Thursday afternoon

HCS182 - The size spatial segregation by sizes in the anchovy population (*Engraulis ringens*) in northern and central part of Peruvian Coast

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Keywords: Peruvian anchovy, spatial segregation, size groups, fishing set, conceptual model, behaviour, size association.

The present work studies the spatial segregation and migratory tendencies related to fish size in anchovy population located in the northern and central part of Peruvian coast. The research takes into account spatial and temporal aspects of two fishery and biological attributes: the relative abundance and the size of individuals. For this reason, multivariate methods for size group determination, traditional methods in fishery biology for cohorts identification were used. Cartography techniques for mapping the distribution of size groups were also applied. Size frequencies and capture data were obtained from fishing sets carried out by commercial purseine fishing vessels and research cruises between 1996 and 2000.
Previously, the optimal effort unit (OEU) was determinated to estimate a spatial index of capture per effort unit (c.p.u.e.). For this, two effort units were evaluated: fishing days and fishing sets. The storing capacity (SC) of the vessels was considered as indicator of fishing power of themselves, for this analysis, the SC was divided in five categories. To face the effect of sampling intensity on the SC, an applied effort rate per vessel (λ) was established. The chosen OEU must show a direct relationship between the λ and SC of vessels. Spatial segregation was measured by Cramer V index (CV), if two groups have the same areas of distribution then the CV is "1", on the contrary, if these areas are absolutely different then the CV is "0". To eliminate possible errors when comparing segregation levels of size groups between years, an standardized index of CV (γ) was established, if γ is negative then segregation exists if γ is positive then spatial segregation of anchovy sizes does not exist. Another studied characteristic was the fish association of different sizes inside the groups, which was measured by a size association index (A_{Gx}).

Results on OEU determination showed the fishing set would be the effort unit more suitable for the estimation of c.p.u.e index if aspects of spatial distribution of relative abundance of anchovy population are required. Also, it was demonstrated the existence of spatial segregation by sizes in the population anchovy, which was characterized by the presence of three size groups in Peruvian coast. The distribution areas of these groups showed a high level of overlapping between 1996 and 1997, intermediate in 1998, and low between 1999 and 2000. These results indicate the spatial segregation not always is notably observed in anchovy population. Furthermore, an indirect relationship was observed between segregation levels and anchovy abundance. Results on association of individuals inside the size groups indicated that this was significantly related to seasonal variations and not to the size of individuals throughout their life span ($p < 0.05$). The major levels of association were observed in spring and summer.
In the other hand, conceptual models built with results obtained from individuals association, superficial distribution and depth distribution of size groups; showed some behavior linked to reproductive and trophic processes of the species: a major level of individuals association of different sizes and movements of anchovy schools (to the coast and to superficial zones in the water column). This behavior was observed from November to December of 1998 and 1999.
Finally, this work concludes that occupation way of the space by anchovy individuals is not at random, but it happens in age related systematic way which is reflected in spatial and temporal migrations by sizes. Also, the presence or absent of spatial segregation by sizes could be considered as indicator of abundance state of anchovy population in a specific period of time. The results obtained in this work give the necessary bases for a future spatial modelation of the most important anchovy population in the East Pacific, being benefited of a better management by fishery administrators and scientists involved.

HCS184 - Changes in the Peruvian marine pelagic biodiversity from 1990 - 2005 related to climate variations and fishery

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Key words: biodiversity indices, ENSO impact, fisheries impact, marine pelagic biodiversity, Peru Humboldt Current system

Change in biodiversity is considered as one of the best indicators of the ecosystem health status. Species diversity indices are therefore classically used to monitor human impact on marine ecosystems. Natural changes of the environmental conditions also lead to dramatic variations in species composition and

biodiversity. This is typically the case of Eastern Boundary Current systems that are strongly affected by climatic variability. These ecosystems support very high fish biomass exploited by extensive fisheries. For these reasons, there is a need to analyze temporal changes in biodiversity according to both, climate and fisheries. Here we study variations in pelagic biodiversity in the Humboldt Current System through classical indices (specific richness, Shannon–Wiener and evenness) to relate them to indicators of environmental conditions (ENSO, SST anomalies) and to the landings of commercial fisheries.

