

## Spatial analysis of some prey-predator interactions and fishing in central Chile

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### Questions:

- How predation by hake (*Merluccius gayi*) and fishing interact spatially in the distribution of red squat lobster?
- Does predation on red squat lobster (*Pleuroncodes monodon*) by hake (*Merluccius gayi*) control the restoration of this crustacean species?
- How predation by jumbo squid and fishing interact spatially in the distribution of hake?
- Does predation on hake by jumbo squid (*Dosidicus gigas*) control the restoration of hake?

### Problems:

The fishery of red squat lobster in central Chile is closed from year 2000 due to heavy over-exploitation without signals in the stock restoration. Predation on red squat lobster by hake seems to be important, mainly on age group 0 (pre-recruits), but not on age group 1+, with the last one supporting the fishery. Then, some questions could be:

- Why the fishery is closed yet?
- Why, after 7 years with the fishery closed, is the stock of red squat lobster in low level of biomass?
- Are fishery and predation by hake operating on the population of red squat lobster to drive its dynamic?
- How do fishery and predation by hake operate spatially on the population of red squat lobster?

Hake is the most important demersal resource in central Chile, but its biomass was down to 1/4 of the maximum in a couple of years. Stakeholders agree that the main cause was predation on hake by jumbo squid. Independent analysis carried out by Universidad de Concepcion (classical stock assessment + EwE) shown that, in year 2003, predation on hake by jumbo squid should have been ~ 150,000 tons, which is similar to the official annual quota (147,000 tons; + 20% of under-reported landings ~ 175,000 tons).

Then, some questions could be:

- Is predation on hake by jumbo squid over all age-groups of prey? Is it age-group specific? In the last case, over what age-groups of hake?
- Is predation on hake by jumbo squid more important than cannibalism in hake?
- Are fishery, predation by jumbo squid and cannibalism operating on the population of hake to drive its dynamic?
- How do fishery, predation and cannibalism operate spatially on the population of hake?

**Number of groups classified by large aggregations: 12**

- marine mammals (dolphins, killer whale, sea lion)
- aquatic birds
- demersals (hake, kingclip, grenadier, flounder, perch, skates)
- small pelagics (anchovy, sardine)
- mid-size pelagics (jack mackerel, mackerel, hoki)
- large pelagic (sword fish)
- squids (common squid, jumbo squid)
- mesoplagics + "mesodemersal" (cardinal fish)
- macrocrustaceans (red + yellow squat lobsters, pink shrimp)
- polychaets
- macrozooplankton (euphausiids, copepods)
- primary producers

**Table of habitats (in this case, depths):**

- = 100 m (fraction of total: 0.257)
- 101 to 200 m (fraction of total: 0.528)
- 201 to 300 m (fraction of total: 0.106)
- = 301 (fraction of total: 0.109)

## Output maps

The abundance (ton/km<sup>2</sup>) of hake juveniles is higher than the abundance of adults due to cannibalism is stronger in the last one (Fig. 1). The distribution of juveniles is nearshore.

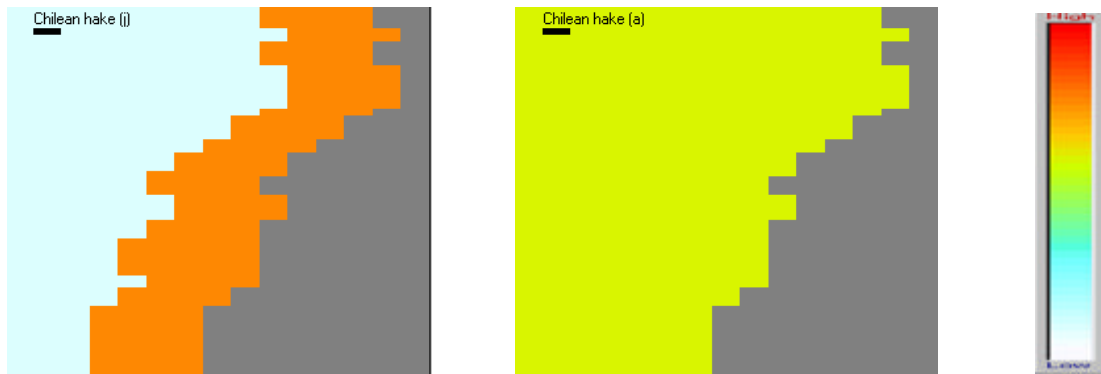


Fig. 1. ECOSPACE simulations for Chilean hake (*Merluccius gayi*) off central Chile. (j) = juveniles; (a) = adults.

Red squat lobster shows similar distribution in juveniles and adults (Fig. 2). But this result pattern is not clear. Some problems with the configuration of the computer was detected, which didn't allow to run successfully the routine Ecospace.

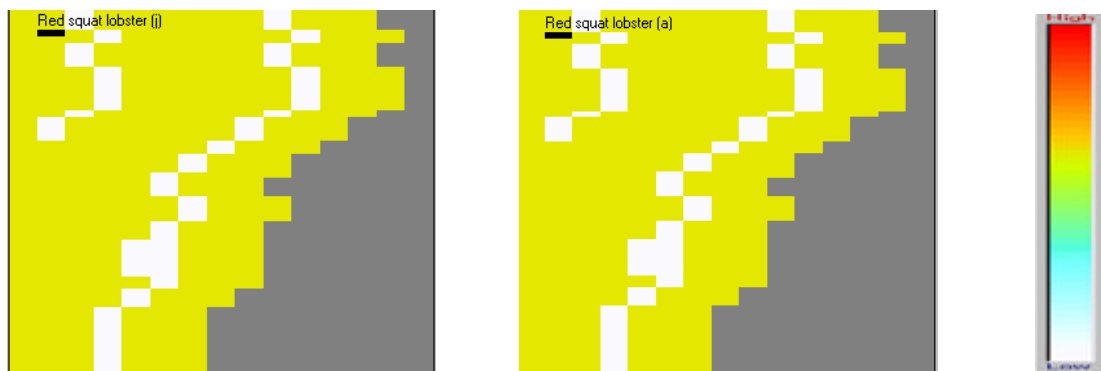


Fig. 2. ECOSPACE simulations for red squat lobster (*Pleuroncodes monodon*) off central Chile. (j) = juveniles; (a) = adults.