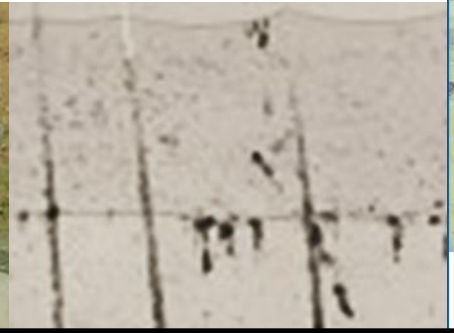


Small Pelagic Fish:
New Frontiers in Science and Sustainable Management

November 7 - 11, 2022
Lisbon, Portugal

PICES ICES CIEM Food and Agriculture Organization of the United Nations

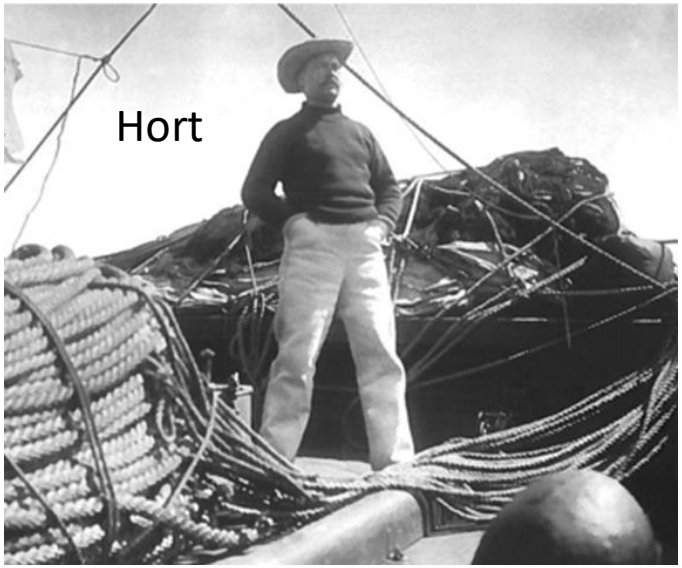
ENDORSED BY 2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Historical perspectives of international collaboration on small pelagic fish research

Jürgen Alheit and Salvador E. Lluch-Cota

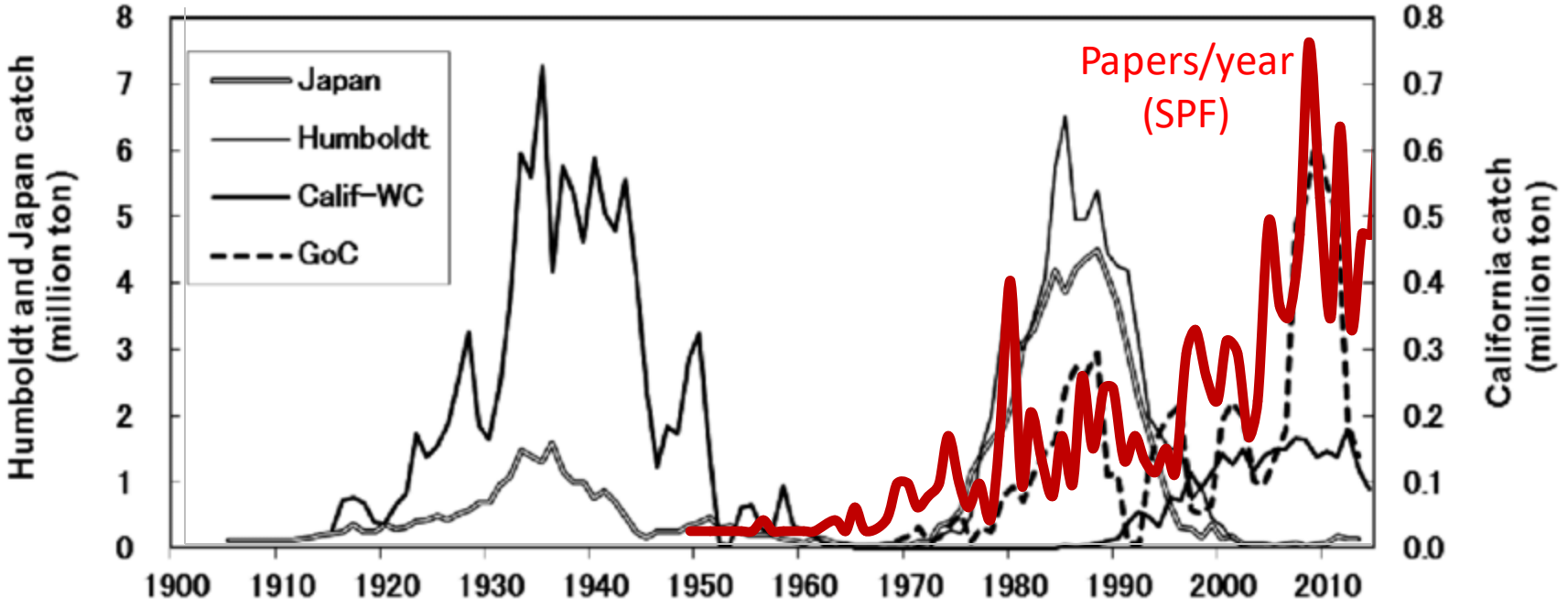
Pettersson

ICES website



Hort

- Development of population/stock concept
- Age determination
- Development of hydroacoustic methods
- Hypotheses of population structure
- Link between fisheries dynamics and hydrography


