HCS189 - Changes in the distribution area of Peruvian hake: effect of fisheries

Claudia Wosnitza-Mendo, Michael Ballón, Carlos Benites, Renato Guevara-Carrasco

Instituto del Mar del Peru: Esqu. Gamarra y Gral. Valle s/n. Callao 22 (Tel 00511 4202000 anex 267), email: claudiawosnitza@yahoo.de

Keywords: Fishing pressure, hake, interaction with anchoveta, spatial distribution

The distribution of hake (*Merluccius gayi peruanus*) off the Peruvian coast is characterized by two patterns. One is determined by changes over the seasons and inter-annually in phase with El Niño events, due to the actual extension of the Cromwell Current. The second pattern is related to a size depending distribution by latitude, larger individuals being found to the north and smaller ones to the south (Del Solar et al., 1965).
During the 1980s and 1990s Peruvian hake's distribution was assumed to comprise mainly the area between the Ecuadorian border and 10° latitude south. This area was determined taking into account exploratory surveys carried out in the late 1970s and early 1980s. Relying on these findings, swept area surveys covered generally the mentioned area to determine hake biomass.
From the start of the heavy trawl fishery in 1973, Peruvian hake has experienced changes in its population structure and a first considerable reduction in biomass in the late 1970s. Hake population, as it shrinks, tends to concentrate again and occupy the northernmost areas of its distribution range (Wosnitza-Mendo et al., 2004).
For this study we used length frequency and biological data collected by the Peruvian Marine Institute (IMARPE) in Paita (5°S), Chimbote (9°S) and Callao (12°S). A separate treatment of the length measurements from the different ports allowed us to reconstruct mean length values over time for the three landing areas (Fig 1). We show that during the whole 1970s decade large hake with mean length >40 cm were present as far south as Callao.
This result illustrates that before the full development of the fishery by factory trawlers, the range of hake distribution was much larger than assumed. We also show the direct effect of combined trawl and purse-seine fisheries on the reduction of hake biomass and hence the range of hake distribution. Possible indirect effects due to changes in the ecosystem species composition and/or environmental long term changes are discussed to explain why hake did not recover the lost range.

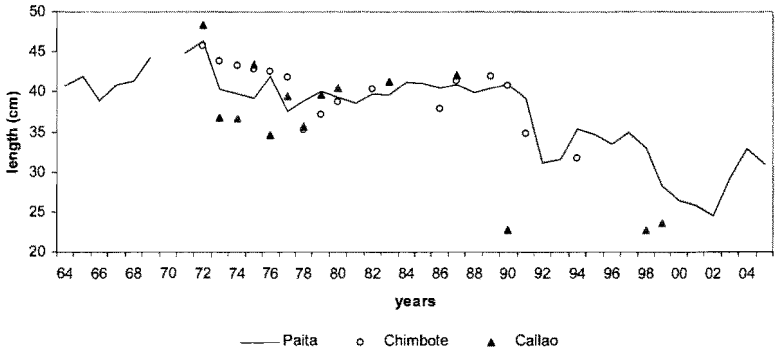

Figure 1. Mean length of Peruvian hake by year and ports (from north to south).

References

Del Solar,E.,Sánchez,J. & Piazza,A. 1965. Exploración de las áreas de abundancia de merluza (*Merluccius gayi peruanus*) en la costa peruana a bordo del "Bettina". *Inf. Inst. Mar Perú*, 8, 28pp.

Wosnitza-Mendo, C, Guevara-Carrasco, R. & Ballón, M. 2004. Possible causes of the drastic decline in mean length of Peruvian hake in 1992. *Bol. Inst. Mar Perú* 21 (1-2), 1-26.

HCS191 - Trend in relative investment of energy in growth and/or reproduction by Peruvian hake from 1972 – 2004: an issue of length dependence

Michael Ballón[1], Claudia Wosnitza-Mendo[1], Arnaud Bertrand[1,2], Jacqueline Palacios[1], Humberto Olivera, Renato Guevara-Carrasco[1]

[1]*Instituto del Mar del Peru: Esqu. Gamarra y Gral. Valle s/nCallao 22 (Tel 00511 4202000 annex 267), email: michballon@googlemail.com*
[2]*IRD, Teruel 357 Miraflores Lima, Peru.*

Keywords: Gonadosomatic index, Fulton's K condition factor, Peruvian hake, El Niño Southern Oscillation, Selective fishery impact.

Peruvian hake (*Merluccius gayi peruanus*) is the most abundant commercial demersal fish species of Northern Peru. Intensively exploited since the early 1970's, this species has experienced drastic declines in biomass leading to the closure of the fishery in 2002. The fishery was reopened in 2004 and total allowable catches and individual nontransferable quotas were implemented to control hake's exploitation. The evolution in biomass was accompanied by biological changes, particularly in size structure and length

at maturity. These changes are assumed to be related to the combined effect of the trawl fishery and El Niño events (Wosnitza-Mendo et al., 2004). However, the effect of fishing pressure and physical environment on hake is still unclear. In this work we study the physiological response of hake to changes in their physical environment and population structure from 1972-2004. In particular, we check for changes in the relative investment of energy in growth and/or reproduction.

