Spatial distribution and temporal trends (1989-2008) of soft-bottom marine benthic alien species in the Nervión estuary (Basque Country, N of Spain)

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The introduction of alien species is a growing environmental issue world-wide since it represents one of the most important drivers of biodiversity loss. Scientific scenarios point to a dramatic increase in biological invasions and the situation is likely to get worse. For this reason, invasive species are under study in several European Strategies (COM 2008; EC 2008). The aim of the present study was to analyse the spatial distribution and temporal trends of soft-bottom marine benthic alien species collected during twenty years in the Nervión estuary, a heavily modified water body located in the south-eastern of the Bay of Biscay. The evaluation of soft-bottom marine benthic alien species was accomplished by using data of the Nervión estuary obtained from 1989 to 2008 in different projects carried out by AZTI-Tecnalia. For the evaluation, a total of 6.688 records were analysed and crossed against a list containing 217 alien species which was based on published data of alien marine species in waters from the Bay of Biscay (Eno *et al*., 1997; Martínez and Adarraga, 2006). Results indicated that, from a total of 742 species, 23 were identified as alien species, belonging to three different phyla: annelida, arthropoda and mollusca. The alien species with more cases recorded were the polychaete *Pseudopolydora paucibranchiata* and the amphipod *Monocorophium acherusicum*. It seems that the main pathway of introduction was linked to maritime transport activities (i.e. input of ballast water, biofouling, etc.) and that the intermediate part of the estuary, where historically the activities of the port of Bilbao were located, was colonized by these two opportunistic species. Although no temporal trends were observed, the presence and abundance of soft-bottom alien species became more evident since middle nineties, when the widening of the Bilbao Harbour started together with the improvement of the water quality that occurred mainly due to the biological treatment of the water treatment plant and the declining of industrial activities. Finally, as the alien species identified are not considered invasive, there is no evidence of great risk for native biodiversity to be threatened but it is desirable to monitor the presence of invasive alien species to prevent future introductions and impacts.

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Phylogeography of the allochthonous calcareous sponge *Paraleucilla magna:* a cue for several introduction events along the Atlanto-Mediterranean European coasts?

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The genus *Paraleucilla* had not representatives in the Atlanto-Mediterranean region until the last decade, when the species *Paraleucilla magna* appeared in Brazil (Klautau *et al*. 2004) and proliferated along the European Atlanto-Mediterranean coasts (Longo *et al*. 2007; Guardiola *et al*. 2012). *P. magna* shows a highly patchy distribution with dense populations in eutrophized areas such as sea farms, which points to aquaculture-related activities as the main introducing vector. The species has been recorded along the Spanish Mediterranean coasts, South Italy, Portugal, Azores, Madeira, and Brazil.

To establish the possible origin, colonization pathway, and introduction vector(s) of *Paraleucilla magna*, we studied the phylogeography, genetic structure and connectivity of ten Atlanto-Mediterranean populations by using nine microsatellite markers.

All populations were highly differentiated except those of the continental Portugal and South Spain, which were genetically connected. The genetic distances between pairs of populations were in general correlated with geographical distance. Some exceptional points, however, seem to reflect several introduction events.

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Catálogo de las especies exóticas marinas pertenecientes al macrozoobentos marino en el ámbito íbero Balear

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Resumen:

La introducción de especies exóticas, además de ser una de las principales amenazas para la biodiversidad, puede causar impactos socio-económicos considerables. Por este motivo, el estudio de estas especies es fundamental para el proceso de su control. El presente trabajo es una contribución al conocimiento de las especies exóticas marinas perteneciente al macrozoobentos en el área íbero-balear. Para llevar a cabo este trabajo, se ha realizado una recopilación y estudio bibliográfico de diferentes fuentes científicas, incluyendo bases de datos, artículos, tesis doctorales y trabajos de investigación relacionados con este tema. De forma complementaria se han aportado observaciones propias realizadas *in situ*. Además de presentar el listado de estas especies se aporta información adicional que incluye: vector probable de introducción, origen, localización y distribución actual en el ámbito íbero balear, fecha probable de introducción y su estatus poblacional, así como su impacto potencial.

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Spread of the invasive seaweed *Lophocladia lallemandii* on the bivalve *Pinna nobilis* in a Marine Protected Area

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The introduction of species is recognized as a major driver of global change and the loss of biodiversity in ecosystems. The Mediterranean Sea is the most heavily invaded region in the world by introduced seaweeds. The fan mussel *Pinna nobilis* is the largest Mediterranean endemic bivalve and one of the biggest in the world, is a protected species whish is present in depths ranging from 0.5 to 60 m. In Cabrera National Park (Balearic Islands, NW Mediterranean) the population of *P. nobilis* is affected by the invasive macroalgae *L. lallemandii* and *C. racemosa*, however the scope of this invasion growing in *P. nobilis* population is unknown. Therefore the main aim of the present study was (i) to find out the extent of the invasion of *L. lallemandii* on *P. nobilis* population, and (ii) test if this invasion shows differences among depths. As results we found a total of 1095 *P. nobilis* individuals, 20.4% of them were dead individuals. *P. nobilis* is distributed in all seagrass meadows censed around the marine protected area. Densities of *P. nobilis* varied from 0 to 37.3 ind/100m^2. With respect to size distribution, individuals from a wide size range ranking from 2.2 to 30 cm in maximum width shell were detected with a unimodal distribution. Regarding epiphytism of the invasive species *L. lallemandii* and *C. racemosa* on *P. nobilis*, it highlights the high presence of *L. lallemandii* and the low presence of *C. racemosa*, being detected in 49.37% and 1.38% of the population of *P. nobilis* respectively. The incidence of *L. lallemandii* on *P. nobilis* population were significant higher at 20 m depth than at 10 m. We have also detected that values of biomass and volume of *L. lallemandi* at different depths showed similar pattern but with different values being higher both variables in deeper areas.

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Photosynthetic acclimation of different species and lineages of the invasive genus Asparagopsis to different temperatures

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Biological invasions are an important element of global change, and represent the second threat in order of importance for global biodiversity. Marine macroalgae are an important component of alien species, ranging between 10 and 40% of total species (Schaffelke *et al.* 2006).

It is known that climate change impacts on many ecological factors such as temperature, thereby directly affecting the invasive alien species, but also indirectly, by producing changes in host communities. In the case of macroalgae it has not been proven that climate change will facilitate the introduction and invasion of exotic species, but it is suspected to be so, since many macroalgae's biogeographic boundaries are determined by thermal limits involved in growth, reproduction and survival. Thermal acclimation may be a key performance of invasive species to cope with climate change and to exhibit some ecological advantage compared to native species.

The genus *Asparagopsis*, includes two species, *A. armata* and *A. taxiformis*, both considered as the ten most invasive species of macroalgae in the Mediterranean Sea. While *A. armata* is sgentically homogeneous throughout the oceans, *A. taxiformis* is a complex of four cryptic lineages, with different geographical distributions, with only one of them, the lineage two, being invasive.

In the present work we try to give light of the reasons for these different geographical distributions of the different species and lineages, as well as the invasive character of only one of them, hypothetically due to differences in photosynthetic acclimation capacities to different temperatures.

To achieve this goal we analysed different photosynthetic parameters (dark respiration, maximun net photosynthetic rate under light saturated condition, the compensation light intensity, the light saturation parameter, the photosynthetic efficiency and• the inhibition factor), estimated from photosynthesis irradiance curves, performed at five different temperatures (12, 15, 18, 22 and 26ºC) with tetrasporophytes of *A. armata*, and three different lineages of *A. taxiformis*, the invasive indo-pacific lineage 2 from two different geographical populations, the atlantic lineage 3, and the Hawaiian lineage 4.

Results showed that differences in photosynthetic plasticity between species and among lineages, may explain the different geographical distributions and the invasive behaviour of the indo-pacific lineage.

For *A. taxiformis*, in general the highest maximun net photosynthetic rate was estimated at the highest temperature, with quantitative differences between lineages. However in *A. armata* this parameter was highest at 22ºC. The hawaian lineage 4 exhibited no photosynthetic activity at the lowest temperature, with higher respiration rates compared to the other lineage and *A. armata*. Among the different lineages of *A. taxiformis*, the indo-pacific lineage 2 collected from invasive populations of Southern Spain, exhibited the highest photosynthetic activity at the lowest temperature, and in general exhibiting the wider thermal plasticity related with the other photosynthetic parameters. In general tropical lineages together with the invasive one, exhibited the highest photosynthetic rate at the highest temperature, which is in agreement with the temperature range at its native habitats.

Differences among lineages and between species in all the analysed photosynthetic parameters, will be discussed in detailed in the presentation, giving light to a hypothetical reason of the different geographical distributions of them, and the invasive character of only one of them, due to differences in thermal acclimation of the photosynthesis.

