Distribution and ecology of the anthozoan *Actinauge richardi* in the Cantabrian Sea

Ruiz-Pico S., Punzón A., Serrano A., Velasco F., Baldó F. and Fernández-Zapico O.

Instituto Español de Oceanografía, Centro Oceanográfico de Santander, Promontorio de San Martín s/n, 39004, Santander, Spain

E mail: Susana.ruiz@st.ieo.es

INTRODUCTION

The anthozoans are one of the dominant groups of the sessile epibenthos. Previous studies describing the Cantabrian and Galician epibenthic communities have shown that *Actinauge richardi* (Marion,1882)(Subclass Hexacorallia, Order Actiniaria, Family Hormathiidae)*;* is the most abundant anthozoan in the area(Olaso,1990; Serrano *et al*, 2006). Nevertheless, there are not studies focused on distribution, ecology and importance of this dominant species.

The present study examines the spatial and annual abundances trends of *A. richardi* and their relationship with environmental variables from 1993 to 2009 in Cantabrian and Galician continental shelf (NW Spain, NE Atlantic Ocean) covering depths between 30 m and 800 m.

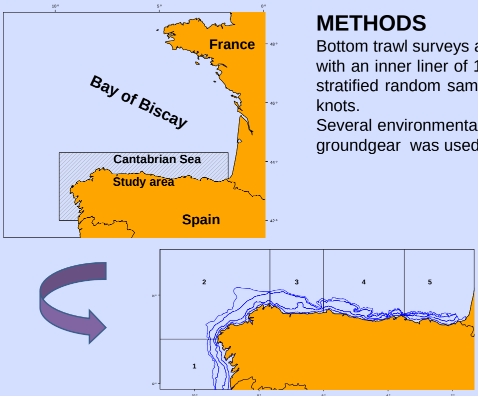

Figure 1.Study area and stratification used in the survey.

METHODS

Bottom trawl surveys aiming to study demersal and benthic ecosystems are carried out every autumn in this area using a baca 44/60 otter trawl gear with an inner liner of 10 mm mesh and 18,9 m horizontal opening. The area has been stratified according to depth and geographical criteria and a stratified random sampling scheme has been adopted (Fig.1).The sampling unit was made up of 30-minute hauls during daytime at a speed of 3 knots.

Several environmental variables were studied (Table 1). CTD Seabird 25 was used to measure temperature and salinity. Sediment collector on the groundgear was used to determinate sediment composition.

Table 1. Explanatory variables

Variable	Remark
year	1993-2009
depth strata	(m) <A= <70, A= 70-120, B= 121-200, C= 201-500, D= >500
sector	1= Miño, 2= Ribadeo, 3= Gijón, 4= Santander, 5= Guetaria
temperature	(°C)
salinity	(ppt)
sediment type	GCS=gravel and coarse sand, CS=coarse sand, MS=medium sand, FS=fine sands ,VFS= very fine sand, M=mud
organic matter	weight percentage of organic matter
particle diameter	(Q_{50} , mm) mean particle diameter
sorting coefficient	Homogeneity/heterogeneity
large sand	(>500 µm) weight percentage of gravel and coarse sand
fine sand	(62–500 µm) weight percentage of medium, fine and very fine sand
silt	(<62 µm) weight percentage of silt

The data used consisted of abundance in number recorded from 2116 hauls from 1993 to 2009. A presence-absence matrix was also used. General lineal models (GLM) were used to identify environmental factors involve the abundance and presence of *A. richardi*.

For the presence-absence model a Binomial distribution for the residuals was assumed, with a logistic as link function. In the case of abundance in number Poisson distribution for the residuals and logarithm as link function was assumed. Deviance reduction was measured with the chi-square statistic and stepwise procedures were used for model comparisons. Partial residual plots based on the deviance and Cook's distance was used to validate model.

Additive general models (GAM) were used to represented spatial presence-absence distribution, supposedly Binomial distribution of the residuals (Fig. 3) .

Tabla 2. Abundance model

	Df	Deviance	Resid. Df	Chi-square value	P-value
<none>			674	18754.86	
Year	16	913.51	658	17841.35	3.60E-184
Sector	4	3169.44	654	14671.91	0
Depth strata	3	248.19	651	14423.72	1.61E-53
Sediment type	4	2581.01	647	11842.71	0
Sortting coefficient	1	246.76	646	11595.94	1.32E-55

Deviance explained=39.2%

Tabla 3. Presence-absence model

	Df	Deviance	Resid. Df	Chi-square value	P-value
<none>			2088	2743.45	
Year	16	74.11	2072	2669.33	1.88E-09
Sector	4	220.97	2068	2448.36	1.16E-46
Depth strata	4	355.53	2064	2092.82	1.12E-75
Sediment type	5	51.94	2059	2040.89	5.56E-10

Deviance explained=28.7%

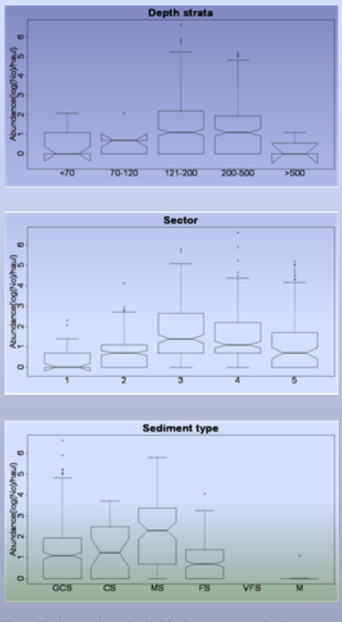

Figure 2. Explanatory data analysis of depth strata, sector and sediment type

RESULTS

Actinauge richardi represents about 61% of Anthozoans caught in the surveys.

