Ecosystem approach in the research and management Of the Chilean fisheries

Cristian M. Canales
Instituto de Fomento Pesquero, Chile
ccanales@ifop.cl

1. Introduction

Research aimed at fishery resource management in Chile has been coordinated for the last 12 years by two governmental organizations: the Fishery Undersecretary (Subsecretaría de Pesca) and the Fishery Research Fund (Fondo de Investigación, FIP). Although Chilean fishery management policies do not explicitly consider an ecosystem approach, this concept has been applied to some practical examples.

In terms of developed research, it should be noted that the ecosystem approach to the analysis of important fishery resources in Chile is recent and has been aimed largely at the use of trophodynamic models that attempt to describe the abundance changes observed in some resources. Nonetheless, and in spite of the value of these contributions, two main problems exist: the imbalance in available knowledge and the number of suppositions that must be considered.

2. Information collection programs

The Chilean fishery industry began to grow in importance over 40 years ago and has been accompanied by the collection of information, which is subjected to increasingly demanding standards in terms of the quality of the information. In this sense, three primary sources stand out:

- The National Fishery Monitoring Program (Programa de Monitoreo de las Pesquerías Nacionales), historically developed by the Fishery Support Institute (Instituto de Fomento Pesquero, IFOP), covers the sampling and analysis of the biological-fishery attributes of over 20 target species and gatheres information related to the diversity of accompanying fauna.
- The Scientist Observer Program (Programa de observadores científicos), recently initiated, attempts to formalize access to private biological-fishery information, as well as to provide a protocol for collecting information on target species and accompanying fauna.
- The Assessment Surveys and Research Fishing Program (Programa de cruceros de evaluación directa y pescas de investigación) detailes the quantitative characteristics of the target species and has generated an interesting quantity of information related to stomach content, thereby providing information related to trophodynamics between species.

3. Application experiences

3.1. Basic research

Noteworthy university research has been done by scientists at the Universidad de Concepción, including quantitative analyses of trophic interactions between the predator common hake (*Merluccius gayi*) and changes in the abundance of squat lobster (*Pleuroncodes monodon*), shrimp (*Cervimunida johni*), and small pelagic fish like anchovy (*Engraulis ringens*) and common sardine (*Strangomera bentinki*) with the EwE model. More recently, FIP financed a project in which these same scientists focused on a description of the biomass fluctuations in hake and other species of national interest with respect to the presence of Humbold giant squid (*Dosidicus gigas*); these results will be available before the end of 2006.

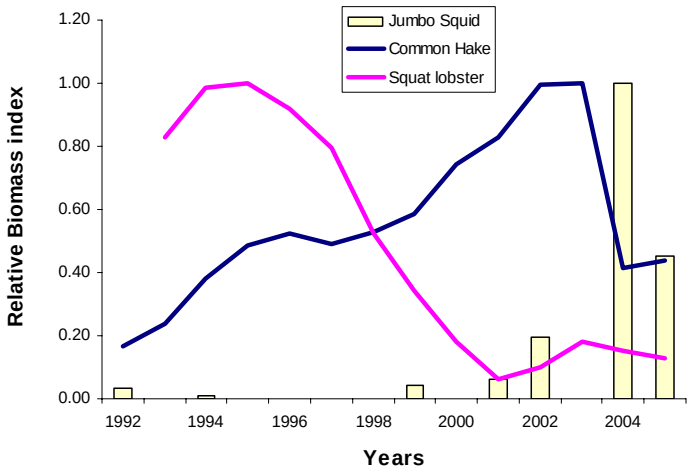

Figure 1. Relative biomass index of Common Hake, Squid and Squat Lobster (Source: IFOP, 2006)

3.2. Applied research

Research aimed at fishery management includes the Stock Evaluation and Total Allowable Catch Calculation Program (Programa de Evaluación de Stock y Cálculo de la Captura Total Permisible), developed by IFOP for over 15 year. Although these studies have normally been carried out for individual species, ecosystem elements have been recently incorporated into the studies to establish recommended catch quotas using a multi-species approach. The models are age-structured formulated from a bayesian perspective.

One example of this is the strong trophic interaction between southern hake (*Merluccius australis*) (predator) and Hoki (*Macroronus magellanicus*) (over 98% prey). The latter species has, in recent years, achieved a significant commercial value due to the decrease in southern hake. One factor that could explain part of the growth of the Hoki population between 1993 and 1998 is decreased predation by southern hake.

