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BIOMASS OF THE CONTINENTAL SHELF OFF THE YUCATAN PENINSULA, MEXICO

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INTRODUCTION

The estimation of biomass by acoustic means is becoming a generalised technique, while in Mexico research in this field is rare. This line of study was taken by personnel of the Fisheries Ministry during two brief periods: in 1975-76[1] and 1976[2]; the second period was in the beginning of the 1980s, through an FAO programme under N. Ehrhardt and L. Fuello. Most of the results are presented as internal reports and few have been published. Another aspect is that the work was aimed towards the Pacific coast, specifically at anchovy (Engraulis mordax). To my knowledge there have been no previous efforts directed to the Gulf of Mexico by local research workers.

OBJECTIVE

The main goal of this paper is to provide a view of the method used to obtain a rough estimate of the distribution and quantity of fish by using echo-grams from a single cruise on the continental shelf off the Yucatan peninsula.

METHODS

First of all it must be mentioned that the cruise from which the echo-grams were taken was not designed or planned as an acoustic survey, therefore, the echo-sounder was sometimes operated only between pre-programmed hydrological stations (Figure 1, Table 1).

The cruise was on board the 50 m RV JUSTO SIERRA in May 1983; the water column was scanned with a Simrad EK400 echo-sounder set on alternate mode (38 and 120 kHz). The fish echo area of the echo-gram was determined directly, the length was estimated in metres, using the ship's average speed taken from the log and the time provided by the echo-sounder minute marker; the height was read directly from the echo-gram against the scale employed. With these data the area and volume occupied by the fish echo was estimated using the following equations:

$$L = v.t$$

$$A = L.H \quad \text{and} \quad V = A.D.\text{Tan } 10°$$

where L = length of the fish echo in m,
v = ship's average speed in m,
t = time in minutes
A = area in m^2,
H = height of the fish echo in m,
D = average depth in m,
V = volume in m^3,
Tan 10° = tangent of beam width at -3 dB.

Inter-station distance was divided into arbitrary units of approximately 10 n.m., and the signals in each unit were added together. The results are also presented in this manner.

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RESULTS

The fish echoes occupied an estimated total area of 1 811 216 m^2 and a volume of 400 486 526 m^3 in a total survey length of 650 n.m. (Table 1, Figure 2). As can be seen in Figure 2, most of the fish echoes were located in the north and north-eastern part of the continental shelf.

Most of the fish echoes were found between 30 and 80 m of depth, but there is no apparent relationship with the total depth of the site, or hour of day, with the amount of signals recorded.

DISCUSSION

Unfortunately, it was not possible to obtain an actual sample of the biomass which was recorded; due to this fact three speculations were made. The first two were: (1) the recordings resulted from inexperience in operating the echo-sounder; (2) the echoes belonged to shoals of small fish and/or invertebrates. After consulting with experienced colleagues in Mexico, England and the USA, who examined the echo-grams, the first idea was rejected.

Two cruises were carried out on board a shrimp type research vessel, RV BIP X, which belongs to the local Fisheries Ministry, in order to obtain information to support, or eliminate, the second idea. This vessel is equipped with a Furuno echo-sounder and designed for trawling from the stern. The ship's track combed the area in a zig-zag pattern in the north-eastern part of the shelf, in the autumn and winter of 1986 and in both cases no targets were detected. Due to the fact that it has not been possible to repeat a cruise during the same season that the echoes were recorded, this idea has not been completely discarded, but these results motivated the third hypothesis: (3) that the recordings could be of larvae and fingerlings of different species. This is based on empirical knowledge of the fishermen and some colleagues who have observed that a reproduction peak of several commercial species occurs in the period April-May.

CONCLUSION

The results obtained are crude, but the existence of this biomass cannot be denied. Efforts should be continued to determine the species composition and distribution in space and time due to the apparent magnitude, and the possible biological and economical implications derived from it.

I would like to express my gratitude to those who viewed the recordings, whose names are omitted intentionally in case of a misinterpretation of their comments, which is the author's responsibility.

REFERENCES

[1] Melcer, J. and Cota, A., 1976. Perdida de blancos acusticos y su dependencia en el rango. Mem. Primer Simp. Nal. Rec. Pesq. Masivos de Mexico, Ensenada B.C., 2: 23-34.

[2] Melcer, J., Garcia, W., Mondragon, E. and Cota, A., 1976. Estimaciones de biomasa y distribucion de peces pelagicos con metodos hidroacusticos en la corriente de California frente a la costa occidental de Baja California. Mem. Primer Simp. Nal. Rec. Pesq. Masivos de Mexico, Ensenada B.C., 2: 301-344.

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Table 1 General information of the added fish echoes in each unit of 10 n.m.

