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Abundant populations of co-existing small pelagic fish species that show periods of alternating dominance are a defining feature of upwelling ecosystems and have been the focus of considerable research, including that directed at investigating their trophodynamics and elucidating their respective trophic roles. In this presentation we compare the trophodynamics of some these co-existing species from the Benguela Current and Humboldt Current systems, and assess whether observed species alternations may be trophically mediated. Information collected from morphological, field and experimental studies is described, and species examined include anchovy (*Engraulis encrasicolus*) and sardine (*Sardinops sagax*) in the northern and southern Benguela; anchovy (*E. ringens*) and sardine (*Sardinops sagax*) in the northern Humboldt; and anchovy (*E. ringens*) and common sardine (*Strangomera bentincki*) in the southern Humboldt.
Aspects of trophic morphology compared include length-related changes in gape size of anchovy and sardine larvae in the northern Humboldt and in early anchovy and sardine juveniles in the southern Benguela; and length-related changes in the branchial basket structure of anchovy and sardine juveniles and adults in the northern Benguela. Comparative dietary studies are described for larvae, juveniles and adults of anchovy and sardine in the northern Humboldt; larvae, juveniles and adults of anchovy and common sardine in the southern Humboldt; and juveniles and adults of anchovy and sardine in the northern and southern Benguela. Experimental studies conducted to investigate the feeding behaviour of southern Benguela anchovy and sardine and anchovy and common sardine from the southern Humboldt are described, as are laboratory studies investigating energetic costs and assimilation efficiencies of southern Benguela anchovy and sardine. Energetics models for southern Benguela species developed from these experiments are also briefly described.
Consistent differences between anchovy and sardine (*Sardinops*) in the Benguela Current and northern Humboldt Current systems, such as a larger gape size at a given length for early stages of anchovy compared to sardine, and a higher contribution by phytoplankton and/or small zooplankton to the diet of sardine compared to anchovy, are indicative of resource partitioning between the two species. This, together with results derived from experimental studies and energetics models that suggest that sardine maximize their net energy gain when filter-feeding on smaller zooplankton whereas anchovy maximize their net energy gain when particulate-feeding on larger zooplankton, indicate that differently-structured food environments can favour anchovy over sardine, and *vice versa*, and suggest that species alternations between the two may be trophodynamically-mediated. In the southern Humboldt, anchovy and common sardine (*Strangomera*) exhibit a high degree of trophic overlap and resource partitioning between the two species is not obvious, although this may be due to a relative paucity of information and further research on this species pair is required.

HCS123 - Identifying trophic controls in the southern Humboldt system off central Chile

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Keywords: trophic controls, physical forcing, southern Humboldt, central Chile, time series, wasp-waist.

Although fishing is considered the main threat to marine ecosystems, predation mortality is the main source of natural mortality and, in some cases, of total mortality for many stocks. Therefore, trophic relationships play a central role in the way ecosystems are self-organized. Information about who eats whom represents one of the first records of naturalists, however, this classic question been replaced by the more dynamic question of who controls whom in marine ecosystems. The traditional way in which trophic controls in marine food webs have been approached indicates that population dynamics are either controlled by predator's consumption (top-down control) or by resource availability (bottom-up control). However, an important characteristic of some marine food webs is the presence of "waists" where an individual taxon located in middle trophic position passes most of the energy from lower to all higher predators (Rice, 1995). Specifically, in upwelling ecosystems this position is occupied by small pelagic fish. This species are dominant in terms of biomass, and exert a trophic control on both their predators (through bottom-up control) and their zooplankton prey (through top-down control), while their own dynamics is not controlled by predator consumption or food availability, but by environmental forcing (Cury et al., 2000).
The southern section of the Humboldt system (SH) is one of the least studied upwelling ecosystems. Consequently, the existence of trophic controls as well as their effects on food web dynamic is still poorly understood. Consequently, the aim of this paper is to analyze available data series to identify i) possible waists in the system, and ii) main controls operating in the food web.
Following Cury et al. (2000), the number of species across important taxa inhabiting SH is analyzed,

considering the following categories: jelly fish, crustaceans, anelida-polichaeta, mollusks, fishes, sea birds and marine mammals. Fish species were split into the following groups: bony fishes and chondrichthyans. Bony fishes were subsequently split into mesopelagic fish, small pelagic fish, other pelagic fish, and demersal fish.

