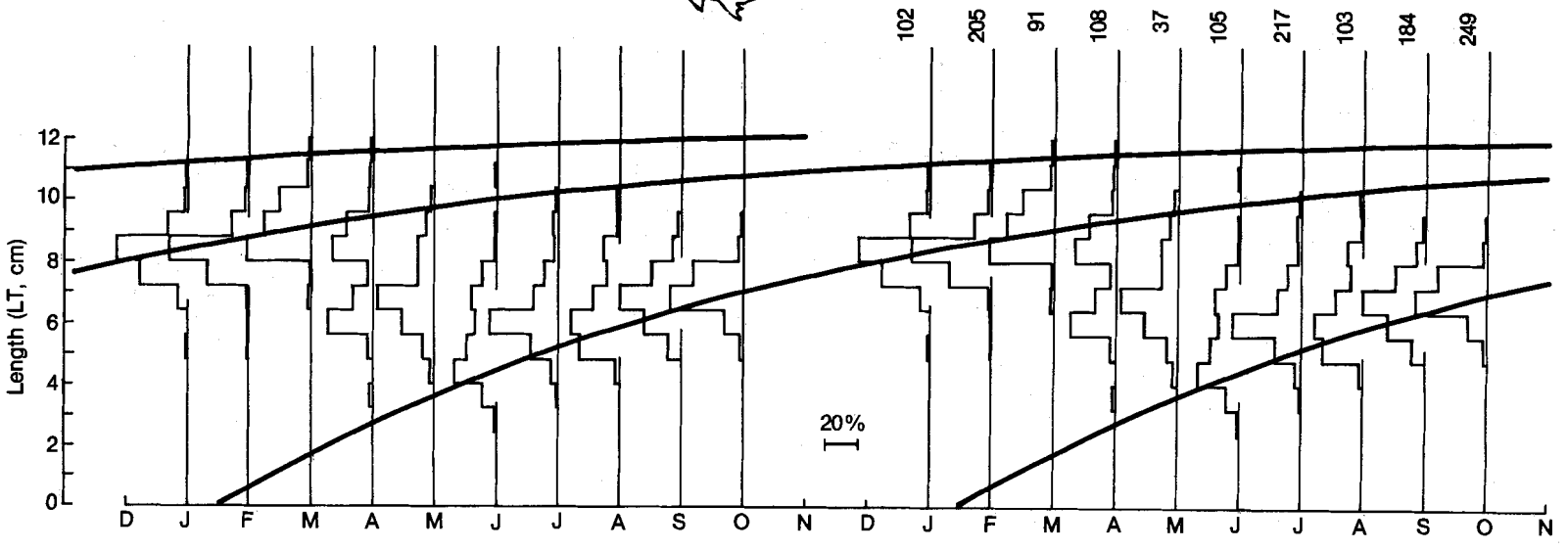


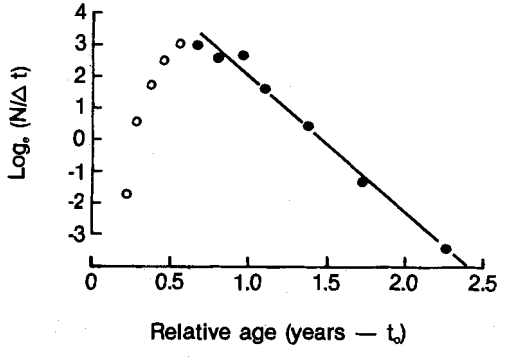
This set of data on Bloch's pony fish was obtained from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. The following parameter estimates were derived: L_∞ = 13.2 cm, K = 1.20, L_c = 5.2 cm, Z = 5.05, M = 2.53 and E = 0.50. Annual recruitment seems to have consisted predominantly of one single pulse. Some additional biological data on *L. blochii* may be found in Gopinath, K. 1946. Notes on the larval and post-larval stages of fish found along the Trivandrum Coast. Proc. Nat. Inst. Sci. India 12(1): 7-21.

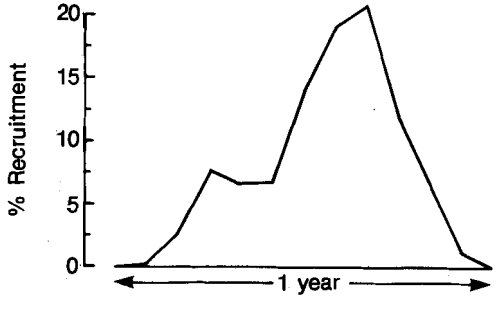
Fam. Leiognathidae:
Leiognathus blochii

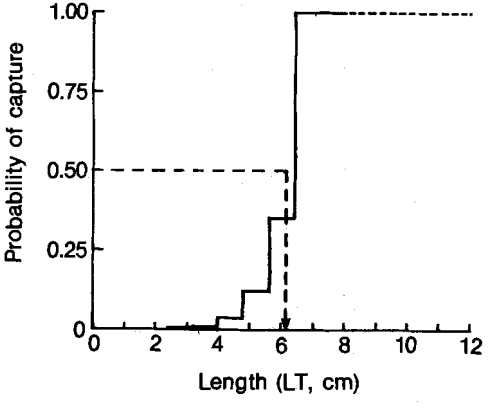


Manila Bay, 1958





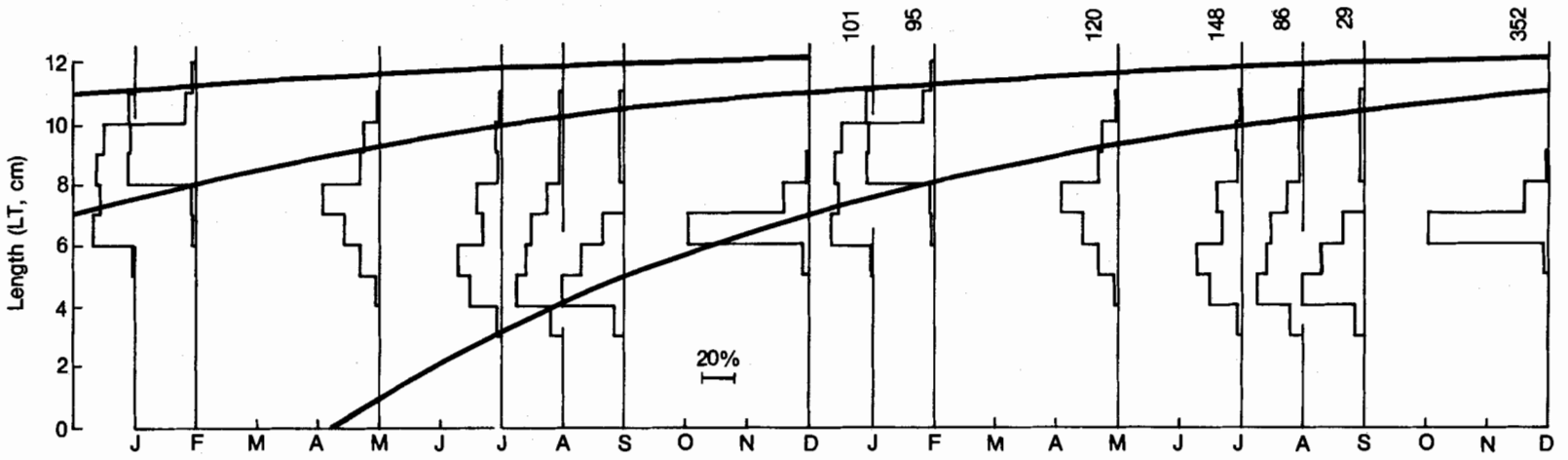


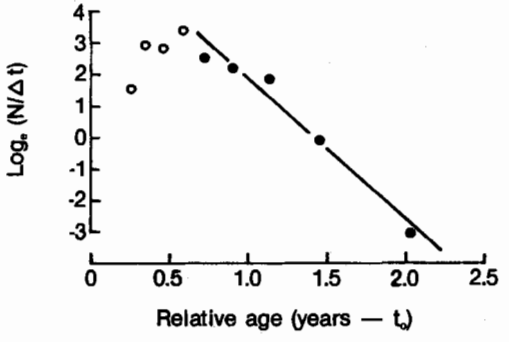


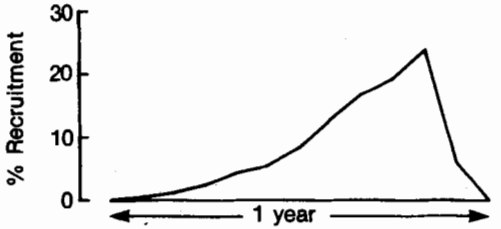
The length-frequency data analyzed here were extracted from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. They led to the following estimates: L_∞ = 12.5 cm, K = 1.16, L_c = 6.1 cm, Z = 4.32, M = 2.51 and E = 0.42. Annual recruitment appears to have consisted of two pulses of unequal strength. *L. blochii* is stated to be "a common food-fish of Borneo" by Seale, A. 1910. Fishes of Borneo, with description of four new species. Philipp. J. Sci. 5(4D): 253-289.

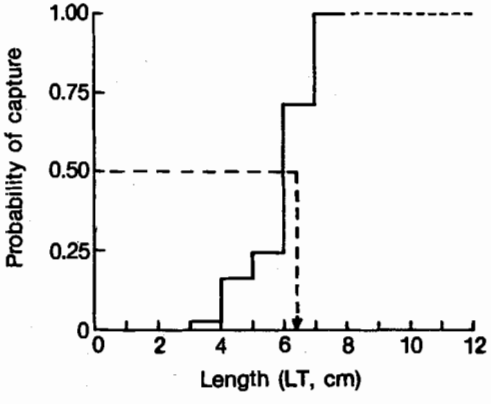
Fam. Leiognathidae:
Leiognathus blochii

Manila Bay, 1959

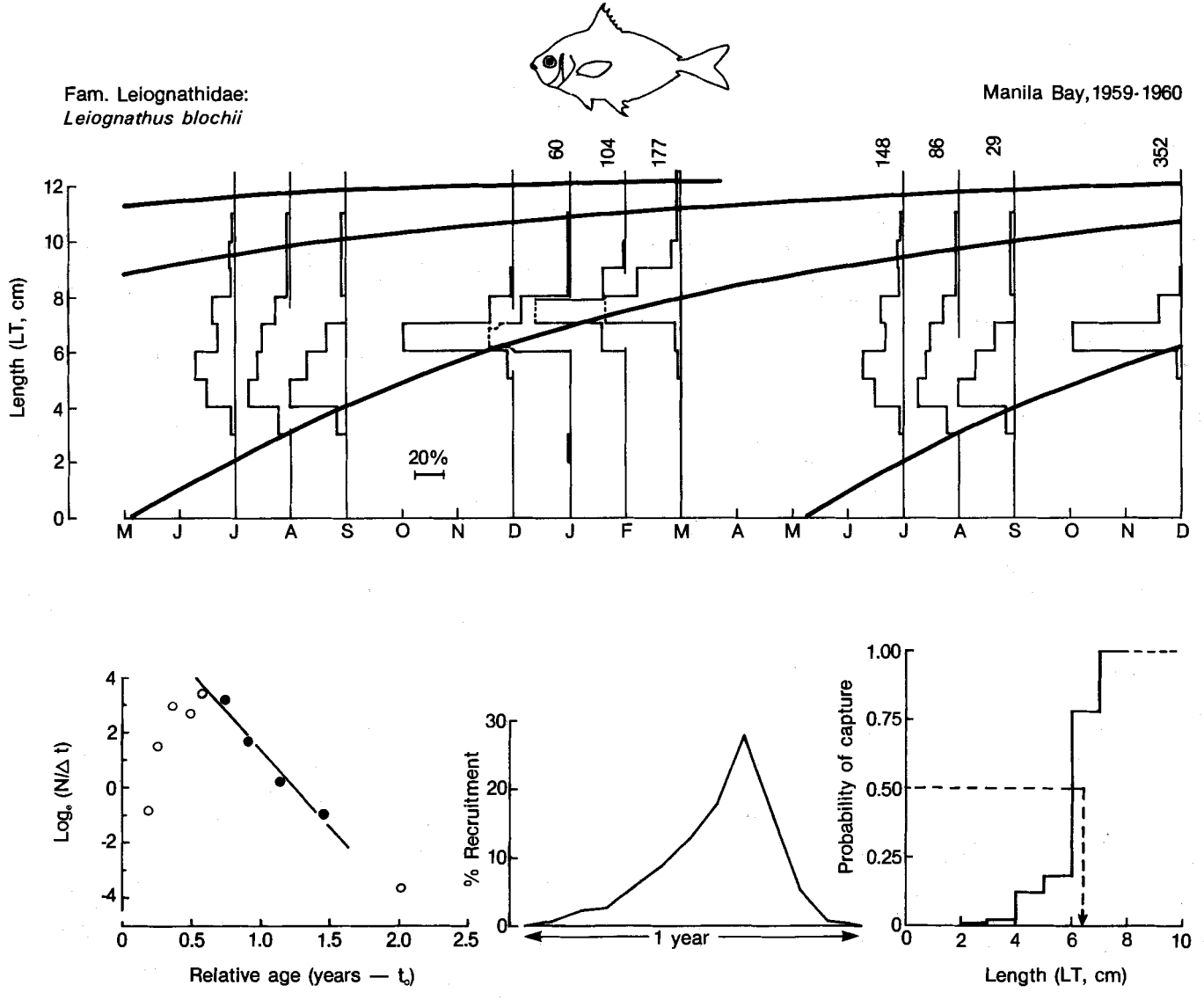






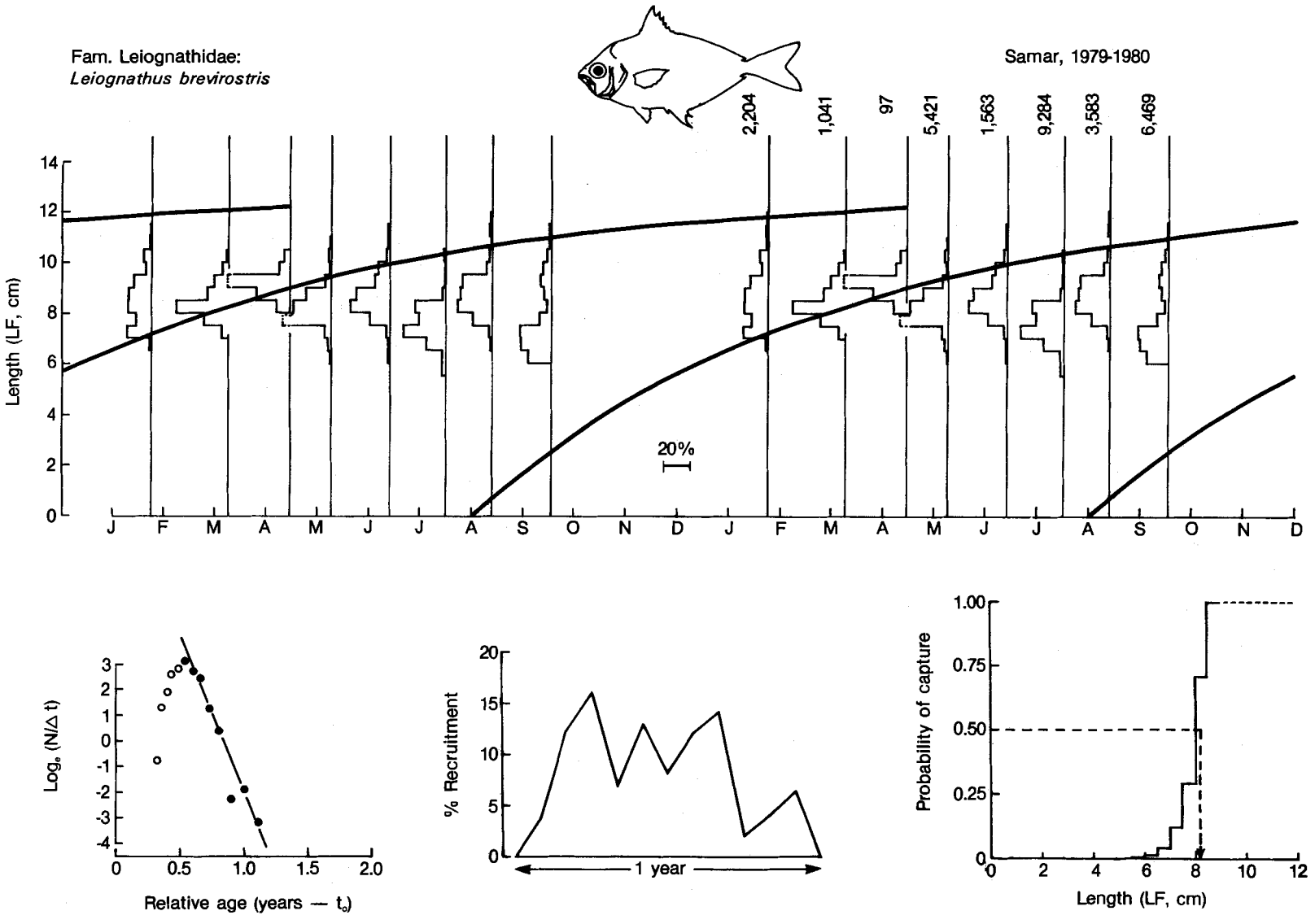


The length-frequency data presented here were culled from the files of the Research Division, BFAR, Manila, and led to the estimation of the following parameter values: L_∞ = 12.5 cm, K = 1.25, L_c = 6.4 cm, Z = 4.51, M = 2.64 and E = 0.41. Recruitment seems to have occurred in two pulses. one stronger than the other. *L. blochii* has often been reported from brackishwaters, e.g., Pillay, T.V.R. 1967. Estuarine fisheries of the Indian Ocean coastal zone, p. 647-667. *In* G.H. Lauff (ed.) Estuaries. Amer. Assoc. Adv. Sci. Publ. Washington.

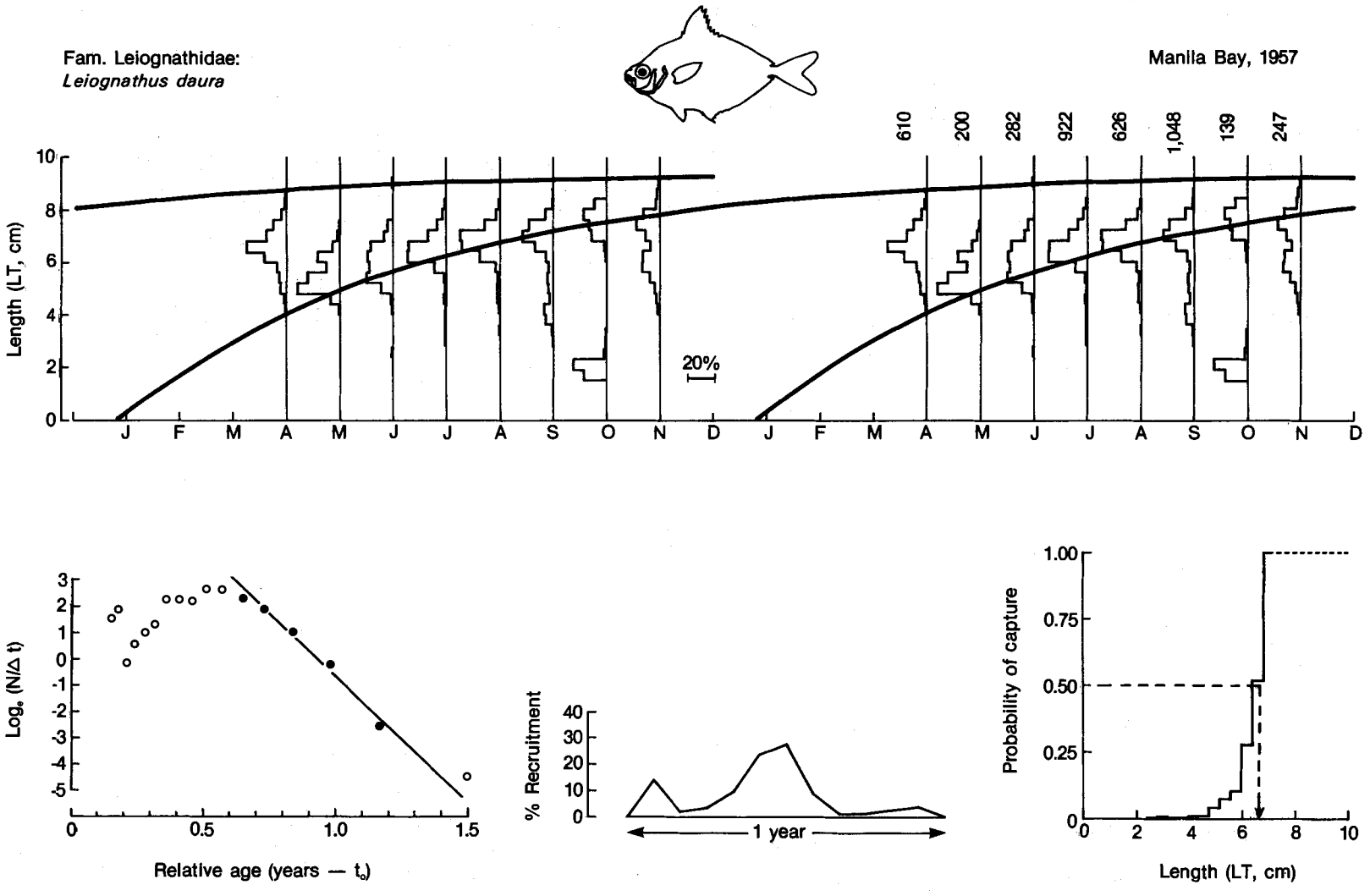


The set of length-frequency data analyzed here was extracted from the files of the Research Division, BFAR, Manila. The following parameter values were estimated: L_∞ = 12.5 cm, K = 1.25, L_c = 6.4 cm, Z = 5.60, M = 2.64 and E = 0.53. Annual recruitment probably occurred in the form of two pulses of unequal strength. The original description of *L. blochii* is given in Cuvier, G.L. and A. Valenciennes. 1835. Histoire naturelle des poissons. Vol. 10, F.G. Leurault, Paris.

Plate 57



This set of length-frequency data on shortnose pony fish was obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following parameter values were estimated: L_∞ = 13.0 cm, K = 1.69, L_c = 8.2 cm, Z = 12.0, M = 3.07 and E = 0.74. The shape of recruitment pattern does not allow for definite conclusions to be drawn on the seasonality of recruitment. Additional data on this fish may be found in James, P.S.R.B. and M. Badrudeen. 1975. Biology and fishery of *Leiognathus brevirostris* (Valenciennes) from the Palk Bay and Gulf of Manaar. Ind. J. Mar. Sci. 4(1): 50-59.

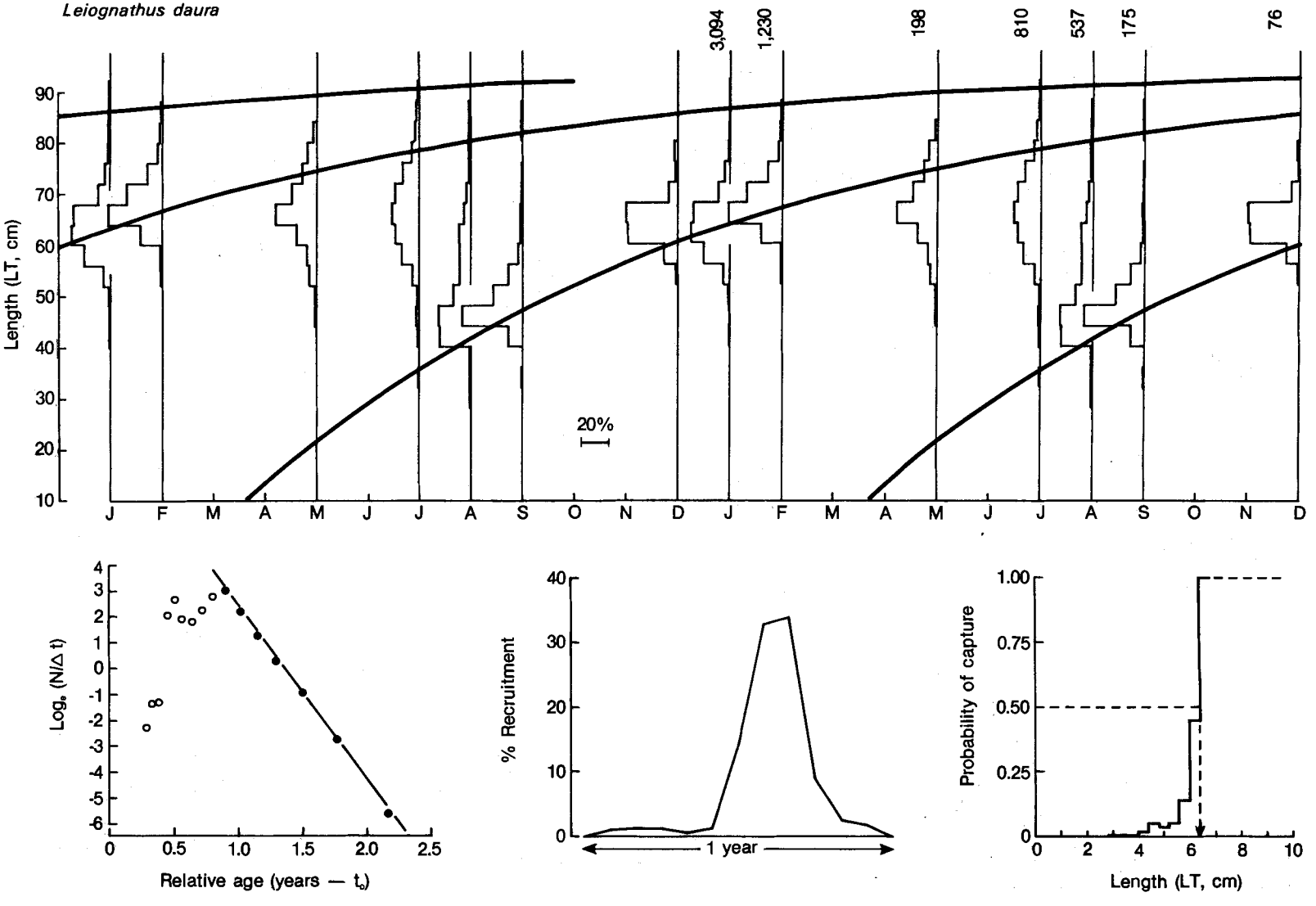


The data presented here on goldstripe pony fish were obtained from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. These length-frequency data led to the following parameter estimates: L_∞ = 9.4 cm, K = 2.10, L_c = 6.6 cm, Z = 9.53, M = 4.01 and E = 0.58. Annual recruitment seems to have consisted of irregular pulses of unequal strength. A length-weight relationship and some size-frequency and other data are presented in Schroeder, R.E. 1977. Preliminary results of the size-maturity survey of commercially important fishes of Honda Bay. Philipp. J. Fish. 15(2): 127-173.

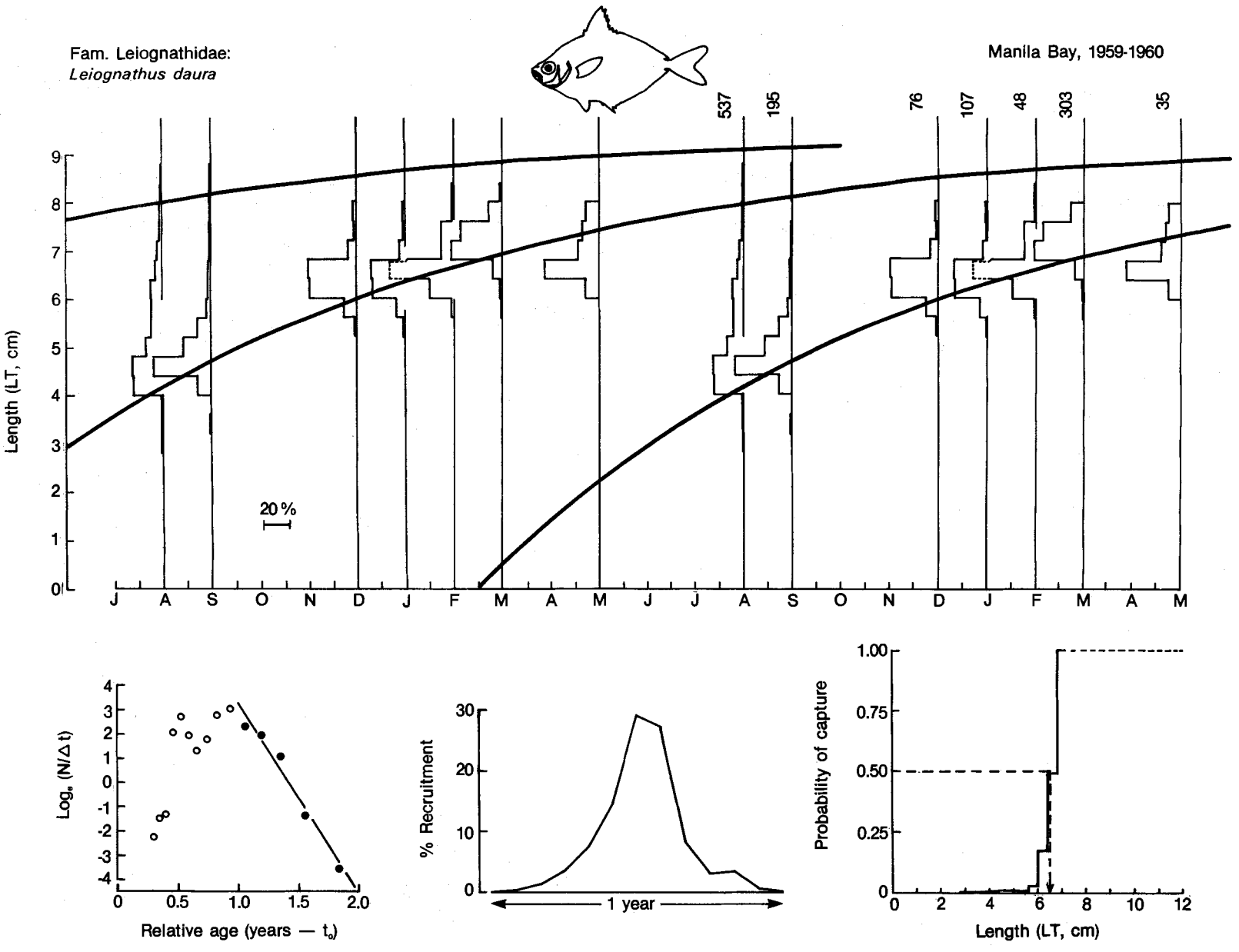
Plate 59

Fam. Leiognathidae:
Leiognathus daura

Manila Bay, 1959

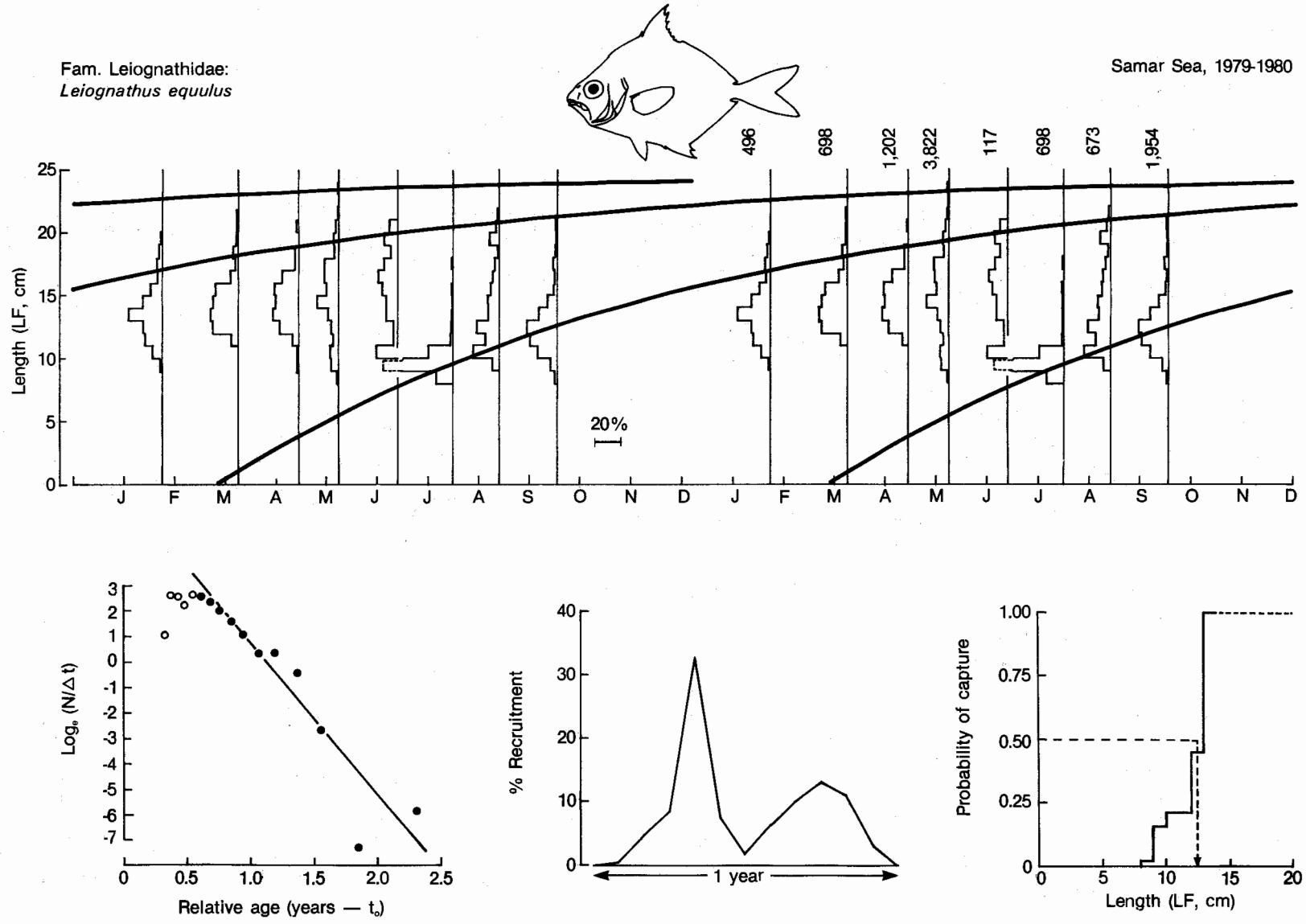


The length-frequency data presented here stem from the files of the Research Division, BFAR, Manila. From these data, the following statistics were estimated: L_∞ = 9.6 cm, K = 1.27, L_c = 6.3 cm, Z = 6.73, M = 2.87 and E = 0.57. Annual recruitment seems to have consisted predominantly of a single pulse. A record and description (with figure) of *L. daura* from Thailand are given in Fowler, H.W. 1937. Zoological results of the Third de Schauensee Siamese Expedition. Part VIII—Fishes obtained in 1936. Proc. Acad. Nat. Sci. Philadelphia 89(1): 125-264.



