Status of the Swordfish Stock in the Southeastern Pacific Ocean, 2005

Prepared for the Working Group on Stock Assessments, May 2006

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Executive Summary

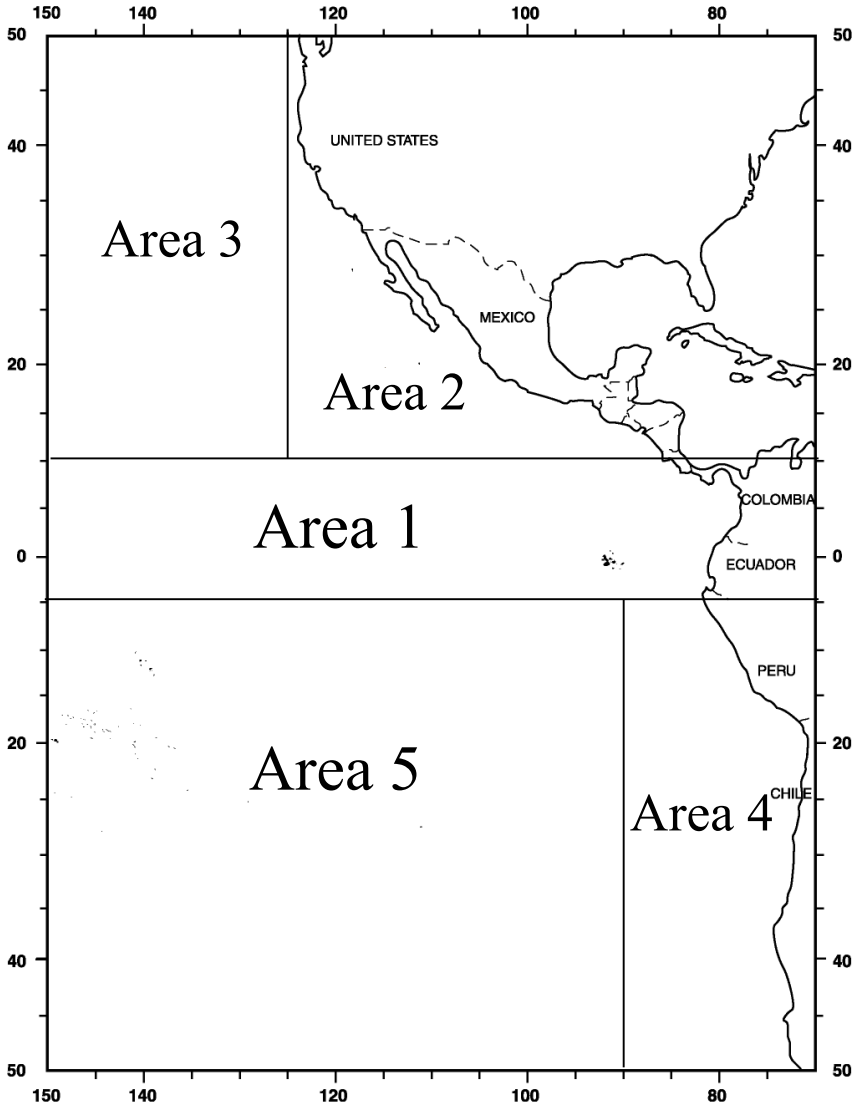
- Multiple genetically identifiable stocks
  - NEPO Stock
  - SEPO Stock
  - Others identified in study
    - CEPO/Hawaii
    - SWPO
- Analysis: SS2 Model: time frame 1945-2003
  - SBR has declined significantly
    - now ~ 0.41 to 0.56
    - SBR at AMSY ~ 0.26
  - AMSY ~ 13,000 to 14,000 t
  - Catches increased substantially since 2001

    now ~ 14,000 to 15,000 t / yr

DATA

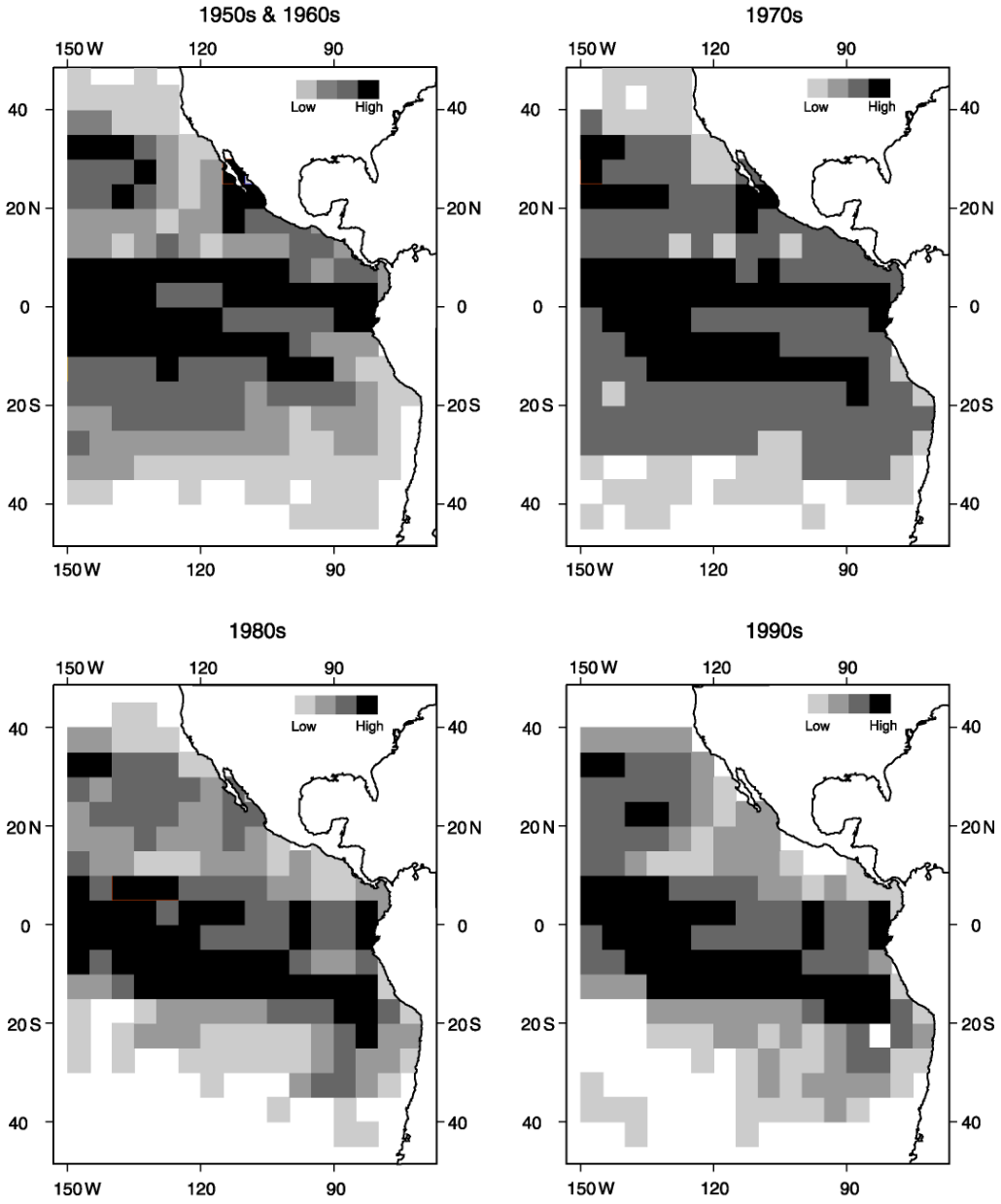
- Stock structure
  - Hinton and Deriso (1998): fisheries oceanography analysis
    - distributions of standardized catch rates
    - distributions of gonad indices/spawning
    - zonal movement analysis
  - Hinton & Bayliff (2002), Hinton (2003): fisheries analysis
    - distributions of length frequencies
    - comparisons of catch rate trends

Stock Study Area Stratification



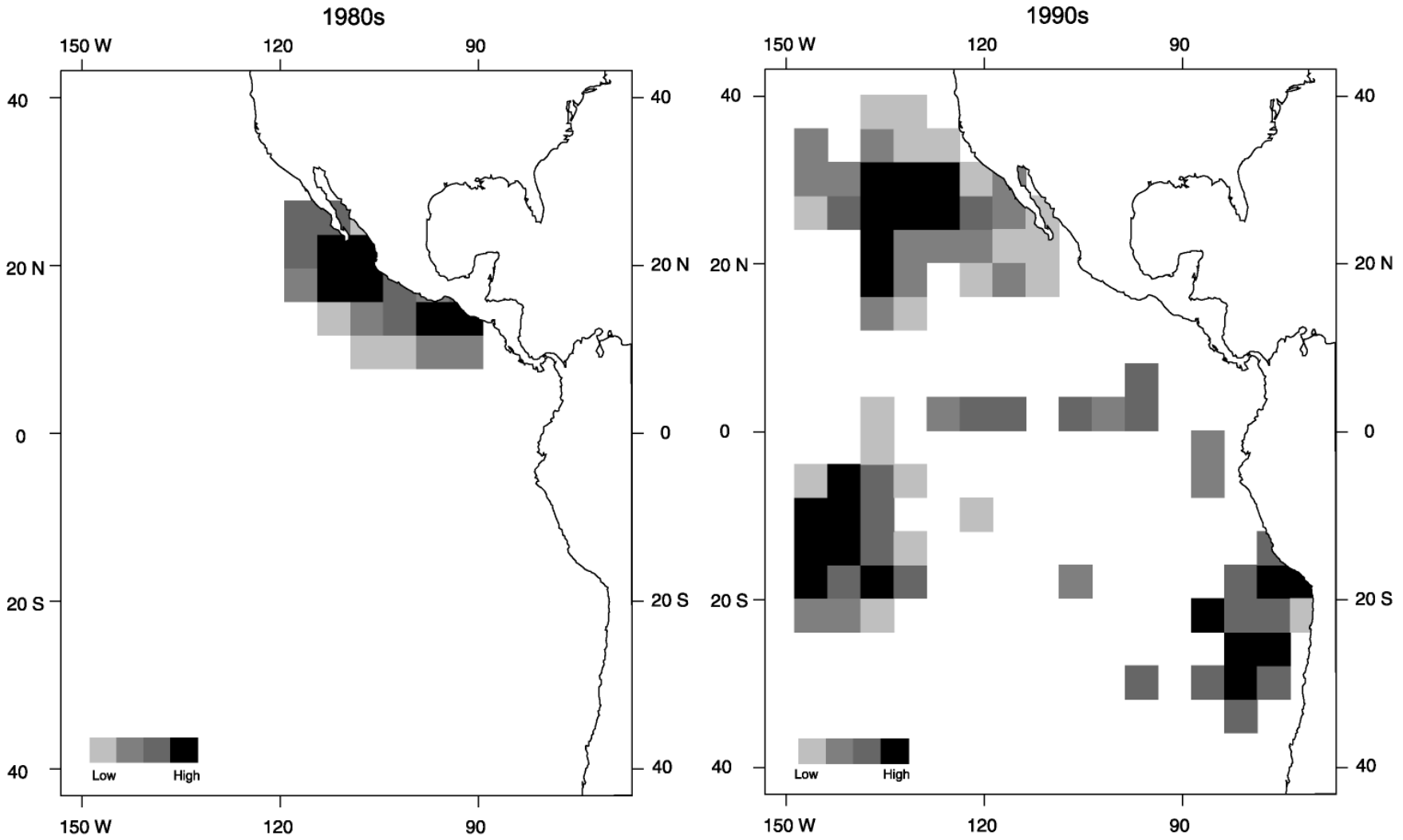
Hinton (2003, Figure 2.1.1a.)