Transect	Local time	Shoal						
		Length m	Height m	Area m^2	Depth m		Average depth m	Volume m^3
					Start	End		
15-16	14:00	9 530	9.0	85 770	45	65	55.0	17 527 478
		9 823	5.4	53 044	40	50	45.0	8 868 941
16-17	17:30	15 045	3.5	52 657	24	44	34.0	6 652 126
		0	0.0	0	0	0	0.0	0
		7 022	3.0	21 066	26	30	28.0	2 191 601
17-18	22:00	7 570	2.0	15 140	24	27	25.5	1 434 457
		8 511	10.0	85 110	16	30	23.0	7 273 271
26-27	12:00	0	0.0	0	0	0	0.0	0
		3 395	8.0	27 160	140	250	195.0	19 678 216
27-28	15:30	28 234	5.4	152 463	40	130	85.0	48 151 124
		13 111	11.0	144 221	50	75	62.5	33 491 134
28-29	19:00	240	2.5	600	26	58	42.0	93 631
		0	0.0	0	0	0	0.0	0
31-32	10:15	0	0.0	0	0	0	0.0	0
		2 375	2.1	4 987	42	46	44.0	815 374
		0	0.0	0	0	0	0.0	0
		0	0.0	0	0	0	0.0	0
32-33	17:00	0	0.0	0	0	0	0.0	0
		2 145	6.0	12 870	12	21	16.5	789 012
		14 260	2.0	28 520	11	16	13.5	1 430 555
		6 110	2.8	17 108	12	19	15.5	985 263
33-34	21:20	8 905	1.8	16 029	10	17	13.5	804 010
		9 908	1.1	10 898	11	30	20.5	830 145
		5 178	0.8	4 142	8	13	10.5	161 608
		2 006	2.5	5 015	25	30	27.5	512 419
34-35	02:00	3 469	2.5	8 672	22	30	26.0	837 797
		0	0.0	0	0	0	0.0	0
		8 992	1.5	13 488	18	24	21.0	1 052 418
		0	0.0	0	0	0	0.0	0
		0	0.0	0	0	0	0.0	0
35-36	08:30	555	9.0	4 995	460	490	475.0	8 815 571
		0	0.0	0	0	0	0.0	0
		2 083	2.5	5 207	200	220	210.0	4 063 216
36-37	10:58	10 667	5.0	53 335	15	40	27.5	5 449 621
		7 778	4.6	35 778	20	30	25.0	3 323 434
		433	2.5	1 082	15	15	15.0	60 331
37-38	16:16	2 162	3.0	6 486	10	14	12.0	289 188
		0	0.0	0	0	0	0.0	0
		686	1.5	1 029	66	68	67.0	256 160
38-39	19:30	1 823	3.5	6 380	18	28	23.0	545 260
		19 686	3.5	68 901	14	66	40.0	10 240 163
		34 687	3.5	121 404	30	66	48.0	21 651 967

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Table 1 continued

Transect	Local time	Shoal						
		Length m	Height m	Area m^2	Depth m		Average depth m	Volume m^3
					Start	End		
39-40	20:30	7 529	2.0	15 058	24	40	32.0	1 790 353
		6 411	2.0	12 822	20	28	24.0	1 143 374
		0	0.0	0	0	0	0.0	0
		11 797	3.0	35 391	18	20	19.0	2 498 433
40-41	04:17	10 611	3.0	31 833	16	30	23.0	2 720 362
		9 388	2.0	18 776	36	50	43.0	2 999 804
		11 028	2.0	22 056	50	62	56.0	4 589 191
		6 190	6.0	37 140	25	80	52.5	7 244 736
		16 705	5.5	91 877	50	110	80.0	27 309 924
		5 317	7.0	37 219	110	110	110.0	15 211 734
42-43	21:46	4 459	10.0	44 590	135	160	147.5	24 437 165
		5 691	6.0	34 146	95	150	122.5	15 541 655
		4 629	2.0	9 258	95	95	95.0	3 267 850
43-44	04:30	2 423	2.0	4 846	95	95	95.0	1 710 521
		21 238	2.5	53 095	40	115	77.5	15 288 915
		22 449	4.5	101 020	30	90	60.0	22 520 711
		4 350	6.0	26 100	38	70	54.0	5 236 675
		0	0.0	0	0	0	0.0	0
44-45	09:56	4 331	2.0	8 662	40	46	43.0	1 383 910
		1 561	2.5	3 902	50	60	55.0	797 493
		15 761	5.0	78 805	50	76	63.0	18 446 571
		8 533	9.5	81 063	50	70	60.0	18 071 655
		0	0.0	0	0	0	0.0	0

