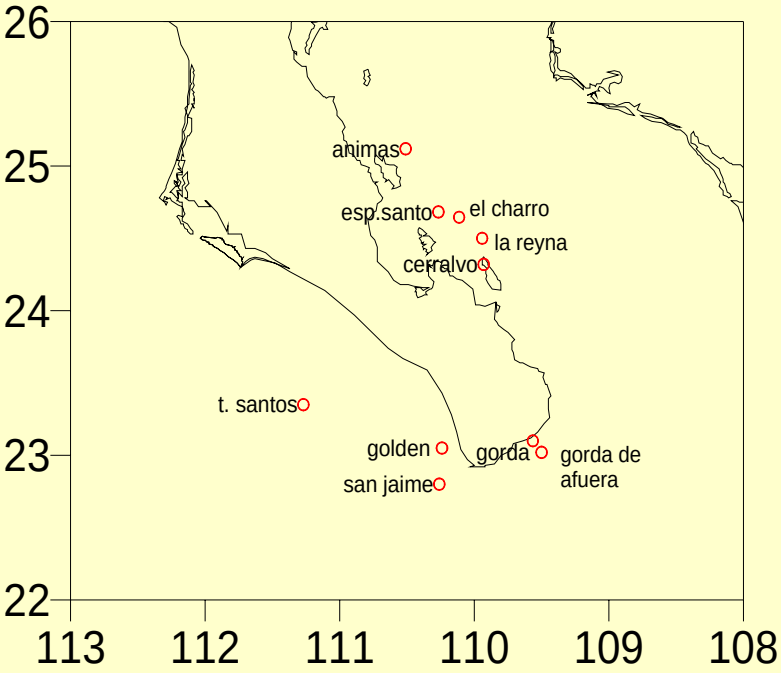
Differences in large pelagic fish larvae and zooplankton volumes over and around a seamount in the Gulf of California.

ROGELIO GONZALEZ-ARMAS1*, A. MUHLIA-MELO2 , A. TRASVIÑA-CASTRO3, G. GUTIERREZ DE VELASCO3, A. VALLE-LEVINSON4 and R. FUNES RODRIGUEZ1

Introduction



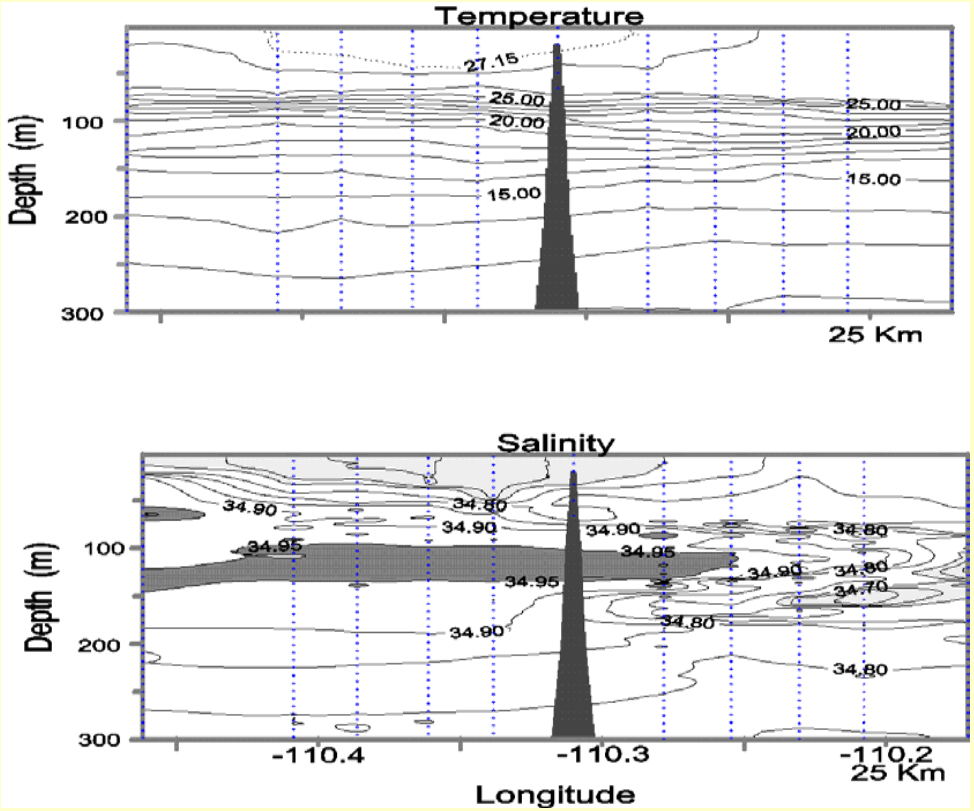
Localizaci? de los bajos
en la parte sur del Golfo de California.

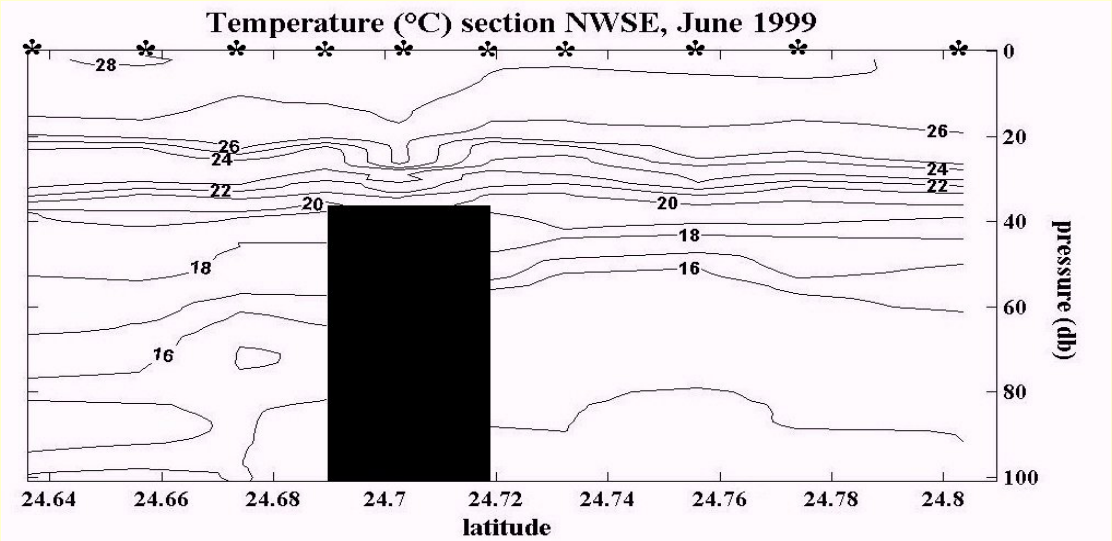
- **At the southern portion of the Gulf of California, there is a group of seamounts surrounding the coastal zone of the Baja California peninsula: Las Animas, El Bajo Espiritu Santo (EBES), Bajo Gorda and San Jaime are the most recognized in the region.**

Seamounts modify the circulation increasing the primary productivity (Bakun, 1996; Roden 1987).

The distortion of isotherms is a feature of interaction between currents and topography, enhancing the local productivity (Mullin, 1993, Roden 1986; Yamanaka, 1986, Bakun, 1996; Trasviña Castro *et al*. 2003)

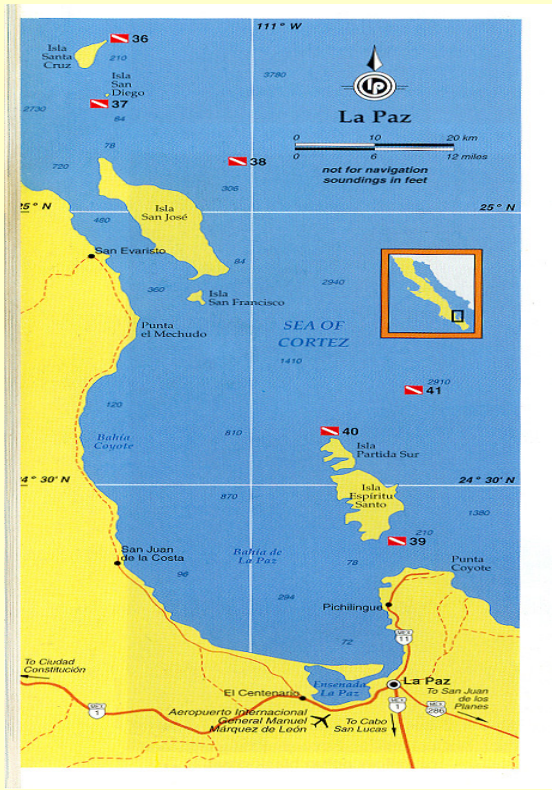
The physical oceanography of seamounts has been characterized by regions of strong mixing, internal wave interactions, eddies and recirculations. This work has been done in oceanic and isolated seamounts, recording anticyclonic eddies, convergence areas and Taylor's column (Boehlert and Genin, 1987, Brink, 1989, Boehlert and Mundy, 1993; Parker and Tunnicliffe, 1994).