Japanese Longline Effort Distribution



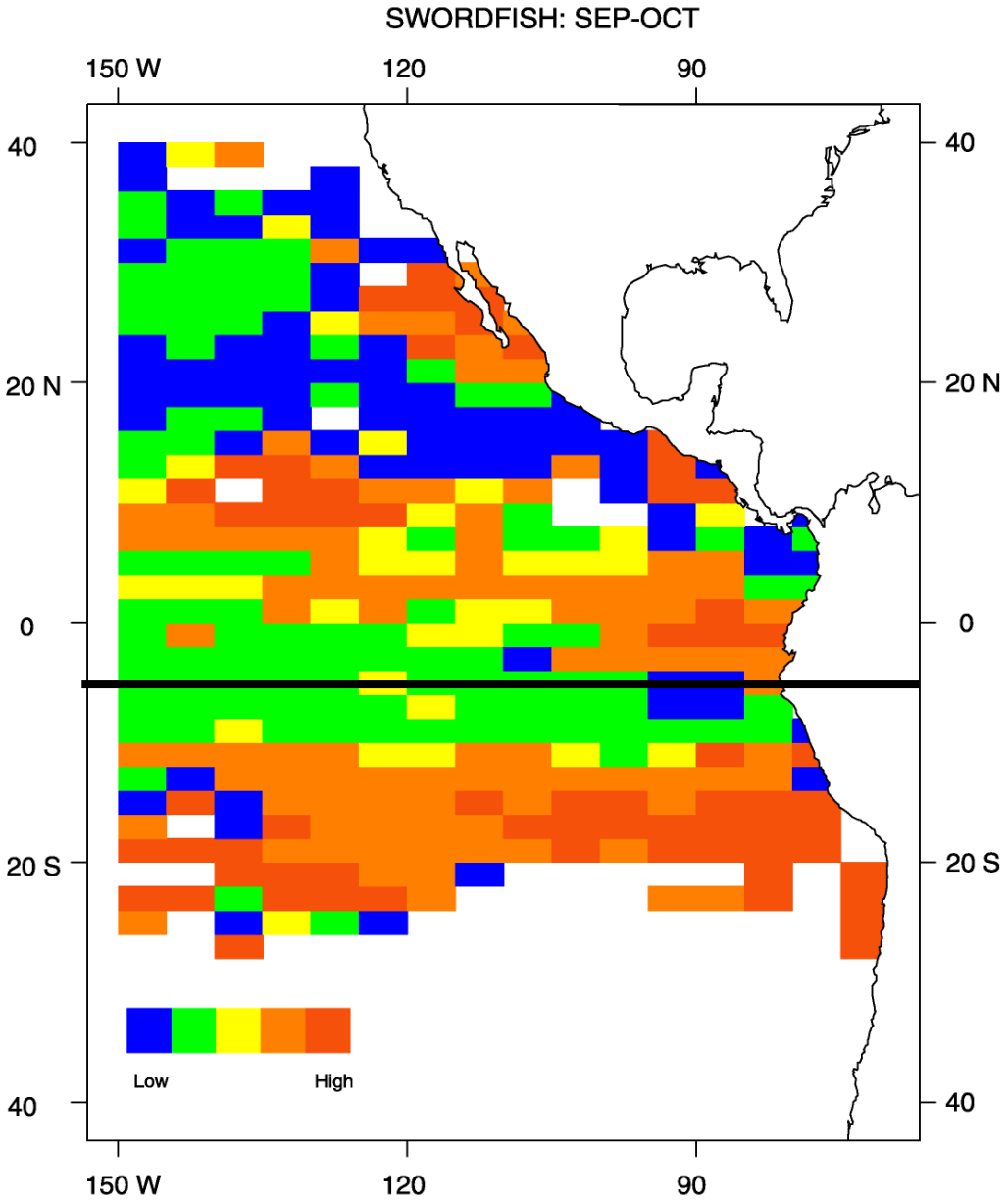
after Hinton & Bayliff 2002

Non-JPN, -KOR, -TWN LL



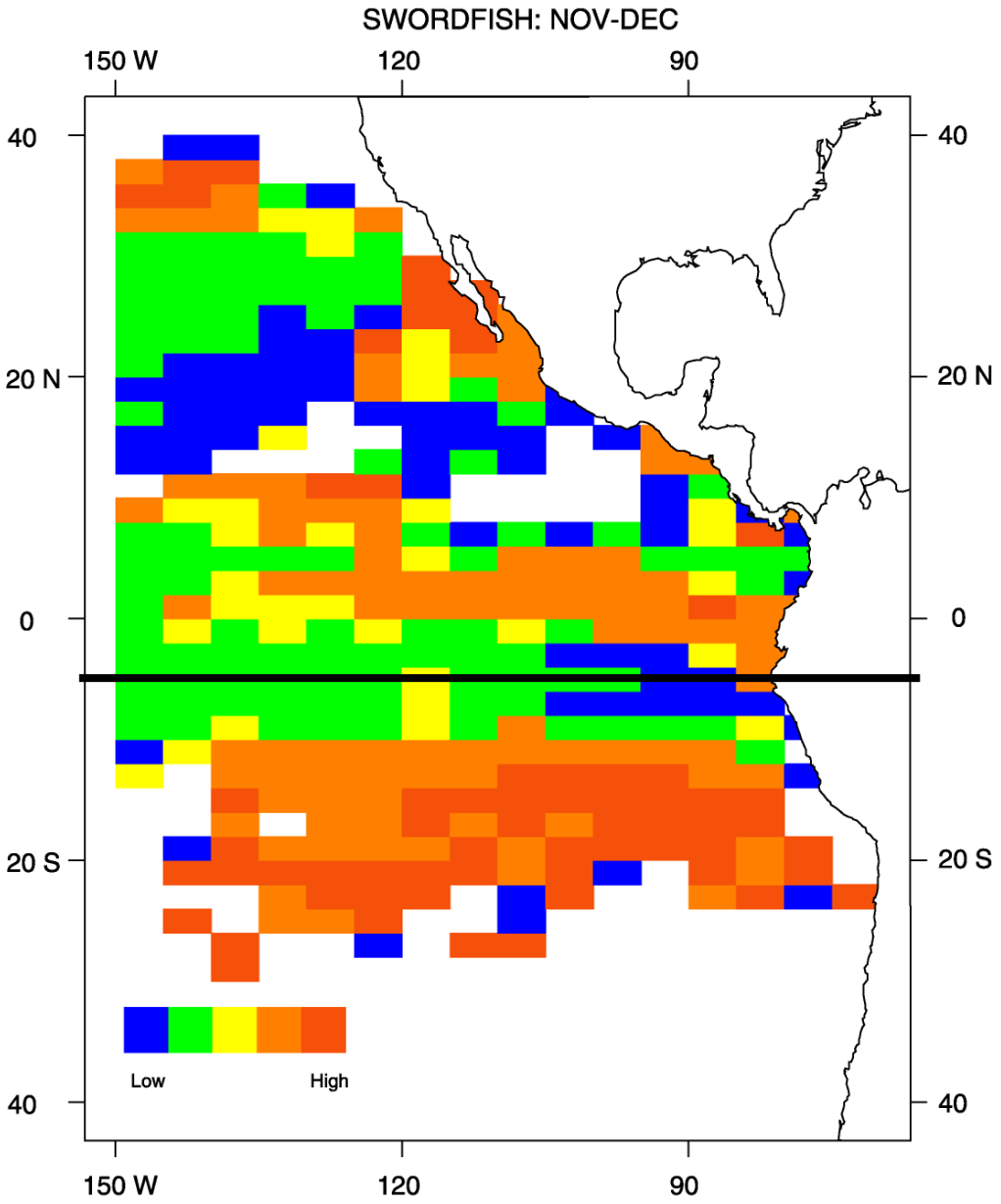
after Hinton & Bayliff 2002

Average SEP-OCT CPUSE



Hinton & Deriso 1998

Average Annual NOV-DEC CPUSE



Hinton & Deriso 1998

CIAT
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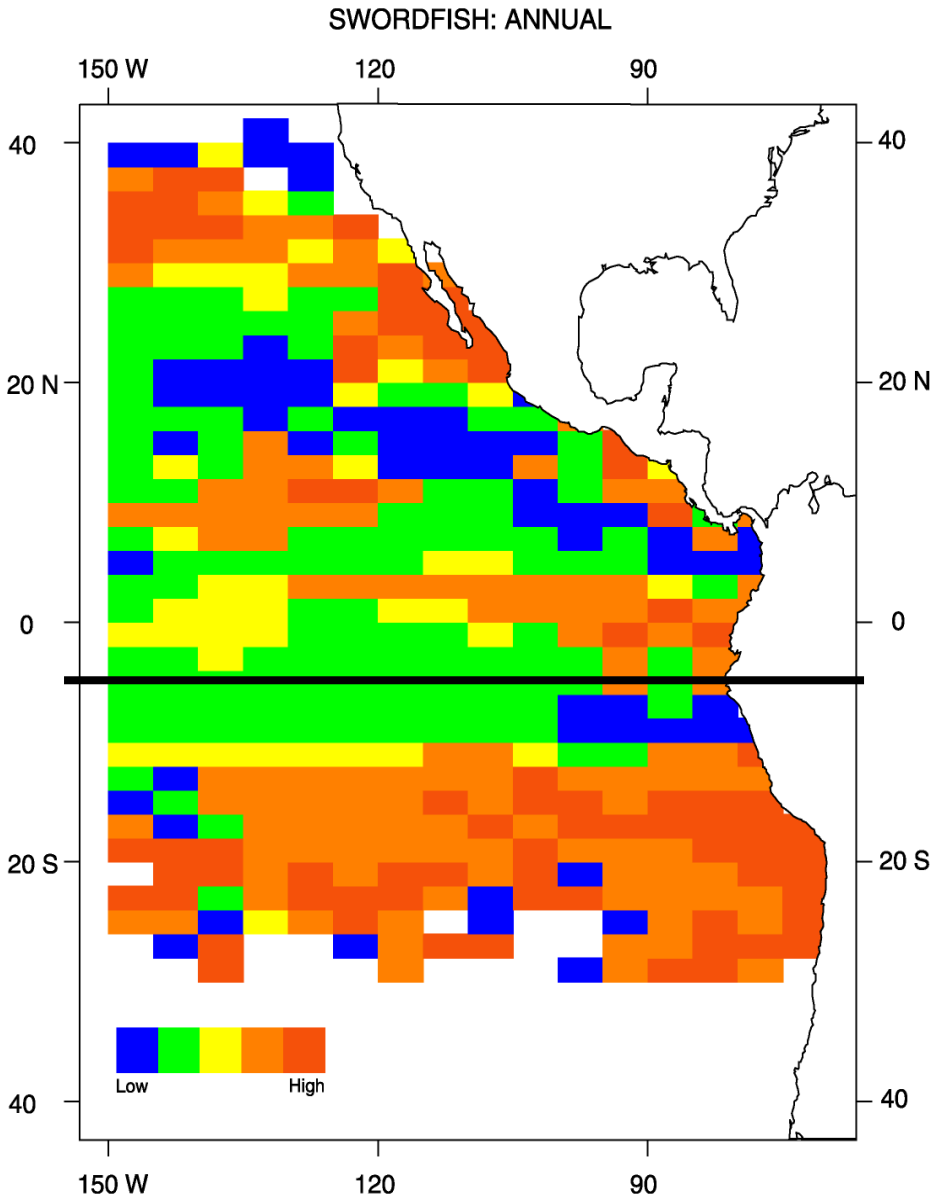
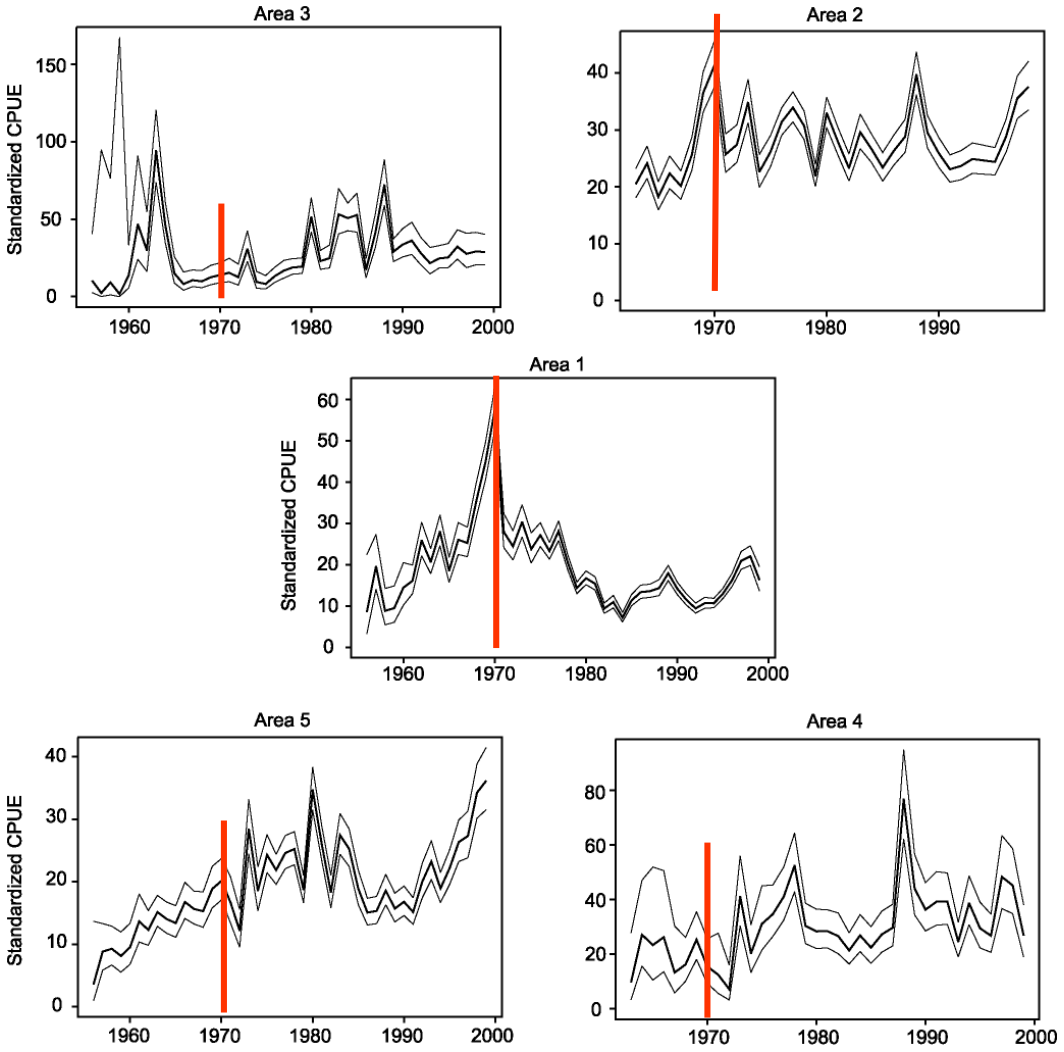
Average Annual CPUSE