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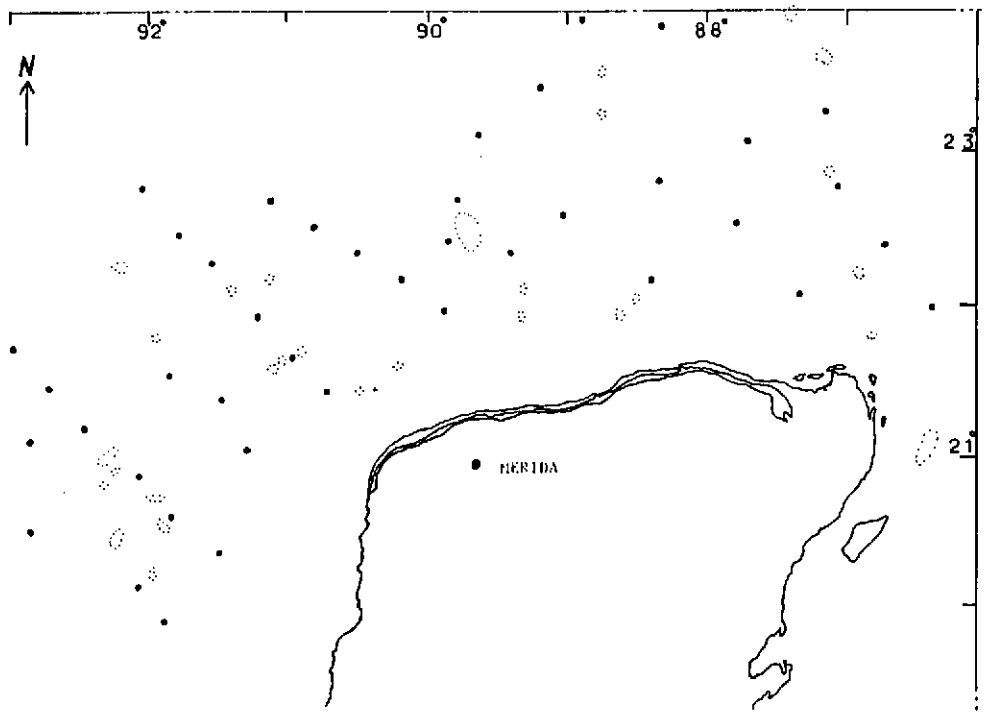

Figure 1. Network of pre-programmed hydrological stations on the Yucatan continental shelf.

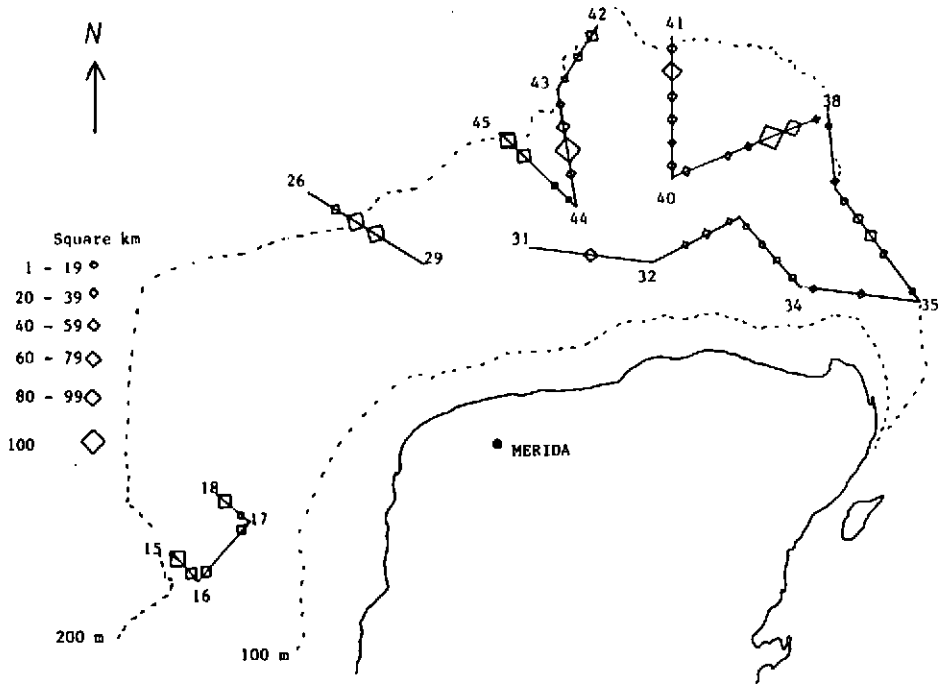

Figure 2. Ships track scanned with the echo-sounder and the estimated biomass per unit of 10 n.m.