USING INDICATORS OF STOCK STATUS WHEN TRADITIONAL REFERENCE POINTS ARE NOT AVAILABLE: EVALUATION AND APPLICATION TO SKIPJACK TUNA IN THE EASTERN PACIFIC OCEAN

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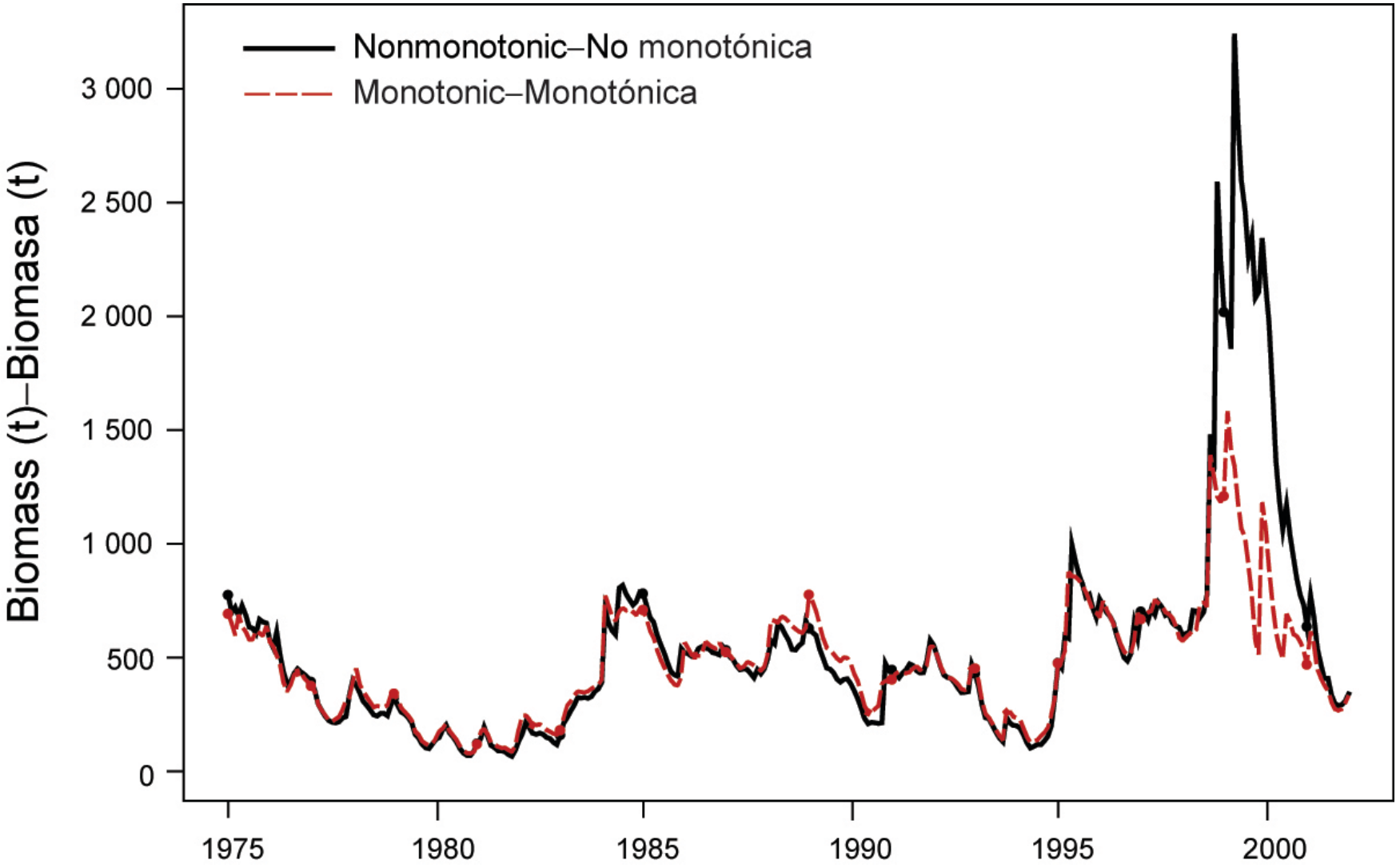
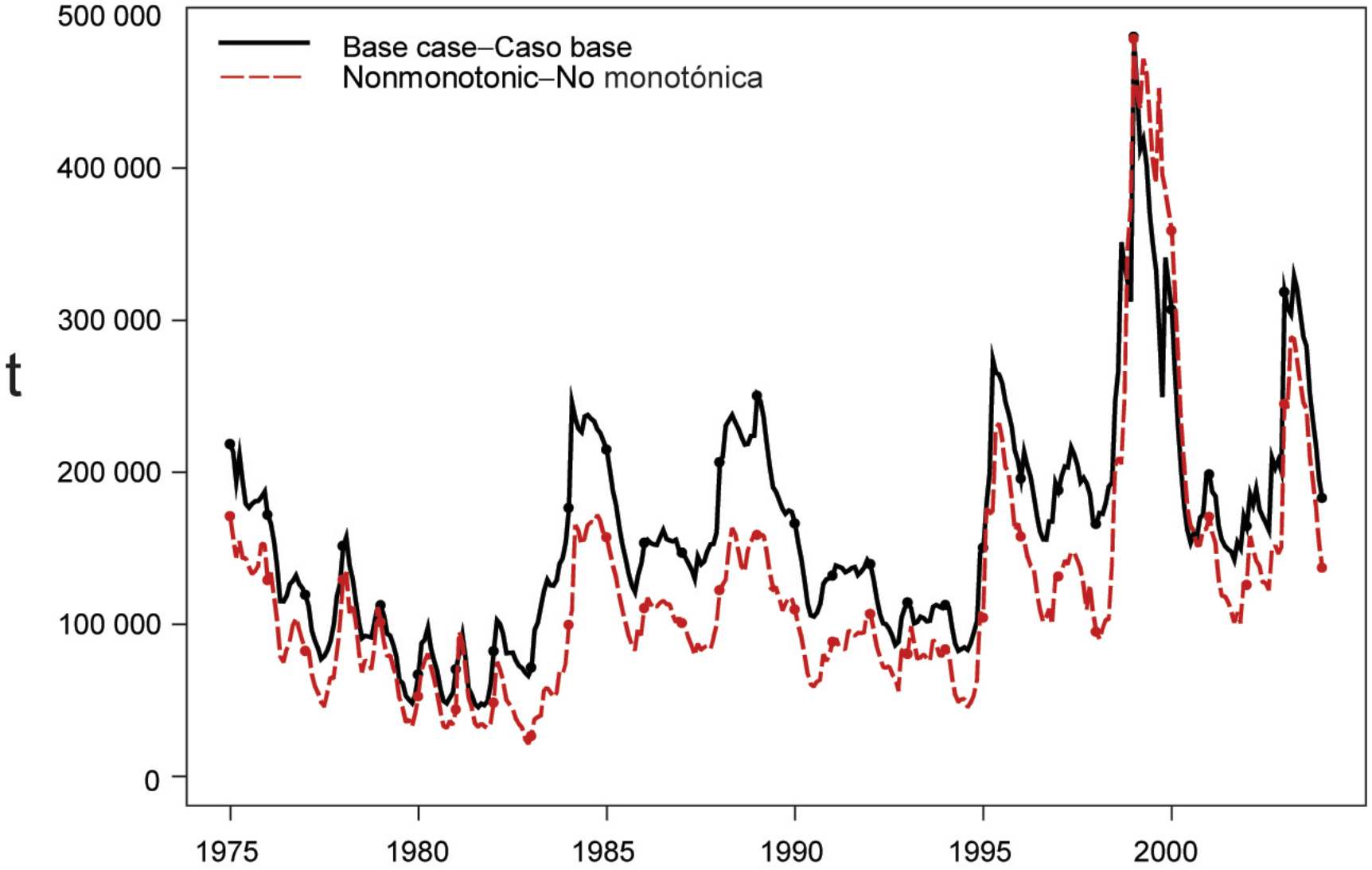
Problems with the EPO skipjack assessment

