International Council for the Exploration of the Sea

C.M. 1985/H:19
Pelagic Fish Committee

Some observations on the biology of sardine (Sardina pilchardus Walb.) off Galicia NW Spain.

by

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SUMMARY

6392 specimen of sardines were sampled during the period 1980-1984. The spawning season was calculated from the monthly percentages of mature individuals, gonadosomatic index, condition factor and visceral fat. The size and age at first maturation and the size/weight ratio were calculated.

RESUME

Pendant la période 1980-1984 des échantillonages biologiques reguliéres sur la sardine ont été realisés et 6932 exemplaires ont été examinées. On determine la saíson de ponte a partir de l'évolution mensuelle du pourcentage des individus mûrs et de la variation du l'indice gonadosomatique, le facteur de condition et la graisse viscerale. On calcule aussi la taille et l'âge de premiere maturation et les equations taílle/poid vive et poid evisceré.

INTRODUCTION

The sardine, Sardina pilchardus (Walb.) is the target species of a traditional fishery on the Atlantic coast of the Iberian Peninsula. It constitutes the most important coastal pelagic resource, both for the volume of the catches and for its social and economical significance. Upwelling in this area makes the study of this species particularly interesting (fig. 1).

Biological aspects of the Iberian sardine (VIIIc and IXa ICES divisions) were previously described by De Buen (1927), Oliver y Navarro (1952) and Andreu (1955), Machado Cruz (1955), Antunes et al (1973), Sobral (1975), Barraca et

al (1977) and Monteiro y Jorge (1982) in Portugal, Fernández y Navarro (1952), from Santander. There are some papers about the sardine from nearby areas: Letaconnoux (1948) and Arbault et Lacroix (1972) in the Bay of Biscay and Hickling (1945) in Cornwall.

The objective of this work is to update some aspects of Iberian sardine biology.

MATERIAL AND METHODS

Purse seine catches landed in the port of Vigo and other catches made during acoustic surveys ("Sardina 82", "Saracus 83" and "Saracus 84") carried out during August each year have been sampled. Between January 1980 and January 1985, a total of 6932 specimen have been examined.

Total and gutted weight (0.01 gr), length (mm), sex, stage of sexual maturity, visceral fat content, and gonad weight (0.01 gr) were measured. Otoliths were removed for age determination.

A key based on the ones elaborated by Pinto y Andreu (1957) and Parnell (1974) was adapted to determine the stage of sexual maturity. The gonadosomatic index, condition factor and fat index were obtained from the following equations:

$$\text{Gonadosomatic index:} \quad \frac{\text{Gonadal weight} \times 10}{\text{Gutted weight}}$$

$$\text{Condition factor:} \quad \frac{\text{Total weight} \times 100}{\text{Length}^3}$$

$$\text{Fat index:} \quad \% \times \text{visceral fat stage}$$

The spawning season was determined by means of monthly measurements of the percentage of mature individuals between 1980 and 1984, the gonadosomatic index between 1981 to 1982 and the condition factor and fat index between 1981 and 1984. The condition factor and the gonadosomatic index were calculated from individuals between 18 and 20 cm. This avoids the errors due to the variations of these indexes with size. The size and age at first maturity were calculated from the samples of the first quarter of 1981, that period was chosen because being included in the spawning season, the samples showed the most adequate range of sizes for the purpose.

The ratios at different ages were calculated from 6020 specimen sampled from 1980 to 1984.

RESULTS

The spawning season extended from early autumn to the end of spring, with winter and spring maxima,(fig.3),coinciding with high values of the gonadosomatic index (fig. 4a). The period of sexual inactivity is in summer, which corresponds to the period of maximum weight per length and maximum visceral fat content (fig.4c).

Different results were found in 1982, when a delay in the increase of the fat index and of the condition factor took place, coinciding with low values of the gonadosomatic index at the end of the year. The decrease of the condition factor (fig. 4b) and the visceral fattening in 1982-1983 coincided with low upwelling rates (Cabanas et al. 1985). The spawning season is the same as that found by other authors in the same area (De Buen, 1927; Oliver y Navarro, 1952). Andreu (1955) mentions a non-spawning season from August to September, Anadón (1954) found two spawning seasons in sardine from Vigo. Ferreiro and Labarta (1982), after studying the icthyoplankton of the Ria de Vigo, postulated two main spawning seasons, in November and March. Barraca et al. (1977) and Ré (1981) describe a long spawning season on the portuguese coast from autumn to the late spring. Solá and Franco (1984) record much higher concentrations of sardine eggs and larvae in Cantabrian than in Galician waters.