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Exploring the response of phytoplankton biomass (chlorophyll-*a*) to climate forcing in the Basque coast (southeastern Bay of Biscay)

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Phytoplankton account for approximately 50% of global primary production and form the trophic base of nearly all marine ecosystems, being fundamental in trophic energy transfer. Therefore, sustained declines in phytoplankton biomass would have important consequences for the abundance and diversity of marine organisms, and ultimately affect marine fisheries. Recent investigations have been focused on long-term trends in phytoplankton biomass or production, as this knowledge is essential for the management of marine resources. However, contrasting findings have been reported, both at global (Boyce *et al*., 2010; McQuatters-Gollop *et al*., 2011) and regional scales (Richardson and Schoeman, 2004; Bode *et al*., 2011). Possible reasons for this controversy are the bias introduced by the mathematical methods used for trend analyses (e.g. Mackas, 2011; Rykaczewski and Dunne, 2011) and site-specific differences in the environmental variables that influence phytoplankton dynamics (Revilla *et al*., 2010; Bode *et al*., 2011).

In the southeastern Bay of Biscay, data on chlorophyll-*a* concentration as a proxy for phytoplankton biomass have been collected since 1986 at a marine station named D2 (Figure 1). The station is located offshore (43º 27' N, 01º 55' W) near San Sebastian, at a water depth of 110 m. This site is considered to be non-impacted by anthropogenic influence, due to its distance from the main pollution sources on land (13.1 km). As such, it is suitable for exploring the phytoplankton response to climate forcing in the Basque coast.

At station D2, CTD and bottle samples were used to obtain vertical profiles of chlorophyll-*a*, together with other oceanographic variables such as temperature, salinity and nutrients. During the period 1986-2011, surveyed months and total number of surveys per year were variable (from 3 to 12). This produced on average 8 measurements per year (~200 data points). Time-series of the East Atlantic (EA) pattern, a climatic index, were obtained from http://www.cpc.noaa.gov/. Meteorological data recorded at the Igeldo Observatory (San Sebastián) were supplied by AEMET ("Agencia Estatal de Meteorología"). The North Atlantic Sea Surface Temperature (SST) averages were obtained from the NOAA ERSST.v2 (Extended reconstructed global SST data based on COADS data; http://www.esrl.noaa.gov/psd/data/timeseries/AMO/) (Smith and Reynolds, 2004). Daily series of SST were obtained also from the Aquarium (Figure 1).

Time-series of chlorophyll-*a*, climatic and physico-chemical variables were analysed by the Kolmogorov-Zurbenko Adaptive (KZA) filter for detecting abrupt changes and trends, following the method described in González *et al*. (2011). The KZA method is based on an iterative moving average that adjusts the length of the window according to the rate of change of the process (see Zurbenko *et al*., 1996; Yang and Zurbenko, 2010).

Results indicate different changes in chlorophyll-*a* concentration at different depths in the water column. In 1996, a drop was observed in the surface waters (0-1 m), from approximately 0.75 to 0.55 µg l^{-1} (Figure 2). In contrast, the concentration averaged throughout the euphotic layer (roughly estimated as 0-50 m) presented an increase of similar magnitude in 2001, which accounts for approximately 25% of the initial phytoplankton biomass. The water-column-averaged chlorophyll-*a* (0-100 m) increased by about 10% in 2004.

These changes, observed in the phytoplankton biomass during the last 26 years, could be related to climatic factors. In this regard, the positive phase of the EA pattern has dominated during this period (Figure 3a). This involves, in the southeastern Bay of Biscay, warmer and drier winters, as well as an increase of downwelling events, caused by the southwesterly winds (Borja *et al.,* 2008).

For the Basque coast, it is hypothesized that the phytoplankton production could have increased in the photic layer, due to the more frequent occurrence of cloudless sky (Figure 3b). On the other hand, in surface waters and specially during summer the phytoplankton production would be negatively affected by the warming (Figure 3c, d, e) associated with the positive EA pattern, as it involves more stratification and, in consequence, less availability of nutrients in the surface layer. However, this would not decrease the magnitude of the sub-surface chlorophyll-*a* maximum; in contrast, a deeper location would have permitted a better access to nutrients. The sum of these processes in the water column would result in a slight increase in the integrated phytoplankton biomass during the last 26 years, in the offshore waters of the Basque coast.

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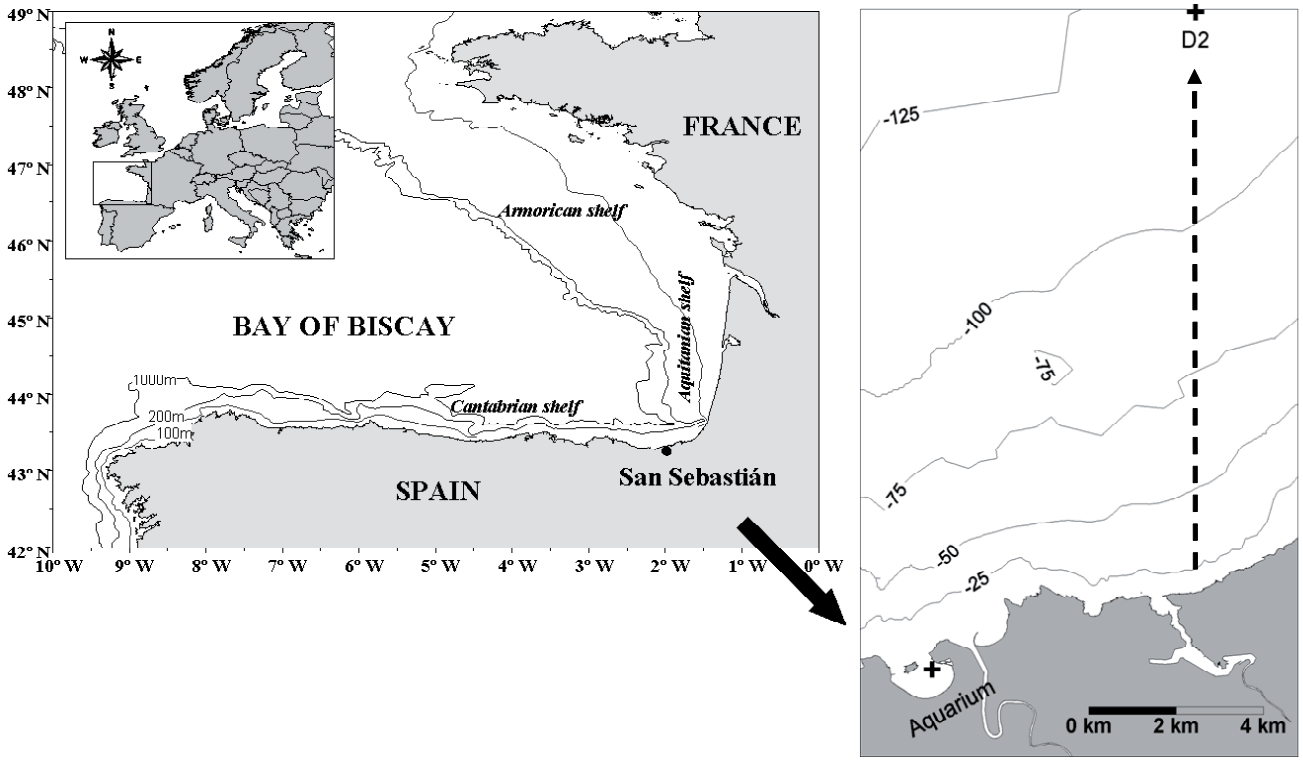

Figure 1. The offshore station D2, in the context of the Bay of Biscay. The location of the Aquarium of San Sebastián (where daily series of sea temperature are recorded since 1947) is also shown

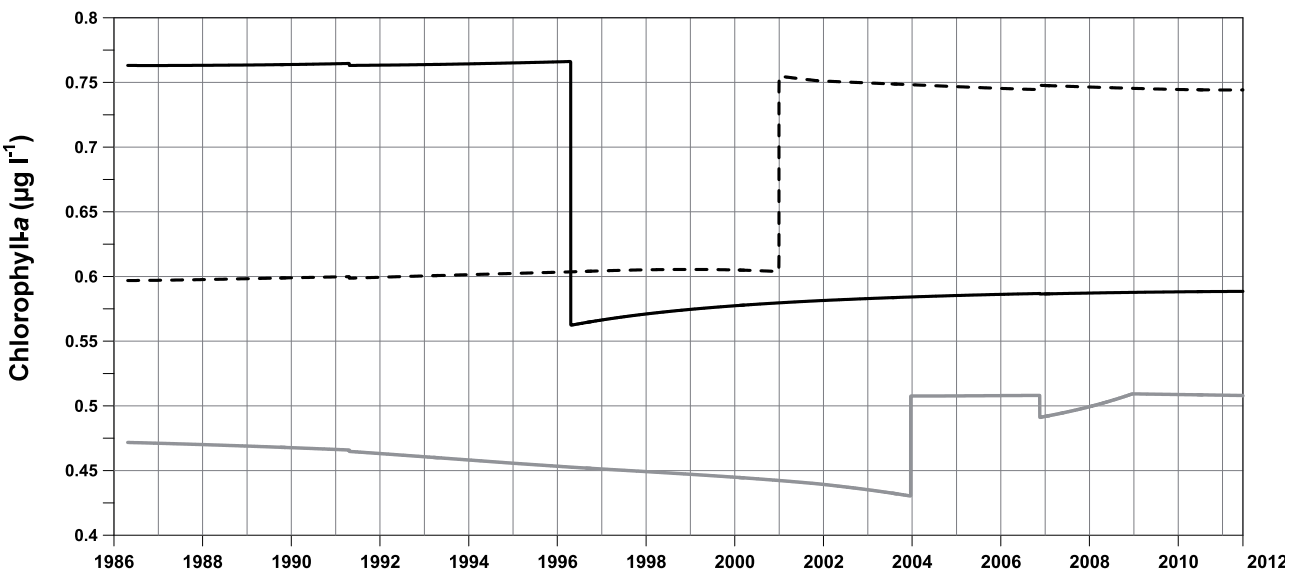

Figure 2. Decadal variability of chlorophyll-*a* concentration at station D2 analyzed by KZA filter (5-year, 4 iterations). The black solid line represents surface waters (0-1 m), the dotted line represents the euphotic layer (0-50 m) and the grey line represents the whole water column (0-100 m).