Humboldt and Japan catch
(million ton)
California catch
(million ton)
Japan
Humboldt
Calif–WC
GoC
Papers/year
(SPF)
0
1
2
3
4
5
6
7
8
0.0
0.1
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1910
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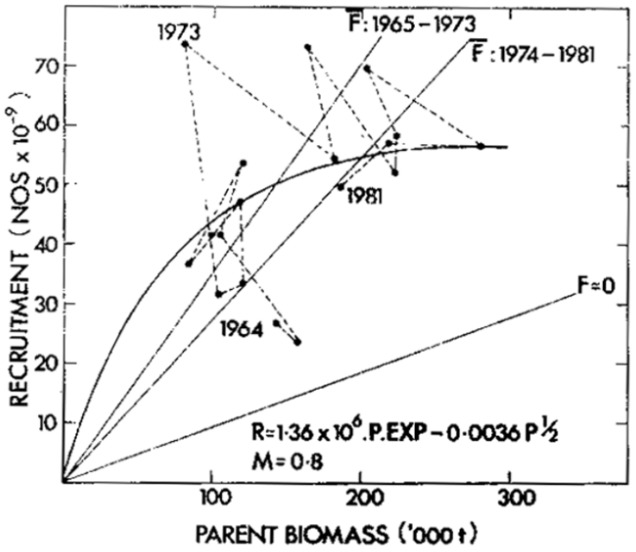
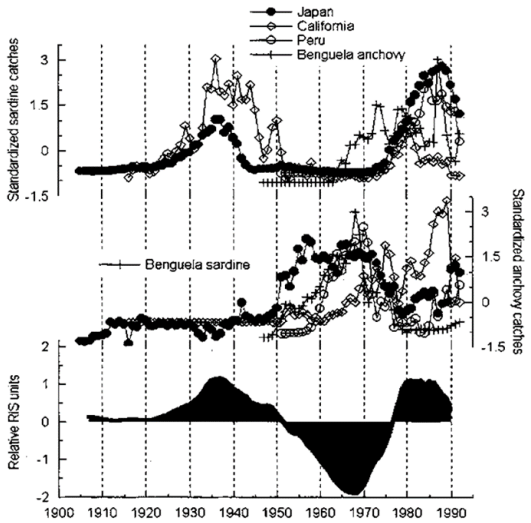
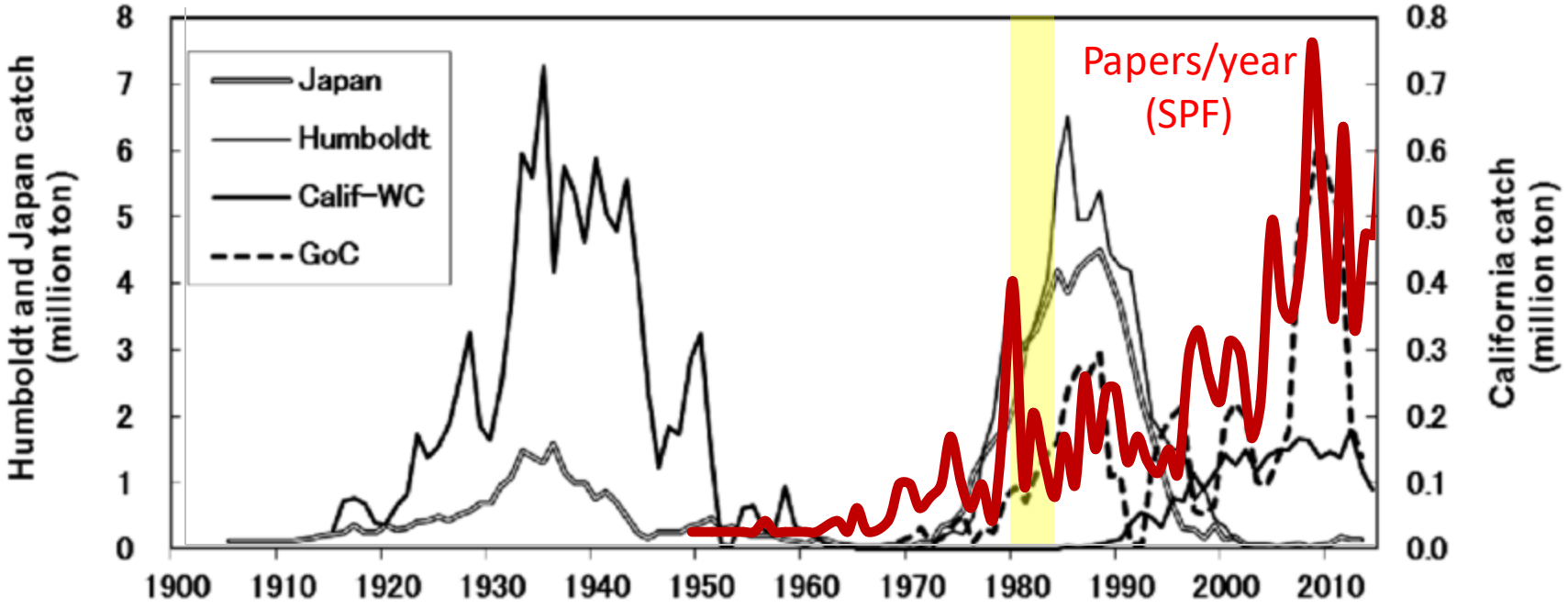
2010





Kawai and Isibasi, 1983



WORKING GROUP 67

OCEANOGRAPHY, MARINE ECOLOGY AND LIVING RESOURCES

Report prepared for the IOC

SUMMARY AND RECOMMENDATIONS:

1. A set of experiments collectively called the International Recruitment Experiment (IREX) is proposed to investigate the relationships between environmental variability and fluctuations of living resources.
2. It is recommended that a separate working group be set up to determine the feasibility of IREX application to high diversity ecosystems.
3. It is recommended that the Committee on Climate Changes and the Ocean (CCCO) support the IREX activities through the Time Series Study Group of the Biology Panel.

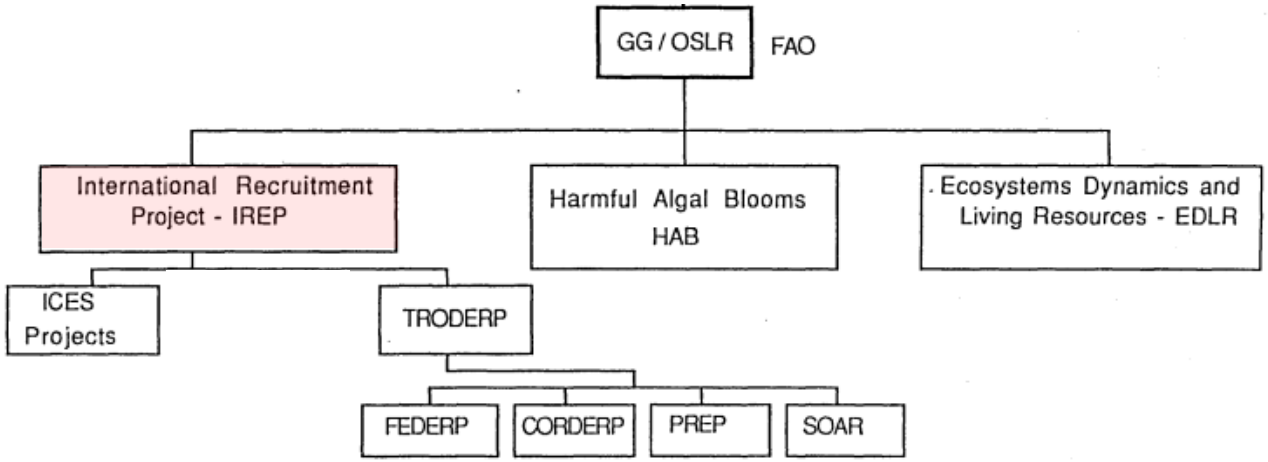
THE CONSEQUENCES OF CANNIBALISM IN THE STOCK-RECRUITMENT RELATIONSHIP OF PLANKTIVOROUS PELAGIC FISHES SUCH AS *ENGRAULIS*

by

Alec D. MacCall
California Department of Fish and Game
c/o Southwest Fisheries Center
P.O. Box 271
La Jolla, California 92038

and

Scripps Institution of Oceanography
University of California, San Diego
La Jolla, California 92093
A-008


GG / OSLR
FAO
International Recruitment Project - IREP
Harmful Algal Blooms HAB
Ecosystems Dynamics and Living Resources - EDLR
ICES Projects
TRODERP
FEDERP
CORDERP
PREP
SOAR





THE "CEOS" program

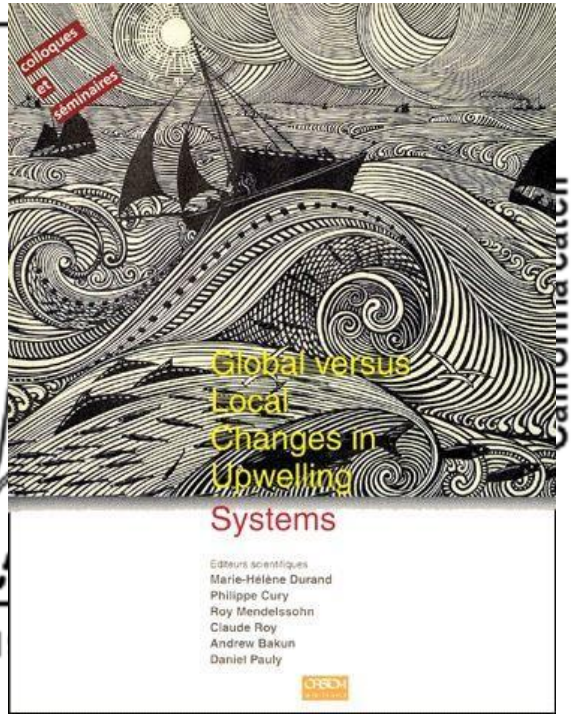
Climate and Eastern Ocean Systems

The dynamics of marine resources and their exploitation in face of climatic variability and changing climatic regimes

