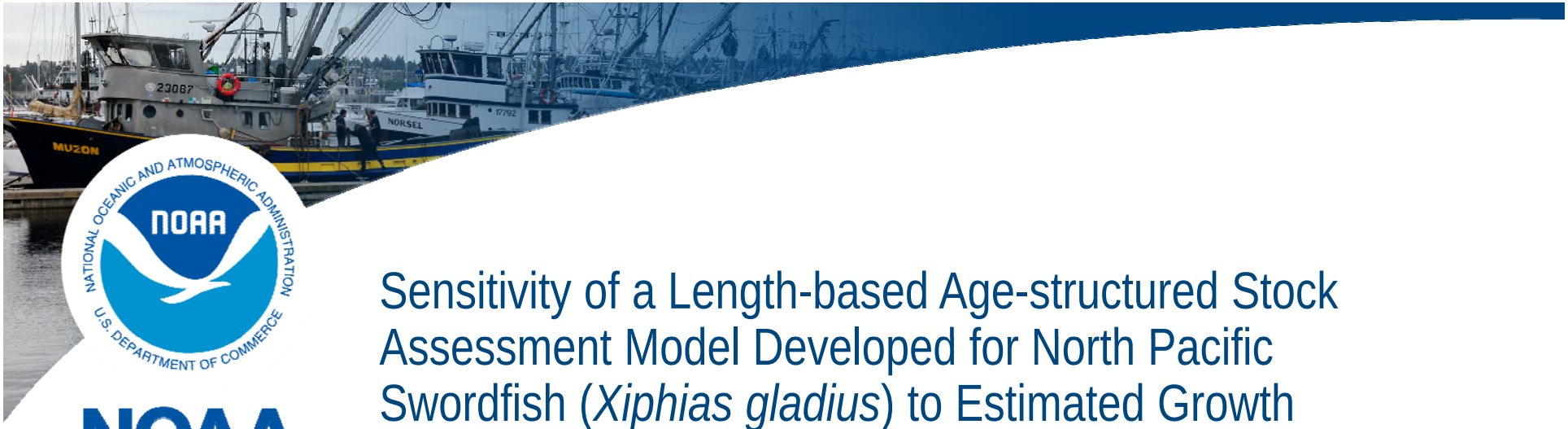

Sensitivity of a Length-based Age-structured Stock Assessment Model Developed for North Pacific Swordfish (*Xiphias gladius*) to Estimated Growth

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[2]SWFSC

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Kevin Piner[2]

Nov, 2014

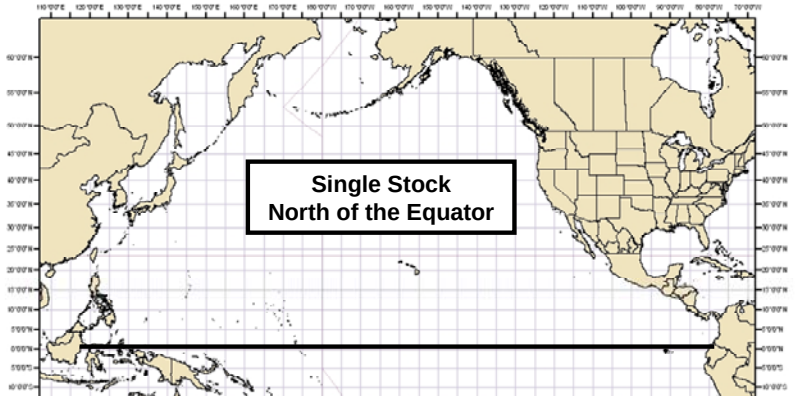
Courtney, D. L., and K. Piner. 2009. Age structured stock assessment of North Pacific swordfish (*Xiphias gladius*) with Stock Synthesis under a single stock scenario. International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific/Billfish, ISC/09/BILLWG-3/08.

