Jack Mackerel (*Trachurus murphyi*) spatial distribution and seasonal acoustic biomass estimated in the north of Chile. 1981 - 1990.

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Abstract

The Jack Mackerel spatial distribution and seasonal acoustic biomass estimates are provided; it was carried out between the coast and the 200 nm in northern Chile, in the 1981-1990 period. The biomass seasonal changes and its geographic distribution with respect to the 1982-1983 presence of the El Niño event were analyzed.

The most important results indicate that the jack mackerel modified its presence and geographic distribution in the studied zone during the spring of 1981, previous to the 1982-1983 El Niño event, suggesting a movement to the south.

The maximum jack mackerel biomasses were estimated in the 1981-through-1983 winter periods, reaching a 5.8-million-tons top in 1981. Since 1982, an important reduction in the jack mackerel biomass is registered, reaching a 34-thousand-tons minimum in 1995. This change matches the presence of the El Niño event in 1982-1983.

Introduction

In 1981, IFOP started a seasonal acoustic survey program, oriented at assessing the jack mackerel biomass inside the EEZ in the northern zone of Chile. This program was stopped in 1995 and re-activated in 2006. These results have allowed knowing the seasonal variability in the jack mackerel biomass, located in north Chile, and the long time changes as well as knowing the biomass distribution and its projection to the south.

Materials and Methods

Between 1981 and 1995, 36 surveys were carried out covering the area delimited by 18°21 to 30°S (**Table 1**) inside the EEZ. The scientific vessels used were ‘‘Itzumi’’ (1984), a 40.59-m stern trawler, and ‘‘Carlos Porter’’ (1985-1990), a 27-m trawler, using SIMRAD scientific systems, composed of EKS (‘‘Itzumi’’), and EKR (‘‘Carlos Porter’’) 38-kHz echosounders and QM-MK II analogue echo integrators, calibrated according to standard procedures (Foote et al., 1987). The acoustic data were collected in 1 nm sampling basic units (EDSU) and performed in parallel diurnal transects. In 1981 and 1982, the transects were located at random separated by 16 nm average, later, they were systematically located separately by 20 nm distance. A-32.5 dB kg^{-1} TS_{kg} was applied to transform the echo integrator output into biomass. Species discrimination in the acoustic readings was done based on purse-seine fishing (‘‘Carlos Porter’’), performed by an auxiliary fishing ship, and midwater trawling (‘‘Itzumi’’).

Since 2006, the acoustic surveys were carried out with a scientific vessel B/I “Abate Molina”, a 43,5 m stern trawler. The biomass was evaluated with acoustic methods (SIMRAD EK-500, double frequency echosounder of 38 and 120 kHz). A systematic sampling with variable conglomerate, where each conglomerate corresponds to a transect. For these purposes, parallel transects perpendicular to the coast were established, on 20-25 nautical miles (nm) distance. The survey considered auxiliary vessels for identification fishing, and a mid-water trawl net (type Engel) was used as a sampling unit.

Table 1.

Acoustic survey carried out in the northern Chile 1981-2007.