Study area

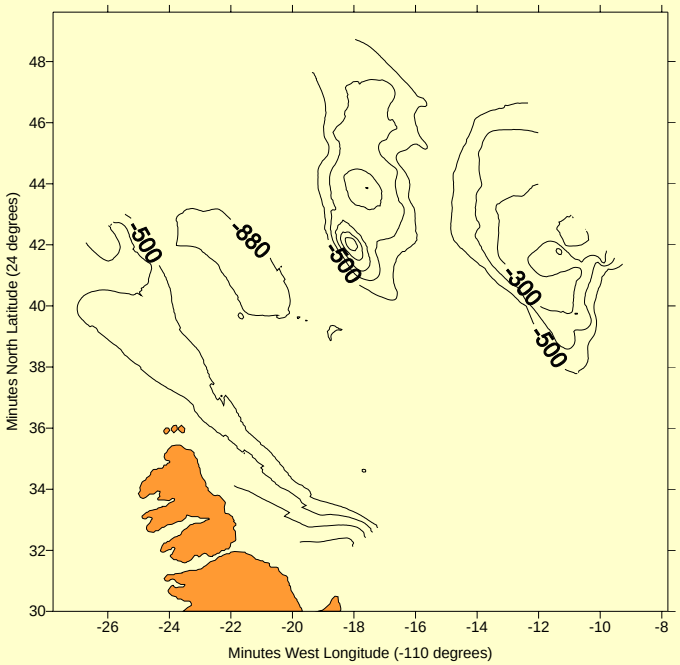
- El Bajo Espiritu Santo seamount (EBES) is located at 24°42´N and 110°18´W, northeast of La Paz, Baja California Sur, Mexico, in the Gulf of California.
- Is visited by scuba divers for the remarkable seasonal aggregation of fish and scalloped hammerhead sharks. (Klimley y Nelson 1981, 1988).

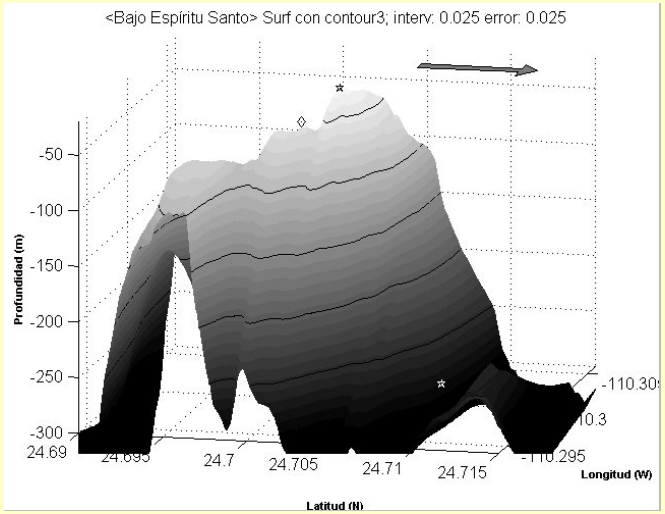


El Bajo del Espíritu Santo (EBES) is a seamount located 9 n.m. from Espiritu Santo island

The base is located 990 m depth.

Is full of marine life, regular visitors include: billfish, snappers, manta rays, sharks and some times the whaleshark.





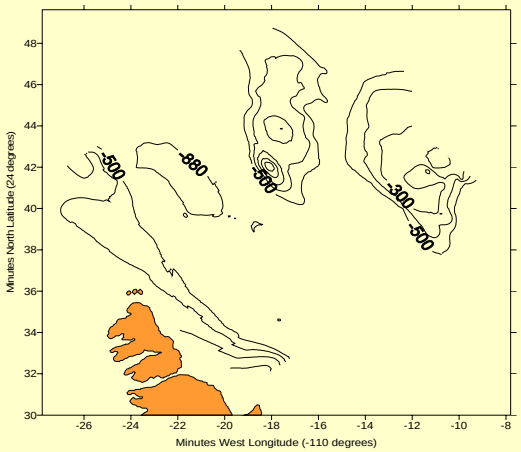
New bathymetric data revealed a deep basin (990 m) between Espíritu Santo island and the EBES seamount .

Is visited by fishermen by the abundance of tunas, billfish, and snappers.

Behaviour of hammershark *Sphyrna lewini* has been studied by Klimley and Nelson (1981, 1988).

Tagging of yellowfin tuna and billfish has been done by Klimley et al, (2003).

Our Pelagic Fish Research Group are still working with pelagic fishes over the seamount.



PELAGIC FISH RESEARCH GROUP

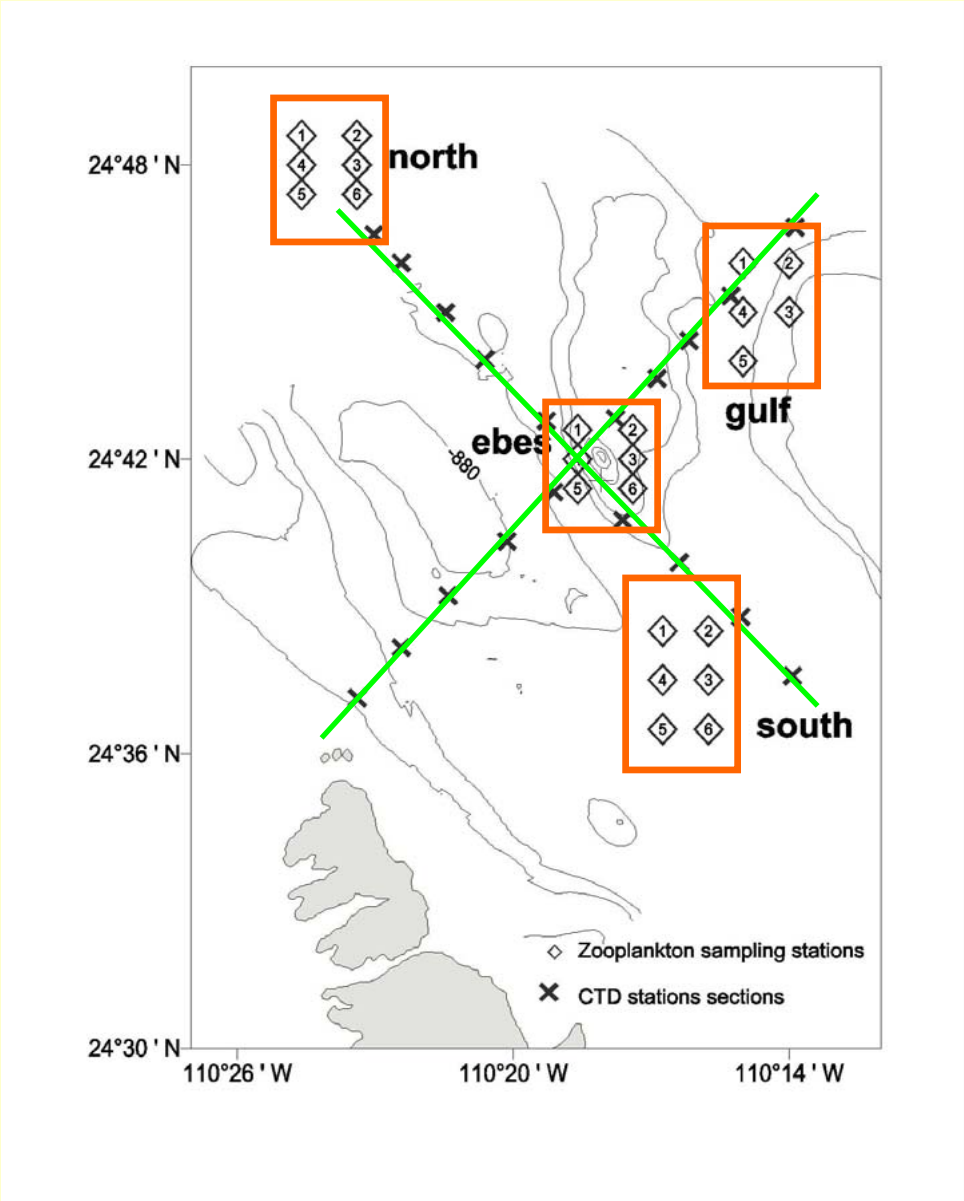
SOUTHERN GULF OF CALIFORNIA

CIBNOR • UC DAVIS • CICIMAR

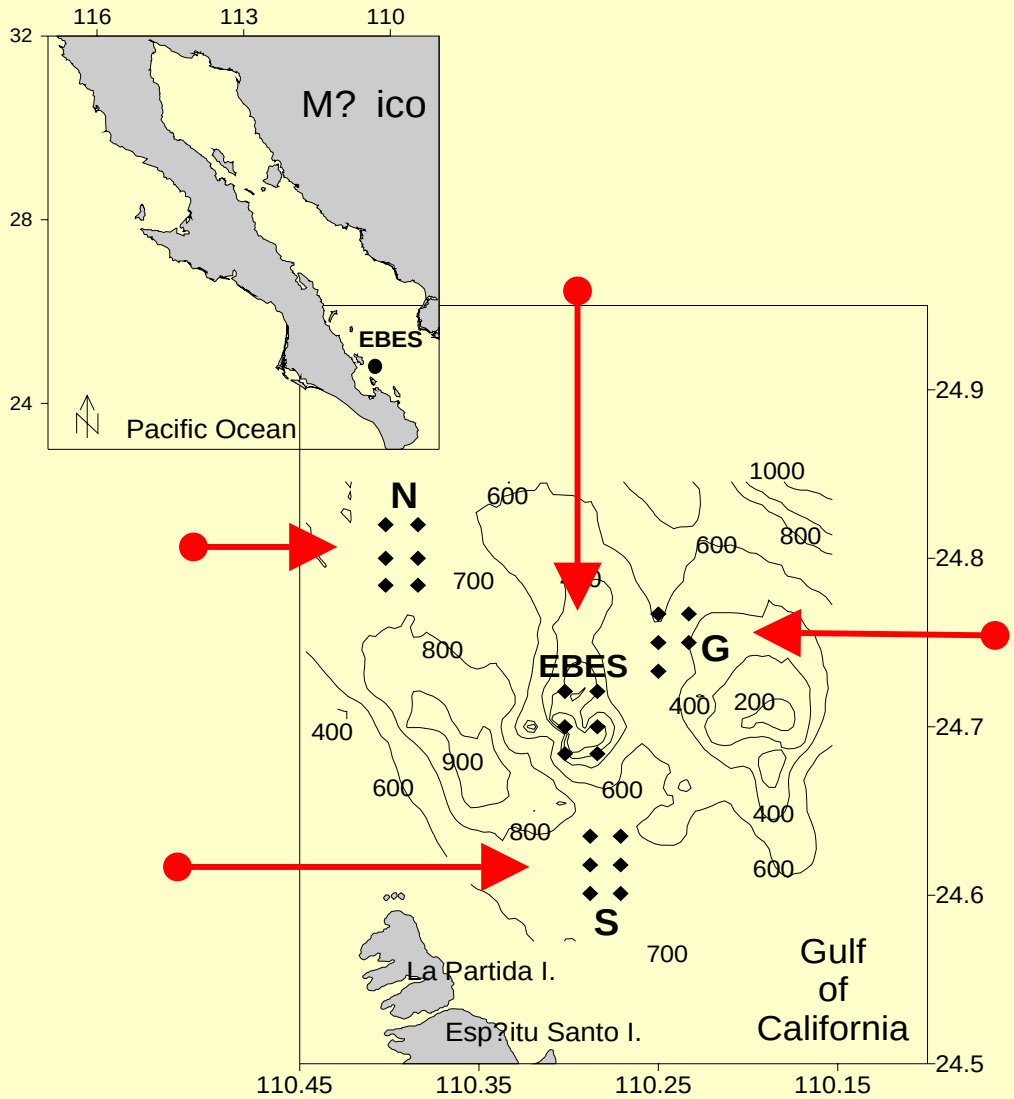
Materials and Methods (Physical Oceanography)