The size and age at first maturation were estimated from eye-fitted curves. These values were 14.5 cm in females, 14 cm in males and 1.2 years in both sexes (fig. 5a). Table I shows these values in different regions.

Fig. 5b shows the percentage of female per age during the period 1980-1984. Changes in the sex ratio within and between years are small. Nevertheless the values of the VI^{+} female groups are always above 50%. The size/weight and size/gutted weight ratios were calculated every three months. Table II shows the values.

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AREA	AUTHOR	YEAR	LENGTH	AGE
Bay of Biscay and English Channel	Le Gall •	1937		During the 3rd year
South of the British Isles	Le Gall •	1937		End of 2nd year
Bay of Biscay	Furnestin •	1945	15.5 cm.	End of 2nd year
Cornwall	Hodgson and Richardson •	1949	20.5 cm.	4 years
Vigo	Andreu	1955	14.4 cm.	End of 1st Begining of 2nd years
Mediterranean	Andreu	1955	10.5 cm.	
Mediterranean	Larrañeta	1976	11.7 cm. ♀ 11.3 cm. ♂	Less ther one year
Central and South Portugal	Monteiro et al	1982		1.9 years
Vigo	Perez et al	1985	14.5 cm. ♀ 14 cm. ♂ 14.5 cm. ♀	1.2 years

Table I.- Weight and age at first maturity (• Cited by Andreu)

		1980	1981	1982	1983	1984
1º	a	0.004441	0.003536	0.002778	0.005515	0.003628
	b	3.203230	3.273284	3.351108	3.131685	3.255796
	r	0.998792	0.993786	0.991499	0.999483	0.998959
2º	a	0.003911	0.003783	0.008839	0.011345	0.003326
	b	3.273650	3.264198	2.976719	2.226382	3.288380
	r	0.991787	0.994980	0.995207	0.995371	0.996732
3º	a	0.004612	0.003903	0.008080	0.006180	0.002599
	b	3.263551	3.298282	3.009493	3.104906	3.424284
	r	0.988732	0.996567	0.998868	0.997940	0.995177
4º	a	0.003509	0.002972	0.004017	0.004025	0.015384
	b	3.310106	3.370415	3.261912	3.249337	2.820908
	r	0.996336	0.997278	0.998278	0.995856	0.997524

		1980	1981	1982
1º	a	0.004675	0.007591	0.003279
	b	3.148549	2.965579	3.245245
	r	0.998342	0.997781	0.989342
2º	a	0.003729	0.004735	0.009640
	b	3.248590	3.145526	2.902349
	r	0.991924	0.993341	0.991269
3º	a	0.003327	0.003110	0.010053
	b	3.321395	3.343073	2.892478
	r	0.999244	0.997707	0.998391
4º	a	0.003068	0.003209	0.004139
	b	3.322665	3.298735	3.220516
	r	0.997726	0.997871	0.996563

TABLE II.- values of a, b and r of size/live weight for period 1980-1984 and size/gutted weight for period 1980-1982.