Date	Latitude rank	West extention (nm)	Cruise days	Ships
17.03-09.05.1981	18°21' - 30°00'	1-200	55	2
16.06-10.08.1981	18°21' - 30°00'	1-200	55	2
15.10-15.12.1981	18°21' - 30°00'	1-100	60	1
20.07-16.09.1982	18°21' - 30°00'	1-200	55	1
19.02-28.03.1983	18°21' – 28°00'	1-100	40	1
07.05-06.06.1983	18°21' – 24°00'	1-200	30	2
31.04-12.09.1983	18°21' – 28°00'	1-180	57	2
12.08-15.09.1984	18°21' – 28°00'	1-100	34	1
29.10-30.11.1984	18°21' – 28°00'	1-100	32	1
26.03-26.04.1985	18°21' – 24°00'	1-100	31	1
24.07-24.08.1985	18°21' – 24°00'	1-100	31	1
31.10-5.12.1985	18°21' – 24°00'	1-100	36	1
21.03-02.05.1986	18°21' – 31°00'	1-100	43	1
20.07-23.08.1986	18°21' – 24°00'	1-100	34	1
20.03-27.04.1987	18°21' – 27°00'	1-100	38	1
23.07-01.09.1987	18°21' – 27°00'	1-200	38	1
08.11-15.12.1987	18°21' – 27°00'	1-200	38	1
12.02-01.03.1988	18°21' – 24°00'	1-200	23	1
04.05-23.05.1988	18°21' – 24°00'	1-200	19	1
10.08-29.08.1988	18°21' – 24°00'	1-200	20	1
17.11-19.12.1988	18°21' – 24°00'	1-200	23	1
20.03-11.04.1989	18°21' – 24°00'	1-200	22	1
05.05-26.05.1989	18°21' – 24°00'	1-200	21	1
21.08-12.09.1989	18°21' – 24°00'	1-200	22	1
16.02-08.03.1990	18°21' – 24°00'	1-200	22	1
02.05-20.05.1990	18°21' – 24°00'	1-200	18	1
31.07-19.08.1990	18°21' – 24°00'	1-200	20	1
17.02-03.03.1991	18°21' – 24°00'	1-200	17	1
25.07-26.08.1991	18°21' – 28°00'	1-200	32	1
19.11-09.12.1991	18°21' – 24°00'	1-200	31	1
23.02-03.03.1992	18°21' – 24°00'	1-200	12	1
10.06-18.06.1992	18°21' – 24°00'	1-200	9	1
26.10-6.11.1992	18°21' – 24°00'	1-200	12	1
20.08-17.09.1993	18°21' – 30°00'	1-100	27	1
01.08–17.09.1994	18°21' – 30°00'	1-100	48	1
06.08–16.09.1995	18°21' – 30°00'	1-100	44	1
03.11–05.12.2006	18°21' – 23°50'	1-100	33	1
28.10-27.11.2007	18°25' – 23°50'	1-200	30	1