An oceanographic cruise was carried out from 19th to 21st June in 1999 on board R/V Francisco de Ulloa . The general pattern of currents over the seamount was determined with an 150 KHz ADCP from the ship. Additionally an ADCP was deployed at 400 m for six months (ValleLevinson, 2004).Hydrographic casts with a CTD were recorded in 20 stations to 1000 m depth, in two perpendicular transects 10 n. m. long each one in Nw-Se and Sw-Ne direction.

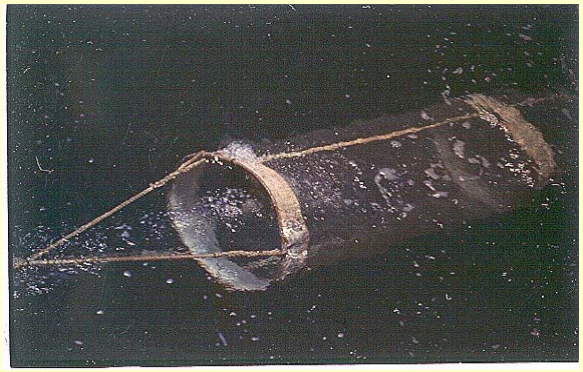
Plankton samples were collected in four fine-scale grids with six stations in each one, EBES, North, Gulf and South.

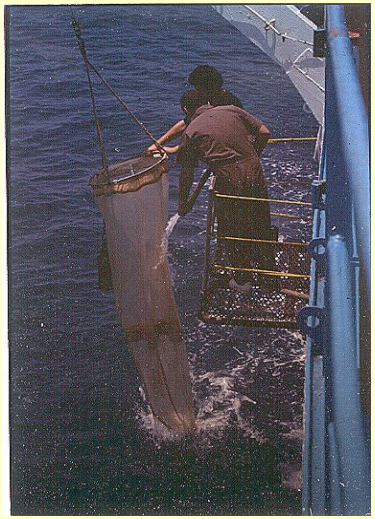


Fine-scale station plan



Plankton:





Surface plankton tows were carried out with a plankton net of 0.6 m diameter and 3 m long and mesh of 505μ at high speed (3.5 knots) during 5 minutes (González Armas et al., 2002).

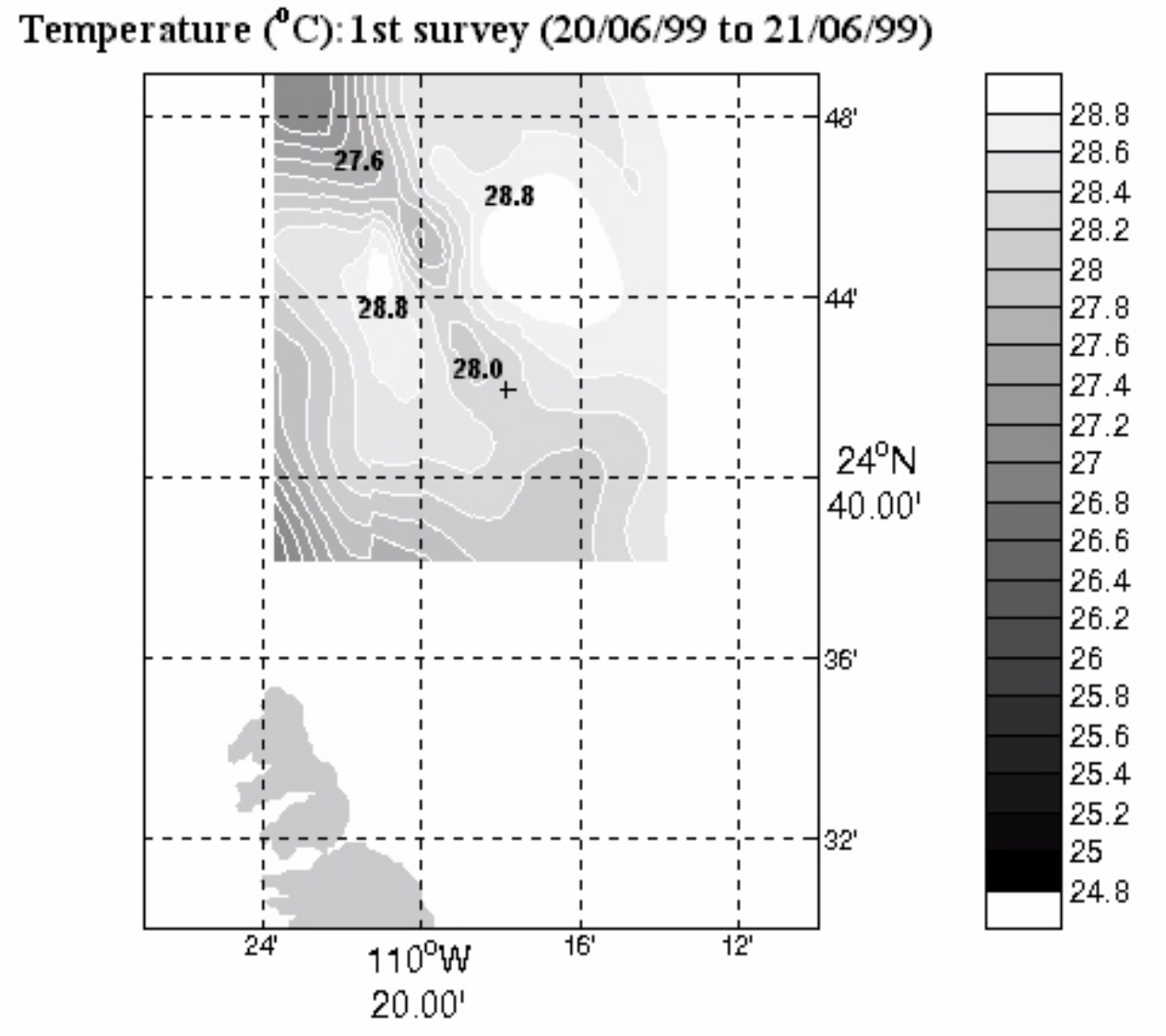
Plankton samples were fixed in 4% formalin. Zooplankton volumes were determined by the Mercury Inmersion Method (Yentsch and Hebard, 1957).

Fish larvae were identified to species level (Moser,1996). Statistical analysis (Kruskal Wallis y Newmann Keuls) were perfomed to corrobarate if significative differences existing between the EBES and the other fine grids in relation to number of larvae and zooplankton volumes

