International Council for the Exploration of the Sea
Statutory meeting - Dublin, Ireland, 23 Sept.- 1 Oct. 1993

Fish Capture Committee
C.M. 1993/B : 32
Ref. Pelagic Fish Com. (H)

Effect of the number of transects and identification hauls on acoustic biomass estimates when several species are present in an area.

by

J. Massé and N. Retière

IFREMER - NANTES (France)

ABSTRACT

Identification of echotraces is an important source of error in acoustic assessment of pelagic stocks when several species are observed in a single area. In order to analyse the reliability of sampling strategy by transects and identification hauls, 48 hours were used at the end of an acoustic survey (DAAG92) in the Bay of Biscay to prospect a second time a small area with small sampling scale. Eight transects separated by one nautical mile were prospected in a 64 square-mile area. Species composition is provided by 8 identification pelagic hauls (one for each transect).

Different combinations of transects and/or hauls have been done. For each set of data, biomass estimates have been calculated. The trawl catches proportions, weighted by specific Target-Strength and density of echotraces observed around the hauls have been used to allocate the acoustic data to each species.

As a conclusion, an increase in the number of transects does not increase the accuracy of the global biomass estimate. The position of the identification hauls has a greater effect on the estimate by species than the number of hauls. The variability of biomass estimates increases when lively species as mackerel or sardine are concerned.

RESUME

L'identification des échos enregistrés lors de campagnes acoustiques constitue une source d'erreur importante dans les évaluations de stocks de poissons. Une période de 48 heures a été mise à profit à la fin d'une campagne de prospection acoustique dans le golfe de Gascogne (DAAG92) pour analyser la fiabilité des stratégies d'échantillonnage par radiales et chalutages d'identification. Dans cette zone atelier de 64 milles carrés, la prospection a été effectuée selon 8 radiales parallèles espacées de 1 mille et 8 chalutages pélagiques ont été réalisés afin de déterminer la composition spécifique.

Plusieurs évaluations de stocks ont été calculées à partir de jeux de données différents selon les radiales et les chalutages considérés. Les proportions par espèces observées dans les captures ont été appliquées aux densités obtenues par acoustique après pondération par l'index de réflexion et par la densité des échos présents sur la zone.

A l'issue de cette étude, il est montré que l'on n'augmente pas la précision des estimations en augmentant le nombre de radiales prospectées. De plus, la position des pêches d'identification a plus d'effet sur les résultats que le nombre de chalutages effectués. Enfin, la variabilité des estimations de biomasses semble augmenter lorsqu'il s'agit d'espèces au comportement vif comme le maquereau ou la sardine.

At the end of an acoustic survey (DAAG92), 48 hours were used to prospect a second time a small area with small sampling scale, in order to analyse the target-strength of anchovy and the reliability of sampling strategy by transects and identification hauls.

I. Material and method

An acoustic survey (DAAG92) was carried out in the Bay of Biscay from 13 to 30 of April. A study area, located between 45° 40 N and 45° 50 N (fig. 1), was chosen after initial prospection where a high density of anchovy was observed and so target-strength analysis was possible. Unfortunately, bad weather occurred between the initial prospection period (17 and 18 of April) and the study area one (28 and 29 of April); consequently the species composition and the echo-traces description were not really comparable.

Schools composed of almost 100 % anchovy were observed in this small area during the first prospection as a thick layer close to the bottom. West of this area, mackerel and horse-mackerel were present and sardine were closer to the coast. During the second prospection, after bad weather, these other species were mixed with anchovy, and all detections were scattered in the whole area as small schools from the bottom to 20 meters above. This new configuration with several species prevented any target-strength analysis but it was a good opportunity to test the sampling method (transects and hauls).

Eight transects were prospected in a 64 square-mile area during a 48 hours period. These transects were 8 nautical miles long and separated by one nautical mile. Species composition is provided by 8 identification pelagic hauls (one for each transect) (fig.2).