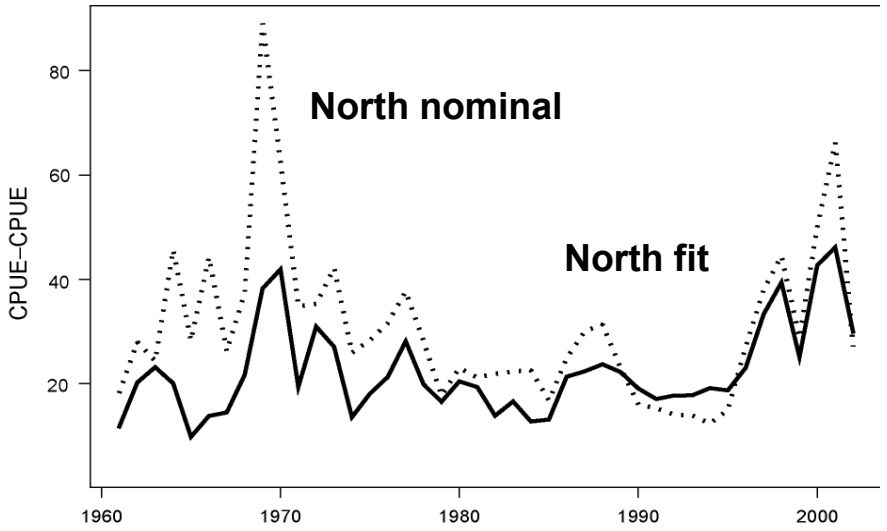
Hinton & Deriso 1998

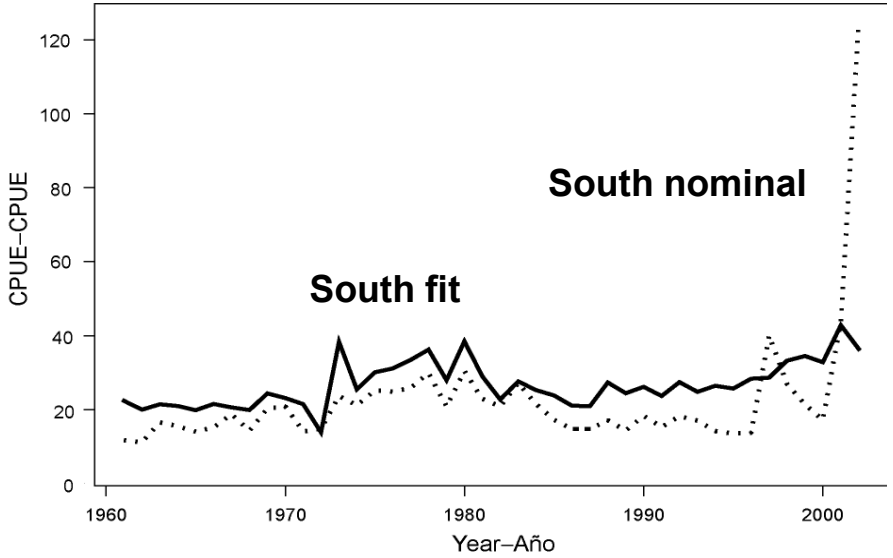
Stock Study Sub-area CPUSE trends



Hinton & Bayliff 2002

Fitted CPUSE trends





Hinton et al 2005

DATA (cont)

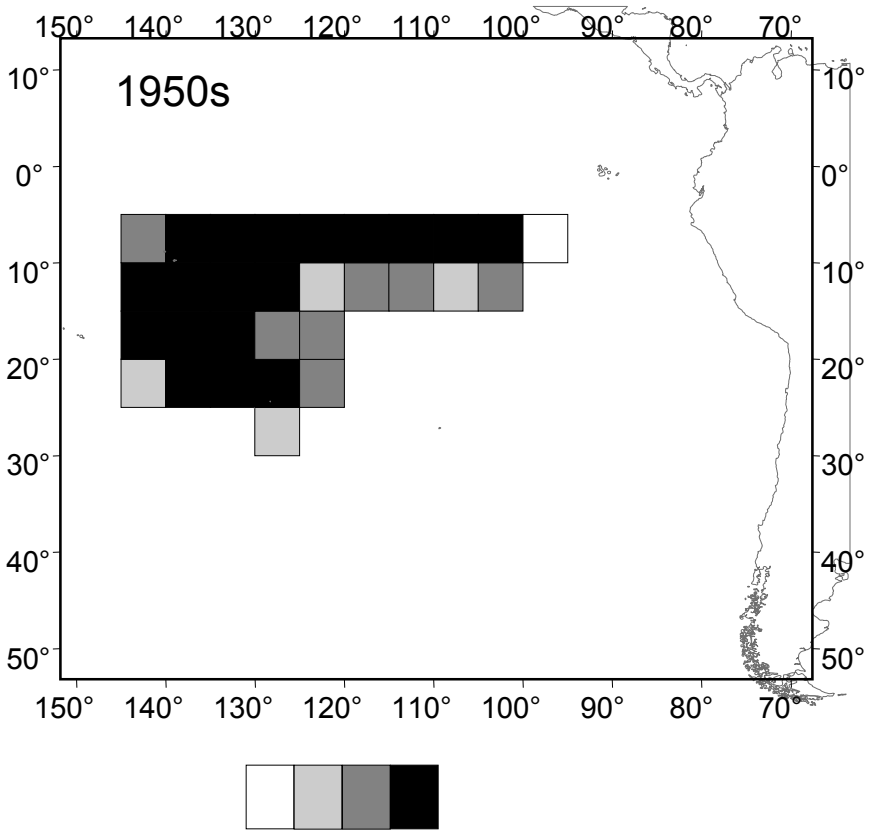
- Stock structure
  - Hinton and Deriso (1998); Hinton & Bayliff (2002), & Hinton (2003): fisheries analysis
  - Genetic Analysis (Alvarado et al [In Press] corrected for multiple tests: initial I = 0.05/6 = 0.008): significant results bold.

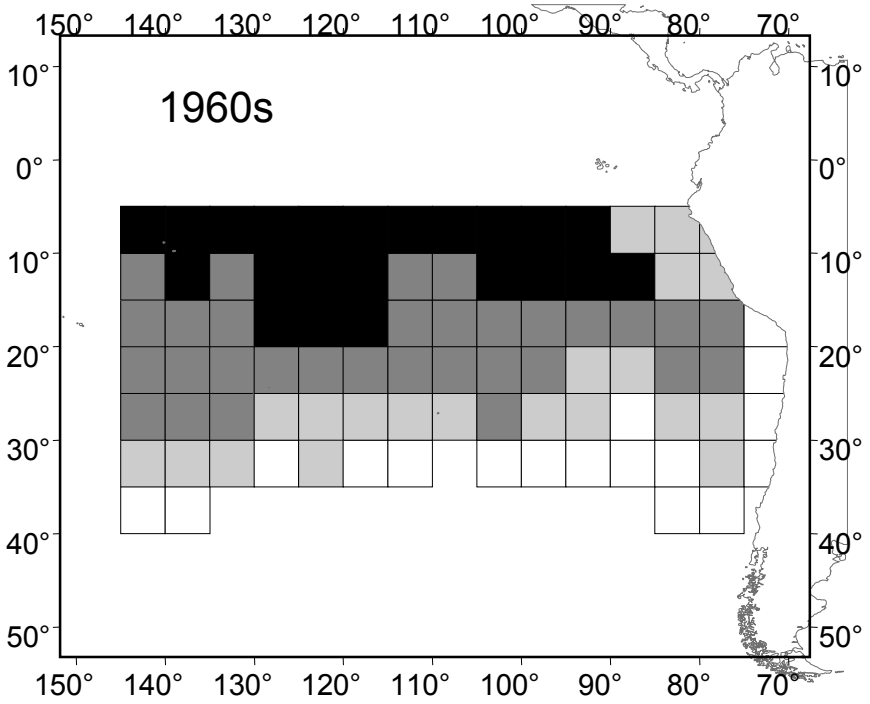
Region	NCPO	NEPO	SWPO	SEPO
NCPO	-	0.0027	0.0081	0.0205
NEPO	**0.00239 (0.00070)**	-	0.0056	0.0185
SWPO	**0.01111 (0.00180)**	0.46940 (0.01044)	-	0.0678
SEPO	**0.00000 (0.00000)**	**0.00204 (0.00086)**	**0.00000 (0.00000)**	-

DATA

- Stock structure
- Principal Fisheries capturing swordfish
  - Chile/Peru
    - artesanal (harpoon and gillnet): 1945 – present
    - longline: 1986 introduction in Chile
  - Japan (longline)
    - modeled with Japan are:
      CHN, ECU, KOR, PYF, TWN, URY, & VUT
  - Spain (longline)
    - Introduced to EPO in 1990
    - Target SWO: gear changing

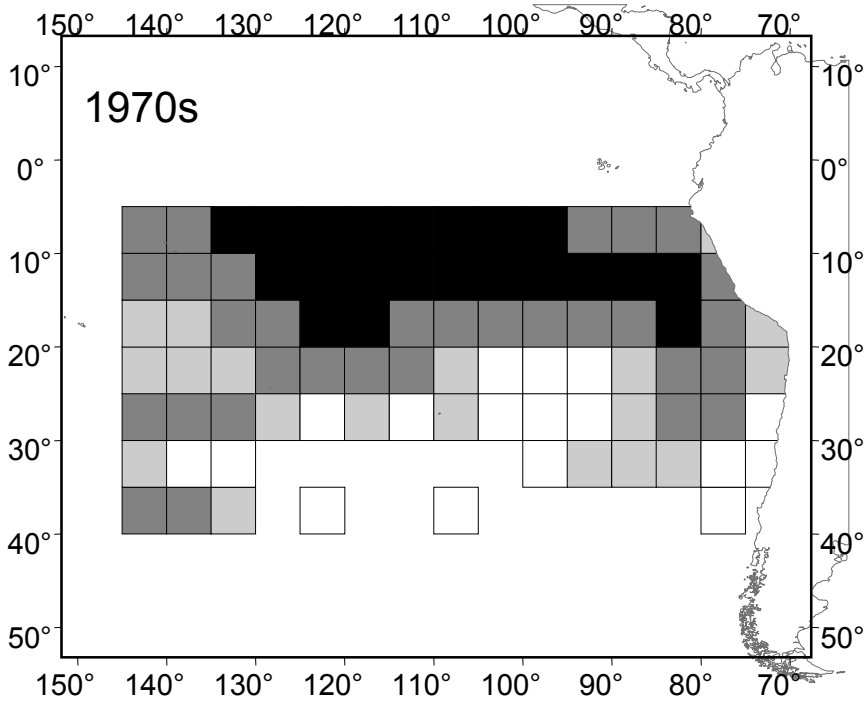
Effort Distributions Japan-like Fisheries

