



## FISH LARVAE AROUND A SEAMOUNT WITH SHALLOW HYDROTHERMAL VENTS FROM THE AZORES

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**Keywords:** Ichthyoplankton, Mesozooplankton, Seamount-Effect, Azores, *Ceratoscopelus maderensis*, Hydrothermal, Stepping-Stone.

### ABSTRACT

This work intended to assess, for the first time, the fish larvae community (regarding its zooplankton ecology scenario and evaluating possible retention/dispersal patterns) above/around shallow-water hydrothermal vents located at a seamount in Azores archipelago (NE Atlantic). In August 2000, ten plankton hauls were performed up to 100m deep, covering different distances to the crown.

Thirty five fish larvae taxa were identified, belonging to seven Families. This community was highly dominated (89% of the sample) by mesopelagic elements of Myctophidae (*Ceratoscopelus maderensis* alone attending 45%) and Gonostomatidae Families, revealing a typical oceanic environment composition. Regarding mesozooplankton, no significant spatial gradient was found but an evident "biomass hole" in the crown's proximity revealed a "seamount effect".

Opposing our hypothesis, *C. maderensis* was the only fish larvae showing a significant correlation with the seamount's proximity, reaching the maximum above the summit (37,3 ind.100m<sup>-3</sup>) where the individuals were significantly larger, suggesting this seamount as a regional "target" for this species' reproduction.

Although we aimed for the spawning season of Azorean coastal/commercial fish species and despite of this seamount's "strategic" location between two major islands, there was no evidence of local auto-recruitment nor of a "stepping stone" effect concerning this larval community.

### INTRODUCTION

Studies of fish larvae are important for numerous marine biology areas, particularly for biogeography and fisheries studies. As fish larvae live in a highly dynamic biological environment being a very small part of a system dominated by a great diversity of predators and competitors (McGowan and Miller 1980), to properly investigate this group's ecology it is fundamental to investigate the whole zooplanktonic community. Studies of ichthyoplankton at seamounts are recent, the first took place in 1970 (Nellen 1973).

D. João de Castro Bank (DJC) is about 40 N miles away from two major Azorean islands - São Miguel and Terceira. This seamount rises from around 1000m

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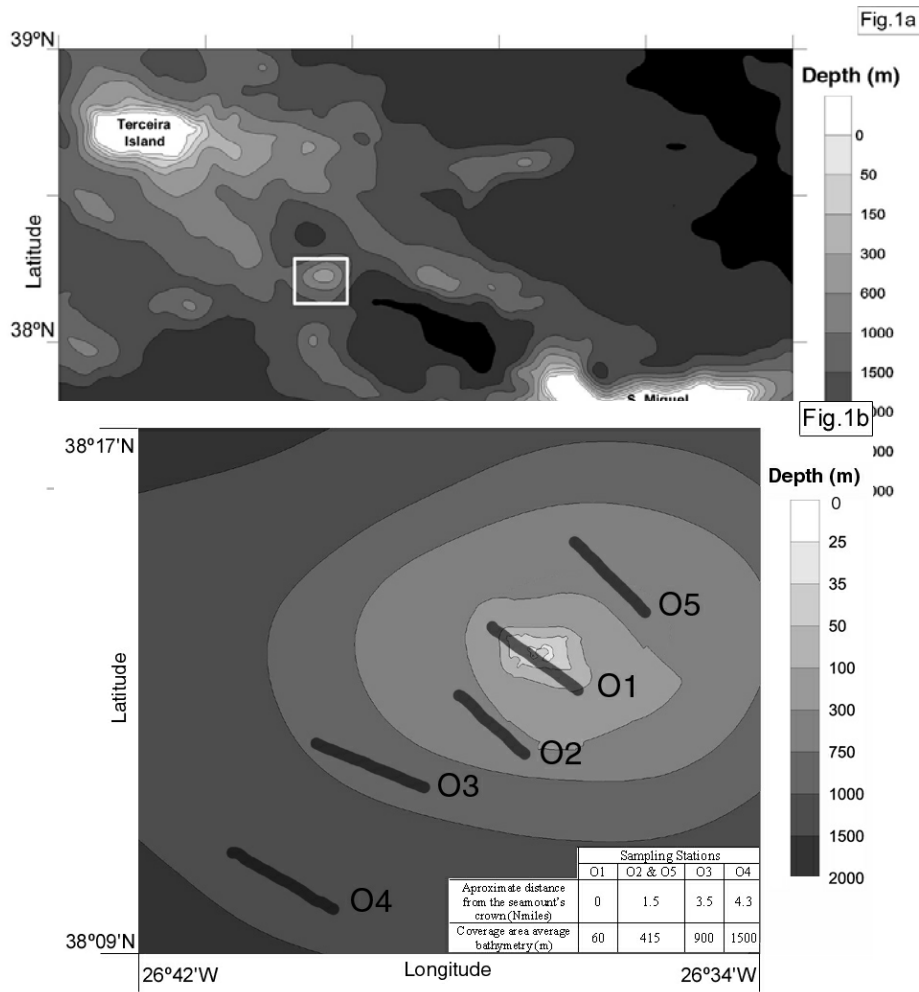