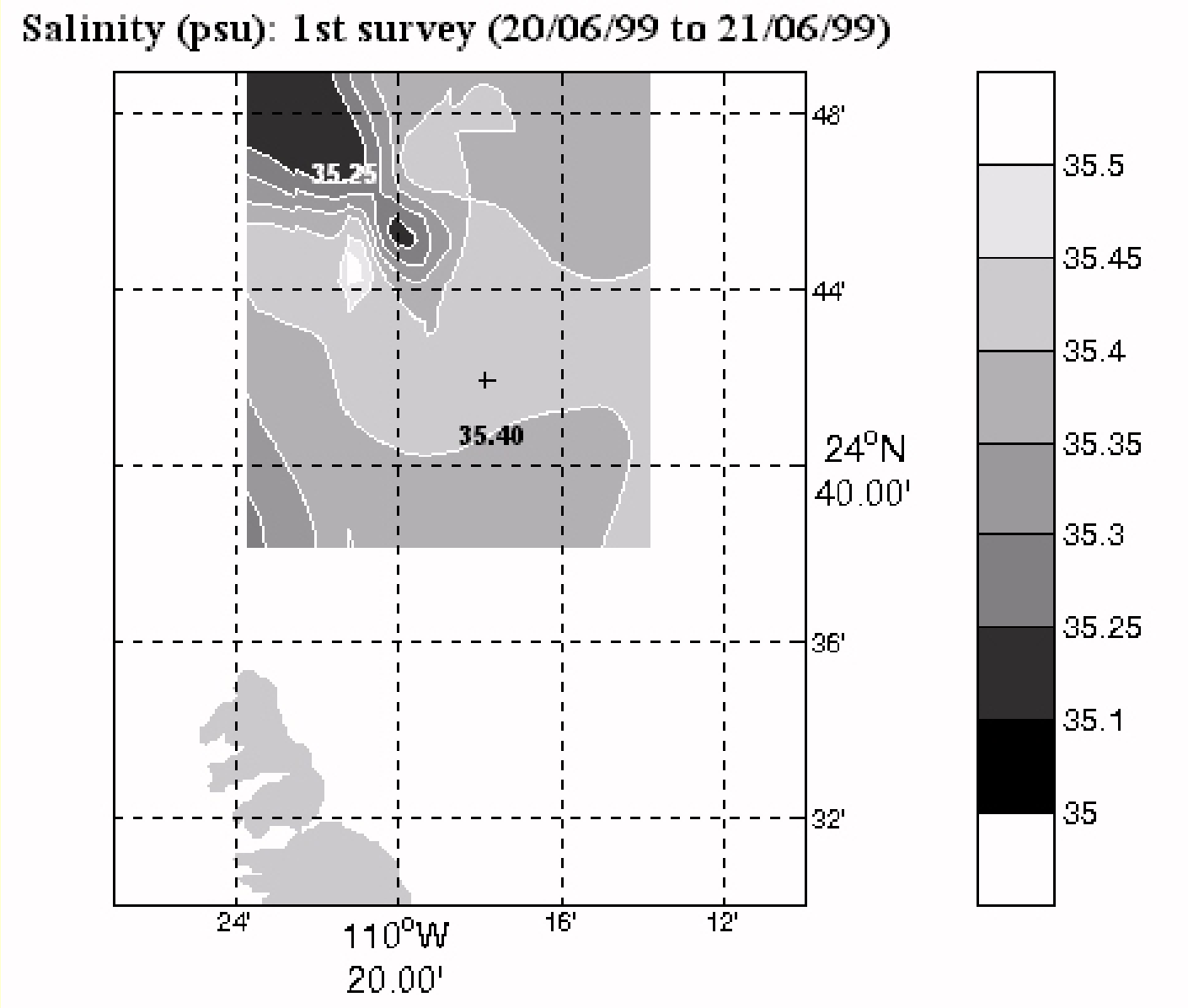
The cluster analysis was performed with the transformed matriz.

Results (Oceanography)

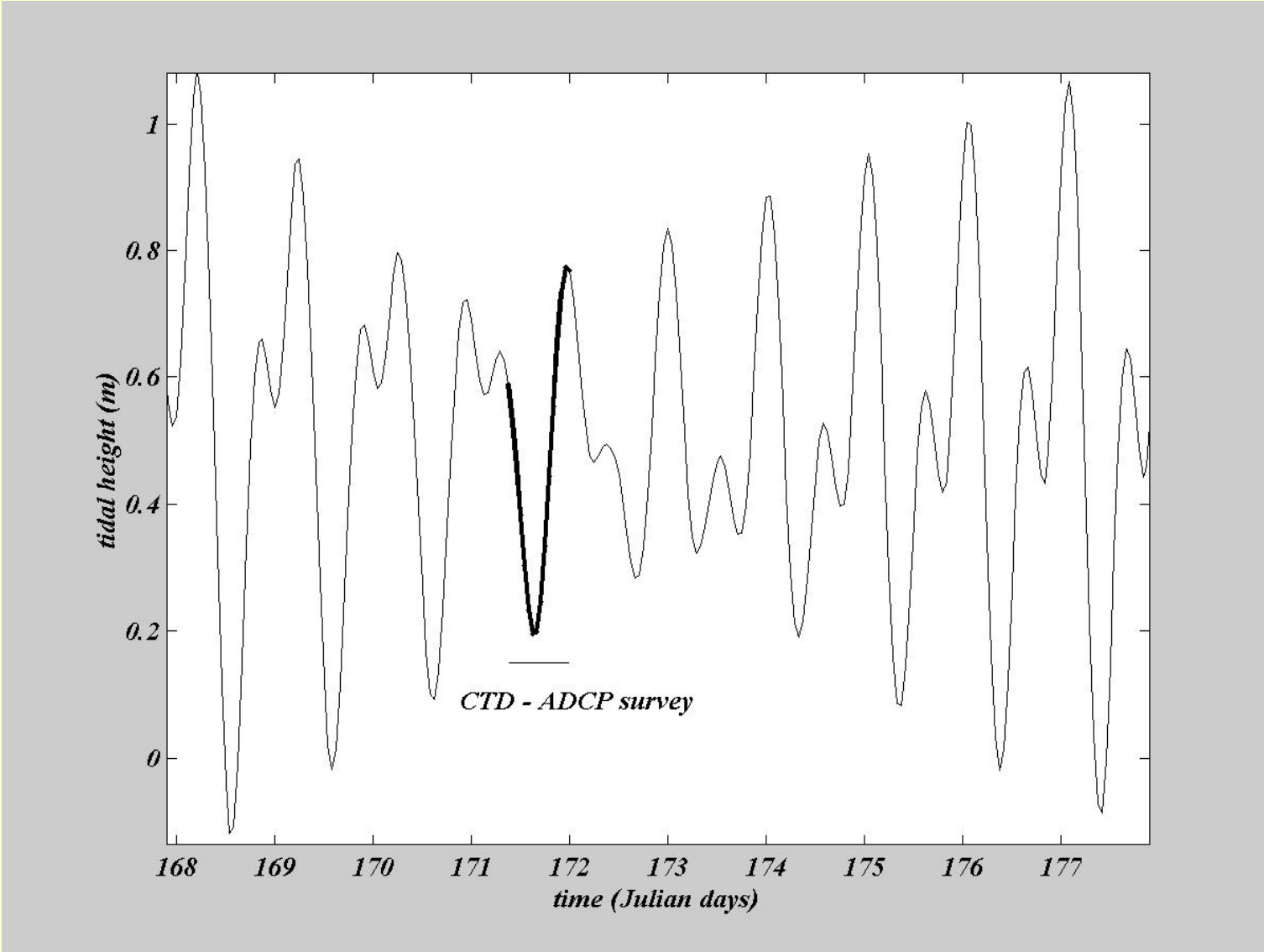
The surface thermosalinometer data show a termosaline front over the seamount.



Salinity (ups)



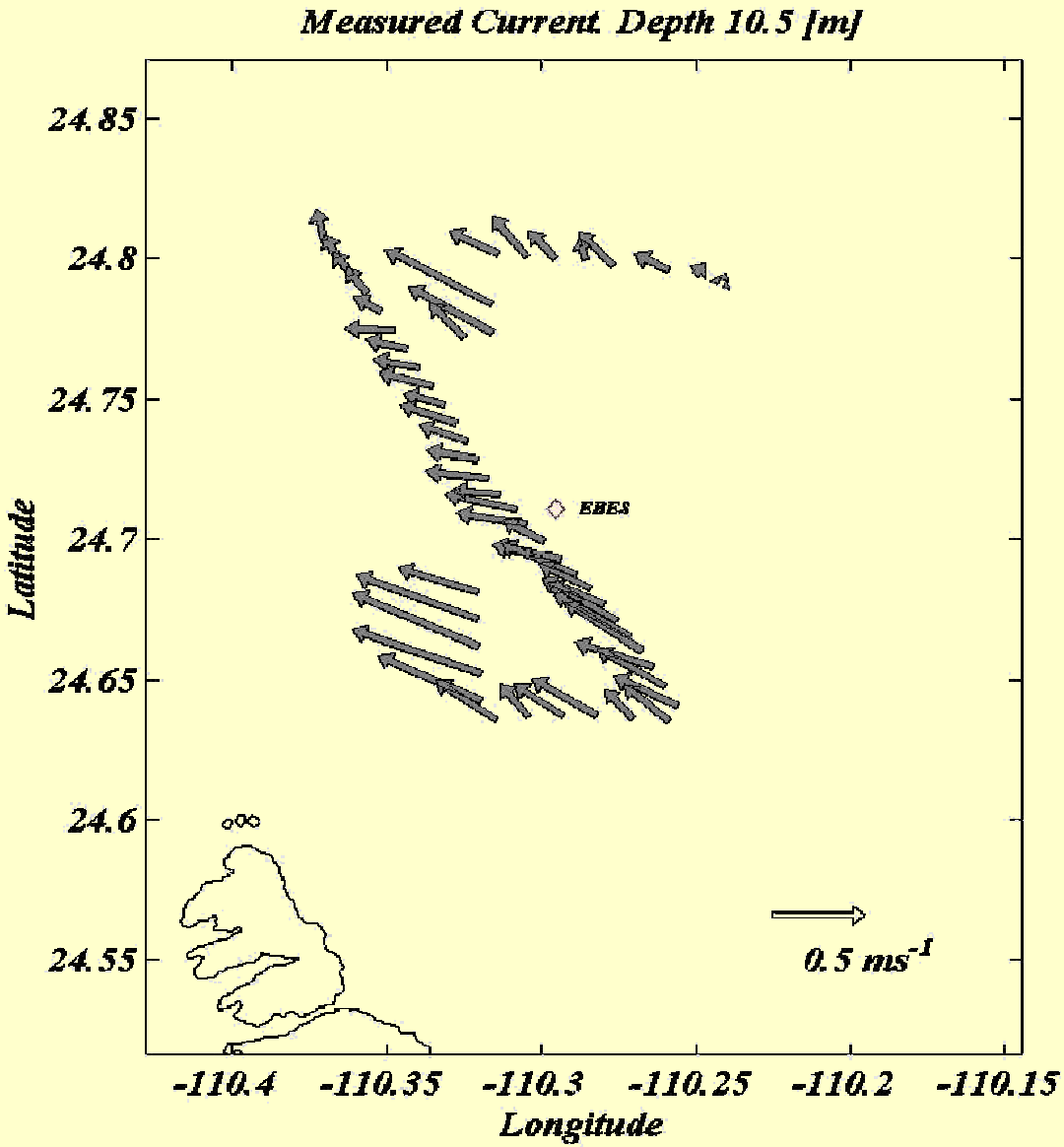
Graph of the tide during the sampling period for the cruise FU9906