Acoustic data were recorded using IFREMER acquisition system, INES/MOVIES (Diner, 1989). The data was plotted using OEDIPE software (MASSE, 1992) and the biomass calculations were done according to Diner (1983) and Massé (1988).

II. Data analysis

II.1 Combinations of transects and pelagic hauls

A comparison between different combinations of transects and/or pelagic hauls is possible, because the delay is very short between the beginning and the end of the prospection on the study area.

a) Separation of the data

Six different estimates were calculated from these data, using two, three, four or eight transects and their corresponding hauls.

Transects were classified from 1 to 8, from north to south of the area (fig.3) and the different sets of calculation were defined, on a systematical base, as following :

- set 1. : all the transects
- set 2. : transects N°1, 3, 5, 7 - hauls N° 38, 37, 35, 34
- set 3. : transects N° 2, 4, 6, 8 - hauls N° 33, 32, 31, 36
- set 4. : transects N° 1, 4, 7 - hauls N° 38, 32, 34
- set 5. : transects N° 2, 5, 8 - hauls N° 33, 35, 36
- set 6. : transects N° 2, 7 - hauls N° 33, 34

b) Results

The biomass estimates from different sets and the respective coefficients of variation have been calculated using species compositions in fishing samples for allocating integrator values to species. According to Diner (1983) and Massé (1988), these species compositions were not directly applied but previously weighted according to the density of fish observed around the fishing location. So a weighting factor Xa_i was calculated for each haul and each species :

$$Xa_i = P_a / (\Sigma_a P_a / C_a)_i$$

where P_a : catch rate for species a in haul i .

C_a : acoustic factor calculated from T.S. and mean length of the species a.

Results are provided in table 1 and 2, and shown in figure 3 and 4. The coefficients of variation must be considered as a characterization of the heterogeneousness of the species distribution in an area. They are based on the trawl catches and the density of fish observed by acoustics.

c) Discussion

It is possible to consider the number of transects which had a direct effect on the deviation (acoustical energy), and the number of hauls on the distribution of energy by species.

The mean deviation does not change very much with the number of transects (from 1.489 to 1.756) but the calculated biomasses per species vary from one set to another. Consequently, the estimates are more dependent on identification hauls.

The sets 1, 2, 3 and 6 calculations (2, 4 and 8 hauls) have rather similar results. This means that the number of hauls does not have a great effect on the calculation. On the other hand, sets 4 and 5 (3 hauls), show very different results.

Figure 2 shows that in sets 1, 2, 3 and 6, hauls were well distributed throughout the area. On the contrary, hauls used in sets 4 and 5 are respectively located in the west and east part of the study are :

- set 4 : hauls N° 32, 34, and 38 were located on the west side of the area, had 60 to 90 % of anchovy in the catch.
- set 5 : hauls N° 33, 35, and 36 were located north and east of the area and less than 50 % of the catch was composed of anchovy.

From these distributions, set 4 provides a better anchovy biomass estimate than set 5. Despite that difference in biomass calculation we can see that globally the coefficient of variation increase when the number of hauls decrease, but that they do not vary very much for the predominant species.

II.2 Influence of particular hauls

The position of the identification hauls seems to have a greater effect on the estimate by species than the number of hauls. The objective of the following analysis is to check the contribution of each haul to the biomass estimates by removing systematically one haul from the biomass calculations. Results are summarized in table 3.

The coefficients of variation for these new estimates show that one haul may induce greater variations for species like mackerel and sardine. The horse mackerel results are not really significant because this species is generally poorly represented in this area.

This peculiarity may be explained by the lively behaviour of such species which are usually aggregated in big shoals, in middle water and characterized by swift reactions to vessels or fishing gears.

III. Conclusion

Despite bad weather which disrupted the fish distribution in the study area, this small-scale study shows that :

- an increase in the number of transects does not increase the accuracy of the global biomass estimate,
- the position of the identification hauls has a greater effect on the estimate by species than the number of hauls.
- the variability of biomass estimates increase when lifely species as mackerel or sardine are concerned.