Figure 1

- a) Regional location of Banco D. João de Castro seamount, between 2 major islands of the Azores archipelago; box indicates location of the study coverage. b) Study area showing sampling tow directions for each station.

depth until 13m at the crown (volcano crater). The most uncommon feature is to have hydrothermal vents at only 20m deep, with very active sites reaching water temperatures of 121°C. The strong release of gas as well as the number of seismic events that take place establishes it as a "Potential Active Volcano" (Santos *et al.* 1996, Machado and Lemos 1998). The area above 50m depth has 300m by 600m providing an important rocky littoral "oasis" in an oligotrophic deep-water surrounding. There are 78 fish species registered for the seamount (Cardigos 2002) which alone gives a measure of this location's biological richness. All these features make this site a very interesting case study to

test hypothesis regarding the mechanisms that lead to and support the well known seamount-associated locally enhanced benthic and nektonic fish stocks.

In the Azores Region, few studies regarding the ecology of fish larvae community have been published: Chicharo and Teodósio (1990), Rodriguez *et al.* (2000) and Sobrinho-Gonçalves and Isidro (2001) - none of which focused on seamounts.

The main objective of this work was to make the first description of the fish larvae community (within its zooplankton scenario) associated with the DJC unusual environment. Furthermore, we intended to examine the following hypothesis:

1- Can our sampling design detect a "seamount effect" on the spatial distribution of mesozooplankton as a whole and of fish larvae in particular?

2- Can this shallow-water seamount support auto-recruitment and/or function as a "stepping stone" for larvae of littoral (summer-spawning) fish species?

3- Can this seamount provide a "safe site" (Frank and Leggett 1983) for fish larvae, involving retention conditions?

**MATERIAL AND METHODS**

Plankton sampling was conducted with ten double oblique pelagic tows above and around shallow-water hydrothermal vents located at D. João de Castro seamount (DJC), Azores archipelago, NE Atlantic. These were performed during the night at 5 stations in August 2000, up to a depth of 100m, - see study area in Figure 1. Three replicates were made for station O1, two for stations O2, O3, O4 and one for O5. The tows were made using a Bongo net of 60 cm mouth diameter with a 335mm mesh size, at a velocity between 1,5 and 3 knots.

Regarding the ichthyoplankton, we considered only the larvae (FL), following the terminology adopted by Moser *et al.* (1984) and Ré (1984) who consider all stages between egg eclosion and transformation.

Regarding zooplankton (ZP), we considered only the organisms with individual volumes less than 5 ml, that includes the mesozooplankton division (Sieburth *et al.* 1978), mainly composed of crustaceans, chaetognaths, molluscs and siphonophores.

The zooplankton samples were initially fixed in buffered formalin 5% (salt water) and later preserved in ethanol 70% (fresh water); the total ZP biomass was estimated by measuring the dry weight (maintained at 60 °C for 24h) - standard methodology (Smith and Richardson 1977, Omori and Ikeda 1984). The FL were sorted without any sub sampling. All *Ceratoscopelus maderensis* larvae were measured for total length (TL).