Later, available biomass time series of small pelagic fish (common sardine, *Strangomera bentincki* and anchovy *Engraulis ringens*), Chilean hake (*Merluccius gayi,* main predator in the system for which time series are available) and copepods (main zooplankton prey for small pelagic fish) were used to analyze relationships that could indicate top-down or bottom-up trophic control between these groups. The time series for small pelagic fish and Chilean hake were collected from official evaluations and correspond to direct estimates of biomass for these species between years 1990 and 2004. Copepod abundance corresponds to *in situ* samples collected during the yearly survey carried out to estimate the biomass of horse mackerel (*Trachurus symmetricus)* in the study area from 1997 to 2004. The *chlorophyll a* data series (1997-2005) for the area 33°S-39°S and from the coast line to 78°W were collected from the SeaWiFS project (http://oceancolor.gsfc.nasa.gov/SeaWiFS/) and kindly processed by Mr. Hervé Demarq (CRH, France).

A "waist" in the number of species along the main animal taxa is observed in the SH system, which is consistent with the pattern observed in the southern Benguela system (Cury et al., 2000) (Fig.1).

Evidence of bottom-up control of small pelagic fish on Chilean hake in the SH system (Fig. 2). On the other side, the short time series for *chlorophyll a* indicates that the bottom (phytoplankton) has not experienced changes (no significant trend found), from 1997 onwards, while copepods are in steep decline in the same period (Fig. 1). These changes have not strongly affected small pelagic fish (waist) or Chilean hake, and therefore it is possible to hypothesize that the system is controlled by changes in the waist.

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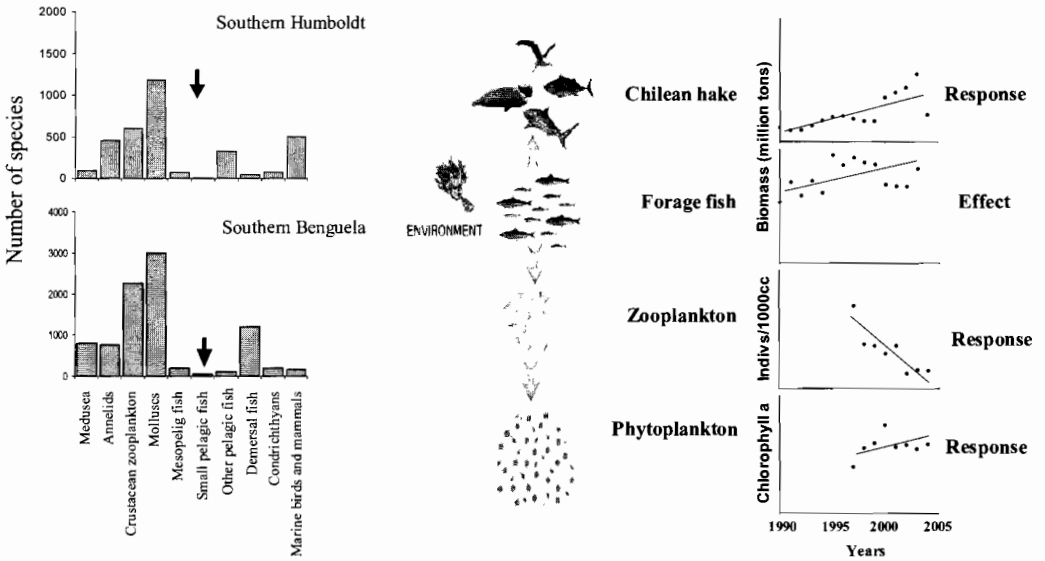

Figure 1. Left, number of species along the most important taxonomic groups in two upwelling ecosystem, Central Chile (Southern Humboldt) and South Africa (Southern Benguela). The arrows indicate the group located in the waist (small pelagic fish); right, relationship between the relative abundance of different groups in the southern Humboldt system.

HCS196 - Trophic flows in the Northern Humboldt Current Ecosystem, Part 1: comparing 1995-96 and 1997-98

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