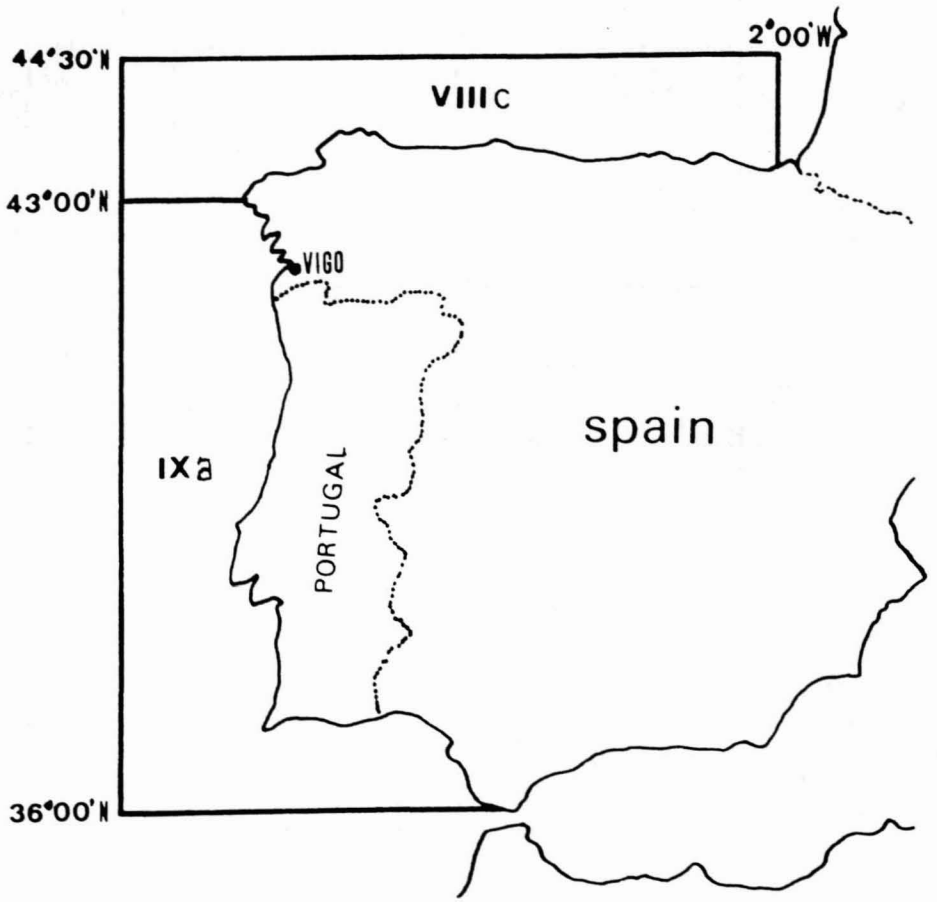

Fig. 1. Geographical area.