In order to analyze the information according with the distance to the seamount's crown, we aggregated stations O2 and O5 into one data set (1.5N miles).

Because FL and ZP abundance (concentration) data did not follow a Normal distribution, we performed non-parametric statistical methods for the analysis.

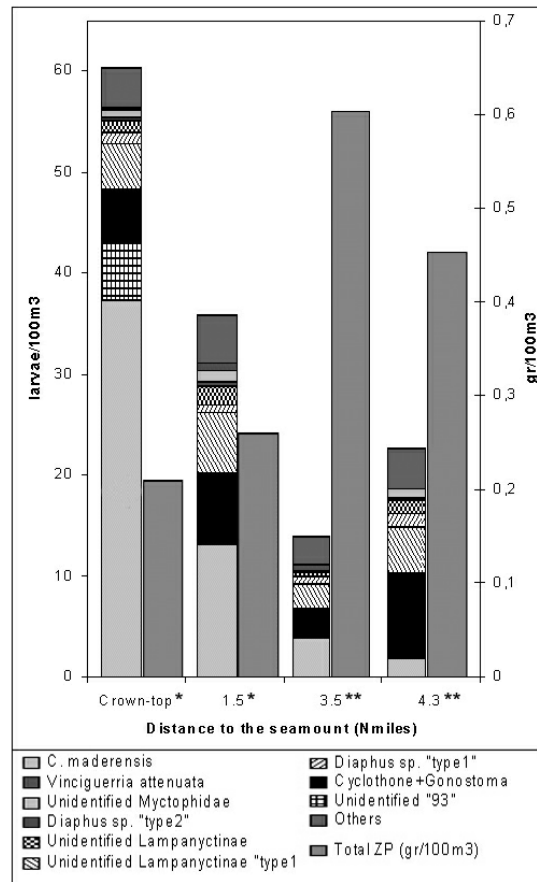


Figure 2 - Spatial distribution of both total FL average abundance (larvae.100m-3) - left bars - and ZP average biomass (gr.100m-3) - right bars - containing the relative proportions of the FL most abundant elements, for each distance to the seamount. Note: \*- 3 replicates; \*\*- 2 replicates.

**RESULTS**

**ZOOPLANKTON (ZP)**

A total of 17.216gr (dry weight) of mesozooplankton biomass was collected in this work. The spatial distribution of ZP is presented in Figure 2.

In order to investigate the 1<sup>st</sup> hypothesis we performed a Spearman correlation analysis (Siegel 1956, Zar 1996) between ZP abundance and the station's distance to the seamount crown. The result showed no correlation: R = 0.563, p = 0.09, n = 10.

Table 1

- Fish larvae taxa average abundances (n° of larvae.100m-3) and proportions (%) for each station. Note: The individuals listed as unidentified "93" and "94" were species with easily discernible individuals but not yet taxonomically identified. Taxa organized by Families according to Nelson (1994) and scientific names adopted from Whitehead et al. (1989).

