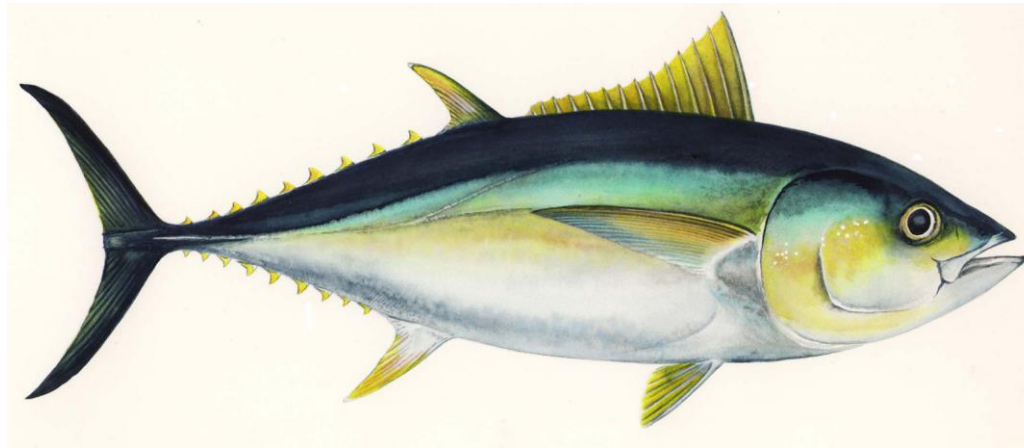


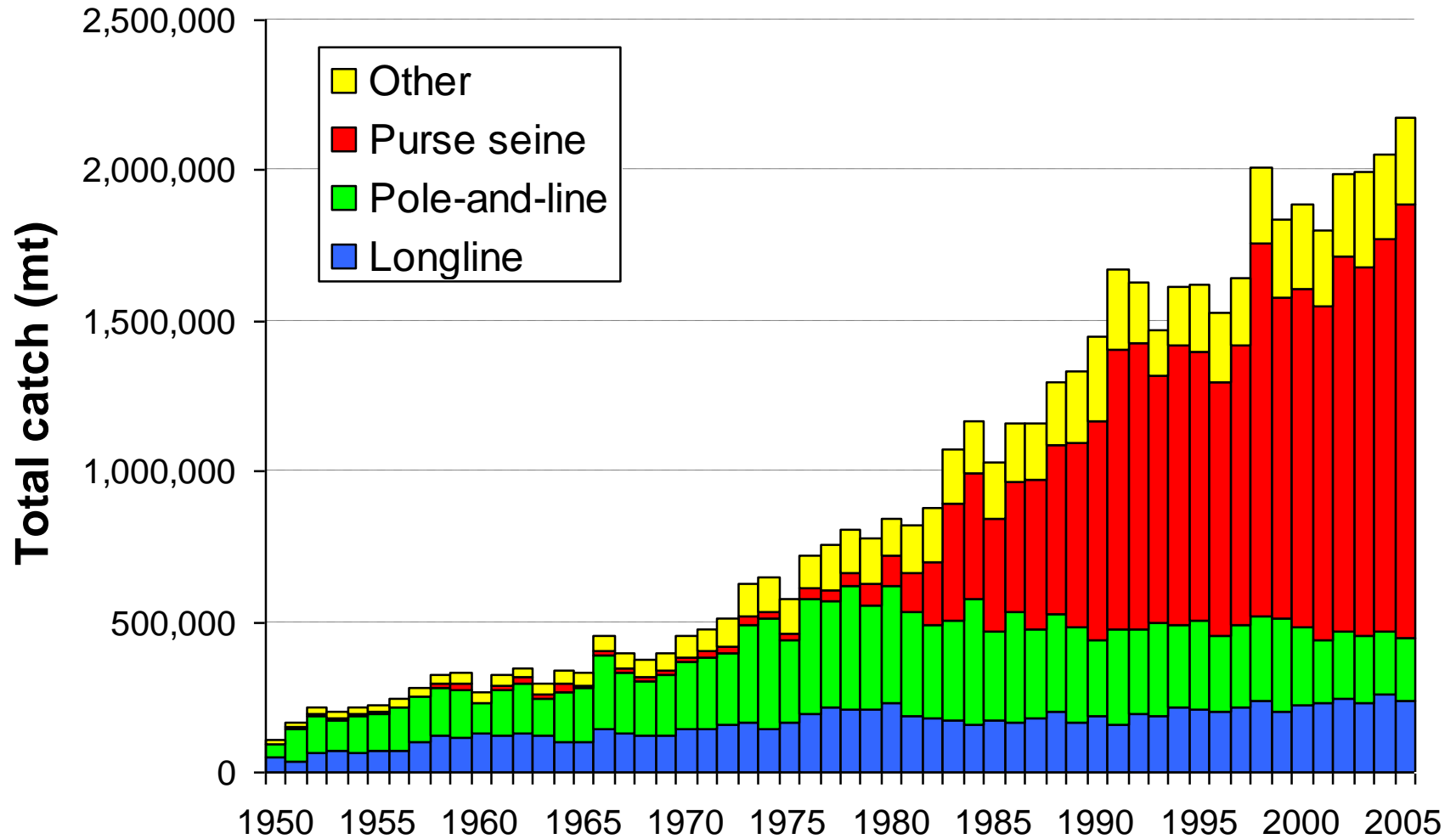
Tuna Stock Assessment Modeling in the Western and Central Pacific Ocean