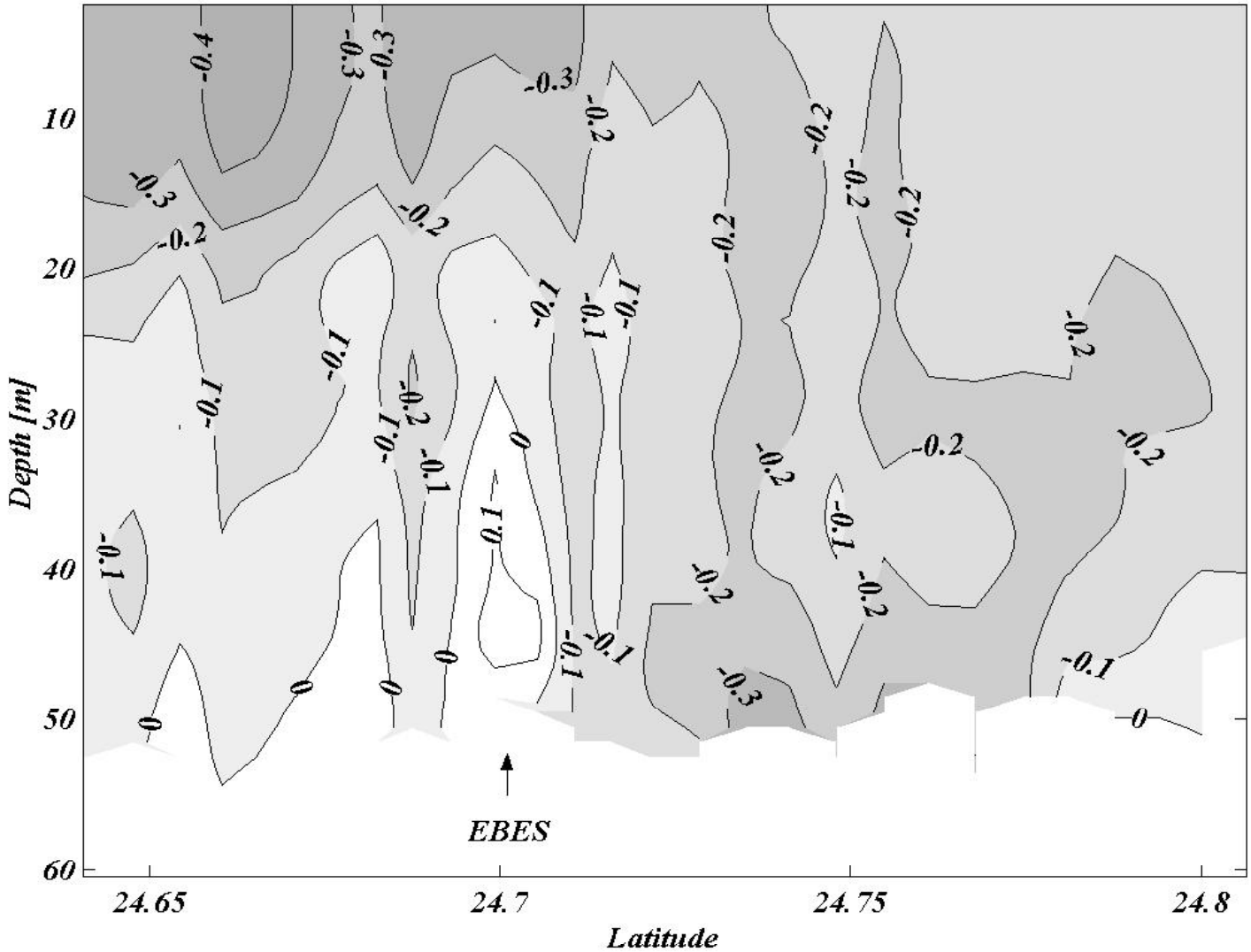
The ADCP data for a period of 10.8 hrs shown for the 10.5 m depth layer, the direction and intensity of the currents.

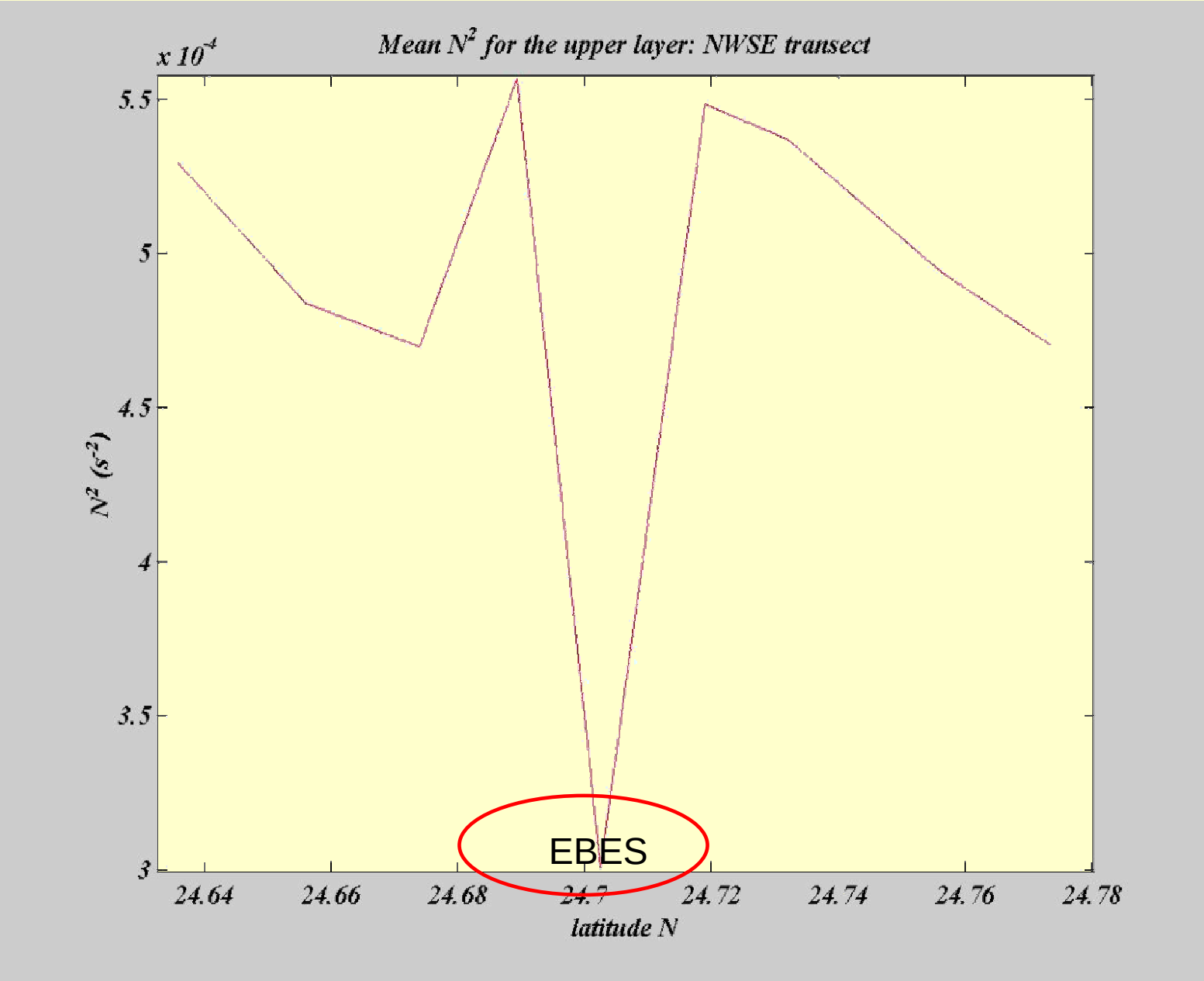
The velocity range recorded was 0.2 m s^{-1} and 0.8 m s^{-1}.

The highest velocities were recorded in the deep zone and smaller velocities were associated with the seamount.