Taxa	Stations											
	O1		O2		O3		O4		O5		O2&O5	
	Density	%	Density	%	Density	%	Density	%	Density	%	Density	%
<b>Gonostomatidae</b>												
Cyclothone + Gonostoma	5,12	8,5	3,95	11,7	2,86	20,5	8,43	37,5	12,64	32,3	6,85	19,3
Vinciguerra attenuata	0,39	0,7	0,59	1,8	0,45	3,2	0,09	0,4	0,97	2,5	0,72	2,0
Vinciguerra nimbaria	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,39	1,0	0,13	0,4
Vinciguerra spp.	0,22	0,4	0,51	1,5	0,36	2,6	0,09	0,4	0,19	0,5	0,40	1,1
<b>Stomiidae</b>												
Stomias sp. ?	0,00	0,0	0,19	0,6	0,00	0,0	0,00	0,0	0,00	0,0	0,13	0,4
Unidentified Stomiformes	0,00	0,0	0,00	0,0	0,24	1,7	0,09	0,4	0,19	0,5	0,06	0,2
<b>Paralepididae</b>												
Paralepis coregonoides?	0,00	0,0	0,00	0,0	0,09	0,6	0,19	0,8	0,19	0,5	0,06	0,2
Unidentified Paralepididae	0,00	0,0	0,11	0,3	0,24	1,7	0,00	0,0	0,00	0,0	0,07	0,2
<b>Myctophidae</b>												
Lampanyctinae												
Ceratoscopelus maderensis	37,07	61,5	15,63	46,3	3,87	27,8	1,85	8,2	8,17	20,9	13,14	37,0
Diaphus sp. "type1"	1,09	1,8	0,11	0,3	0,68	4,9	1,34	6,0	1,75	4,5	0,65	1,8
Diaphus sp. "type2"	0,55	0,9	0,75	2,2	0,12	0,9	0,09	0,4	0,00	0,0	0,50	1,4
Diaphus spp.	0,19	0,3	0,00	0,0	0,12	0,9	0,09	0,4	0,00	0,0	0,00	0,0
Lampanyctus pusillus	0,29	0,5	0,19	0,6	0,00	0,0	0,56	2,5	1,17	3,0	0,51	1,4
Lampanyctus sp. "type1"	0,06	0,1	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0
Lampanyctus sp. "type2"	0,18	0,3	0,19	0,6	0,00	0,0	0,28	1,2	0,00	0,0	0,13	0,4
Lampanyctus spp.	0,00	0,0	0,30	0,9	0,00	0,0	0,19	0,8	0,00	0,0	0,20	0,6
Unidentified Lampanyctinae "type1"	4,45	7,4	5,08	15,1	2,44	17,5	4,41	19,6	8,17	20,9	6,11	17,2
Unidentified Lampanyctinae	1,08	1,8	1,59	4,7	0,42	3,0	1,36	6,1	2,33	6,0	1,84	5,2
Myctophinae												
Symbolophorus veranyi	0,17	0,3	0,21	0,6	0,36	2,6	0,28	1,2	0,00	0,0	0,14	0,4
Hygophum hygomii	0,18	0,3	0,48	1,4	0,00	0,0	0,09	0,4	0,00	0,0	0,32	0,9
Hygophum benoiti ?	0,00	0,0	0,00	0,0	0,12	0,9	0,00	0,0	0,00	0,0	0,00	0,0
Myctophum punctatum	0,00	0,0	0,00	0,0	0,00	0,0	0,19	0,8	0,00	0,0	0,00	0,0
Diogenichthys atlanticus	0,00	0,0	0,19	0,6	0,24	1,7	0,19	0,8	0,19	0,5	0,19	0,5
Lobianchia doffeini	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,19	0,5	0,06	0,2
Unidentified Myctophinae	0,06	0,1	0,00	0,0	0,00	0,0	0,19	0,8	0,00	0,0	0,00	0,0
Unidentified Myctophidae	0,53	0,9	1,35	4,0	0,12	0,9	0,96	4,3	0,78	2,0	1,16	3,3
<b>Melanocetidae</b>												
Melanocetus johnsoni	0,06	0,1	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0
Unidentified Ceratioidei	0,06	0,1	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0
<b>Melamphidae</b>												
Melamphaes spp.	0,06	0,1	0,19	0,6	0,09	0,6	0,00	0,0	0,00	0,0	0,13	0,4
Unidentified Melamphidae	0,00	0,0	0,11	0,3	0,00	0,0	0,00	0,0	0,00	0,0	0,07	0,2
<b>Blenniidae</b>												
Coryphoblenius galerita	0,00	0,0	0,00	0,0	0,00	0,0	0,09	0,4	0,00	0,0	0,00	0,0
<b>Unidentified</b>												
Unidentified Perciformes	0,00	0,0	0,19	0,6	0,12	0,9	0,00	0,0	0,00	0,0	0,13	0,4
Unidentified "93"	5,94	9,8	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0	0,00	0,0
Unidentified "94"	0,17	0,3	0,00	0,0	0,09	0,6	0,00	0,0	0,00	0,0	0,00	0,0
Unidentified	2,40	4,0	1,83	5,4	0,92	6,6	1,39	6,2	1,75	4,5	1,80	5,1