Although scanty, the length-frequency data presented here, which were culled from the files of the Research Division, BFAR, Manila, allowed the estimation of the following statistics: L_∞ = 9.6 cm, K = 1.25, L_c = 6.6 cm, Z = 7.91, M = 2.84 and E = 0.64. Annual recruitment seems to have occurred in the form of two pulses, one much stronger than the other. As many other leiognathids, *L. daura* occurs in brackishwaters. For a record from Indonesia, see Hardenberg, J.D.F. 1937. Observations on fishes of the Kumai River. Treubia 16(1): 1-14.

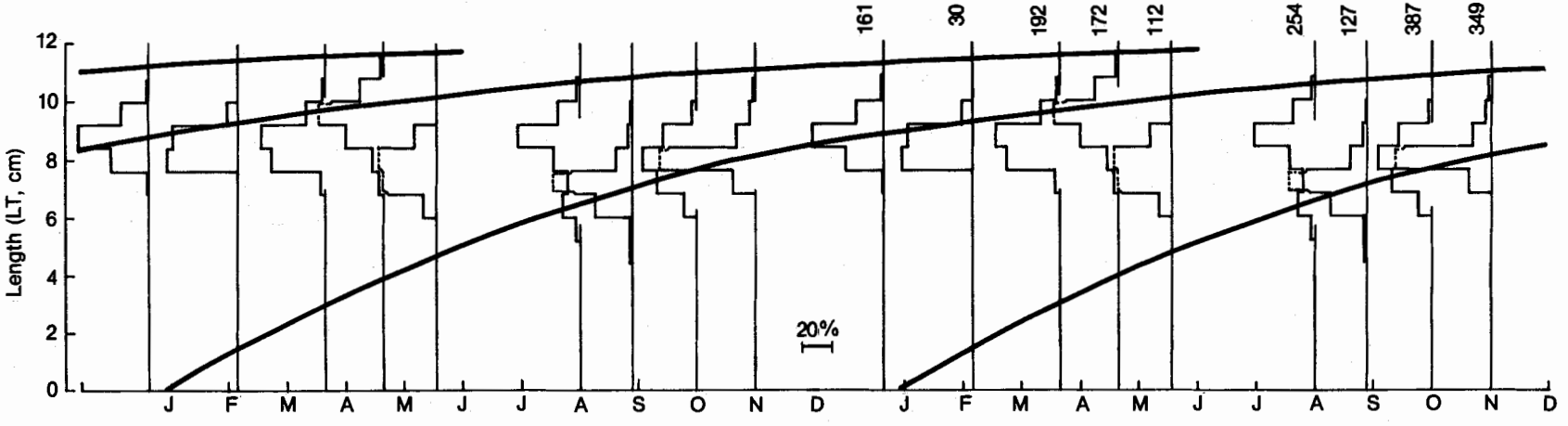
Plate 61

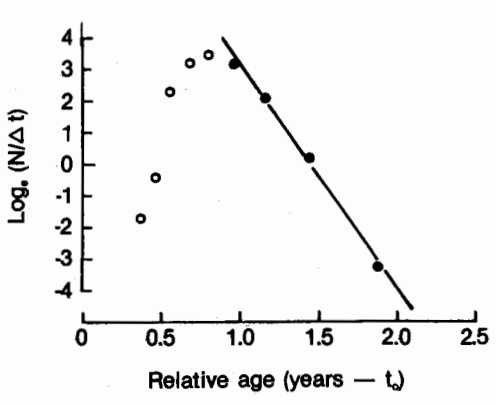


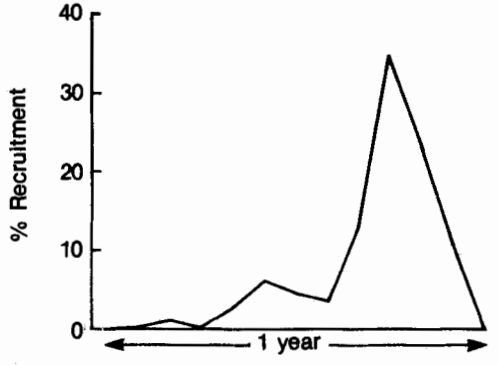
The set of length-frequency data presented here was obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following parameter values were estimated: L_∞ = 24.8 cm, K = 1.28, L_c = 12.4 cm, Z = 5.97, M = 2.22 and E = 0.63. Annual recruitment consisted of two well-separated pulses. The aut- and synecology of this species, the largest in the family, is discussed in Chabanne, J. and R. Plante. 1969. [The benthic populations (endofauna, penaeid shrimps, fishes) of a bight of the northwest of Madagascar: ecology, biology and fishery] Cah. ORSTOM, Ser. Océanogr. 7(1): 41-71 (in French).

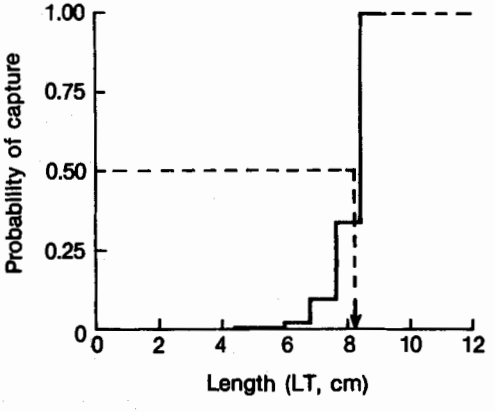
Fam. Leiognathidae:
Leiognathus leuciscus

Manila Bay, 1957



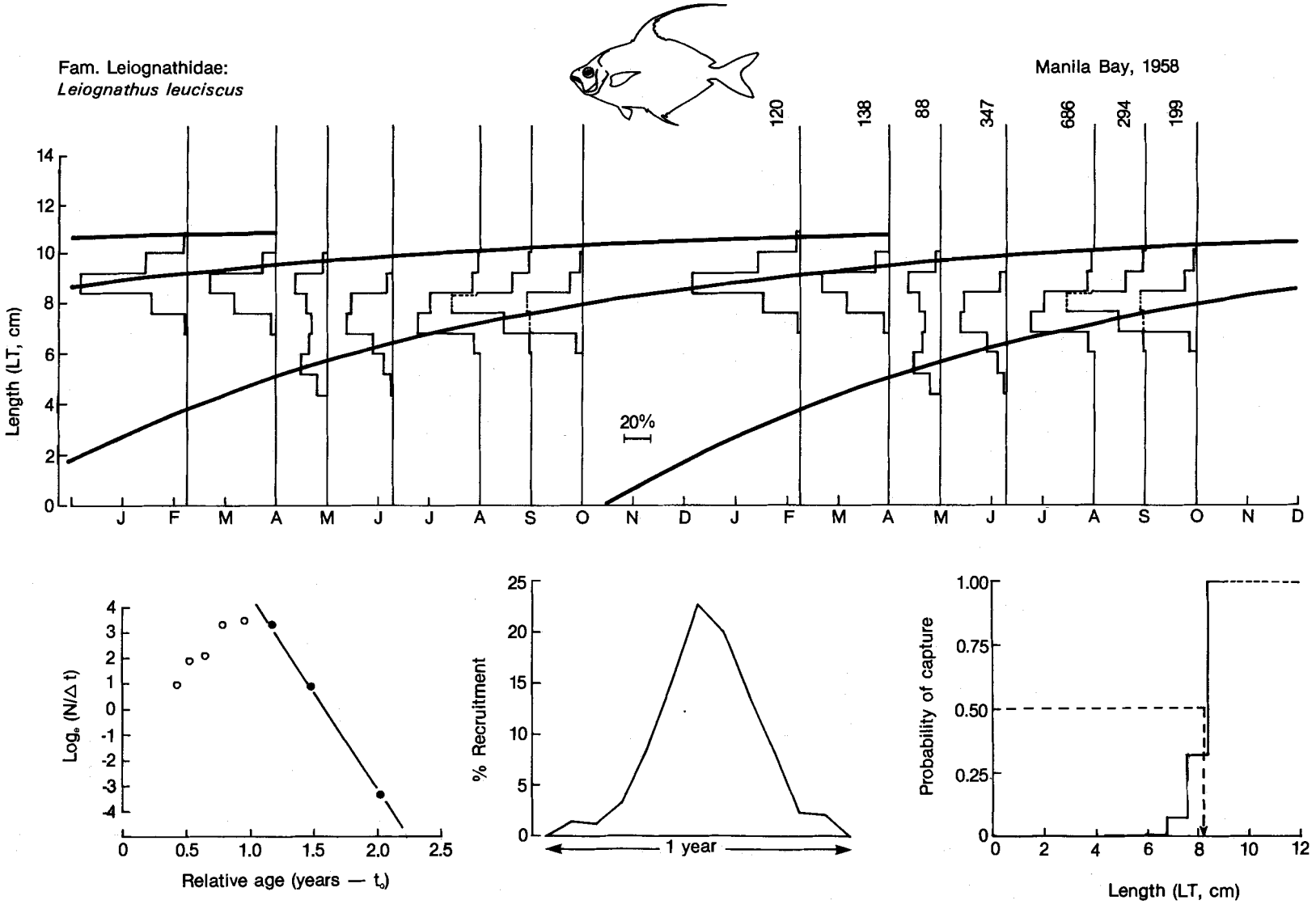






The length-frequency data analyzed here were extracted from the files of the Research Division, BFAR, Manila. They led to the following parameter estimates: L_∞ = 11.8 cm, K = 1.30, L_c = 8.2 cm, Z = 7.17, M = 2.72 and E = 0.62. Annual recruitment appears to have consisted predominantly of a single large pulse. A detailed description of this fish, whose biology is little known, is given in James, P.S.B.R. 1967. *Leiognathus leuciscus* (Günther) and *Leiognathus smithursti* (Ramsay and Ogilby) (Family Leiognathidae: Pisces)—two new records from the Indian Seas. J. Mar. Biol. Assoc. India 9(2): 300-302.

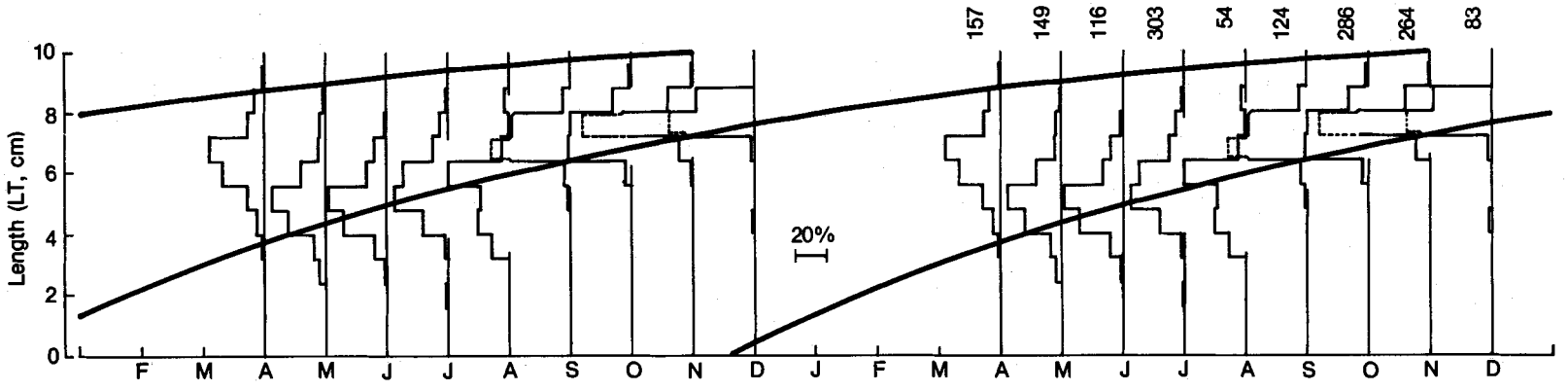
Plate 63

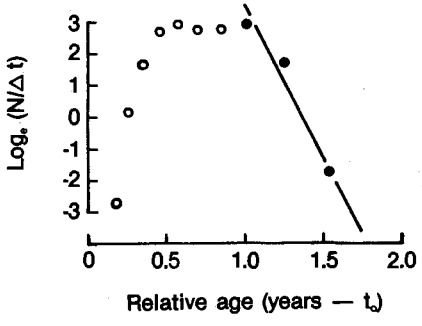


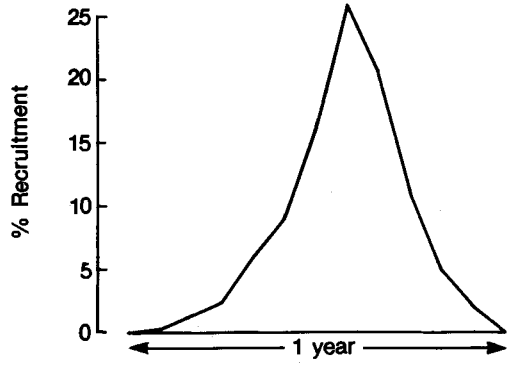
The source of the length-frequency data used here is the files of the Research Division, BFAR, Manila. The following parameter values were estimated from these data: L_∞ = 10.8 cm, K = 1.30, L_c = 8.2 cm, Z = 7.42, M = 2.79 and E = 0.62. The bulk of the annual recruitment appears to have been contributed by a single recruitment event. An excellent color photo of *L. leuciscus* is given in Masuda, H., C. Araga and T. Yoshino. 1975. Coastal fishes of Southern Japan. Tokai Univ. Press, Tokyo.

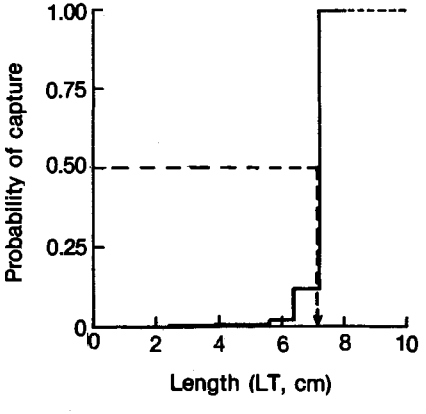
Fam. Leiognathidae:
Leiognathus lineolatus

Manila Bay, 1957





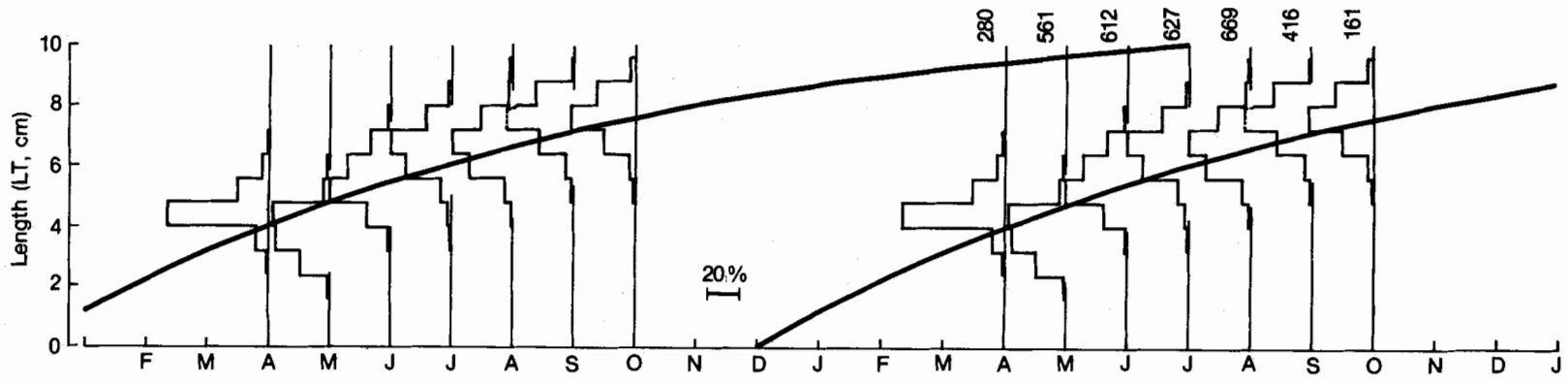


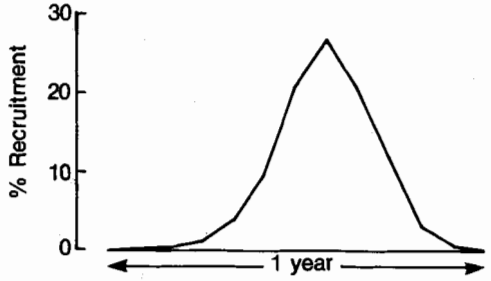


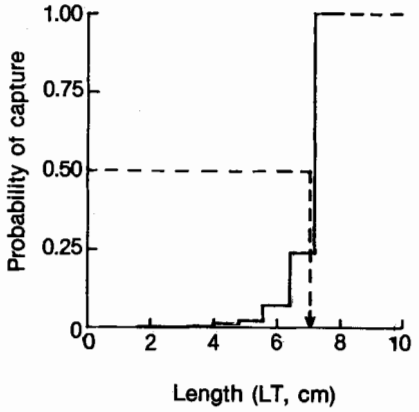
The length-frequency data analyzed here stem from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. From these, the following parameter values were estimated: L_∞ = 11.5 cm, K = 1.05, L_c = 7.1 cm, Z = 9.53, M = 2.41 and E = 0.75. Annual recruitment seems to have occurred in the form of two pulses of very unequal strength. The occurrence of young fish attributed to *L. lineolatus* has been reported by John, M.A. 1951. Pelagic fish eggs and larvae of the Madras coast. J. Zool. Soc. India 3(1): 38-66.

Fam. Leiognathidae:
Leiognathus lineolatus

Manila Bay, 1958



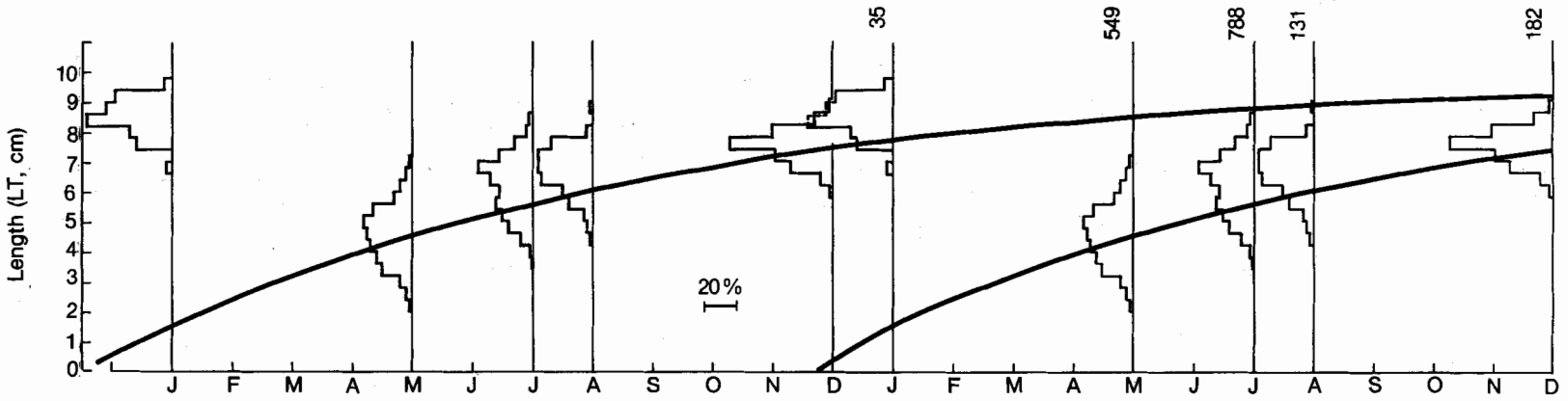


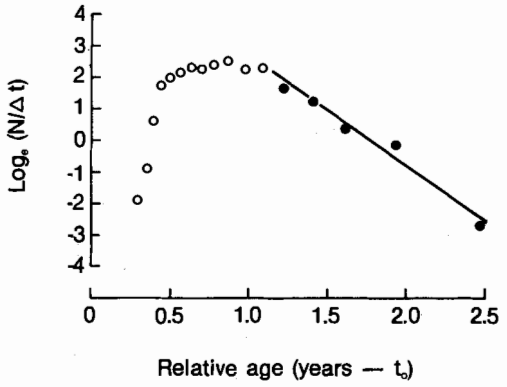


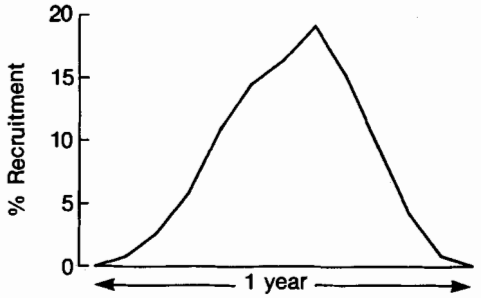
The source of the length-frequency data used here is the important paper by Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. The following statistics were estimated from these data: L_∞ = 11.5 cm, K = 1.30, L_c = 7.1 cm, Z = 9.23, M = 2.77 and E = 0.70. Annual recruitment appears to have consisted of a single pulse. The ecology of *L. lineolatus*, i.e., factors affecting its distribution, are discussed in Kuronuma, K., editor. 1974. Arabian Gulf fishery—oceanography survey by Umitika-Maru. Trans. Tokyo Univ. Fish. 1: 1-118.

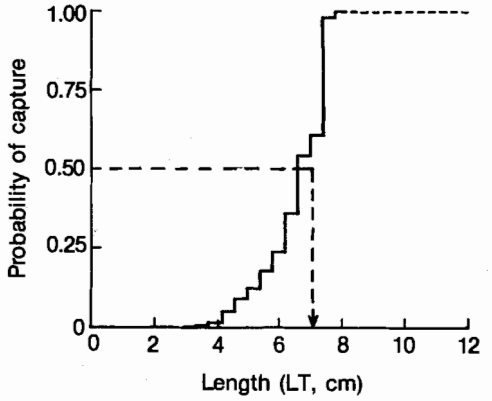
Fam. Leiognathidae:
Leiognathus lineolatus

Manila Bay, 1959





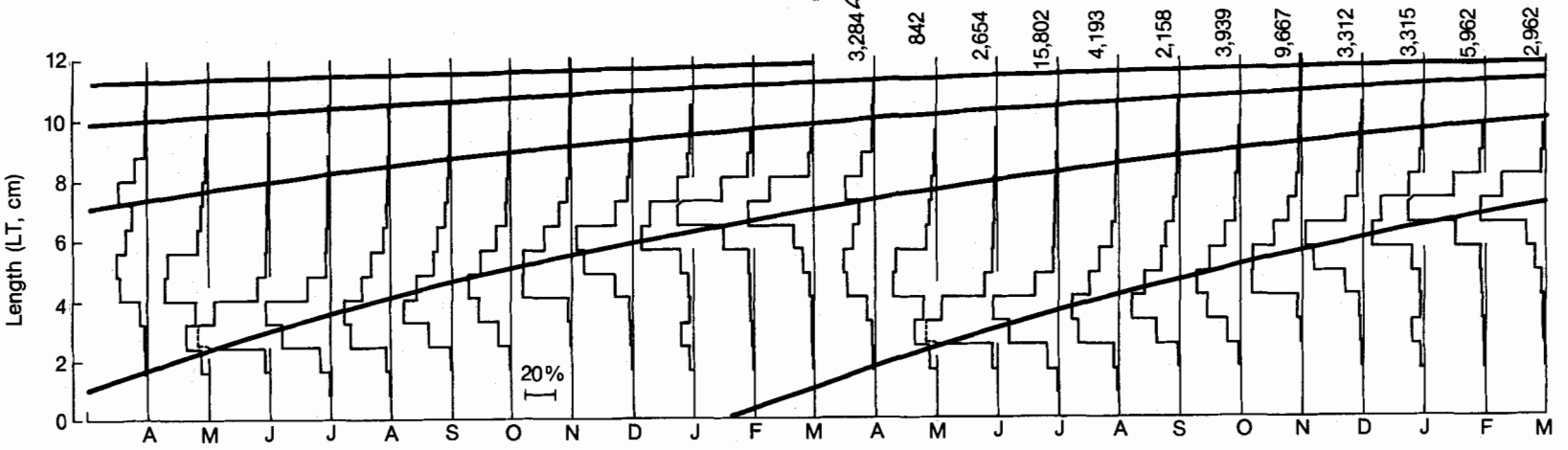


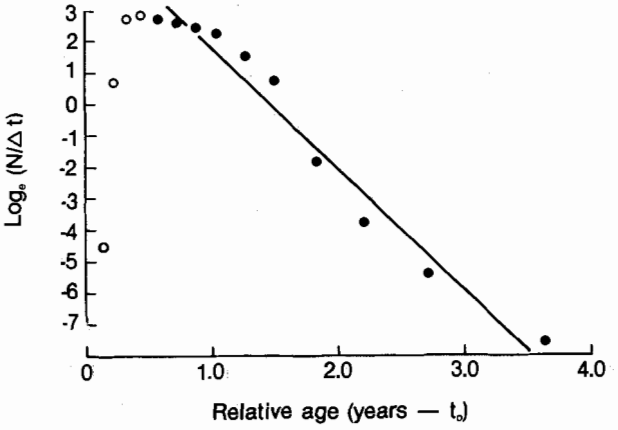


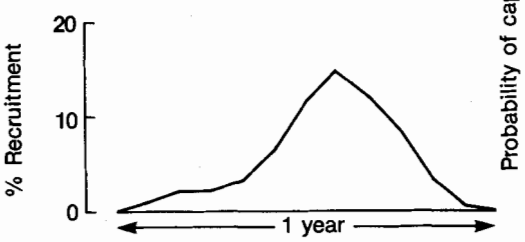
The length-frequency data presented here stem from the files of the Research Division, BFAR, Manila, and led to the following parameter estimates: L_∞ = 10.0 cm, K = 1.30, L_c = 7.1 cm, Z = 3.48, M = 2.88 and E = 0.17. Recruitment seems to have consisted of two protracted pulses. Some additional information on *L. lineolatus* is given in Joseph, B. 1974. Preliminary report on experimental fishing with purse seines and lampara nets for small pelagic fish varieties around Sri Lanka. Bull. Fish. Res. Stn. Ceylon 25(1/2): 1-13.

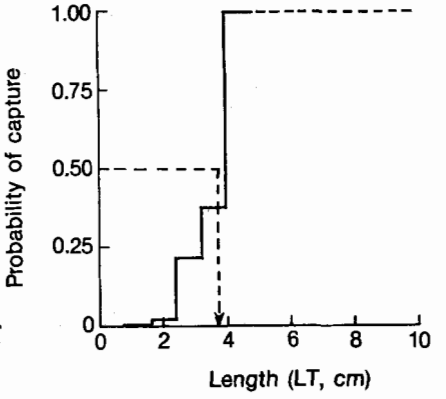
Fam. Leiognathidae:
Leiognathus splendens

Manila Bay, 1957-1958

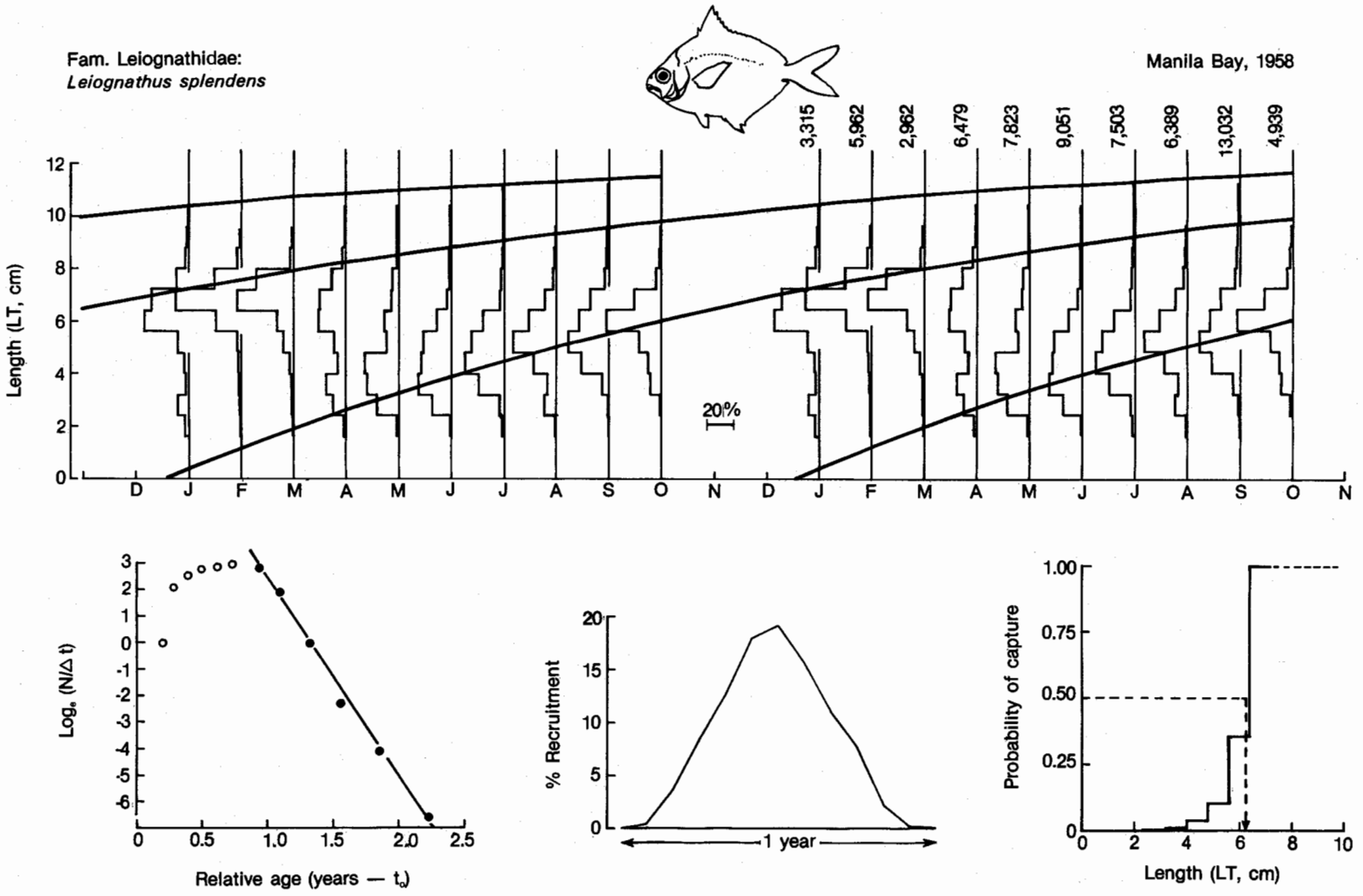




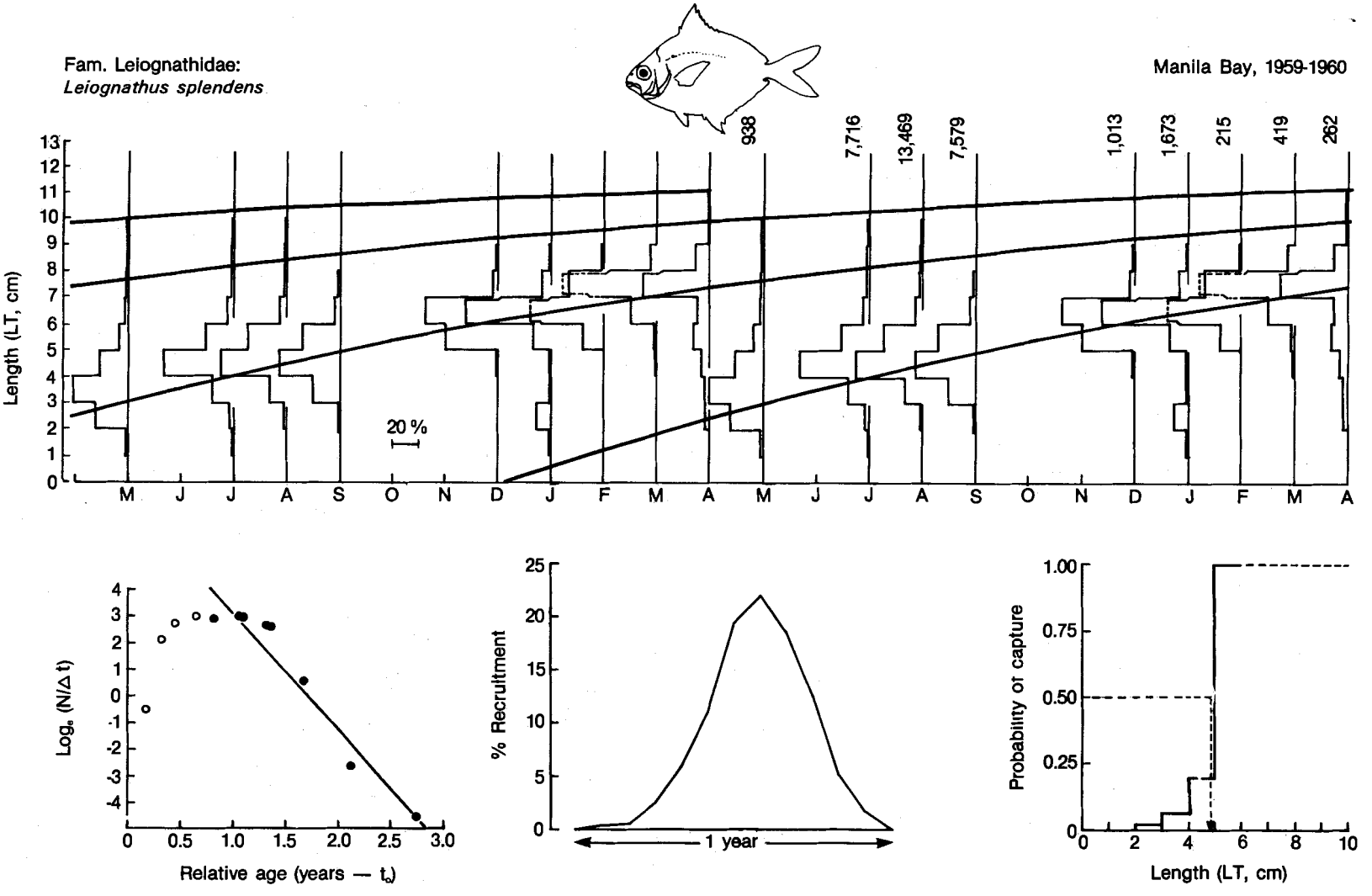




The set of length-frequency data used here stems from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. The following parameter values were derived from these data: L_∞ = 12.4 cm, K = 0.75, L_c = 3.8 cm, Z = 3.85, M = 1.89 and E = 0.51. Annual recruitment seems to have occurred in the form of two pulses of unequal strength. A comprehensive discussion of the reproductive biology of *L. splendens* is given in Rao, K. Satyararayana. 1967. Reproductive cycles and lipid levels in *Leiognathus splendens* (Cuvier) J. Mar. Biol. Assoc. India 9(2): 303-322.