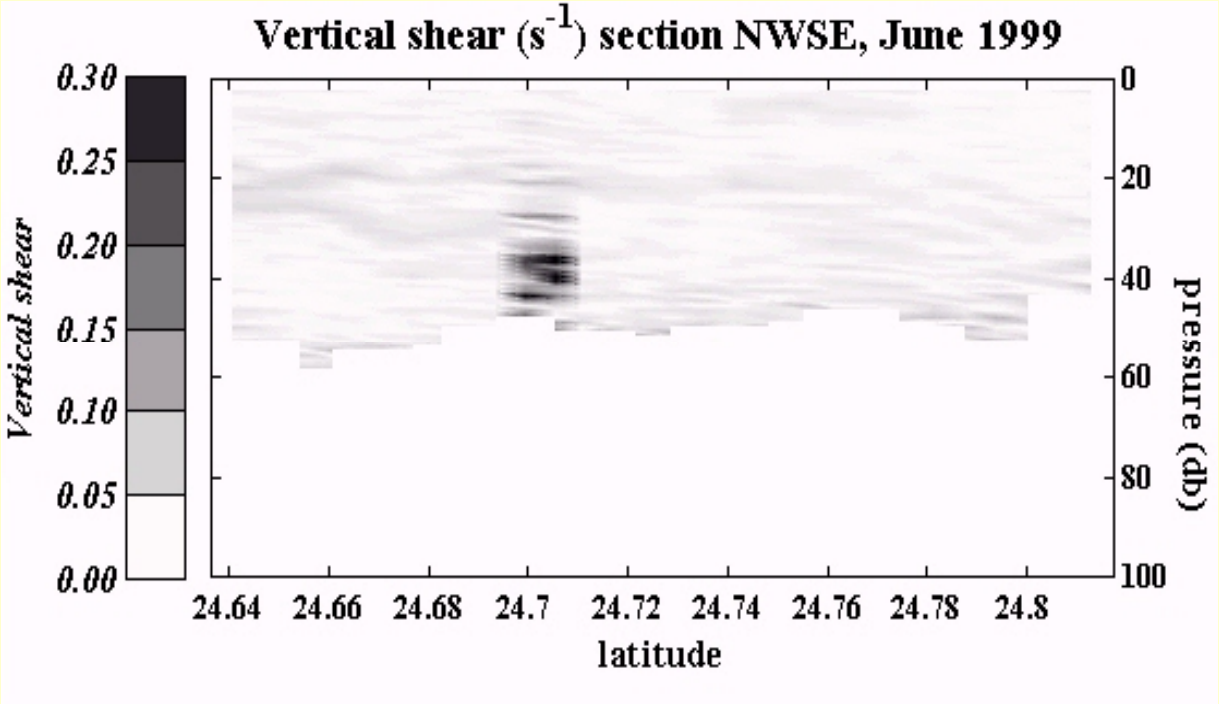


Two patterns were observed in the vertical profile.





The Minimum of Stratification was recorded over EBES.



- The summit of the seamount show important vertical shear, associated with low stratification. This is consintent with the existence of Lows Richardson's Number's , that indicate mixing by currents.(Trasviña-Castro et al., 2003).

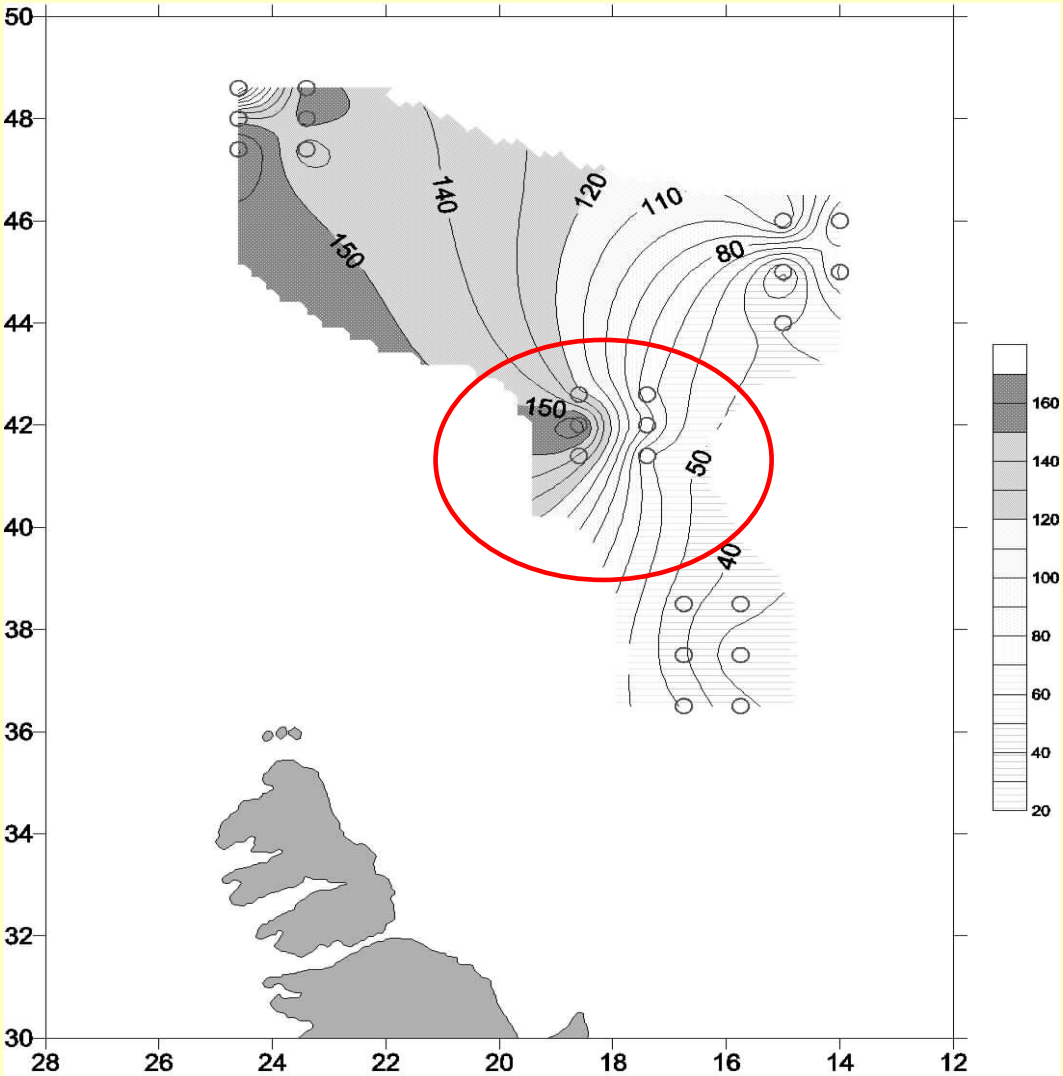
Results (zooplankton)

Zooplankton volumes were obtained for each station for all fine-scalegrids and standarized to (ml/1000m^3).

The EBES grid showed the highest values.

The South and Gulf grids were the minimum values in zooplankton biomass.

The plankton biomass distribution is similar to the temperature and salinity.

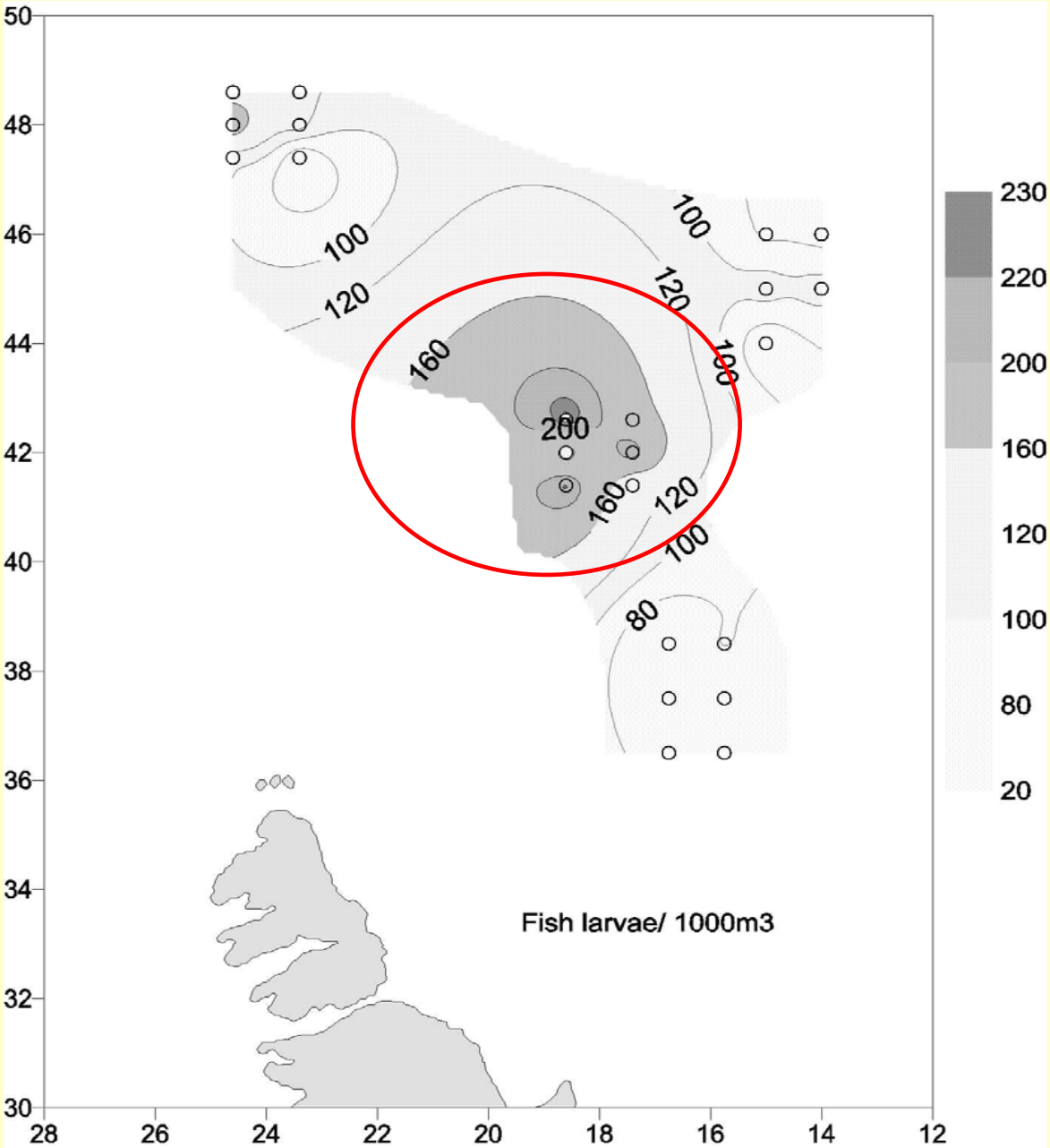


Fish larvae

In the case of fish larvae, it is evident the highest abundanceis in the EBES grid (larvae/1000m^3).