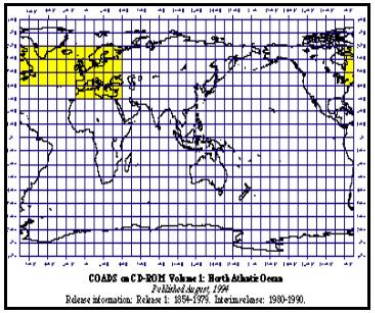
NOAA ORSTOM

ICLARM

Humboldt and Japan catch



California catch (million ton)



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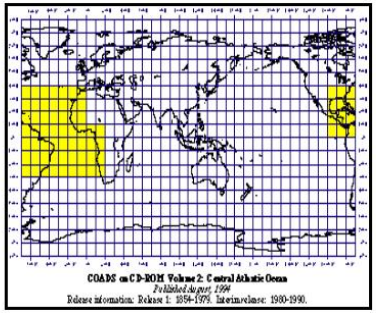
Published August, 1994
Release information: Release 1: 1854-1979. Interimrelease: 1980-1990.



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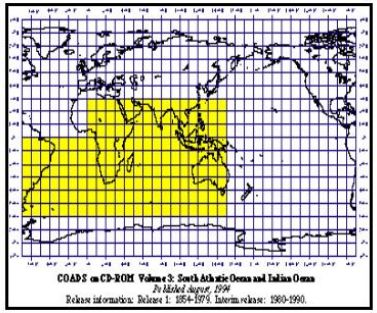

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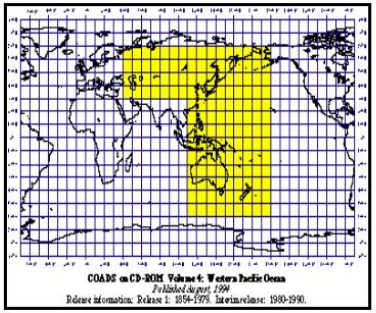

COADS on CD-ROM Volume 4: Western Pacific Ocean
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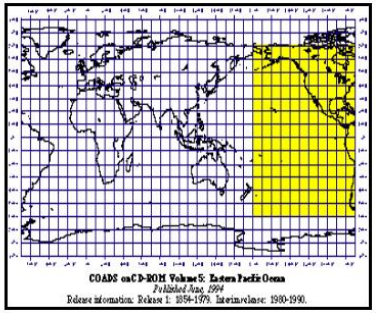

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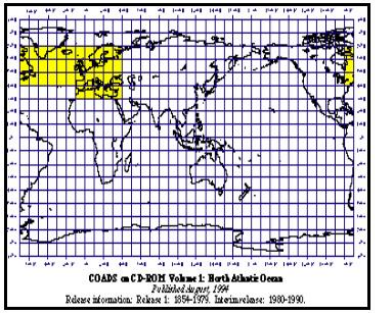
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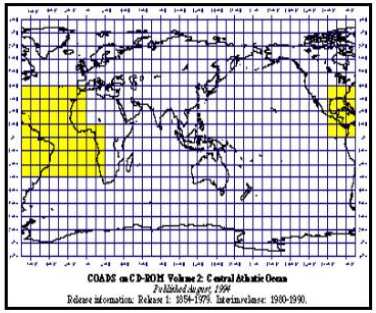
Published August, 1994
Release information: Release 1: 1854-1979. Interimrelease: 1980-1990.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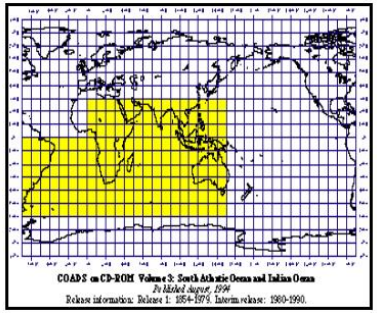
COADS on CD-ROM Volume 3: South Atlantic Ocean and Indian Ocean
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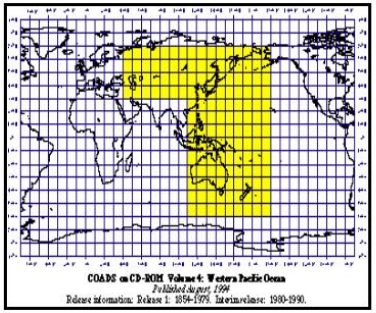
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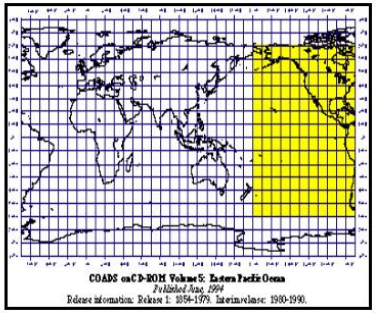
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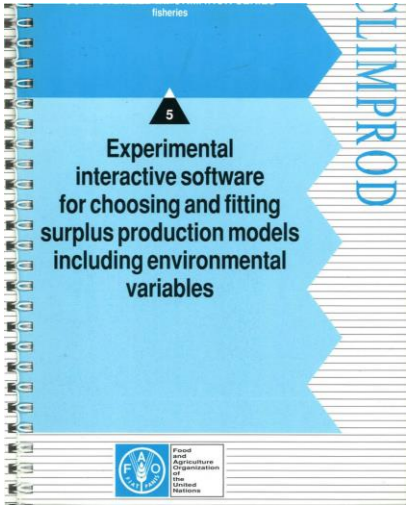
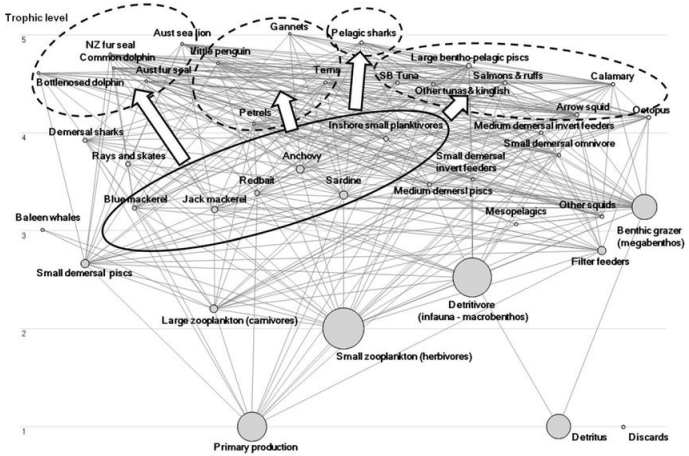
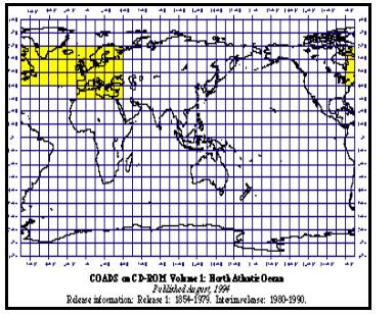
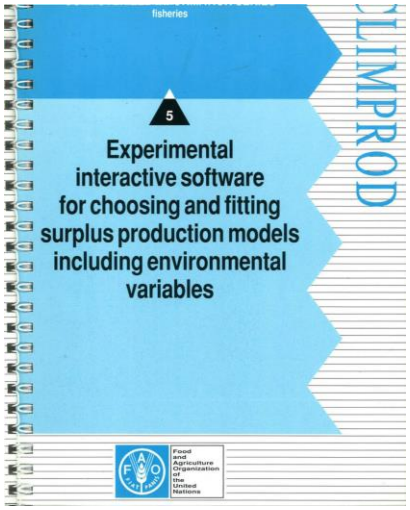
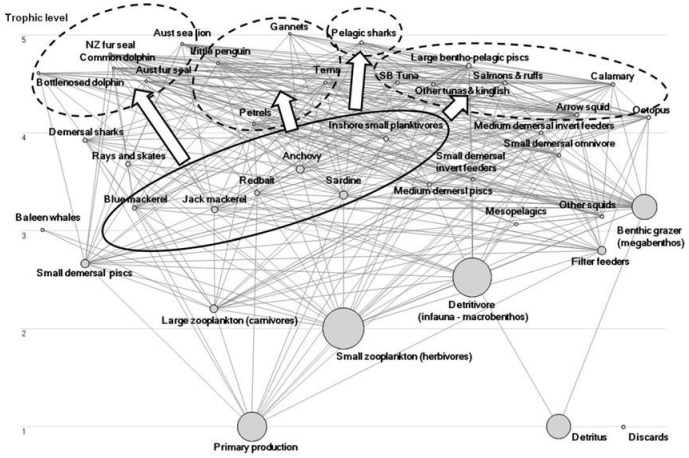
Release information: Release 1: 1854-1979. Interimrelease: 1980-1990.