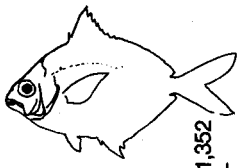


The length-frequency data presented here were extracted from the files of the Research Division, BFAR, Manila. From these data, the following parameter values were estimated: L_∞ = 13.2 cm, K = 0.76, L_c = 6.2 cm, Z = 7.52, M = 1.88 and E = 0.75. Recruitment seems to have occurred in the form of two pulses of unequal strength. An independent estimate of M = 1.8 for *L. splendens* in the Sunda Shelf area was derived by Pauly, D. 1980. The use of a pseudo catch curve for the estimation of mortality rates in *Leiognathus splendens* (Pisces: Leiognathidae) in Western Indonesian waters. Meeresforsch. 28(1): 56-60.

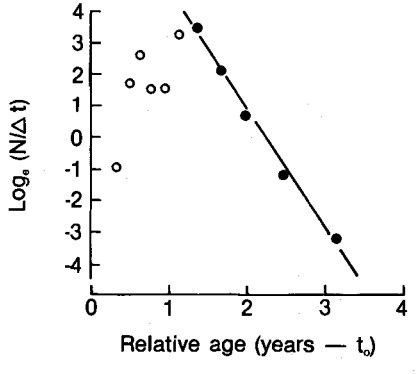


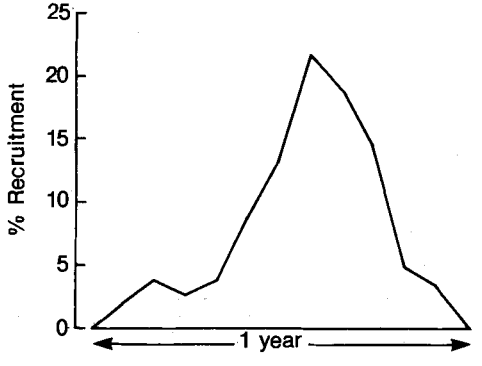
The data analyzed here stem from the files of the Research Division, BFAR, Manila. From these length-frequency data, the following parameter values were estimated: L_∞ = 12.3 cm, K = 0.70, L_c = 4.9 cm, Z = 4.46, M = 1.81 and E = 0.59. Annual recruitment appears to have consisted of two pulses of unequal strength. An account of the population dynamics of *L. splendens,* including a yield-isopleth diagram and a discussion of stock-recruitment relationships is given in Pauly, D. 1979. Theory and management of tropical stocks, a review with emphasis on the Southeast Asian demersal fisheries. ICLARM Studies and Reviews 1, 35 p. International Center for Living Aquatic Resources Management, Manila.

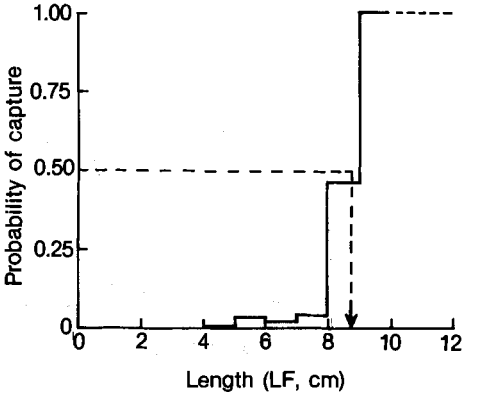
Fam. Leiognathidae:
Leiognathus splendens



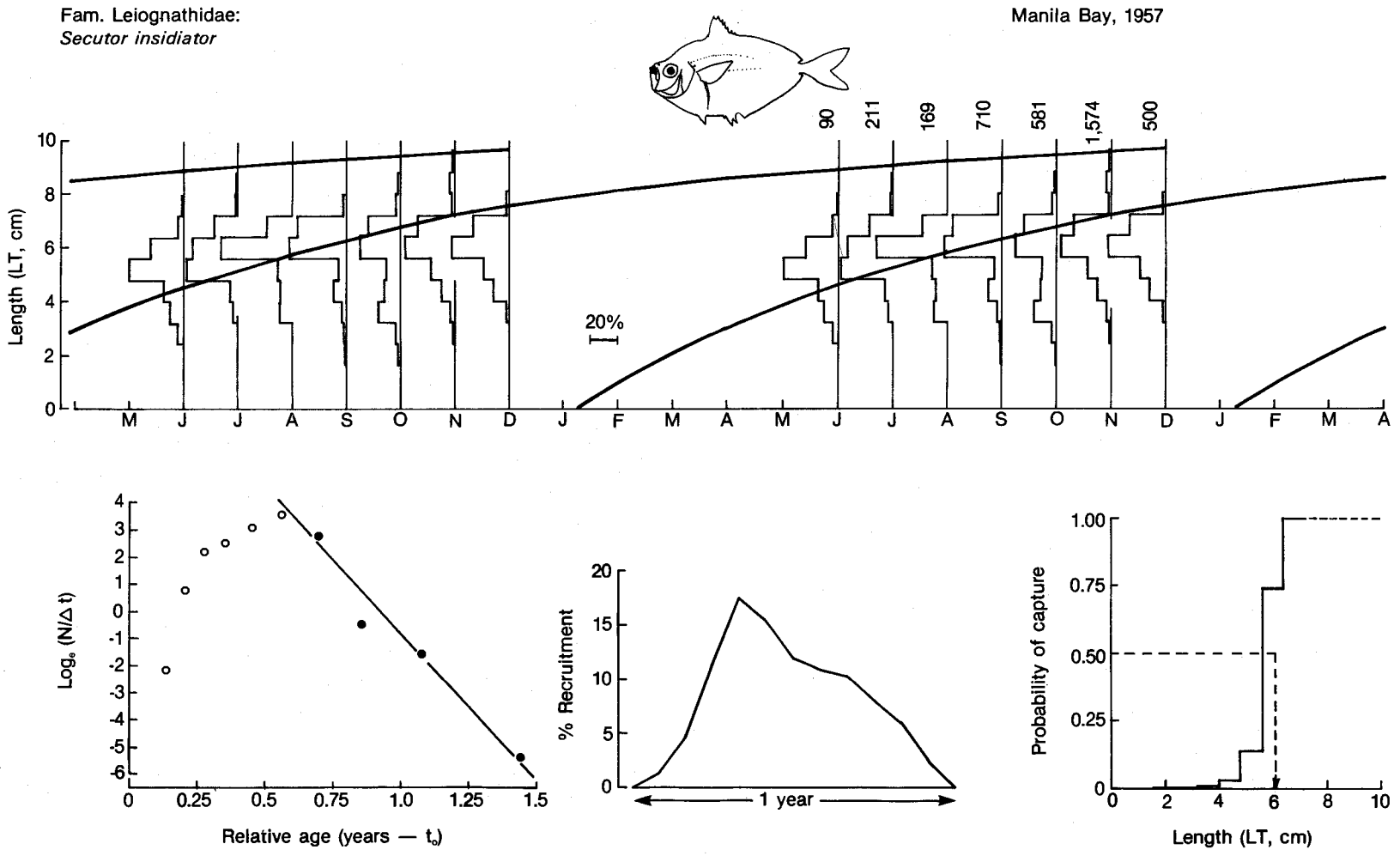
Samar Sea, 1979-1980





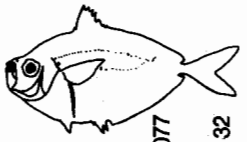


The length-frequency data used here, which were culled from the files of the Research Division, BFAR, Manila led to the following parameter estimates: L_∞ = 15.0 cm, K = 0.72, L_c = 8.7 cm, Z = 3.77, M = 1.76 and E = 0.53. Annual recruitment clearly consisted of two distinct events of unequal magnitude. A large number of references on *L. splendens* and other leiognathids may be found in D. Pauly and S. Wade-Pauly. 1981. An annotated bibliography of slipmouths (Pisces: Leiognathidae). ICLARM Bibliographies 2, 62 p. International Center for Living Aquatic Resources Management, Manila.

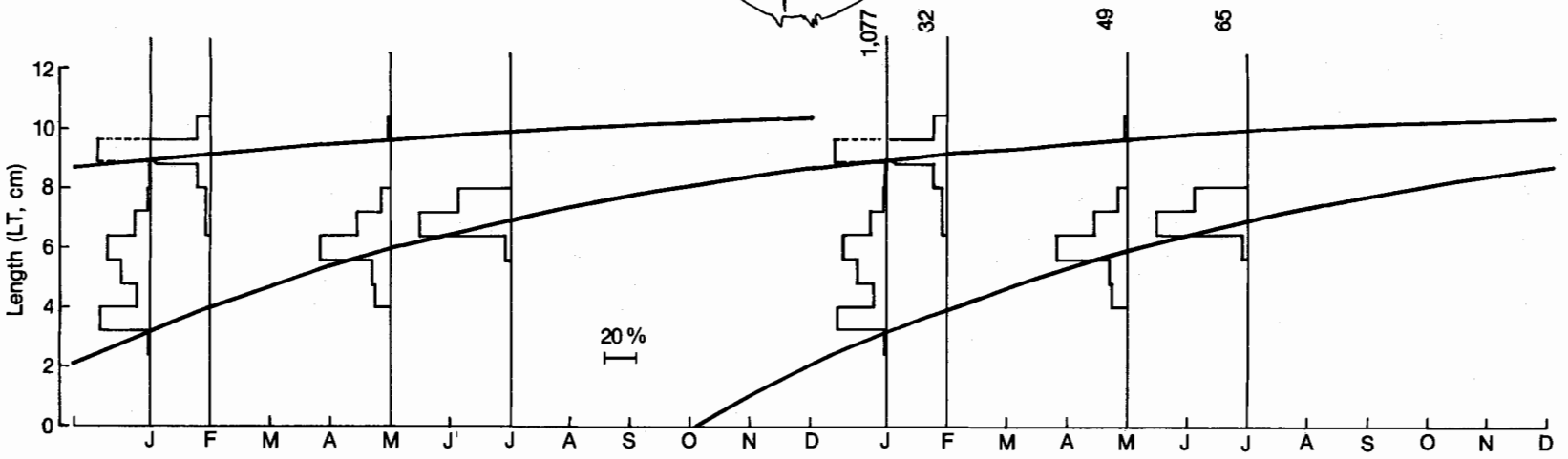


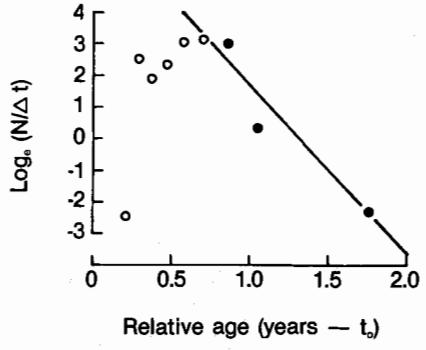
The data presented here stem from Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. These length-frequency data led to the following estimates: L_∞ = 10.2 cm, K = 1.50, L_c = 6.00 cm, Z = 10.7, M = 3.13 and E = 0.71. Annual recruitment occurred in two major pulses of unequal strength. The occurrence, size range and food of juvenile *S. insidiator* (and of other fishes) are discussed in Basheeruddin, S. and K.N. Nayar. 1962. A preliminary study of the juvenile fishes of the coastal waters off Madras City. Indian J. Fish. 8(1): 169-188.

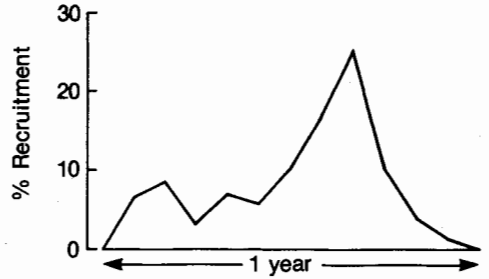
Fam. Leiognathidae:
Secutor insidiator

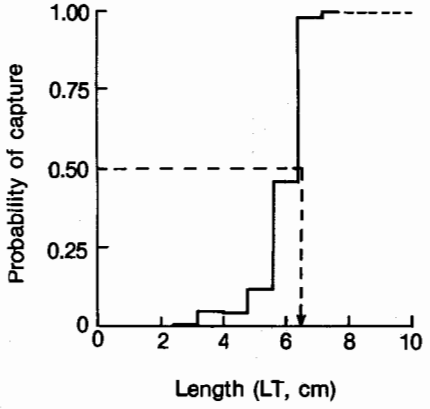


Manila Bay, 1959





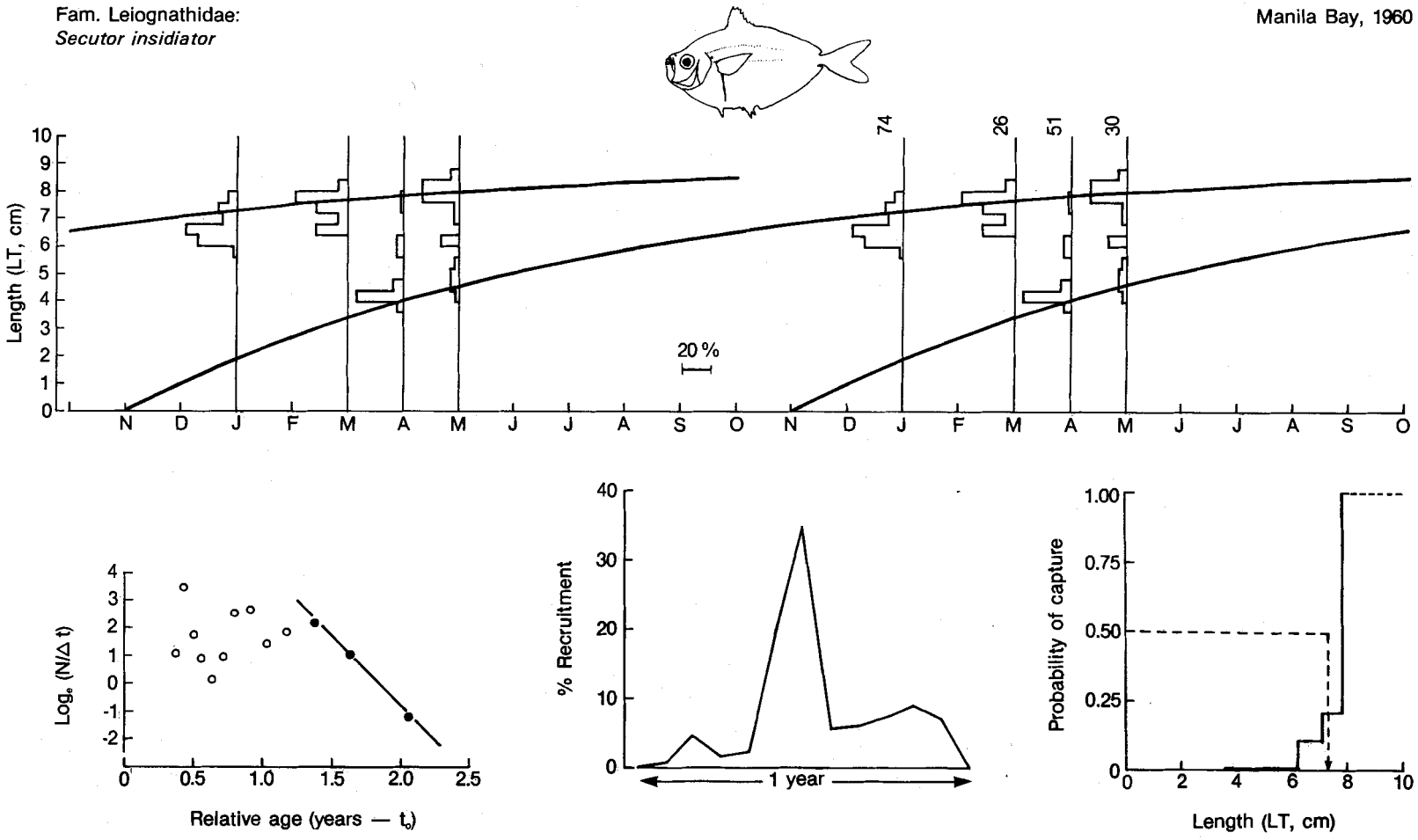




This set of length-frequency data on pugnose pony fish was extracted from the files of the Research Division, BFAR, Manila. The following parameter values were estimated from these data: L_∞ = 11.0 cm, K = 1.35, L_c = 6.5 cm, Z = 5.31, M = 2.88 and E = 0.46. Recruitment appears irregular, but this is probably due to the scantiness of the data used. Information on the food and feeding habit of this and other leiognathids may be found in Tiews, K., P. Divino, I.A. Ronquillo and J. Marques. 1972. On the food and feeding habits of eight species of *Leiognathus* found in Manila Bay and San Miguel Bay. Proc. Indo-Pac. Fish Counc. 13(3): 93-99.

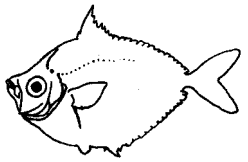
Fam. Leiognathidae:
Secutor insidiator

Manila Bay, 1960

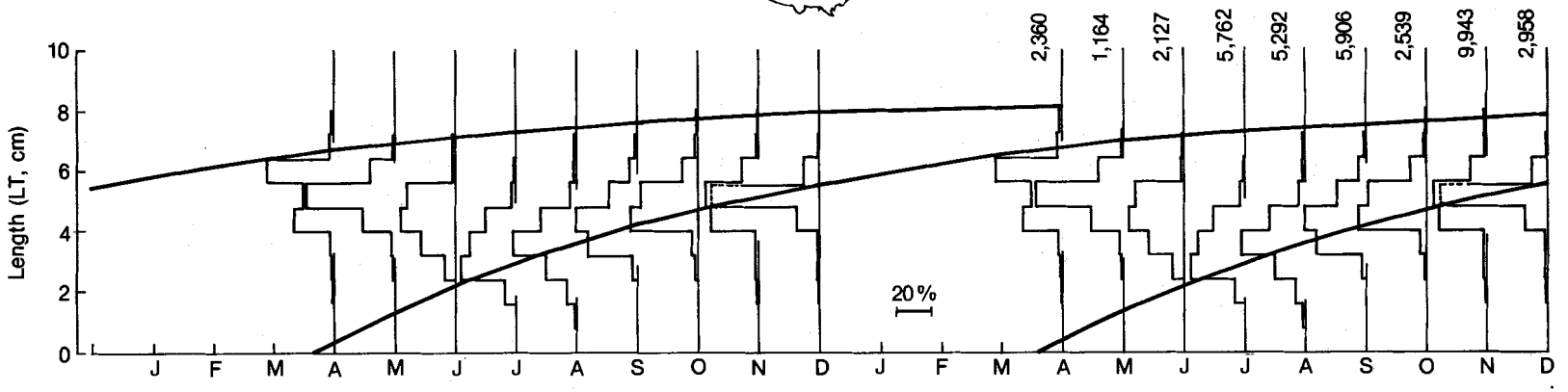


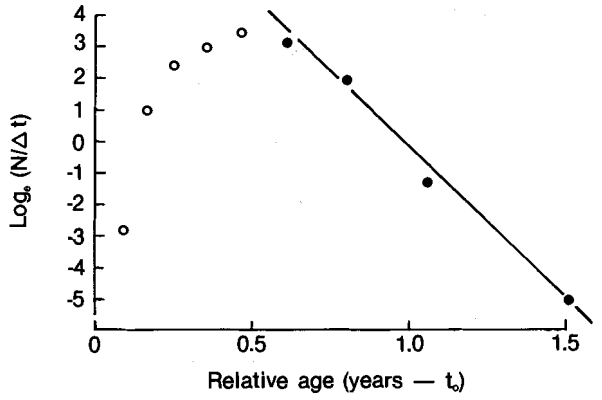
The length-frequency data presented here which were extracted from the files of the Research Division, BFAR, Manila, led to the following parameter estimates: L_∞ = 9.1 cm, K = 1.40, L_c = 7.5 cm, Z = 5.04, M = 3.10 and E = 0.38. Recruitment appears to have been irregular, but this may be due to the limited data available. *Secutor insidiator* is, as are all leiognathids, a bioluminescent fish, which protects itself against predation through counter illumination. A description of the light organ of *S. insidiator* is given in Haneda, Y. 1950. Luminous organs of fish which emit light indirectly. Pac. Sci. 4(3): 214-227.

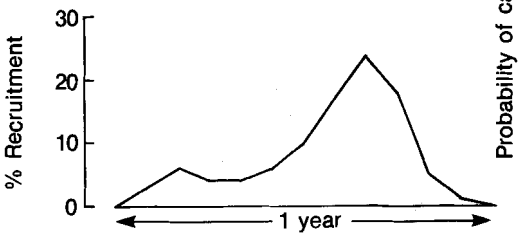
Fam. Leiognathidae:
Secutor ruconius

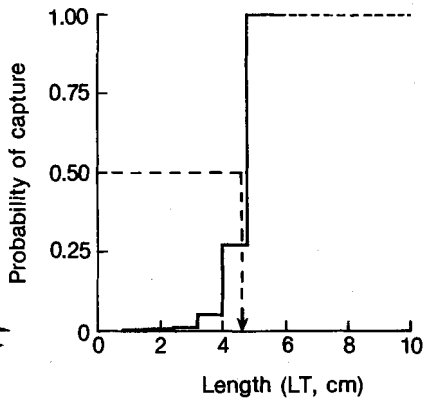


Manila Bay, 1957



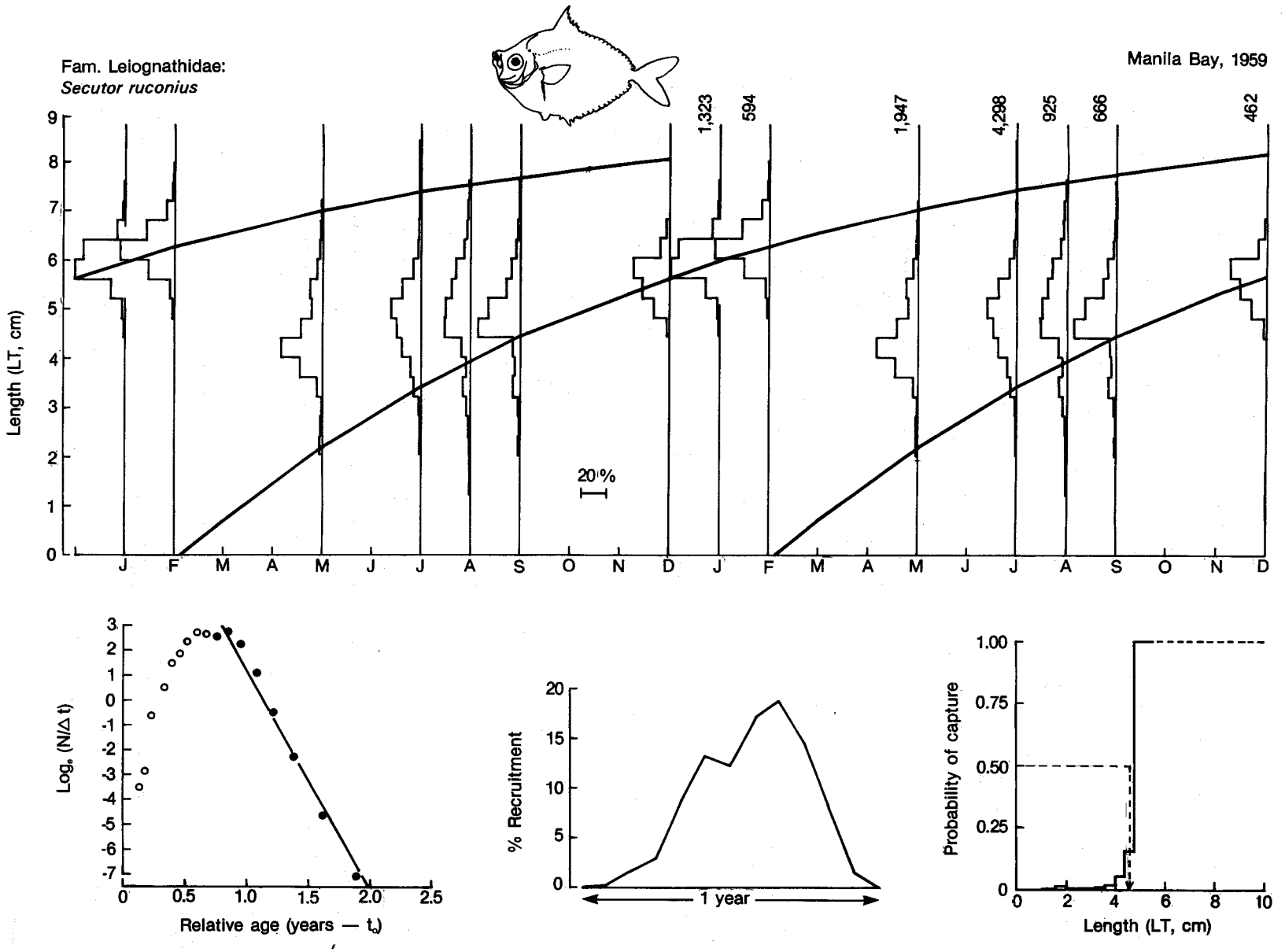






The source of the length-frequency data on deep pugnose pony fish presented here is Tiews, K. and P. Caces-Borja. 1965. On the availability of fish of the family Leiognathidae Lacépède in Manila Bay and San Miguel Bay and their accessibility to controversial fishing gears. Philipp. J. Fish. 7(1): 59-83. The data allowed the estimation of the following parameter values: L_∞ = 8.4 cm, K = 1.55, L_c = 4.7 cm, Z = 9.57, M = 3.39 and E = 0.65. Annual recruitment consisted of two well separated pulses. Data on postlarval stages attributed to this fish have been presented by Nair, R.V. 1952. Studies on some post-larval fishes of the Madras plankton. Proc. Indian Acad. Sci. 35B(5): 225-244.

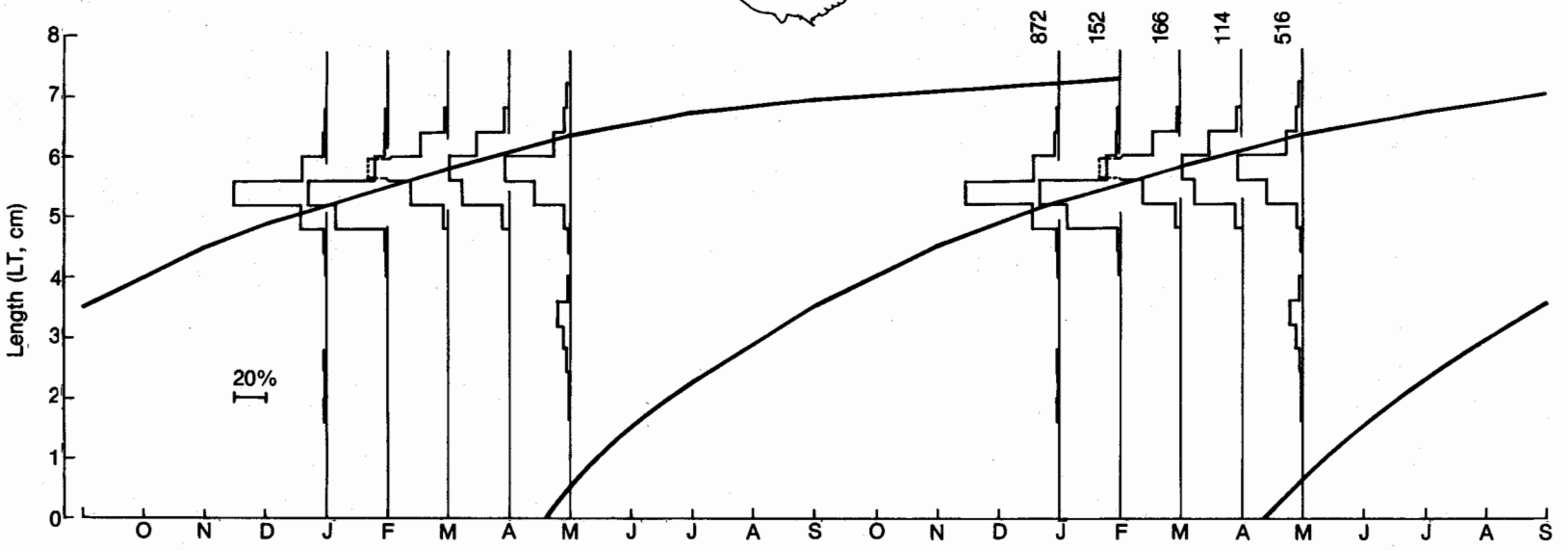
Plate 75

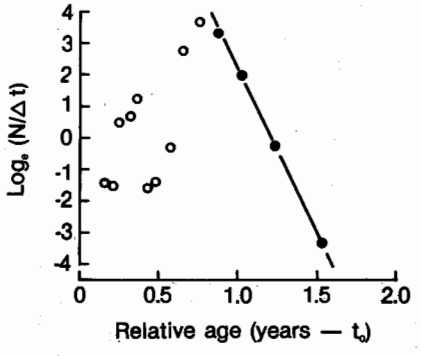


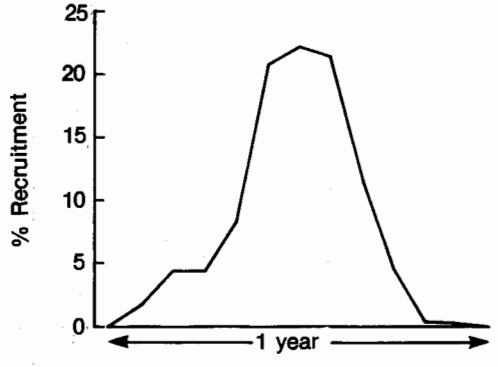
The length-frequency data analyzed here were extracted from the files of the Research Division, BFAR, Manila. The following parameter values were estimated from these data: L_∞ = 9.2 cm, K = 1.15, L_c = 4.8 cm, Z = 8.69, M = 2.72 and E = 0.69. Annual recruitment appears to have consisted of two pulses. The depth distribution in relation to light emission of this fish and of other leiognathids was discussed in Pauly, D. 1977. The Leiognathidae (Teleostei): a hypothesis relating their mean depth occurrence and the intensity of their countershading bioluminescence. Mar. Res. Indonesia 19: 137-146.

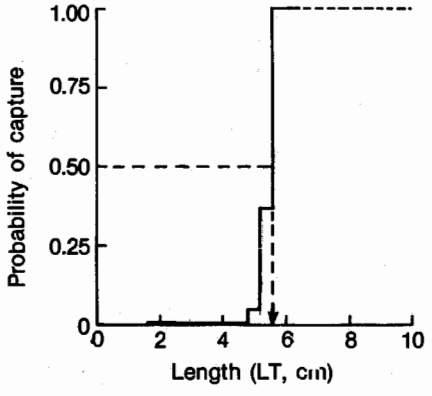
Fam. Leiognathidae:
Secutor ruconius

Manila Bay, 1960







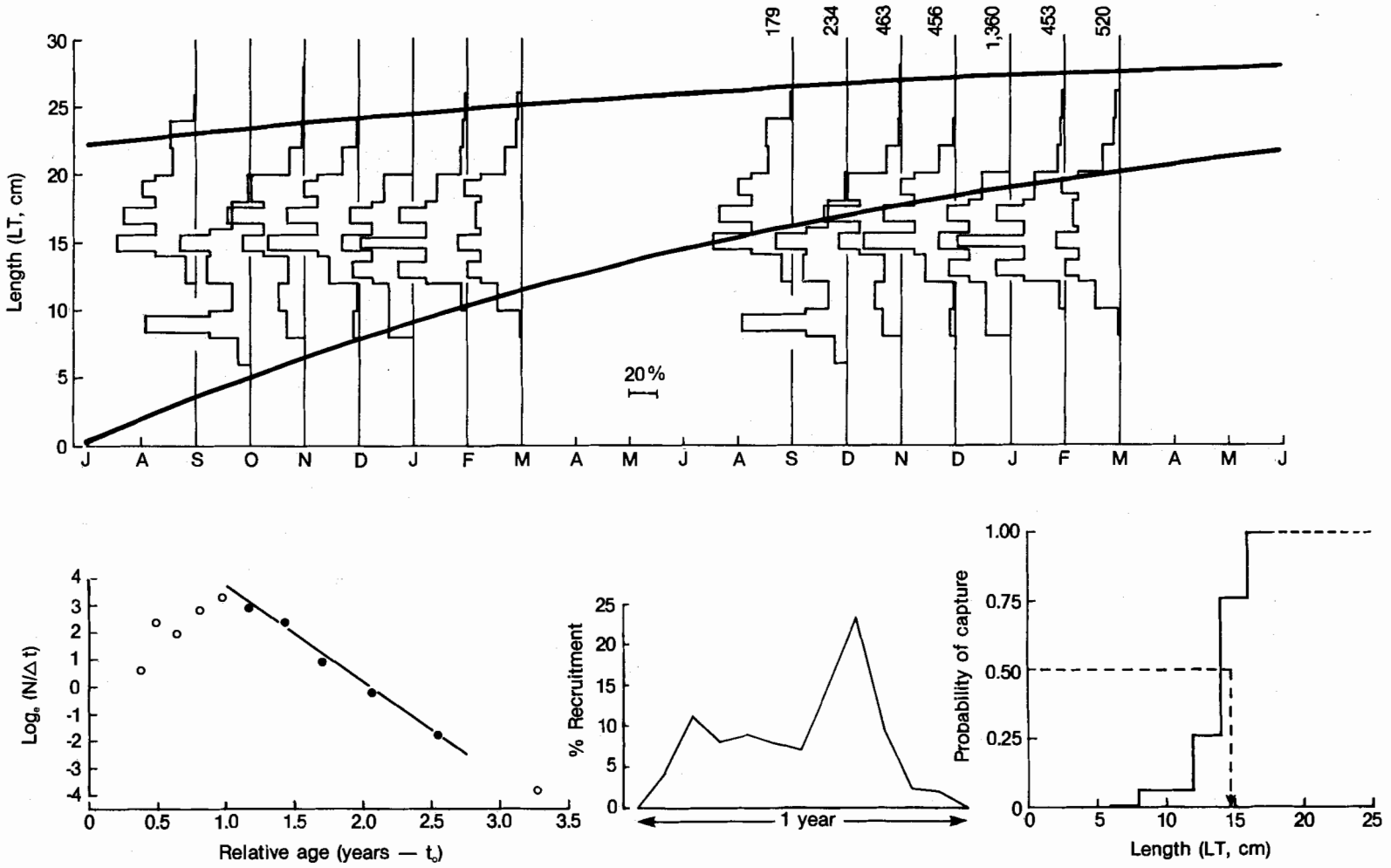


The length-frequency data used here were culled from the files of the Research Division, BFAR, Manila, and led to the following parameter estimates: L_∞ = 7.6 cm, K = 1.60, L_c = 5.5 cm, Z = 10.35, M = 3.56 and E = 0.66. Annual recruitment appears to have consisted of two pulses of very unequal strength. The taxonomic status of this and other leiognathids has been reviewed in James, P.S.B.R. 1975. A systematic review of the fishes of the family Leiognathidae. J. Mar. Biol. Assoc. India 17(1): 138-172.