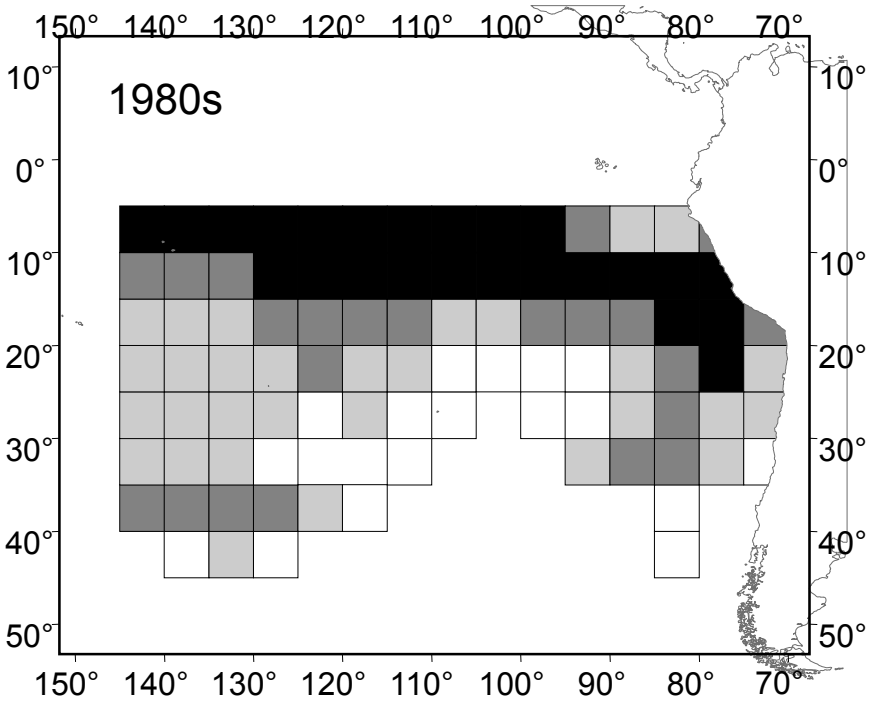




Total effort quartile levels: low – high

Effort Distributions Japan-like Fisheries





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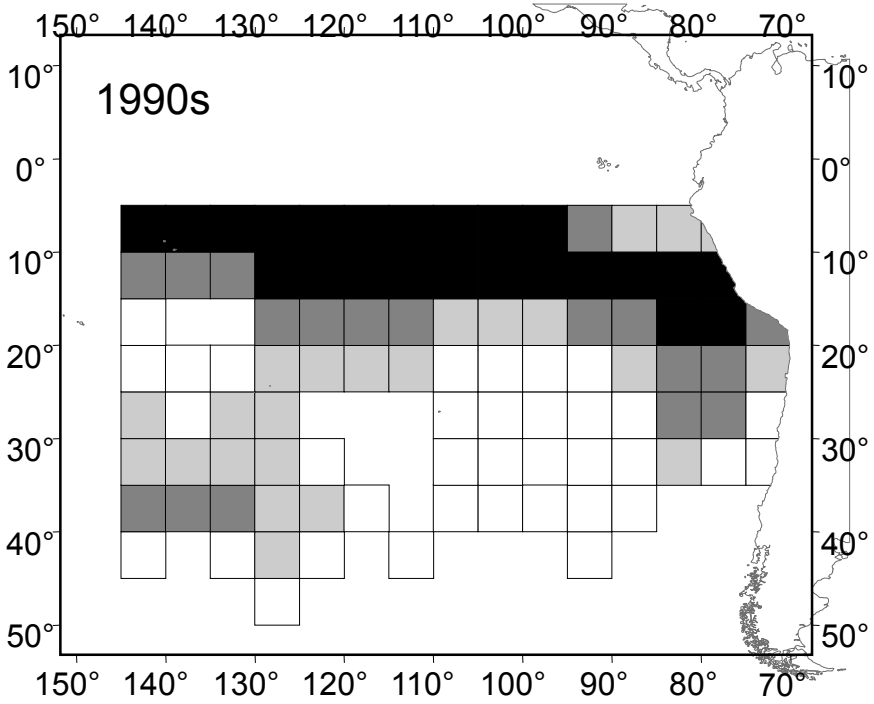
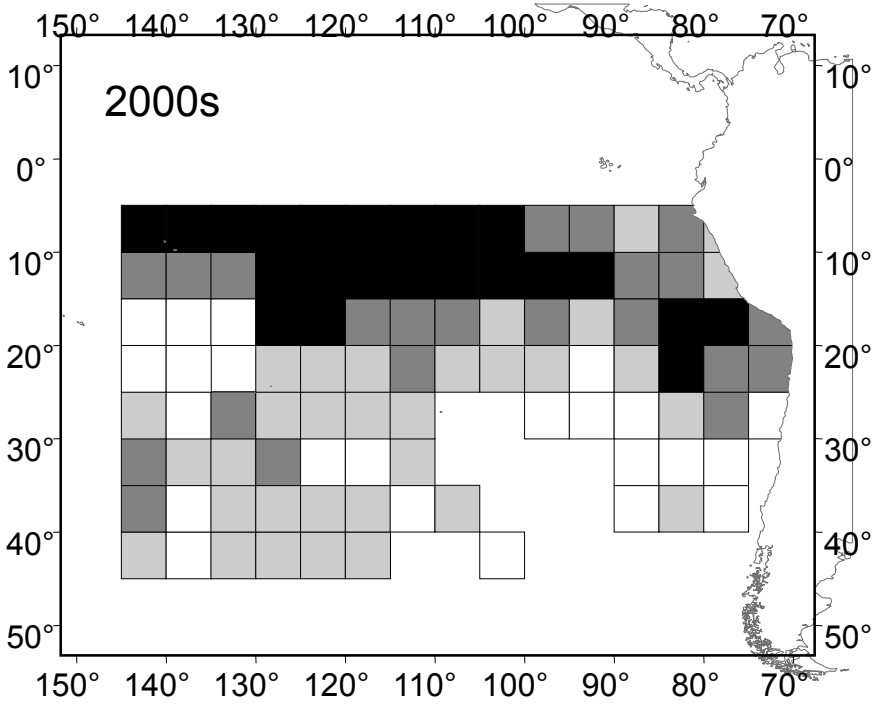
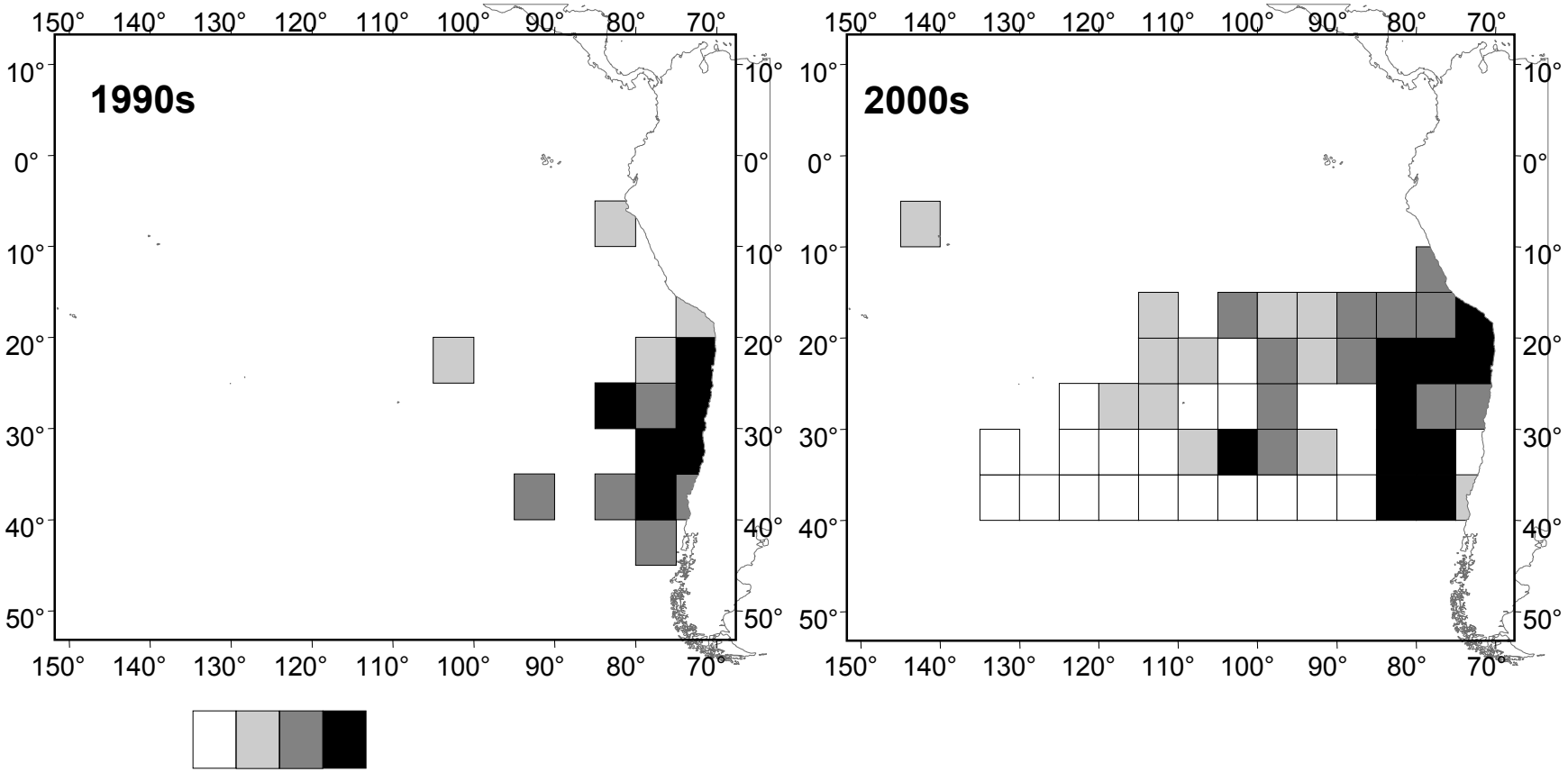
Effort Distributions Japan-like Fisheries





Total effort quartile levels: low – high

Effort Distributions Spanish Fisheries



Total effort quartile levels: low – high

Distribution of the Peruvian and Chilean Fisheries

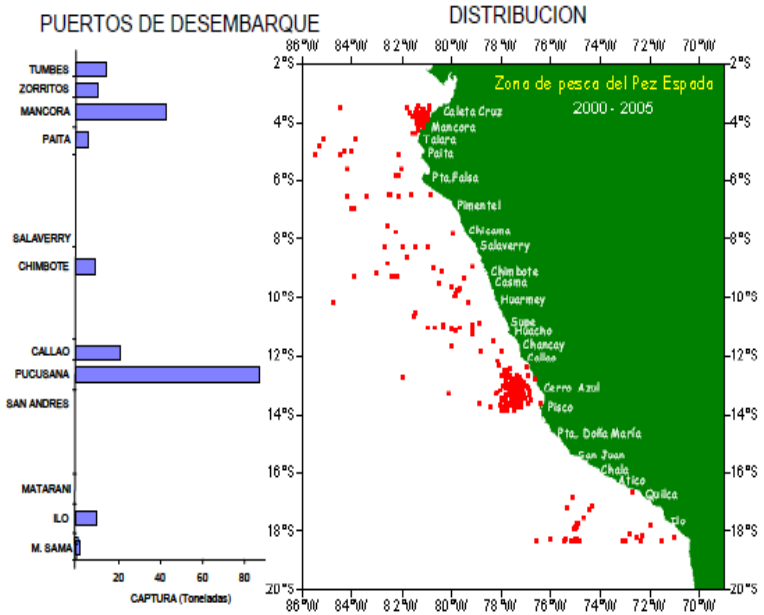


Figura 7. Principales áreas de pesca de Pez Espada (1996-Abril 2005)

Peru

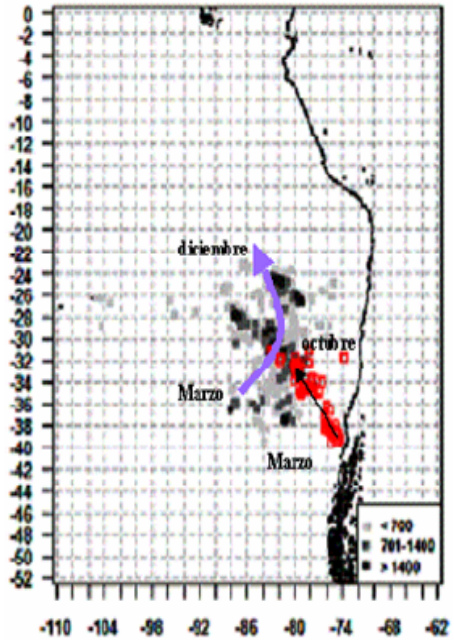


Figura 8. Distribución espacial migratoria mensual de la pesquería del Pez Espada, durante 2001 al 2004. La flecha azul indica desplazamientos de la flota industrial, y la flecha negra el desplazamiento de la flota artesanal.

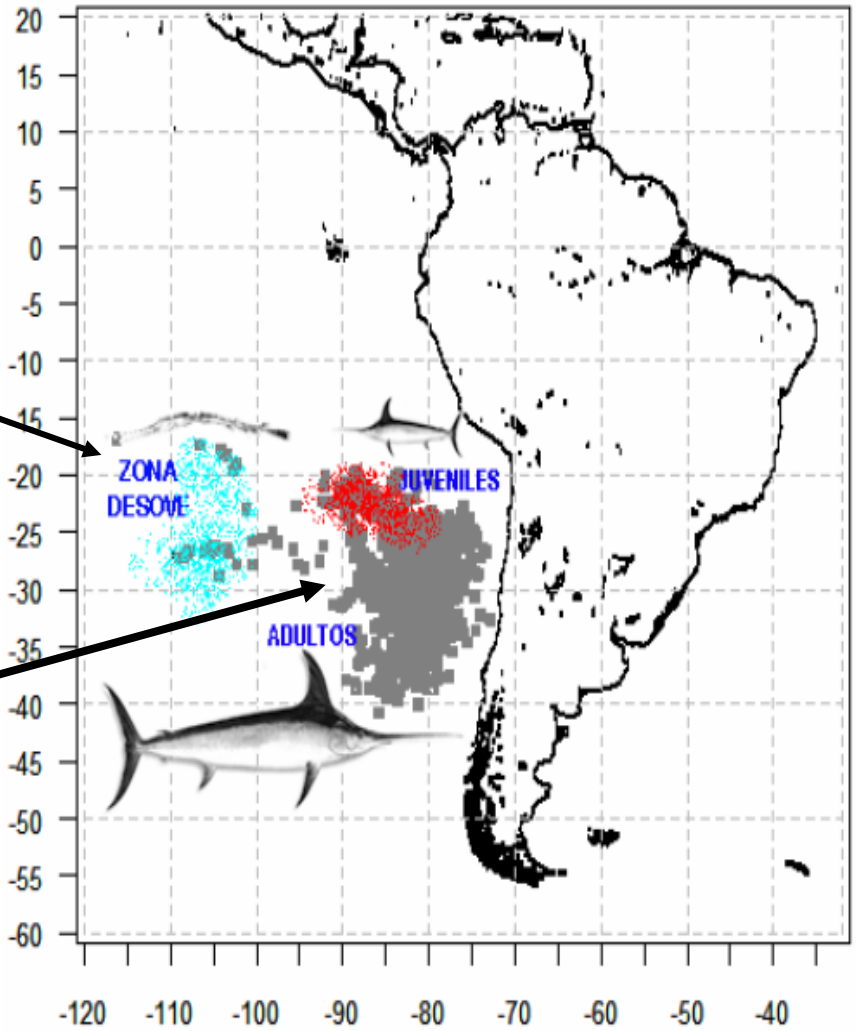
Chile

Anon. (2005)