Outline

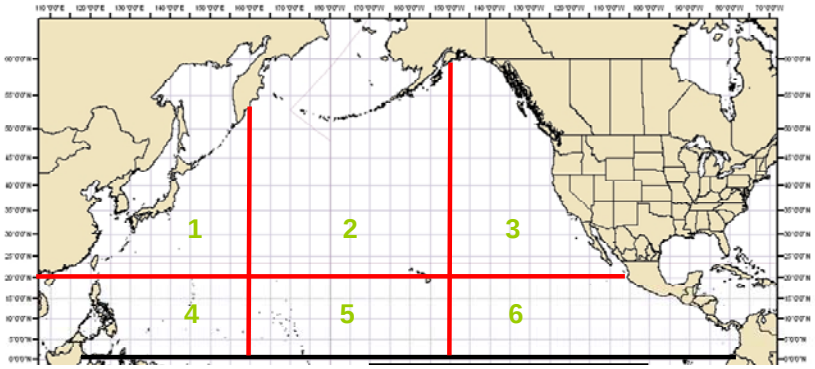
- Model sensitivity to internally estimated growth
  - External versus Internal (Stock Synthesis)
  - Combined sex versus two sex
- Caveats of the application
  - No age composition data
  - No sex specific length composition data
  - Based on preliminary model (stock structure)

Preliminary SS Model Structure

- Standardized CPUE
  - Single stock north of the equator

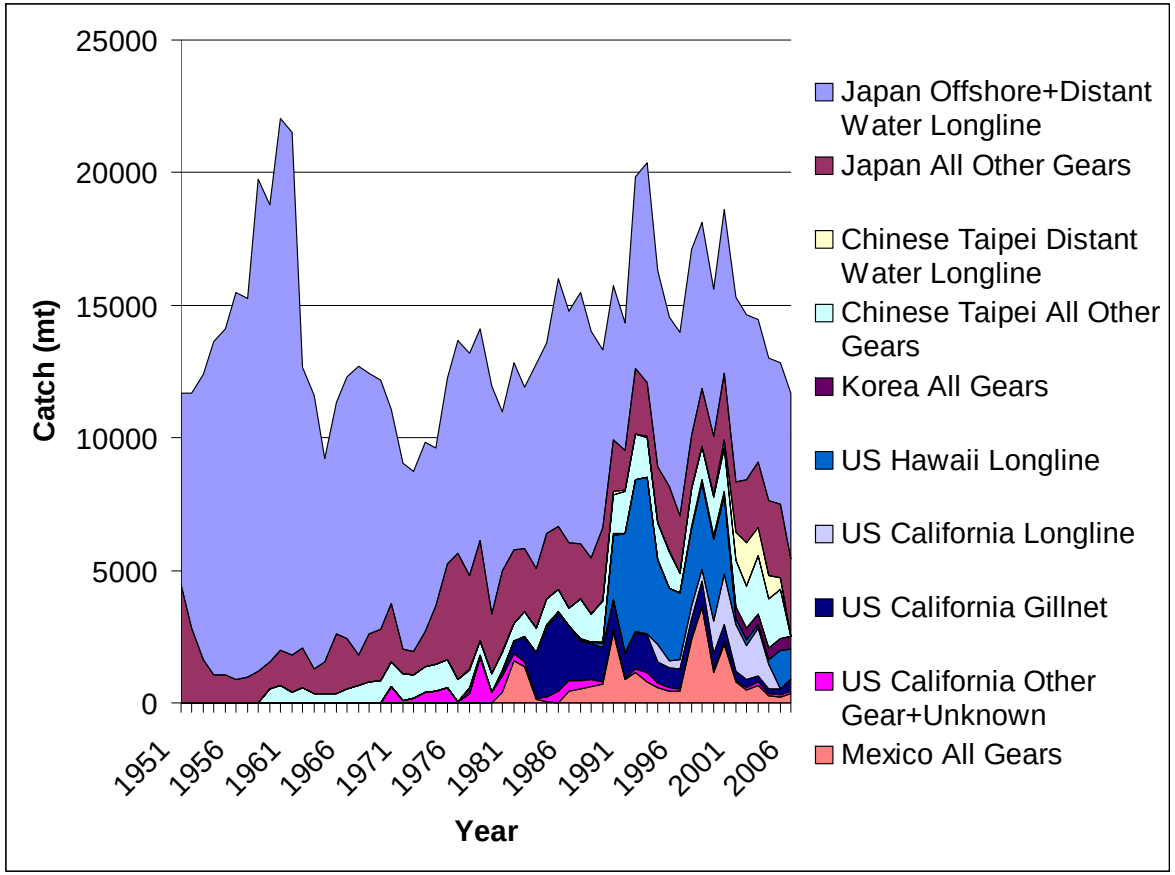


- Catch and length data
  - Regionally stratified (6 regions)
  - Quarterly time step