Plate 77

Fam. Nemipteridae:
Nemipterus japonicus

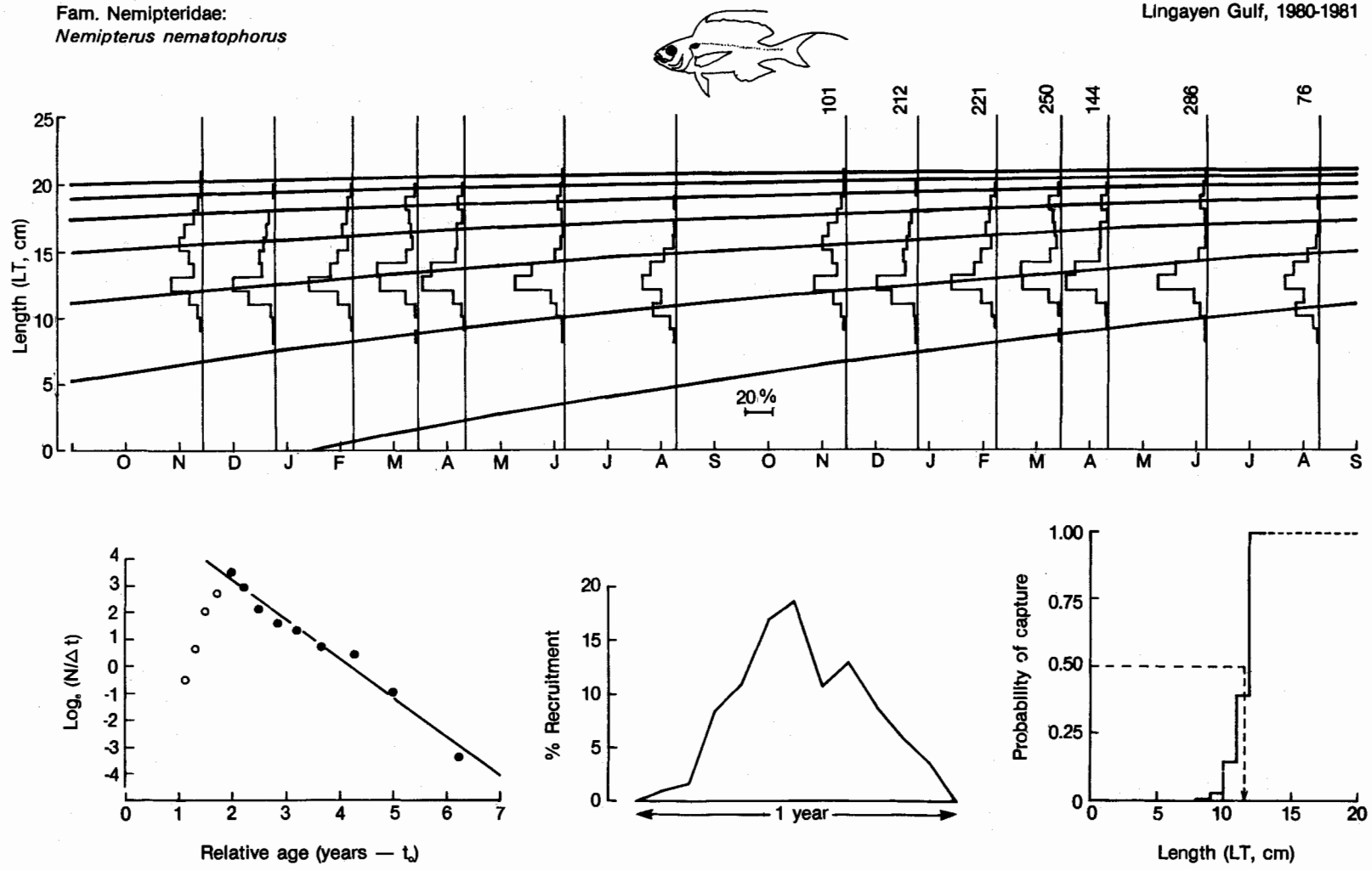
Manila Bay, 1978-1979



This set of data on the Japanese threadfin bream was obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The data led to the following parameter estimates: L_∞ = 30.0 cm, K = 0.70, L_c = 14.8 cm, Z = 3.31, M = 1.41 and E = 0.57. Annual recruitment seems to have occurred in the form of two pulses. Further information on this important species may be found in Krishnamoorthi, B. 1971. Biology of the threadfin bream, *Nemipterus japonicus.* Indian J. Fish. 18(1-2): 1-21.

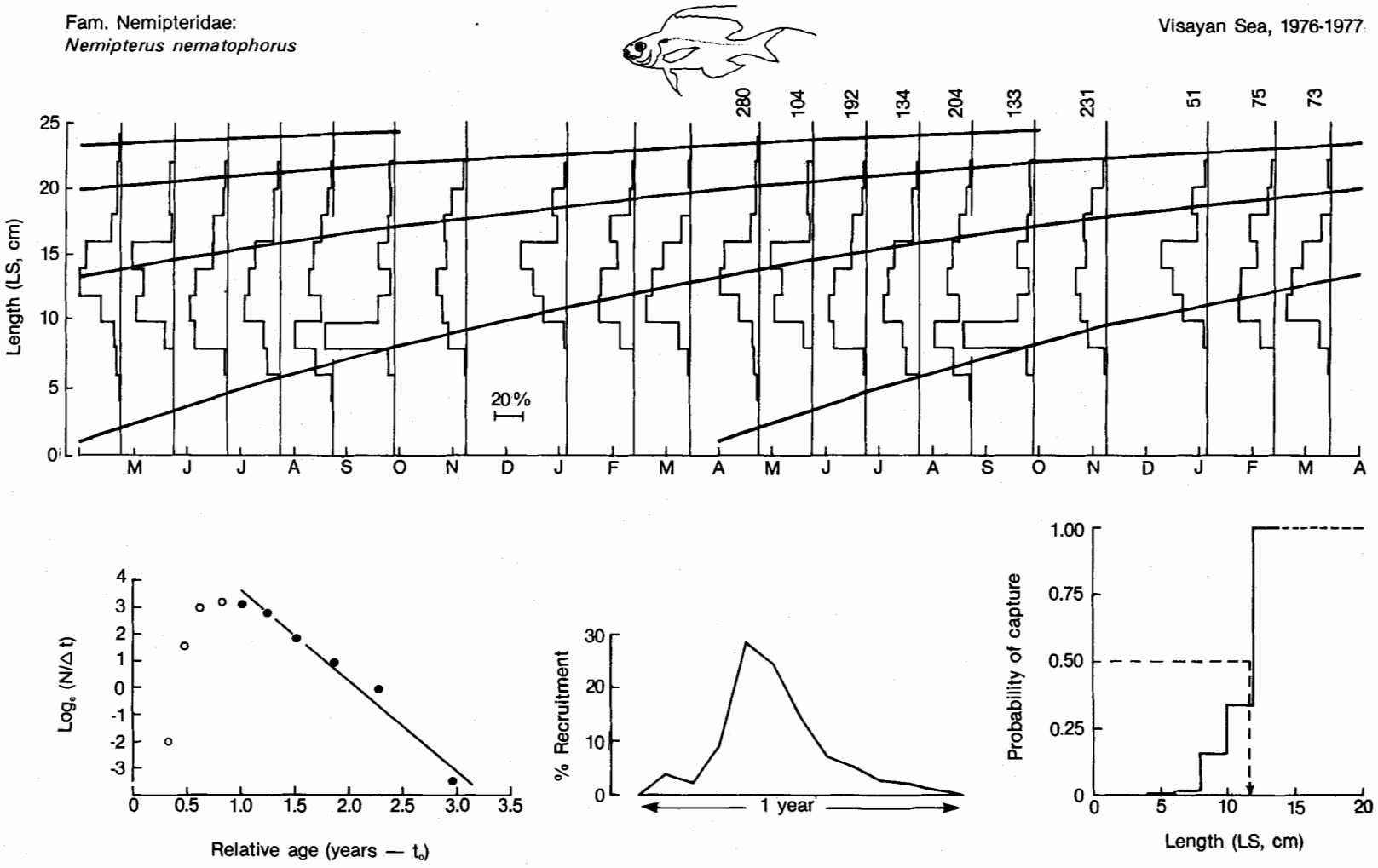
Fam. Nemipteridae:
Nemipterus nematophorus

Lingayen Gulf, 1980-1981



The length-frequency data on doublewhip threadfin bream were collected in the frame of PCARR Project 886 "Studies on coastal (sustenance) fisheries of San Isidro Norte and San Isidro Sur, Agoo, La Union" [A. Hernando, pers. comm.]. They led to the following statistics: L_∞ = 22.0 cm, K = 0.43, L_c = 11.7 cm, Z = 1.48, M = 1.12 and E = 0.24. Annual recruitment probably occurred in the form of two pulses. The distribution off Northern Borneo and preliminary mortality estimates of this and other nemipterids are presented in Weber, W. and A. Jothy. 1977. Observations on the fish *Nemipterus* spp. (Family: Nemipteridae) in the coastal waters of East Malaysia. Arch. Fischwiss. 28: 109-122.

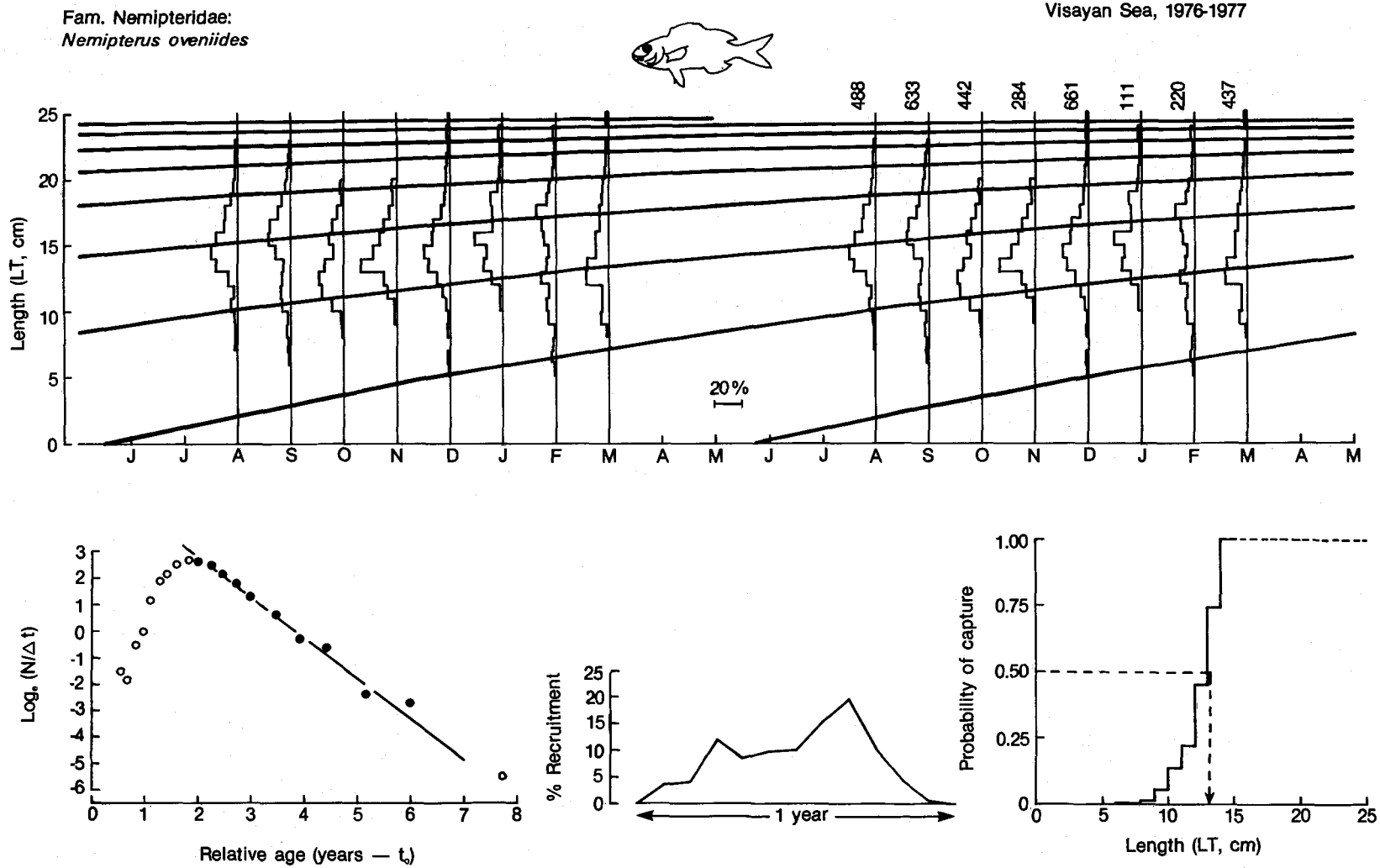
Plate 79



The set of length-frequency data discussed here was obtained from Arce, F. 1981. Distribution and relative abundance of nemipterids and carangids (Pisces: Nemipteridae and Carangidae) caught by trawl in Visayan Sea with notes on the biology of *Nemipterus oveniides* and *Selaroides leptolepis.* University of the Philippines, Quezon City. 67 p. M.Sc. thesis. The following parameter estimates were obtained from these data: L_∞ = 27.0 cm, K = 0.65, L_c = 11.5 cm, Z = 3.38, M = 1.39 and E = 0.59. Annual recruitment appears to have originated from two pulses of unequal strength. Additional information, including a color photo, on *N. nematophorus* may be found in Eggleston, D. 1974. Nemipteridae. *In* W. Fischer and P.J.P. Whitehead (eds.) FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71). Vol. 3. (var. pag.) FAO, Rome.

Fam. Nemipteridae:
Nemipterus oveniides

Visayan Sea, 1976-1977

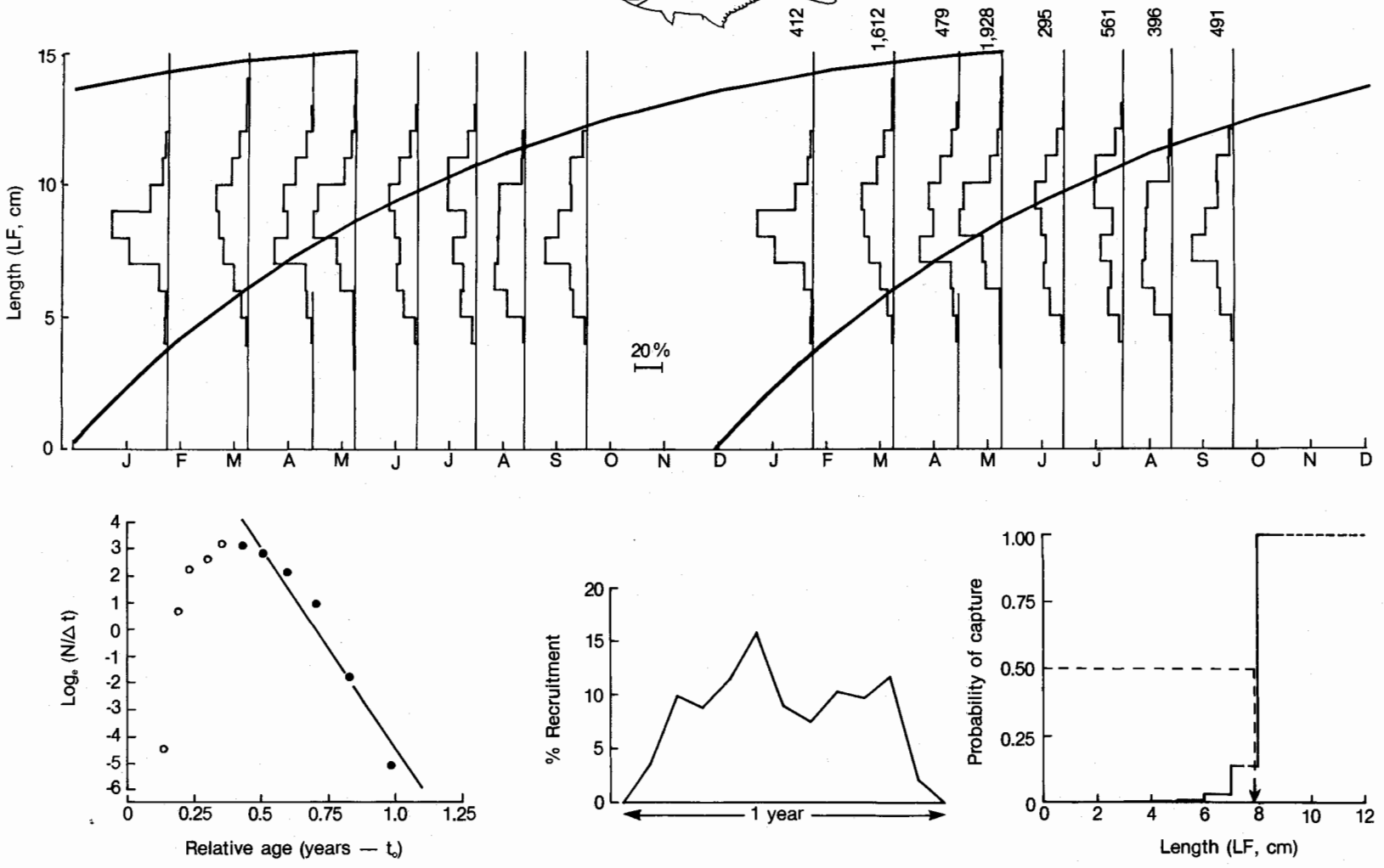


These length-frequency data originate from Arce, F. 1981. Distribution and relative abundance of nemipterids and carangids (Pisces: Nemipteridae and Carangidae) caught by trawl in Visayan Sea with notes on the biology of *Nemipterus oveniides* and *Selaroides leptolepis.* University of the Philippines, Quezon City. 67 p. M.Sc. thesis. They led to the parameter estimates: L_∞ = 25.5 cm, K = 0.42, L_c = 13.1 cm, Z = 1.52, M = 1.06 and E = 0.30. Annual recruitment appears to have been irregular. A detailed description of *N. oveniides* and other nemipterids may be found in Wongratana, T. 1972. Identification of *Nemipterus* in Thailand, p. 465-487. *In* Proceedings of the Second Cooperative Study of the Kuroshio and Adjacent Regions (CSK) Symposium, Tokyo.

Plate 81

Fam. Gerridae:
Pentaprion longimanus

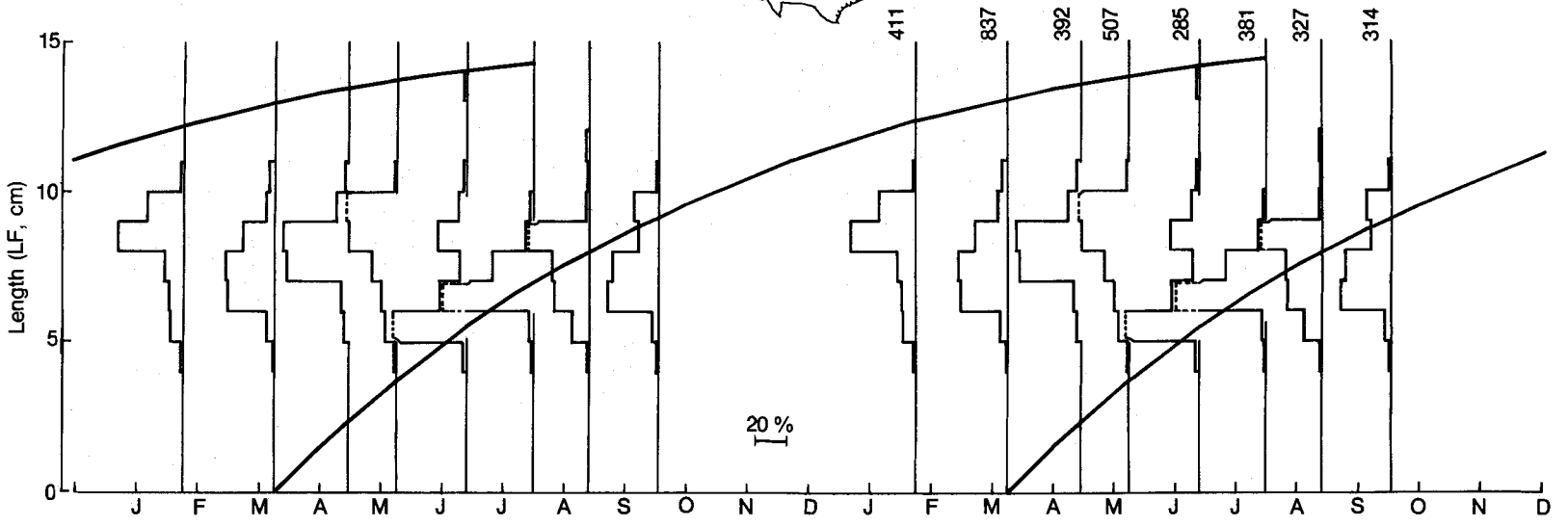
Carigara Bay, 1979-1980

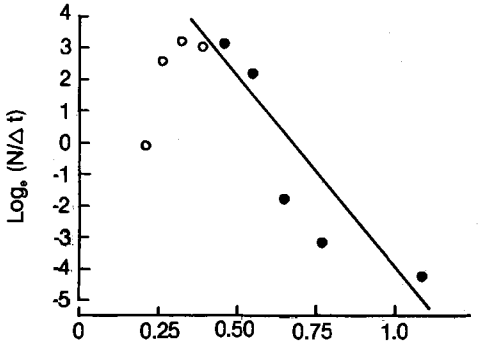


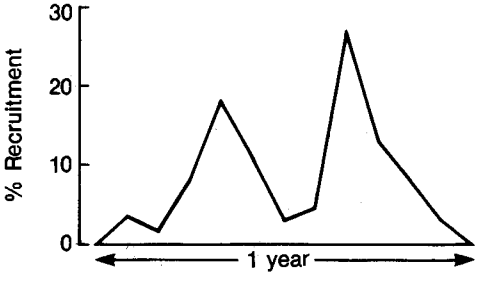
This set of length-frequency data was obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following statistics were estimated: L_∞ = 17.0 cm, K = 1.59, L_c = 7.9 cm, Z = 15.2, M = 2.83 and E = 0.81. No clear inference on the seasonality of this fish, including recruitment, can be made. The depth distribution and growth of this fish in the Java Sea are discussed in Beck, U. and A. Sudradjat. 1978. Variation in size and composition of demersal trawl catches from the north coast of Java with estimated growth parameters for three important food-fish species. Mar. Fish. Res. Rep. (Spec. Rep.)/Contrib. Demersal Fish. Proj., Jakarta 4: 1-80.

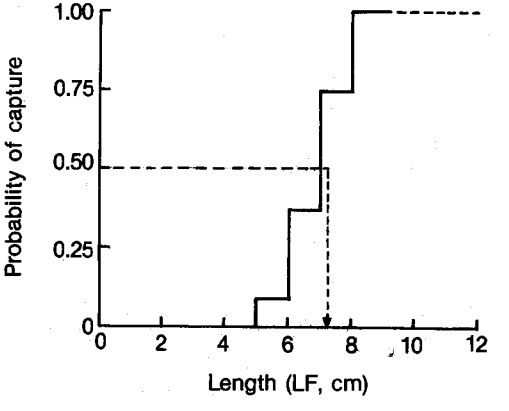
Fam. Gerridae
Pentaprion longimanus

Samar Sea, 1979-1980

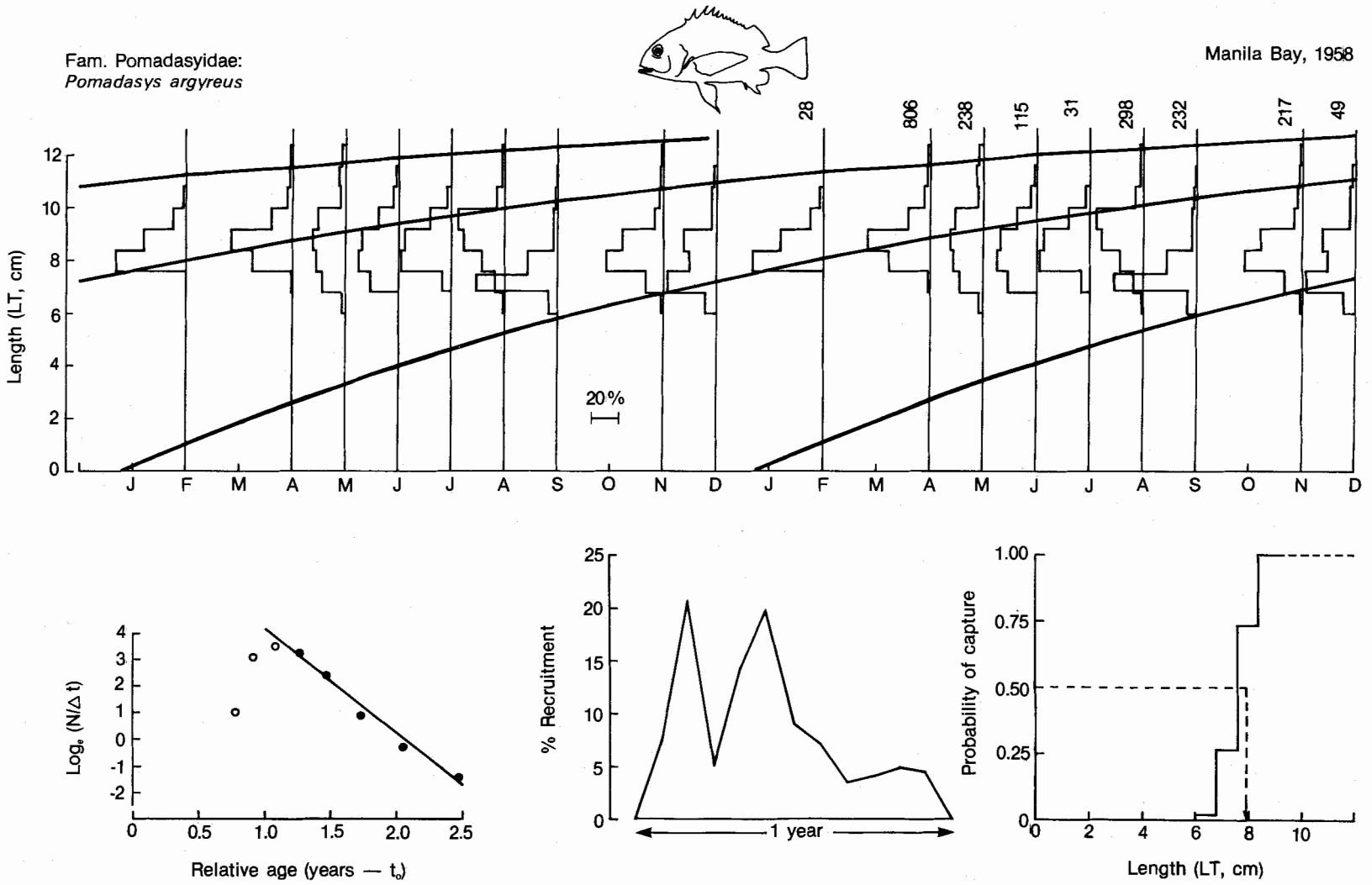








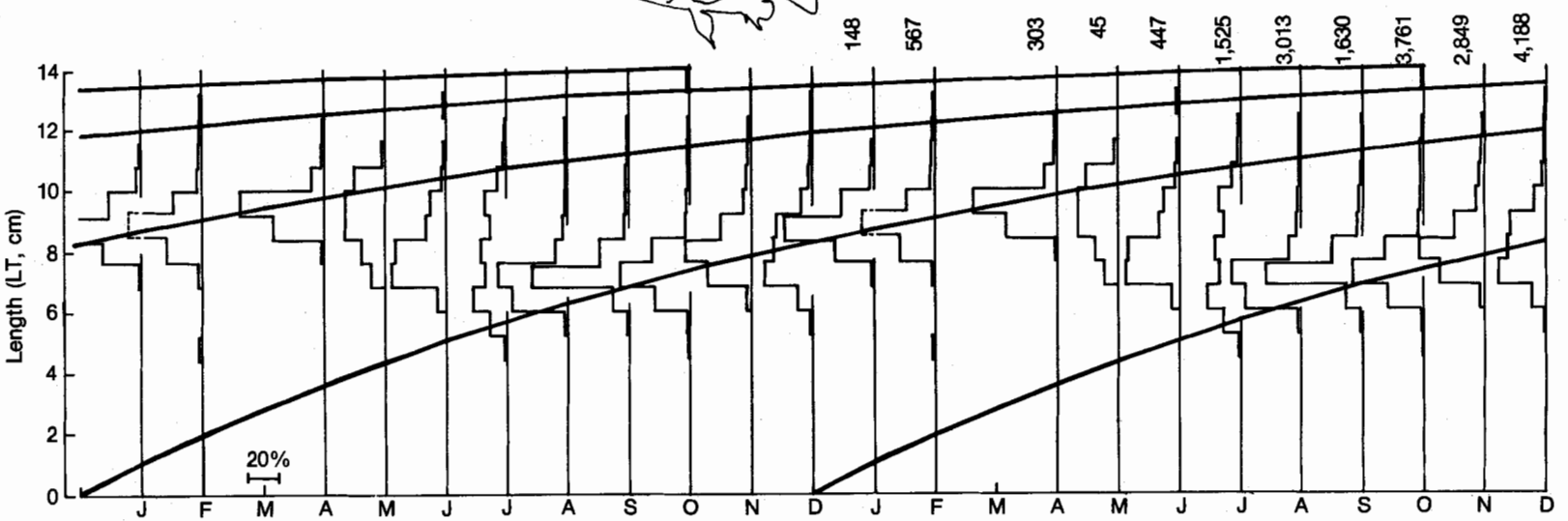
The length-frequency data analyzed here stem from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. From these, the following parameter values were obtained: L_∞ = 16.5 cm, K = 1.55, L_c = 7.4 cm, Z = 12.2, M = 2.81 and E = 0.77. Recruitment consisted of two well-separated pulses. *Pentaprion longimanus* in the Sunda Shelf area often forms the bulk of trawl catches at depths beyond 50 m; for an example of this see Pathansali, D., K.S. Ong, S.S. Latiff and J.L. Carvalho. 1967. Preliminary results of trawling investigations off Penang. Proc. Indo-Pac. Fish. Counc. 12(2): 181-201.

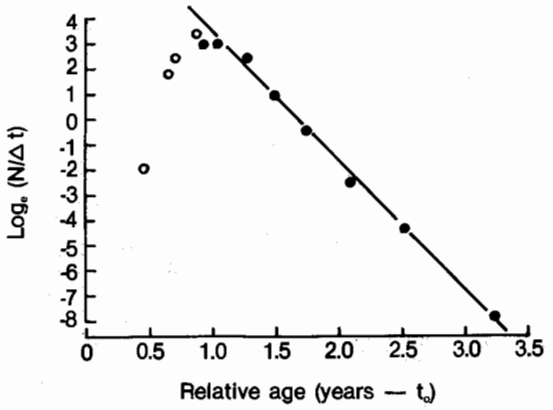


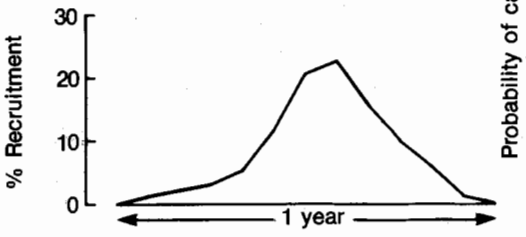
This set of length-frequency data, reported to pertain to bluecheek silver grunt, originates from the files of the Research Division, BFAR, Manila. These data led to the estimates: L_∞ = 13.6 cm, K = 0.78, L_c = 8.0 cm, Z = 3.90, M = 1.88 and E = 0.52. The recruitment pattern is too irregular to allow any inference of seasonality. The large discrepancy between the maximum recorded size in *P. argyreus* (40 cm) and the value of L_∞ obtained here suggests that this species may have been misidentified. For a detailed figure of this fish under the name *"Pristipoma argenteum"*, see Bleeker, P. 1873-1876. Atlas Ichthyologique des Indes Néerlandaise, Vol. 7 (plate 320, Fig. 4).