REFERENCES

DINER N. et LE MEN R., 1983.- Evaluation acoustique des stocks de poissons pélagiques dans la partie sud du golfe de Gascogne en avril-mai 1983.- CIEM, CM 1983/H : 44.

DINER,N., WEILL,A., COAIL,J.Y. and COUDEVILLE,J.M., 1989. INES/MOVIES : A new acoustic data acquisition and processing system. ICES,Doc. C.M. 1989/B:45

MASSE J., 1988.- Utilisation de l'échointégration en recherche halieutique (analyse de 5 campagnes effectuées dans le golfe de Gascogne de 1983 à 1987)- DRV.88.030 RH Nantes.

MASSE J., CADIOU Y., 1992. "OEDIPE (Organisation et Exploitation des Données issues du système INES-MOVIES et des Pêches Expérimentales)" - Logiciel + Manuel Utilisateur (38 p.) - Commercialisation par la Sté ORCA (Brest).

Set	(8 h.) 1	(4 h.) 2	(4 h.) 3	(3 h.) 4	(3 h.) 5	(2 h.) 6
Mean deviation (acoustic energy)	1.676	1.756	1.593	1.754	1.541	1.489
Standard deviation	1.389	1.578	1.183	1.003	1.126	0.820
abundance indices						
Sardine	87	40	125	17	245	66
Anchovy	1707	1769	1639	2542	968	1894
Sprat	371	386	355	177	1020	238
Horse mackerel	26	22	30	47	9	21
Mackerel	131	90	165	25	191	55
Other species	289	348	236	173	276	210
Total	2611	2655	2550	2983	2709	2484

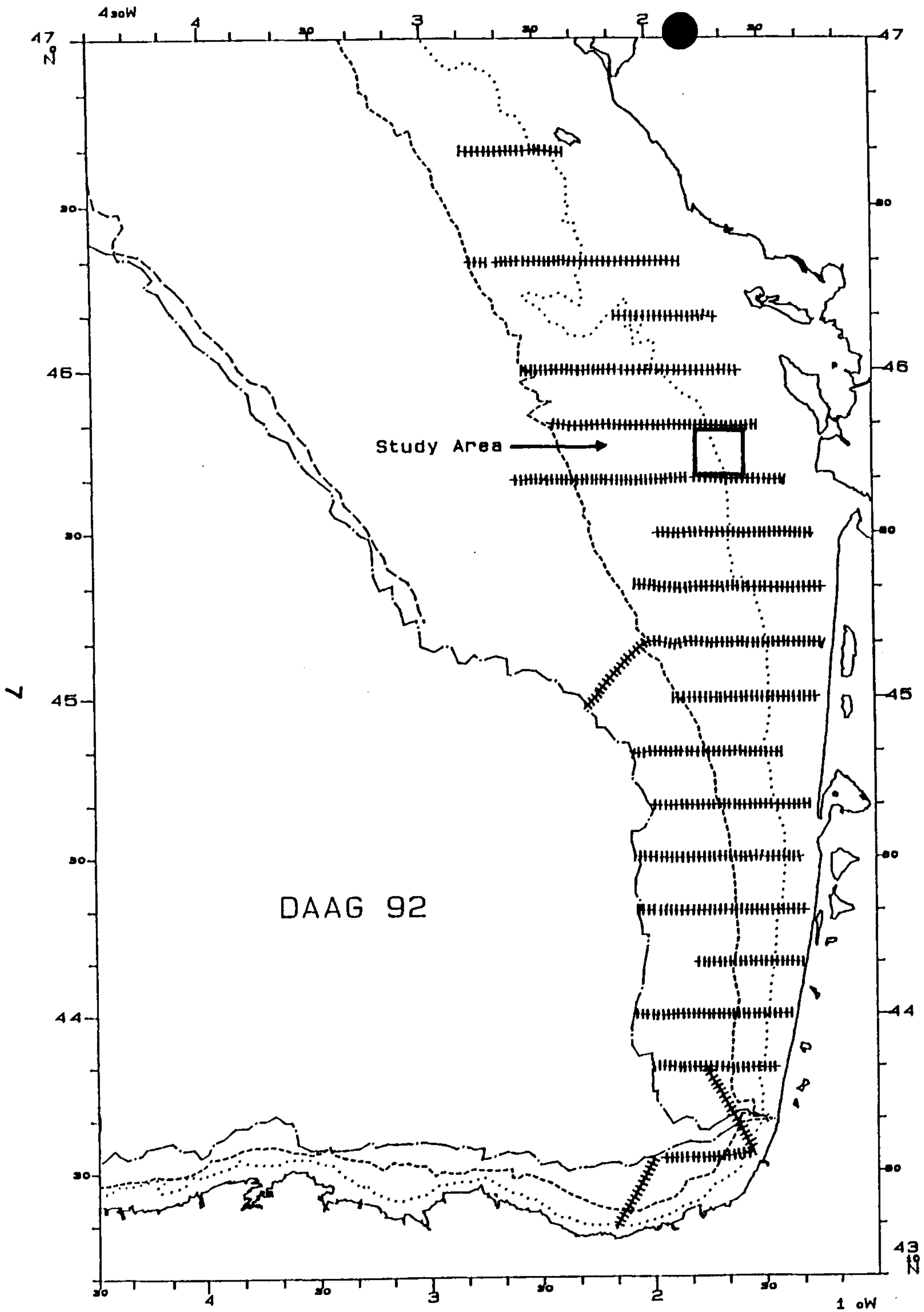
Table 1. Mean deviations and abundance indices