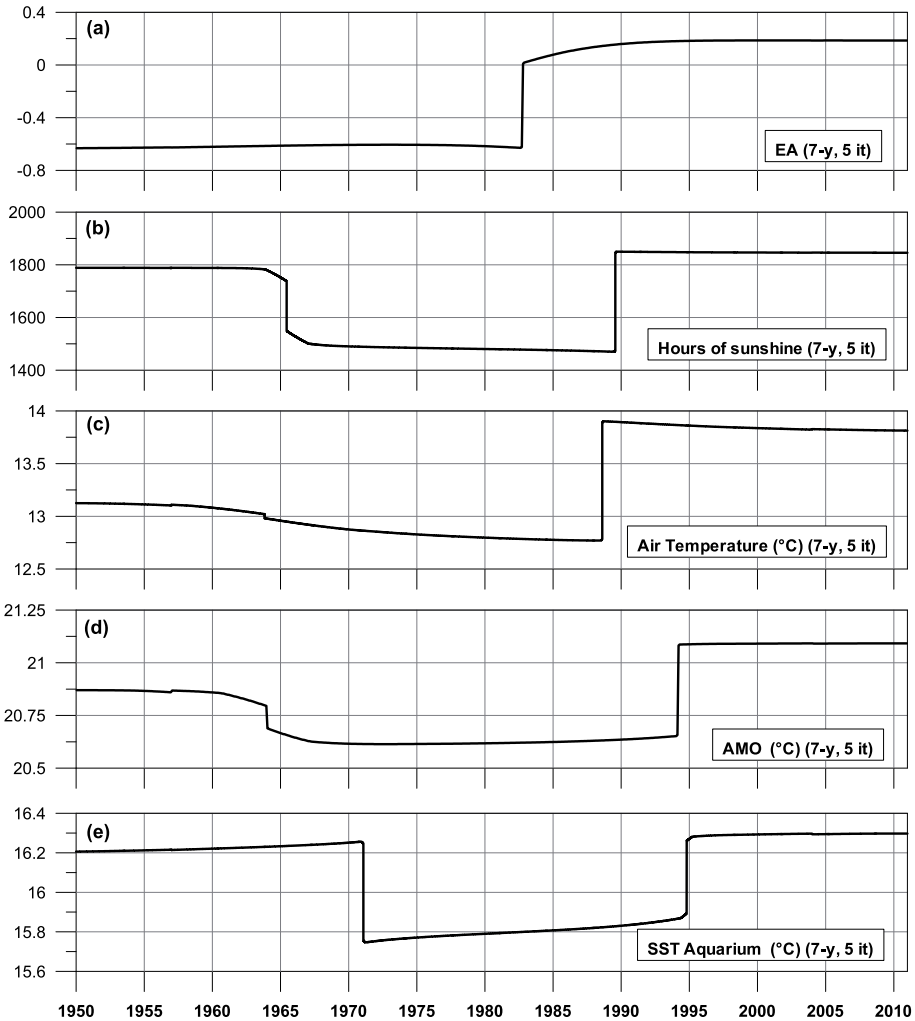

Figure 3. Long-term trends in environmental conditions obtained by KZA filter: (a) East Atlantic (EA) pattern (b) Cloudless (c) Air temperature (d) Sea Surface Temperature derived from the Atlantic Multidecadal Oscillation (AMO) (e) Sea Surface Temperature (SST) recorded at the Aquarium.

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Los fondos y arrecifes de *Cladocora caespitosa* en las Islas Columbretes, un patrimonio natural del Mediterráneo amenazado por el cambio global

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Cladocora caespitosa es el único coral endémico del Mediterráneo con zooxantelas simbiontes y con capacidad de formar arrecifes. En la actualidad las grandes bioconstrucciones de este coral se localizan en contadas zonas del Mediterráneo, siendo las más importantes, por el tamaño y área ocupada por las colonias, las bioconstrucciones de las Islas Columbretes (España, Mediterráneo NW) y Mljet (Croacia, Adriático). En las Islas Columbretes *Cladocora caespitosa* se concentra en la caldera volcánica sumergida de L'Illa Grossa (150.000 m^2). En esta bahía abierta al NE, que asegura cierta protección frente al oleaje y corrientes pero también un intercambio continuo de agua, *C. caespitosa* forma lechos de colonias y arrecifes de hasta 10 m^2 de superficie. Los resultados obtenidos mediante transectos de 50 x 1 m distribuidos homogéneamente por la bahía, muestran que la distribución espacial de *C. caespitosa*, entre 5 y 27 m, es agregada y fuertemente asociada a la morfología de fondo; siendo más abundantes las colonias en las zonas de mayor relieve, en busca de protección frente al hidrodinamismo. En las dos zonas de la bahía en las que este coral es más abundante, NW y SE, las colonias alcanzan superficies acumuladas de 240 m^2 y 910 m^2, respectivamente. Se estima que en la totalidad de la bahía la superficie acumulada que ocupan las colonias de *C. caespitosa* es de 2900 m^2. *C. caespitosa* presenta un crecimiento extremadamente lento, las tasas de crecimiento anual obtenidas en Columbretes, mediante el análisis de radiografías de coralitos y tinción con rojo de alizarina, rondan los 2,5 mm/año. Teniendo en cuenta estas tasas de crecimiento y el tamaño de las bioconstrucciones, se calcula que algunos de los arrecifes de Columbretes pueden alcanzar los 300 años de edad. En la actualidad, *C. caespitosa* se ve amenazada en Columbretes por los efectos del cambio global, principalmente por la ocurrencia de mortalidades recurrentes asociadas a la temperatura del agua de mar y por la presencia de algas invasoras. En Columbretes la primera mortalidad masiva de este coral se registró en 2003; en este evento se alcanzó un porcentaje de necrosis media del 25 %. Tras esta primera mortalidad los eventos se han ido repitiendo con menor intensidad y mostrando relación con las anomalías térmicas positivas. Por otra parte, desde 2006 las algas introducidas *Caulerpa racemosa* y *Lophocladia lallemandii* están presentes en la bahía de L'Illa Grossa, donde han llegado a ocupar las zonas en las que se concentran las colonias de *C. caespitosa*. Se ha podido constatar que *Caulerpa racemosa* no presenta crecimiento sobre las partes vivas de *C. caespitosa*, aunque sí lo hace sobre las superficies muertas de las colonias. De momento parece ser que ninguna de las dos algas invasoras tiene efectos letales sobre esta especie. Dada la singularidad y alto valor patrimonial de estas grandes bioconstrucciones y las amenazas a las que están expuestas, su protección y seguimiento son fundamentales para su correcta conservación.

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Distribution patterns and shifts in abundance of rocky shore gastropods along a latitudinal gradient: A response to climate change

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Climate change is widely recognized as a major threat to global biodiversity and this is expected to intensify over time. Previous studies have found significant shifts in the geographic distribution, abundance and reproduction periods of several intertidal taxa related to global warming (Mieszkowska *et al*., 2006; Mieszkowska *et al*., 2007; Hawkins *et al*., 2008). Intertidal organisms have proved to be good models for the study of the dynamic and processes at the range boundaries, because they are easy to manipulate and have almost linear geographic distribution (Sagarin and Gaines, 2002). Moreover, they live in the interface of land and sea and thus are subjected to the environmental conditions and changes of aquatic and aerial climatic regimens, frequently living in the limit of their physiological tolerances (Helmuth *et al*., 2006). The key aim of this study is to investigate how the global warming will modify the patterns of distribution and abundance of cold-water species (CWS) and warm-water species (WWS), along the Iberian Peninsula Atlantic coast. A set of WWS and CWS of intertidal gastropods, was defined before sampling as target species. A fully hierarchical sampling design was used to study the spatial distribution of these gastropods.

Results showed that the abundance and distribution of WWS *Gibbula umbilicalis*, *Osilinus lineatus*, *Melarhaphe neritoides*, and *Patella depressa*, have not suffered significant changes during the last decades, in contrast with the results found at their northern limit in the U.K. (Mieszkowska *et al*., 2006; Mieszkowska *et al*., 2007; Hawkins *et al*., 2008). On the other hand, CWS like *Nucella lapillus*, *Littorina littorea* and *Littorina saxatilis* seem to have experienced a reduction in their abundance and distribution range along the Atlantic coast of the Iberian Peninsula. This is especially remarkable for *L. littorea* that has almost disappeared from the exposed rocky shores of the western Iberian Peninsula. Finally, the sub-tropical pulmonate false limpet, *Siphonaria pectinata*, showed the inverse pattern than CWS, i.e. an increase of its distributional range to the north when compared to previous data. We found populations of *S. pectinata* in Moledo, about 185 km north from the locations studied by Nobre (1940).