Results of exploratory data analysis showed the following:

• "Year" variable did not have a clear trend although it showed lowest values in years 2000, 2003, 2006 and 2008.

• "Sector" variable had a positive relationship with *A. richardi* and abundance values were lower in west than in east (Fig. 2).

• The highest coefficients values in "depth strata" were between 121 m and 500 m (B and C strata) and it showed a negative relationship over 500 m (Fig. 2).

• "Sediment type" had only a positive relationship with *A. richardi* in medium sand (Fig. 2).

• Abundances values showed a clear decrease trend with regard to "sorting coefficient" variable.

Poisson GLM model using abundance in number as response variable and year, sector, depth strata, sediment type and sorting coefficient as explanatory variables showed a deviance explained of 39,2% (Table 2).

Year, sector, depth strata and sediment type were significant for the presence-absence GLM model which showed a deviance explained of 28,7% (Table 3).

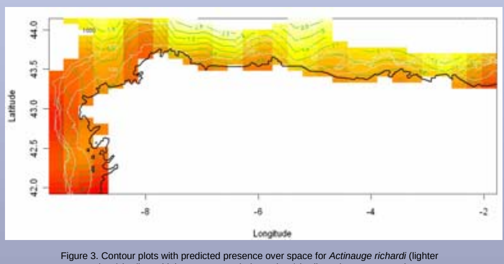

Figure 3. Contour plots with predicted presence over space for *Actinauge richardi* (lighter colour/shading – higher presence; darker colour/shading – lower presence).

CONCLUSIONS

• *Actinauge richardi* dwells in the Cantabrian Middle and Outer shelf as was already described in previous studies on benthic communities in that area (Serrano *et al*, 2006; Serrano *et al*, 2008).

• An eastward trend in abundance and presence values of *A. richardi* is in accordance with the continentalization pattern of littoral benthic fauna described by Ibáñez (1989), as a consequence of warming of shallowest waters towards the east due to its scarce oceanic dynamism and its geographical shape. Eastward increase in species richness in the shallowest stratum in Cantabrian coast is also described by Serrano *et al* (2006).

• There is no clear patterns in *A. richardi* abundances in sixteen years, although some low values at the end of data serie could been suggesting a slow decline due to intensive fishing in the area (Sánchez & Olaso, 2004).

• *A. richardi* not show a significant effect with temperature, salinity. Its sessile behavior could make us think that these variables might have more influence on the distribution of pelagic lifestyle of juvenile stages than on adults (Riemann-Zürnek, 1998).

• Sediment preferences of *A. richardi* in Cantabrian shelf are homogeneous medium sand (lower values of sorting coefficient). This results was not expectable, in the light of its especial sensible behavior and morphology. Contrary to other sea anemones, usually lives free whit a ball of mud in its base that is typically invaginated forming a cavity (Fig.4; Manuel, 1981). This morphology indicates a mud preference, nevertheless the lowest abundances values were showed on that sediment. This fact can be consequence of the absence of mud in the Cantabrian middle shelf and the low presence in the outer shelf, only present in the eastern area nearest to French shelf (Serrano *et al*, 2006). *Actinauge richardi* is forced to enclose sand in its cavity and changing its habitat preferences.

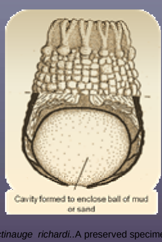

Figure 4.*Actinauge richardi*..A preserved specimen with retracted tentacles (Manuel ,1981)

REFERENCES

Ibáñez,M.,1989.Implicaciones biogeográficas de la continentalización de la costa vasca. Lurralde 12:71-101.

Manuel, R.L.,1981. British Anthozoa. Synopses of the British Fauna (New Series).*No 18. Linnean Society Academic* Press, London, 241 pp.

Olaso, I.1990. Distribución y abundancia del megabentos invertebrado en fondos de la plataforma cantábrica.Publ.Espec.Inst.Esp.Oceanogr.5 128 pp.

Riemann-Zurneck, K. (1998). How Sessile are Sea Anemones? A Review of Free-living Forms in the Actiniaria (Cnidaria: Anthozoa). *Mar. Ecol.*, 19(4): 247-261.

Sánchez, F,Olaso, I. 2004.Effects of fisheries on the Cantabrian Sea shelf ecosystem. Ecological Modelling 172. 151–174

Serrano, A., Sánchez, F., García-Castrillo, G., 2006. Epibenthic communities of trawlable grounds of the Cantabrian Sea. Sci. Mar.70, 149-159.

Serrano, A., Preciado, I., Abad, E., Sánchez, F, Parra, S., Frutos, I., 2008.Spatial distribution patterns of demersal and benthic communities of the Galician continental shelf (NW Spain).Journal of Marine Systems 72,87-100.