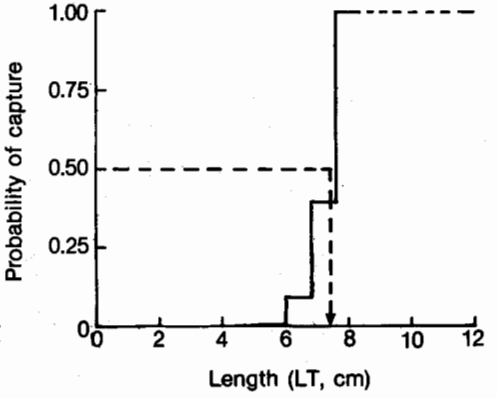
Fam. Pomadasyidae:
Pomadasys argyreus

Manila Bay, 1959



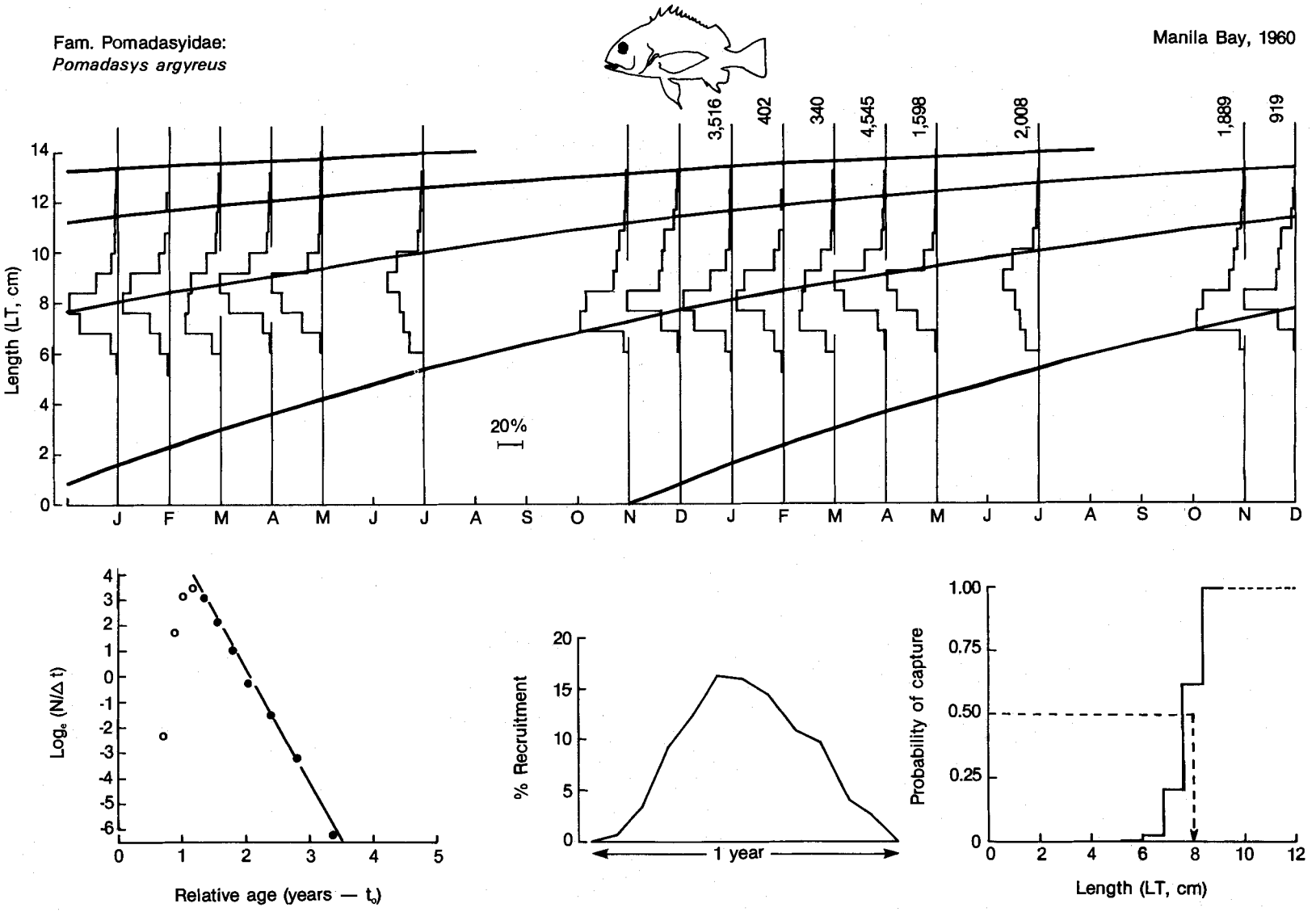






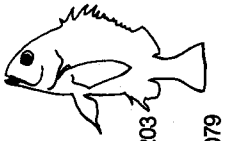
This set of length-frequency data, reported to pertain to bluecheek silver grunt, stems from the files of the Research Division, BFAR, Manila. The following parameter values were estimated: L_∞ = 14.2 cm, K = 0.83, L_c = 7.4 cm, Z = 5.08, M = 1.93 and E = 0.62. Annual recruitment appears to have consisted of two pulses, one much more important than the other. The large discrepancy between the maximum recorded size in *P. argyreus* (40 cm) and the value of L_∞ reported here suggests the possibility of this species having been misidentified. An exhaustive synonymy and Philippine records of *P. argyreus* are given in Herre, A.W. 1953. Check list of Philippine fishes. US Fish. Wildl. Serv. Res. Rep. 20. 977 p.

Plate 85

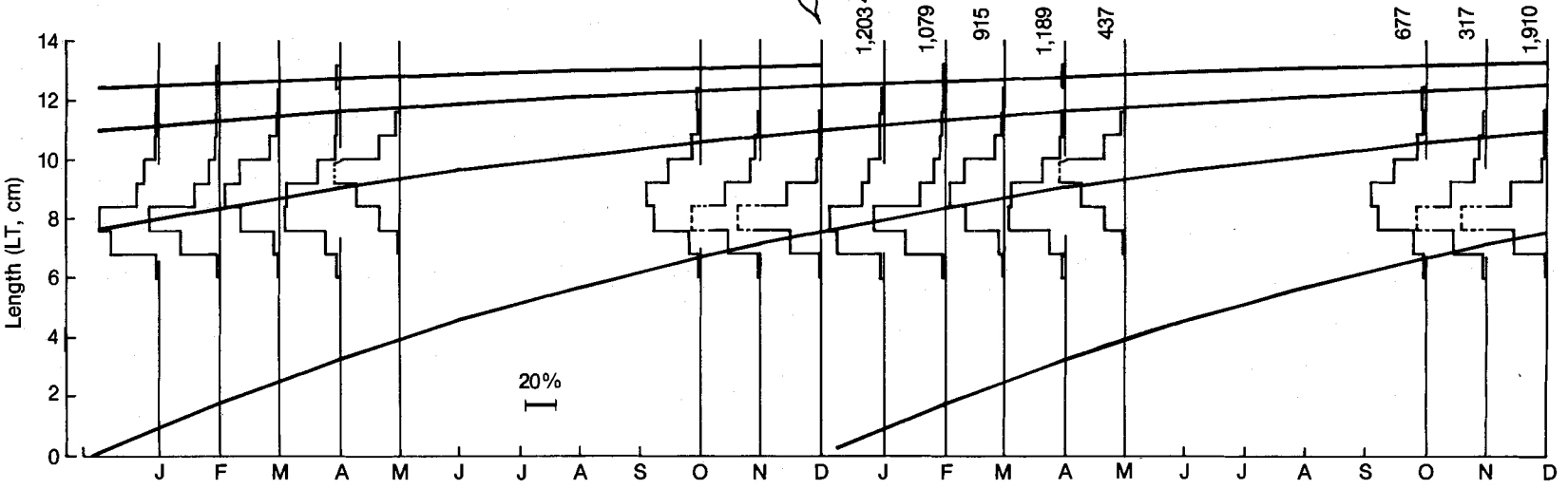


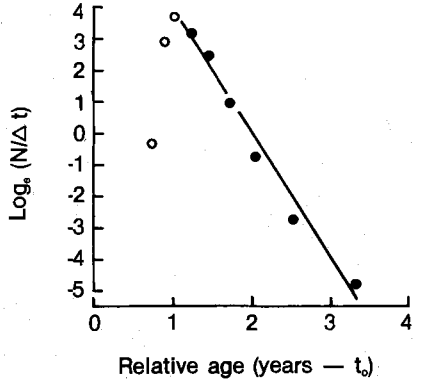
This set of length-frequency data, reportedly on bluecheek silver grunt, originates from the files of the Research Division, BFAR, Manila. From these data, the following parameter estimates were obtained: L_∞ = 15.1 cm, K = 0.62, L_c = 8.1 cm, Z = 4.50, M = 1.57 and E = 0.65. Annual recruitment may have consisted of a single, protracted event. The large discrepancy between the maximum recorded length of *P. argyreus* (40 cm) and the value of L_∞ reported here suggests the possibility of this species having been misidentified. A description of the type of habitat in which *P. argyreus* occurs and a list of associated species are given in Kailola, P.J. and M.A. Wilson. 1978. The trawl fishes of the Gulf of Papua. Dept. of Primary Industry Res. Bull. No. 20. 85 p. Port Moresby.

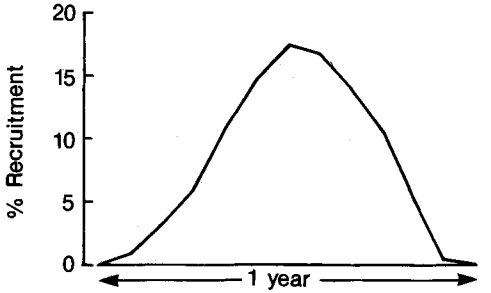
Fam. Pomadasyidae:
Pomadasys argyreus

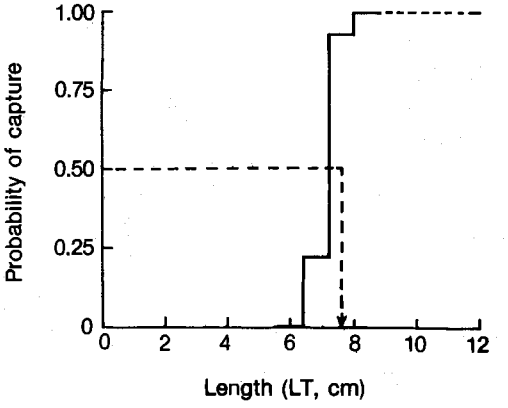


Manila Bay, 1961



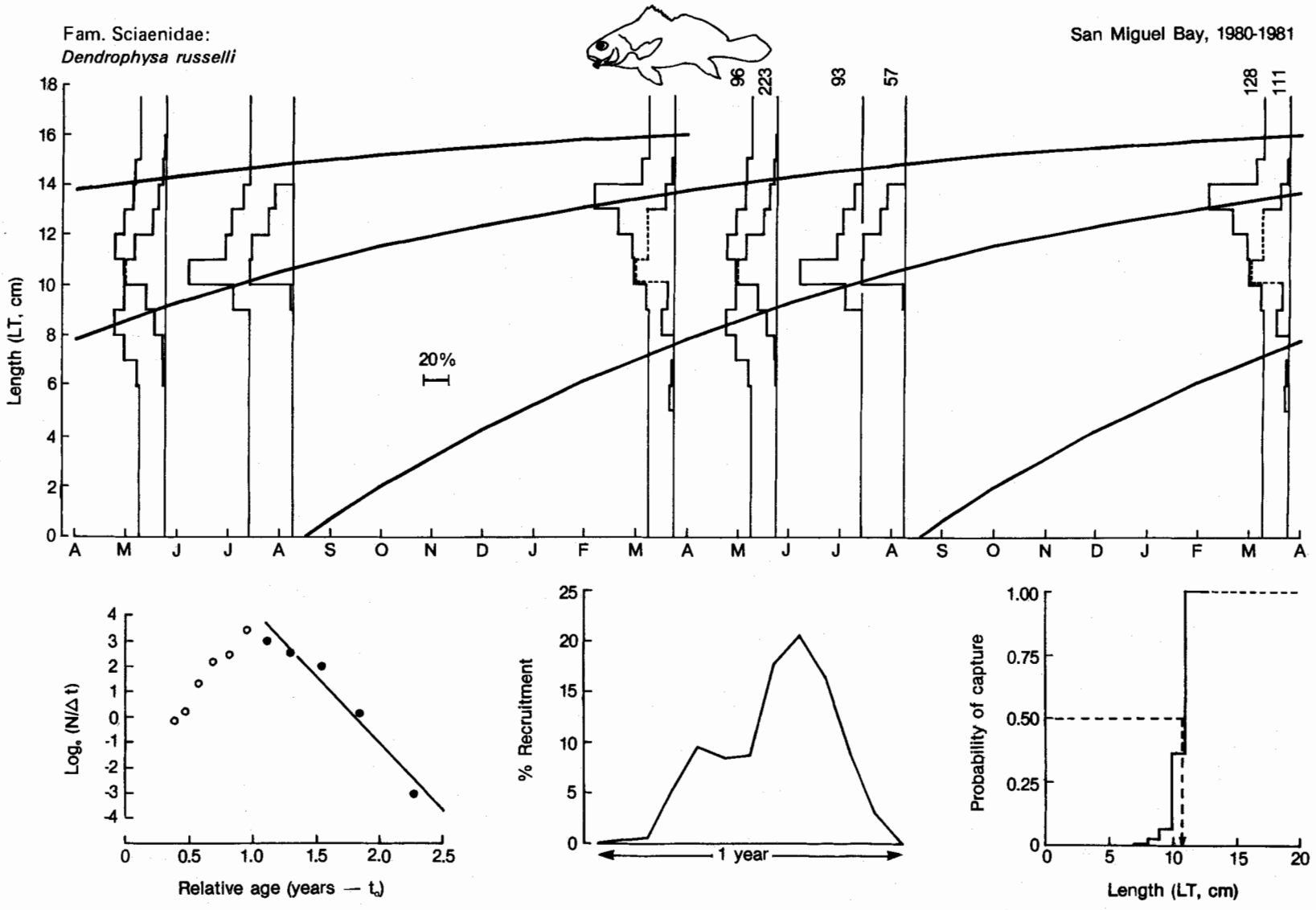






This set of length-frequency data, reportedly on bluecheek silver grunt, stems from the files of the Research Division, BFAR, Manila. The data allowed the estimation of the following parameter values: L_∞ = 12.9 cm, K = 0.81, L_c = 7.5 cm, Z = 3.94, M = 1.94 and E = 0.51. Annual recruitment seems to have occurred in the form of a single protracted pulse. The large discrepancy between the maximum recorded size of *P. argyreus* (40 cm) and the value of L_∞ reported here suggests the possibility of this species having been misidentified. Information on the distribution of this species and aids for identification may be found in McKay, R.J. 1974. Haemulidae. *In* W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean (fishing area 51). Vol. 2. (var. pag.) FAO, Rome.

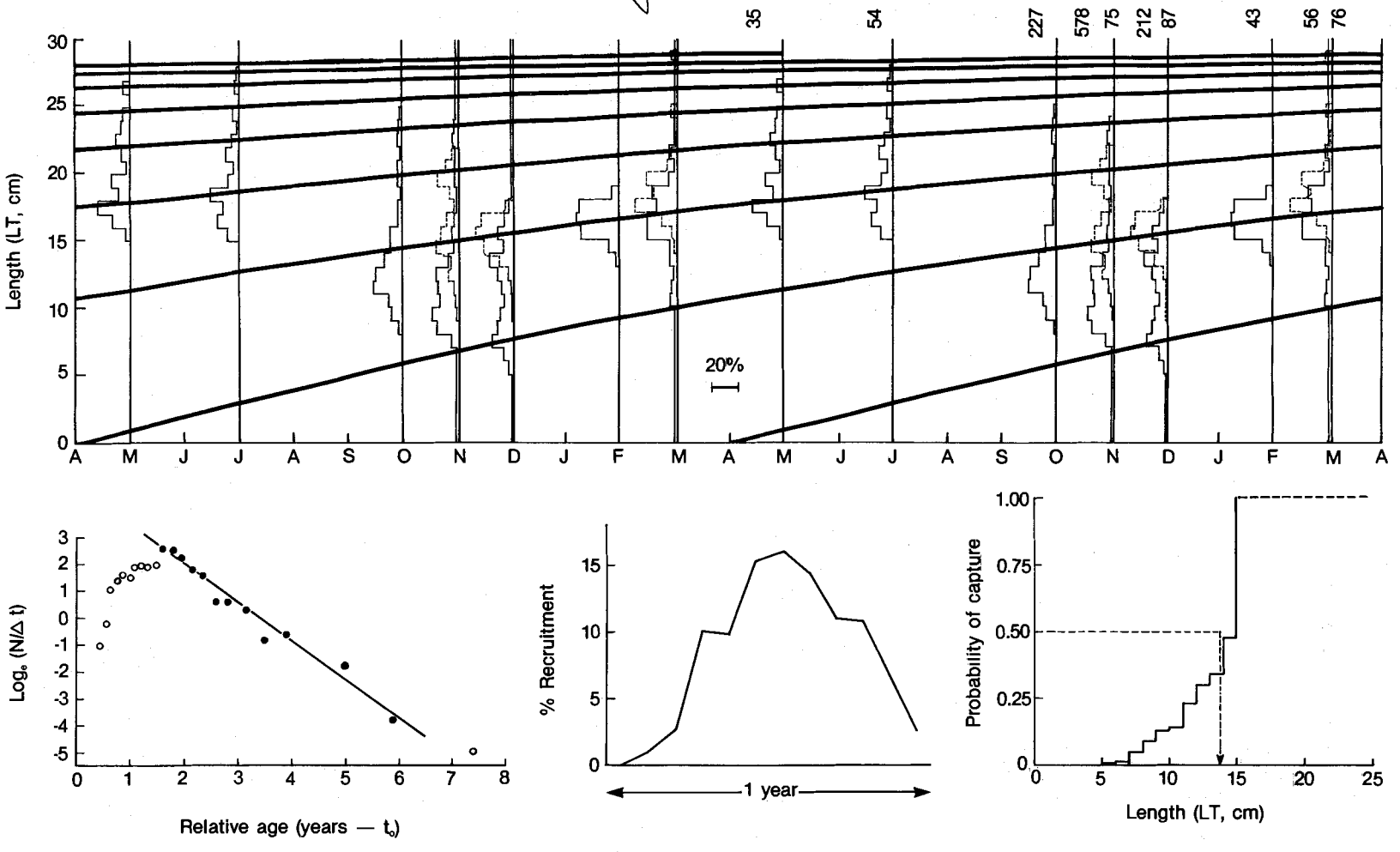
Plate 87



The length-frequency data were collected in the frame of the multidisciplinary San Miguel Bay Project between the International Center for Living Aquatic Resources Management and the University of the Philippines (College of Fisheries). The following parameter estimates were obtained: L_∞ = 17.5 cm, K = 0.95, L_c = 10.8 cm, Z = 5.32, M = 2.01 and E = 0.62. Annual recruitment consisted of two pulses. Some biological notes and a complete description of this fish are given in Chan, W., U. Bathia, D. Carlson and E. Trewavas. 1974. Sciaenidae. *In* W. Fischer and P.J.P. Whitehead (eds.) FAO species identification sheets for fishery purposes. Eastern Indian Ocean (fishing area 57) and Western Central Pacific (fishing area 71). Vol. 3. (var. pag.) FAO, Rome.

Fam. Sciaenidae:
Otolithes ruber

San Miguel Bay, 1958-1961

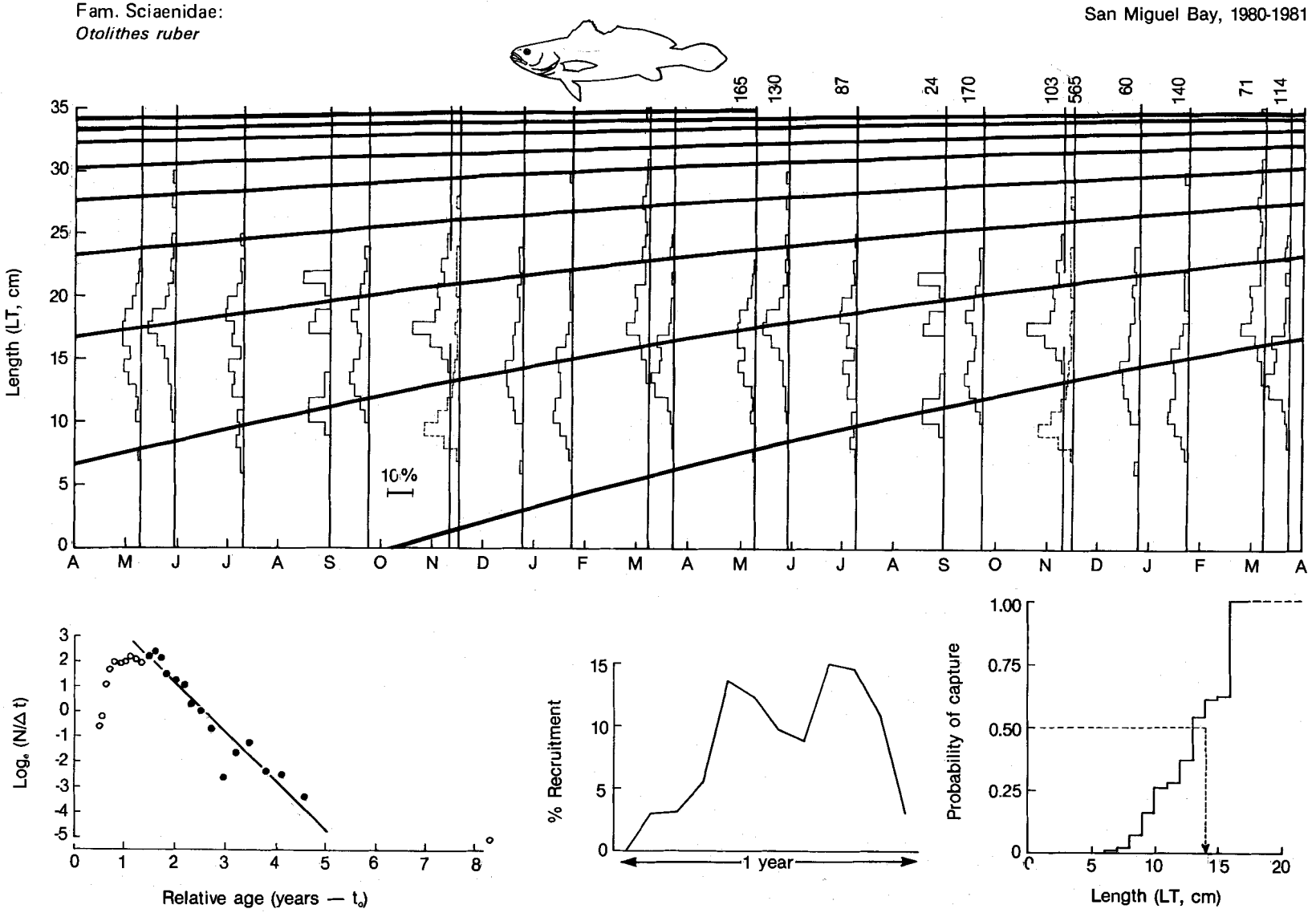


The length-frequency data on the tiger-toothed croaker ("abo") presented here were extracted from the files of the Research Division, BFAR, Manila. They suggest L_∞ = 29.5 cm, K = 0.455, L_c = 13.7 cm, Z = 1.46, M = 1.07 and E = 0.27 (see also legend of plate 89). Recruitment seems to have occurred as a single, protracted pulse. The value of L_∞ given above is probably an underestimate, as these fish reach sizes of up to 70 cm. This and other additional information may be found in van der Elst, R. 1981. A guide to the common sea fishes of Southern Africa. C. Struik, Cape Town.

Plate 89

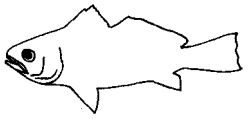
Fam. Sciaenidae:
Otolithes ruber

San Miguel Bay, 1980-1981

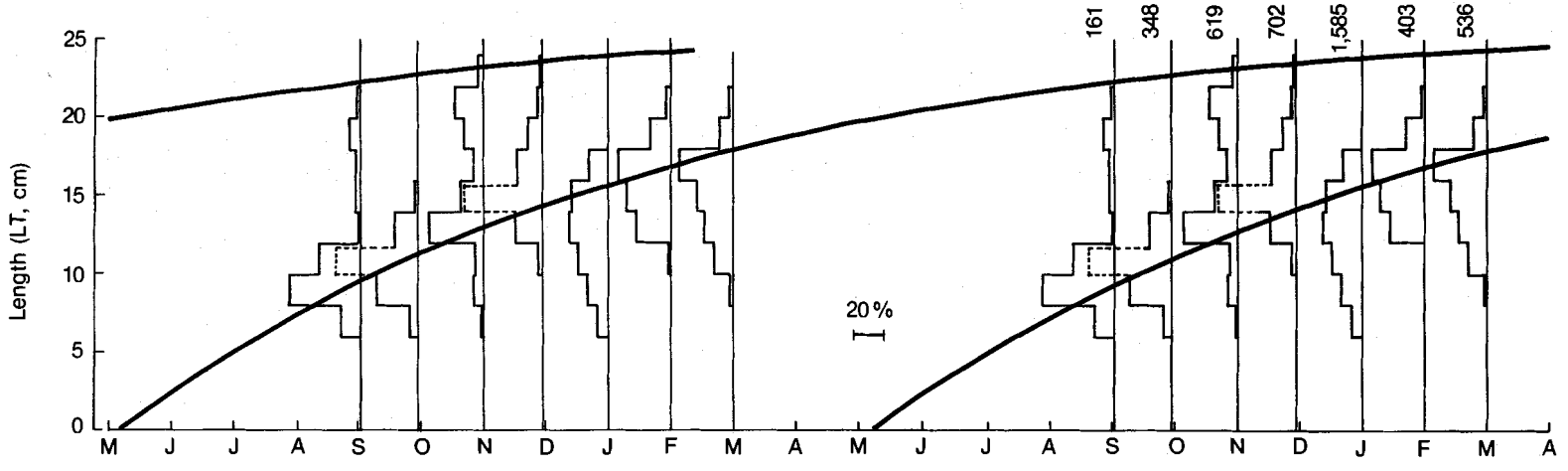


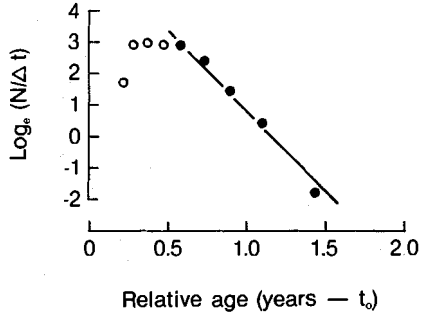
The length-frequency data presented here were collected in the frame of a multidisciplinary San Miguel Bay Project between the International Center for Living Aquatic Resources Management and the University of the Philippines (College of Fisheries). The data led to the estimates: L_∞ = 35.5 cm, K = 0.43, L_c = 13.9 cm, Z = 1.95, M = 0.98 and E = 0.50. Recruitment appears to have occurred in two pulses of similar strength. The value of L_∞ given above is probably an underestimate, as this fish is known to reach much larger sizes. The reason for this underestimation and a comprehensive account of this fish are given in Navaluna, N.A. 1983. Morphometrics, biology and population dynamics of the croaker fish, *Otolithes ruber*, p. 35-55. *In* D. Pauly and A.N. Mines (eds.) Small-scale fisheries of San Miguel Bay, Philippines: biology and stock assessment. ICLARM Technical Reports 7, 124 p. Institute of Fisheries Development and Research, College of Fisheries, University of the Philippines in the Visayas, Quezon City, Philippines; International Center for Living Aquatic Resources Management, Manila, Philippines and the United Nations University, Tokyo, Japan.

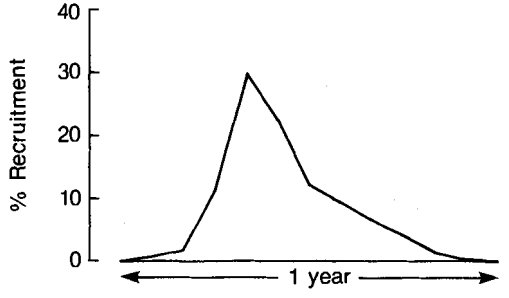
Fam. Sciaenidae:
Pennahia macrophthalmus

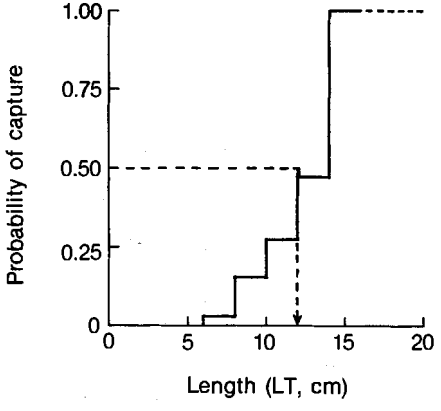


Manila Bay, 1978-1979





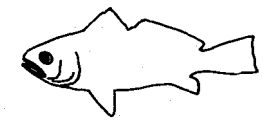




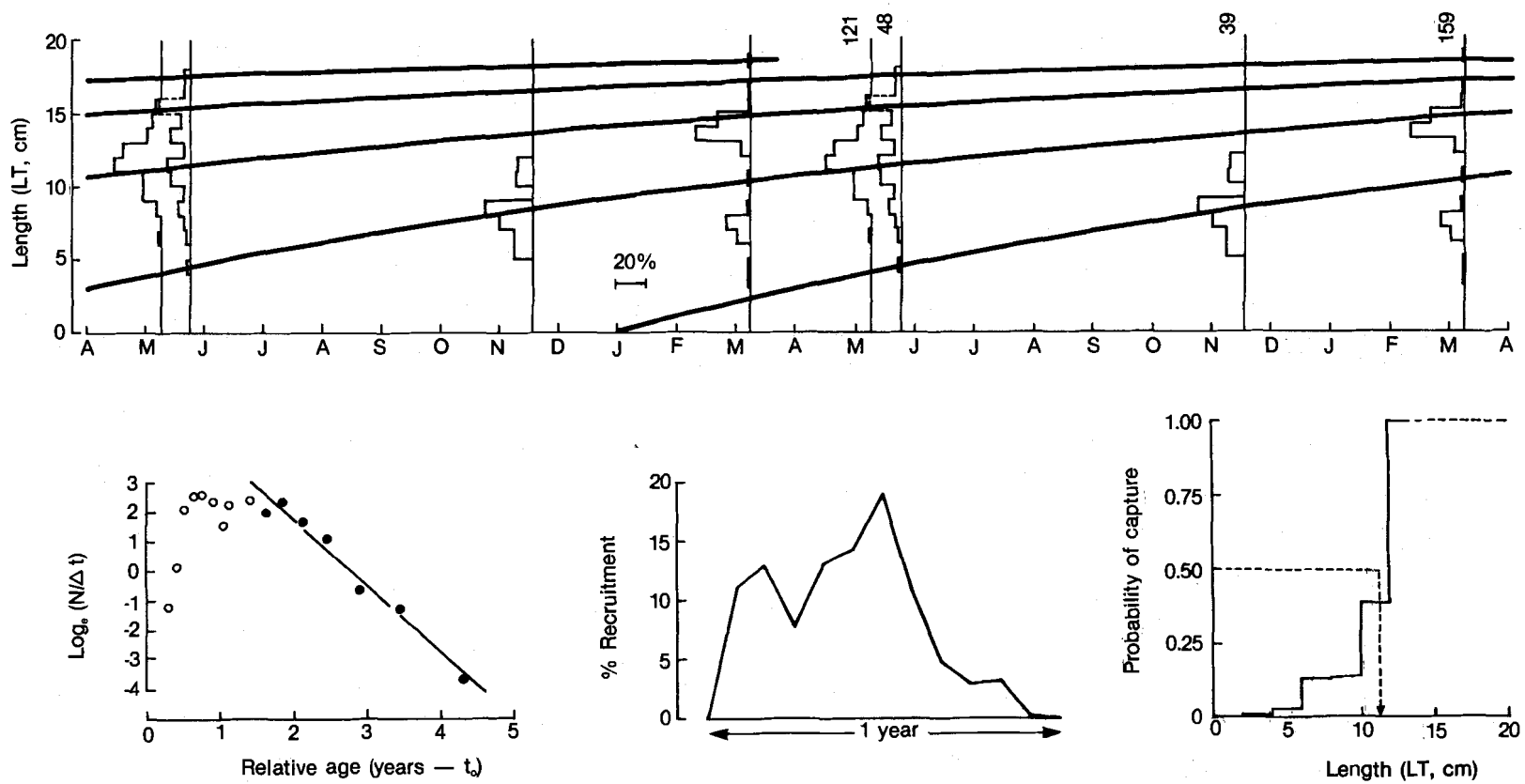
The set of length-frequency data on bigeye croaker, *P. macrophthalmus* (= *P. aneus*), was collected by Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. They led to the following parameter estimates: L_∞ = 26.5 cm, K = 1.40, L_c = 13.1 cm, Z = 5.55, M = 2.30 and E = 0.58. Annual recruitment may have consisted of two pulses, one much stronger than the other. For some additional information, including a detailed description, see Lal-Mohan, R.S., E. Trewavas and P.J.P. Whitehead. 1984. Sciaenidae. *In* W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean (fishing area 51). Vol. 4. (var. pag.) FAO, Rome.