In conclusion, the observed patterns of spatial distribution and abundance of the targeted gastropods along the Iberian Peninsula showed a reduction on the distributional range of CWS and an increase toward the north of the sub-tropical species *S. pectinata*.

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Seasonal variation of biological responses to gradual temperature raising in digestive gland of mussels

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Marine ecosystems have been significantly affected by global warming during the last decades and its impact is expected to increase in the near future due to the current acceleration of warming. The consequences of temperature increase for biota may be very different depending on the season. In this context, the seasonal variability in biomarker responses to gradual temperature raising was investigated under controlled laboratory conditions in marine mussels, *Mytilus galloprovincialis*, collected from a reference site (Mundaka) in the Bay of Biscay in July and November 2009 and March 2010. At each season, mussels were kept in each own's seawater and acclimated to laboratory conditions at local seawater temperature (20ºC in July, 16ºC in November and 12ºC in March) for 5 d. In the 3 experimental sets, temperature was raised 1ºC per day for the first 8 d and then kept constant for the following 6 d. Cell and tissue level biomarkers were recorded in the digestive gland just before temperature increase started (t0) and at 1, 4, 8, 14 days during the experiment. Lysosomal enlargement, membrane stability, intracellular neutral lipid accumulation, cell type replacement, atrophy of the digestive diverticula and tissue integrity in digestive gland were measured and histology of gonad was assessed as supporting parameter. Increasing temperature accelerated gametogenic cycle; also significant lysosomal membrane destabilization and lysosomal enlargement were observed in summer and autumn, being more marked in summer. Furthermore, connective to diverticula ratio increased in summer and autumn. On the other hand, not quantifiable responses were observed in winter. In general, a gradual temperature increase of 8ºC provoked alterations at cell and tissue level biomarkers; and mussel response was different depending on the season, being more sensitive in summer.

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Preliminary assessment of European eel (*Anguilla anguilla*) stocks in north-eastern Spain: the role of introduced species

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The stocks of European eel (*Anguilla anguilla*) has strongly declined in last 30 years and this species is considered Critically Endangered based on UICN criterion. The recruitment of glass eels has declined from 1980, and since 2000 is at an historical low at just 1-5% of the pre-1980 levels, showing a 95 to 99% decline. This decline in recruitment will translate into a future decline in adult stock, at least for the coming two decades (ICES 2006). In 2007, CITES listed the species in Appendix II (this came into force in March 2009) and will require exporting states (Spain included) to have an export permit which can only be issued if the export will not be detrimental to the survival of the species. Also the European Commission has issued a Regulation requiring all member states to produce eel management plans, amongst other measures. These management plans were required to be in place by July 2009 and have the objective to permit the escapement to the sea of at least 40% of the silver eel biomass. Prior to the development of a management plan, it is crucial to make a diagnosis of the status of fish populations (i.e. population tendency) and to identify its main pressures. In the case of the European eel, the establishment of the reasons for its decline is not easy because the species range is so vast and the life cycle incorporates stages on sea and rivers, and a large migration to the Sargasso Sea. It is then difficult to determine which stage of the life cycle has been affected to cause the dramatic species decline. Common threats to native species and, in particular to species with high commercial value are habitat degradation (e.g. pollution), the introduction of exotic species (e.g. predators, trophic competitors, exotic diseases) and overfishing. The European eel is a catadromous species that, after reaching the Iberian coast, some specimens remain at the mouth of rivers whereas others swim upstream and live in freshwater up to reach sexual maturation and starting migration to Sargassos Sea. In this regard, Catalan rivers have a long history of anthropogenic perturbations that can strongly determine the life-cycle of eel (e.g. dams) and pollution. Additionally, this area is considered a hotspot of introduced fish species in where exotic species richness is over 60% of native freshwater fish species. The present study was performed based on 325 sampling sites surveyed covering the Mediterranean Sea coast from la Sènia to Fluvià Rivers. First, we present an evaluation of the population trends of European eel in the last 50 years in Catalonian rivers considering the historical range of the species, the range in 2002-2003 and the current range in 2010-2011. These changes in ranges were evaluated using a binomial test. Secondly, we analyzed the role of exotic and native fish communities with the presence of European eel in these waterbodies. Considering those sites under the potential distribution area of European eel (*Anguilla anguilla)*, fish assemblage was evaluated using an analyses of similarities (ANOSIM). Additionally, the average density of native and exotic species was compared between sites with and without European eel using a Wilcoxon's test. Spearman's bivariate correlations were also used to test the relationship between European eel density and the density of introduced and native species. Our results confirmed the recovery of European eel stocks in some basins. Lacking studying in depth the role of synergic effects with other anthropogenic impacts, our findings revealed that fish assemblage does not significantly change with European eel occurrence. The density of native and introduced species was higher in those sites with European eel compared to sites without eel. We also tested the potential effect of the presence of fish predators (e.g. black-bass, zander), but the relationship was also significantly positive with the presence of European eel. Therefore, it seems that the presence of introduced species is not crucial for the conservation of European eel populations at least in these Mediterranean streams of Iberia. Other factors such as dams, bioaccumulation of pollutants, overfishing and the incidence of disease may be caused a strongly impact and require further research.

Keywords: European eel, introduced species, population trends, fisheries, conservation.

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Is *Caprella scaura* Templeton, 1836 displacing the native *C. equilibra* Say, 1818 along the Iberian Peninsula and Northern Africa?

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Caprella scaura Templeton 1836 is a native species to the western Indian Ocean. It was first described from Mauritius and later reported from several regions of the world. During the last decade, *C. scaura* spread out of the Adriatic Sea via ship fouling and aquaculture activities. In 2005, it was reported in the north-eastern coast of Spain and two years later the species was found in the Strait of Gibraltar and Canary Islands, indicating that it is probably invading the whole Mediterranean and the Atlantic coast of Spain. In order to assess the rapid expansion of *C. scaura* in its introduced range, we surveyed marine fouling communities associated with artificial hard substrata from 88 marinas along the whole Iberian Peninsula and North Africa. The study was conducted between June 2011 and July 2011. The results of this survey confirm an extensive distribution of *C. scaura* along the Mediterranean coast of Spain and offer additional evidence in support of recreational boating as an important vector for secondary spread. *C. scaura* was also found for the first time in the Moroccan coast and the center coast of Portugal. In the marinas where *C. scaura* was abundant the dominant native species found, *Caprella equilibra* Say, 1818 were absent, or present in very low abundances. Moreover, along the whole coast of the Iberian Peninsula we observed very little overlap in the distribution of the invasive caprellid *C. scaura* and the native *C. equilibra*. *C. scaura* dominates the more saline and warmer Mediterranean coast of Spain and *C. equilibra* the less saline and cooler Atlantic coast of the Iberian Peninsula. We have detected a clear overlap in the transitional area of the Strait of Gibraltar, including the southern coast of Spain and North Africa, characterized by a mixture of waters from the Mediterranean Sea and the Atlantic Ocean. Since both species were commonly found in the same substrata, the bryozoan *Bugula neritina* (Linnaeus, 1758), it is likely that this pattern could be due to spatial competition and not only to environmental factors. Further studies are necessary to evaluate the possible impact of *C. scaura* on the native fauna and to understand the potential mechanism underlying the replacement of the native *C. equilibra* by *C. scaura* in the Mediterranean coast of Spain.

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Genetic signature of a recent invasion: *Bursatella leachii* coming to Mar Menor coastal lagoon

Mercedes González-Wangüemert[a], Jorge Martínez Godino[a], Francisca Giménez Casalduero[b], Ester A. Serrão[a]

In the last years, biological invasions are being recognized as an important element of global change, following the observation of increasingly spectacular developments of alien species in various regions of the world. Since the opening of the Suez Canal in 1869, a large number of Indo West Pacific molluscs have entered the Mediterranean through the Canal and established permanent populations along its coasts.

Bursatella leachii (Blainville, 1817), is a circumtropical species, widespread along the temperate water of the Indo-Pacific and Atlantic Ocean, and nowadays common in the eastern Mediterranean (Zenetos *et al*. 2004). The first record from the Mediterranean Sea was found in Palestine (O'Donoghue and White, 1940) and successively recorded in Turkey (Swennen, 1961), Malta (Bebbington, 1970), Israel (Eales, 1970), Sicily (Piani, 1980), Tunisia (several records since 1982, Enzenross and Enzenross, 2001; Zakhama-Sraieb *et al*., 2009), Italy (Fasulo *et al*., 1984), Slovenia (Jaklin and Vio, 1989), Greece (Koutsoubas, 1992), Lebanon (collected by G. Bitar and H. Zibrowius, identification confirmed by J. Templado), Sardinia (collected by A. Olita, identification confirmed by J. Templado) and finally in Southern Spain (Izquierdo-Muñoz personal communication). This pattern of dispersal is typical of a Lessepsian species migration.