Set	(8 h.) 1	(4 h.) 2	(4 h.) 3	(3 h.) 4	(3 h.) 5	(2 h.) 6
Sardine	54.7	36.4	76.6	27.2	68.5	72.8
Anchovy	22.7	39.2	30.3	17.3	24.2	47.4
Sprat	41.6	77.6	48.2	48.3	40.0	96.3
Horse mackerel	51.9	55.4	80.3	47.2	115.5	82.2
Mackerel	47.2	58.0	67.5	108.8	25.8	114.2
Other species	28.5	38.0	48.5	54.9	37.6	64.4

Table 2. Coefficients of variation

Haul missing N°	Sardine	Anchovy	Sprat	Horse mackerel	Mackerel	Other species	TOTAL
31	94	1808	405	30	82	262	2681
32	106	1464	431	14	166	347	2528
33	79	1822	341	31	129	270	2672
34	99	1425	442	24	159	328	2477
35	89	1771	268	26	119	288	2561
36	47	1700	317	29	126	304	2523
37	88	1856	417	30	137	246	2774
38	98	1762	371	31	136	271	2669
considering *8 hauls	87	1707	371	27	131	289	2612
Average (* excluded)	88	1701	374	27	132	290	2611
Standard deviation (* excluded)	17	155	57	5	24	32	96
Coefficient of variation (* excluded)	20	9	15	20	18	11	4

Table 3. abundance indices when removing systematically one haul.