Plate 91

Fam. Sciaenidae:
Pennahia macrophthalmus



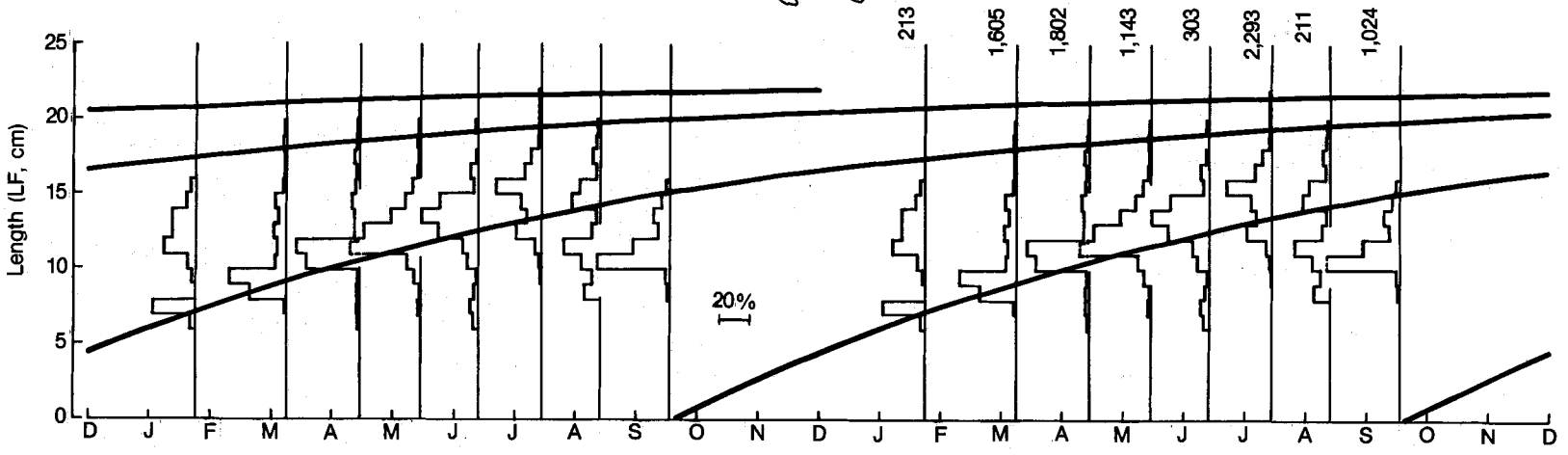
San Miguel Bay 1980-1981

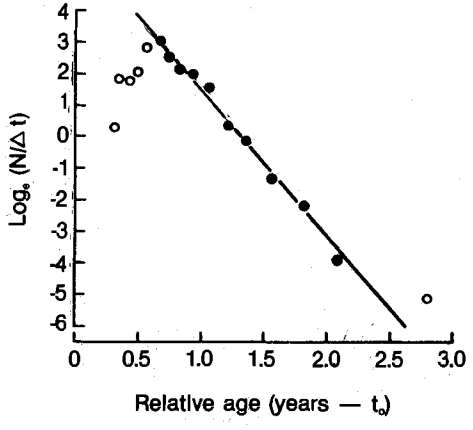


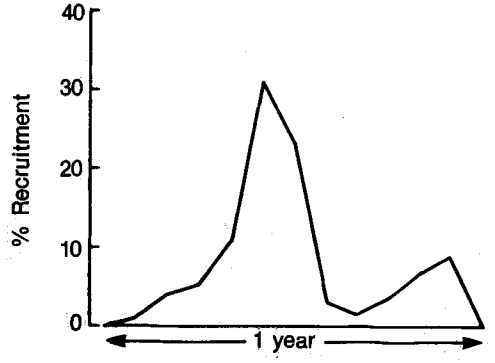
This set of length-frequency data was collected in the frame of the multidisciplinary San Miguel Bay Project between the International Center for Living Aquatic Resources Management and the University of the Philippines (College of Fisheries). (E. Cinco and N.A. Navaluna, pers. comm.) These (rather scanty) data led to the following statistics: L_∞ = 20.0 cm, K = 0.60, L_c = 11.2 cm, Z = 2.28, M = 1.43 and E = 0.37. Recruitment appears irregular, but may have consisted of two seasonal pulses. A length-weight relationship for the San Miguel Bay stock of *P. macrophthalmus* has been computed, based on fish ranging from 7.5 to 17 cm by Cinco, E. 1983. Length-weight relationships of fishes, p. 34-37. *In* D. Pauly and A.N. Mines (eds.) Small-scale fisheries of San Miguel Bay, Philippines: biology and stock asssessment. ICLARM Technical Reports 7, 124 p. Institute of Fisheries Development and Research, College of Fisheries, University of the Philippines in the Visayas, Quezon City, Philippines; International Center for Living Aquatic Resources Management, Manila, Philippines and the United Nations University, Tokyo, Japan.

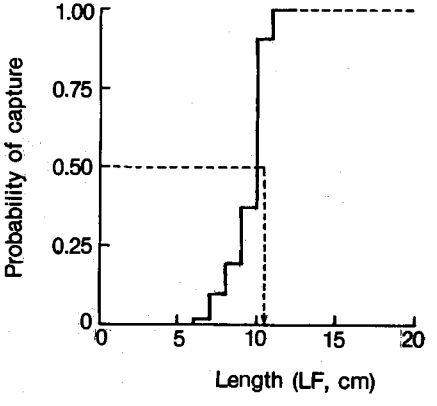
Fam. Mullidae:
Upeneus moluccensis

Samar Sea, 1979-1980



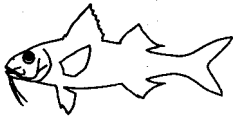




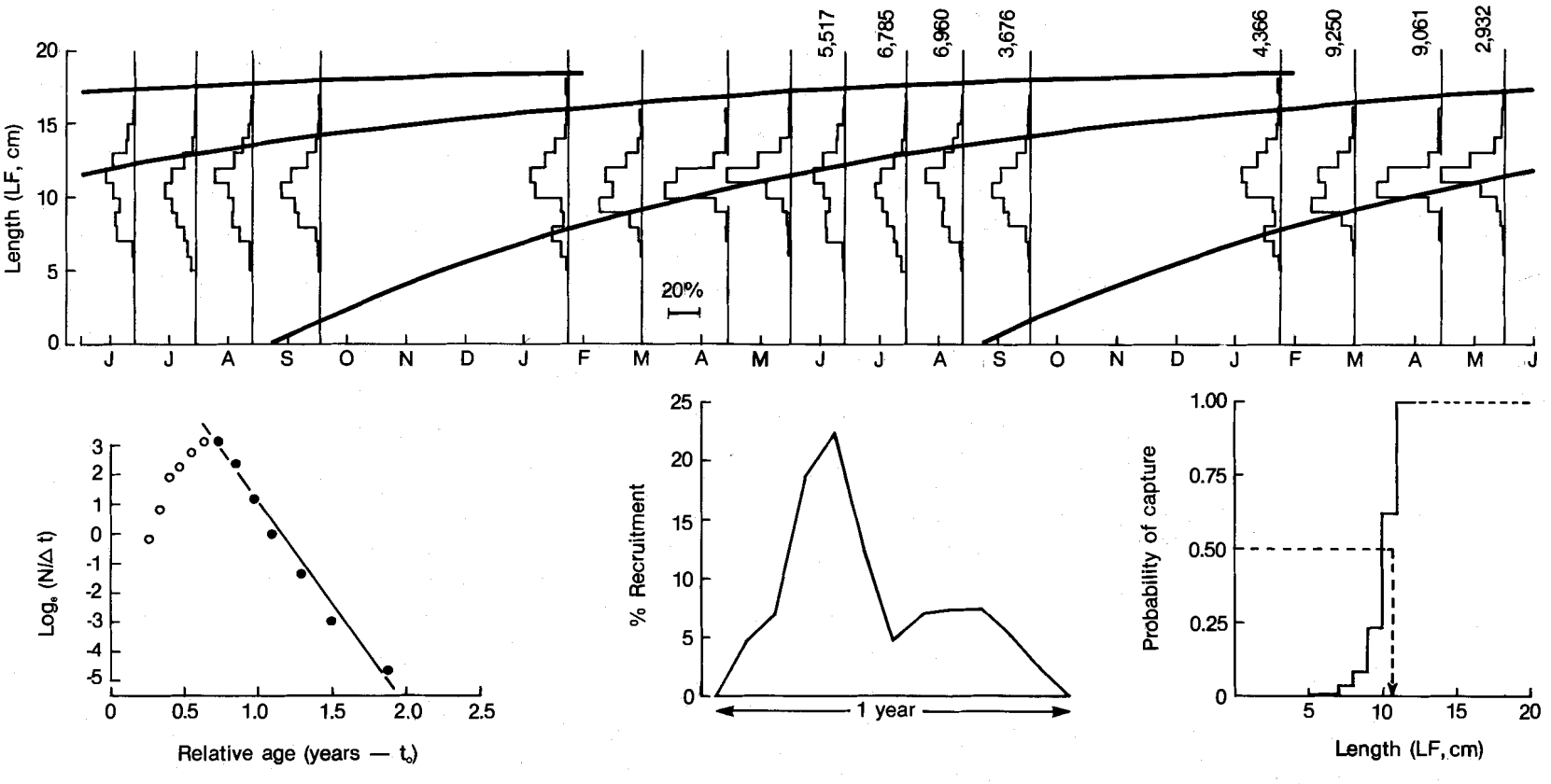


The length-frequency data used here were collected by Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. From these data, the following parameter values were estimated: L_∞ = 22.5 cm, K = 1.10, L_c = 10.3 cm, Z = 4.02, M = 2.06 and E = 0.49. Annual recruitment occurred in two well-separated pulses. Additional information on biology and population dynamics of the goldband goatfish may be found in Lee, C.K.C. 1974. The reproduction, growth and survival of *Upeneus moluccensis* (Bleeker) in relation to the commercial fisheries in Hongkong. Hongkong Fish. Bull. 4: 17-32.

Fam. Mullidae:
Upeneus sulphureus



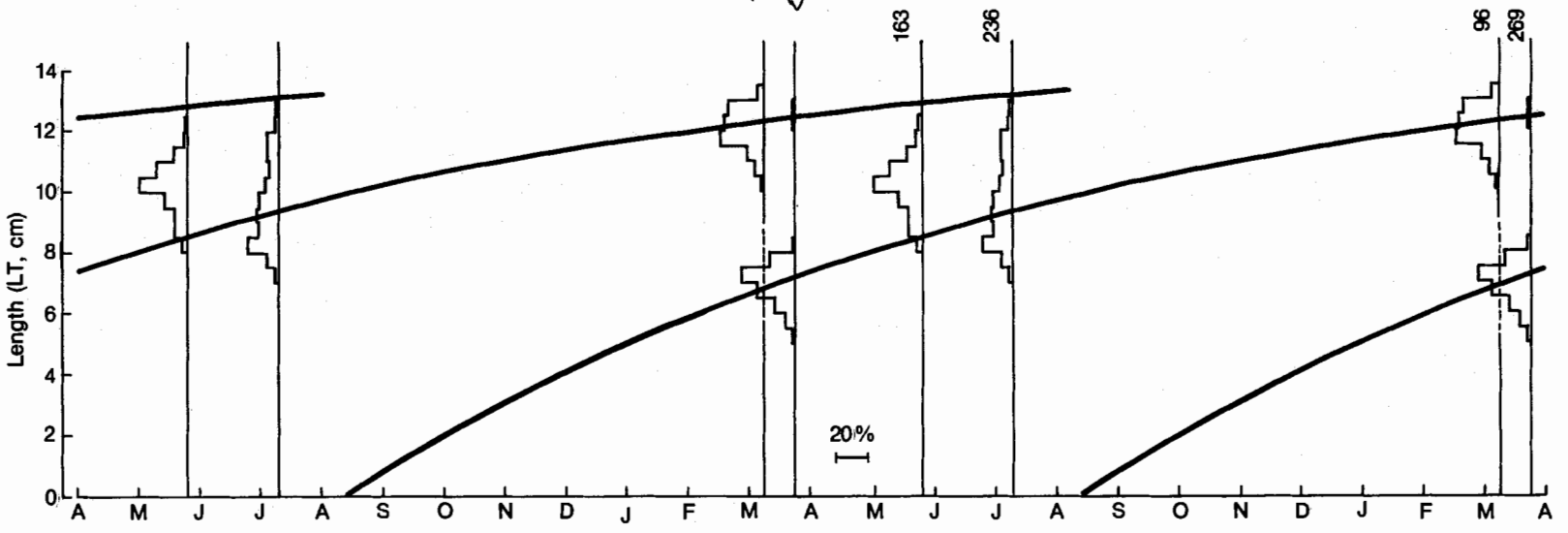
Samar Sea, 1979-1980

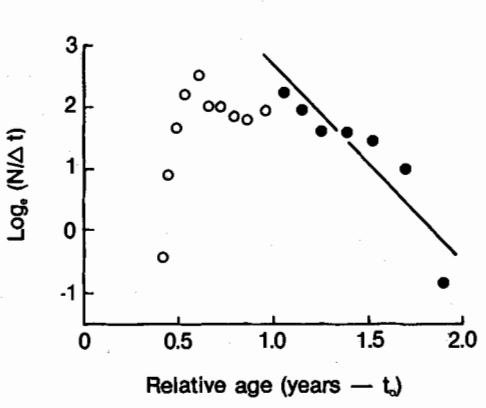


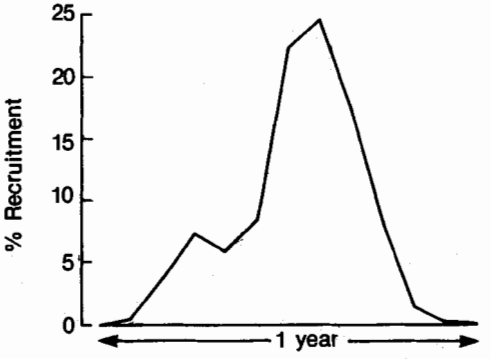
This set of length-frequency data on yellow goatfish was obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following statistics were estimated: L_∞ = 19.5 cm, K = 1.20, L_c = 10.5 cm, Z = 6.96, M = 2.27 and E = 0.67. Annual recruitment occurred as two well separated pulses. The selection factor of and related information on *U. sulfureus* and other fishes are given in Table 2.2 of Jones, R. 1976. Mesh size regulation in the demersal fisheries of the South China Sea. SCS/76/WP/34. 75 p. South China Sea Fisheries Development and Coordinating Programme, Manila.

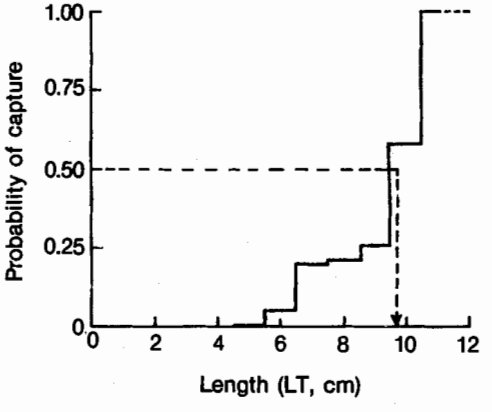
Fam. Mullidae:
Upeneus sulphureus

San Miguel Bay, 1980-1981





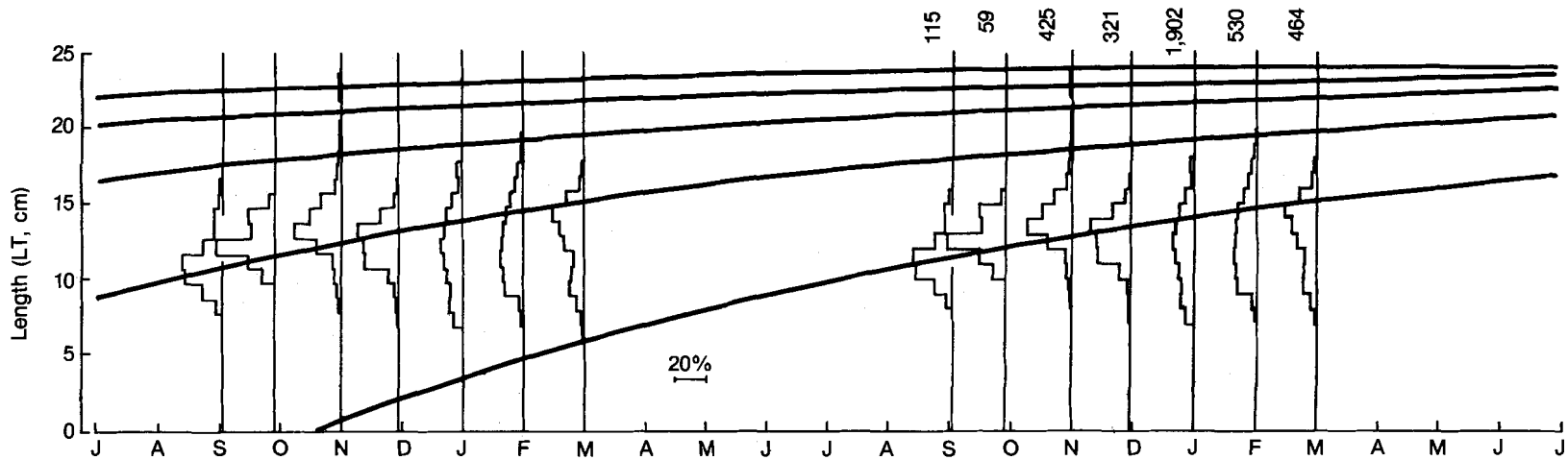


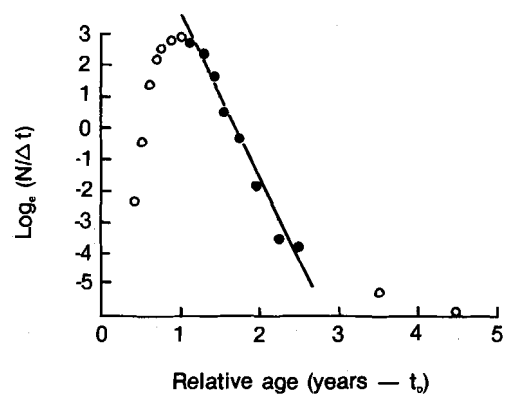


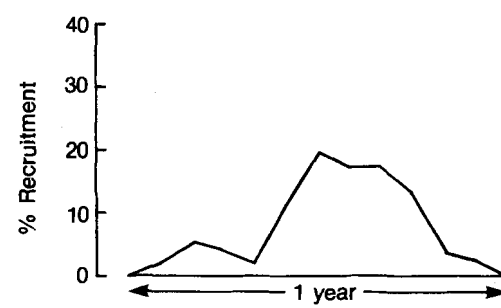
The scanty length-frequency data presented here were collected in the frame of the multidisciplinary San Miguel Bay Project between the International Center for Living Aquatic Resources Management and the University of the Philippines (College of Fisheries). The following parameter values were estimated: L_∞ = 15.3 cm, K = 1.05, L_c = 9.7 cm, Z = 3.18, M = 2.23 and E = 0.30. Annual recruitment occurred in two well identifiable pulses. A spectacular photo of a school of yellowstriped goatfish may be found in Bagnis, R., P. Mazellier, J. Bennet and E. Christian. 1972. Fishes of Polynesia. Les Edition du Pacifique, Tahiti.

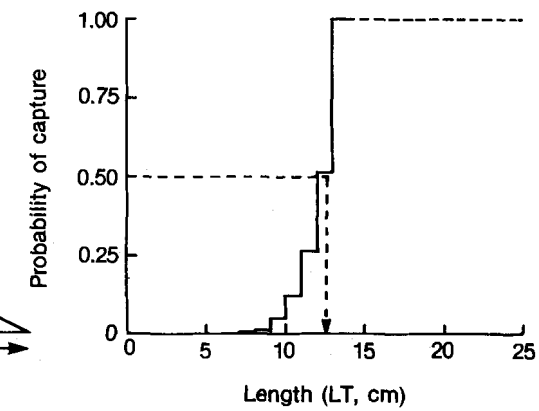
Fam. Mullidae:
Upeneus vittatus

Manila Bay, 1978-1979





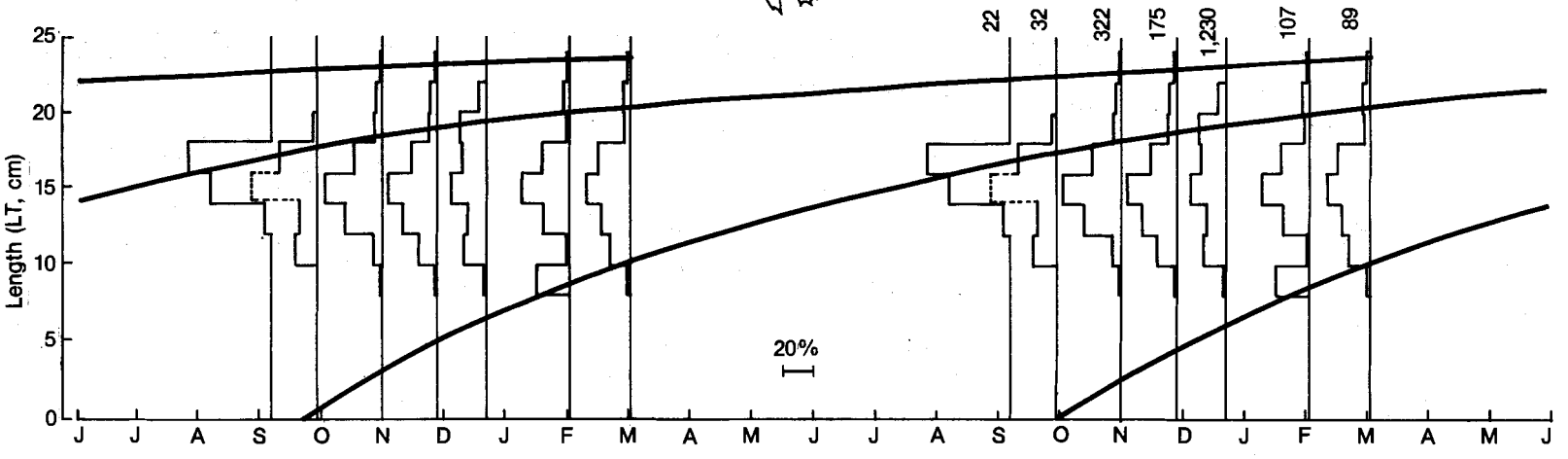


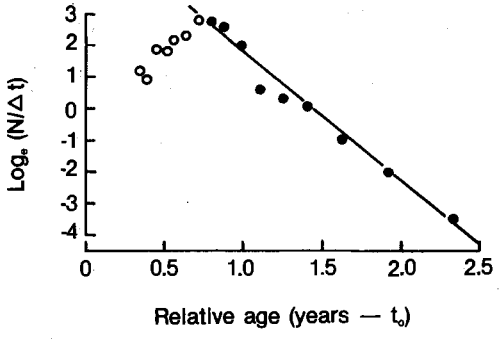


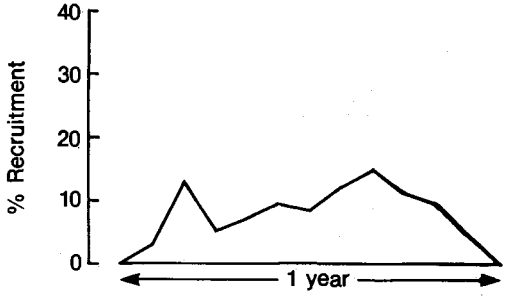
The length-frequency data available here on yellowstriped goatfish were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The following parameter estimates were obtained from these data: L_∞ = 24.5 cm, K = 0.71, L_c = 12.5 cm, Z = 5.18, M = 1.51 and E = 0.71. Annual recruitment consisted of two well separated pulses. Additional data on *U. vittatus* may be found in Gopinath, K. 1946. Notes on the larval and postlarval stages of fishes found along the Trivandrum Coast. Proc. Nat. Inst. Sci. India 12(1): 7-21.

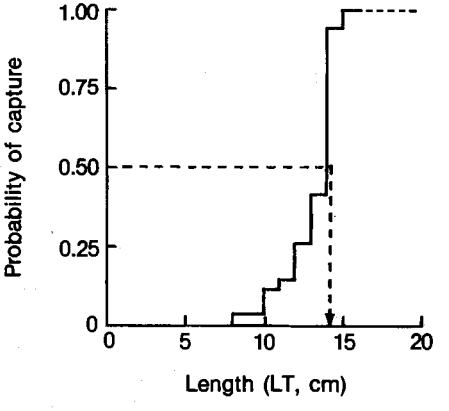
Fam. Scatophagidae:
Scatophagus argus

Manila Bay, 1978-1979





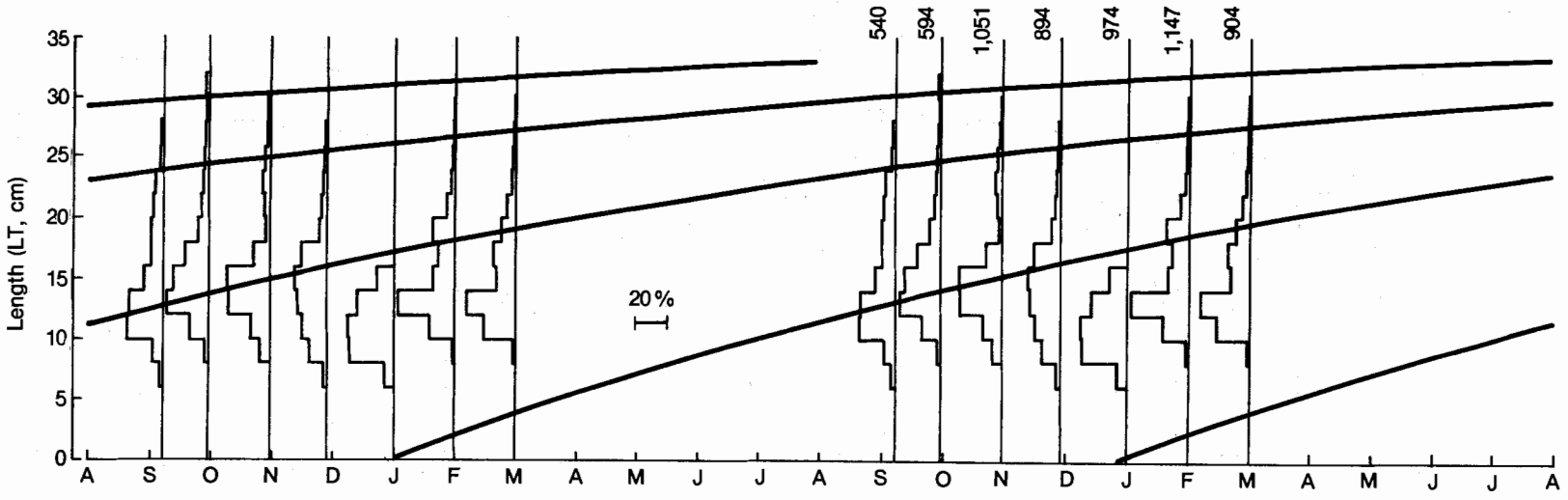


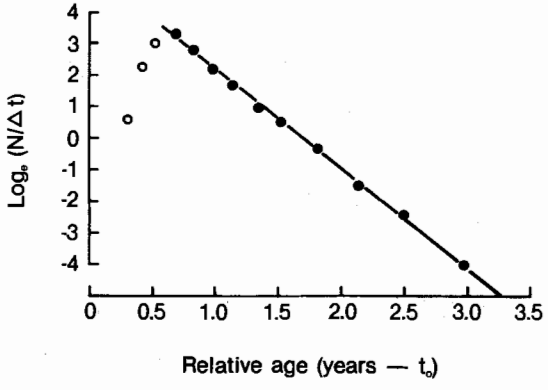


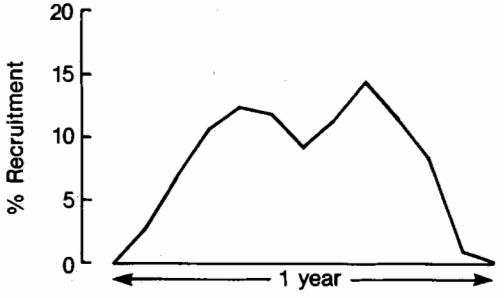
The data presented here stem from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. These length-frequency data led to the following parameter estimates: L_∞ = 25.0 cm, K = 1.20, L_c = 14.0 cm, Z = 4.12, M = 2.12 and E = 0.49. Recruitment appeared to be irregular. Information on the reproduction of *S. argus* and other fishes may be found in Bal, D.V. and L.B. Pradhan. 1951. Occurrence of fish larvae and postlarvae in Bombay waters during 1944-1947. J. Univ. Bombay, New Ser. 20B: 1-15.

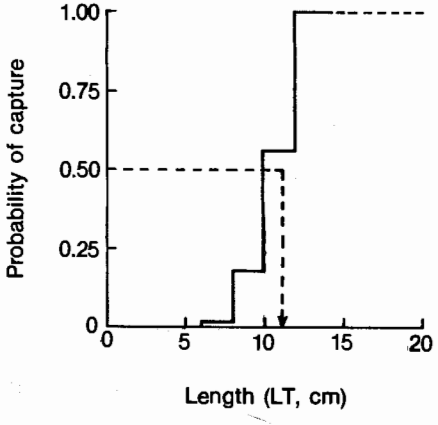
Fam. Mugilidae:
Liza subviridis

Manila Bay, 1978-1979





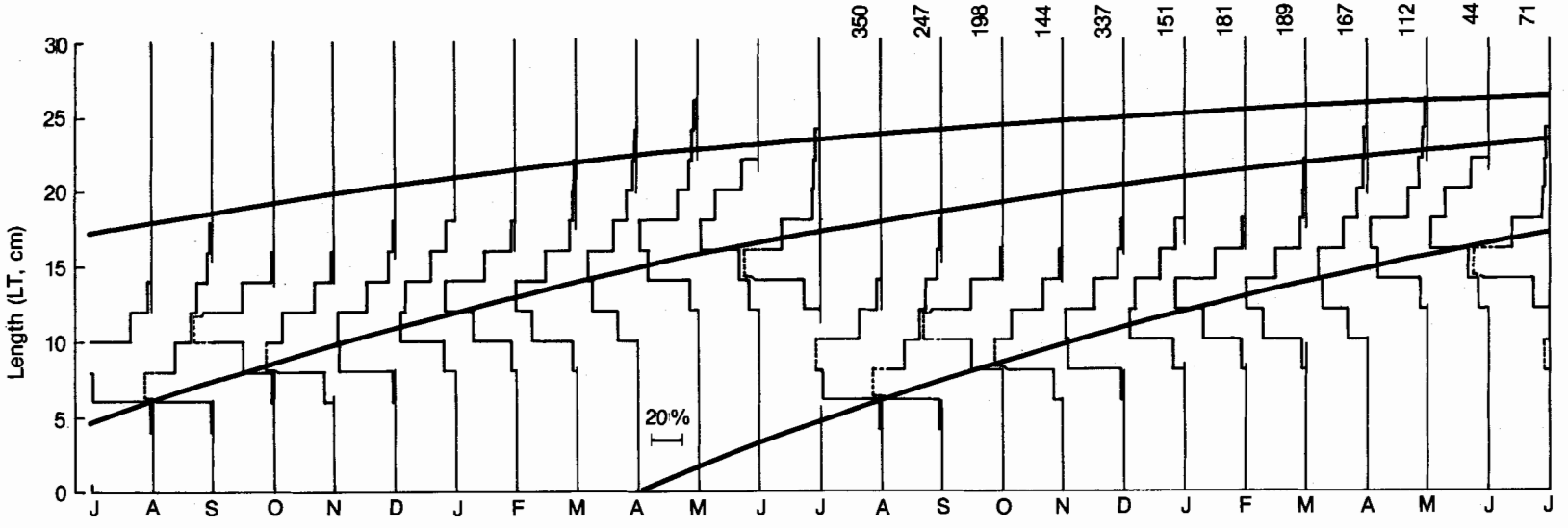


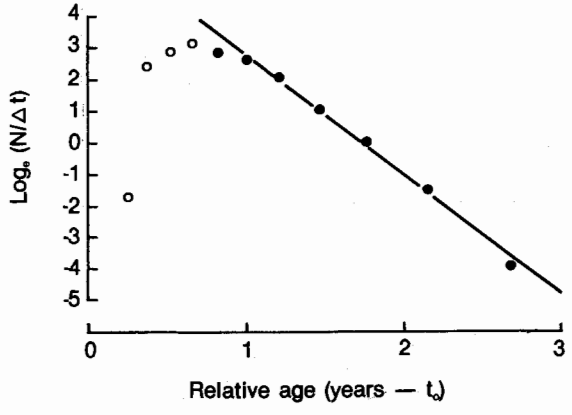


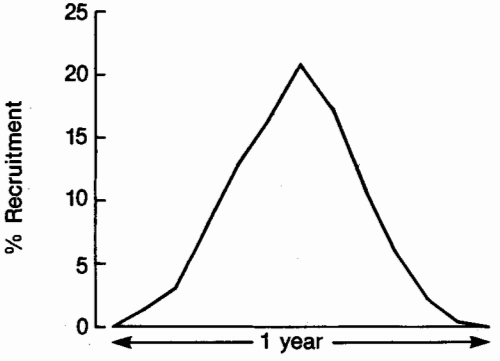
The length-frequency data presented here were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. These data led to the following parameter estimates: L_∞ = 36.5 cm, K = 0.63, L_c = 11.2 cm, Z = 3.19, M = 1.25 and E = 0.61. Annual recruitment clearly appears to have been generated in two pulses of similar strength. A review of the literature on grey mullet, which includes information on *L. subviridis* (= *L. dussumieri*) is given by Thomson, J.M. 1966. The grey mullets. Oceanogr. Mar. Biol. Ann. Rev. 4: 301-335.

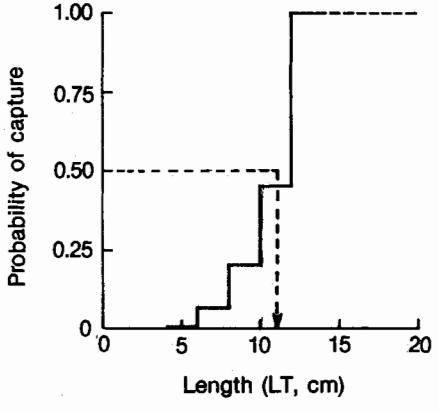
Fam. Gobiidae:
Glossogobius giurus

Cardona, Laguna de Bay,
1958-1959





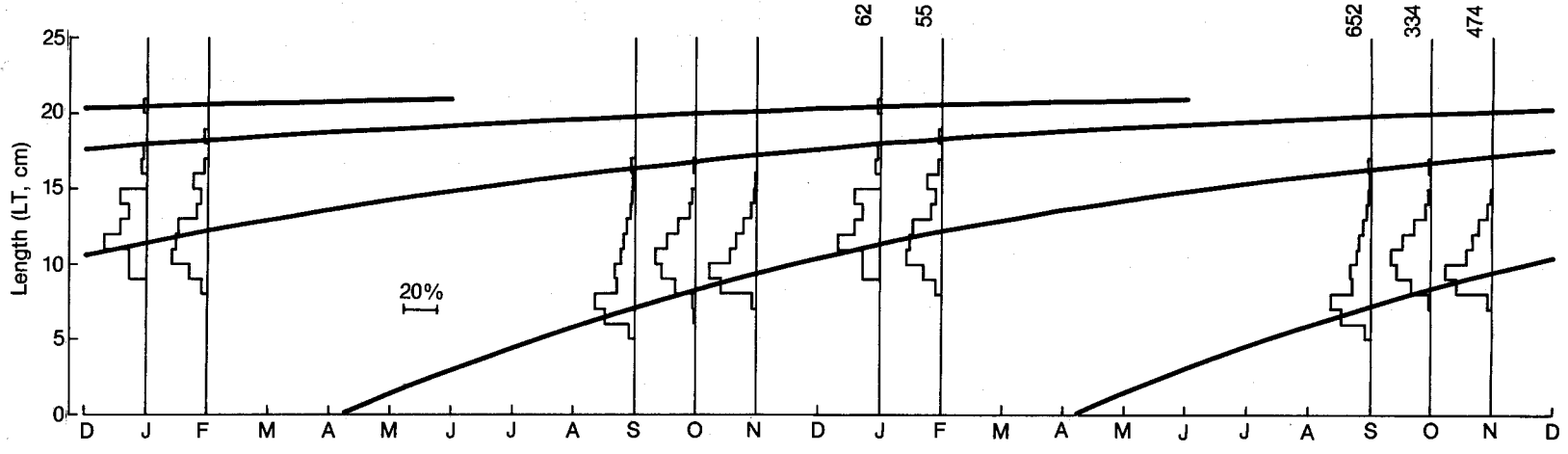


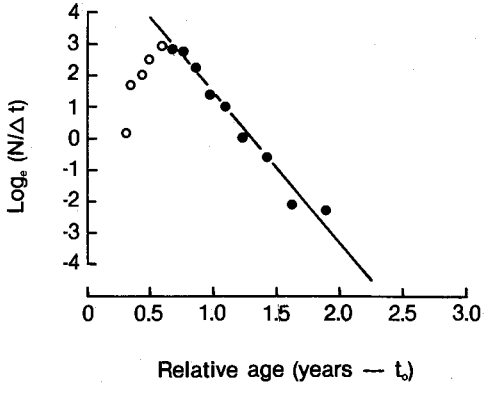


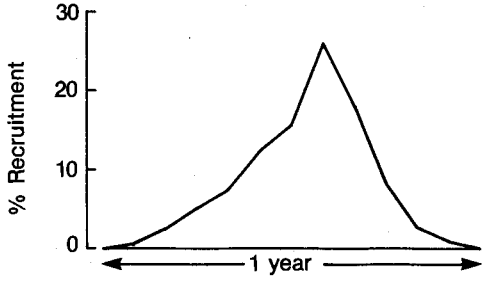
The length-frequency data presented here had previously been published in Marquez, J. 1960. Age and size at sexual maturity of goby, *Glossogobius giurus,* a common species of fish of Laguna de Bay, with notes on its food habits. Philipp. J. Fish. 8(1): 71-89. As analyzed here, they yielded the following parameter values: L_∞ = 29.5 cm, K = 0.70, L_c = 11.3 cm, Z = 3.77, M = 1.42 and E = 0.62. Recruitment appears to have consisted of a single, protracted pulse. For a classic account of the taxonomy of Philippine gobies, including *G. giurius,* see Herre, A.W. 1927. Gobies of the Philippines and the China Sea. Philipp. Bur. Sci. Monogr. Publ. Fishes No. 23, 352 p. (Reprinted 1965 by TFH for the Smithsonian Inst.)