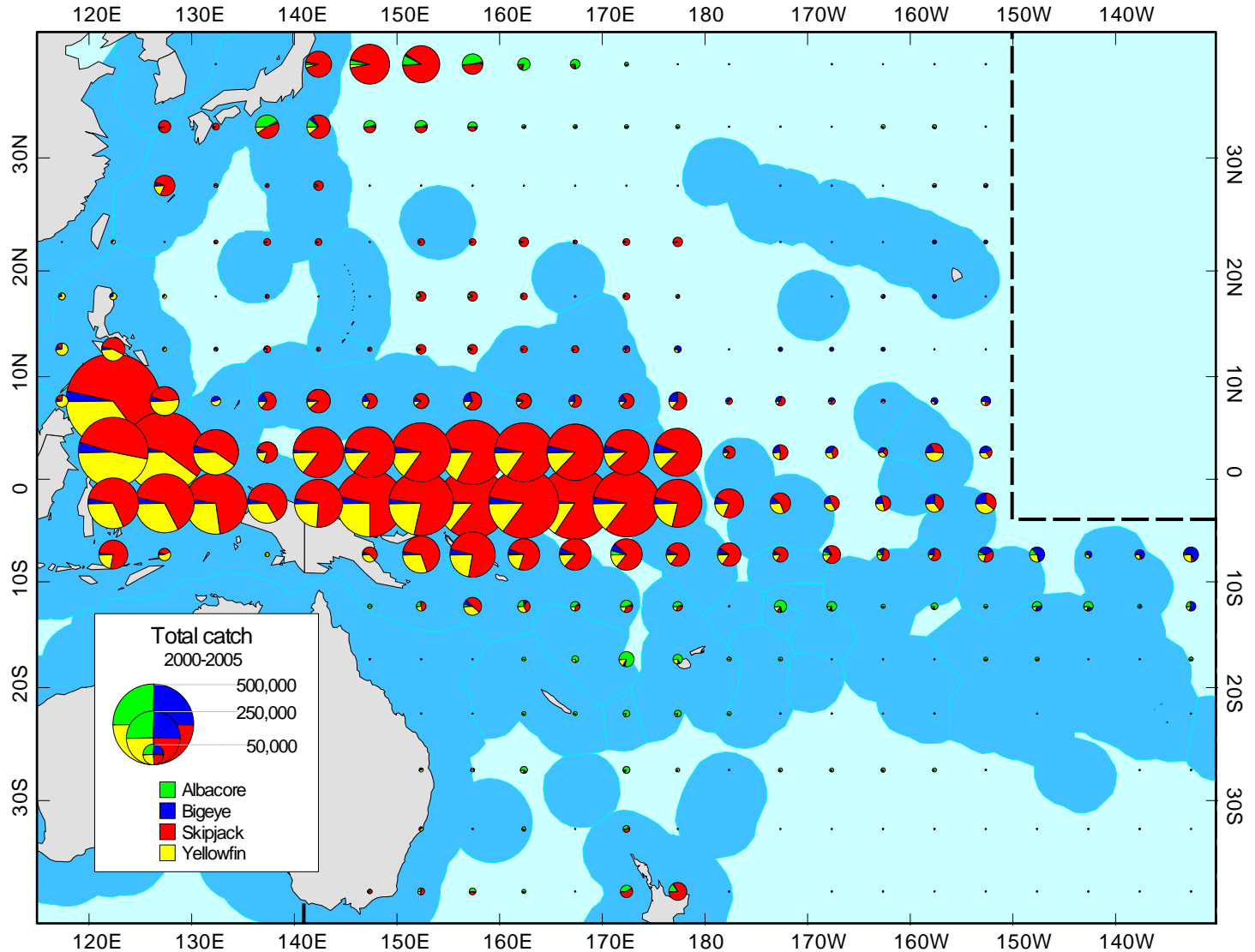
John Hampton

Oceanic Fisheries Programme
Secretariat of the Pacific Community

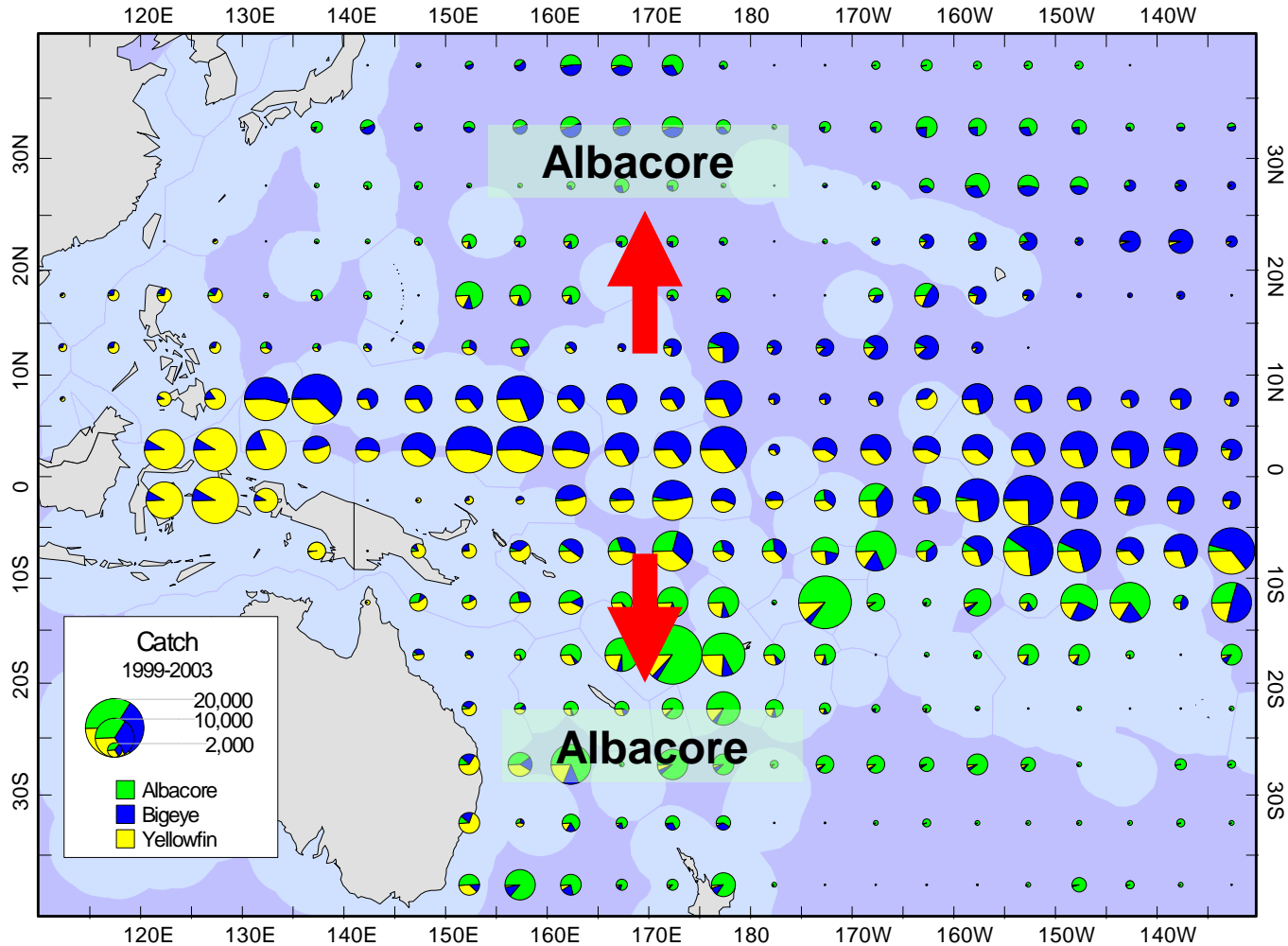
Western & Central Pacific Tuna Fishery



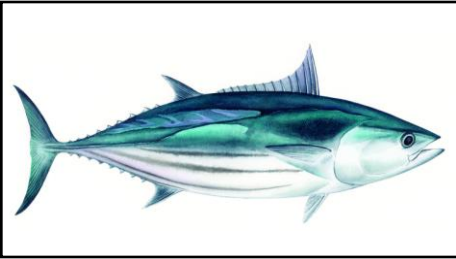
Fishery Distribution



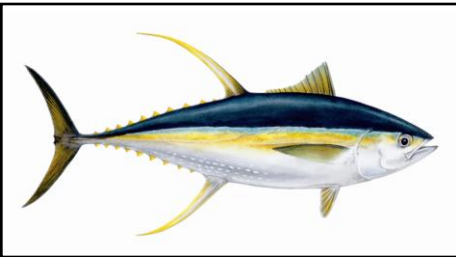
Longline Fishery



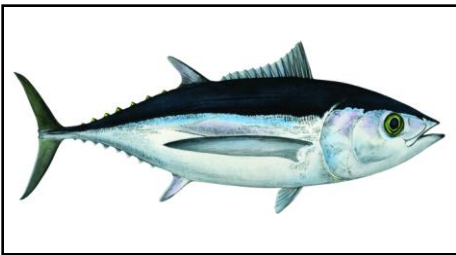
Stock Status Summary



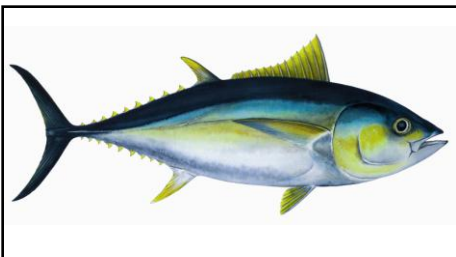
Skipjack: short lived (2-3 years), fast growth, very productive, high resilience to fishing. **No overfishing.**



Yellowfin: longer lived (5-6 years), fast growth, moderately productive, moderate resilience to fishing. **Overfishing.**



Albacore: long lived (10+ years), slow growth, moderately productive, moderate resilience to fishing. **No overfishing.**



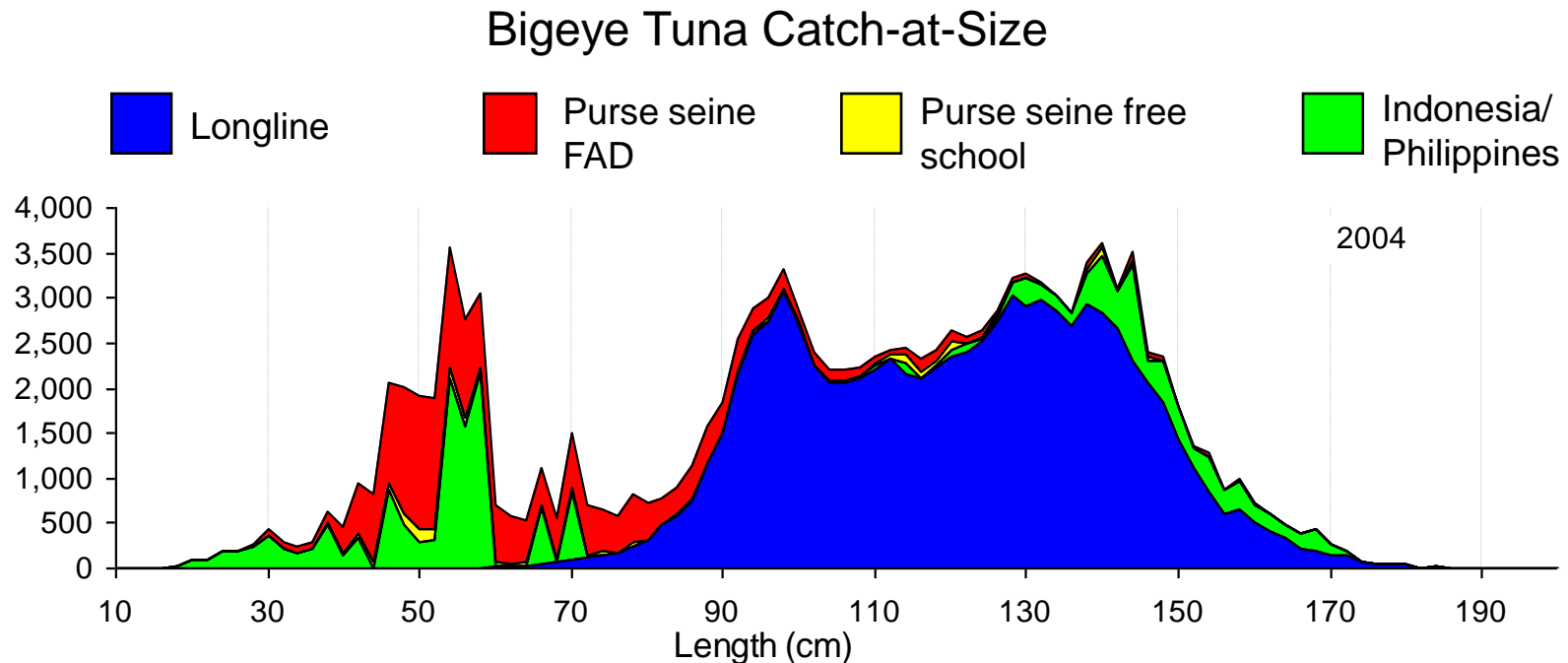
Bigeye: long lived (12+ years), moderate growth, lower productivity, lower resilience to fishing. **Overfishing.**