- High and variable productivity (*i.e.* annual recruitment is a large proportion of total biomass)
- Difficult to detect the effect of fishing on the population with standard fisheries data and stock assessment methods.
- Continuous recruitment and rapid growth mean that the temporal stratification needed to observe modes in length-frequency data make the current sample sizes inadequate.
- Not known whether catch per day fished for purse-seine fisheries is proportional to abundance
- Lack of age-frequency data and the limited tagging data.
- Possible dome-shaped selectivity curve
- yield per recruit (YPR) maximized by catching the youngest skipjack in the model
- Neither biomass- or fishing mortality-based reference points or the indicators to which they are compared are available

2002 assessment



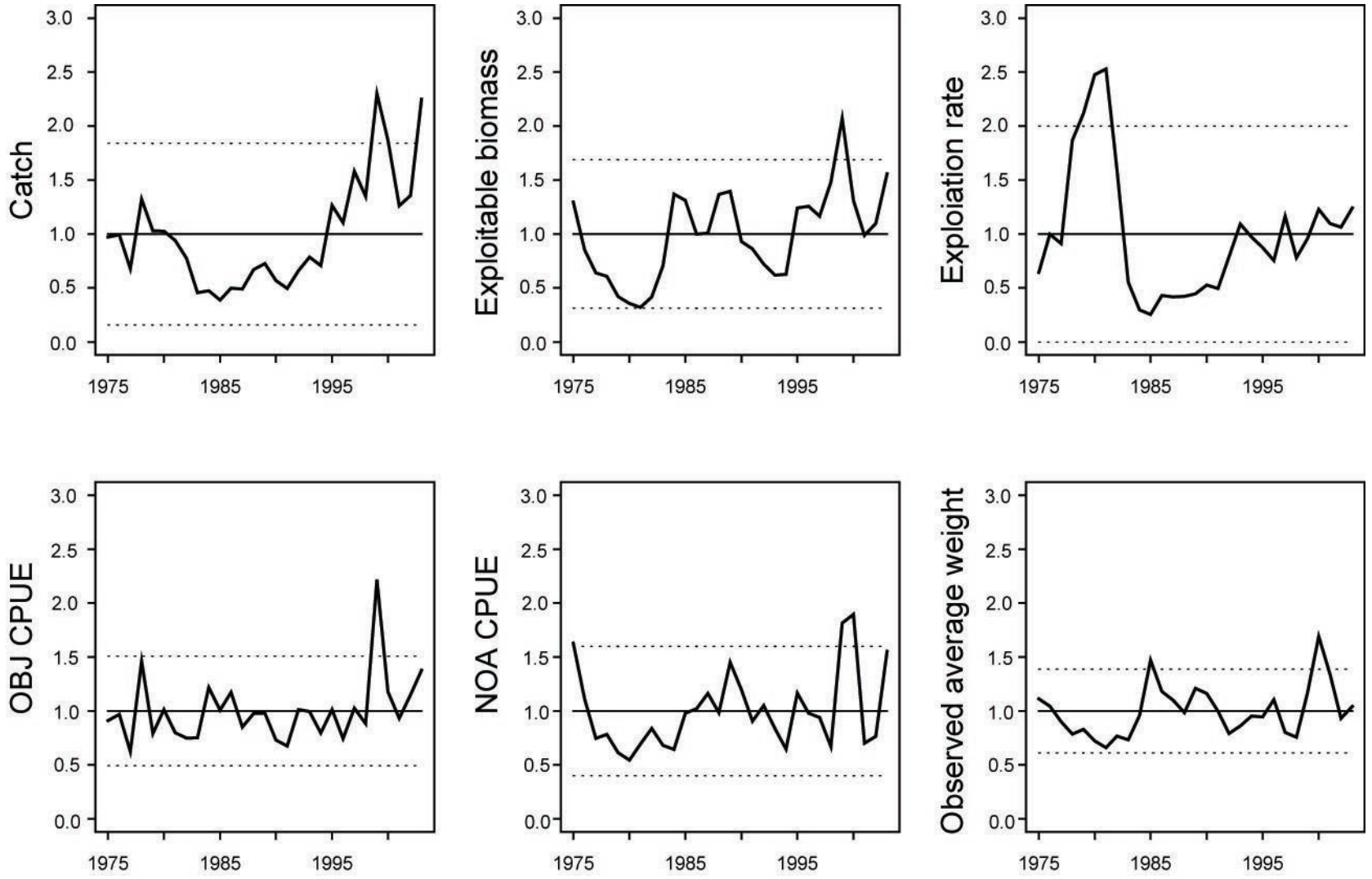
2004 assessment



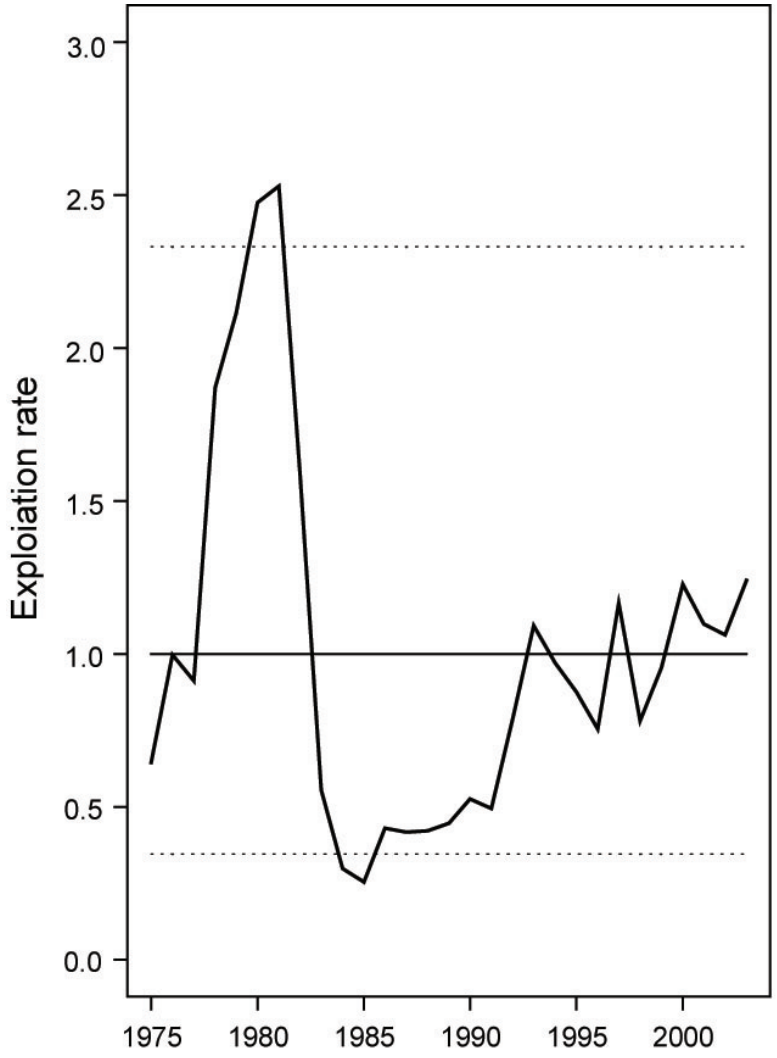