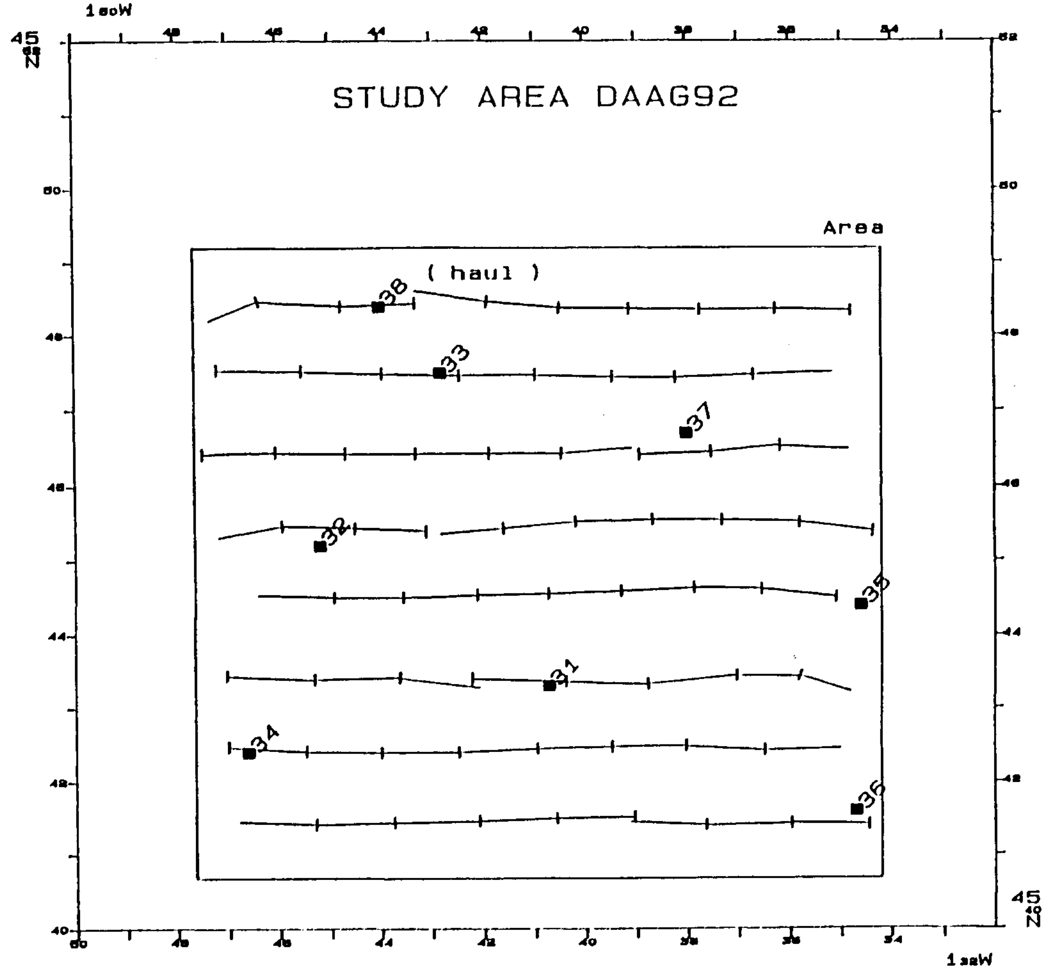


Figure 1. Area surveyed during DAAG92 and study area

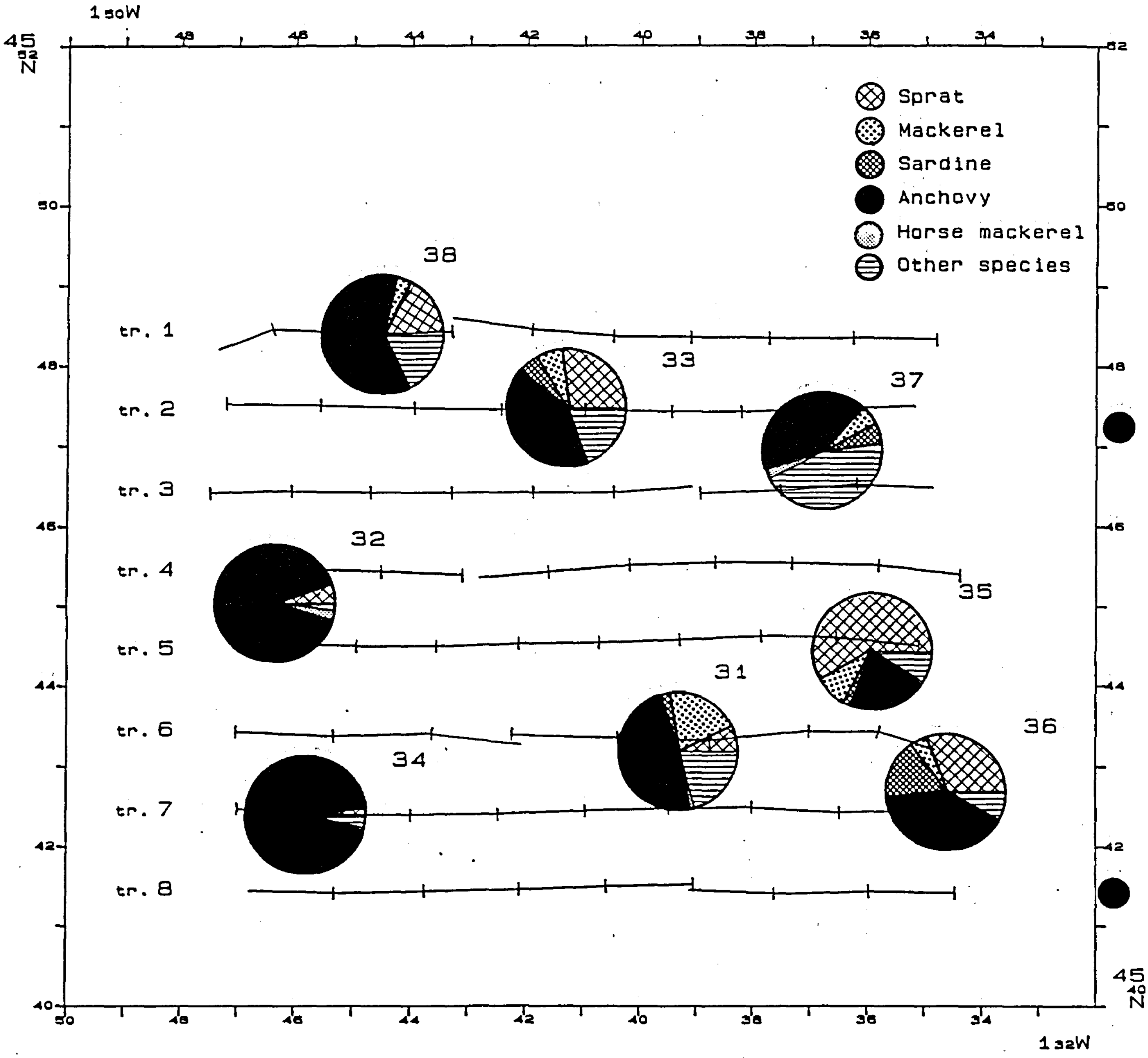


