Large-Scale Bigeye and Yellowfin Tuna Population Models for Regional Stock Assessment

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Collaborators

- SPC
- IATTC (bigeye)
- NRIFSF, Japan
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Yellowfin tuna spatial structure
Bigeye tuna spatial structure
Some model features
(MULTIFAN-CL)

- Statistical age-structured model
- Length-based
- Spatial structure
- Fishery-specific catchability and selectivity
- Catchability may vary over time
- Age-specific movement and natural mortality
Some model “compromises”

- Selectivity assumed constant over time
- Movement patterns do not vary with time
- Growth and natural mortality constant among regions and over time
- Discreet quarterly recruitment as an approximation to continuous (but highly variable) recruitment
Models fitted to several data sets

1. Total catches by fishery and time
2. Length-frequency data by fishery and time
3. Tagging data (primarily 1990s)
   - Effort data used as “independent” variable
   - Time window 1962-1999, by quarter
Bigeye Tuna

- Model fits to the data
- Biological “reasonableness” of various parameter estimates
Model fit to bigeye catch data

Longline 1

PS discards
Model fit to bigeye length data (time aggregated)
Model fit to bigeye length data - longline

North

Tropics
Model fit to bigeye length data - purse seine
Model fit to bigeye tag return data
Longline exploitable abundance vs CPUE
Bigeye growth estimates

![Graph showing growth estimates for Bigeye fish with data points and a trend line indicating age vs. length.]
Bigeye natural mortality

![Graph showing natural mortality rate vs. length (cm)]
Movement

- **Region 1 recruits**: Region 4 recruits are the highest in number, followed by Region 3, Region 2, and Region 1.
- **Region 2 recruits**: Region 4 recruits are also the highest, followed by Region 3, Region 2, and Region 1.
- **Region 3 recruits**: Region 4 recruits are the highest, followed by Region 3, Region 2, and Region 1.
- **Region 4 recruits**: Region 4 recruits are the highest, followed by Region 3, Region 2, and Region 1.

The graphs show the number of fish recruited by quarters for each region, with Region 4 recruits consistently higher than the other regions.
Bigeye catchability - longline

Fishery 1

Fishery 2

Fishery 3

Fishery 4
Bigeye catchability - purse seine

Catchability

WCPO log sets

WCPO FAD sets
Bigeye recruitment

Region 1

Region 2

Region 3

Region 4
Bigeye adult biomass

Adult biomass

Region 4
Region 3
Region 2
Region 1
Bigeye tuna spatial structure
Further work

- Examine sensitivity to assumptions
- Develop an “assessment module”
  - reference point risk analysis
  - stock projections
  - YPR analysis
- Incorporate new data, partic. tagging
- Model testing (simulations, etc)
Yellowfin Tuna
Yellowfin tuna spatial structure
Model fit to yellowfin length data (time aggregated)
Yellowfin growth estimates
Yellowfin growth vs otoliths
Yellowfin growth vs tags
Yellowfin natural mortality

![Graph showing natural mortality rate for Yellowfin across different age classes.](image)
Yellowfin recruitment

Recruitment millions of age class 1 fish

Year: 1960-2000
Yellowfin adult biomass

![Graph showing Yellowfin adult biomass over time in different regions.](image-url)