Distribution of Swordfish in Region of Chile

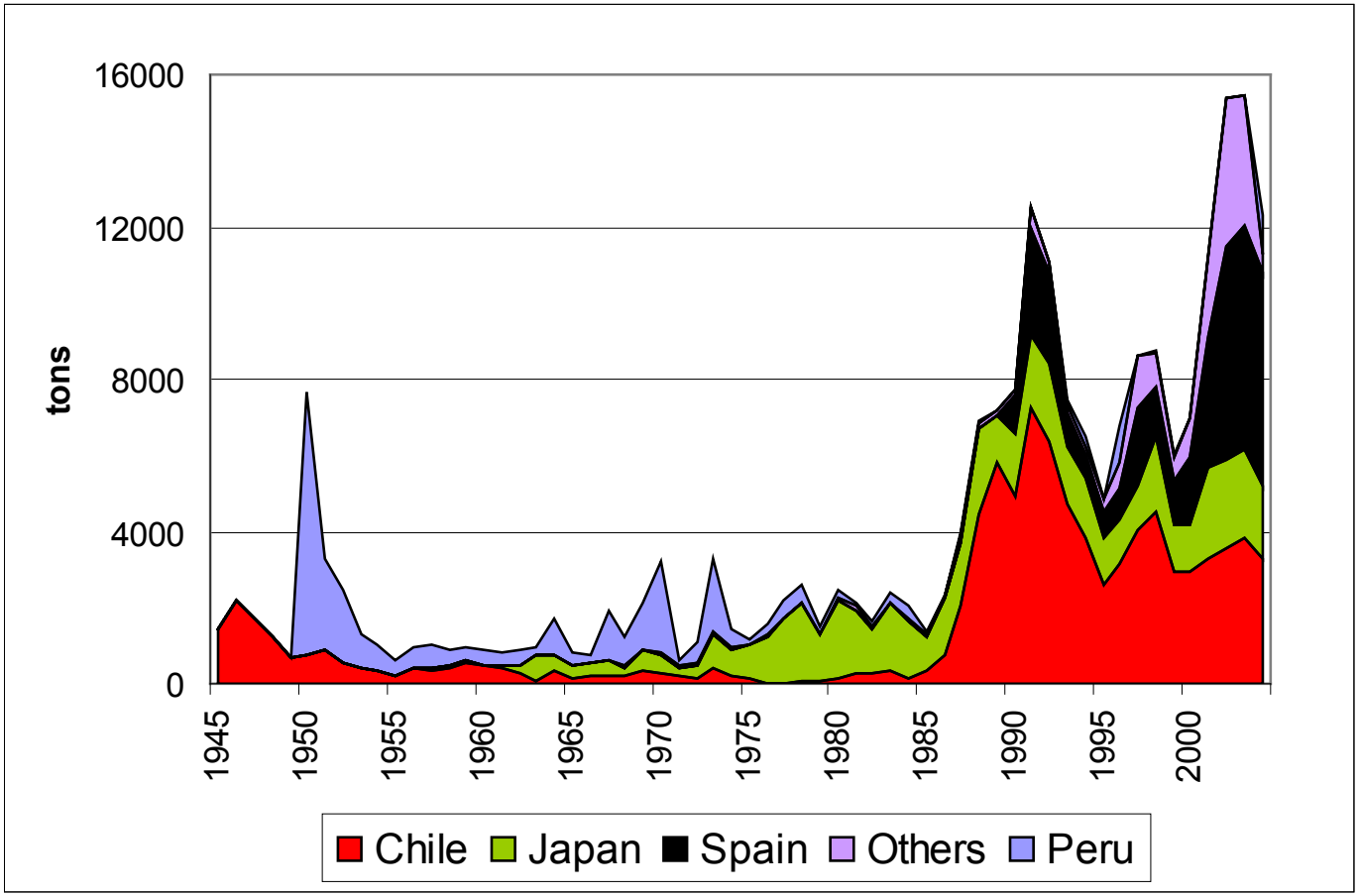
Females which have spawned

Fishing areas



Anon. (2005)

Trend in Total Catch SEPO SWO Stock



Assessment Model Structure

- Fisheries: 7
  - Identifiers: Gear, Flag and/or Spatial Distribution
  - Little change in age-specific selectivity
  - Area: Previous standardizations (GLM) offshore/coastal significant

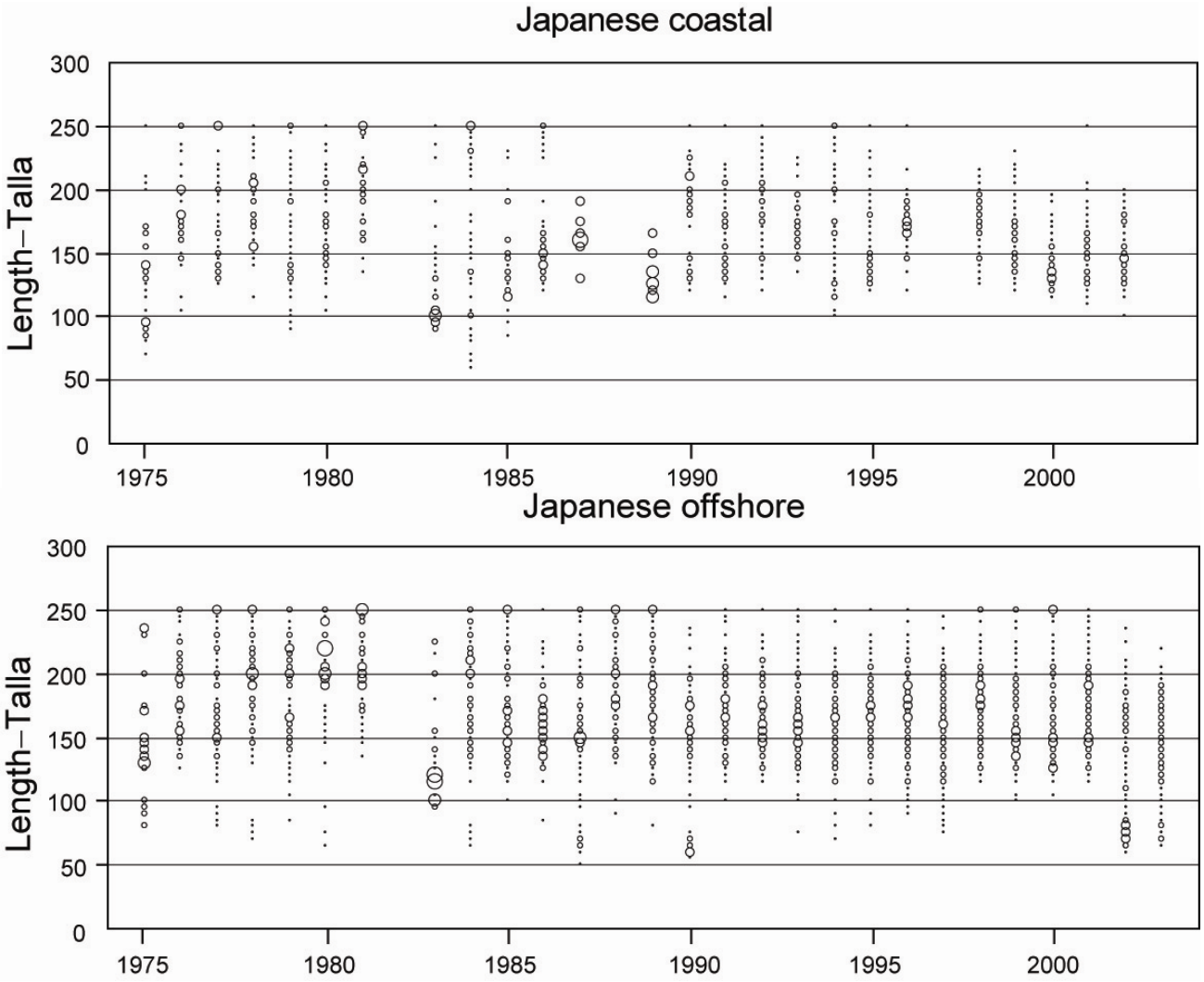
Fishery	Fishery name	Description
1	JPN coastal	Japanese longline in area 4 (east of 90□W) (pre-1999 only for scenario B)
2	JPN offshore	Japanese longline in area 5 (west of 90□W)
3	SPN early	Spanish longline before 2001
4	SPN late	Spanish longline 2001 and later
5	Chilean artesanal	Artesanal fishery catch from Chile, Peru, and other costal nations
6	Chilean industrial	Chilean industrial longline
7 (scenario B only)	JPN coastal	Japanese longline in area 4, 1999 and later

Input CPUEs

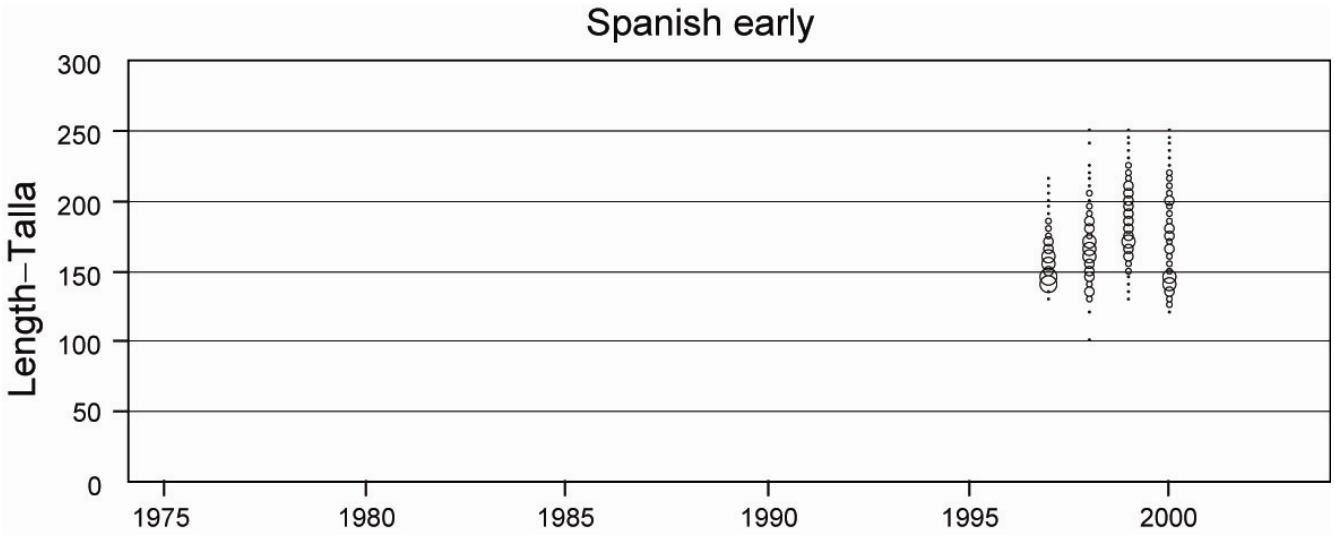
- Japan: NRIFSF, Nominal 5x5 by month, fish/hook
  - starts in 1955 in offshore area
  - reaches coastal area in about 1967
- Spain: EU(IEO), Nominal 5x5 by month, fish/hook
  - starts in 1991 in the coastal area
  - is treated with two time periods, early (pre-2001) and late
- Chile: (a) Yáñez et al (2003); (b) Barría (2003)
  - Nominal artesanal: (a) 1987-1999
  - Nominal longline: (a) 1994-1999; (b) 2001-2002
  - Others available were identified, compared, and included in various other runs with results consistent with those presented here