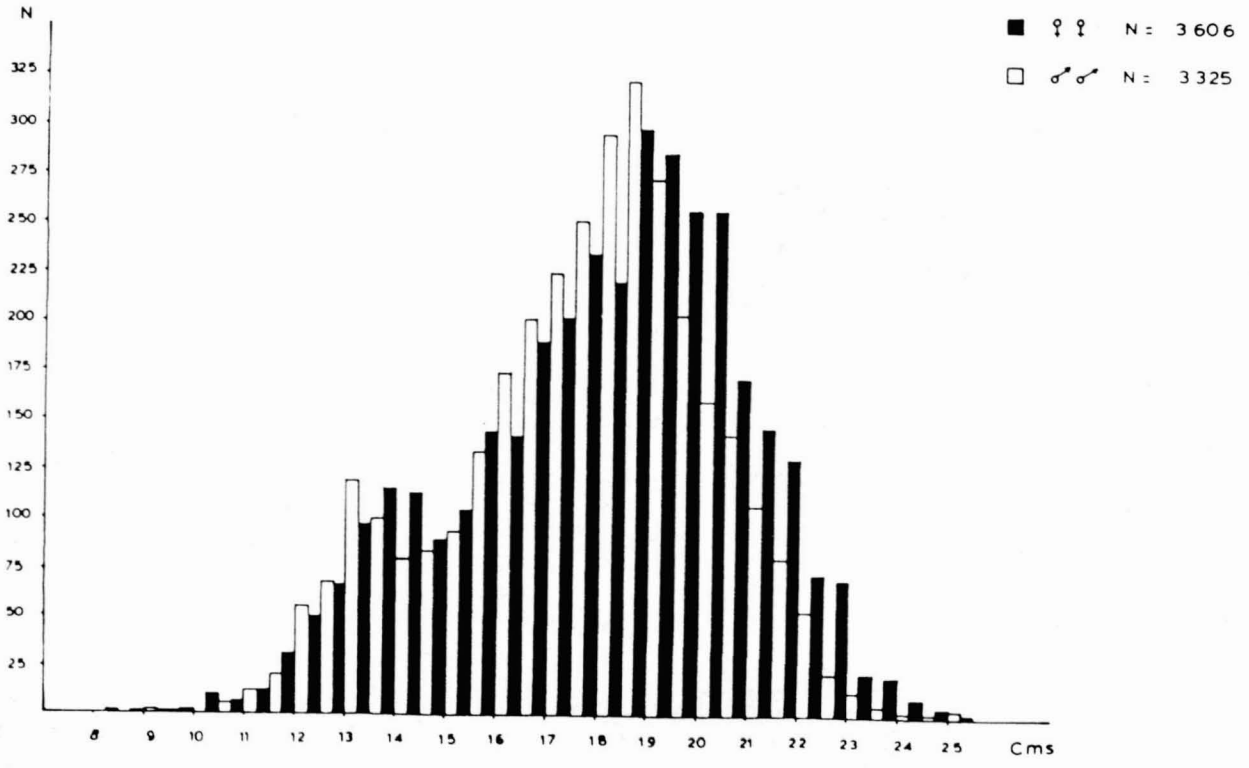

Fig. 2. Size distribution of samples.

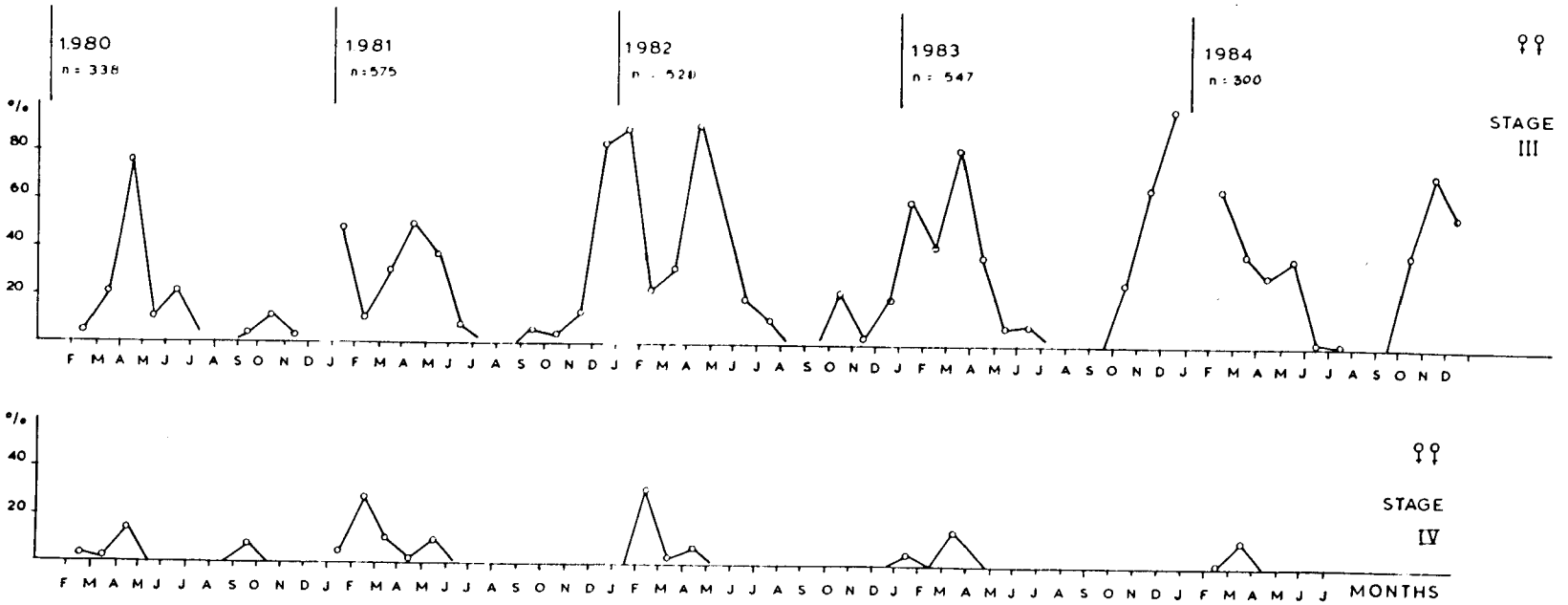

Fig. 3. Changes in maturity stages III (prespawning) and IV (spawning).