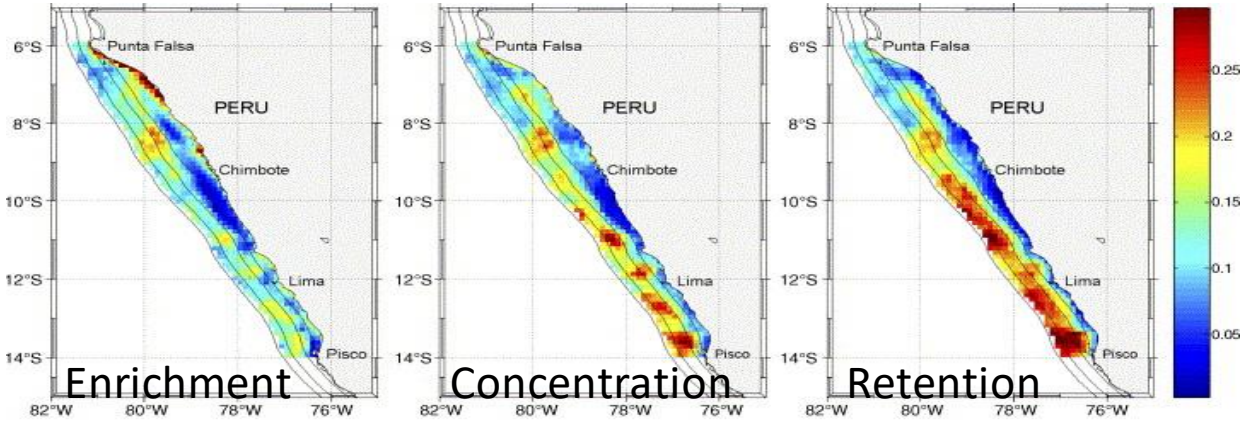

fisheries
5
Experimental interactive software for choosing and fitting surplus production models including environmental variables
LIMPROD
Food and Agriculture Organization of the United Nations

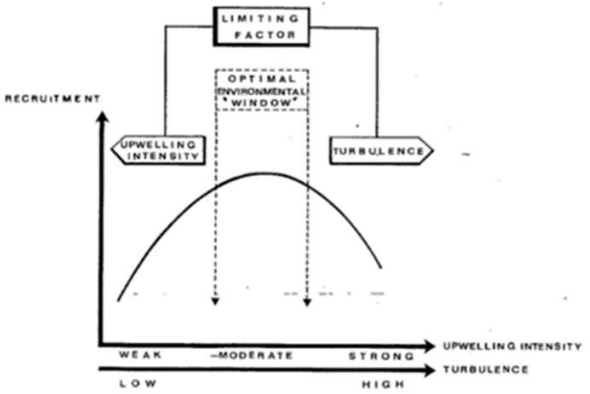

Trophic level
5
4
3
2
1
NZ fur seal
Common dolphin
Bottlenose dolphin
Aust sea lion
Aust fur seal
Little penguin
Gannets
Pelagic sharks
Terns
Large bentho-pelagic piscs
SB Tuna
Salmons & ruffs
Calamary
Other tunas & kingfish
Arrow squid
Octopus
Petrels
Inshore small planktivores
Medium demersal invert feeders
Small demersal omnivore
Demersal sharks
Rays and skates
Anchovy
Small demersal invert feeders
Redbait
Sardine
Medium demersl piscs
Blue mackerel
Jack mackerel
Mesopelagics
Other squids
Baleen whales
Benthic grazer (megabenthos)
Filter feeders
Small demersal piscs
Detritivore (infauna - macrobenthos)
Large zooplankton (carnivores)
Small zooplankton (herbivores)
Primary production
Detritus
Discards











Lett et al., 2007. J Mar Sys

Daily egg production method (DEPM)

- Developed at the SFSC in the late 1970s
- Traditional methods such as acoustics and the Larval Census Method were no longer considered sufficiently reliable
- Independent biomass
- Understanding of the reproductive biology of SPF across different ecosystems.
- International cooperation.

$$Bs = K \times A(P0 \times Wf)/(R \times F \times S)$$

Where Bs = spawning biomass, P0 = daily egg production WF = average weight of mature females R = sex ratio F = batch fecundity, S = spawning fraction, A = survey area and K conversion factor grams to metric tons.

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BULLETIN OF MARINE SCIENCE, 53(2): 750–767, 1993

USE OF THE DAILY EGG PRODUCTION METHOD FOR ESTIMATING BIOMASS OF CLUPEOID FISHES: A REVIEW AND EVALUATION

Jürgen Alheit

International Council for the Exploration of the Sea

C.M. 1991/L:43
Session V

THE SARDINE-ANCHOVY RECRUITMENT PROJECT (SARP): RATIONALE, DESIGN AND DEVELOPMENT

Andrew Bakun*, Jürgen Alheit** and Gunnar Kullenberg***

The SARP species complex is a major factor in world fisheries production, a key trophic basis for other valuable stocks, and notoriously variable and prone to population collapse. SARP was selected as the initial focal project of the International Recruitment Project, which is part of the Ocean Science and Living Resources Program of IOC and FAO because of (1) the need to address within-year variability in survival and (2) the opportunity provided by newly developed technologies. The comparative method is a major element in the SARP project design. SARP projects have been implemented in European waters, in the Southwest Atlantic, in the upwelling region of the Southeast Pacific, off California and off Japan.

PROCEEDINGS OF THE EXPERT CONSULTATION TO EXAMINE CHANGES IN ABUNDANCE AND SPECIES COMPOSITION OF NERITIC FISH RESOURCES SAN JOSE, COSTA RICA 18–29 APRIL 1983