Our study relies on 55000 female hakes sampled from commercial landings. Each individual was assigned to a 5 cm interval length group (range: 20 - 50 cm), and condition factor (Fulton´s K), gonadosomatic and fullness indexes were calculated. Generalized Additive Models (GAM) were applied to examine potential relationships between condition factor, gonodosomatic, and fullness indexes and sea surface temperature (SST) anomaly, population structure (biomass, sex ratio) and time.

Large positive SST anomalies (>2°C) were related to low condition factor, gonadosomatic index and, to a lesser extent, fullness index, suggesting a negative impact of El Niño on hake. We found that condition factor and gonadosomatic index had rather similar fluctuations over time with higher values during the mid 1980s, lower values during the mid 1990s and then an increasing trend (Fig.1). When the analysis was repeated by length class a different picture emerged. Condition factor and fullness indexes for large hake (>35 cm) increased after El Niño 1991-93 reaching their highest values during the 2000s, whereas the gonadosomatic index had its highest values in mid 1980s decreasing thereafter and staying at a low level despite the high condition factor and fullness index. Small hake (<35 cm) showed a different trend with increasing values of condition factor, fullness and gonadosomatic indexes since the mid 1990s. In comparison to large hake, small hake spent more energy in reproduction after the mid 1990s, coinciding with a reduced length at maturity. Additionally, the sex ratio shifted toward females (reaching almost 100% for fish larger than 35 cm) during that period. We discuss the results regarding the influence of the fishery, density dependent effects, prey abundance, and physical environment and hypothesize that the low investment of energy in reproduction by large female hake might be related to the lack of large males, due to a selective sex-related fishery and El Niño impact.

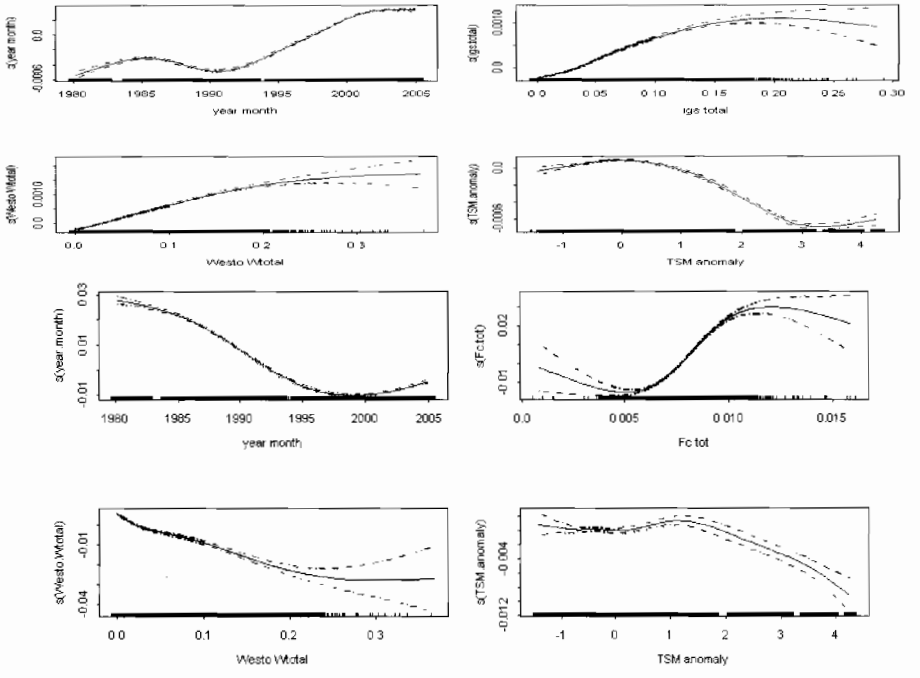

Figure 1. Cubic spline smoothers fits (black solid lines) of GAM models based on condition factor (a) and gonodosomatic index (b) of female hake according to time, condition factor (CF), gonodosomatic index (GI), stomach fullness and sea surface temperature anomaly (SST anomaly) for the complete set of data. The black dotted lines show the 95% confidence limits of GAM models. The y-axes are in relative scale, they correspond to the spline smoother that was fitted on the data, so that a y-value of zero is the mean effect of the variables on the response.

Reference

Wosnitza-Mendo C, Guevara-Carrasco R, Ballón M. 2004. Possible causes of the drastic decline in mean length of Peruvian hake in 1992. Bol. Inst. Mar Perú 21(1-2):1-26.

Ballon M., Wosnitza-Mendo C., Bertrand Arnaud, Palacios J., Olivera H., Guevara-Carrasco, Gutierrez M., Chirichigno N. (2006)

Trend in relative investment of energy in growth and/or reproduction by peruvian hake from 1972-2004 : an issue of lenght dependence

In : *Climate ocean dynamics, ecosystem processes and fisheries : the Humbolt current system : book of extended abstracts*

La Paz (BOL) ; La Paz : IMARPE ; IRD, p. 77-78

International Conference on The Humboldt Current System : Climate, Ocean Dynamics, Ecosystem Processes and Fisheries, Lima (PER), 27/11/2006-01/12/2006.