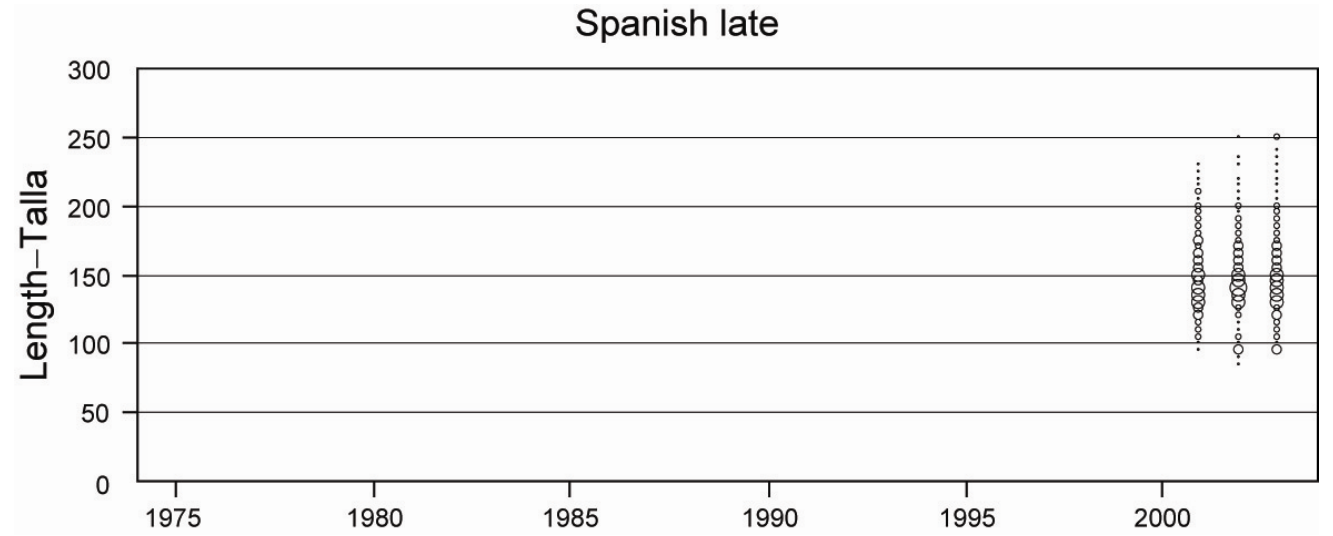
Size Composition

- Model run in LJFL



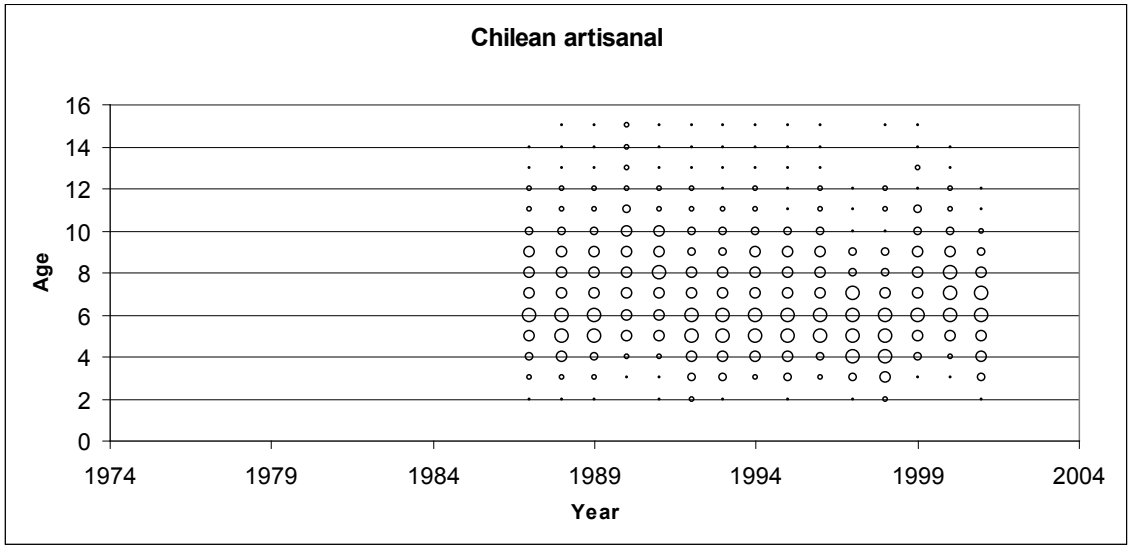
Size Composition

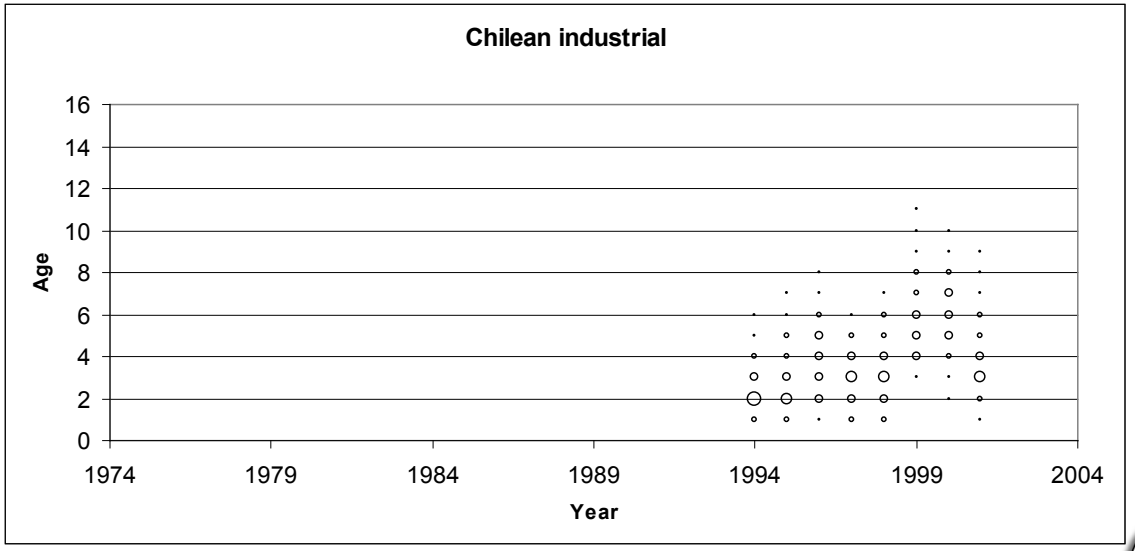




Age Composition

Age frequency decomposition from combined AF data for 1987-1997 was done using fisheries specific LF data and a combined sex AF distribution developed from sex specific growth models (Montiel 1996) for Chilean swordfish.

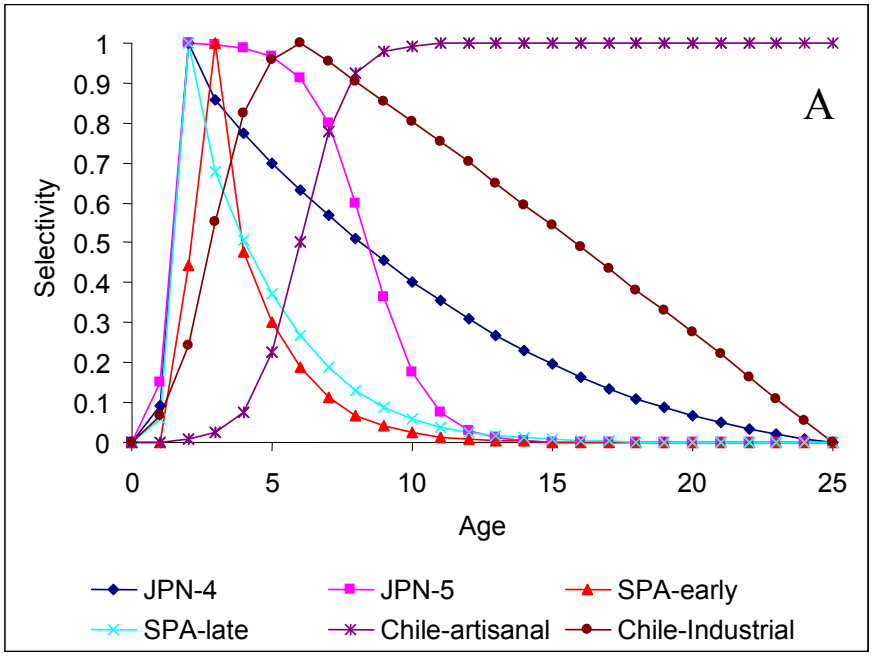


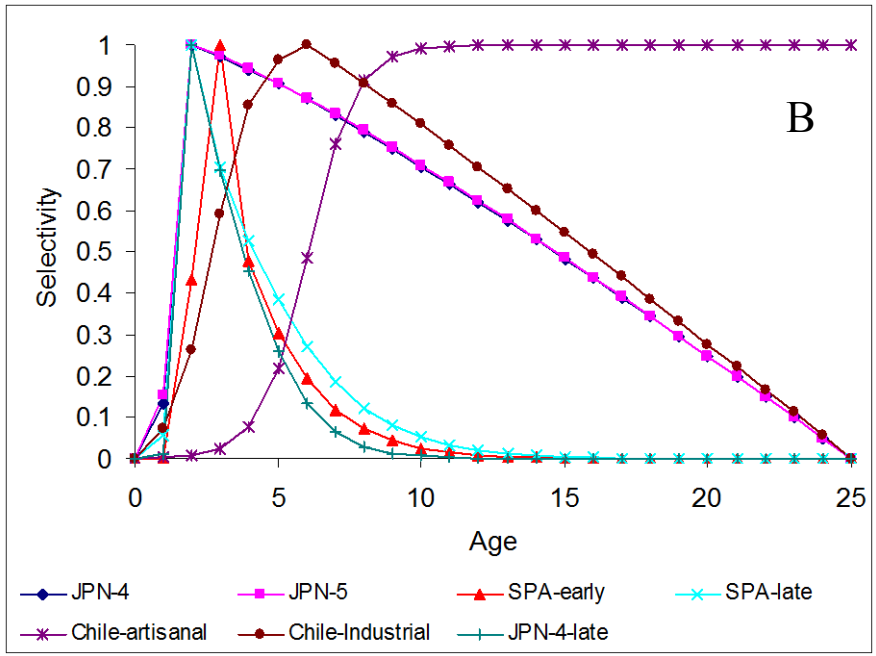


Other Model Parameters/Assumptions

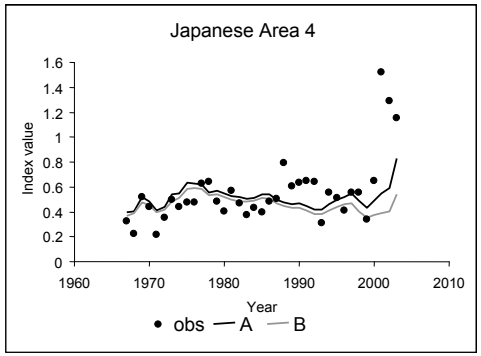
- Growth: sex-specific (Montiel 1996)
  - CV of length at age assumed 0.075
  - Common length-weight relationship used (max age 15+)
- Recruitment & Reproduction
  - Age of first maturity: estimated 4-6 yr
    - 50% maturity set at 5 yr in model
  - BH model with steepness = 0.75 assumed
  - annual recruitment devs: distributed log-normal, sd = 0.6
- M estimated range 0.2 – 0.5: assumed 0.4
- Population ~ equilibrium exploitation in 1945 (Weidner & Serrano)
- Catch for Chilean & Spain in weight, others in numbers
- Age selectivity for Chilean artesanal fishery asymptotic, others dome-shaped: these based on observations of sizes of catch
- Abundance indices were all given same s.d. of likelihood