Stock Assessment Objectives

- Estimate population characteristics (biomass, recruitment) over the history of significant exploitation
- Discriminate effects of fishing from “natural” variation
- Use the model results to determine stock status, consistent with management objectives
- Provide a basis for evaluating management actions
- Model must be consistent with fisheries data and understanding of biological characteristics of stocks

Key Model Requirements (1)

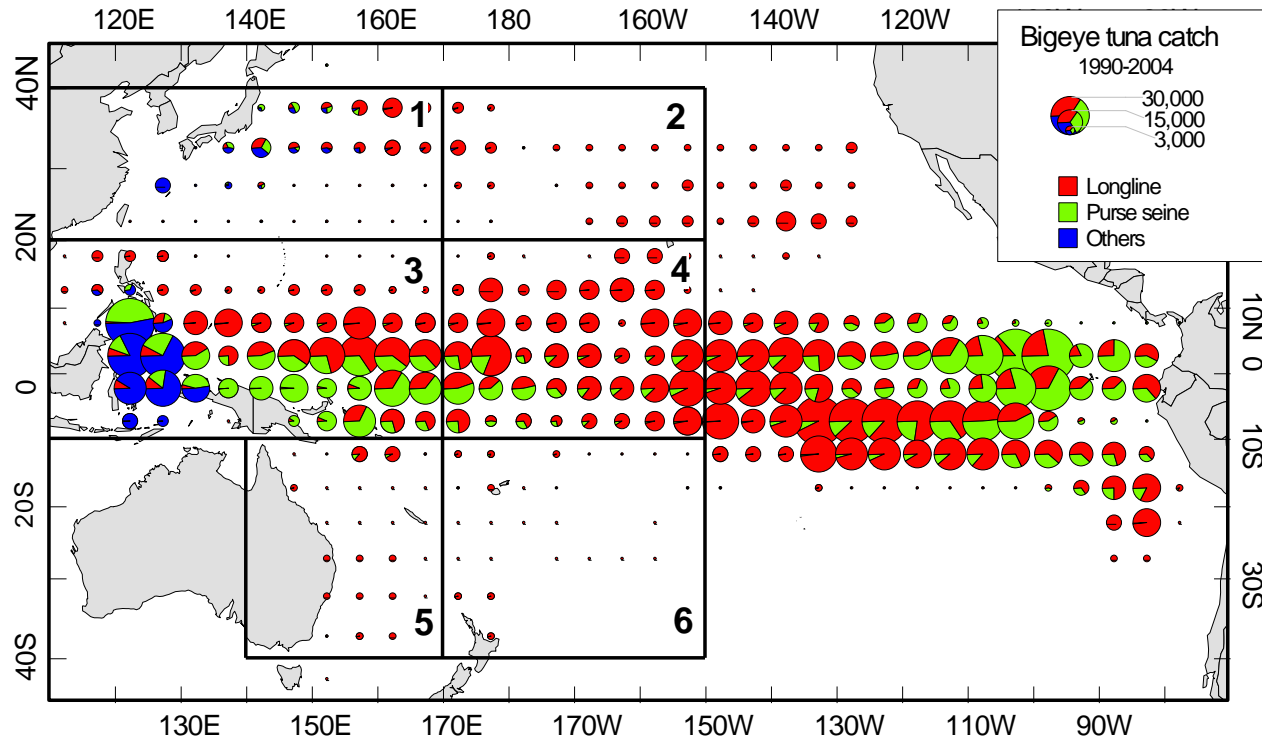
- Must accommodate multiple fisheries targeting different size/age groups



→ Size- and/or age-structured model

Key Model Requirements (2)

- Must accommodate spatial heterogeneity



→ Spatially structured model

Key Model Requirements (3)

- Must accommodate heterogeneous, possibly incomplete catch, effort, size data of inconsistent quality
 - Statistically fitted model in which likelihood components are weighted to reflect data “informativeness”
 - Model that is robust to “bad” data

www.multifan-cl.org

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A length-based, age and spatially-structured model for fisheries stock assessment

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What is MULTIFAN-CL?

MULTIFAN-CL is a computer program that implements a statistical, length-based, age-structured model for use in fisheries stock assessment. The model is a convergence of two previous approaches. The original MULTIFAN model (Fournier et al. 1990) provided a method of analysing time series of length-frequency data using statistical theory to provide estimates of von Bertalanffy growth parameters and the proportions-at-age in the length-frequency data. The model and associated software were developed as an analytical tool for fisheries in which large-scale age sampling of catches was infeasible or not cost effective, but where length-frequency sampling data were available. MULTIFAN provided a statistically-based, robust method of length-frequency analysis that was an alternative to several ad hoc methods being promoted in the 1980s. [more](#)

Done Internet

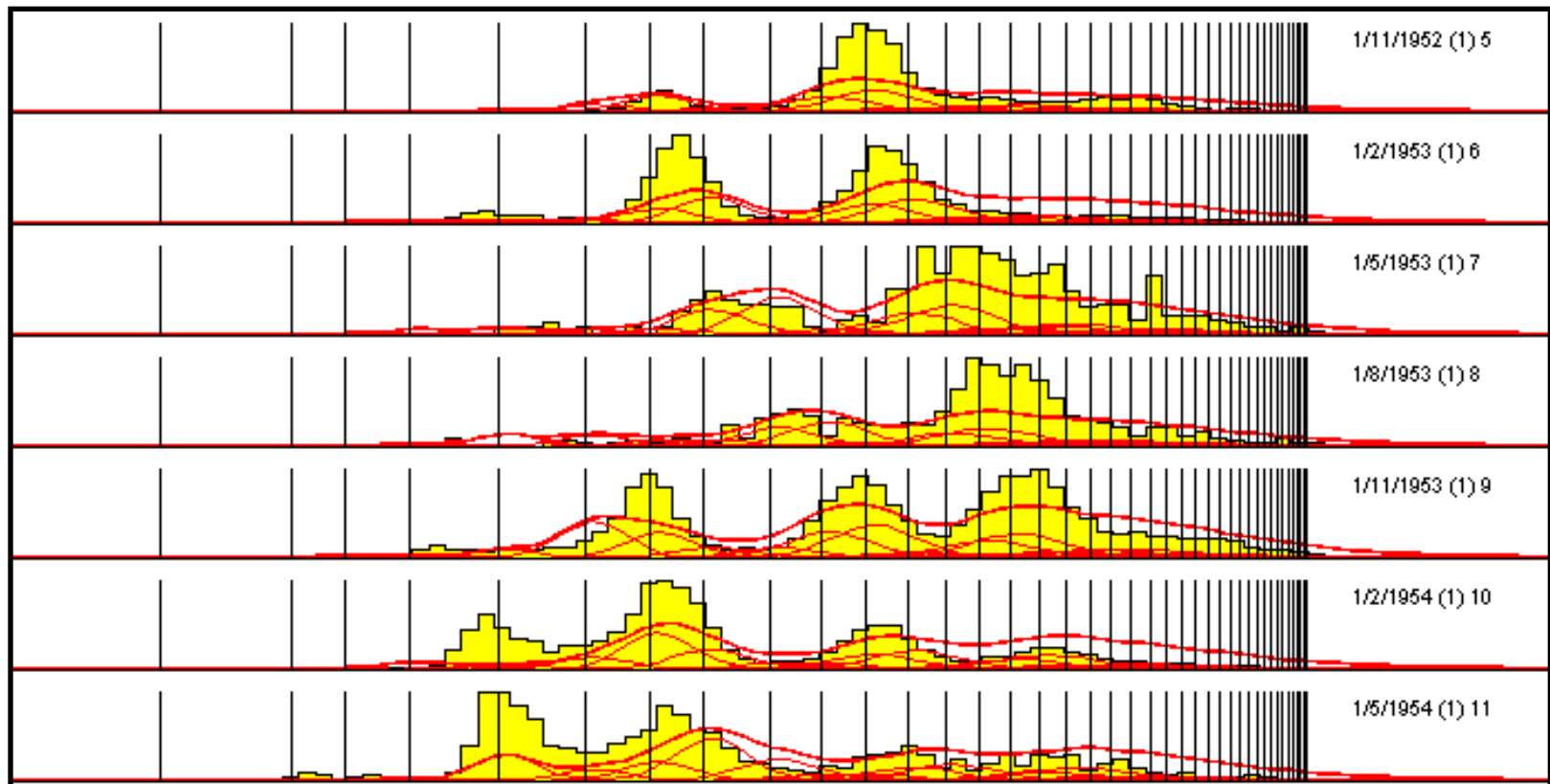
Start Microsoft Power... Local Disk (C:) 23:59:29 - inter... MULTIFAN-CL ... 6:46 PM

Data Requirements

- Catch (number of fish, weight)
- Effort – standardised (LL), nominal
- Length frequency
- Weight frequency (whole weights)
- Tag releases and recoveries
- Auxiliary information used to formulate priors, e.g. estimates of tag reporting rates.