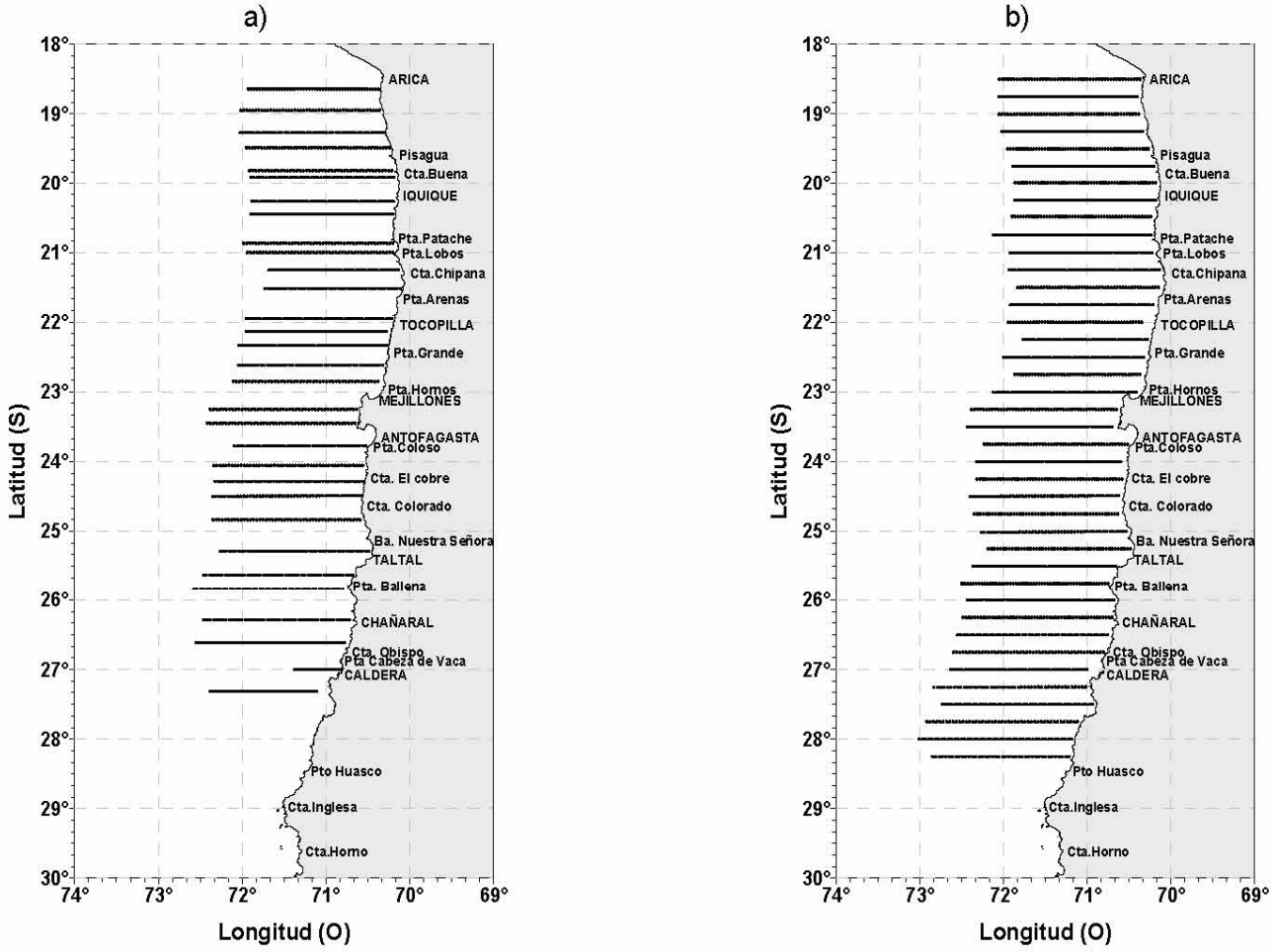


Figure 1. Acoustic survey design applied in the north of Chile between 1981-1982 (a: random design) and after years (b: systematic design).

Results / discussion

Important changes in the acoustic biomass levels were observed before and after 1983, this is probably related to the "El Niño 82/83" phenomenon. In this period, the biomass was estimated on around 6-7 mill tons in the northern area of Chile (18°25' – 30° S), decreasing since 1983 to 10% of these levels. These surveys show that, in general, the highest biomasses were found in winter time. (**Table 2, Figure 2**).

Table 2.

Jack mackerel acoustic biomass estimated in northern Chile (18°25' – 30° S) 1981-2007

	18°25' - 24° S					24° - 30° S			
	Summer	Autumn	Winter	Spring		Summer	Autumn	Winter	Spring
1981		1,415,000	5,808,000	1,312,000	1981		2,766,000	1,483,000	1,695,000
1982			2,767,000		1982			5,275,000	
1983	302,800	2,120,000	1,825,500		1983	113,400		1,638,000	
1984			46,600	99,000	1984			482,300	284,000
1985		303,500	262,000	323,800	1985		122,900	187,000	
1986		29,250	102,400	123,100	1986		160,710	225,525	
1987		276,200	306,000	212,900	1987		78,200	124,800	51,600
1988	154,759	92,700	296,800	133,900	1988				
1989	120,700	111,450	610,000		1989				
1990	215,000	102,430	116,000		1990				
1991	74,000		258,400	242,000	1991			582,480	
1992			803,420		1992				
1993			511,150		1993			292,780	
1994			212,972		1994			241,557	
1995			34,460		1995			274,660	
2006				114,600	2006				
2007				272,600	2007				

The decline in biomass was observed both from 24°S to the north and to the south. However this biomass scale changes, the acoustic biomass in this area has shown high variability and a trend to increase. In this period, two peaks were observed; one in 1989, and the other in 1992, but since this year, there has been a downward trend (**Figure 3**). In the north, while the biomass decreased, in the southern area this biomass maintained its levels. This suggests that the contraction of the available biomass followed north-south direction.