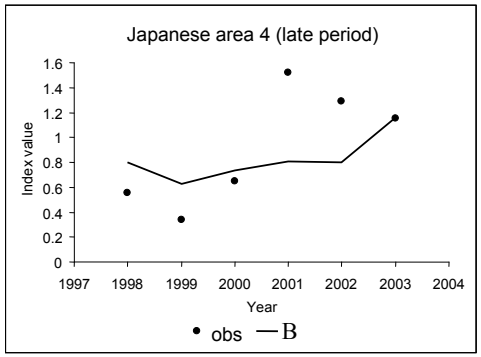
Gear Selectivities in Model

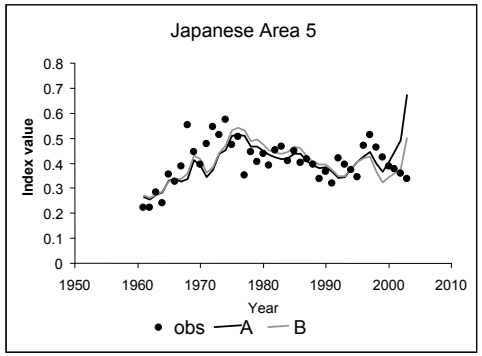


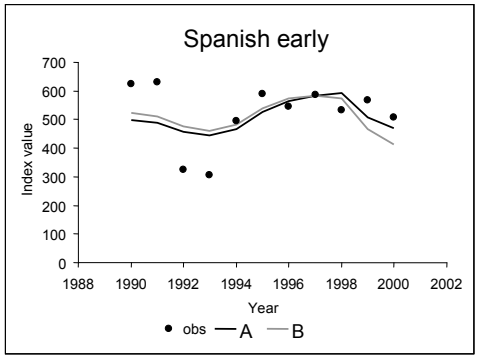


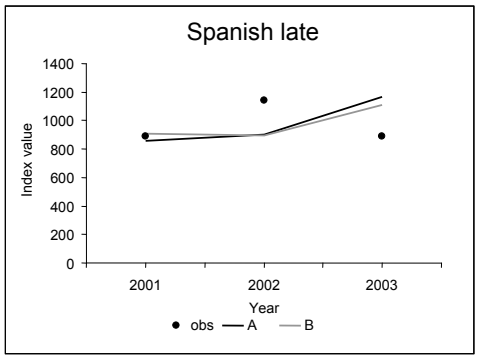
Observed CPUE and Model Fits

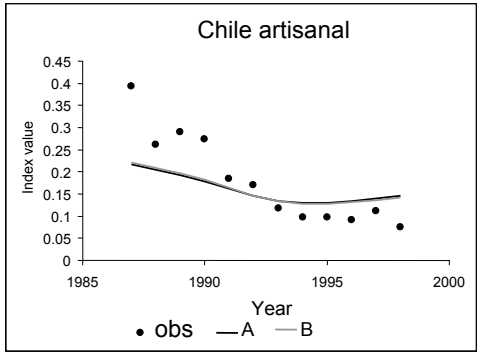


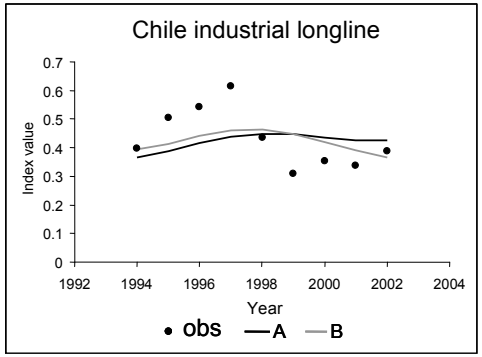




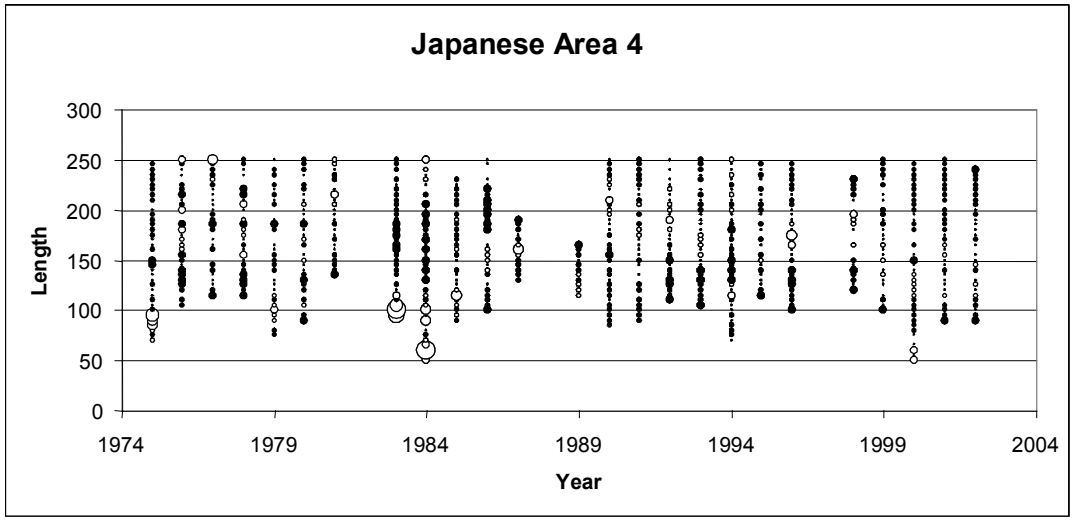


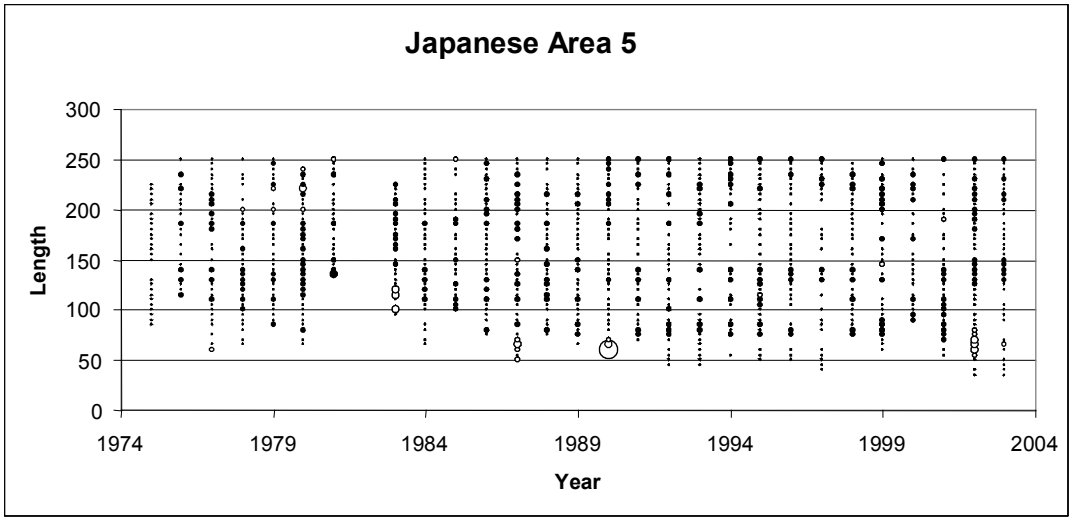




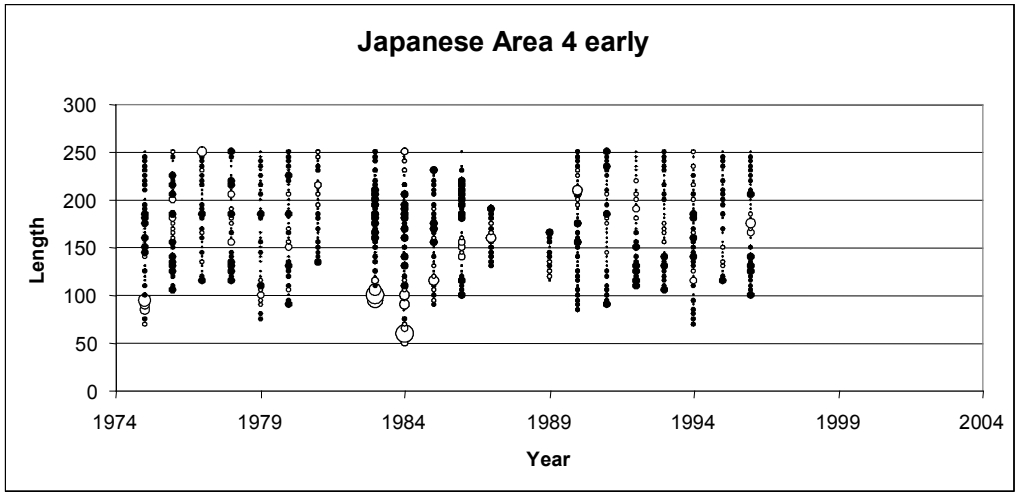


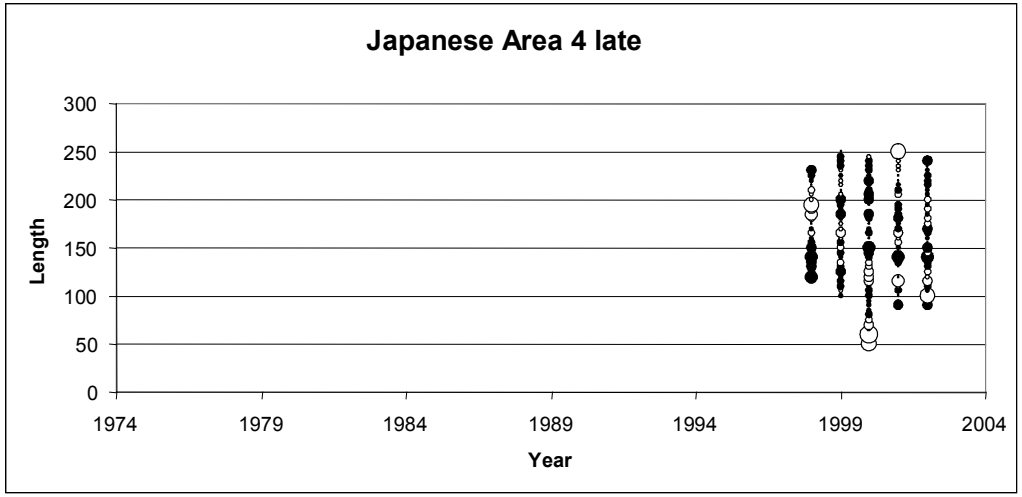
Residuals for fits to LF Data (Scenario A)



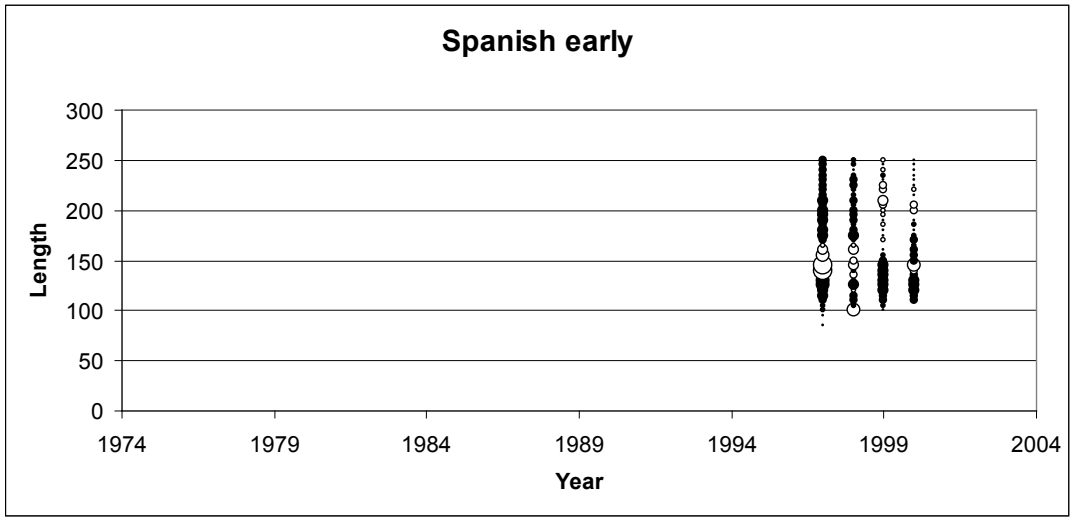


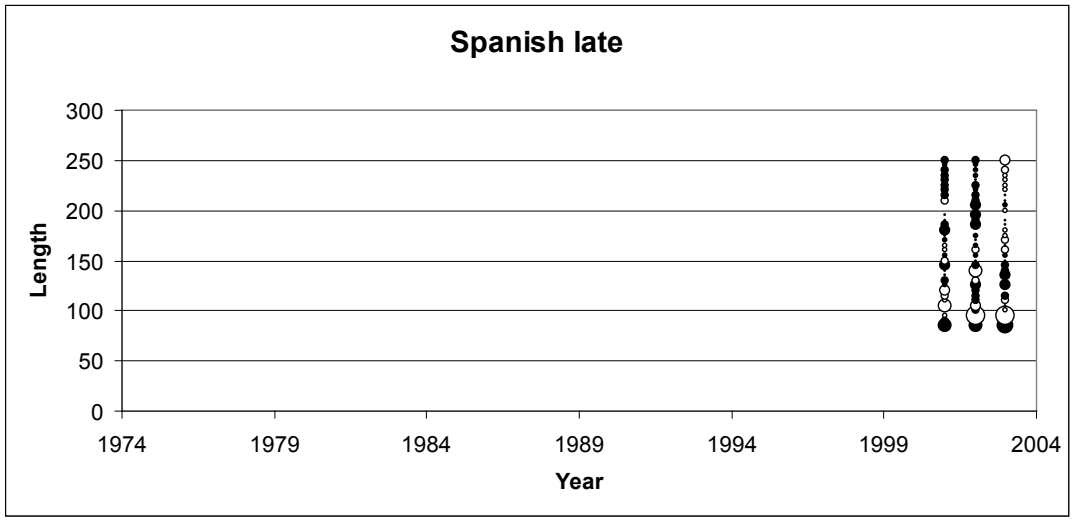
Residuals for fits to LF data (Scenario B)