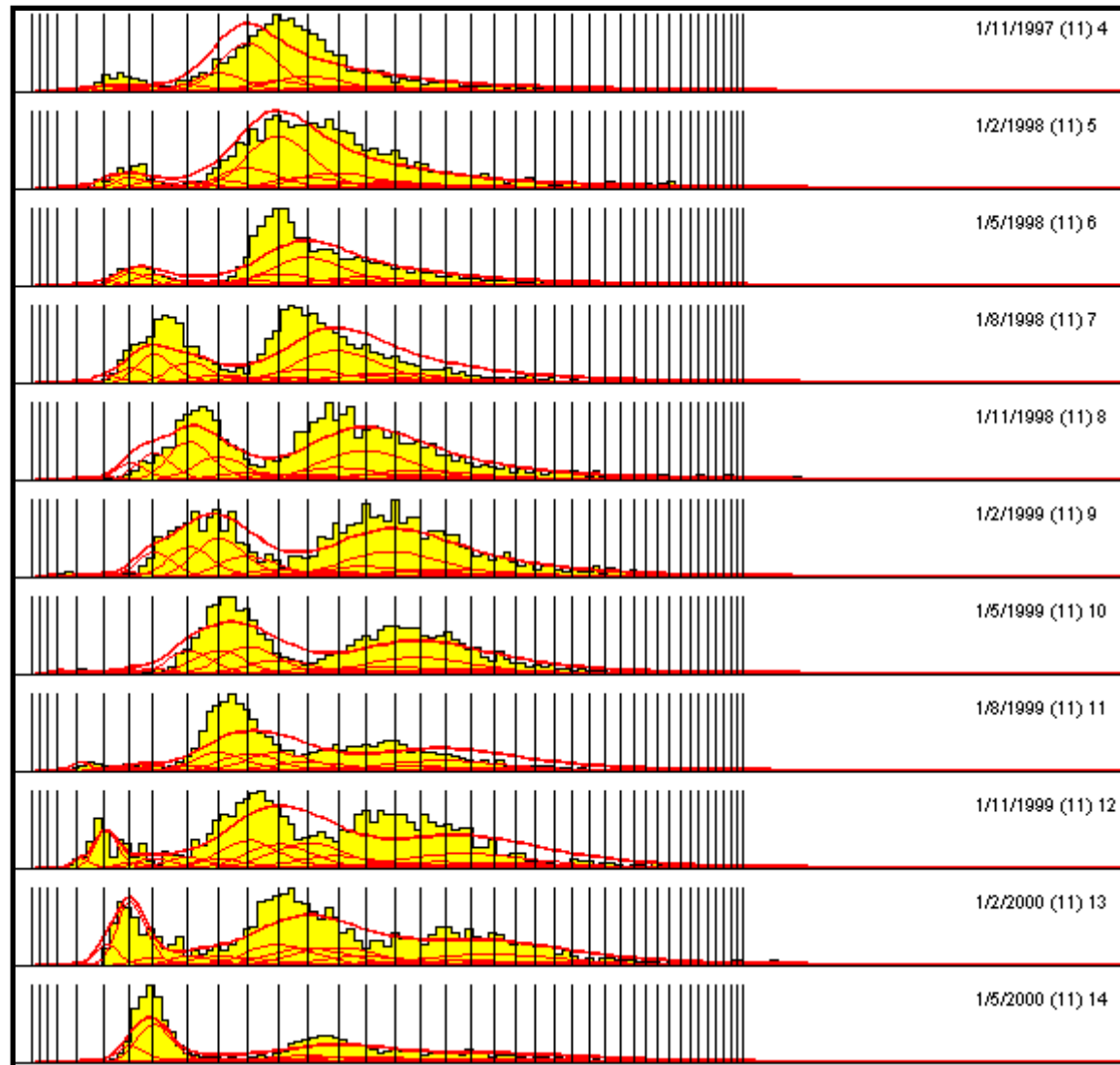
Informative Size Data

Length-frequency

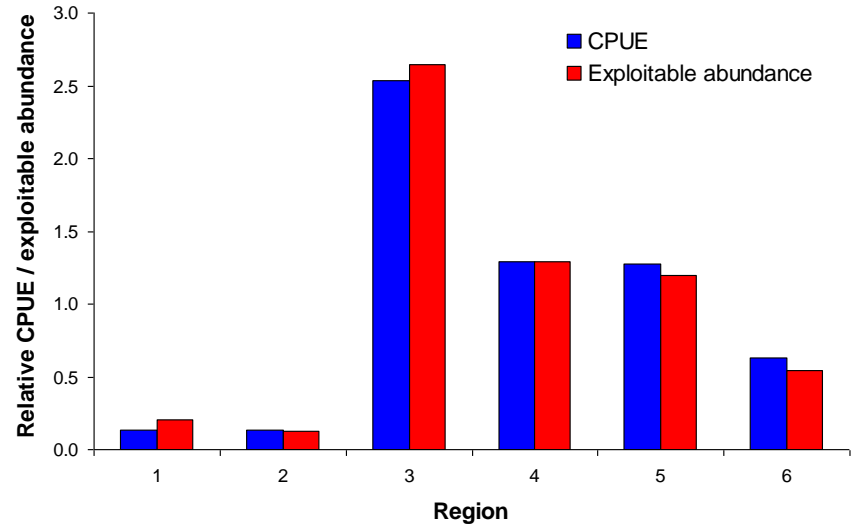
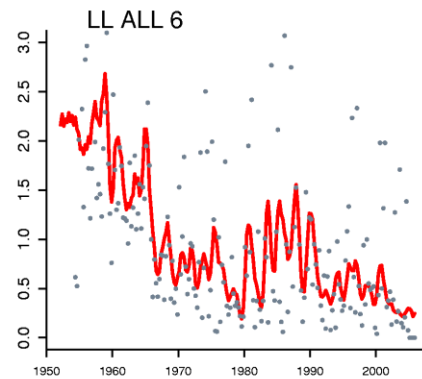
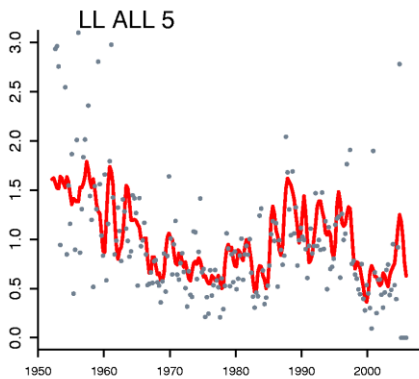
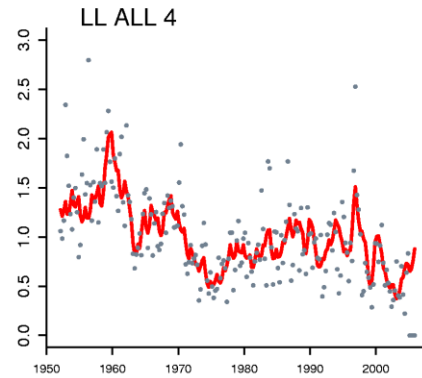
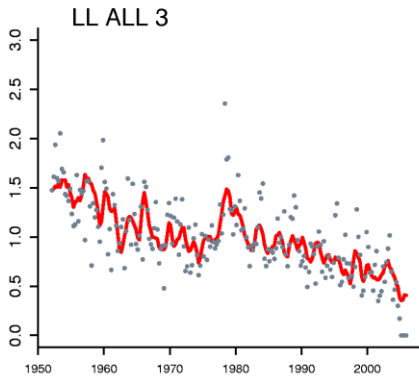
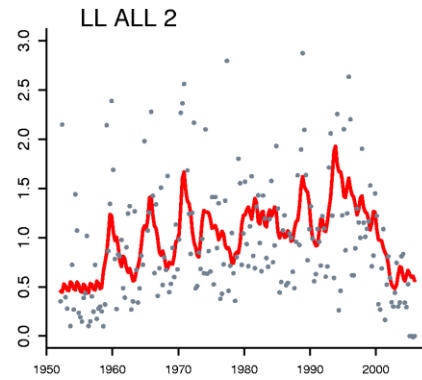
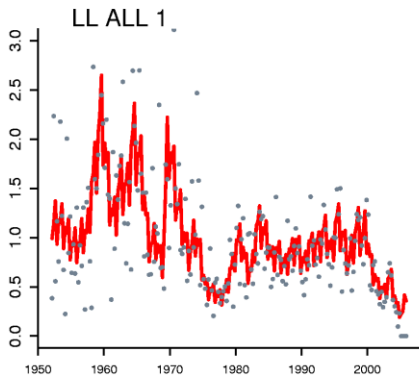