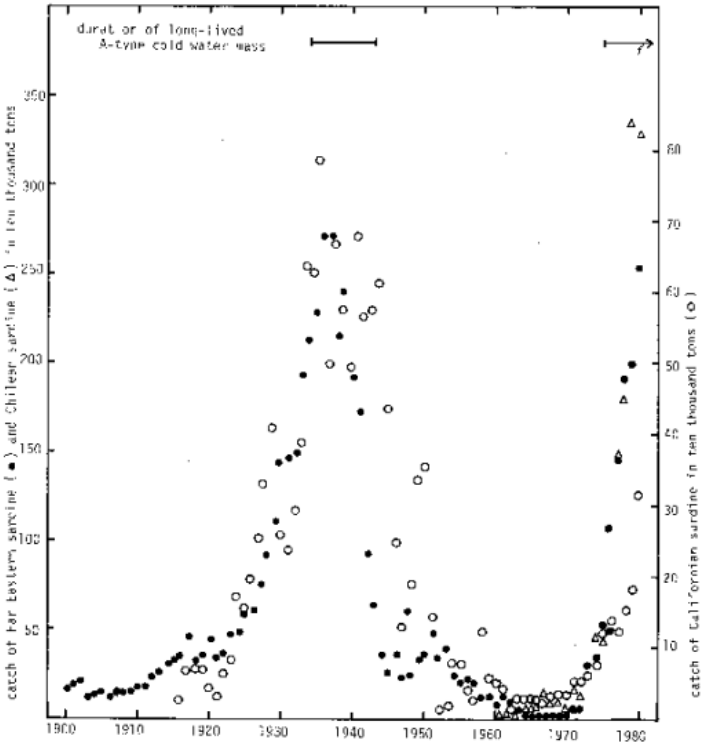
ACTAS DE LA CONSULTA DE EXPERTOS PARA EXAMINAR LOS CAMBIOS EN LA ABUNDANCIA Y COMPOSICION POR ESPECIES DE RECURSOS DE PECES NERITICOS SAN JOSE, COSTA RICA 18–29 APRIL 1983

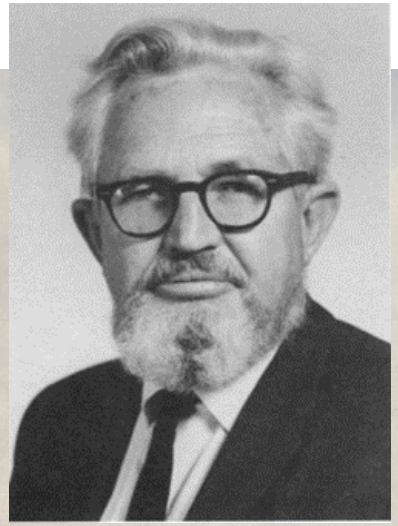
Edited by
Editadas por

G.D. Sharp and/y J. Csirke
Fisheries Department/Departamento de Pesca

A preparatory meeting for the FAO World Conference on Fisheries Management and Development

Una reunión preparatoria para la Conferencia Mundial de la FAO sobre Ordenación y Desarrollo Pesqueros





S. Afr. J. mar. Sci. 8: 195-205
1989

WORLD-WIDE FLUCTUATIONS OF SARDINE AND ANCHOVY STOCKS: THE REGIME PROBLEM

D. LLUCH-BELDA[1], R. J. M. CRAWFORD[2], T. KAWASAKI[3], A. D. MacCALL[4], R. H. PARRISH[5], R. A. SCHWARTZLOSE[1,6] and P. E. SMITH[7]

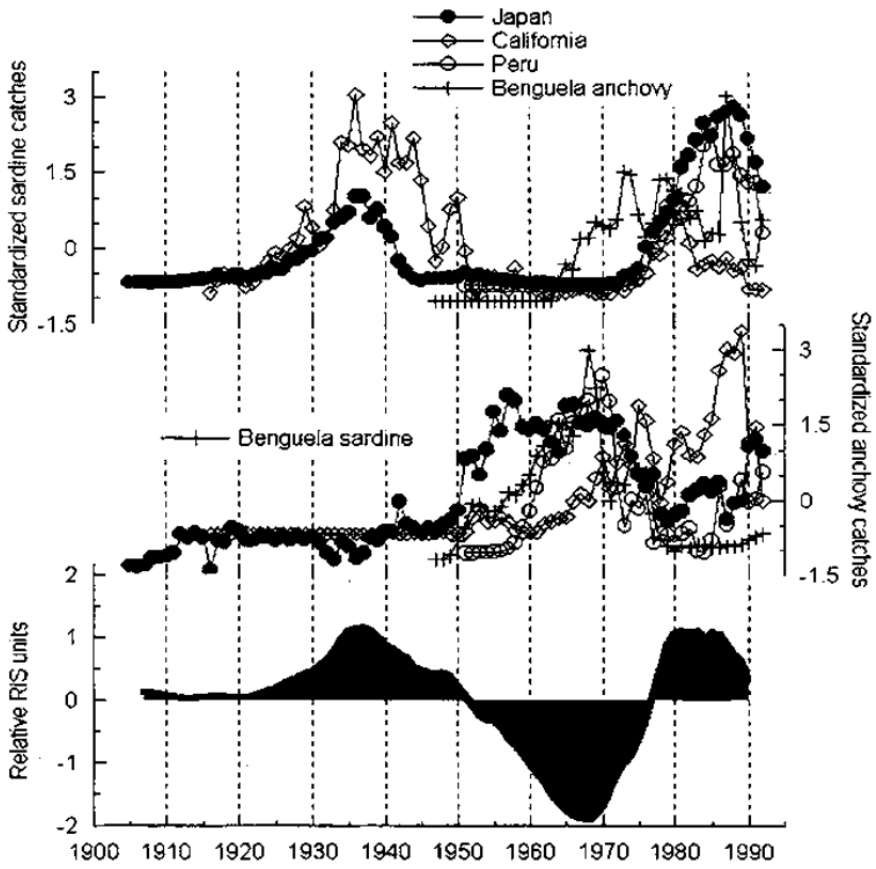
S. Afr. J. mar. Sci. 21: 289–347
1999

WORLDWIDE LARGE-SCALE FLUCTUATIONS OF SARDINE AND ANCHOVY POPULATIONS

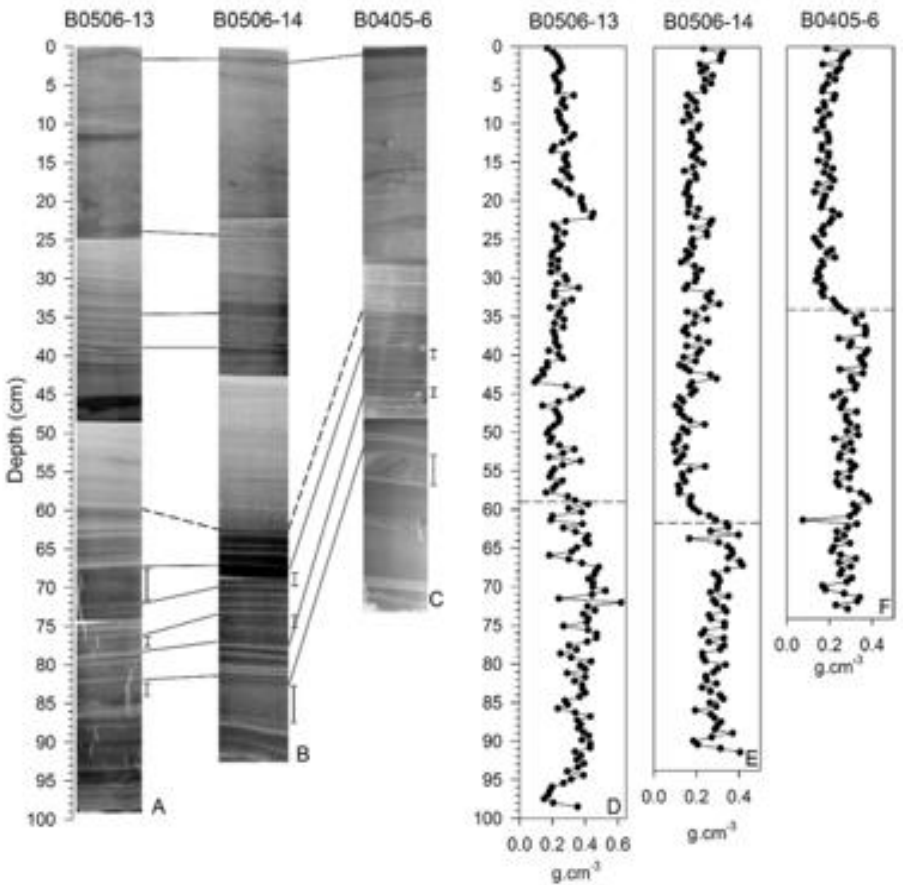
R. A. SCHWARTZLOSE[1], J. ALHEIT[2], A. BAKUN[3], T. R. BAUMGARTNER[4], R. CLOETE[5], R. J. M. CRAWFORD[6], W. J. FLETCHER[7], Y. GREEN-RUIZ[8], E. HAGEN[2], T. KAWASAKI[9], D. LLUCH-BELDA[10], S. E. LLUCH-COTA[11], A. D. MacCALL[12], Y. MATSUURA[13], M. O. NEVÁREZ-MARTÍNEZ[14], R. H. PARRISH[15], C. ROY[6], R. SERRA[16], K. V. SHUST[17], M. N. WARD[18] and J. Z. ZUZUNAGA[19]