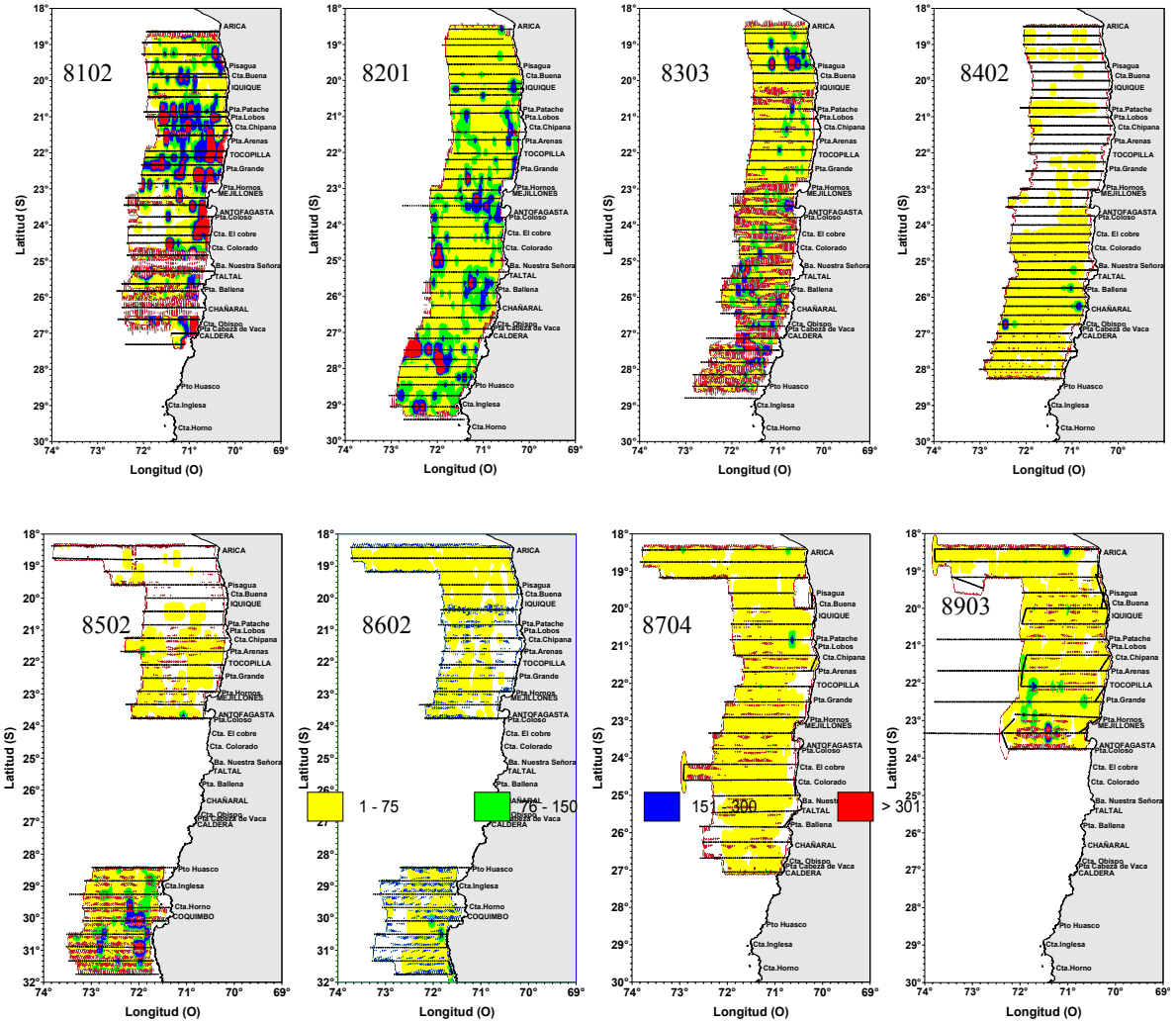


Figure 2. Spatial jack mackerel biomass distribution in the north of Chile in winter periods between 1981 and 1989.