In the last four years, several population explosions of this species are occurring in Mar Menor coastal lagoon (SE Spain) with densities higher than 15 individuals per m2. We studied the genetic structure of *B. leachii'* inside the Mar Menor coastal lagoon using a mitochondrial marker (COI gene) to assess its genetic diversity, test for founder events (bottlenecks), and to improve the understanding of colonization/invasion events and dispersal patterns of this species. To reach these aims, we sampled 4 localities from Mar Menor covering all its distribution (Lo Pagán, San Javier, Los Narejos and Ciervo Island). Analysis of 70 individuals with COI mitochondrial gene sequences of 460-bp in length, detected only one haplotype. This result is surprising considering the 39 haplotypes detected in *Cerastoderma glaucum* (Vergara-Chen *et al*., in review) or the 32 haplotypes found in *Holothuria polii* (Vergara-Chen *et al*., 2010) using the same gene in the same Mar Menor populations. This genetic homogeneity can however be expected for a genetic bottleneck, caused by a founder event due to an introduction of a subsample of the original populations, followed by fast expansion inside Mar Menor. Considering the dates of collection and locations of our samples, it seems probable that the Mar Menor population of *B. leachii* represent a single invasion event by very few individuals of this simultaneous hermaphrodite species, or by many individuals but all sharing the same mitochondrial lineage, due to previous bottleneck events along the Mediterranean expansion. Our findings reaffirm the difficulty of predicting the potential for invasion success and adaptation of a new invader on the basis of its genetic diversity. Future studies using other mitochondrial and nuclear markers in *B. leachii* populations across the invaded range in the Mediterranean and from the native regions, will be need for a better understanding of its colonization patterns.

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Molecular ecology and climate change: adaptive differentiation of *Cymodocea nodosa* populations through environmental clines

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The consequences of climate change include variations in the distribution ranges, bottlenecks and local extinctions. Increasingly, genetic evidence has been showing that adaptive and/or evolutionary responses can be produced at short temporal scales. Low genetic diversity can reduce the ability to respond to climatic stress at ecological and evolutionary temporal scales. Genetic diversity is expected to be particularly necessary for high adaptive potential in habitats with important environmental variability (temperature, salinity and irradiance), therefore improving the chances of population persistence along large temporal scales (Barret *et al*., 2007). The genetic structure and reproductive mode (clonal versus sexual) of habitat-structuring seagrasses, and therefore their population status, might be affected by extreme environmental variables linked to climatic change.

In this study, we assess the genetic diversity of *Cymodocea nodosa* populations distributed along the SE Spanish coast under different environmental conditions. Using 10 microsatellites, we distinguished and removed clonal copies before calculating diversity estimates. The clonal richness ranged from 15 (Lo Pagán) to 30 (Los Urrutias). We detected the highest genetic diversity in two populations, one of them located inside the Mar Menor coastal lagoon (Los Urrutias, H_E=0.57; allelic richness = 3.89) and the other one nearby Cabo de Palos - Islas Hormigas marine reserve in Cala Reona (H_E=0.52; allelic richness = 3.00). Most of the sampled localities showed significant deficit of heterozygotes reaching a maximum in Ciervo Island (F_{IS} = 0.32; $p<0.05$). Significant genetic differentiation was found among populations inside and outside Mar Menor and there was no correlation with geographic distances. The more isolated populations inside Mar Menor (Ciervo Island (IC) and Lo Pagán (LP)) had the highest genetic differentiation ($F_{ST}>0.40$; $p<0.05$) and the lowest estimated number of migrants per generation, which ranged from 0.86 to 10.14 in IC and from 1.05 to 8.07 in LP. A multivariate analysis explained more than 60% of observed genetic variance, differentiating four groups: first one including Bolnuevo, second one La Azohía and third one Cala Reona, all them open sea populations. The fourth group includes Los Cocedores populations in the Mediterranean Sea and all the populations from Mar Menor, which can be explained by the similarity of the environmental conditions under these meadows are growing: high irradiance during all year, high temperature variations due to the shallowness of the habitat and low hydrodynamic and swell.

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Physiological adaptation to Mediterranean waters of the native crab *Pachygrapsus marmoratus* and the invasive crab *Percnon gibbesi*

Silvia Tejada [a], Antonio Box [b], Salud Deudero [c], Antoni Sureda [b]

The rapidly accelerating human activities over the past century (trade, transport, tourism) have dramatically enhanced the spread of alien species. Invasive species often represent a potential risk to native organisms because they can highly compete with the resident species altering the normal population dynamics. The Mediterranean Sea is very sensitive to biological invasions with around 600 introduced species. The main vectors for invasions in the Mediterranean are the colonisation by Indian Ocean species, the so-called Lessepsian migrants which have been entering through the Suez channel, aquaculture and unintended transport. *Percnon gibbesi* (H. Milne Edwards, 1853), a small crab (Decapoda, Grapsidae) with a subtropical distribution, is one of the newcomers in the Mediterranean Sea. This species is associated with shallow rocky bottoms that have boulders where the crab can easily hide from predators when threatened and found algae for feeding. *Pachygrapsus marmoratus* is a native crab in the Mediterranean Sea that inhabits supralittoral crevices. We hypothesize that the absence of visual indicators of direct interaction and competence between *P. gibbesi* and *P. marmoratus* could be reinforced with biochemical analysis. The aim of the present study was to compare markers of oxidative stress in hepatopancreas and the carotenoids and vitamin E content in the carapace as indicators of the physiological habits of the crabs.

Samples of *P. gibbesi* and *P. marmoratus* were collected by apnea diving in Portals Vells (Mallorca, Balearic Islands, Western Mediterranean) in July 2009 at 0-1 meters depth. Both crabs' species were collected in a similar way and immediately carapace length (CL) was recorded. Crabs (n=14 for each species) were dissected out and tissues (hepatopancreas and carapace) were immediately frozen at -70ºC until further processing.

The size of crabs was similar with carapace width of 2.05 ± 0.18 cm for *P. gibbesi* and 2.12 ± 0.17 cm for *P. marmoratus* without significant statistical differences. The hepatopancreas was homogenised in five volumes (w/v) of 100 mM Tris–HCl buffer pH 7.5. Each homogenate was sonicated briefly (2–3 s) using ultrasonic processor and centrifuged at 9000 g at 4 °C for 15 min. After centrifugation, supernatants were collected and immediately used for biochemical assays. Carapace samples were extracted using n-hexane after deproteinization with ethanol containing 0.2% BHT. Vitamin E (-tocopherol) and carotenoid concentration were determined by HPLC in the n-hexane extract of carapace homogenates after drying in an N_2 current and dissolving in methanol.

Vitamin E levels in crab carapaces were significantly higher in *P. marmoratus* than in *P. gibbesi* (29% higher). All carotenoid concentrations, except the astaxanthin, were significantly higher in *P. gibbessi* (Lutein/Zeaxantin, 167% higher; Criptoxanthin, 76% higher; Lycopene, 36% higher; and -carotene, 112% higher). The results show that the range of concentrations varied in the analyzed samples, corresponding the higher value to vitamin E. The activities of catalase, glutathione peroxidase and glutathione reductase (Table 1) were significantly greater in *P. marmoratus* than in *P. gibessi* (49%, 31% and 173% respectively). No significant differences were evidenced for SOD activity. MDA concentration was higher in hepatopancreas of *P. gibbesi* when compared to *P. marmoratus* (38% higher).

The different carotenoid content and vitamin E in the two crab species could be directly related with their patterns of habitat and different lifestyle. As the native *P. marmoratus* lives in shallow areas more in contact with atmospheric oxygen the vitamin E content is higher to protect against oxygen oxidation. The invader *P. gibbesi* lives completely submerged in rocky boulders or sciaphile rocky bottoms covered by incrusting red coralline algae and consequently its carapaces present a similar chromatic pattern to the seabottom. *P. gibbesi* had a less activated antioxidant system as it was evidenced by the low antioxidant enzyme activities, although MDA was higher, in comparison with the crab *P. marmoratus*. These results could be explained by the fact that the alien species is a new inhabitant, having to cope with new environmental conditions, and its antioxidant system is not completely responding to the stress that a new place means, increasing the damage in lipids. In conclusion, according to the crabs' physiological responses, *P. gibbesi* does not seem to be a potential competitor for the native crab *P. marmoratus*, although exclusion of native crabs may occur in some areas.

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Evaluación del estado actual de la malacofauna exótica en la costa vasca

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Los moluscos marinos constituyen junto a los artrópodos y poliquetos la principal fracción de la macrofauna bentónica en la costa vasca, tanto desde el punto de vista numérico como de la biomasa. A pesar de ello, los estudios encaminados a conocer la diversidad real y la naturaleza de sus poblaciones son relativamente recientes. El primer censo general de especies marinas fue realizado por Borja a finales de los años 80 (Borja, 1987). En dicho trabajo se listan 382 especies distintas. Años más tarde, el mismo autor (Borja, 2001), completa el inventario con la incorporación de otras 28 especies. En dichos catálogos se proporciona una somera información sobre el tipo de hábitat, grado de rareza y localidades de la costa vasca en donde aparecen las diversas especies; pero no se aportan datos sobre el rango geográfico de su distribución.

Los continuos sucesos de invasiones biológicas que vienen ocurriendo en los últimos años (algunos con fatales consecuencias medioambientales), nos motivó a realizar en 2005 y 2006 dos estudios centrados en catalogar las especies invasoras presentes en las rías y costa de la C.A.P.V. Aunque para el caso de los moluscos, el carácter autóctono o foráneo de las poblaciones no fue contemplado en los inventarios de Borja, sus listados constituyeron un punto de partida muy útil para tratar de establecer o esclarecer los orígenes de este grupo faunístico.