Fish larvae belonging to 39 taxa were identified.

In the EBES grid, 22 taxa were recorded and in the South grid 10 taxa.



Significative differences ($p<0.005$) between EBES and the others grids were found in relation with number of larvae and geographic location.

The Newman-Keuls test shows significative differences ($p<0.01$) between EBES and the others grids.

Among North,Gulf and South grids there is not significative differences ($p>0.1$) in all the cases.

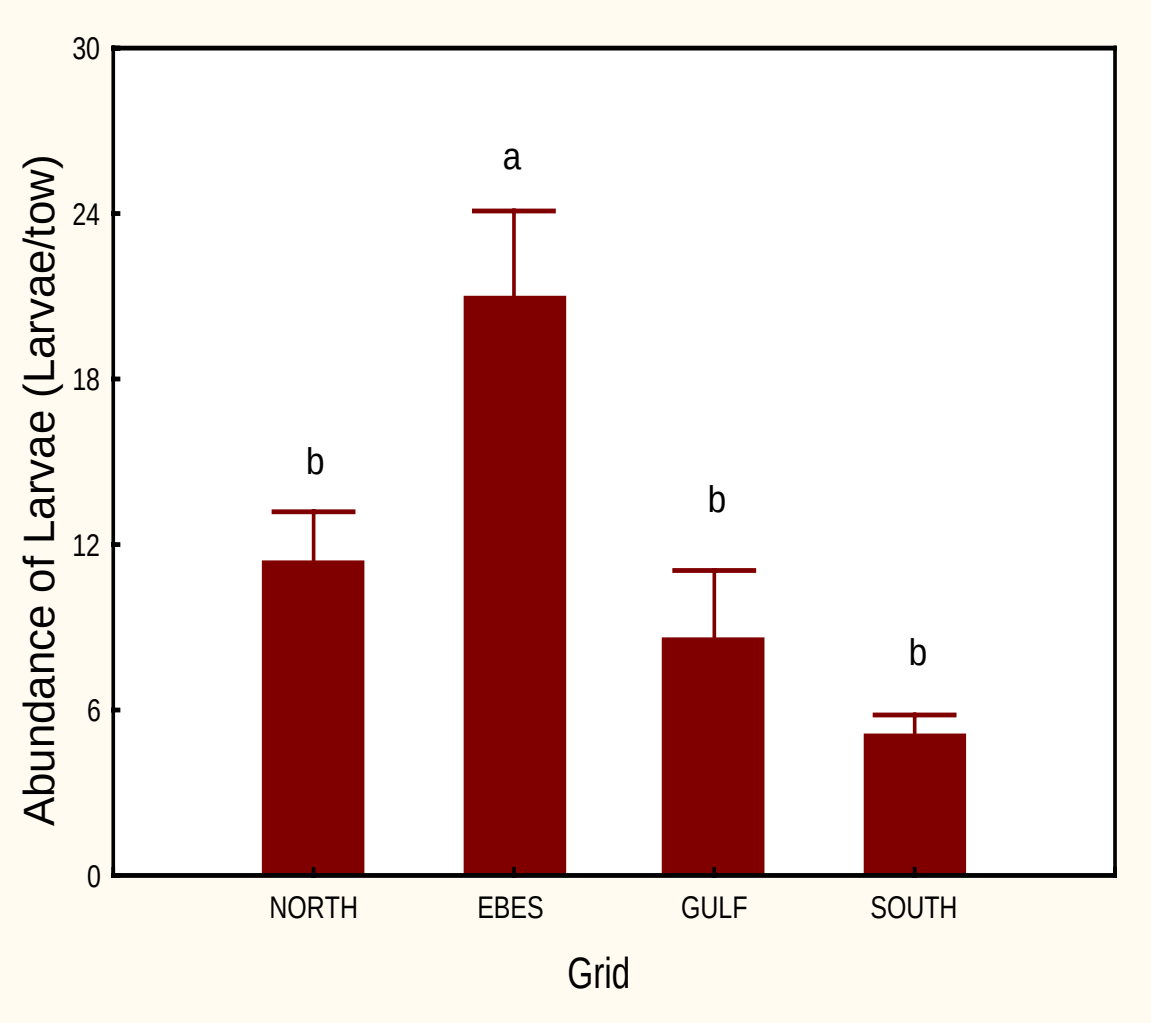
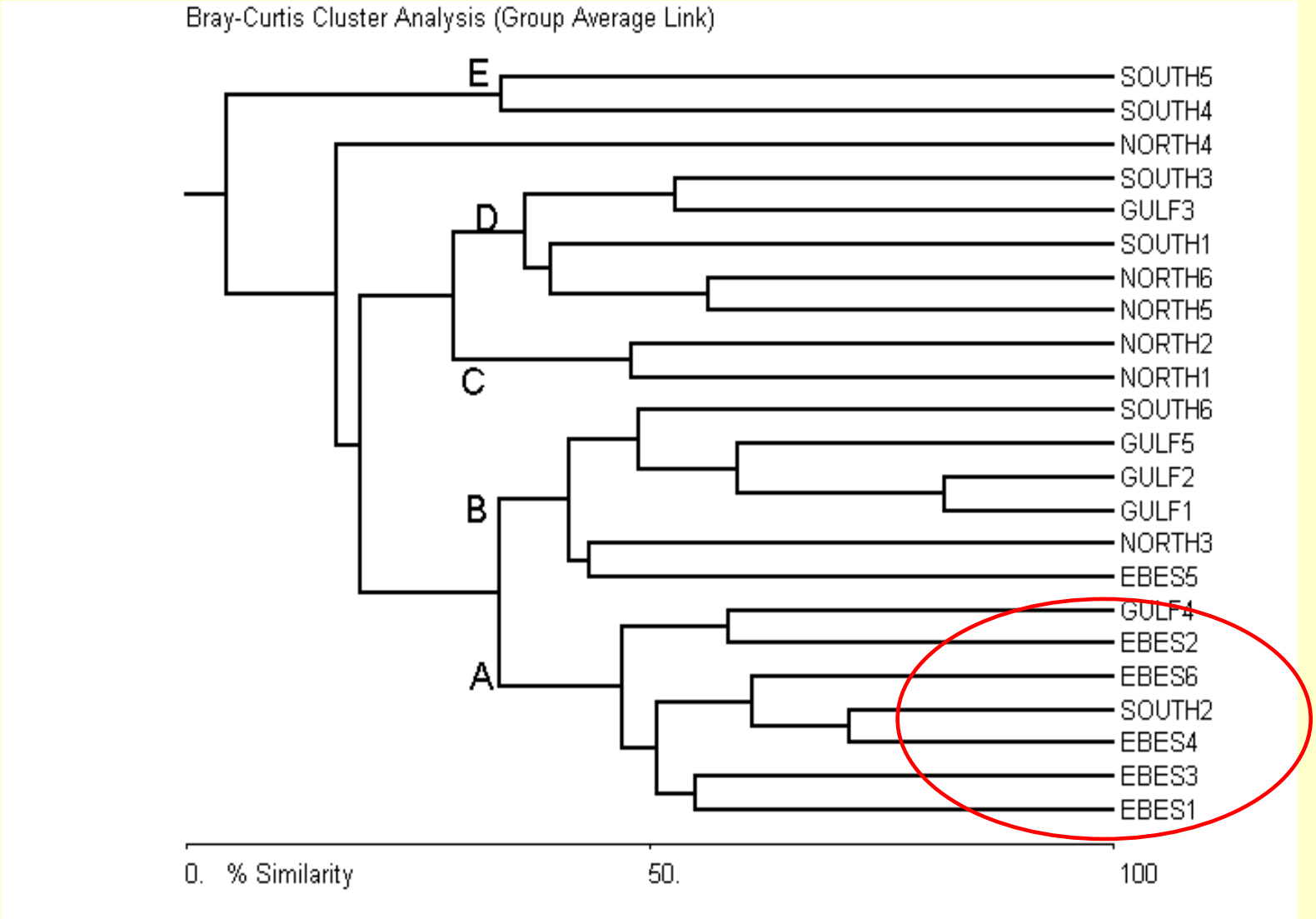


Table 1. Number of total individuals, total taxa, and all fish larvae taxa by each fine-grid (stations pooled).