Informative Size Data

Weight-frequency

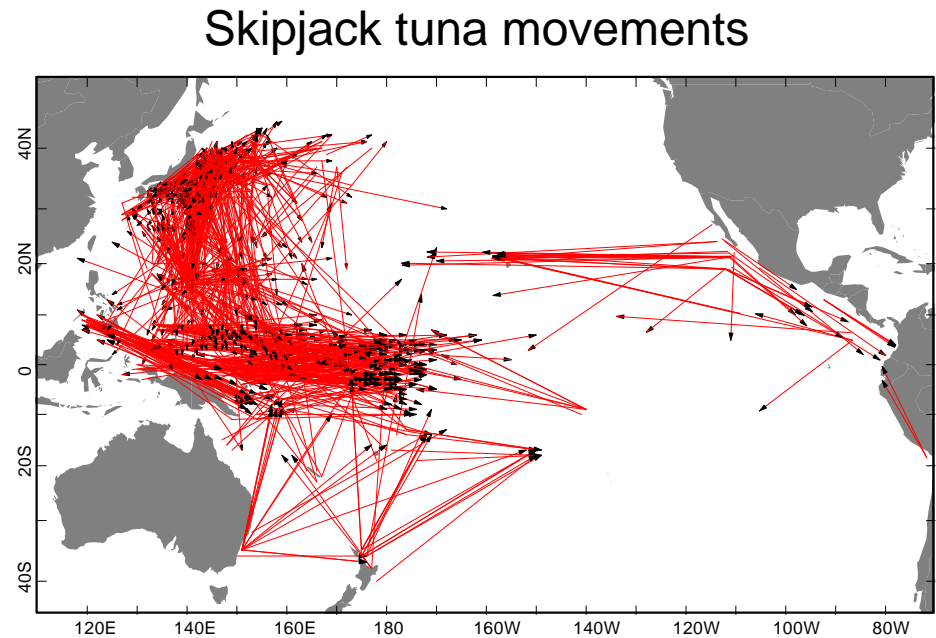
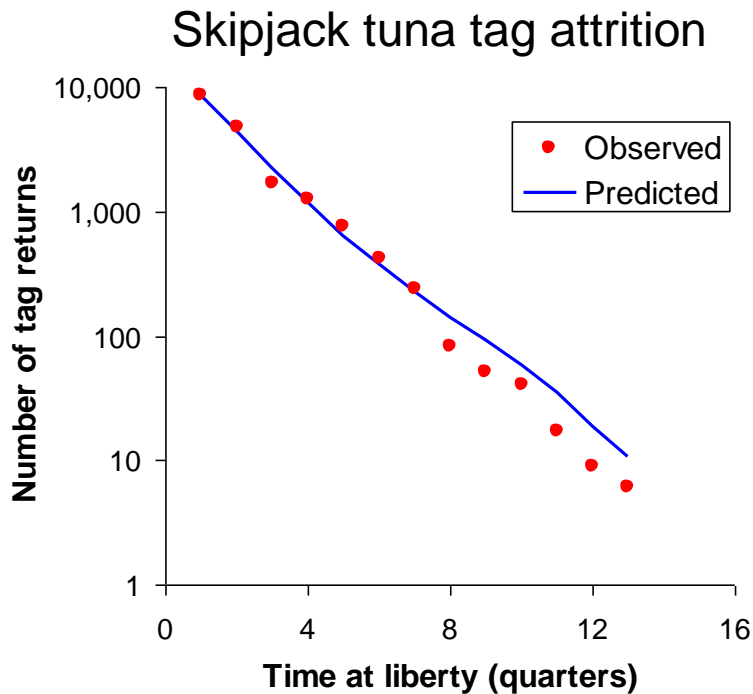