According to Figure 2 graphical indications, Figure 3 shows that ZP reaches higher biomasses away from the seamount (more than 3.5Nmiles) than near the crown. Although not significantly, the Kruskal Wallis test (Siegel 1956, Zar 1996) also points out this difference,  $H(1, n = 10) = 3.682, p = 0.055$ .

### FISH LARVAE (FL) COMMUNITY CHARACTERIZATION

A total of 1814 FL were counted in this work. Figure 2 presents the abundance spatial distribution of the FL community main components. We identified 35 taxa belonging to 7 Families - see Table 1. Of these taxa, 23 were identified to genus or species. The fish larvae community was completely dominated (89% of the sample) by mesopelagic and bathypelagic *taxa*, mainly pertaining to Families Myctophidae (firstly) and Gonostomatidae (secondly), with a tremendous abundance of *Ceratoscopelus maderensis*, attending alone 45% of the sample. Neritic *taxa* were extremely rare, reaching less than 0,1%. Although in small amounts, we found elements of other ecological groups, for example: deep sea - *Melanocetus johnsoni*; shallow waters - *Coryphoblennius galerita*.

From Table 2, it is noticeable that the FL community is more diverse away from the seamount (3.5 and 4.3 Nmiles), although the difference is not significant - Kruskal Wallis  $H(3, n=10) = 6.982; p = 0.072$ . If we rule out the dominant *C. maderensis*, the diversity values become similar throughout the study area. - Kruskal Wallis  $H(3, n=10) = 0.60; p = 0.896$ .

Like for ZP, we investigate the 1st hypothesis: the Spearman's correlation analysis between FL and the station's distance to the seamount crown resulted specifically significant for only *C. maderensis* ( $R = -0.919, p < 0.001, n = 10$ ) and not significant for the FL community excluding this species ( $R = -0.194, p = 0.591, n = 10$ ).

Also regarding the 1st hypothesis, we investigated the replicates homogeneity (for relative composition)

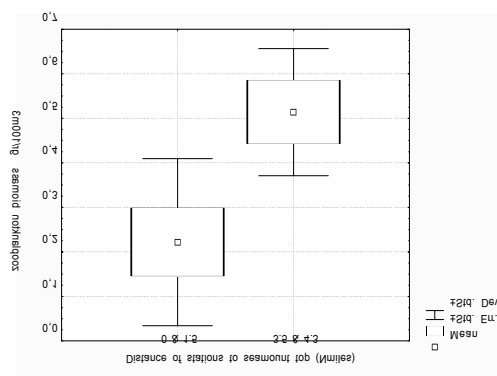


Figure 3  
- Box & Whiskers plot of mesozooplankton biomass in 2 groups of stations.

within each distance to the crown by applying the Wilcoxon's matched pairs test (Siegel 1956, Campbell 1974) on the FL *taxa* concentrations. The results showed that with any of three different sets of data only the crown-top station replicates (3) were not significantly different from each other - see Table 3.

Using this same test to compare the FL community samples between the four different distances to the seamount's crown (using *taxa* averages), the results show that the community captured at 3.5Nmiles is different from the rest in terms of relative composition (significant with the crown-top and 1.5Nmiles samples) - 3.5 vs crown-top:  $T=111.0, Z=2.0949, p=0.0361$ ; 3.5 vs 1.5:  $T=90.0, Z=2.5731, p=0.0100$ ; 3.5 vs 4.3:  $T=132.0, Z=1.3694, p=0.1708; N=35$ .