A partir de dichos trabajos, el análisis de documentos bibliográficos y numerosas campañas de muestreos pudimos elaborar un primer listado de especies exóticas y criptogénicas. Dicho censo recoge 28 especies exóticas marinas y estuarinas para la costa vasca, la mayoría procedentes de áreas tropicales, subtropicales o de regiones templadas (Martínez & Adarraga, 2005, 2006).

Desde entonces, hemos tenido la oportunidad de analizar multitud de muestras recogidas a lo largo de todo el litoral vasco. Del mismo modo, hemos realizado decenas de salidas a la zona intermareal y recabado información de multitud de inmersiones con escafandra autónoma. Fruto de ello, se han constatado otras especies exóticas establecidas en nuestra costa (Adarraga & Martínez, 2011, 2012). De ellas, *Limnoperna securis* (Lamarck, 1819), *Theora lubrica* Gould, 1861 y *Musculista senhousia* (Benson in Cantor, 1842) están actualmente consideradas como tres de las especies invasoras más peligrosas de Europa (Balena *et al*., 2002; SEBI 2010). Del mismo modo hemos podido comprobar la persistencia u ausencia de ciertas especies.

En el trabajo que se presentará en el Simposio daremos a conocer el estado actual de la malacofauna exótica presente en los ambientes estuarinos y litorales costeros de las provincias de Bizkaia y Gipuzkoa.

El área de estudio incluye todo el tramo litoral costero de las provincias de Bizkaia y Gipuzkoa. El material analizado proviene de diversas fuentes. La mayor parte procede de trabajos de monitoreo ambiental efectuados por el Centro Tecnológico AZTI-TECNALIA para diversas Instituciones públicas y privadas. El resto se reparte en campañas personales efectuadas por los propios autores, Estudios Ambientales efectuados por la S.C. INSUB para Diputación Foral de Gipuzkoa e información proporcionada por los buceadores del club deportivo A.P.S.A.S. La metodología empleada, obviamente varía en función de la zona. En las áreas intermareales, se recorre la zona a pie en marea viva registrando las especies "a visu". Complementariamente, se toman muestras de rascados de diversas superficies en los diferentes horizontes vegetales y animales. En los sedimentos se toman muestras con un corer de 0,25 m^2 de superficie. El material recogido se fija con formaldehido al 4%. En el laboratorio las muestras se separan e identifican los ejemplares bajo una lupa binocular Olympus y un microscopio Zeiss. Las muestras de sedimento previamente se cuelan "in situ" a través de un tamiz de 1 mm de luz de malla. En las áreas submareales y circalitorales, las muestras se toman con una draga Van Veen de 0,1 m^2 de superficie efectiva y una draga Shipeck de 0,04 m^2. El material obtenido se tamiza a través de una malla de 1mm de luz y se procede de manera análoga a lo explicado para las áreas intermareales.

A fecha de hoy, el número de especies de moluscos marinos y/o estuarinos exóticos registrados en la C.A.P.V. es de 32. De este conjunto, las especies: *Tricolia speciosa* (von Mühlfeldt, 1824), *Alvania cimex* (Linnaeus, 1758), *Alvania hispidula* Monterosato, 1884, *Phalium saburon* (Bruguière, 1792), *Cabestana cutacea* (Linnaeus, 1767), *Orania fusulus* (Brocchi, 1814), *Sphaeronassa mutabilis* Linnaeus, 1758, *Cerithiopsis jeffreysi* Watson, 1885, *Pollia dorbignyi* (Payraudeau, 1826), *Raphitoma echinata* (Brocchi, 1814), *Turbonilla delicata* Monterosato, 1864,

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Mangiliella bertrandi (Payraudeau, 1826), *Pinna nobilis* Linnaeus, 1758 y *Bornia geoffroyi* (Payraudeau, 1826) han sido citadas hace más de 10 años y en una única ocasión.

Los gasterópodos: *Turritella turbona* Monterosato, 1877, *Monophorus perversus* (Linnaeus, 1758) y *Nucella lapillus* (Linnaeus, 1758); el nudibranquio *Armina maculata* Rafinesque, 1814; y el bivalvo *B. geoffroyi* han sido recolectadas en dos ocasiones. Los registros para las tres primeras especies son bastante antiguos. Las últimas referencias de *T. turbona* y *M. perversus* datan de 11 años; mientras que la de *N. lapillus* se remonta a 30 años. Por el contrario las colectas de *A. maculata y B. geoffroyi* son relativamente recientes (1996/2205 y 2005/2006, respectivamente).

A diferencia de las anteriores, los gasterópodos: *Rissoa decorata* Philippi, 1846, *Thais haemastoma* (Linnaeus, 1767) y *Cerithiopsis minima* (Brusina, 1864); y el bivalvo *Tellina compressa* Brocchi, 1814 son recolectadas de manera regular a lo largo de toda la costa vasca.

Ocho especies exóticas inventariadas están consideradas como especies invasoras muy agresivas. Éstas son: *Potamopyrgus antipodarum* (Gray, 1840), *Urosalpinx cinerea* (Say, 1822), *Cyclope neritea* (Linnaeus, 1758), *Limnoperna securis,* Lamarck, 1819) *Musculista senhousia* (Benson in Cantor, 1842)*, Crassostrea gigas* (Thunberg, 1793), *Theora lubrica* Gould, 1861 y *Tapes philippinarum* (Adamd & Reeve, 1852). De éstas, *M. senhousia*, *T. lubrica* y *L. securis*, parecen incrementar paulatinamente sus poblaciones, por lo que serán objeto de un tratamiento más completo en el póster que se presentará en el Simposio.

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Is invasive macroalgae *Lophocladia lallemandii* inducing changes in epiphyte community of endemic bivalve *Pinna nobilis*?

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Invasive species are one of the main factors that threat ecological communities. The red alga *Lophocladia lallemandii* (Montagne) F. Schmitz is a recognized invader in marine ecosystems around the Mediterranean. The aim of the present study is to characterize the structure of the epiphytic native species of *Pinna nobilis* population in the Archipelago of Cabrera National Park (ACNP) among which *L. lallemandii* is attaining high colonization rates. The study is integrated in a protected area where it is least influenced by human activity, and consequently, less impacted by invasive macroalgae. Although we found that more than a half of the population of *P. nobilis* in Cabrera was epiphyted by *L. lallemandii*. The study was carried out monthly during eight months, from April to November 2011, according to the length size distribution of *P. nobilis* population census in the ACNP: 3 small (≤19 cm), 4 medium (19-38 cm) and 3 large (>38 cm). It has been quantified a total of three size ranges in a population with a high number of individuals. The community of native epiphytes on the shell of *P. nobilis* has high ecological importance because it is a centre of aggregation and contributes to increase the biotope complexity level. The results suggest that the presence of the invasive macroalgae *L. lallemandii* produce changes on the composition of the native species on the fan mussel *P. nobilis* individuals in the ACNP. Native species of *P. nobilis* denote a high variability in the number of species, species coverage and species richness. Diversity of native species declines over time with the presence of *L. lallemandii*.

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Non-indigenous faunal species of subtidal hard benthic substrates in the "Abra de Bilbao" (N. Spain)

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Marine transportation and the associated ballast water exchange has been recognized as a mayor route of entrance of non indigenous species (NIS) (Hewitt and Campbell, 2007; Gollasch, 2007; Ruiz *et al*., 2000) that could led to ecological, economic and social consequences (Pimentel, 2005; Edresen *et al*., 2004; Davidson *et al*., 2009). NIS are now recognised as one of the most serious threats to the natural ecology of biological systems worldwide. This work analyses NIS abundance and diversity over a period of 15 years (1994-2009) at 9 subtidal localities in the internal and external areas of the "Abra of Bilbao" using visual estimates of the faunal species abundance in 50x50 quadrats. We considered as native species those who are known to be endemic to the Basque biogeographical region. Non-indigenous species included species introduced as a result of human activities. Criptogenic species comprise those whose identity as either native or non-indigenous remains ambiguous, while indeterminates species include taxa that could not be reliably identified to species level. In the study area, a total of 215 taxa were identified. NIS species reached higher cover values during two periods: 1994 and 1995 and, specially, in 2007-2009. Nevertheless, in the second period a decreasing tendency was detected. The evolution of the richness of NIS was variable from 1994 to 2004. However, it has risen gradually from 2005, reaching its maximum in 2009. Taking into account the different localities of the study area, the cover of NIS was low in general. In the localities affected by the freshwater discharge of the Nervion river, an slight decrease of the NIS cover was observed as it increases the distance of the river mouth increase. The richness in the different localities belonging to the artificial breakwater was lower than in the rest ot the study area.