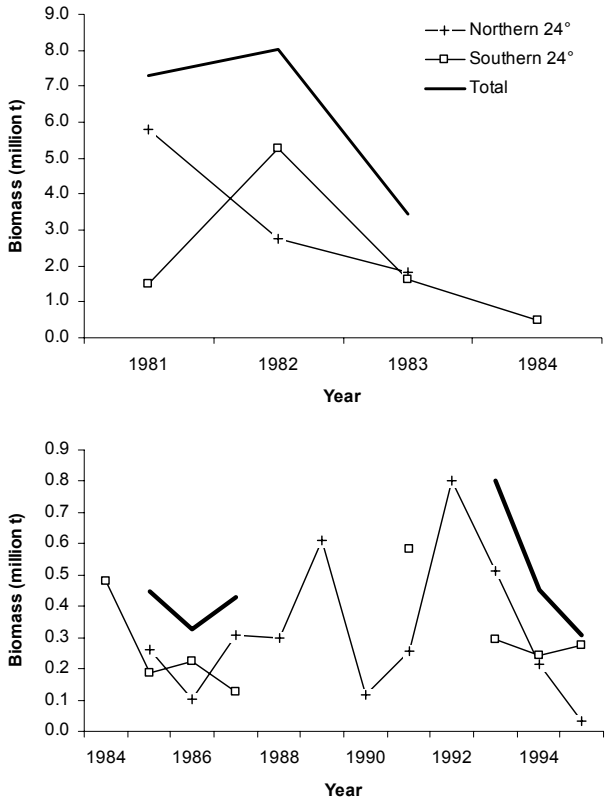
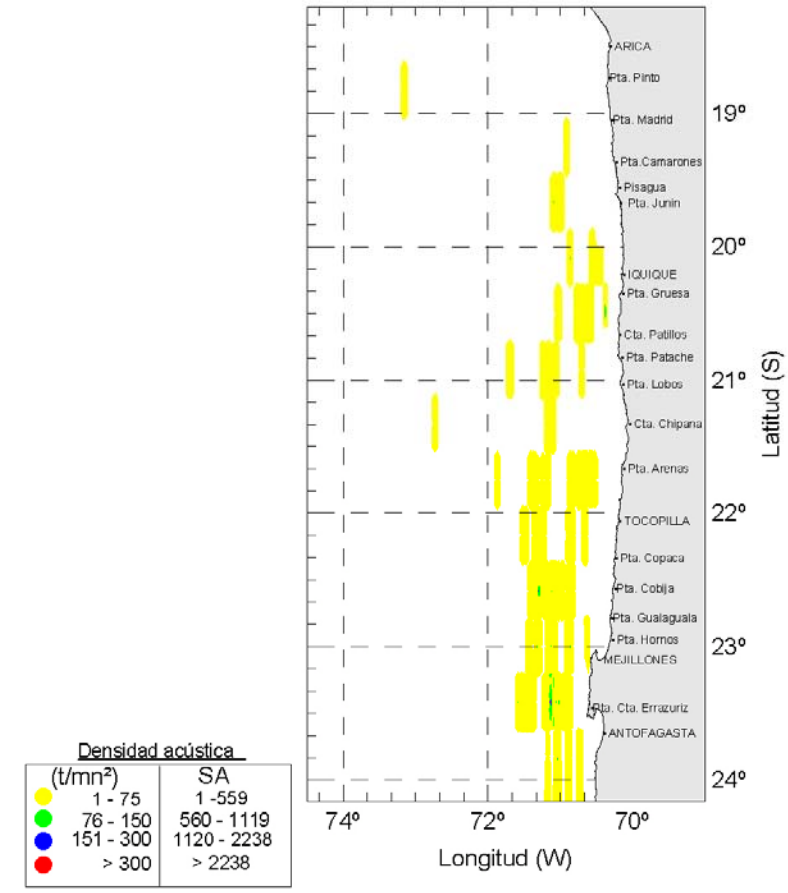


Figure 3. Winter acoustic jack mackerel biomass 18°25'-30°S in the 1981-1994 period