Despite the shortage of data, we can point out (from simple graphical evaluation) several indications of possible *taxa* groupings showing particular spatial distribution patterns: i) *Melanocetus johnsoni*, Unidentified *Ceratioidei* and *Lampanyctus* sp. "type 1" occurred only on top of the BDC's summit but with very low concentration; ii) *Diogenichthys atlanticus*, Unidentified Stomiformes and *Paralepis coregonoides* were not found on top of the crown although evenly distributed in the rest of the study area. iii) *Myctophum*

Table 2

- Shannon-Wiener diversity index (log natural) and Equitability for the FL community, calculated with average densities for each distance to the seamount's crown. a) for all taxa; b) for all taxa except *C. maderensis*.

	Crown-top	1.5Nmiles	3.5Nmiles	4.3Nmiles
H' & J' (a)	1.37 & 0.45	1.80 & 0.63	2.13 & 0.72	1.99 & 0.65
H' & J' (b)	2.0 & 0.67	2.05 & 0.70	2.16 & 0.75	1.85 & 0.62

Table 3

- Wilcoxon's test results on the comparison of the FL community samples between the three crown-top station replicates using different sets of data.

Data sets	Test results
All taxa (N=35)	64<=T<=82; 0.3077<=Z<=1.2475 ; 0.2122<=P<=0.7583
Excluding <i>C. maderensis</i> (N=34)	54<=T<=82; 0.7239 <=Z<=0.9799 ; 0.3271<=P<=0.4691
Excluding the 7 most common elements (N=28)	25<=T<=52; 0.0314 <=Z<=0.3922 ; 0.6949<=P<=0.9749

Table 4

- Spearman's correlation coefficient (R) between ZP and FL. a) community as a whole; b) and c) by species (only the significant results are presented).

a) ZP vs FL	R= 0.503	p= 0.138; n= 10
b) ZP vs <i>Ceratoscopelus maderensis</i>	R= -0.709	p= 0.022; n= 10
c) ZP vs <i>Hygophum hygomii</i>	R= -0.807	p= 0.004; n= 10

*punctatum* and *Coryphoblenius galerita* only occurred at the most distant station (4.3Nmiles) but with very low numbers.

#### RELATIONSHIP BETWEEN FL AND ZP

Rodríguez and Rubín (1991) admitted that the ideal condition to study eventual relations between these two communities is that both follow the same distribution model - in the present work both showed a lognormal distribution.

From Table 4 we show that there was no significant correlation between the concentration of the two communities as a whole. At the FL specific level, we found only two strong (negative) associations. Nevertheless, it is important to report the simultaneous occurrence of the ZP maximum and the FL minimum 3.5Nmiles away from the seamount top.

#### SIZE-RELATED VARIATIONS IN THE DISTRIBUTION OF *Ceratoscopelus maderensis*

The large number of larvae collected made this myctophid species the only one with potential to investigate our 3rd hypothesis. Figure 4 shows that, above the BDJC's crown, the sampled specimens presented a lower length-class variance and larger

larvae (in average) than away from the seamount. This is confirmed when comparing the TL distribution between samples with a Kolmogorov-Smirnov test (Zar 1996): the larvae collected above the crown were significantly more developed than the ones caught 1.5Nmiles and 3.5Nmiles away - with  $p < 0.001$  and  $p < 0.01$  respectively. The results from 4.3Nmiles were difficult to analyze because of the small number of specimens and large TL variance.

#### DISCUSSION

##### ZOOPLANKTON (ZP)

Although the sampling scale was limited (less than 6Nmiles), our results indicate a confirmation of the 1st hypothesis regarding the mesozooplankton community. We think that the clear tendency for the ZP not to aggregate on the crown-top area is a "seamount effect". This work contributes for the growing evidence that ZP biomass may be reduced over shallow seamounts (Dower and Mackas 1996). Genin et al. (1988, 1994) and Haury et al. (1995) also found these "zooplankton holes" and suggested that they could result from either or both of the following: i)

disruptive interaction between shallow topography and the diel vertical migratory behavior of most ZP species; ii) increased predation pressure from fish resident on the seamount.