Figure 2. Study area: transects and pelagic hauls

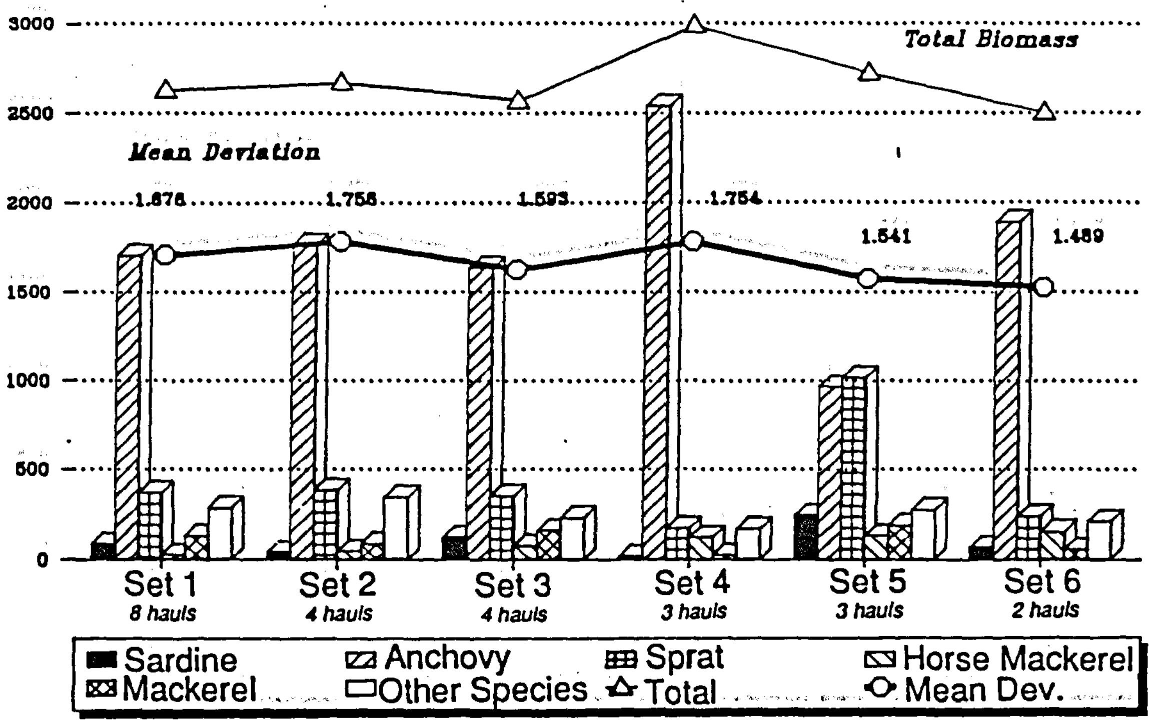