Data came from 40 acoustic surveys, carried out by IMARPE to estimate the biomass and monitor the distribution of the main pelagic species from 1990 - 2005. An average of 200 pelagic trawls per survey was performed for species composition and biological measurement. A maximum of 107 species were identified from these samples. Indices were calculated for each survey as a whole and also according to the diel period, the ecological domain *i.e.* shelf or offshore, and ecological provinces (transitional zone, north of 6°S and Humboldt System, south of 6°S). Besides, multivariate analyses were used to determine species assemblages and their temporal variability.

Results showed that species richness presented a similar trend in time series when considering each survey as a whole or when taking into account the diel period and the ecological domain but different patterns were found between ecological provinces. Spatiotemporal variations in species richness (Fig. 1) show that El Niño 1992-1993 had no apparent effect on biodiversity whereas biodiversity dramatically increased during and after El Niño 1997-1998. The effect of this event lasted more than four years and had strong effects on the dynamics of assemblages during the studied period. No direct impact of pelagic fisheries on pelagic biodiversity could be observed. The period of higher biodiversity (1997-2002) corresponds to very high pelagic landings (mean: 7 million tons). In the specific case of pelagic biodiversity off Peru, changes in biodiversity appear more related to changes in environmental conditions than to direct human activities (even if climate is now affected by human activities).

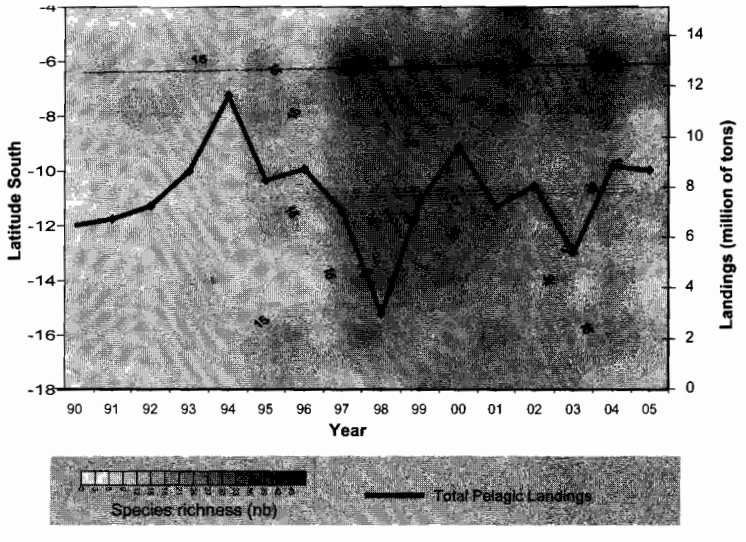

Figure 1. Spatiotemporal variations in species richness and total pelagic fishing landings in Peru from 1990 - 2005.

HCS187 - Influence of the oscillating distribution of water masses on the relative distribution patterns of mesopelagic fishes (*Vinciguerria lucetia* and mictophiids) and Peruvian anchovy (*Engraulis ringens*) off Peru

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Keywords: anchovy, oscillation, seasonality, mesopelagic fish, water masses

The main water masses in presence in the Northern Humboldt Current System off Peru are the cold coastal waters (CCW) and the subtropical surface waters (SSW). Each has a distinct range of temperature and salinity, as well as a specific biological diversity that may change according to decadal cycles. In the present decade, anchovy (*Engraulis ringens*) and munida (*Pleuroncodes monodom*) are the dominant species in the CCW, and *Vinciguerria* (*Vinciguerria lucetia*) and myctophids are the main species associated with the SSW.

In relation with the fluctuating intensity of the upwelling, the relative extent of the CCW and SSW waters exhibit a year-round oscillation. Between these two oscillating water masses exist a mixing zone whose localization varies is particularly attractive to fish due to its high dynamic and productivity. As most of the processes in the pelagic domain, the overall distribution of these water masses is not linked to specific geographic limits, and thus cannot be defined by latitudinal or longitudinal limits, like the continental shelf for instance.

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