CPUE that indexes abundance

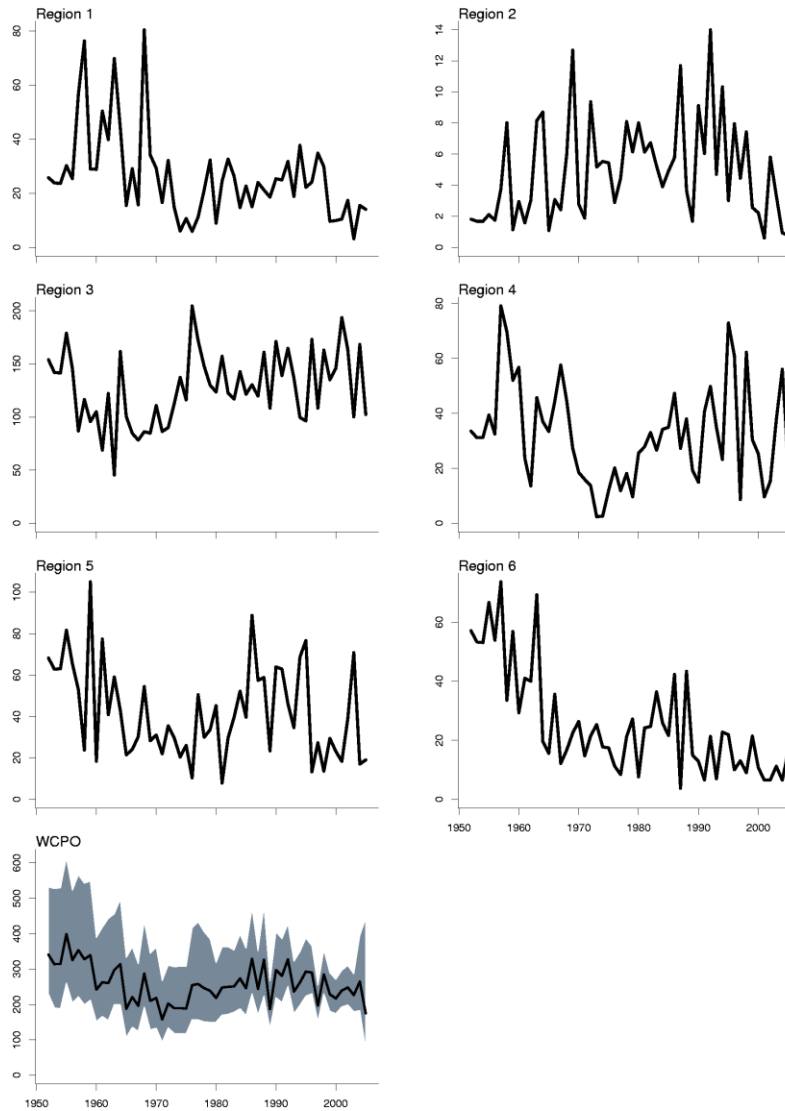


Importance of Tagging Data

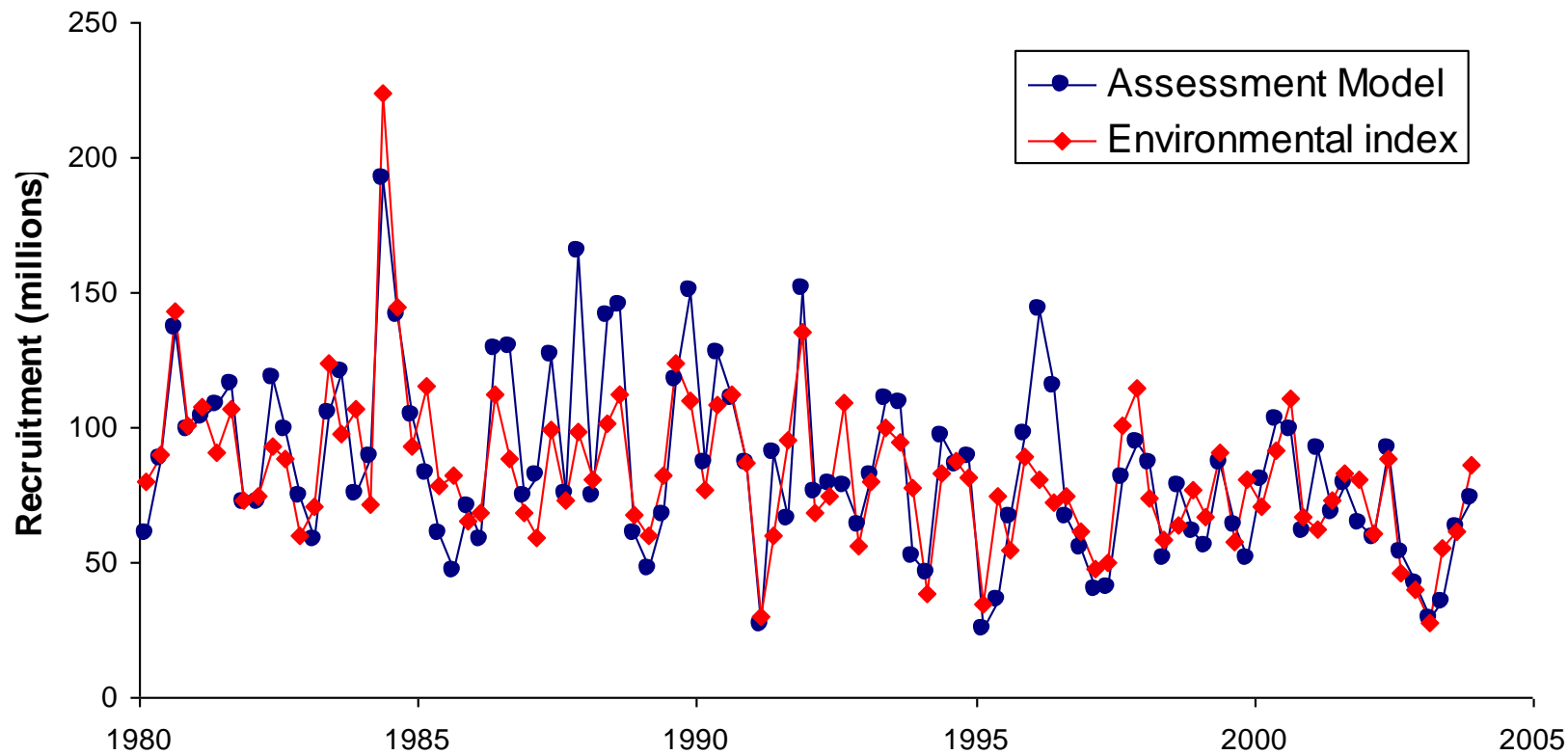
- Semi-fishery-independent data providing additional information on movement and mortality



Assessment Results – Recruitment

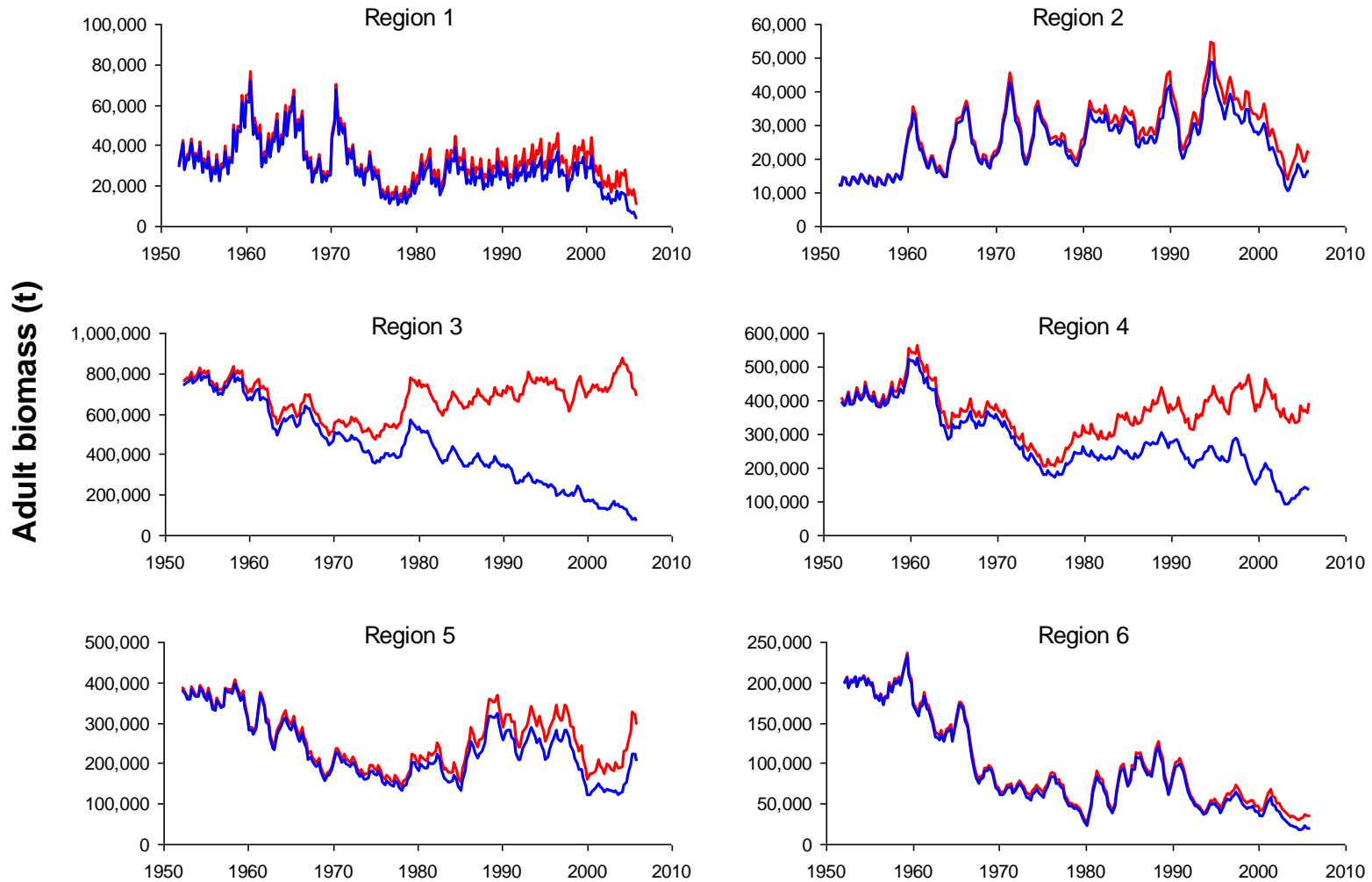


Recruitment prediction



Assessment Results – Fishery Impact

Yellowfin Tuna

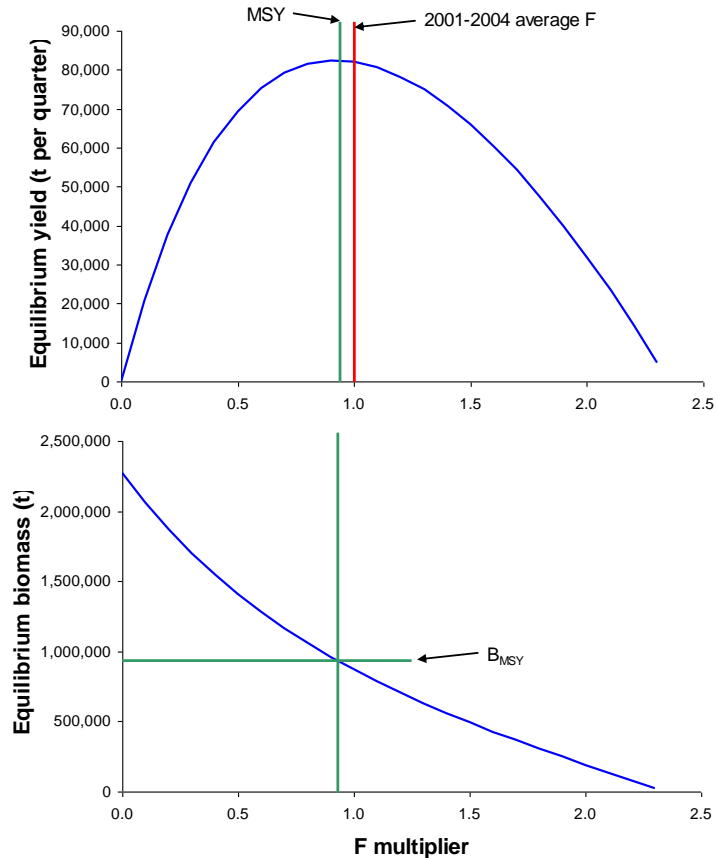
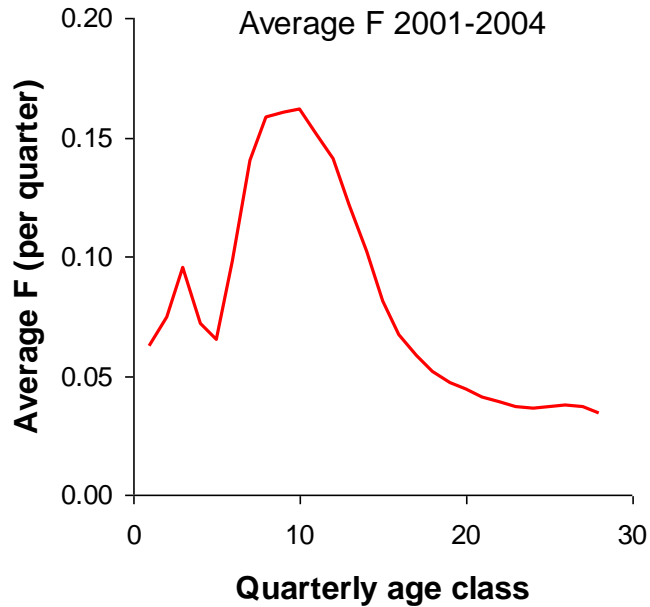