Methods

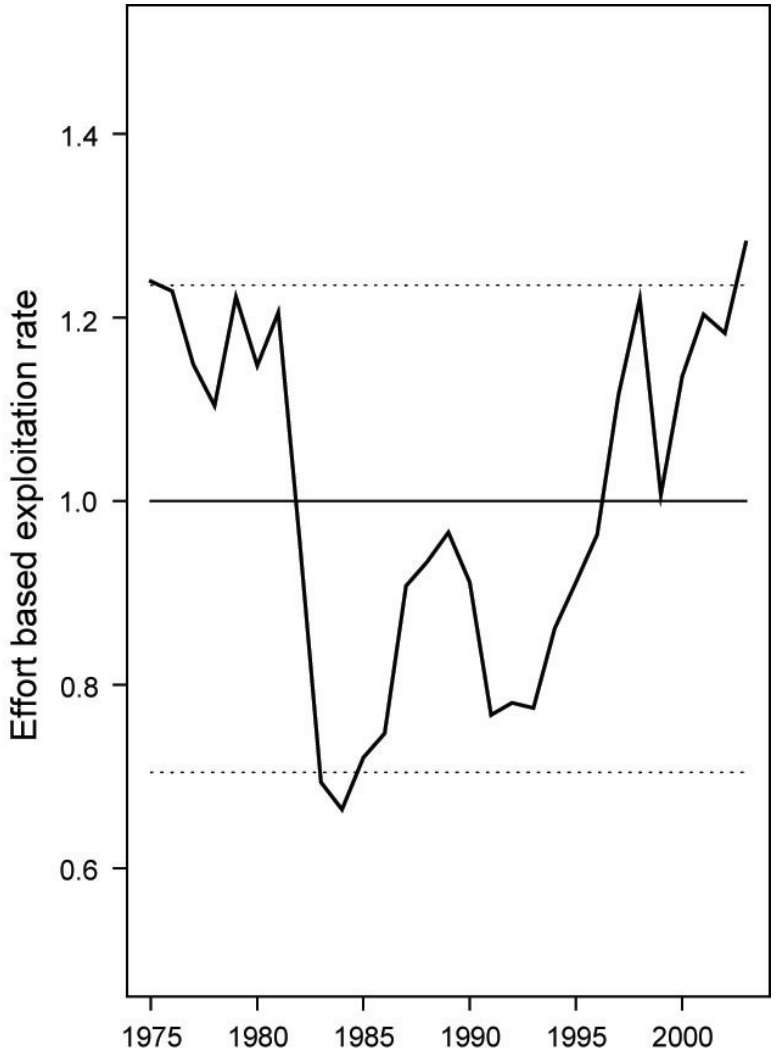
- Identify data based indicators
  - CPUE
  - Standardized effort
  - Average weight
  - Catch
- Develop reference levels
  - 5th and 95th percentiles
- Compare with previous assessment results
- Investigate compatability with simple population dynamics model

Indicators from the 2004 assessment



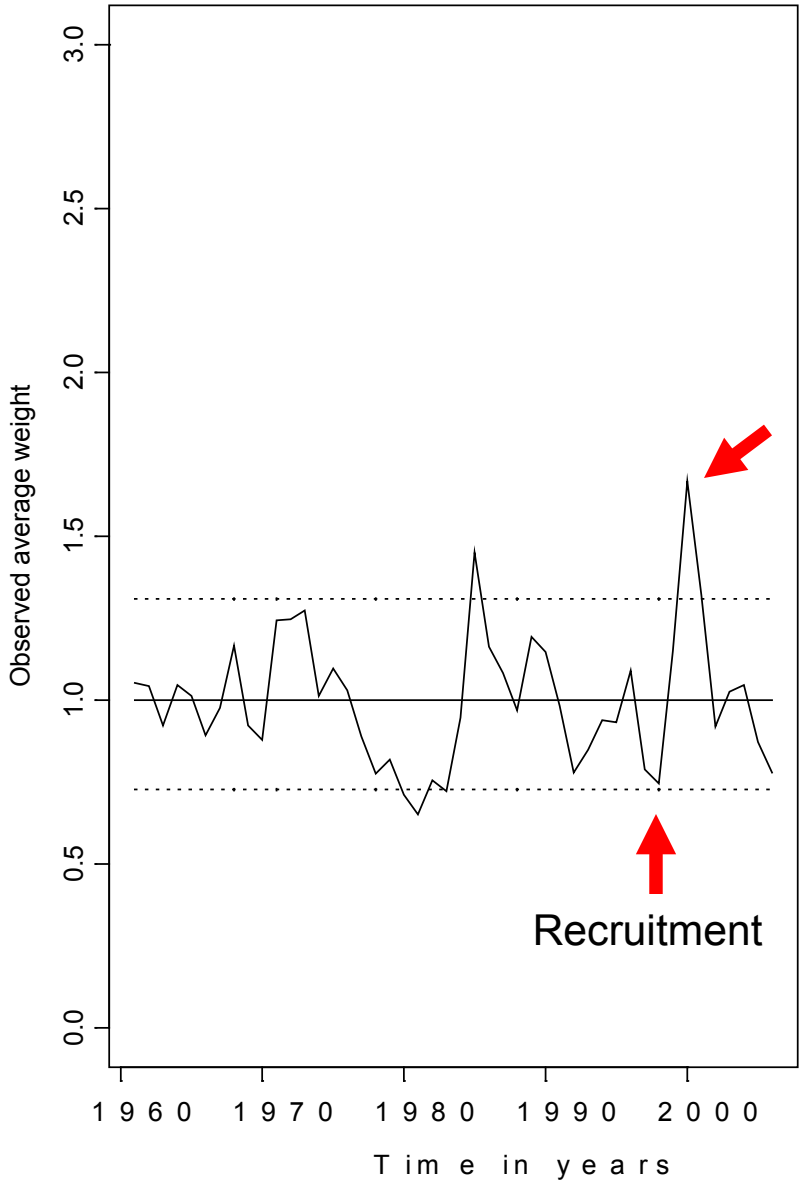
Exploitation rates from assessment model and standardized effort