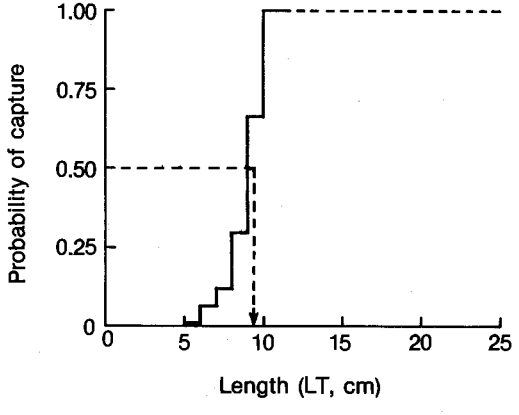
Fam. Gobiidae:
Glossogobius giurus

Taguig, Laguna de Bay,
1958-1959



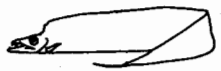




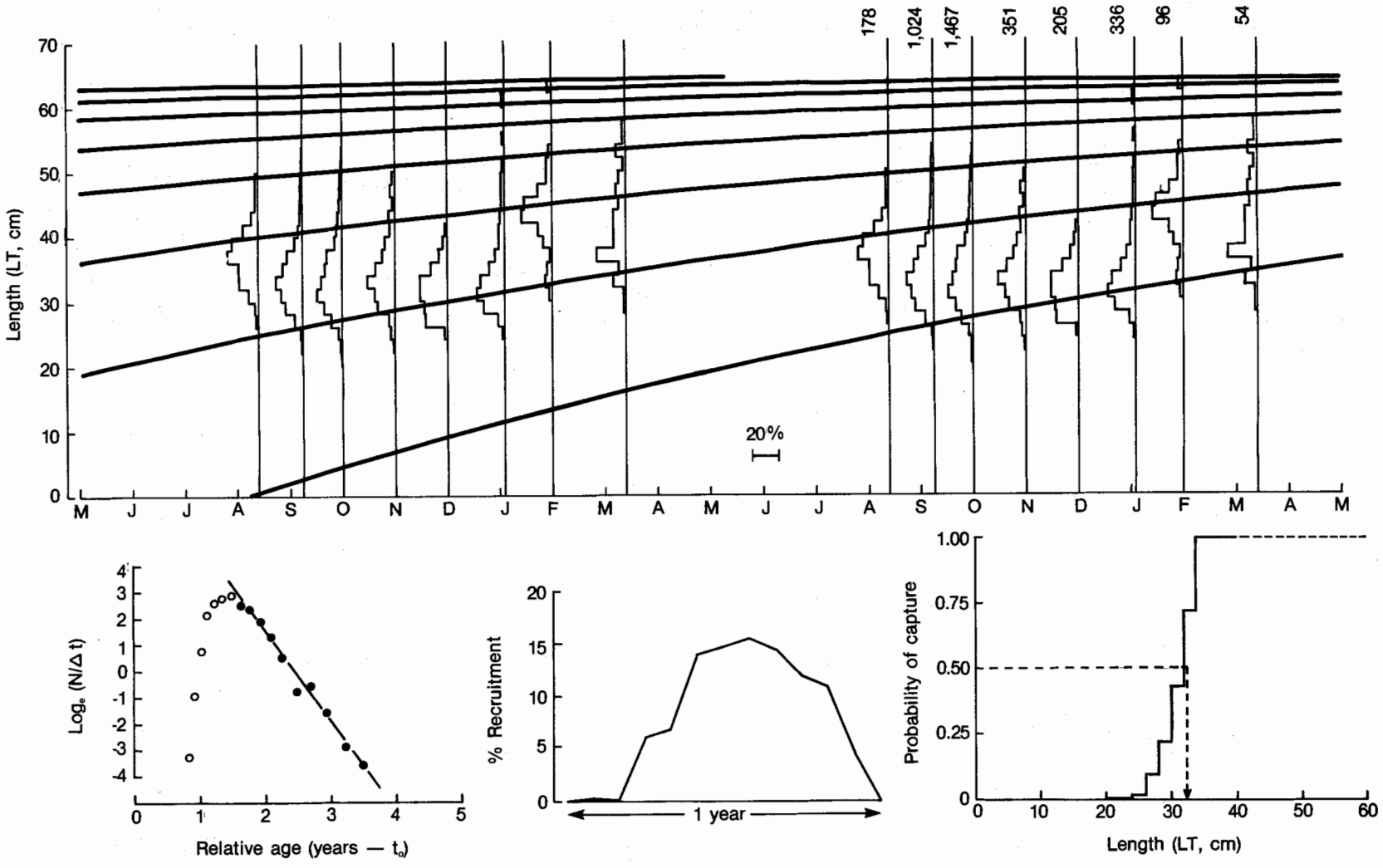


The length-frequency data used here stem from Marquez, J. 1960. Age and size at sexual maturity of goby, *Glossogobius giurus*, a common species of fish of Laguna de Bay, with notes on its food habits. Philipp. J. Fish. 8(1): 71-89. They led to the following estimates: L_∞ = 21.9 cm, K = 0.99, L_c = 9.4 cm, Z = 4.68, M = 1.94 and E = 0.59. Annual recruitment consisted of two pulses, one stronger than the other. An account of the catadromous migration of gobies, including *G. giurus*, is given in Blanco, G.J. 1956. Assay of the goby fry (ipon) fisheries of the Laoag River and its adjacent marine shores, Ilocos Norte Province. Philipp. J. Fish. 4(1): 31-72.

Fam. Trichiuridae:
Trichiurus lepturus ♀



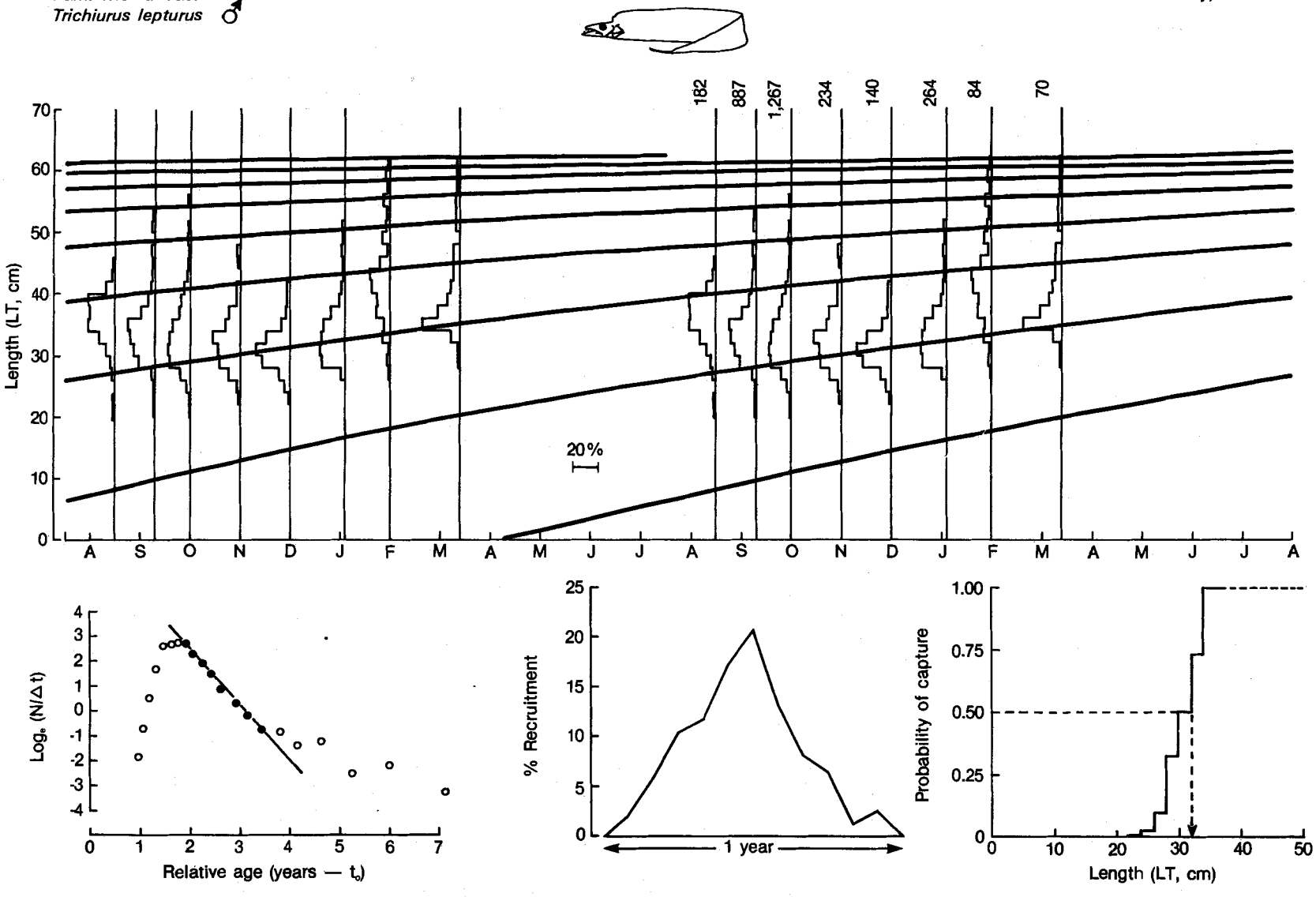
Manila Bay, 1960-1961



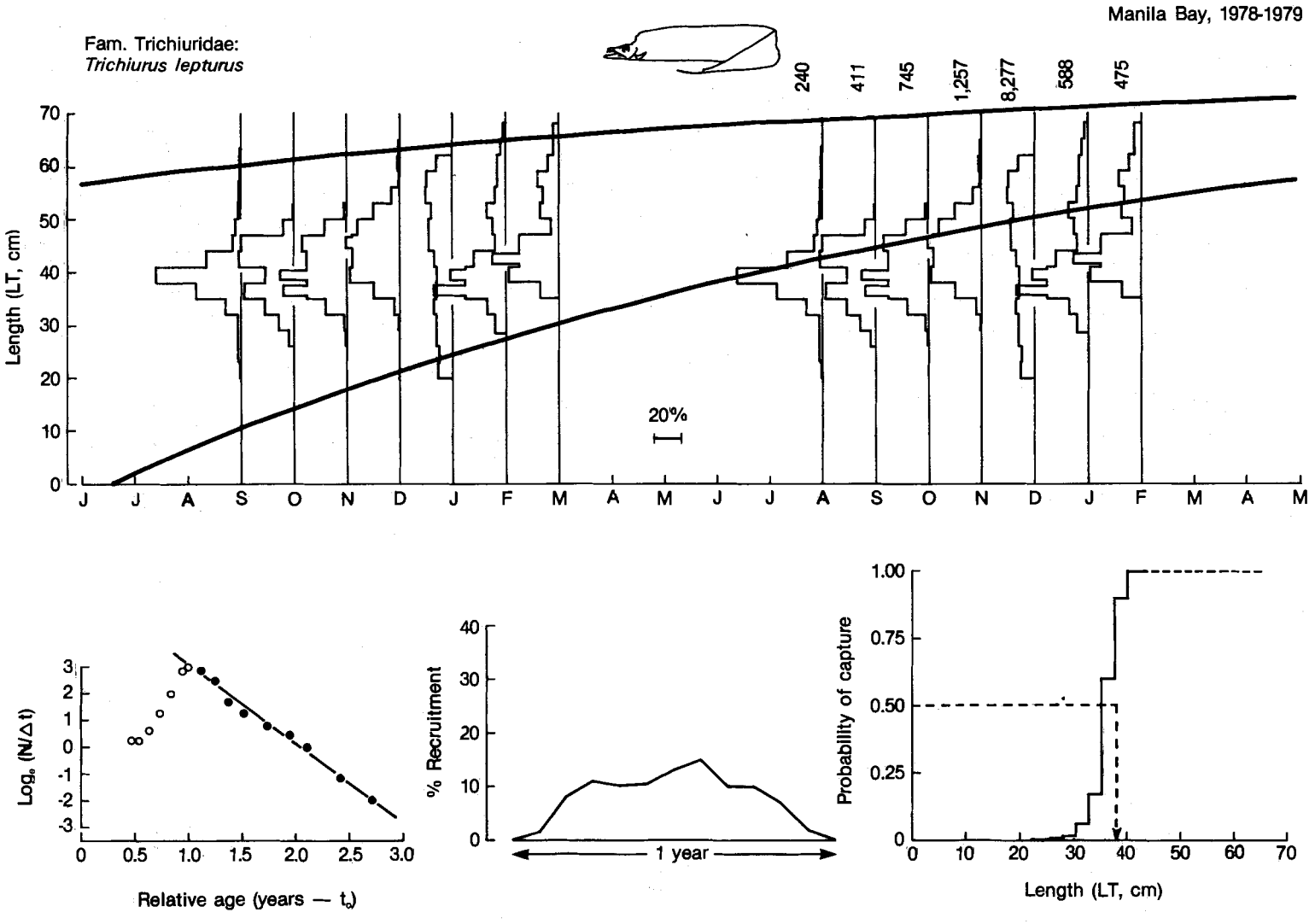
The set of length-frequency data on female largehead hairtail presented here was culled from the files of the Research Division, BFAR, Manila. The following parameter values were estimated from these data: L_∞ = 66.0 cm, K = 0.46, L_c = 32.3 cm, Z = 3.46, M = 0.86 and E = 0.75. Annual recruitment may have occurred in two pulses. Growth parameters roughly comparable to those presented here, but based on readings of otoliths are given in Chen, W.Y. and S.C. Lee. 1982. Age and growth of the ribbonfishes *Trichiurus* (Perciformes: Trichiuridae) of Taiwan Bull. Inst. Zool. Acad. Sinica 21(1): 9-20.

Fam. Trichiuridae:
Trichiurus lepturus ♂

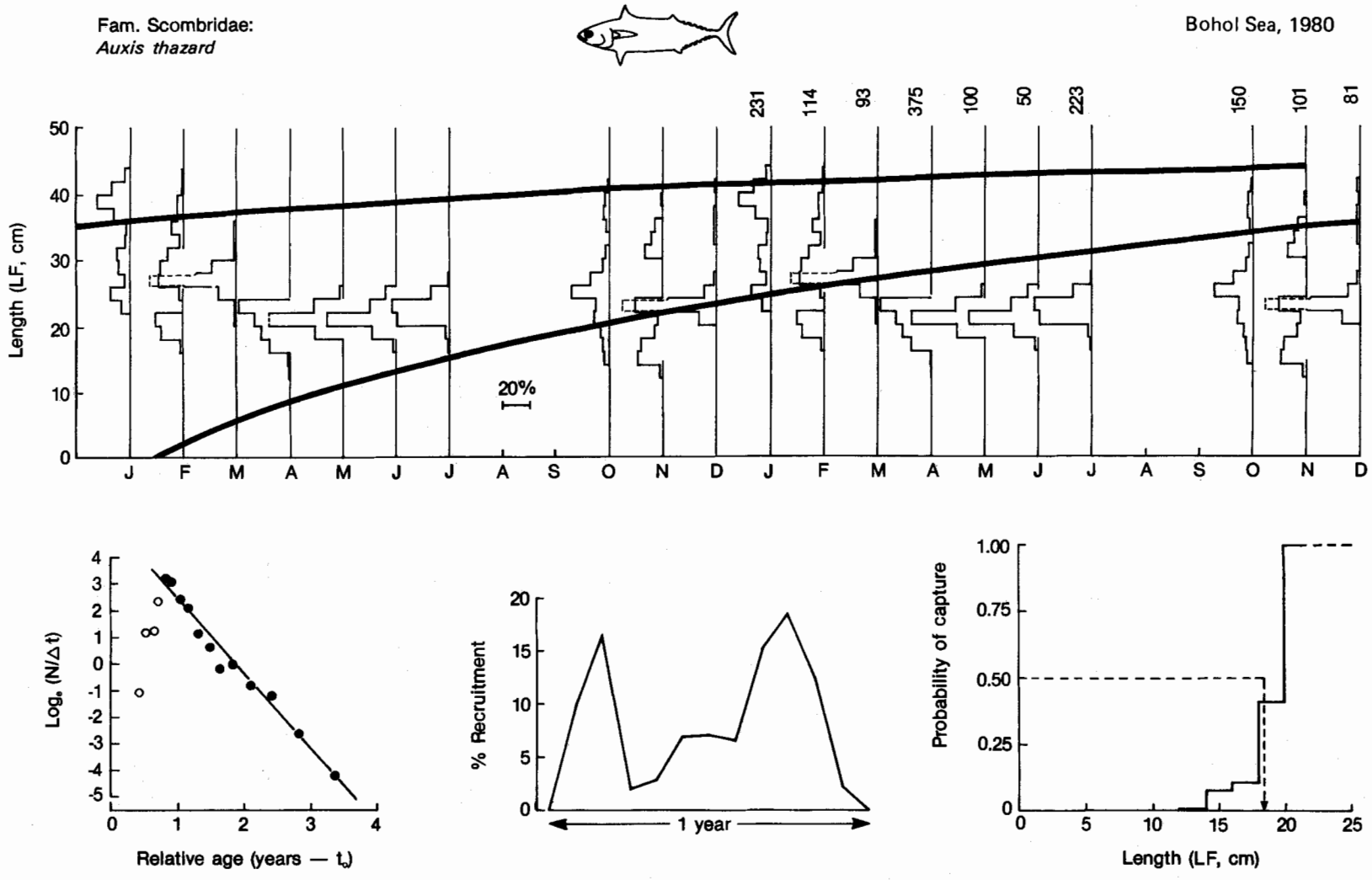
Manila Bay, 1960-1961



This set of length-frequency data on male largehead hairtail was extracted from the files of the Research Division, BFAR, Manila. From these data, the following statistics were obtained: L_∞ = 64.5 cm, K = 0.41, L_c = 32.1 cm, Z = 2.29, M = 0.80 and E = 0.65. Annual recruitment may have consisted of two pulses. Growth parameters roughly comparable to those presented here have been estimated, also based on the analysis of length-frequency data, by Narasimham, K.A. 1976. Age and growth of ribbonfish *Trichiurus lepturus* Linnaeus. Indian J. Fish. 23(1/2): 174-182.



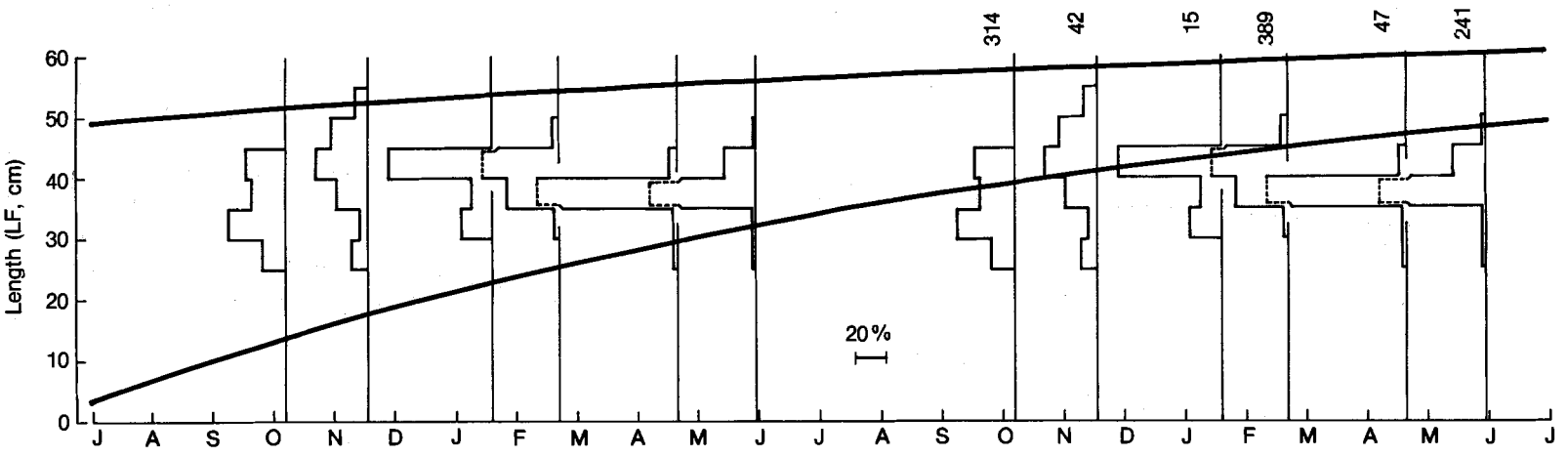
The length-frequency data on largehead hairtail ("bolungonas") analyzed here were collected by Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The following parameter values were estimated: L_∞ = 78.0 cm, K = 0.70, L_c = 38.2 cm, Z = 2.97, M = 1.08 and E = 0.64. The original length-frequency data and the recruitment pattern suggest, when considered together, that annual recruitment should have occurred in the form of two pulses of similar strength. A review of the literature on this and allied fishes may be found in James, P.S.B.R. 1967. The ribbon-fishes of the family Trichiuridae in India. Mem. Biol. Assoc. India (1): 1-226.

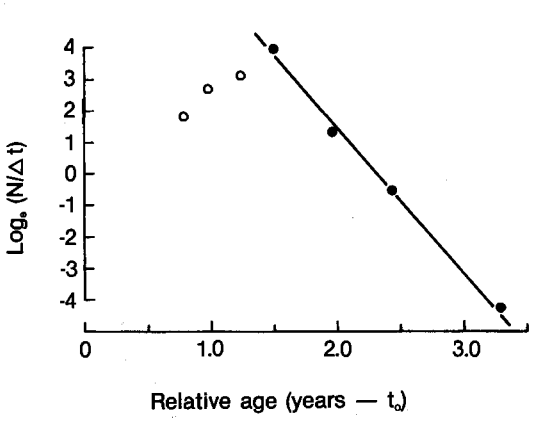


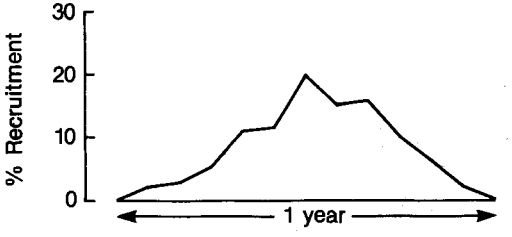
The length-frequency data presented here on frigate mackerel were collected in the frame of BFAR's tuna project (Atty. R. Ganaden, pers. comm.). They led to the following parameter estimates: L_∞ = 47.0 cm, K = 0.73, L_c = 19.4 cm, Z = 2.84, M = 1.28 and E = 0.55. Recruitment appears to have been irregular. An early paper on this fish in the Philippines, which includes detailed descriptions of juvenile stages is Wade, C.B. 1949. Notes on the Philippine frigate mackerels family Thunnidae, genus *Auxis.* Fish. Bull. (U.S.) 51(46): 227-240.

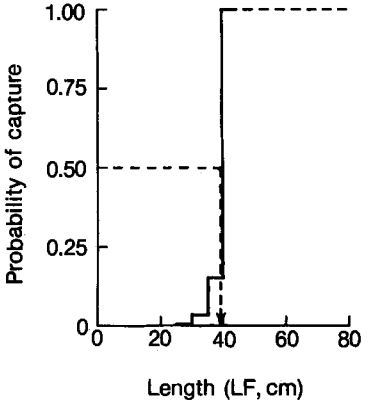
Fam. Scombridae:
Auxis thazard

Moro Gulf, 1976-1977





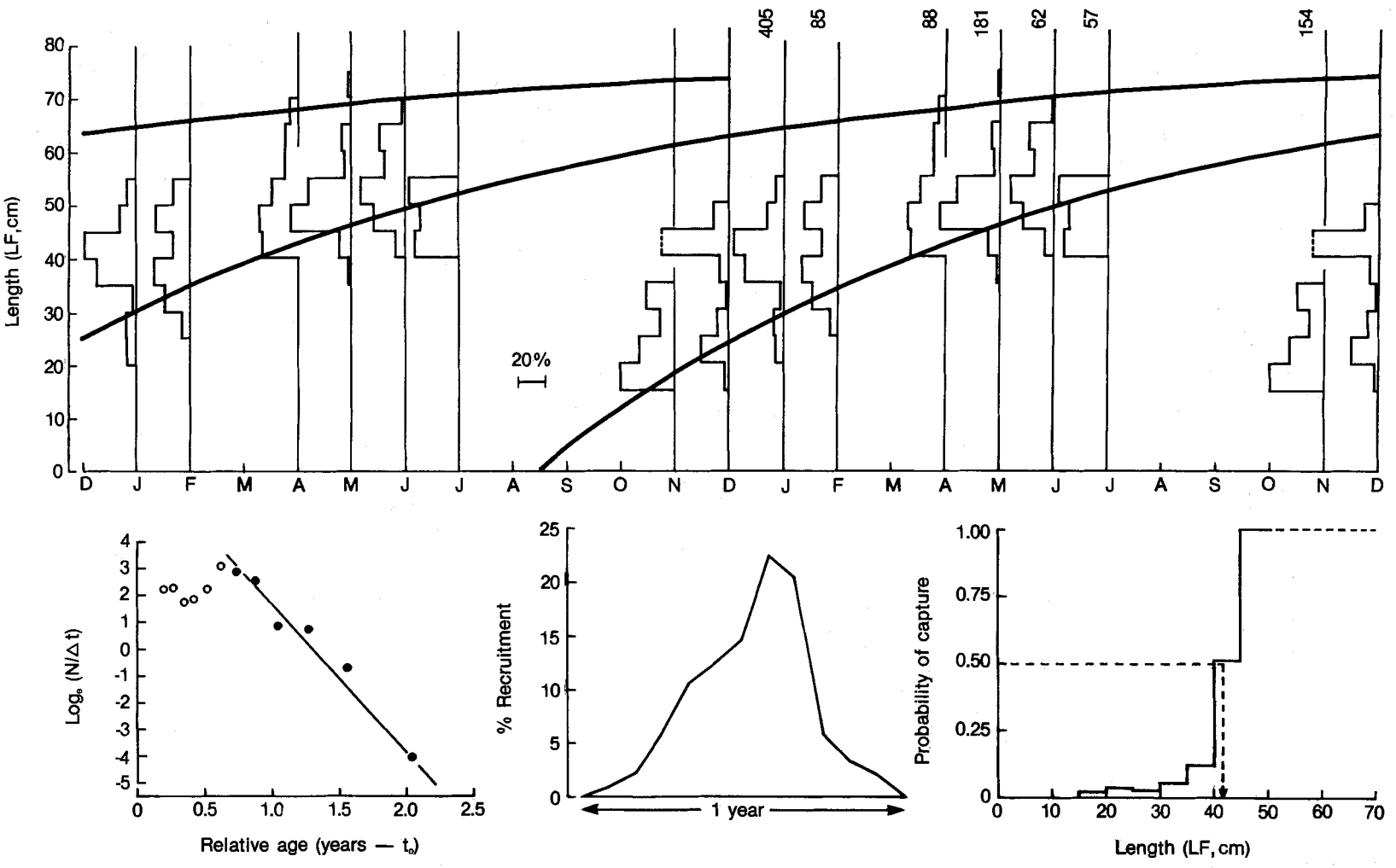




The length-frequency data presented here were compiled from trip reports of exploratory fishing vessels chartered by the South China Sea Fisheries Development and Coordinating Programme, i.e., Simpson, A.C. and W.R. Murdoch. 1976-1977. SCS/76/WP/48-51; SCS/77/WP/58; Murdoch, W.R. and P.S. Walczak. 1977. SCS/77/WP/56-57, 59. These data led to the following parameter values: L_∞ = 63.5 cm, K = 0.72, L_c = 39.5 cm, Z = 4.52, M = 1.17 and E = 0.75. Recruitment appears to have been irregular, but this is probably due to the scantiness of the data at hand. For additional information on frigate mackerels see Sivasubramaniam, K. 1973. Co-occurrence and the relative abundance of narrow and broad corseletted frigate mackerel *Auxis thazard* (Lacépède) and *Auxis rochei* (Risso) around Ceylon, p. 537-547. *In* Proceedings of the Symposium on the Living Resources of the Seas Around India. Spec. Publ. Centr. Mar. Fish. Inst. Cochin.

Fam. Scombridae:
Katsuwonus pelamis

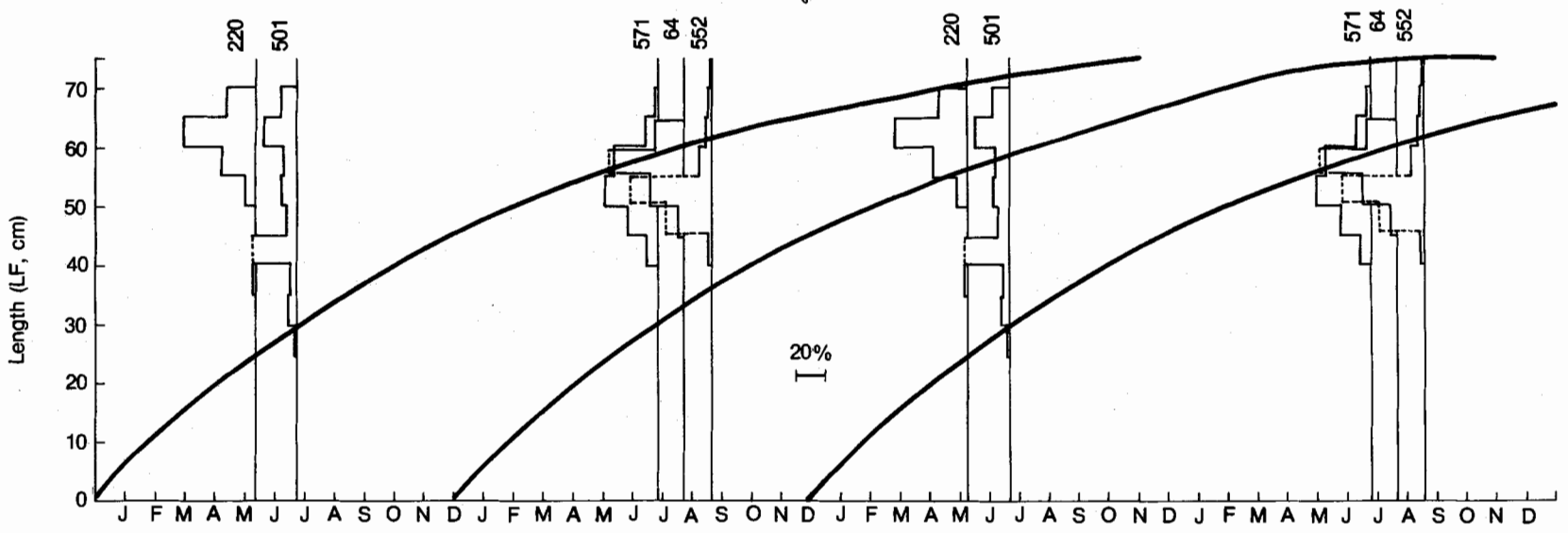
Bohol Sea, 1980

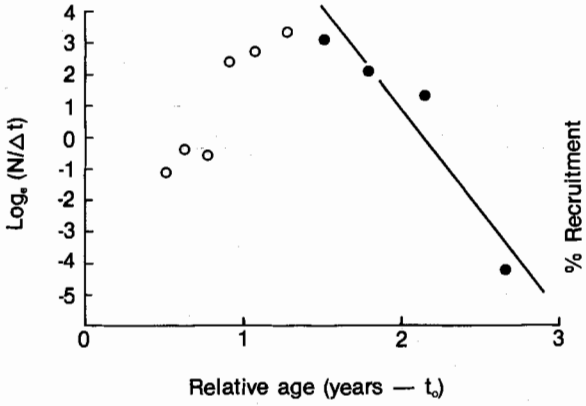


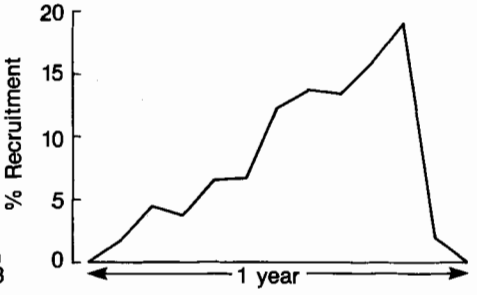
This set of length-frequency data on skipjack tuna was collected in the frame of BFAR's tuna project (Atty. R. Ganaden, pers. comm.) From these, the following parameter values were estimated: L_∞ = 78.5 cm, K = 1.25, L_c = 43.1 cm, Z = 5.55, M = 1.58 and E = 0.72. Annual recruitment appears to have consisted of two pulses of unequal strength. A review of the biology of and fishery for skipjack and some other tunas is presented in Silas, E.G. and P.P. Pillai. 1982. Resources of tunas and related species and their fishery in the Indian Ocean. Centr. Mar. Fish. Inst. Bull. 32, Cochin. 174 p.