#### FISH LARVAE (FL) COMMUNITY CHARACTERIZATION

The presented FL community description was generally expected for a North Atlantic seamount environment. The mesopelagic and bathypelagic groups taxonomical composition correspond to observations made by Sobrinho-Gonçalves and Isidro (2001) for central Azores but their dominance in the present work is even stronger (89% against 76% of samples). The FL diversity we found is naturally lower than in an Azorean island vicinity (Sobrinho-Gonçalves and Isidro 2001) because of oceanic isolation. Regarding the extraordinary *C. maderensis*, its maximum abundance (37 larvae.100m<sup>-3</sup>) above the seamount is much lower than the observed in a summer survey off Faial island, Azores (68 larvae.100m<sup>-3</sup> max.) (Sobrinho-Gonçalves, unpublished data) but, inversely, its dominance is higher (45% against 32% of samples).

The unexpected part of these results was the extreme rarity of topographically-associated taxa that makes the FL community found around DJC fit the typical faraway isolated, more than 200m deep oceanic seamount general model proposed by Boehlert and Mundy (1993). In fact, because of the following three reasons, we expected to collect reasonable numbers of these taxa larvae like Belyanina (1985) and Gordina and Bladimirtsev (1987) reported for Indian Ocean shelf-proximal shallow seamounts: i) DJC has 21 hectares above 50m only 40 nautical miles away from two important islands, ii) DJC supports considerable adult populations of neritic and/or shallow-water species of Labridae, Serranidae, Epinephelidae, Carangidae, Scorpaenidae, many of which reproduce during summer (Cardigos, 2002), iii) Sobrinho-Gonçalves (unpublished data) collected important numbers (reaching 15% of samples) of littoral-species larvae, like the ones mentioned above, during the summer off an Azorean island.

These results do not corroborate our 2<sup>nd</sup> hypothesis in any way. It seems that, for larvae of this group of species, DJC seamount does not support local auto-recruitment nor function as a "stepping stone" between

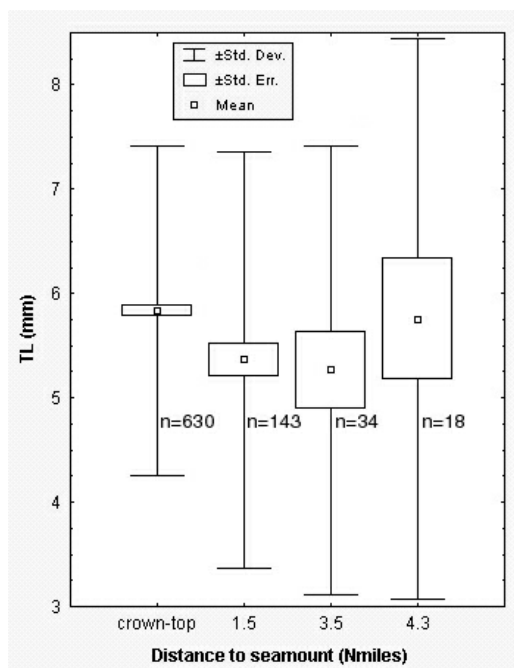


Figure 4  
- Box plot of total lengths (TL) of *C. maderensis* for each distance to the seamount's crown.

neighboring islands. The first conclusion was expected because that hypothesis is not entirely supported by other studies (Boehlert and Mundy 1993), the latter statement was unexpected as mentioned earlier. Our work supports the idea that the bottom-related ichthyofauna found at DJC seamount is essentially originated from migration of adult and juvenile individuals. The case of sedentary species (like several Scorpaenidae) cannot fit this model and therefore needs further investigation about their larval ecology.

The homogeneity (in relative composition) found among the crown-top station replicates could reflect a localized reduction in FL community patchiness but the evidence is weak because, regardless of not being tested, it probably resulted from the shallower sampling tows that were performed, collecting a vertically lower variability.