Figure 3. Mean deviations and biomass calculations

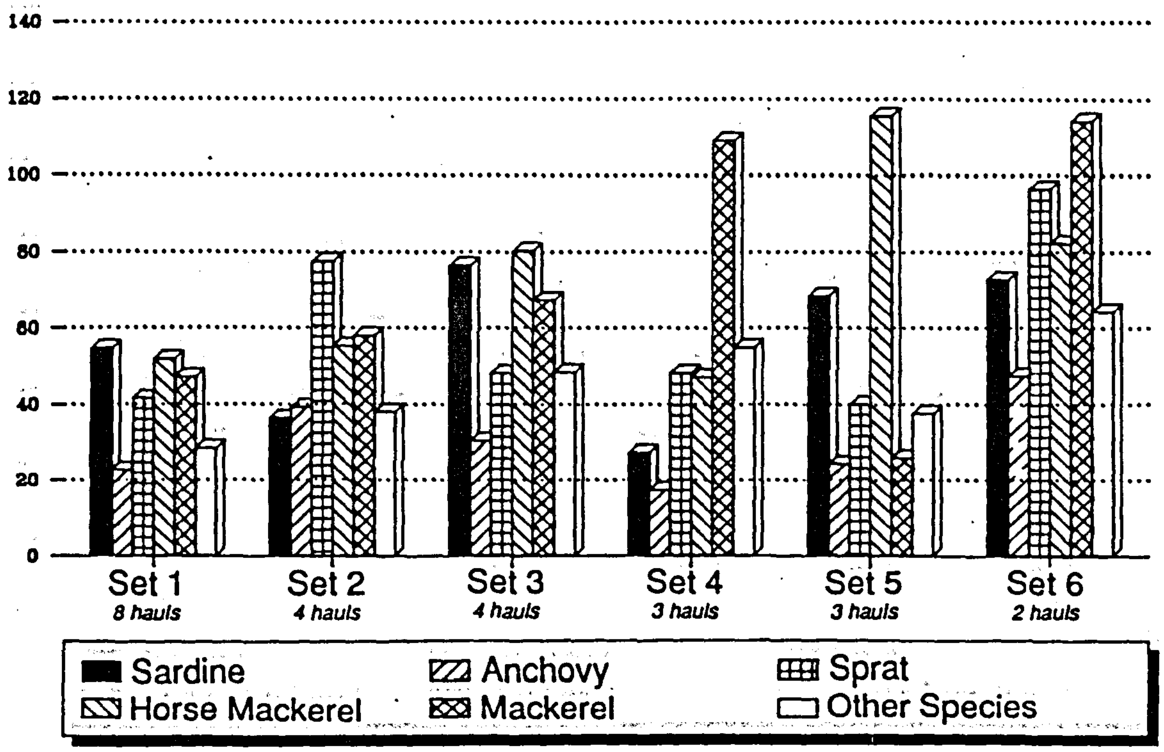


Figure 4. Variation coefficients