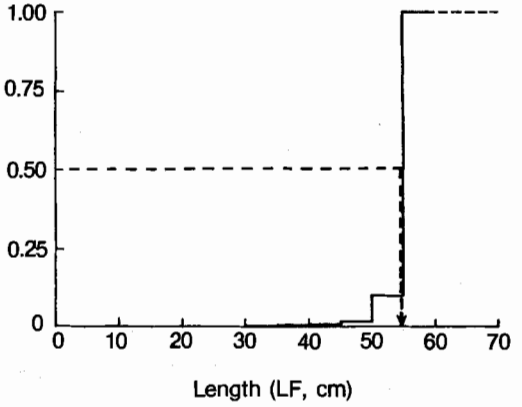
Fam. Scombridae:
Katsuwonus pelamis

Sulu Sea, 1975-1976





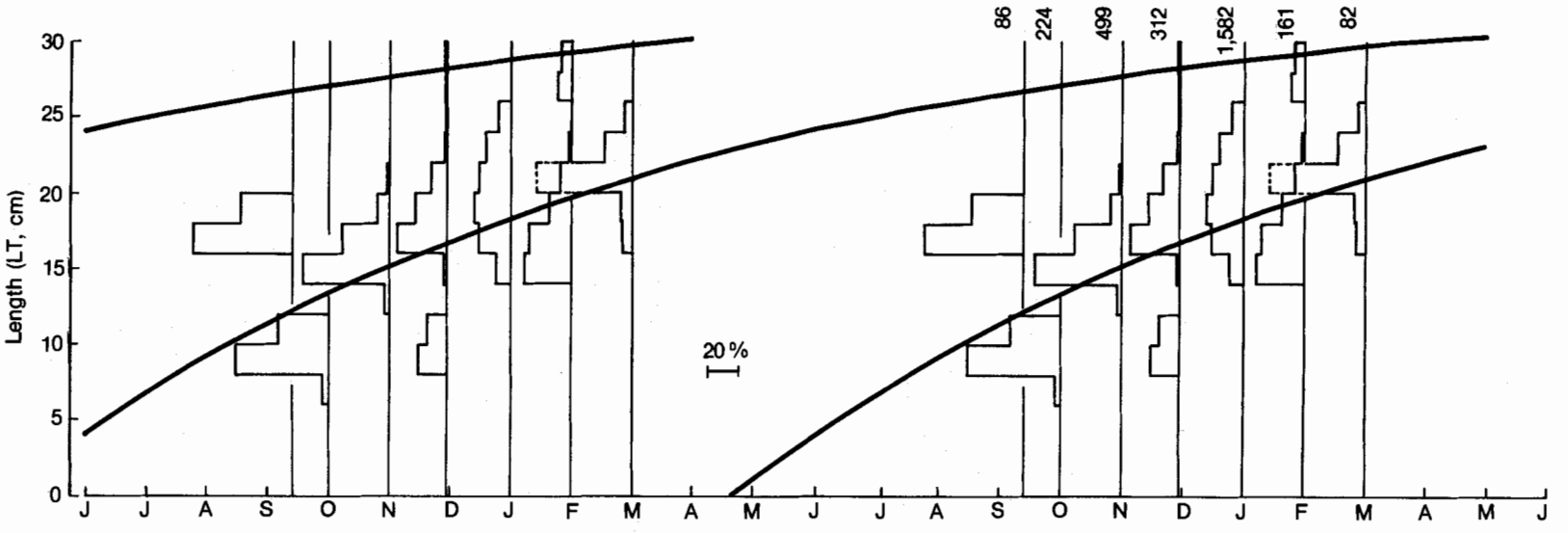


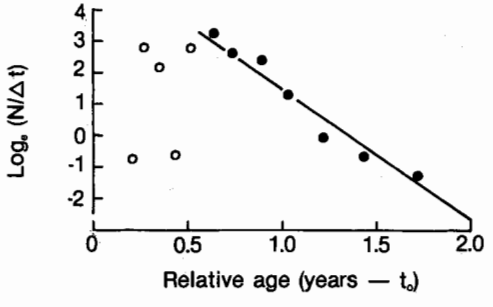


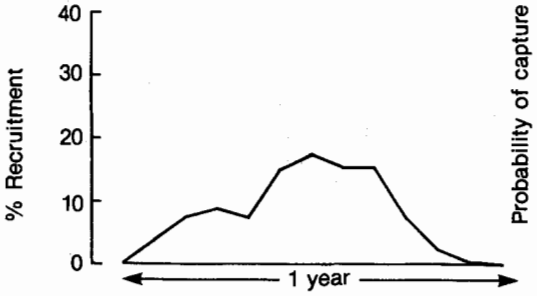
The length-frequency data used here were compiled from trip reports of exploratory fishing vessels chartered by the South China Sea Fisheries Development and Coordinating Programme, i.e., Simpson, A.C. and W.R. Murdoch. 1976-1977. SCS/76/WP/48-51; SCS/77/WP/58; Murdoch, W.R. and P.S. Walczak. 1977. SCS/77/WP/56-57, 59. The following parameter values were estimated from these data: L_∞ = 83.0 cm, K = 0.78, L_c = 54.7 cm, Z = 6.57, M = 1.14 and E = 0.83. The recruitment pattern is irregular, but this is due to the skimpy data used here. When better data were used, recruitment in this fish was found to consist of two pulses of unequal strength. This, plus a wealth of other information on skipjack may be found in White, T. 1982. The Philippine tuna fishery and aspects of the population dynamics of tunas in Philippine waters. Indo-Pacific Tuna Development and Management Programme, IPTP/82/WP/5. 64 p. Colombo.

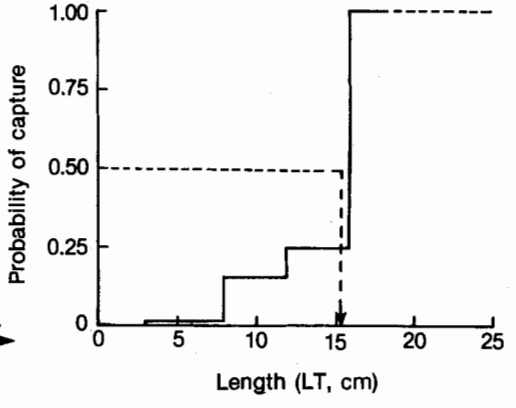
Fam. Scombridae:
Rastrelliger brachysoma

Manila Bay, 1978-1979





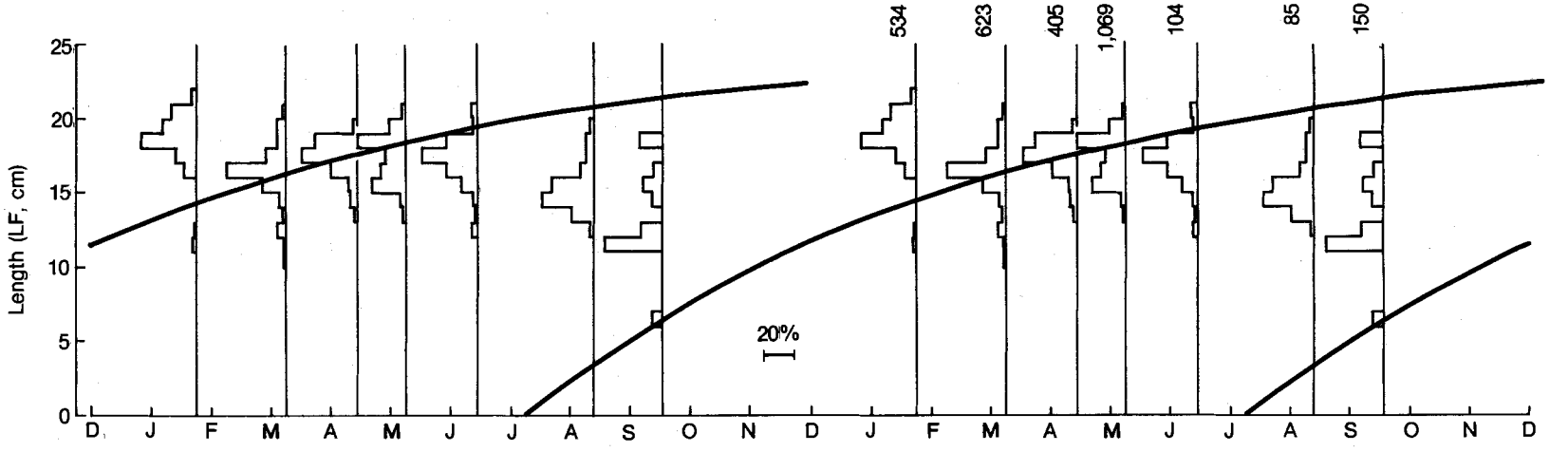


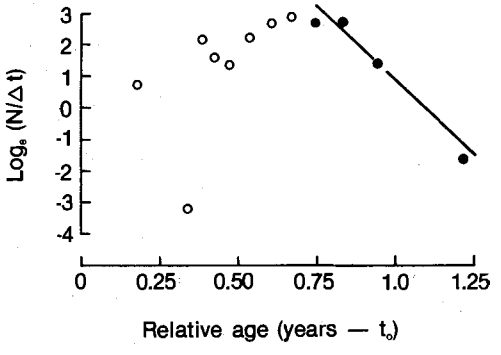


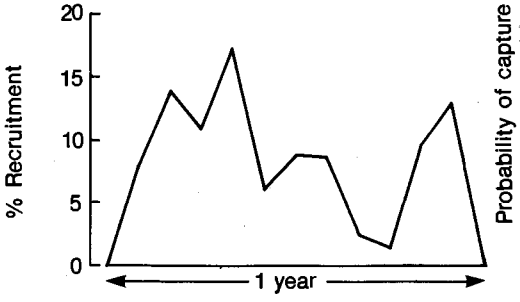
The length-frequency data on short-bodied mackerel ("hasa-hasa") presented here were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. From these, the following parameter estimates were obtained: L_∞ = 34.0 cm, K = 1.10, L_c = 15.2 cm, Z = 4.27, M = 1.84 and E = 0.57. Annual recruitment appears to have consisted of two pulses. Additional data on this fish may be found in Tan, E.O. 1970. Notes on the biology of chub mackerels *Rastrelliger brachysoma* (Bleeker), in Manila Bay, p. 479-480. *In* J.C. Marr (ed.) The Kuroshio, a symposium of the Japan current. East-West Center Press, Honolulu.

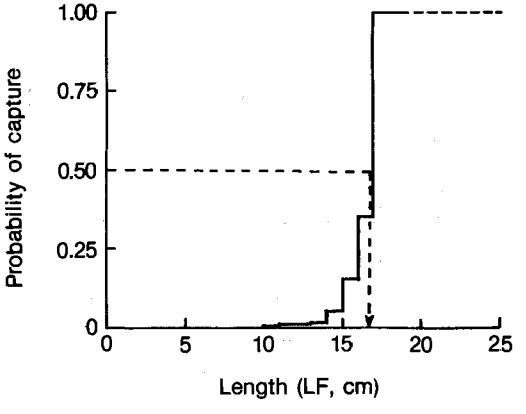
Fam. Scombridae:
Rastrelliger brachysoma

Samar Sea, 1979-1980





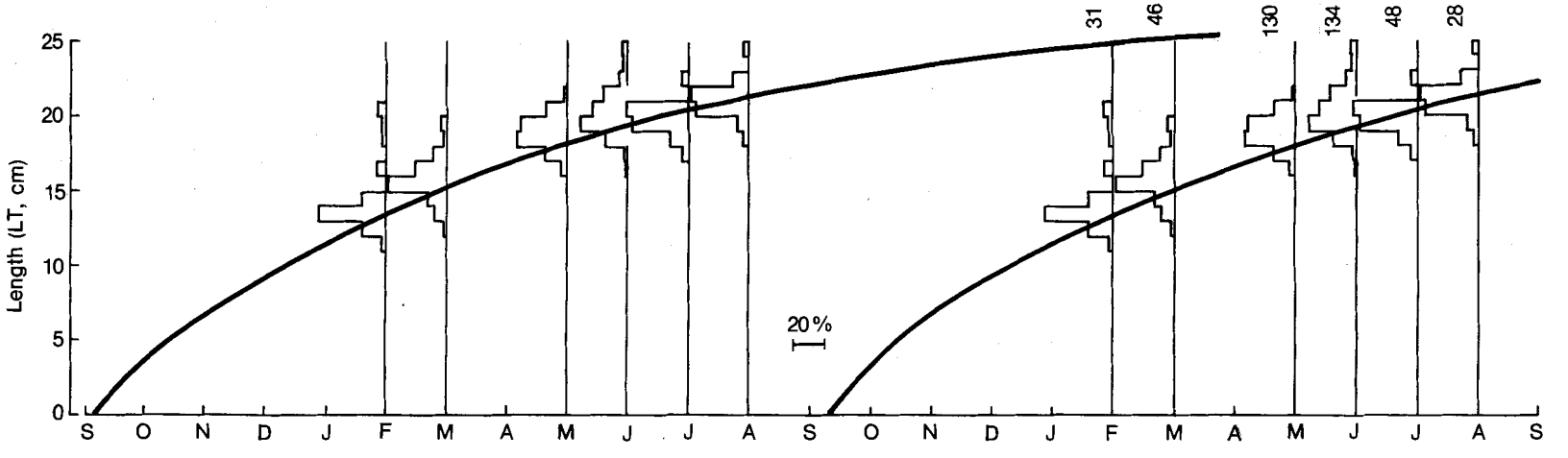


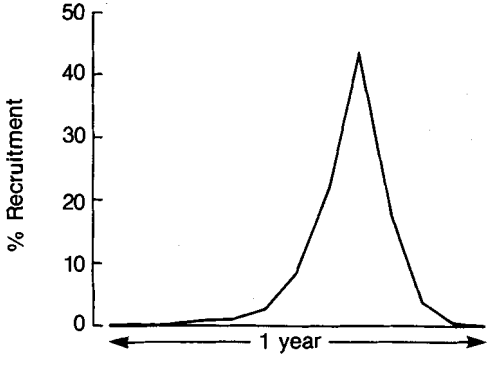


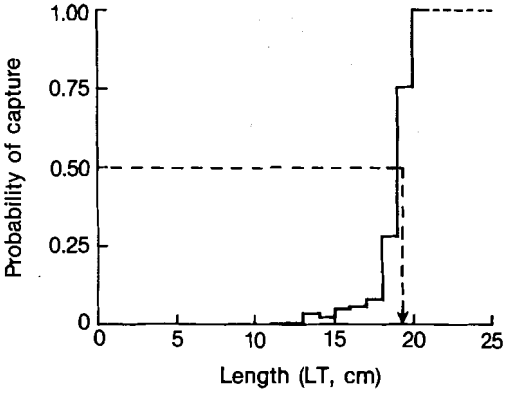
This set of length-frequency data was obtained from Armada, N. and G. Silvestre. 1980. Demersal fish resources survey in Samar Sea and Carigara Bay. Report prepared for UP-NSDB Project 7811.1c Ag, 56 p. The following parameter values were estimated from these data: L_∞ = 25.0 cm, K = 1.60, L_c = 16.7 cm, Z = 9.49, M = 2.56 and E = 0.73. Recruitment appears to have been irregular. A very comprehensive account of the biology and population dynamics of *R. brachysoma* (= *R. neglectus*) has been given by Hongskul, V. 1972. Population dynamics of Pla-tu, *Rastrelliger neglectus* in the Gulf of Thailand. Proc. Indo-Pac. Fish. Counc. 15(3): 297-350.

Fam. Scombridae:
Rastrelliger kanagurta

Palawan, 1965



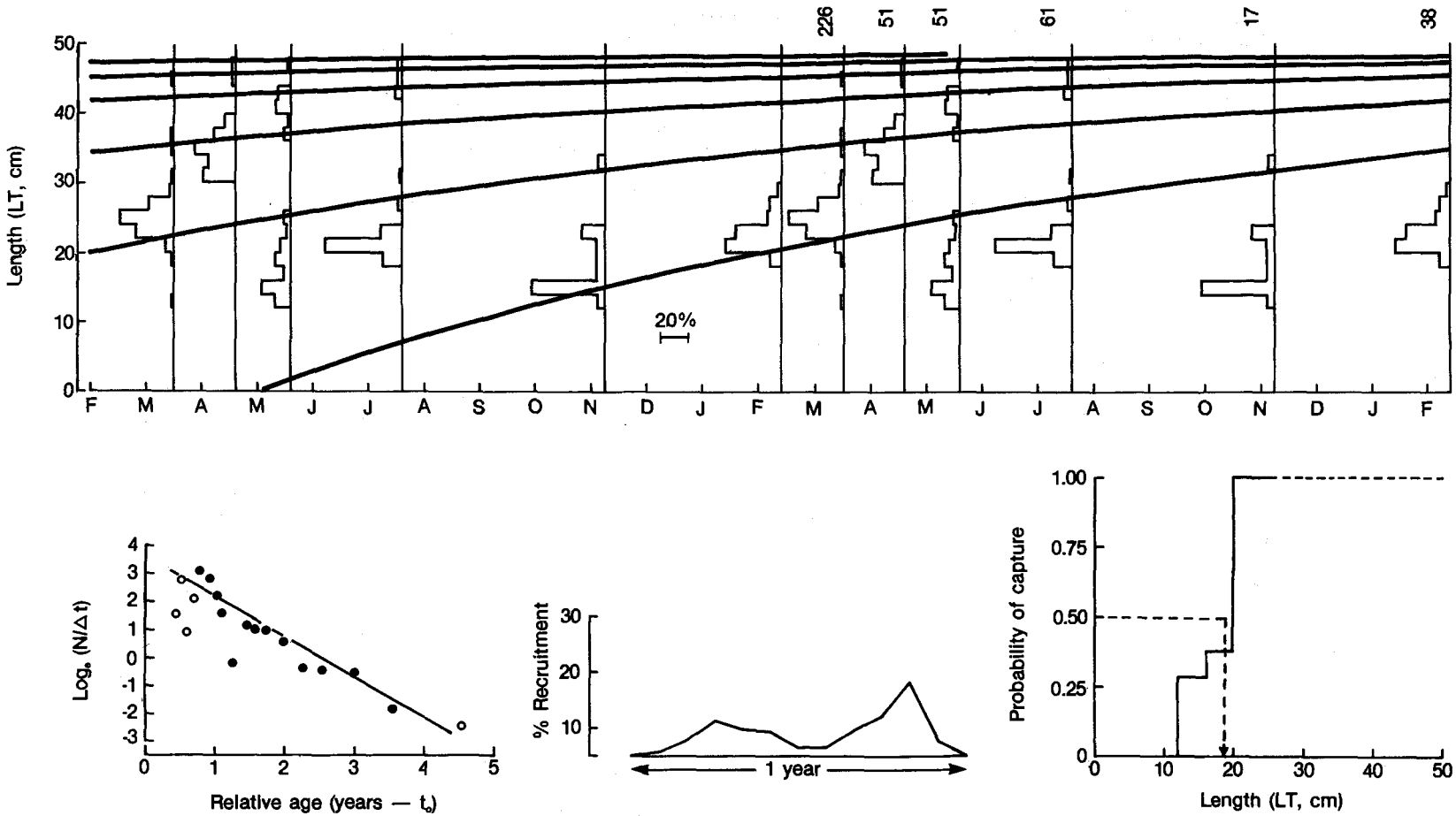




The set of data presented here, which was extracted from the files of the Research Division, BFAR, Manila, led to the following parameter estimates: L_∞ = 28.0 cm, K = 1.55, L_c = 19.3 cm, Z = 8.27, M = 2.43 and E = 0.71. Annual recruitment appears to have consisted of a single short event. An important reference on this fish is George, K. and S.K. Banerji. 1964. Age and growth studies on the Indian mackerel *Rastrelliger kanagurta* (Cuvier) with special reference to length-frequency data collected at Cochin. Indian J. Fish. 11(2): 621-638.

Fam. Scombridae:
Scomberomorus commersonii

Visayan Sea, 1976-1977

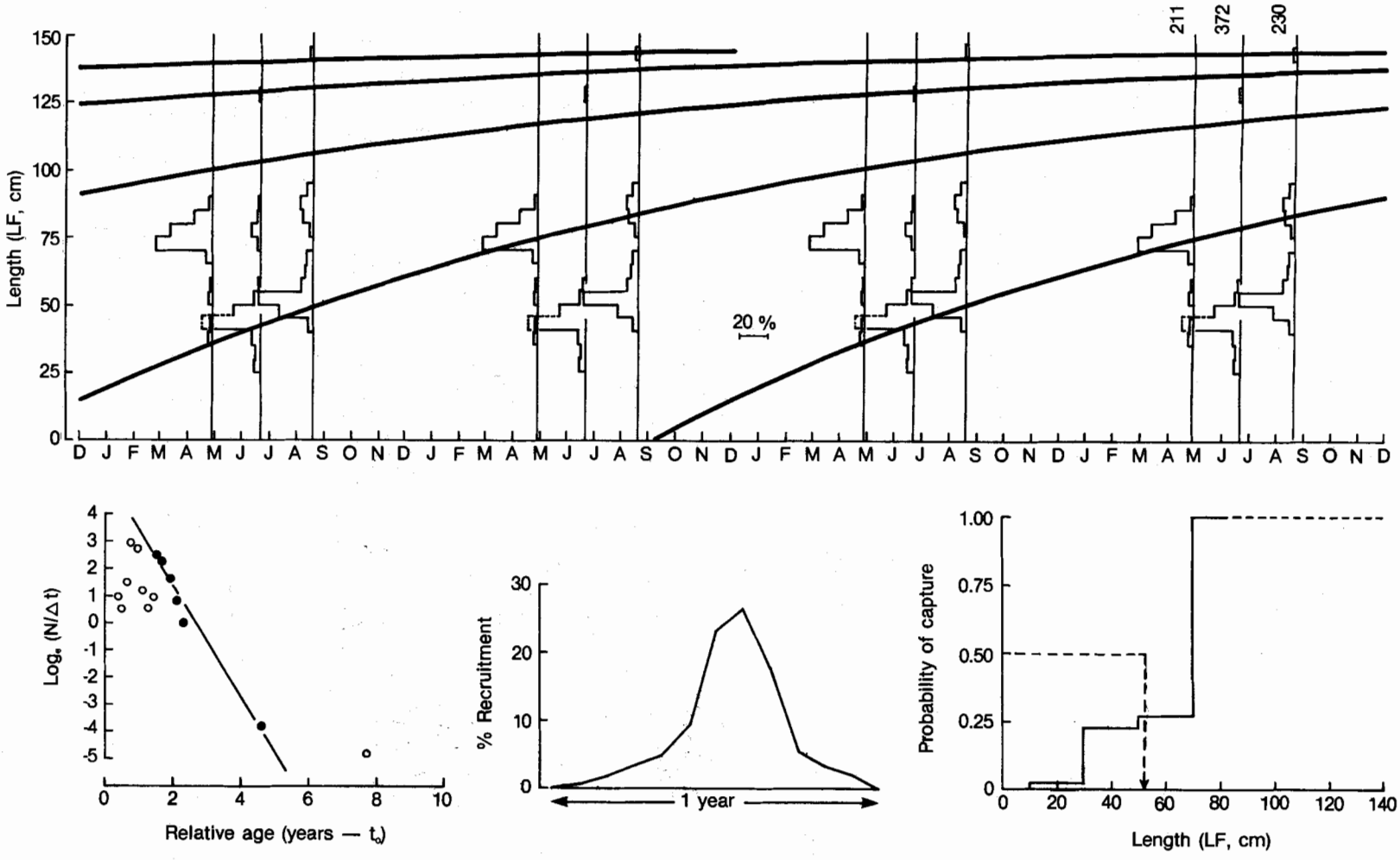


The length-frequency data on narrow-barred Spanish mackerel ("tangingi") presented here were collected in the frame of the PCARR Project 129 "Trawl fishery investigations on traditional and non-traditional fishing grounds in the Philippines" (R. Labit, pers. comm.). From these, the following parameter values were estimated: L_∞ = 49.0 cm, K = 0.70, L_c = 18.5 cm, Z = 1.49, M = 1.23 and E = 0.17; the scantiness of the data at hand makes some of these values, particularly L_∞, questionable. Annual recruitment appears to have consisted of two pulses. Additional data on the biology of this and other scombrids have been compiled by Collette, B. and C.E. Nauen. 1983. Scombrids of the world. An annotated and illustrated catalogue of tuna, mackerels, bonito and related species known to date. FAO Fish. Synopsis No. 125, Vol. 2. 137 p.

Plate 111

Fam. Scombridae:
Thunnus albacares

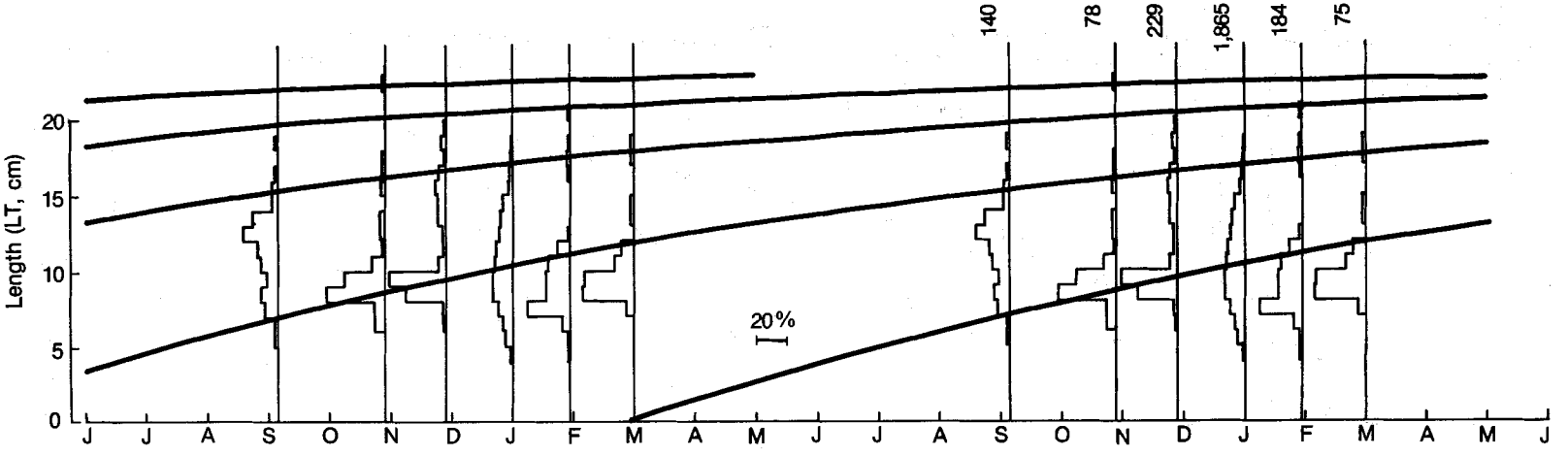
Sulu Sea, 1975-1976

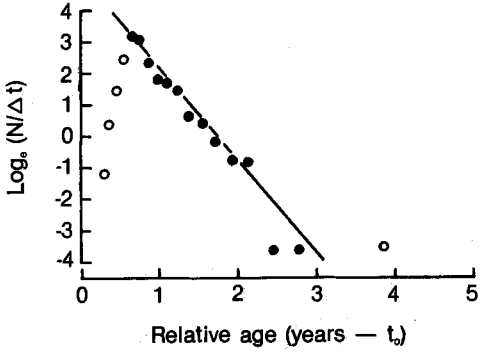


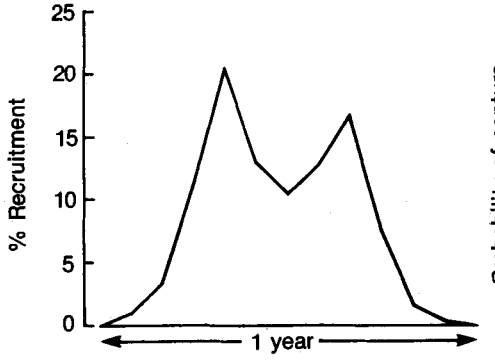
The length-frequency data presented here were compiled from trip reports of exploratory fishing vessels chartered by the South China Sea Fisheries Development and Coordinating Programme, i.e., Simpson, A.C. and W.R. Murdoch. 1976-1977. SCS/76/WP/48-51; SCS/77/WP/58; Murdoch, W.R. and P.S. Walczak. 1977. SCS/77/WP/56-57, 59. The data yielded the following parameter estimates: L_∞ = 148 cm, K = 0.42, L_c = 52.0 cm, Z = 2.06, M = 0.65 and E = 0.68. The length-frequency data suggest that recruitment occurs twice annually, while the recruitment suggests only one recruitment event per year. Data and a review of the literature on yellowfin in the Philippines are available which can help resolve this contradiction. See Yesaki, M. 1983. Observations on the biology of yellowfin *(Thunnus albacares)* and skipjack *(Katsuwonus pelamis)* tunas in the Philippines. Indo-Pacific Tuna Development and Management Programme. IPTP/83/WP/7. 66 p. Colombo.

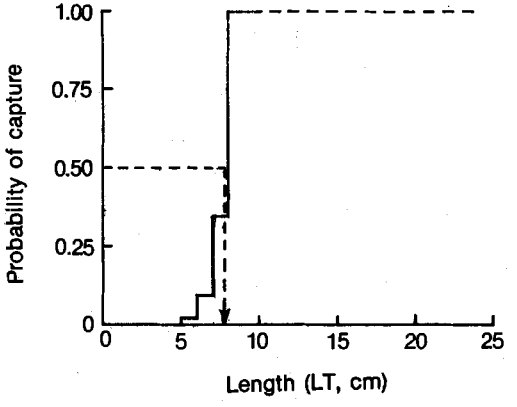
Fam. Cynoglossidae:
Cynoglossus puncticeps

Manila Bay, 1978-1979









The length-frequency data presented here on speckled tonguesole were obtained from Ziegler, B. 1979. Growth and mortality rates of some fishes of Manila Bay, Philippines as estimated from the analysis of length-frequencies. Kiel University, West Germany. 116 p. M.Sc. thesis. The following parameter values were derived from these data: L_∞ = 24.5 cm, K = 0.65, L_c = 7.8 cm, Z = 3.29, M = 1.43 and E = 0.57. Annual recruitment appears to have consisted of two pulses of similar magnitude. A brief account of the biology of this fish with a detailed description may be found in Menon, A.G.K. 1984. Cynoglossidae. *In* W. Fischer and G. Bianchi (eds.) FAO species identification sheets for fishery purposes. Western Indian Ocean (fishing area 51). Vol. 2. (var. pag.) FAO, Rome.

Postscript

Since the bulk of the work on this atlas was performed, a number of features, positive and negative, of ELEFAN I have been studied in some detail by the authors and some other users of this program.

Also, improved versions of ELEFAN 0, I and II have been developed by the authors and others, which largely overcome the negative features. Of these, the two major ones may be briefly mentioned here:

i) When the length range of length-frequency data used for estimating growth using length-frequency data is very narrow, there is a strong tendency for ELEFAN I to underestimate the value of K, because the peaks pertaining to young fishes, on the left side of the samples, are depressed, and sometimes completely suppressed by incomplete selection. This problem can be partly overcome by using the probabilities of capture obtained in a first run of ELEFAN II to correct the original length-frequency samples for selection effects, then to reestimate the growth parameters, using ELEFAN I and the corrected samples. It is thus possible to improve, using this feature of the ELEFAN system, some of the growth parameter estimates presented in this atlas.

ii) The version of ELEFAN I used to perform the analyses in this atlas has a strong tendency, when tracing a number of growth curves through a set of length-frequency data, to identify as "best" such growth curves which hit *repeatedly* the *same* peaks, especially those pertaining to isolated large, old fishes (see e.g., plates 78, 80, 95, 100 or 101). This defect has been corrected, with the result that growth curves are now identified as "best" which usually have slightly higher K-values than before.

Program listings and/or diskettes of ELEFAN I which incorporate the changes mentioned in (i) and (ii) are available from ICLARM, along with improved versions of ELEFAN 0 and ELEFAN II in both microsoft and applesoft BASIC. The former will run without modification on Radio Shack TRS 80 (Model III, 48K), and with slight modifications on most CP/M-based systems. The latter will run on Apple IIe (64K) and compatibles. For details write to ICLARM.

Acknowledgements

An undertaking such as that presented here would never have been completed were it not for the kind assistance of a large number of people who contributed their sets of length-frequency data and/or helped access additional data sets, and advised on the quality of such sets. Also, we benefitted from the unflagging cooperation of skilled draftsmen and typists, and of a number of other persons without whose support this atlas would have remained a dream. To all those named below and to those we may inadvertently have omitted go our sincerest thanks.

B. Anicete, University of the Philippines (UP); V. Aprieto, UP; F. Arce, Research Division, BFAR; N. Armada, UP; R. Bugay, (formerly) ICLARM; P. Calalang, ICLARM; R. Calvelo, Research Division, BFAR; P. Castañeda, Research Division, BFAR; E. Cinco, UP; P. Deanon, Research Division, BFAR; E. Enderez, Development Bank of the Philippines; O. Espiritu, ICLARM; R. Estudillo, Research Division, BFAR; G. Evangelista, UP; R. Ganaden, Research Division, BFAR; S. Ganaden, Research Division, BFAR; A. Gonzales, ICLARM; F. Gonzales, BFAR; A. Hernando, (formerly) UP; R. Hutching, Philippine Ministry of Human Settlements; R. Labit, Development Bank of the Philippines; E. Llana, Research Division, BFAR; T. Mendoza, Research Division, BFAR; R. Miclat, Research Division, BFAR; A. Mines, UP; N.A. Navaluna, UP; J. Ordoñez, Research Division, BFAR; L. Palomares, ICLARM; C. Pagdilao, Philippine Council for Agriculture and Resources Research and Development; R. Regalado, Research Division, BFAR; I.A. Ronquillo, Research Division, BFAR; J. Saeger, German Agency for Technical Cooperation; R.E. Schroeder, (formerly) Research Division, BFAR; G. Silvestre, UP; A.C. Simpson, (formerly) FAO/UNDP South China Sea Programme; K. Tiews, Bundesforschungsanstalt für Fischerei (FRG); E. Villoso, UP; B. Ziegler, German Agency for Technical Cooperation.