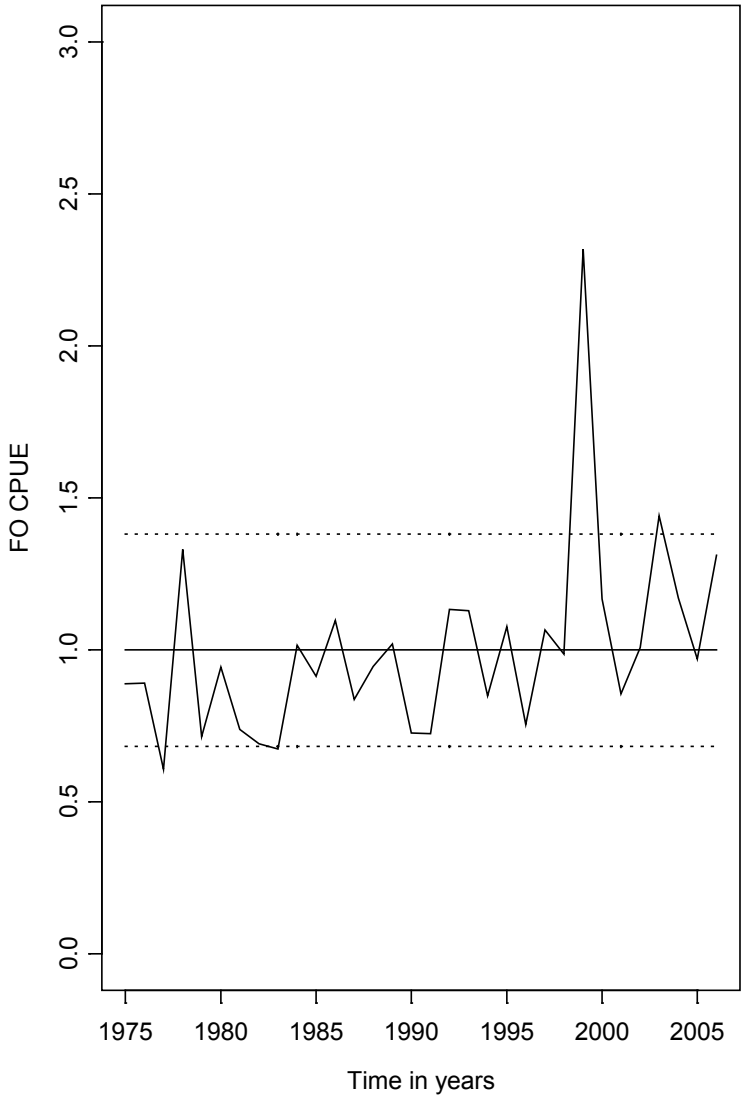


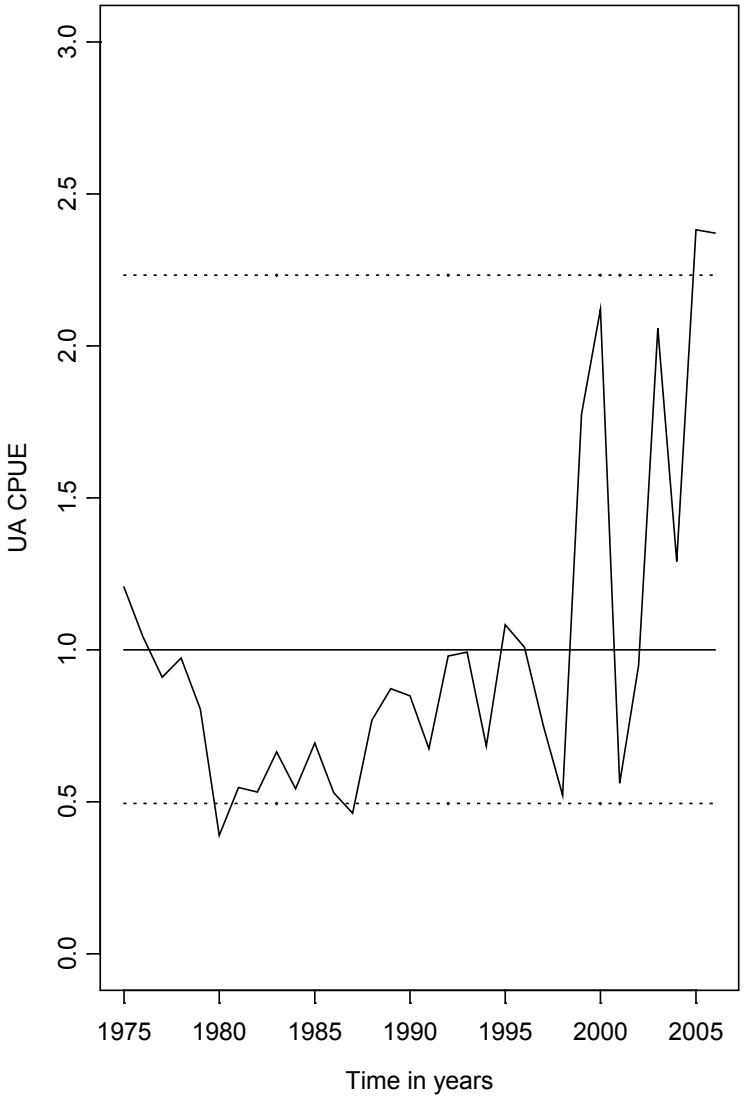
Indicator	Lower reference level	Upper reference level
CPUE	Undesirable	Healthy, but may be due to increased catchability
Average weight	Undesirable, but may be due to large recruitment	Healthy, but may be due to poor recruitment
Effort	Healthy	Undesirable
Catch	Ambiguous	Ambiguous

Average weight



CPUE


FO CPUE
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1975
1980
1985
1990
1995
2000
2005
Time in years


UA CPUE
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1975
1980
1985
1990
1995
2000
2005
Time in years

Exploitation rate indicator based on standardized effort

Catch


Purse seine catch
0.0
0.5
1.0
1.5
2.0
2.5
3.0
1975
1980
1985
1990
1995
2000
2005
Time in years

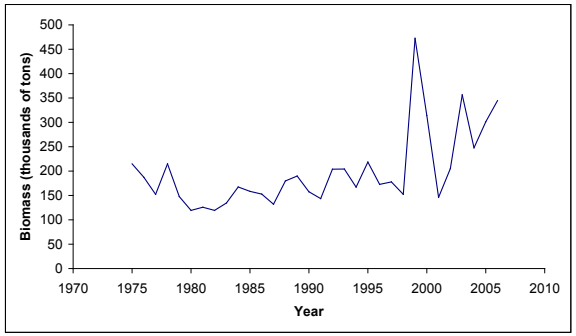
Indicator	Lower reference level	Upper reference level
CPUE	Undesirable	Healthy, but may be due to increased catchability
Average weight	Undesirable, but may be due to large recruitment	Healthy, but may be due to poor recruitment
Effort	Healthy	Undesirable
Catch	Ambiguous	Ambiguous