The acoustic survey program started in 1981; it was stopped in 1995, and re-activated in 2006. The biomass estimated in 2006-2007 confirmed low values for this area, similar to the 90's, with levels between 115 – 300 thousand tons. These surveys confirm that the main biomass concentration is distributed from 22° S to the south with its highest values found offshore (Figure 4 and 5). This supports the idea that jack mackerel abundance is located offshore and south of this study area, which coincides with the discussed by Serra (1991) for the 80's.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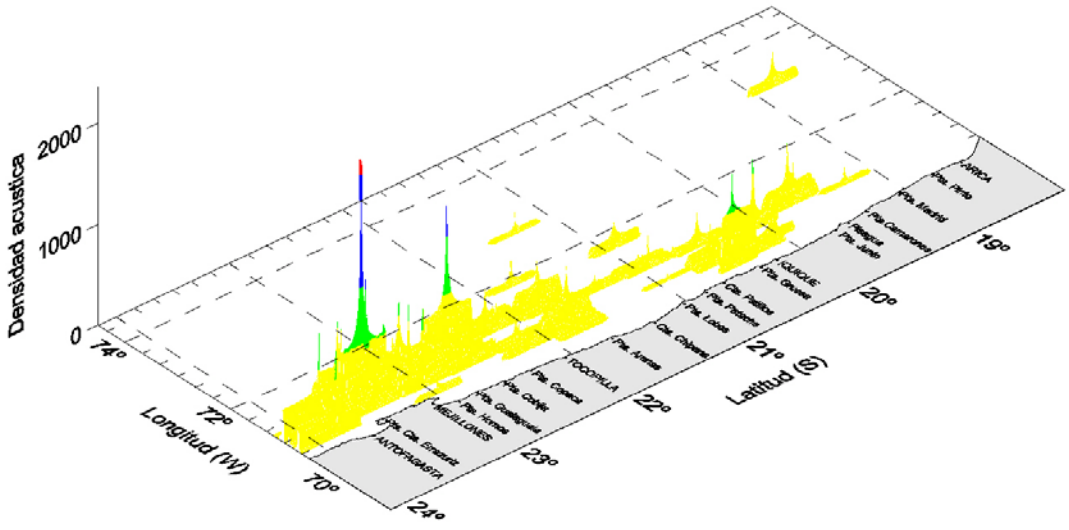
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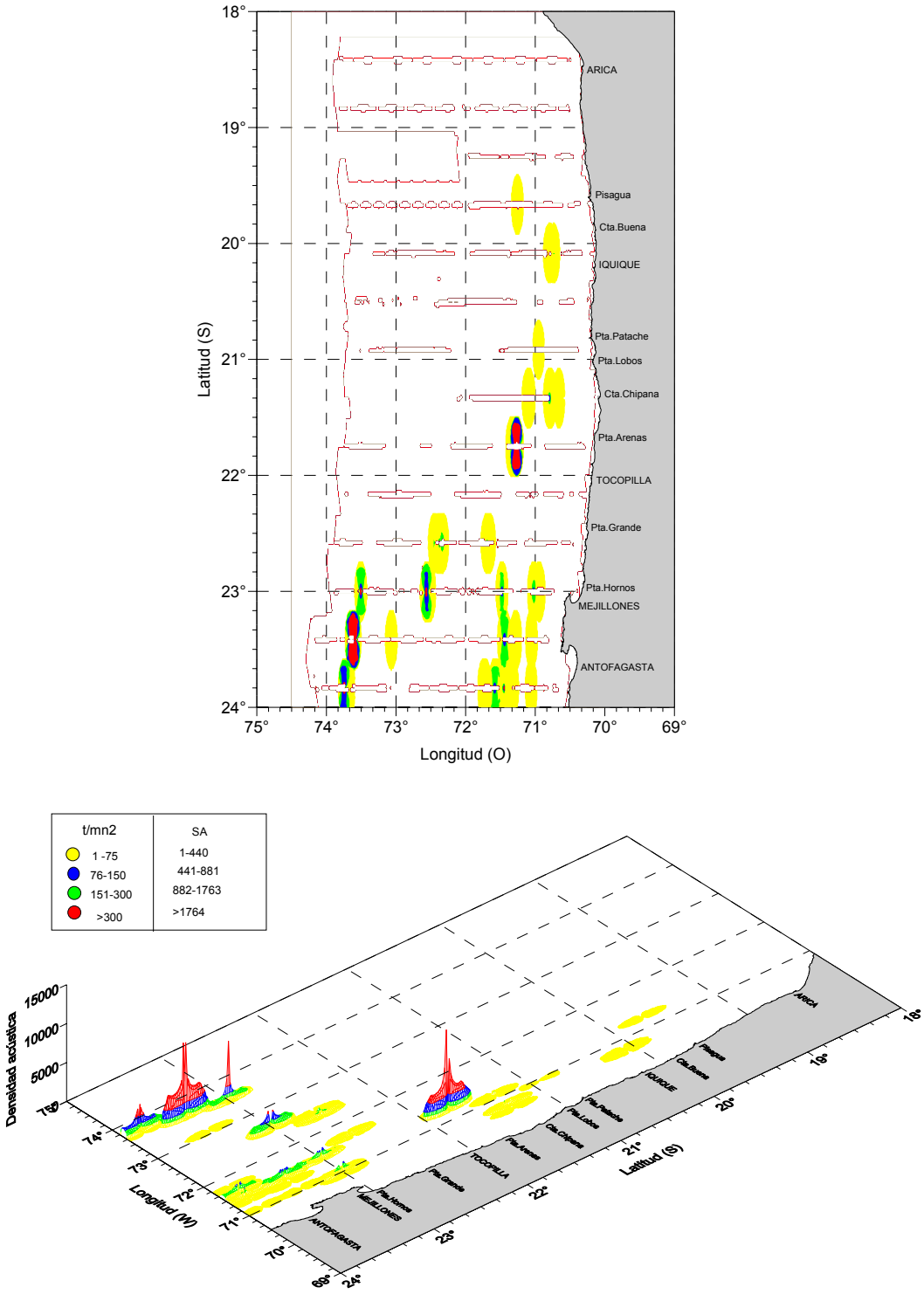

Figure 5. Jack mackerel acoustic biomass distribution in 2007.

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