Having this in mind, we can only confirm the 1<sup>st</sup> hypothesis for *C. maderensis* larvae that presented a marked positive spatial gradient towards the crown-top, proving that the reproductive ecology of the species is regionally "seamount affected" - the data

indicate that our sampling was likely to be preceded by an important spawning event by this species, with BDJC as a "target". For the rest of the FL community a "seamount effect" on spatial distribution patterns was not detected because of the complete lack of significant correlations and marked connections with the seamount-top proximity and because of the diversity index uniformity across the study area.

Regarding the FL assemblages investigation, the crown-top "hole" encountered for *Diogenichthys atlanticus*, Unidentified Stomiformes and *Paralepis coregonoides* can possibly group them according to shared larval behavior patterns - marked diel vertical migration (incompatible with shallow waters as discussed for ZP) and/or active seamount avoidance (there is growing evidence showing that many fish larvae are not strictly planktonic and can respond to environmental cues (Stobutzki and Bellwood 1998, Jones *et al.* 1999), nevertheless, the numbers collected for these taxa are too low to prove a "seamount effect".

We can further conclude that this work presents an absolute need for additional sampling with an extended time scale in order to test the emerging doubts and remaining questions.

#### RELATIONSHIP BETWEEN FL AND ZP

Limited food availability and predation are normally considered as the main factors responsible for ichthyoplanktonic mortality. In this scenario, several authors consider it likely to occur negative relations between the fish larvae abundance and the mesozooplankton biomass when the latter community reaches high concentrations, thus magnifying drastically the pressure of competition and predation (Alvariño 1980, McGowan and Miller 1980). Although we did not detect a general trend between these two communities, the results from 3.5N miles (where the maximum of ZP was found) probably reflect this type of scenario like in other works (Ali Khan and Hempel 1974, Sobrinho-Gonçalves and Isidro 2001). We can further speculate that the high ZP concentration "modified" the local FL community not only by forcing a general reduction in its abundance but also by inducing a relative taxonomical composition alteration.

The strong negative correlation of ZP with both *C. maderensis* and *Hygophum hygomii* is naturally explained by the marked concentration of these species

above the seamount summit where we found a "mesozooplankton hole". We can speculate that these 2 fish species (namely the first) might be adapted to profit from a bottom elevation proximity in order to avoid mesozooplankton "high pressures". This speculation (if true) raises an interesting question for further studies at BDJC: how can *C. maderensis* larvae, being vulnerable prey, survive the important concentration of benthonic and nectonic predators associated with the seamount's crown?

#### SIZE-RELATED VARIATIONS IN THE DISTRIBUTION OF *Ceratoscopelus maderensis*

No larval age/growth work for this species was made so far in the Azores so we can only refer to other East-Atlantic studies like Linkowski *et al.* (1993) that stated a linear growth during the first 6 months of life of *C. maderensis*. Thus we presume there is a general positive association between the larval total length (TL) and its ontogenetic development.

As explained before, this work proves that DJC seamount is a regional "target" for this typical Atlantic temperate-subtropical species spawning. In this scenario, the concentration of significantly larger larvae (older) that we collected next to the seamount (above the top and 1.5 N miles distance) can only be explained by the action of some kind of retention mechanism that keeps developing individuals near their hatching location; without retention, the "normal" oceanic dispersing processes would make the capture of larger/older more probable to occur farther from the crown. Furthermore, this kind of concentration could only be possible if the retention mechanism was synchronized with a period of favorable ecological conditions (specially food availability and predation). The information gathered confirms the 3<sup>rd</sup> hypothesis - DJC seamount can provide a "safe site" (Frank and Leggett 1983) at least for larval *C. maderensis*.

Although we did not collect water-current information in this work, it is reasonable to speculate that the retention mechanism mentioned above did not have a pure physical-oceanographical nature (Taylor column, for example) because merely this one species revealed evidence for this occurrence, among 35 identified taxa (of which several elements are known to spawn during August). We find this particular retention phenomenon more likely to be determined by larval active behaviour like vertical migrations



(profiting from vertically-different water movement directions) following chemical signals associated with the seamount as a spawning location. In order to learn more about these difficult-to-prove seamount larval retention processes, it is fundamental to enlarge the time scale of sampling in future studies at BDJC.

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