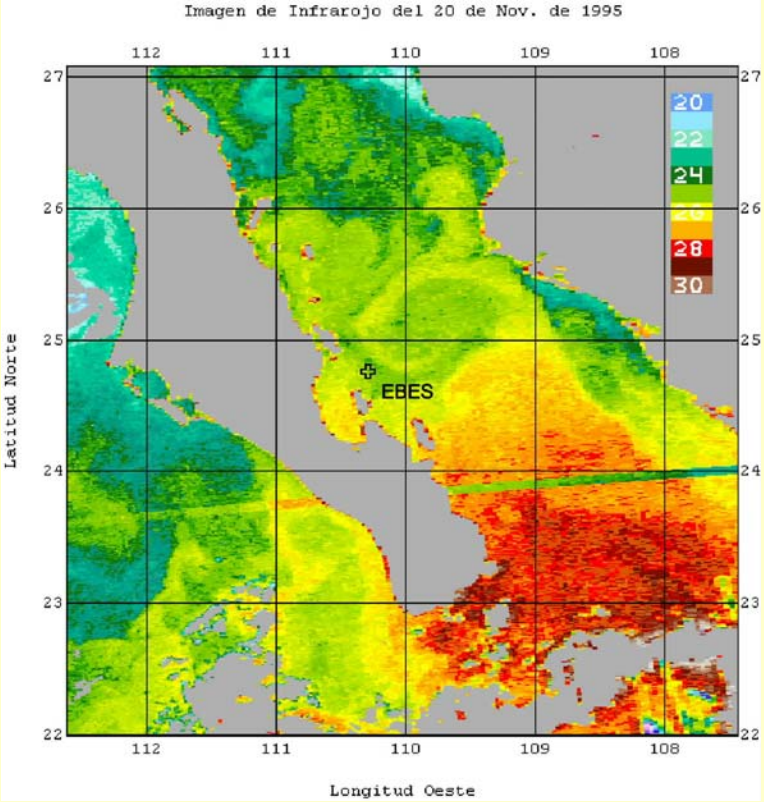
EBES		NORTH		GULF		SOUTH	
Total individuals	126	Total individuals	68	Total individuals	43	Total individuals	30
total taxa	22	total taxa	20	total taxa	13	total taxa	10
Abudefduf troschelii	28	***Scomber japonicus***	19	***Auxis sp.***	14	*Opisthonema libertate*	7
Mugil cephalus	26	***Auxis sp.***	15	*Mugil cephalus*	10	*Mugil cephalus*	6
Hyporhamphus rosae	15	*Opisthonema sp.*	4	*Hyporhamphus rosae*	5	*Polydactilus approximans*	5
Vinciguerria lucetia	14	*Cubiceps pauciradiatus*	4	***Thunnus albacares***	2	*Abudefduf troschelii*	4
Polydactilus approximans	10	Engraulidae	3	*Polydactilus approximans*	2	***Auxis sp.***	3
Scorpaena guttata	7	*Mugil cephalus*	3	*Diplophos proximus*	2	*Mulloidichthys dentatus*	1
Cubiceps pauciradiatus	4	*Opisthonema libertate*	3	***Euthynnus lineatus***	2	***Euthynnus lineatus***	1
Auxis sp.	3	*Lutjanus peru*	2	***Scomber japonicus***	1	***Coryphaena hippurus***	1
Mulloidichthys dentatus	2	*Scorpaena guttata*	2	*Vinciguerria lucetia*	1	*Hyporhamphus rosae*	1
Euthynnus lineatus	2	Anthiinae	2	*Prognichthys tringa*	1	*Exocoetus volitans*	1
Thunnus albacares	2	*Hyporhamphus rosae*	2	***Gempylus serpens***	1		
Diplophos proximus	2	Pomacentridae	1	***Coryphaena hippurus***	1		
Caranx sexfasciatus	2	*Apogon retrosella*	1	*Ophiodon sp.*	1		
Scomberomorus sierra	1	*Stegastes rectrifaenum*	1				
Syacium ovale	1	*Abudefduf troschelii*	1				
Symphurus sp.	1	*Caranx caballus*	1				
Coryphaena hippurus	1	*Lutjanus spp.*	1				
Chloroscombrus orqueta	1	*Mulloidichthys dentatus*	1				
Calamus brachysomus	1	Bythitidae	1				
Naucrates ductor	1	*Myripristris leiognathos*	1				
Harengula thrissina	1						
Eucinostomus dowii	1						

Cluster analysis



Over the seamount both oceanic and coastal conditions coexist and many are capable of locally enhancing the productivity. The zooplankton and fish larvae values show a pattern related with the hydrographic variables.

The highest values were recorded over the meander of the front over the EBES grid.The greater taxonomic diversity over the seamount could be explained by the presence of the seamount creating a region where mixing due to the vertical shear of the flow often occurs.A similar front using satellite imagery have been reported by Klimley y Butler (1988), changes in the pelagic fish community by the order of days were associated with changes of the sea water mass over the seamount. Had been suggested that this eddies are the main mechanism to transport and retain eggs and larvae within the gulf of California (Hamman *et al.* 1988, Green Ruiz e Hinojosa Corona, 1997). Satellite images of sea surface temperature (AVHRR) demonstrated that mesoscale events (*e.g*. eddies) and other events of local scale (*e.g*. water coming from Bahía de La Paz), influence the EBES Seamount (Trasviña Castro *et al* , 2003).



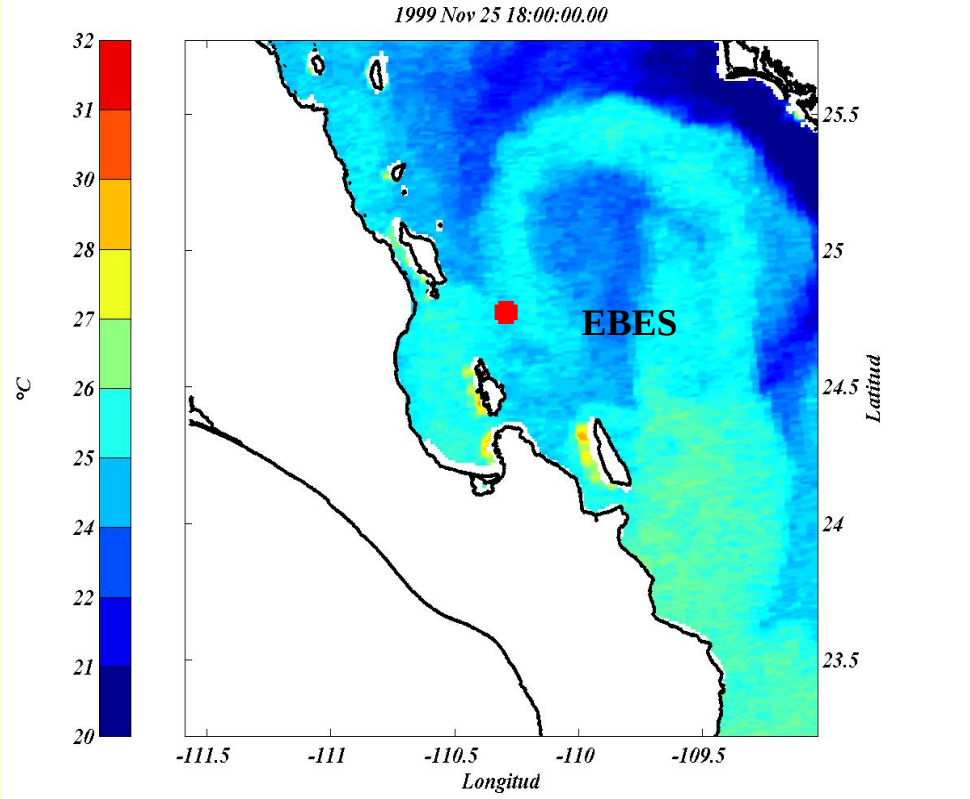


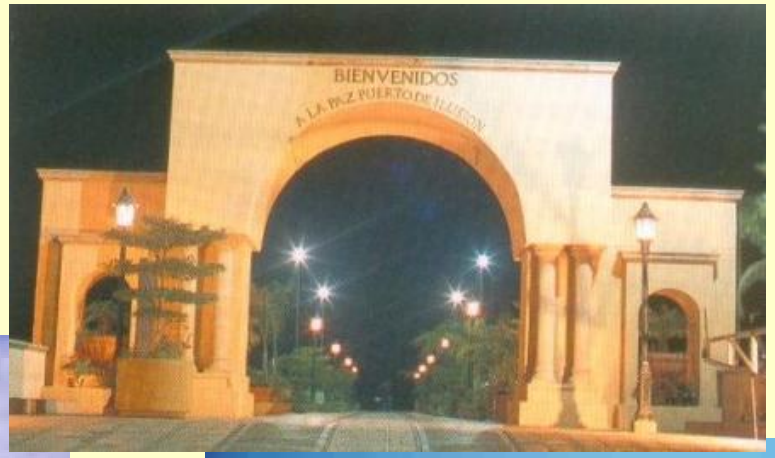
Figure 25 Zoogeographical subdivisions of Gulf of California inshore fishes (based on Walker, 1960).

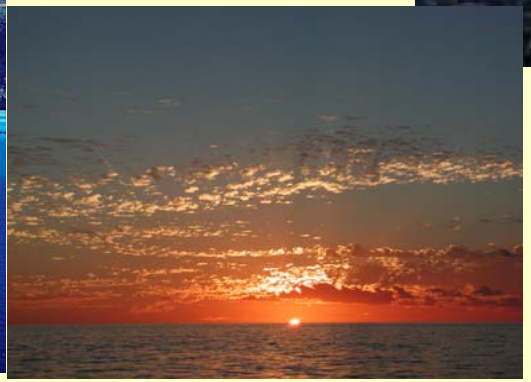
The high diversity of species is thought to be due to its specific geographical location. Due that Central and Lower zoogeographic regions make that tropical and temperate faunas mixing(Walker, 1960 , Thomson et al.,1979)

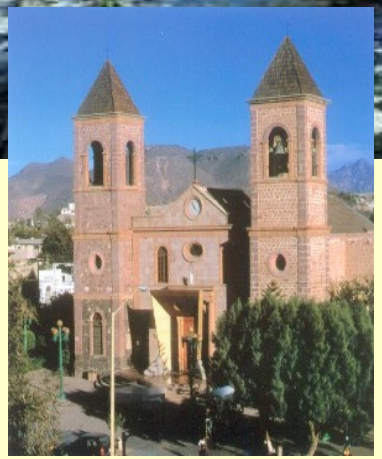
Processes such as the outflows of the Bay of La Paz promote higher diversity of species by carrying larvae and zooplankton from regions biologically different to the EBES seamount (González Armas et al, 2002).

Conditions of high dynamic instability (*e.g*. mixing) induced by the vertical shear of the currents were encountered over the EBES Seamount.

The interactions between the currents and the submarine topography favored the accumulation of larvae at the seamount.







Gracias

Isla Espíritu Santo, B.C.S.,MEXICO