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Alimentación del ctenóforo invasor Mnemiopsis leidyi: predación sobre larvas de peces

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Mnemiopsis leidyi es una especie de ctenóforo nativo de la costa Atlántica de América (Purcell *et al.* 2001). Esta especie tiene una alta tolerancia a las condiciones ambientales, pudiendo habitar en aguas con temperaturas que varían de 0ºC a 32ºC y salinidades desde ≤ 2 a 38. Dada esta característica, *M.leidyi* ha sido capaz de invadir diferentes mares del mundo (Costello *et al.* 2012) y su presencia ha tenido un importante impacto negativo en los ecosistemas de algunas de las zonas invadidas. En estas áreas, se ha observado una reducción de la biomasa del zooplancton, cambios en su composición, e incluso el colapso de las pesquerías debido a su depredación sobre larvas y huevos de peces, tal como ocurrió en el Mar Negro (Shiganova, 1998; Shiganova & Bulgakova, 2000; Shiganova, 2005; Roohi *et al.*, 2008; Roohi *et al.*, 2010).

En julio del 2009 fue reportada por primera vez la presencia de *M. leidyi* a lo largo de la costa mediterránea española. Durante el verano del 2010 éste ctenóforo reapareció en el Delta del Ebro, esta vez sobreviviendo al invierno, lo que sugiere un establecimiento de la especie en la zona (Marambio *et al*. en preparación). Dadas las características de esta especie, es de gran interés la interacción que *M. leidyi* pueda tener sobre las poblaciones de peces costeros. Para ello, es necesario determinar las tasas de alimentación sobre larvas de peces. Con este objetivo, se han realizado una serie de experimentos con larvas de dos especies de peces, *Sparus aurata* y *Dicentrarchus labrax*. Se ha medido el tiempo de digestión de ambas presas bajo diferentes condiciones de temperatura y salinidad. Las condiciones han sido: 35; 37,7 y 38 de salinidad y en cada una de las salinidades 4 temperaturas: 12, 21, 25 y 28ºC, valores que se ajustan a las condiciones que se encuentran a lo largo del año en la costa Catalana.

Los resultados indican que el tiempo de digestión de *M. leidyi* puede variar entre 4 y 6 horas. Se observan diferencias entre ambas especies de peces, siendo el tiempo de digestión de *S. aurata* menor que el de *D. labrax*. También se observan diferencias entre las distintas condiciones experimentales. Así, el tiempo de digestión es menor a altas temperaturas y baja salinidad.

La información sobre los tiempos de digestión es esencial para poder inferir las tasas de alimentación de *M.leidyi* junto con la información de su dieta natural a partir del estudio de los contenidos estomacales. A su vez estos resultados constituyen los primeras datos sobre la interacción entre este gelatinoso y larvas de pez siendo además estas aproximaciones una importante contribución a los aspectos ecológicos de esta especie invasora en las costas Españolas.

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The ECLIPSE project: Effects of CLImate change in Polar Shallow benthic Ecosystems

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Antarctic marine benthic communities have been described as rich and diverse, presenting some unique features since they are dominated by suspension feeders and posses complex three-dimensional structures. It has been hypothesized that this particular structure of Antarctic communities could be due to the absence of hard skeleton predators; the limited action of sedimentation processes during glaciation-deglaciation periods and to the absence of riverine and aeolic input of sediments that can severely affect suspension feeders.

The current process of Global Warming, particularly in the Antarctic Peninsula, can threaten this image of diverse and unique communities. Changes in the environmental conditions of the Antarctic have been detected in the last decades, especially the Western Antarctic Peninsula (WAP) has been defined as a hot spot of global warming, with the highest surface air temperature increase in the southern hemisphere: 2,5 °C over the last 50 years, and among the highest in the world (mean warming trend of 0,6 ºC). The atmospheric warming trend seem to be still not transferred to the Antarctic marine environment since there is up to date no real evidence for a rise in coastal seawater temperature. However, the glaciers on the WAP and the nearby islands showed direct responses to the increase of air temperature, as the rapid retreat of glacier fronts, break-up and disintegration of ice shelves, and speed-up of inland ice masses. Two hundred twelve (87%) of the 244 marine glaciers and associated islands of the Antarctic Peninsula have shown overall retreat since 1953. Changes produced in coastal waters as result of the glacier retreatment are factors that strongly affect benthic and pelagic systems. In Potter Cove (King George Island, WAP), changes in the taxonomic composition of benthic communities has been detected, and those changes are been linked to increasing sediment rates originated by glacier retreat. The megabenthic communities show nowadays a shift to a community dominated by groups typical for soft bottoms, as infaunal filter feeders, predators, scavengers or necrophagous. This trend indicates the main role that air temperature increase and glacier melting could have in the benthic communities of Antarctic coastal ecosystems. Other consequence of glacier retreatment, are newly ice-free areas that make available new substrate for benthic organisms. Further, at Potter Cove the retreatment of the Fourcade glacier uncovered in 2003 a new island (which offer rocky substrate), as well new soft bottom sea floor extensions. Those "new" available substrates are being colonized by benthic organisms.

Potter Cove and other surrounding areas in Maxwell Bay offer an excellent opportunity to study, analyze and interpret not only the effects of glacier retreatment on established communities, but also the dynamics of colonization and succession processes in the ice-free new areas. At Potter Cove long-term data on environmental variables are available and the effects of glacier retreatment are being assessed in the frame of the international and interdisciplinary ESF Program IMCOAST.

In this context, the project **ECLIPSE** is contributing to improve the current knowledge of coastal Antarctic Ecosystems and Global Warming effects, addressing the investigation of the current biodiversity in coastal benthic Antarctic communities and evaluating the effect of glacier retreat, as consequence of climate change, in these communities.

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First evidence of an established population of the invasive ctenophore *Mnemiopsis leidyi* (A. Agassiz 1865), in the Ebro River Delta (Spain, NW Mediterranean)

Macarena Marambio[a], Jennifer E. Purcell[b], Antonio Canepa[a], Alejandro Olariaga[a], Josep M. Gili[a] and Verónica Fuentes[a]

The American comb jelly *Mnemiopsis leidyi*, endemic from estuaries and coastal regions of the western Atlantic Ocean (Mianzan 1999), was introduced in the Black Sea in the early 1980's, probably via ballast water (Vinogradov *et al*. 1989), and expanded to almost all Eurasian waters within the last three decades (i.e., Sea of Azov, Sea of Marmara, Aegean Sea, Caspian Sea, North Sea, Baltic Sea, and the Mediterranean, including areas in both, the eastern and western basin). This ctenophore posses a strong physiological and ecological plasticity, and a prolific reproductive output among other characteristics, turning it in a potential invader in a wide range and variety of habitats (Purcell *et al*. 2001). Moreover, M. leidyi's invasions are followed with deep concern due to the association of this species with important and drastic reductions on the zooplankton and commercial fisheries communities in the Black Sea, where it was the major blame of an ecological and socio-economic disaster in the late 90's (reviewed in Dumont *et al*. 2004). Even though lately, there have been controversial opinions on Mnemiopsis effects, it is clear that a combination of the invasiveness of the species together with a disturbed recipient habitat, lack of predators, and favourable environmental local conditions, can triggered a very successful invasion event with irreversible effects in the invaded habitat.

The occurrence of this invasive species in the Spanish Mediterranean coast was first reported and genetically confirmed as M. leidyi in 2009 (Fuentes *et al*. 2009, 2010), when it spanned several and different locations. In spring of 2010, its presence was again detected in Spanish waters, but this time in a more specific location; the Alfacs Bay located in the southern edge of the Ebro River Delta, northeastern Spanish coast. Consequently, since 2010, an on-going monitoring and sampling programme has been taking place in diverse stations of the Alfacs Bay, including collection and analysis of specimens, and measurement of environmental variables like temperature and salinity.

Water conditions in the Alfacs Bay presented a temperature regime with a minimum of 10.1 °C in winter months, and reaching 30.1 °C in summer season (mean = 19.8 ± 7.3 °C). Water salinity ranged from 33.9 to 36.5 (mean = 35.6 ± 0.9 °C). All life-stages (i.e., tentaculate larvae, transitional larval-stage and lobate adults) were observed and collected during sampling. Tentaculate larvae presented a size range of 0.1 to 3.5 mm (mean = 1.5 ± 0.6 mm), transitional stages (4-10 mm) presented an average size of 6.5 mm (± 5.9 mm), and the largest collected individuals achieved 100-120 mm of total length (i.e., oral-aboral with lobes; average size 37 mm). The reproduction cycle followed a seasonal pattern, with successful reproduction starting in mid-September and continuing until May, with no reproduction observed during summer season (July-August). Peak of reproduction, in terms of larval output, occurs between winter and spring season (December-May) when the temperature is about 10-22 °C and salinity is the range of 34.5-36.5. The seasonal dynamics showed that adults dominate the population structure during summer and autumn, reaching in the latter its maximum densities of 227 individuals m-3 (1048g WW m-3). On the contrary, during winter and spring season, larvae, including tentaculate and transitional stages, comprised the main part of the population, with densities of 45 individuals m-3, although in autumn, when reproduction starts, larvae can be found in densities higher than 50 individuals m-3 in some points of the bay. The major diversity in size classes is observed in autumn, when the individuals that conform the population structure present sizes that range from 2.0 to 70.0 mm, and with a mean size of 35.0 mm.