Stock Status Determinations

WCPFC Management objective: “stocks to be maintained at levels capable of producing the maximum sustainable yield”

Assessments therefore estimate 2 reference points: F_{MSY} and B_{MSY}

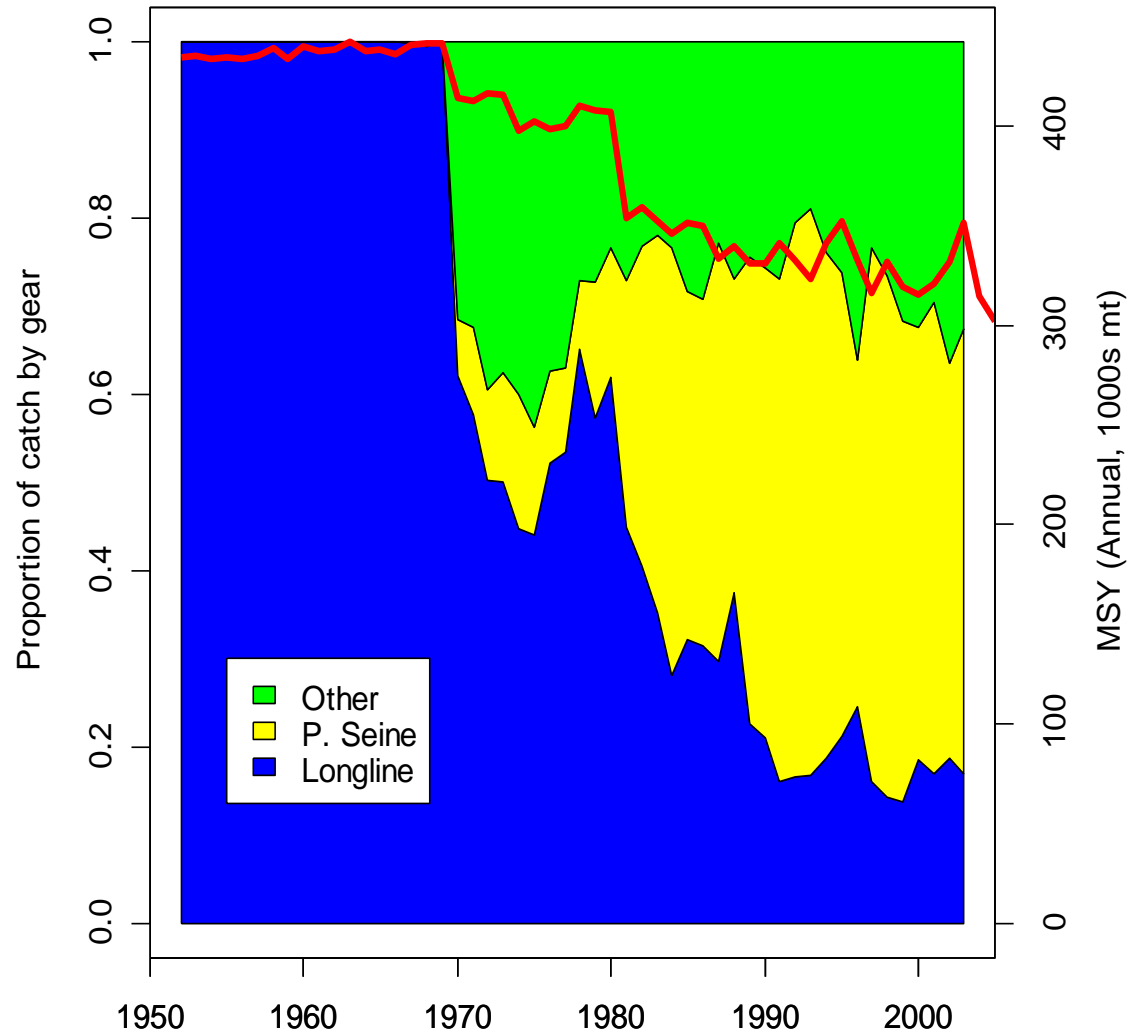
Generation of the Yield Curve



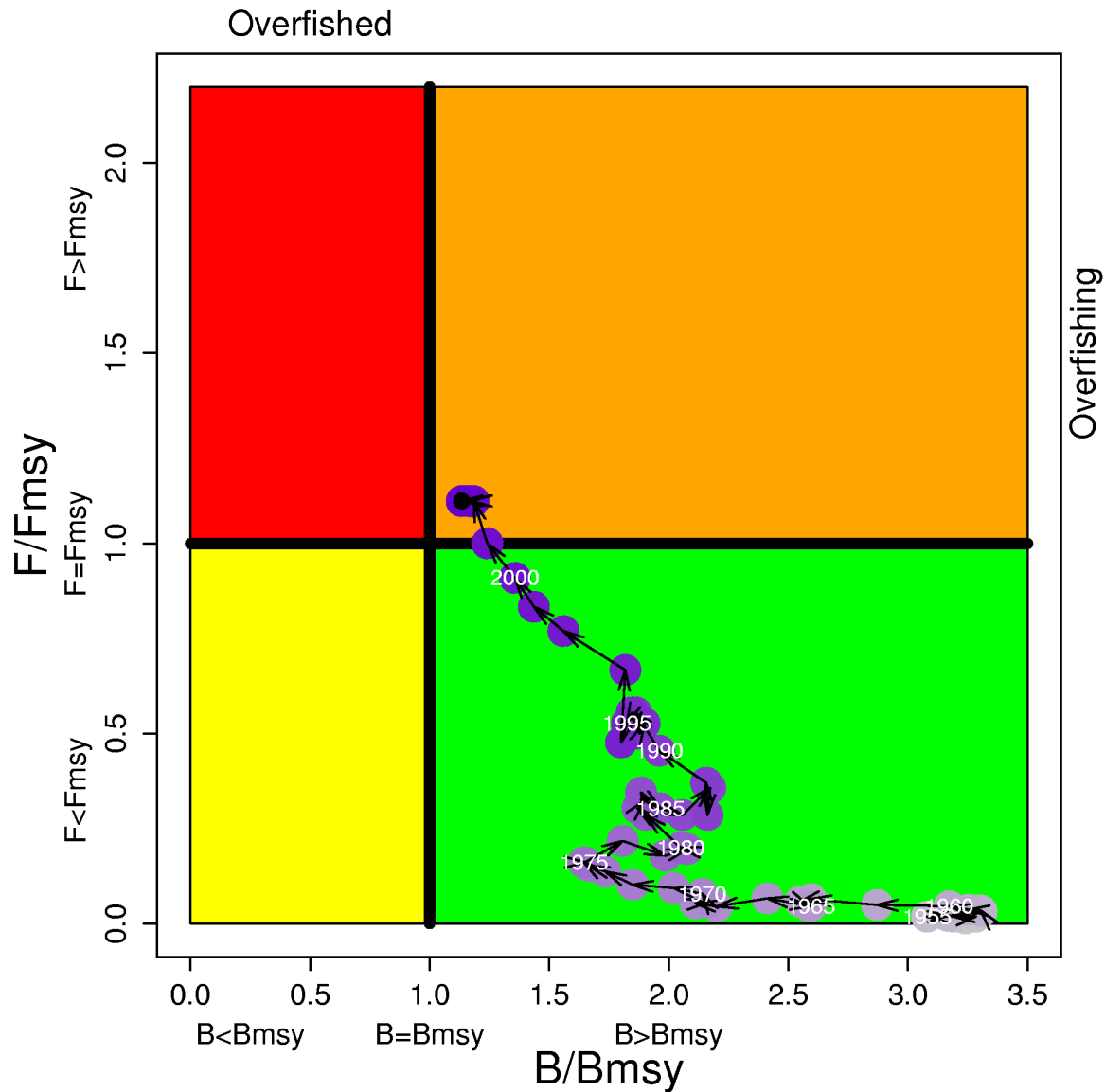
Stock Status Indicators $\Rightarrow F_{2001-2004}/F_{MSY} = 1/f_{mult}(MSY)$