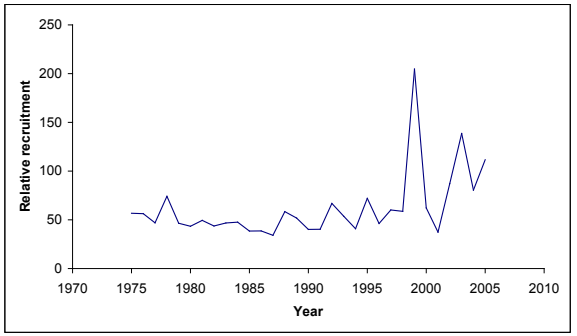
Summary of indicators

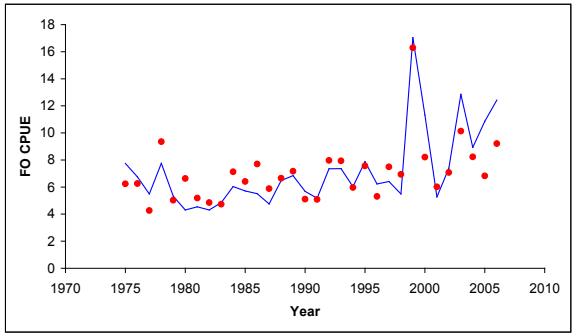
- Average weight near lower reference level - Undesirable, but may be due to large recruitment
- Exploitation rate near upper reference level - Undesirable
- CPUE near upper reference level - Healthy, but may be due to increased catchability
- Catch near upper reference level - Ambiguous

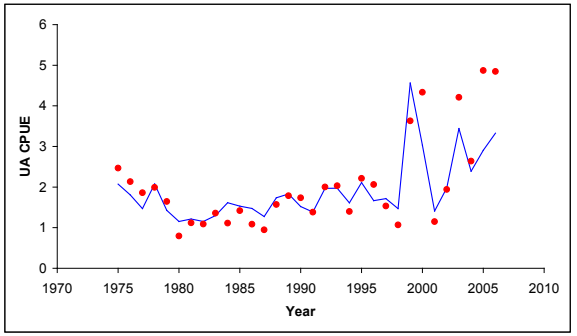
Simple stock assessment model

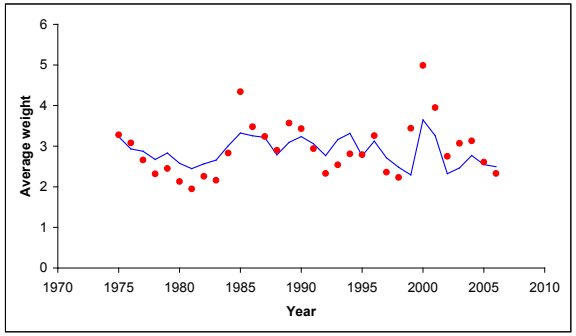
- Data
  - Catch
  - CPUE
    - FO
    - UA
  - Average weight

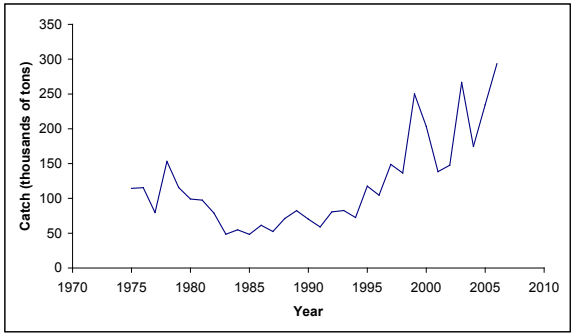

Biomass (thousands of tons)
0
50
100
150
200
250
300
350
400
450
500
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

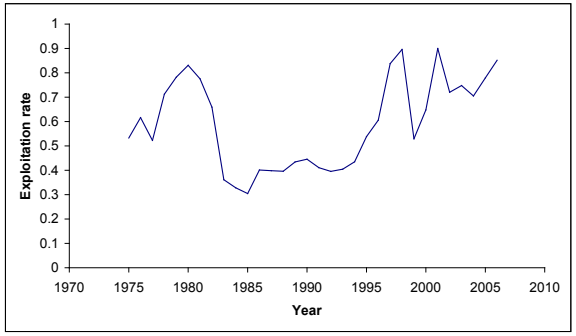

Relative recruitment
0
50
100
150
200
250
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


FO CPUE
0
2
4
6
8
10
12
14
16
18
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


UA CPUE
0
1
2
3
4
5
6
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Average weight
0
1
2
3
4
5
6
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Catch (thousands of tons)
0
50
100
150
200
250
300
350
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year


Exploitation rate
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year

Conclusions

- Contradiction between the recent CPUE increase and the changes in the standardized effort (increase) and average weight (decrease)
- Can be explained by
  - a parallel increase in both exploitation rate and abundance OR
  - increasing catchability

Indicators of stock status for skipjack tuna compared to estimates of exploitable biomass and exploitation rate from the 2004 assessment