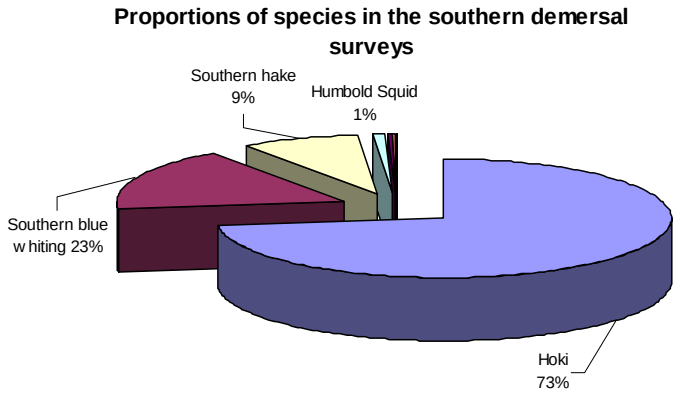

Figura 2. Proportions of species in the southern demersal surveys (Source: IFOP, 2006)

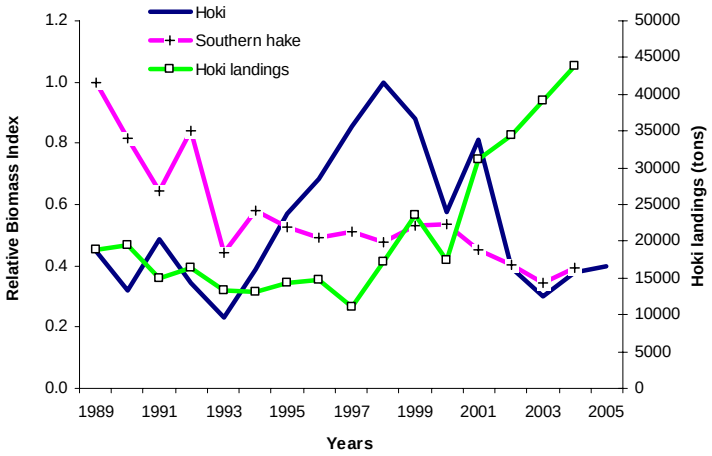

Figure 3. Relative biomass index of Southern Hake, Hoki, and landings of Hoki 1989-2005 (Source: IFOP, 2006)

A historical analysis of southern hake stomach contents shows that this species has a clear preference for Hoki by size. These elements have been evaluated and considered in multispecies modeling for these two species in order to establish recommendations for the 2007 catch quotas.

Another analysis was recently done on the common hake stock and its trophic interactions with Humbold giant squid, an important predator of hake after humans. According to the stock evaluation model, only the set of deaths by fishing and Humbold giant squid predation can explain the drastic decrease in hake biomass and structure. For 2006, the catch quota recommended by IFOP was determined based on the following factors:

- Fishing mortality (PBR)
- Expected recruitment
- Relative Humbold giant squid presence

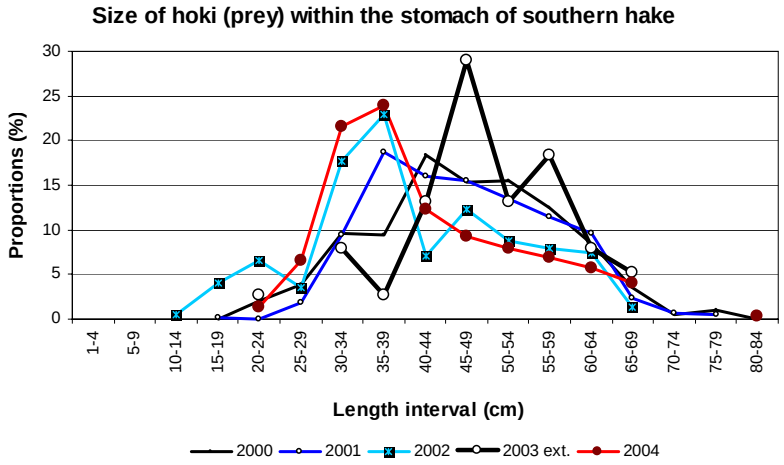

Figura 4. Size of hoki (prey) within the stomach of southern hake. (Source: IFOP, 2006)

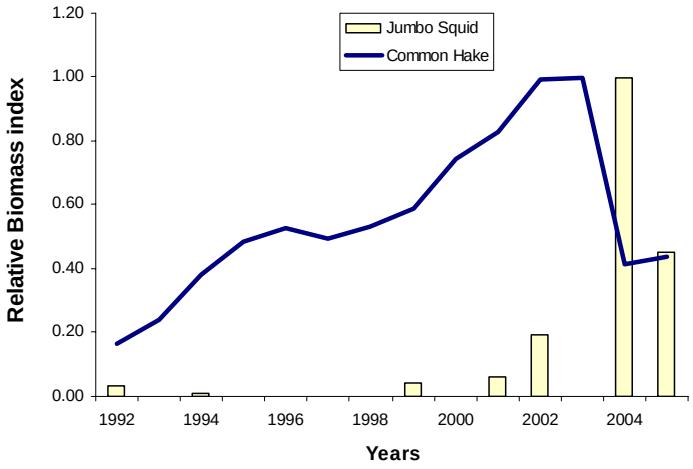

Figura 5. Relative biomass index of common hake and squid (Source: IFOP, 2006)

3.3. Plans for action and protection policies regarding biodiversity

The State's continuing interest in mitigating the effects of fishing on secondary species should be pointed out, and two important plans of action are currently in the process of public consulting:

- A protection plan for sharks and rays, as incidental fauna in the industrial long-line fishery mainly targeting sword fish.