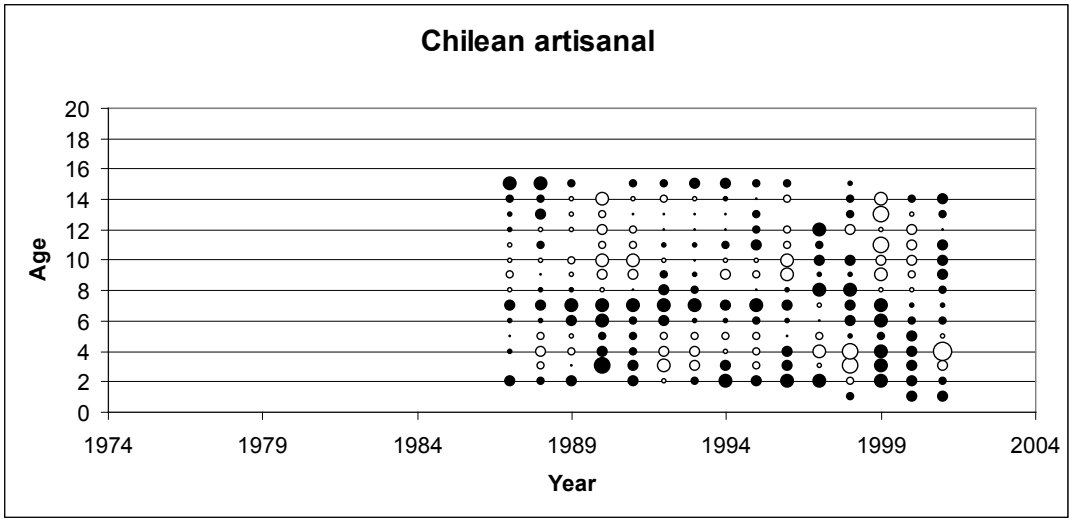


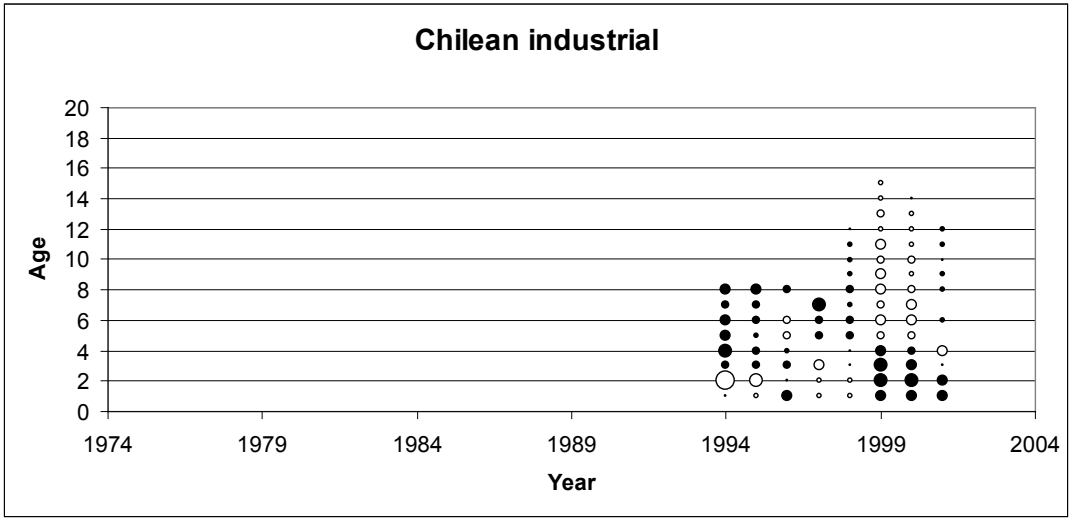
Residuals to fits to LF data



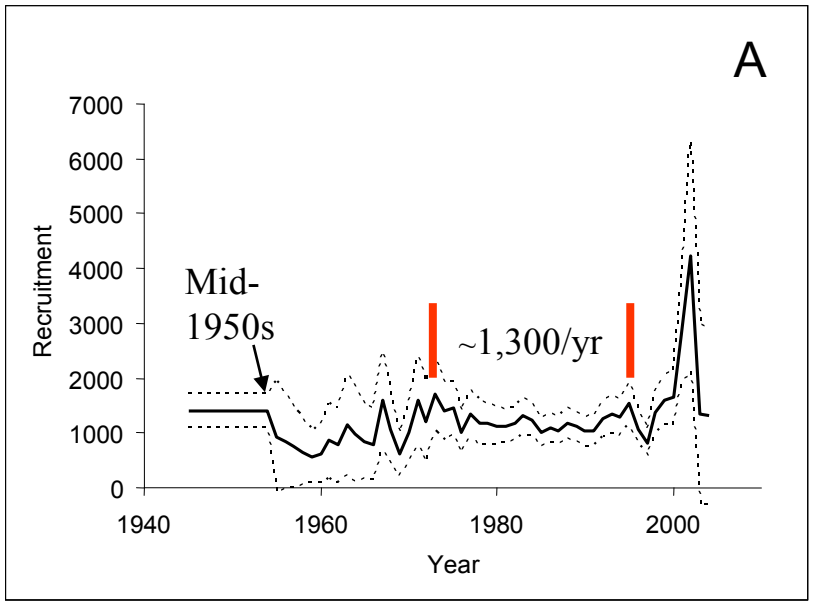


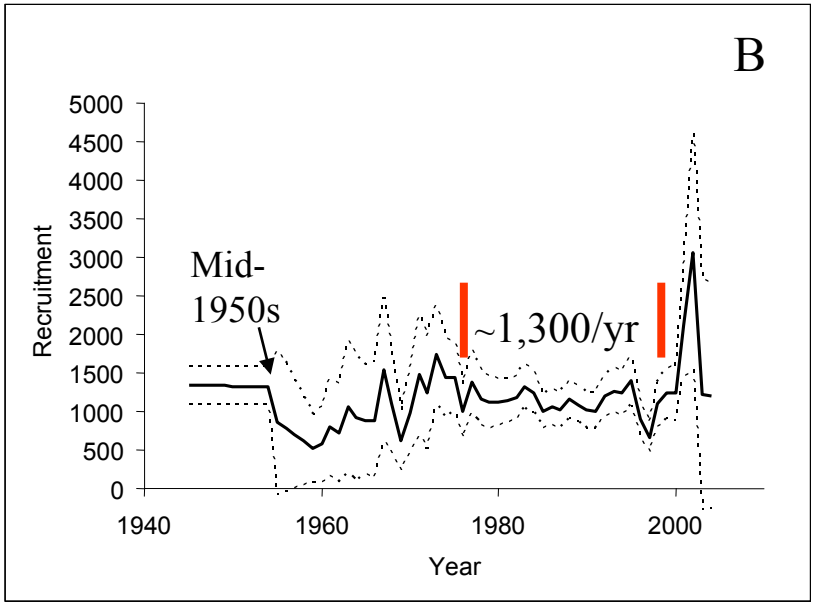
Residuals to fits to AF data



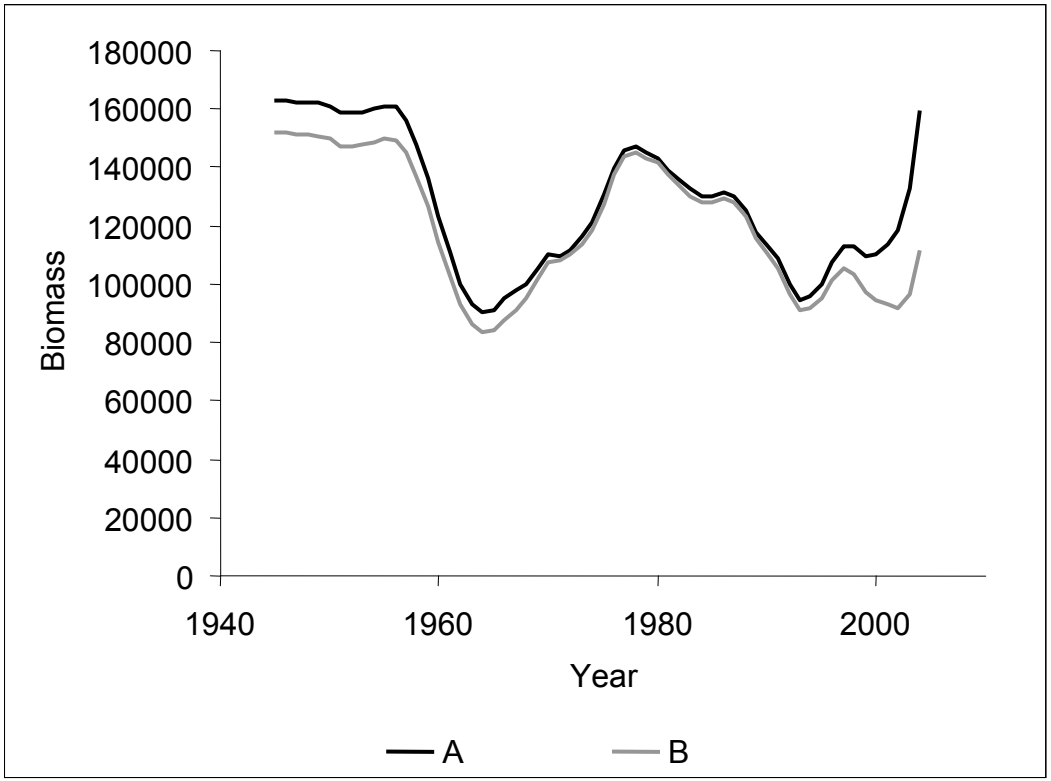


Estimated recruitment for Scenarios A & B

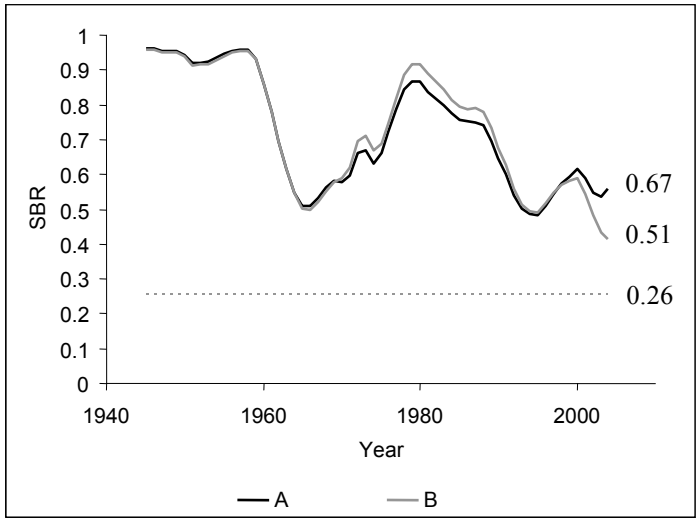




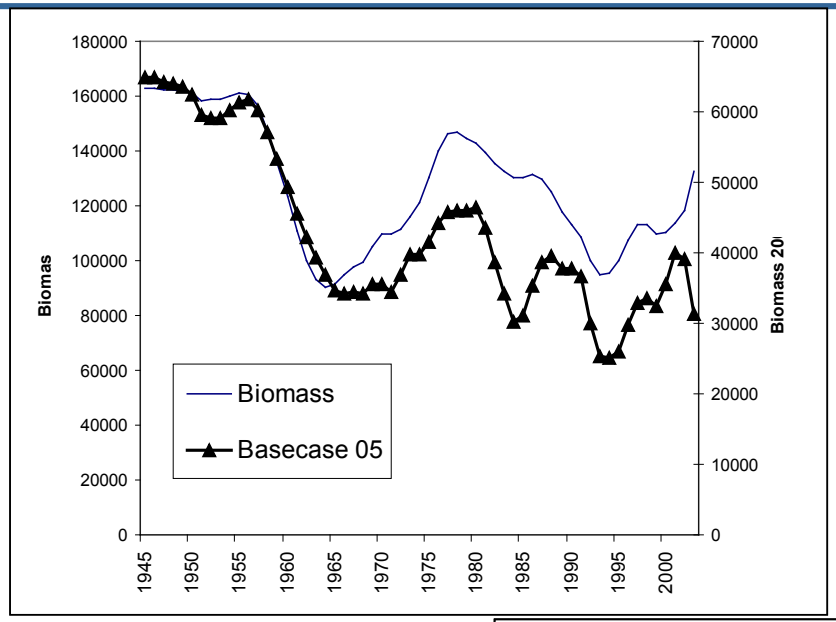
Vulnerable Biomass

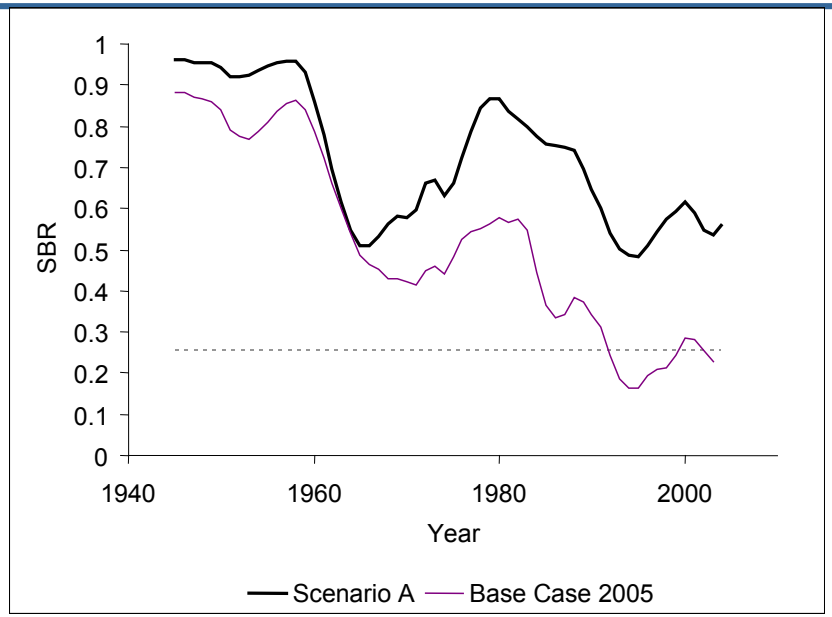


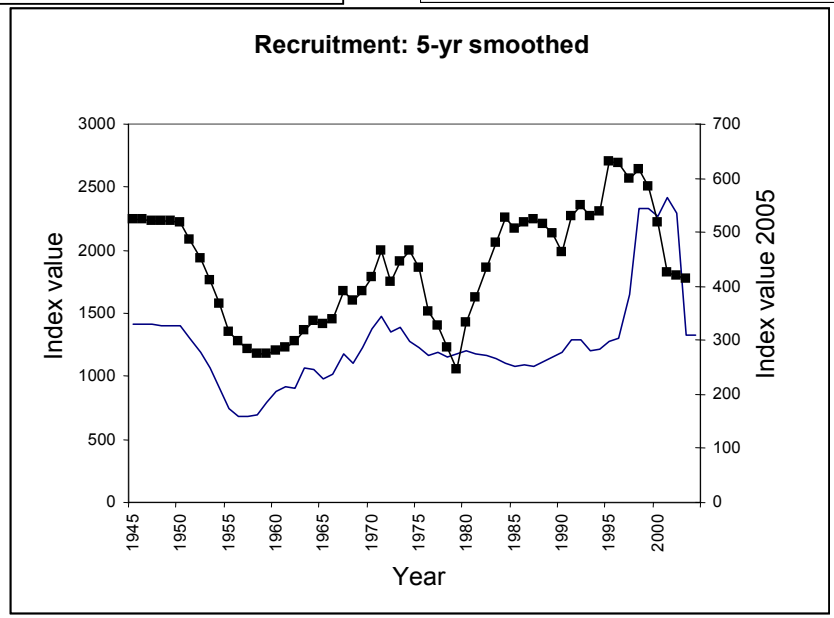
SB for and SBR for Scenarios A & B



Comparisons to H & M (2005)







Assessment Results

- From Spawning Biomass
  - SBR ~ 0.51 (Scenario B) to 0.67 (Scenario A)
  - SBR at AMSY ~ 0.26 under both Scenarios

- From AMSY
  - AMSY ~ 13,000 to 14,000 t under both Scenarios
  - SBR at AMSY ~ 0.26 under both Scenarios
  - Current SBR ~ 0.41 (Scenario B) to 0.56 (Scenario A)
- Current trends & issues
  - Average annual catch: 12,000 – 13,000 t
  - Increased targeting of SWO in SEPO
  - Lack of detailed data on fisheries and cooperation from parties/cooperating non-parties, and Chile

Recommendations

- Conduct Yield-per-recruit analysis to explore status of stock
- Obtain detailed information from all parties to IATTC for development in models
- Conduct comprehensive standardization of CPUE for data series used in model
- Recognizing access to data from Chile is problematic: seek these data via all identified means
- Closely monitor fisheries for change

- Given status of fisheries, assessment, and trends in SB & SBR: update assessment in 2007