$B_{2001-2004}/B_{MSY}$

MSY depends on fishery composition

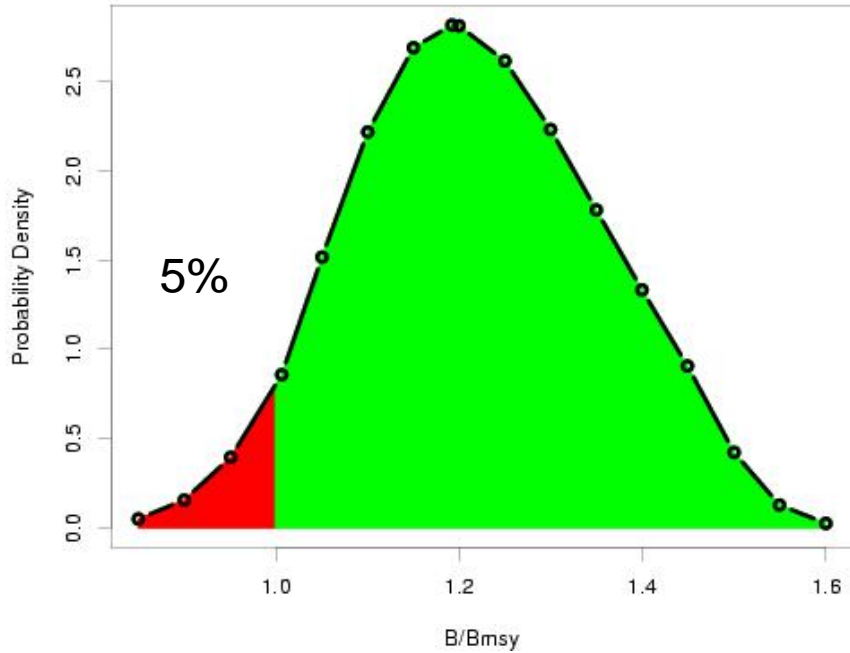


Assessment Results – Reference points

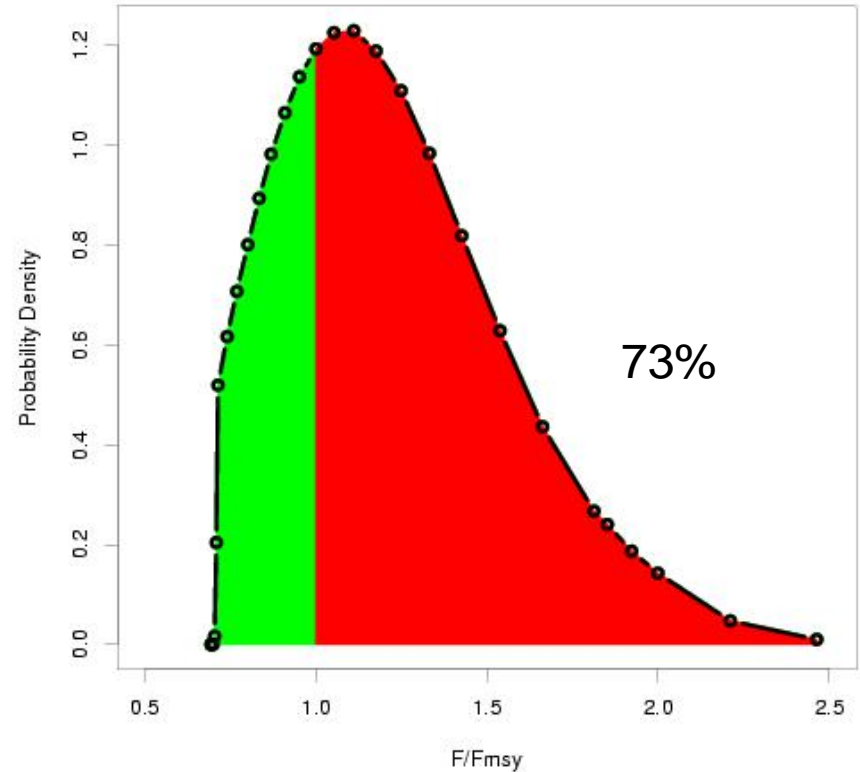


Profile Likelihoods for Reference Points

$B_{2001-2004} / B_{MSY}$



$F_{2001-2004} / F_{MSY}$



Evaluation of Management Options

- Projections with specified effort or catch levels
- Equilibrium yield as a function of fishery-specific effort

Yield Tradeoffs – Bigeye Tuna

Assuming *status quo* for Indonesia & Philippines

Large reductions in effort required to achieve F_{msy} for BET.

LL 50%, PS 0%

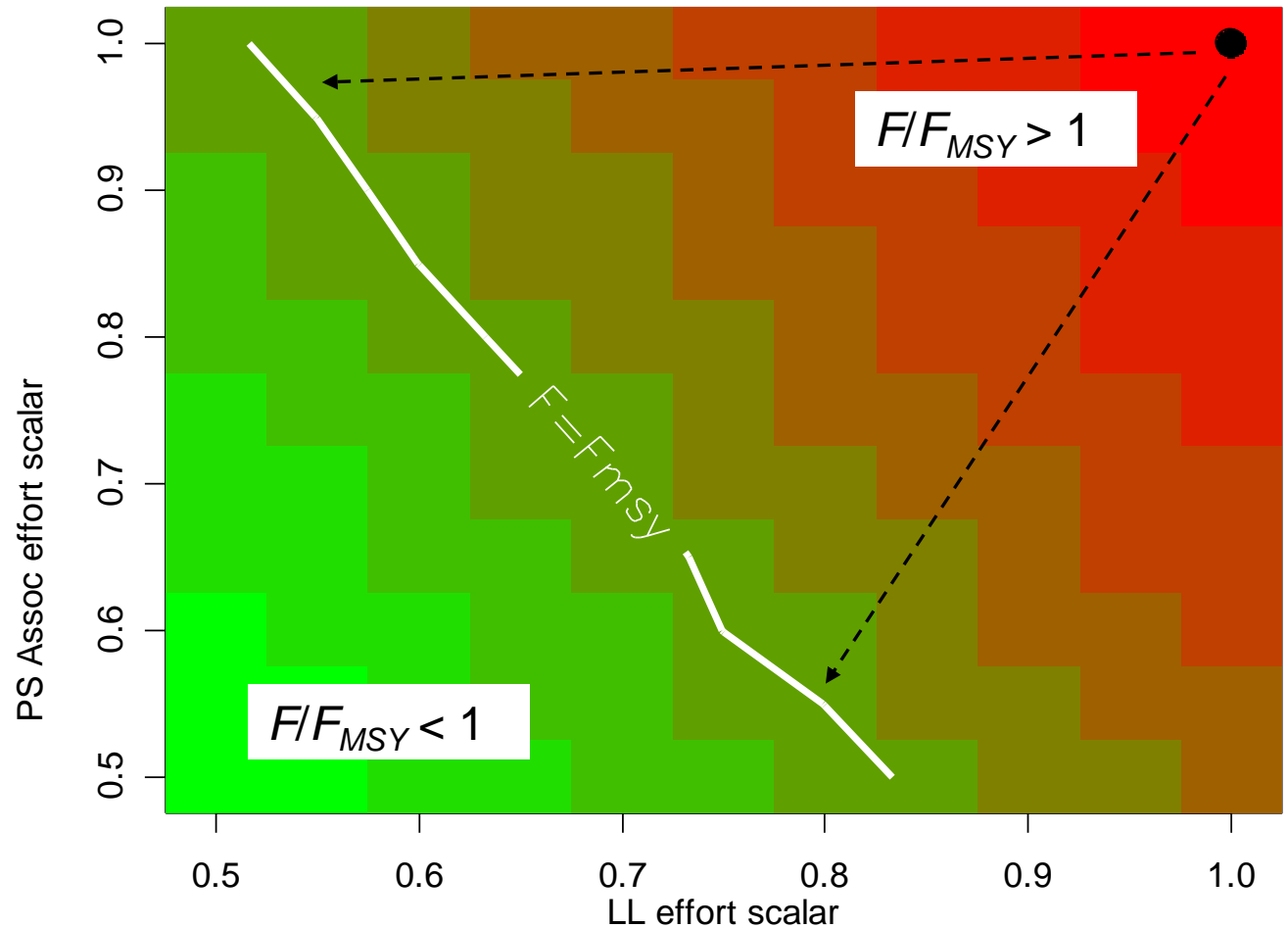
LL 40%, PS 15%

LL 30%, PS 30%

LL 20%, PS 45%

LL 10%, PS >50%

LL 0%, PS >>50%



Recap (1)

- Tuna stock assessments need to satisfy a number of scientific and management related objectives
- Assessment models need to recognize the common features of most tuna fisheries – multiple size-selective gears, spatial heterogeneity and incomplete/variable quality data
- Quality assessments require good data – catch, effort, size. Some fisheries for which CPUE provides a reliable index of abundance
- Tagging data can provide semi-fishery-independent data that can potentially improve tuna assessments
- Recruitment estimates may be improved by identification and use of environmental correlates

Recap (2)

- Assessments need to:
 - Explicitly differentiate fishery and environmental impacts on stock biomass
 - Incorporate estimation of reference points and performance indicators relative to RPs
 - Allow the evaluation of alternative management options or strategies
 - Recognize both statistical and structural uncertainty

Thank you for your attention !