- A protection plan for marine birds, whose incidental deaths are recorded in the industrial long-line fishery targeting hake in southern Chile.

The main objective of these plans is to prevent, detain, and eliminate both illegal fishing and under-reporting.

Along with this, Chile has initiated protection policies for biodiversity through the publication of decrees that regulate the administration and operation of Marine Reserves and the creation of three Protected Marine Areas, two of which are found in northern Chile and whose administrative plans are being elaborated; the third area is in southern Chile and baseline studies will begin shortly.

4. Conclusions

Chile faces the challenges of improving the integration of large amount of information, generating and developing specific research programs, and joining the efforts that attempt to manage resources based on an ecosystem approach.

6. Bibliography

Arancibia, H., S. Neira; V. Christensen; R. Olson; F. Arreguín-Sánchez; L. Cubillos; R. Quiñones; C. Gatica & M. Medina. 2002. Enfoque metodológico para el análisis ecosistemico en la administración de pesquerías de la zona central de Chile. Informe final, proyecto FIP Nº 2001-29.

Botsford, L., J. C. Castilla, C. H. Peterson. 1997. The management of fisheries and marine ecosystems. Science, 277: 509-515.

Canales C., R. Cespedes, I. Payá y P. Gálvez. 2006. Investigación Evaluación de Stock y CTP regionalizada de Merluza de Cola . Informe Complementario, Instituto de Fomento Pesquero, Chile. 35 pp.

Christensen, V. & D. Pauly. 1993. Trophic models of aquatic ecosystems. ICLARM Conference Proceedings, Nº 26, 390 pp

E. Yañez; C. Silva; J. Maraboli; F. Gomez; N. Silva; E. Morales & A. Bertrand. 2002. Caracterización ecológica y pesquera de la cordillera de Nazca como área de crianza del pez espada. Informe final, proyecto FIP Nº 2002-04.

Escobar, J.J. 2001. El aporte del enfoque ecosistémico a la sostenibilidad pesquera. Serie de recursos naturales e infraestructura. División de recursos Naturales e Infraestructura. CEPAL. Naciones Unidas. Santiago de Chile. 57 pp.

FAO. 1984. Informe de la Conferencia Mundial de la FAO sobre Ordenación y Desarrollo Pesquero. Roma, 27 de junio al 6 de julio de 1984. Púb. Organización de las Naciones Unidas para la Agricultura y la Alimentación, Roma 1984.

FAO. 1992. Declaración de Cancún. Conferencia Internacional de Pesca Responsable, Cancún, México, 6 – 8 de mayo de 1992, 5 pp.

H. Arancibia. S. Neira; A. Milessi; L. Cubillos; G. Aedo; E. Acuña & Rafael Leon. 2004. Evaluación de la mortalidad por predación de la merluza común sobre el langostino colorado y langostino amarillo, y canibalismo. Informe final, proyecto FIP Nº 2004-43.

Neira, S. E. 2003. Simulación de cambios en los niveles de captura de los principales recursos pesqueros cuantificando su impacto en la estructura comunitaria del ecosistema marino de Chile central. Tesis de grado. Magíster en Ciencias mención Pesquerías. Universidad de Concepción. Concepción, Chile. 89 pp.

PNUMA/FAO. 2000. Ecosystem-Based Management of Fisheries: Opportunities and Challenges for Coordination between Marine Regional Fishery Bodies and Regional Seas Conventions. Report on the Tirad Global Meeting of Regional Seas Conventions and Actions Plan Monaco, 6 – 11 de noviembre de 2000, UNEP(DEC)/RS 3.7.1

Payá, I. 2006. Investigación Evaluación de Stock y CTP de Merluza Común, 2006. Informe Final, Instituto de Fomento Pesquero, Chile. 47 pp. + anexos

Reykiavik, 2001. Hacia una ordenación pesquera basada en el ecosistema. Documento de antecedentes preparado por la FAO para la Conferencia de Reykjavik sobre la Pesca Responsable en el Ecosistema Marino. 13 pp.

Sinclair, M., R. O'Boyle, D.L. Burke & G. Peacock. 1997. Why do some fisheries survive and other collapse?. *En*: Developing and Sustaining World Fisheries Resources: The State of Science and Management. Second World Fisheries Congress, Brisbane 1996. D. A. Hancock, D. C. Smith, A. Grant, & J. P. Beumer (Eds.). pp 23-35. CSIRO publishing,Melbourne.

UICN. 1995. The Law of the Sea: Priorities and Responsibilities in Implementing the Convention. In: United Nations Convention on the Law of the Sea: A Framework for Marine Conservation, A Marine Conservation and Development Report, UICN, Gland, Switzerland, 155 pp.