Apparently, environmental conditions and dynamics of the Alfacs Bay are suitable for M. leidyi throughout the year, though, physical conditions in the study area are unlikely to constrain the ctenophore's successful establishment. Moreover, the Bay's situation and disturbance turns it in a more vulnerable system, and even a more appropriate habitat for the development of this species, and other, invasive species. Therefore, herein we present the first confirmed record of an allyear established living and sustainable population of this species not only in the Spanish coast, but also in the western Mediterranean basin, which might constitute the onset of this species' invasion in the area, and that may undoubtedly behave as a source population, at least for adjacent coastal areas.

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Mixed but not admixed: Post-border processes shaping populations of an introduced ascidian on natural and artificial substrates

Víctor Ordóñez[a], Marta Pascual[a], Marc Rius[b,c], Xavier Turon[c]

Following arrival to a new area (pre-border dispersal), post-border processes are responsible for the successful introduction of alien species in the sea. *Microcosmus squamiger* is a temperate ascidian originated from Australia which has been introduced worldwide. It can colonize and grow quickly in man-made artificial structures in harbours, marinas or breakwaters, but it can also establish itself in natural substrate, thus altering natural communities and becoming an ecological problem. The aim of the present work is to assess post-border processes in eight populations found on natural and artificial substrates between two large commercial ports in W Mediterranean (that could act as source points) by using microsatellite markers. A high diversity was found in all populations, with an overall deficit of heterozygotes. Autocorrelation analyses showed that there was no within-population genetic structure (at a scale of tens of m), as well as no significant differentiation in pairwise comparisons between populations (tens of Km apart). However, despite the lack of genetic differentiation, a significant isolation-by-distance pattern was found. The results point to a natural capacity for the stepping-stone dispersal of the species following patches of hard substrate, and no difference whatsoever could be substantiated between natural and artificial substrates, which could facilitate the colonization of wide stretches of coast. Thus, once arrived in a new area the species seems to be able to quickly expand to neighbouring localities. Two clusters of genetically differentiated individuals were detected that could be related to two known source areas for the worldwide expansion of the species. Individual assignment tests showed the coexistence of individuals of these two clusters in all populations but with little interbreeding among them since the frequency of admixed individuals was only 15%. The mechanism responsible for the maintenance of these different genetic pools is unknown, but it apparently does not compromise the colonization potential of the introduced populations. Overall, pre-border management seems the only workable way to tackle with the expansion of this species.

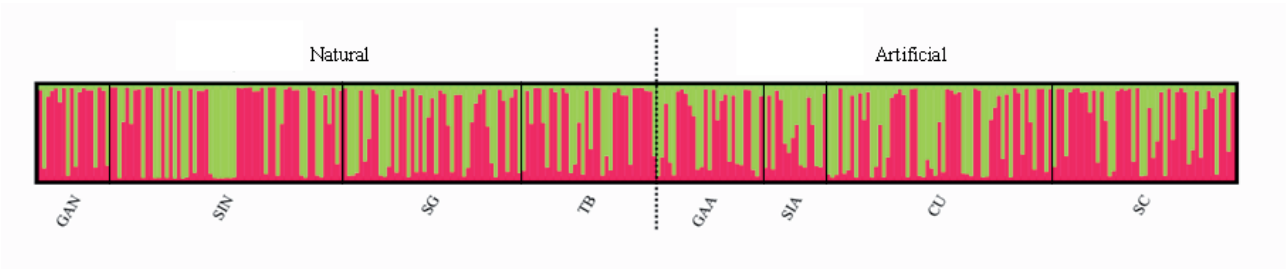

Figure 1. Population structure in the eight populations studied with the most likely number of clusters (k=2) inferred using a Bayesian clustering approach as implemented in the STRUCTURE program. Note the lack of structure related to locality or type of substratum, as well as the scarcity of admixed individuals. Codes for populations: Garraf-natural (GAN), Sitges-natural (SIN), El Roc de Sant Gaietà (SG), Torredembarra (TB), Garraf-artificial (GAA), Sitges-artificial (SIA), Cubelles (CU) and Segur de Calafell (SC)

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Tough adults, frail babies: sensitivity to abiotic factors across multiple life-history stages of widely introduced marine invertebrates

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Population persistence depends on the performance of both adults and offspring in their variable environments. Most studies analysing the influence of abiotic conditions on species performance have focussed on adults, while studies covering early life-history stages remain rare. We investigated the responses of early life-history stages of two widely introduced ascidians, *Styela plicata* and *Microcosmus squamiger*, to different abiotic stressors in two populations in South Africa. Stressors mimicked conditions in the habitats where both species occur and responses were related to genetic diversity (assessed with the *COI* gene) of the populations. Four developmental stages (egg fertilisation, larval development, settlement, metamorphosis) were studied after exposure to high temperature (30ºC), low salinities (26 and 22‰) and high copper concentrations (25, 50 and 100 µg/L). All treatments affected the development of both species, though responses differed with stage and stressor (Fig.1). Fertilisation and larval development were the most sensitive. Remarkably, most stressors effectively led to failure of development (fertilisation through metamorphosis). *S. plicata* was overall more resistant to copper, and some stages of *M. squamiger* to low salinities (Fig. 1). No relationship was found between parental genetic composition and responses to stressors. We conclude that successful development can be prevented at several life-history stages, so considering a single stage can result in misleading conclusions about species' abilities to tolerate stress. Moreover, we found that early life-history processes of these species cannot be completed under conditions prevailing where adults live. Given the short dispersal potential of many marine invertebrates, our results raise the questions of how populations in environmentally stressful situations are established and maintained.

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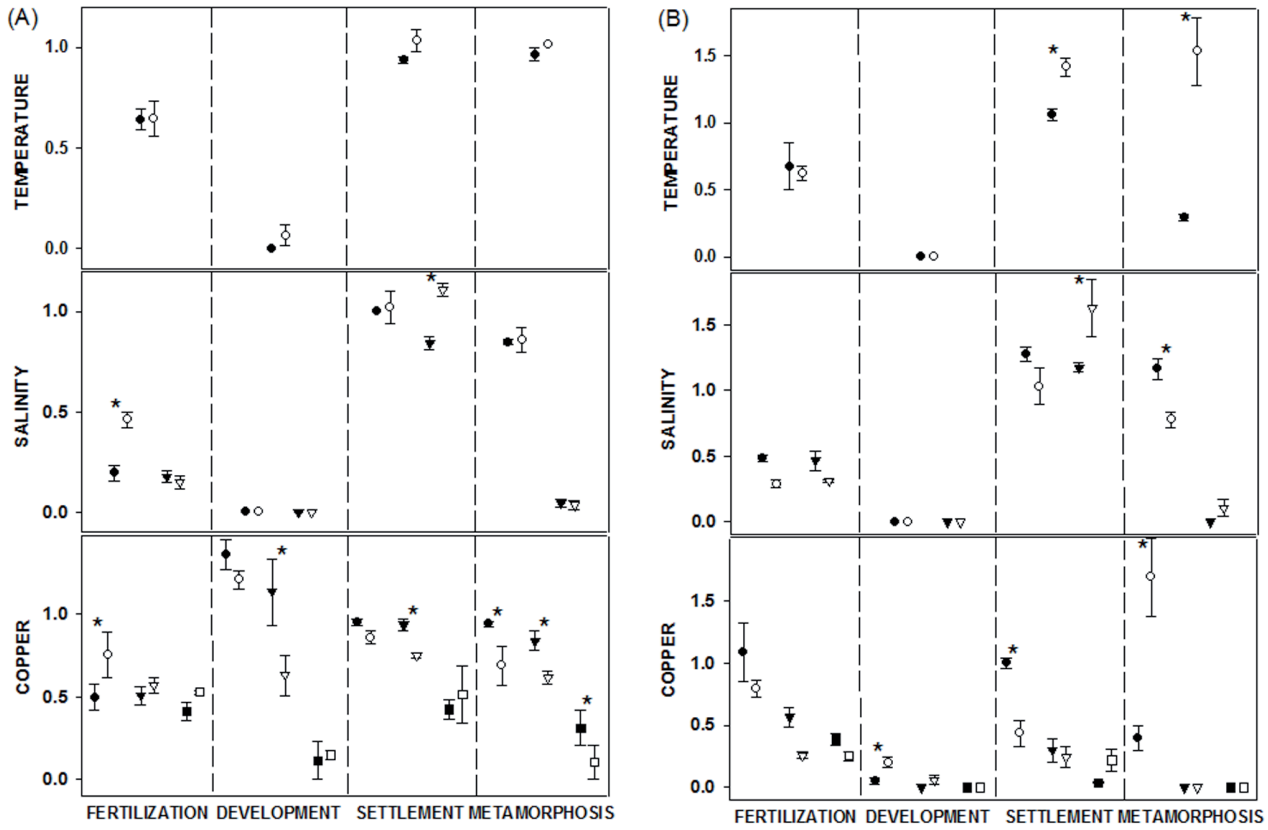

Figure 1. Success ratios (relative to controls) of each developmental stage of A) *S. plicata* and B) *M. squamiger*. Treatments include: temperature (30ºC), salinity (circles for 26‰ salinity, triangles for 22‰) and copper (circles for copper concentration of 25 µg/L, triangles for 50 µg/L and squares for 100 µg/L). Black symbols correspond to the population at Port Elizabeth, while white symbols correspond to the population at Knysna. Values are means ±standard errors. Asterisks indicate significant differences between locations.