Sardine and anchovy regime fluctuations of abundance in four regions of the world oceans: a workshop report

D. LLUCH-BELDA,[1] R. A. SCHWARTZLOSE,[1,2]
R. SERRA,[3] R. PARRISH,[4] T. KAWASAKI,[5]
D. HEDGECOCK,[6] AND R. J. M. CRAWFORD[7]



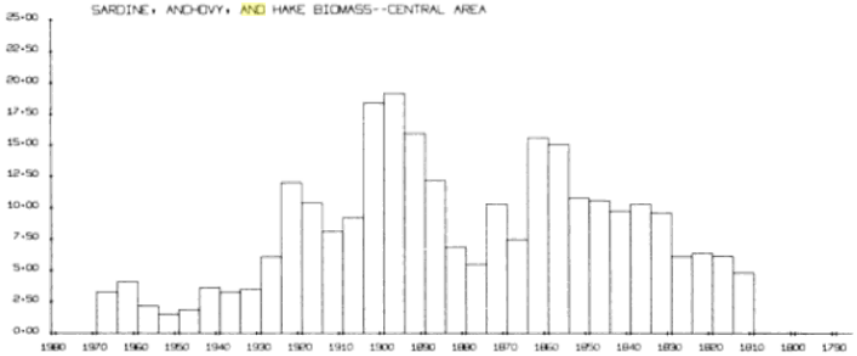
Paleoreconstructions



Paleobiology, 38(1), 2012, pp. 52–78

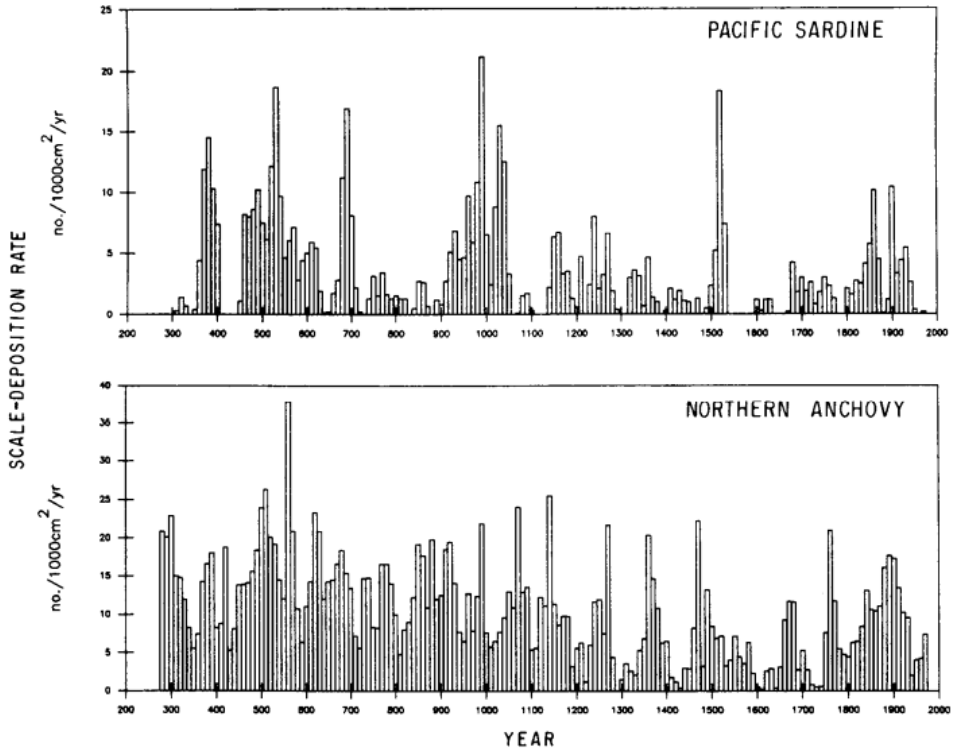
Evaluating fish scale preservation in sediment records from the oxygen minimum zone off Peru

Renato Salvatteci, David B. Field, Timothy Baumgartner, Vicente Ferreira, and Dimitri Gutierrez



ABUNDANCE OF PELAGIC FISH DURING THE 19TH AND 20TH CENTURIES AS RECORDED IN ANAEROBIC SEDIMENT OFF THE CALIFORNIAS

ANDREW SOUTAR AND JOHN D. ISAACS[1]



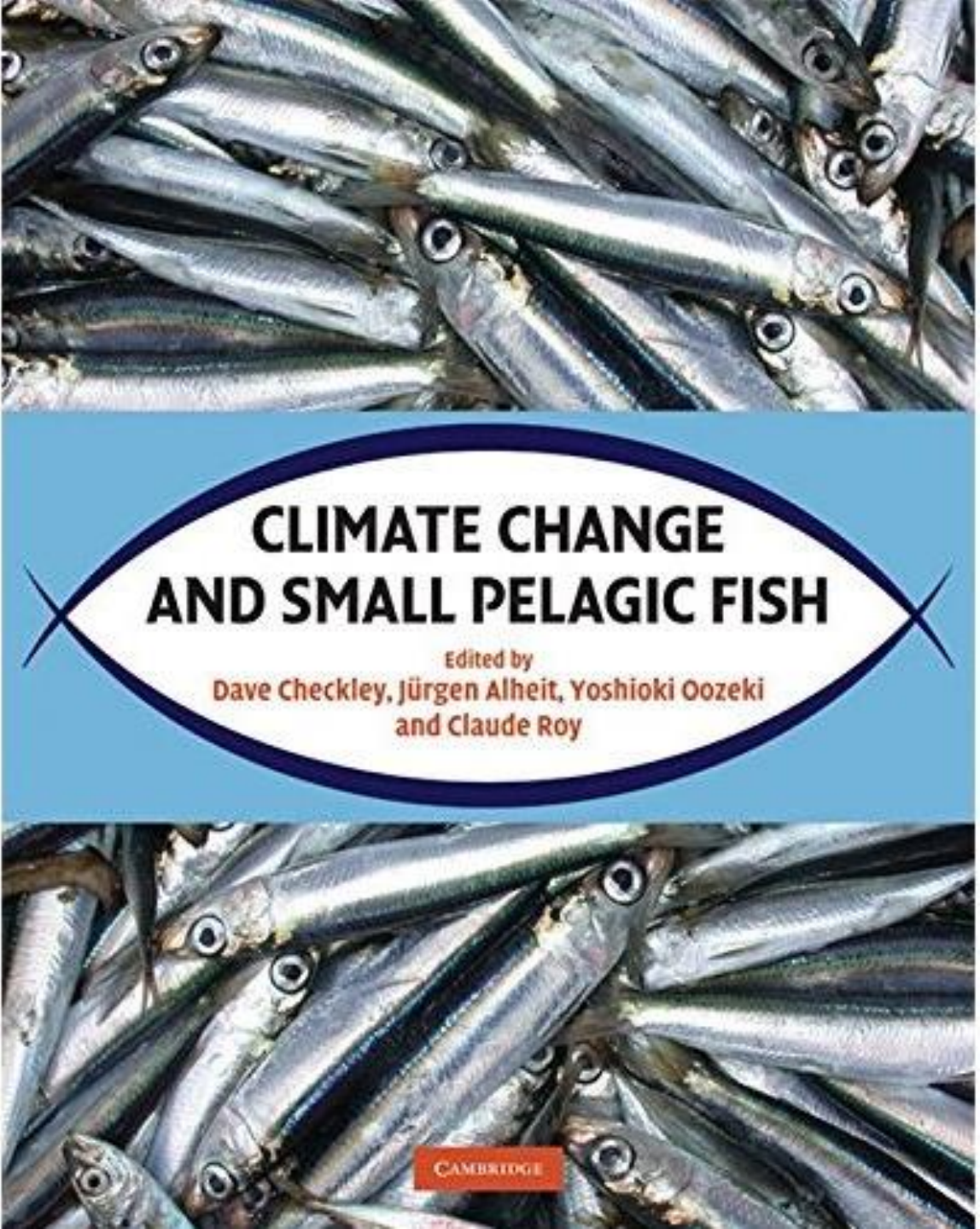
BAUMGARTNER ET AL.: HISTORY OF PACIFIC SARDINE AND NORTHERN ANCHOVY POPULATIONS
CalCOFI Rep., Vol. 33, 1992