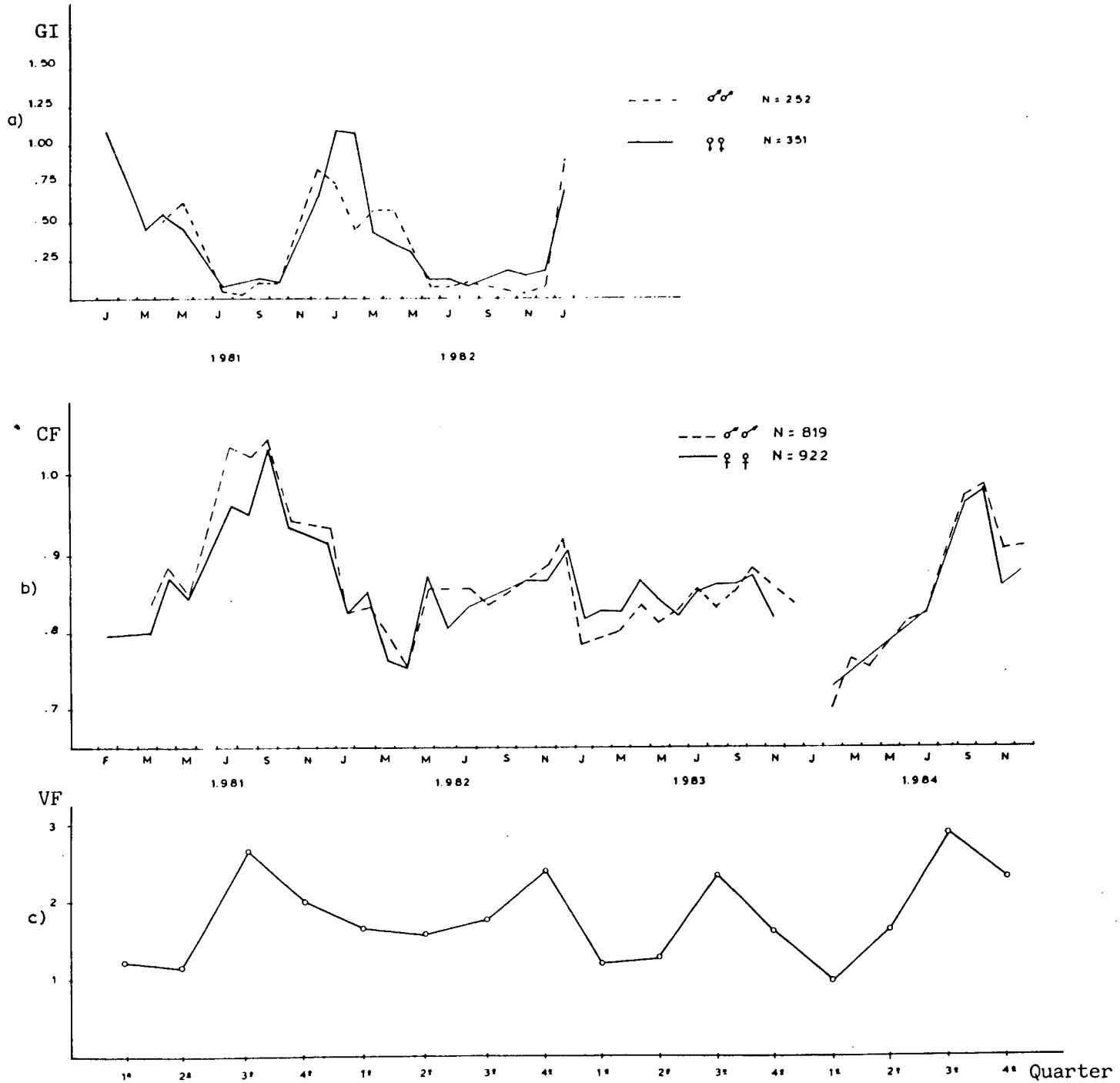

Fig. 4. Gonadosomatic index (a), condition factor (b) and visceral fat index (c).

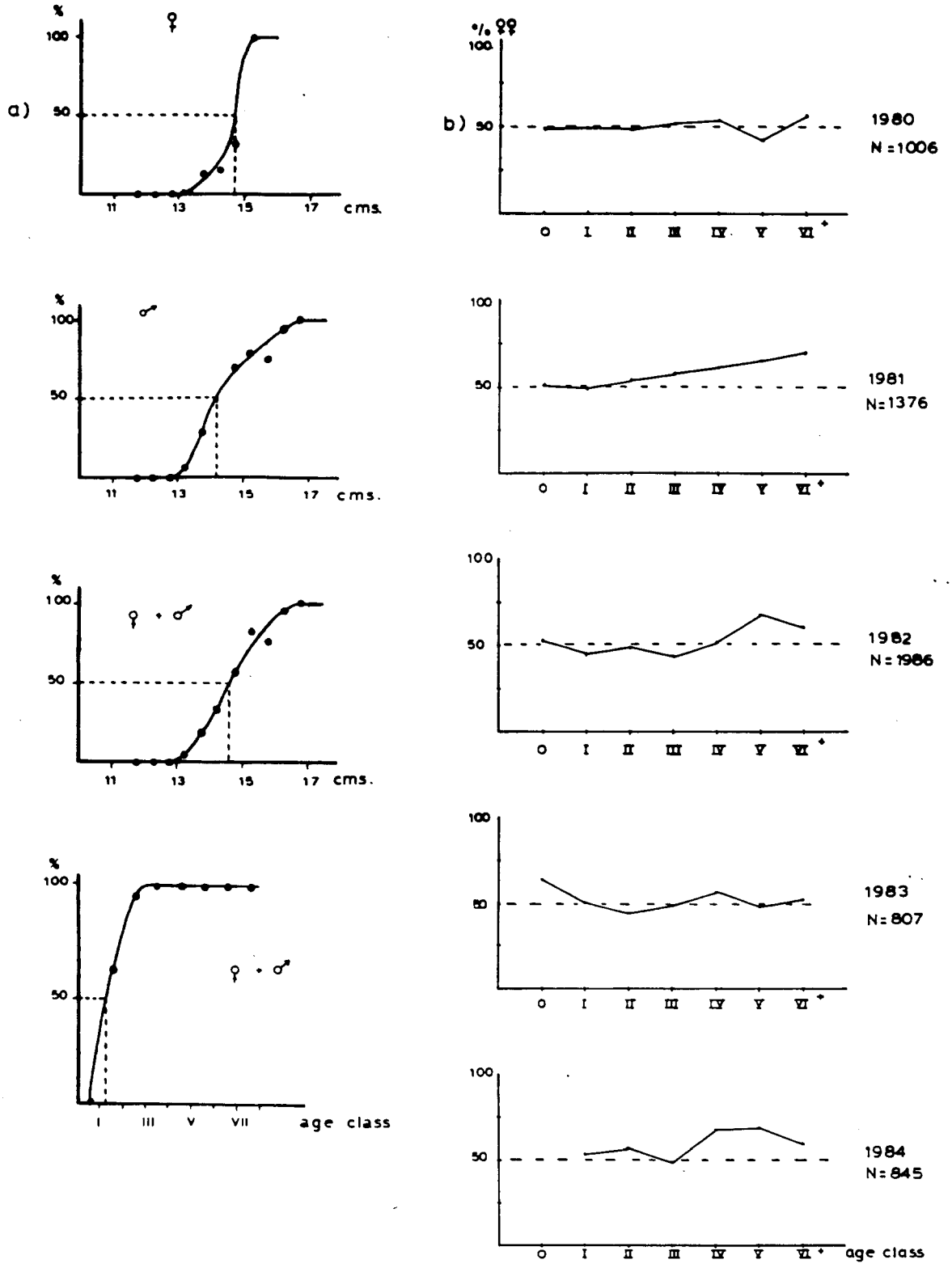

Fig. 5. Maturity ogives fitted by eye (a) and sex ratio by age (b).