SPACC

Small Pelagic Fish and Climate Change

Science plan included:

- **The physical environment,**
- **Climate changes and their impacts on local habitat**
- **Trophic ecology**
- **Zooplankton production**
- **Sedimentary records**
- **Systematics and population genetics**
- **Socio-eocnomics**



GLOBEC

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- **The physical environment,**
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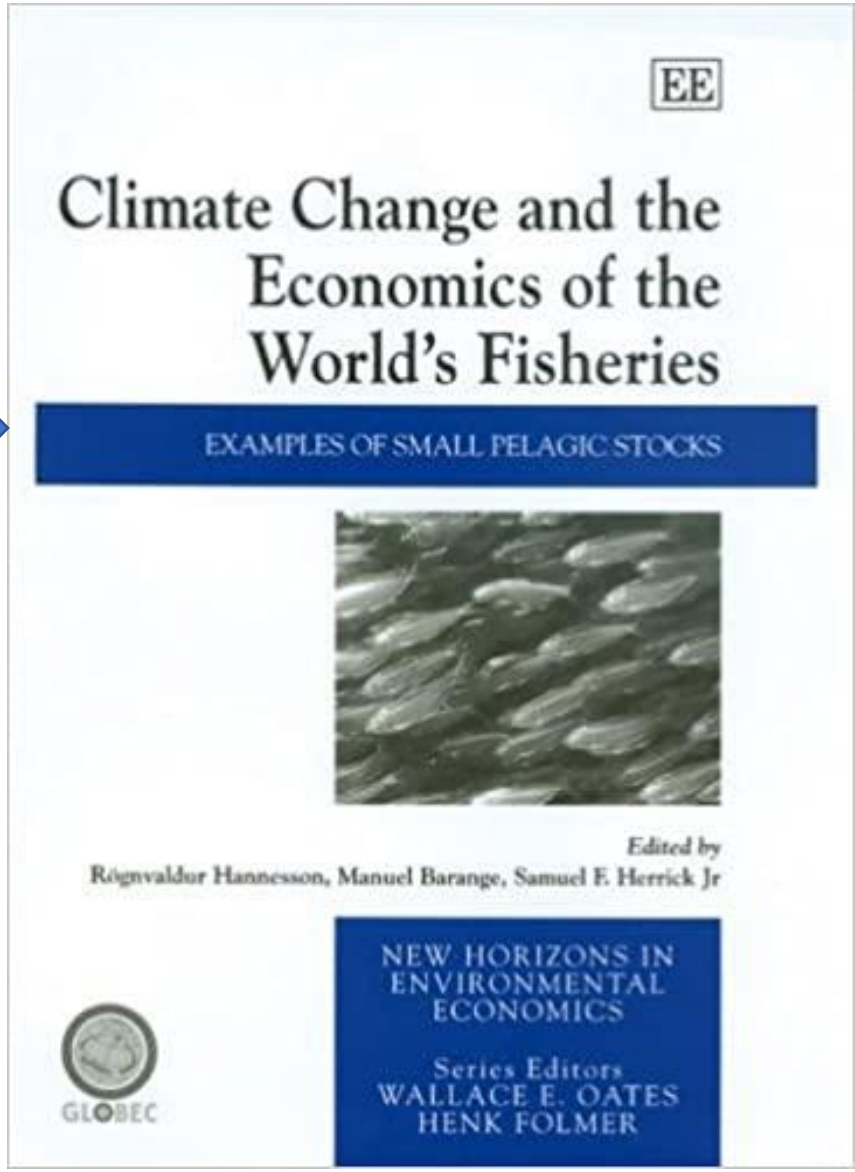
- **Systematics and population genetics**
- **Socio-eocnomics**

SPACC

how climate variability and change will affect the economics of small pelagic fisheries

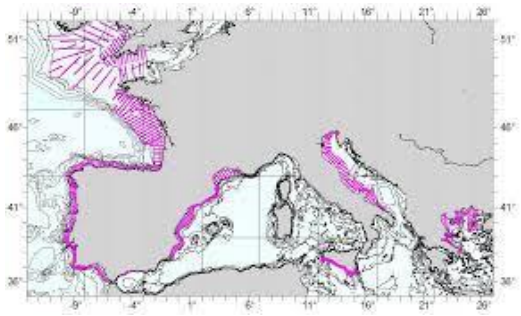


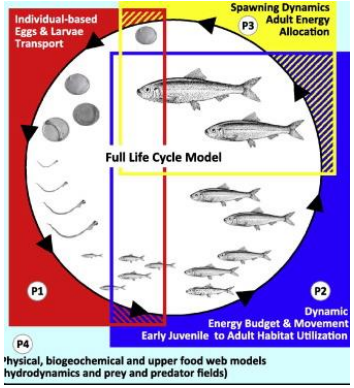
GLOBEC

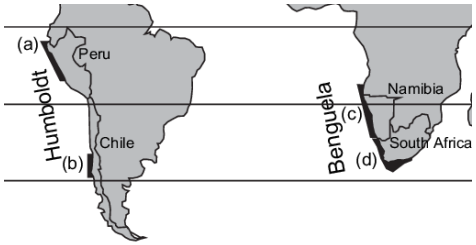
SPACC

PICES

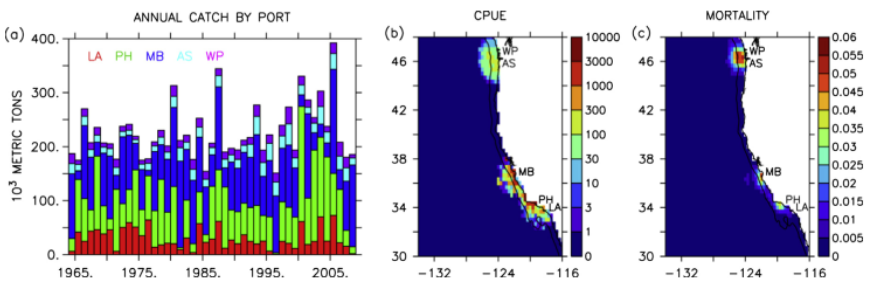
ICES CIEM







PALEO TRACES



Demonstration of a fully-coupled end-to-end model for small pelagic fish using sardine and anchovy in the California Current

CrossMark

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Humboldt and Japan catch
(million ton)
California catch
(million ton)
0
1
2
3
4
5
6
7
8
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
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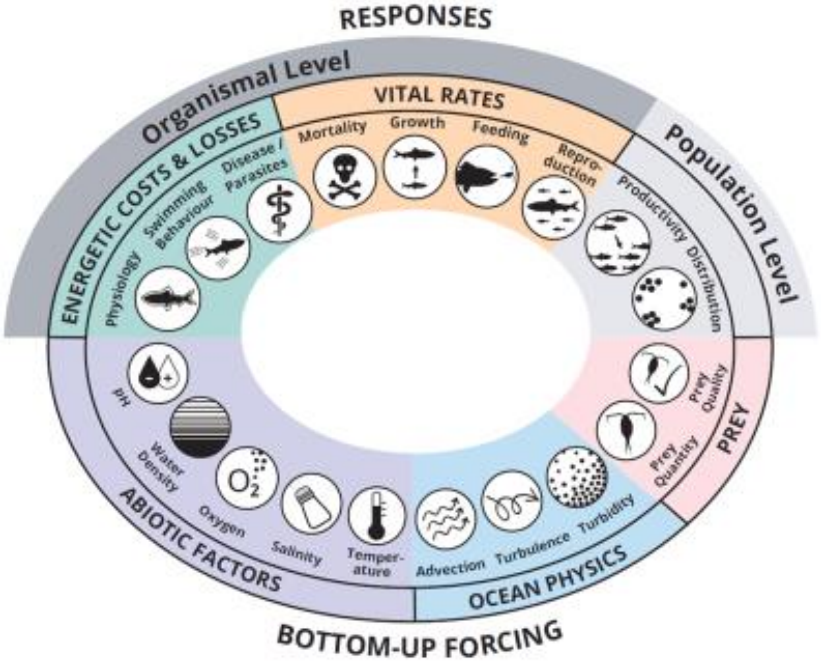
Small pelagic fish in the new millennium: A bottom-up view of global research effort

Myron A. Peck [a,*], Jürgen Alheit [b], Arnaud Bertrand [c], Ignacio A. Catalán [d], Susana Garrido [e], Marta Moyano [f], Ryan R. Rykaczewski [g,k], Akinori Takasuka [h], Carl D. van der Lingen [i,j]



- Gaps in ecological knowledge on young juveniles and on impacts of hypoxia and heatwaves
- Utility of paleo studies
- Need to develop spatially explicit, full life-cycle models
- Density-dependent processes impact vital rates
- International collaboration for knowledge transfer and building unifying hypotheses.

Small pelagic fish in the new millennium: A bottom-up view of global research effort

Considerations for management strategy evaluation for small pelagic fishes

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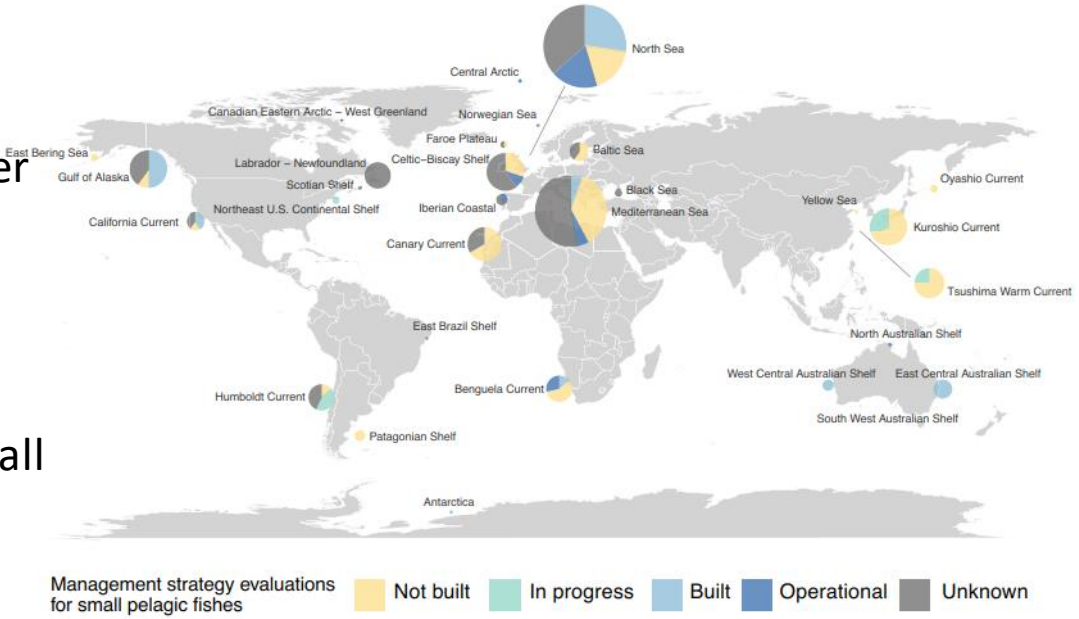
Key considerations for SPF:

- Variability in recruitment and other life-history rates
- Spatial structure and movement
- Species interactions

Roadmap for the MSE process for small pelagic fishes.



Small pelagic fish in the new millennium: A bottom-up view of global research effort

Considerations for management strategy evaluation for small pelagic fishes

Joint ICES/PICES Working Group on Small Pelagic Fish

Goals include:

- Synthesis of mechanisms and the reconciliation of existing hypotheses
- Ecosystem-level understanding of fluctuations and their drivers
- SPF in social–ecological systems
- New monitoring and modelling technologies
- Projection of climate change impacts

Quite a few old hands in the field of SPF research have recently retired, or will do so soon, and that it is time to 'pass on the torches' to the next generation. We should not wait again several decades for the next small pelagic fish symposium.

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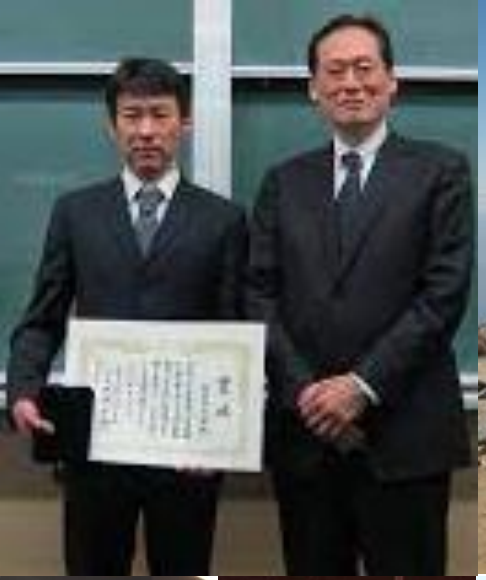
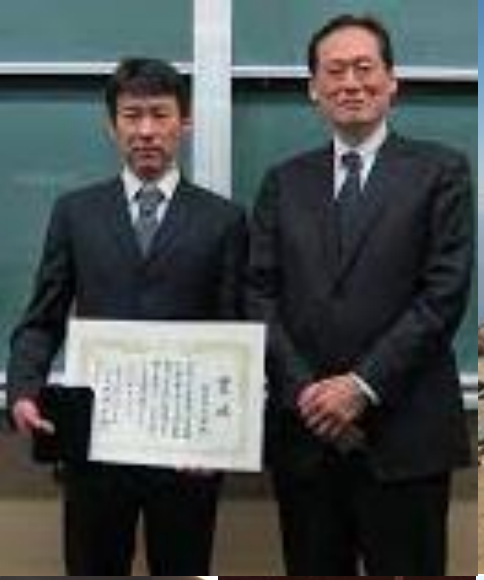




Thanks for the legacy



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Lisbon, Portugal

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Historical perspectives of international collaboration on small pelagic fish research

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