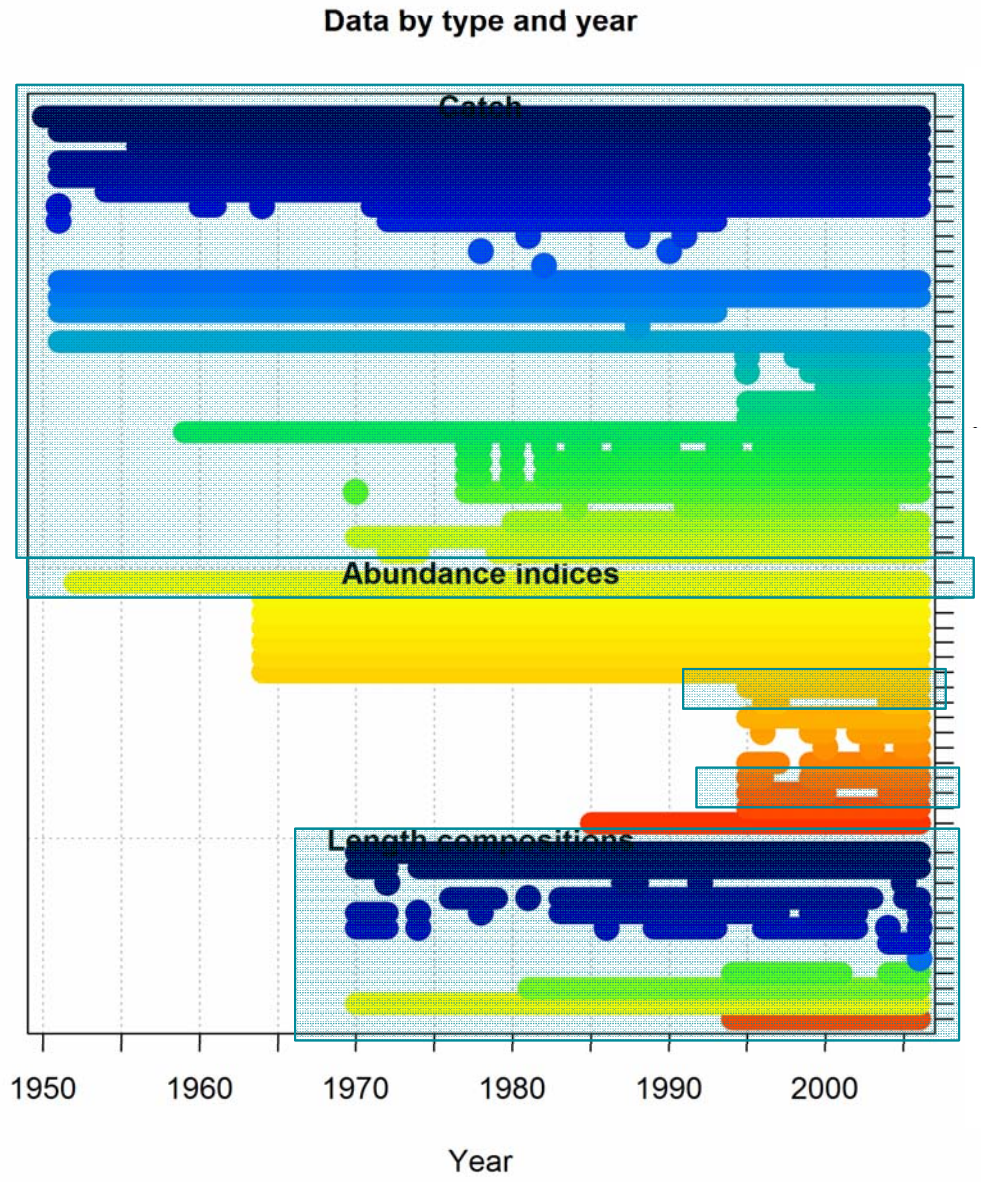


Input Data

- Catch
  - 10 fleets



Input Data by Type and Year



- Catch by region
  - 33 fleets
- Abundance (standardized CPUE)
  - 3 surveys
  - Plus several regional surveys not fit in likelihood
- No age composition data
- Length composition
  - 10 series
- Selectivity
  - Length based
  - Primarily asymptotic, but with dome-shaped for some fleets and time blocks within fleets

Externally Estimated Growth

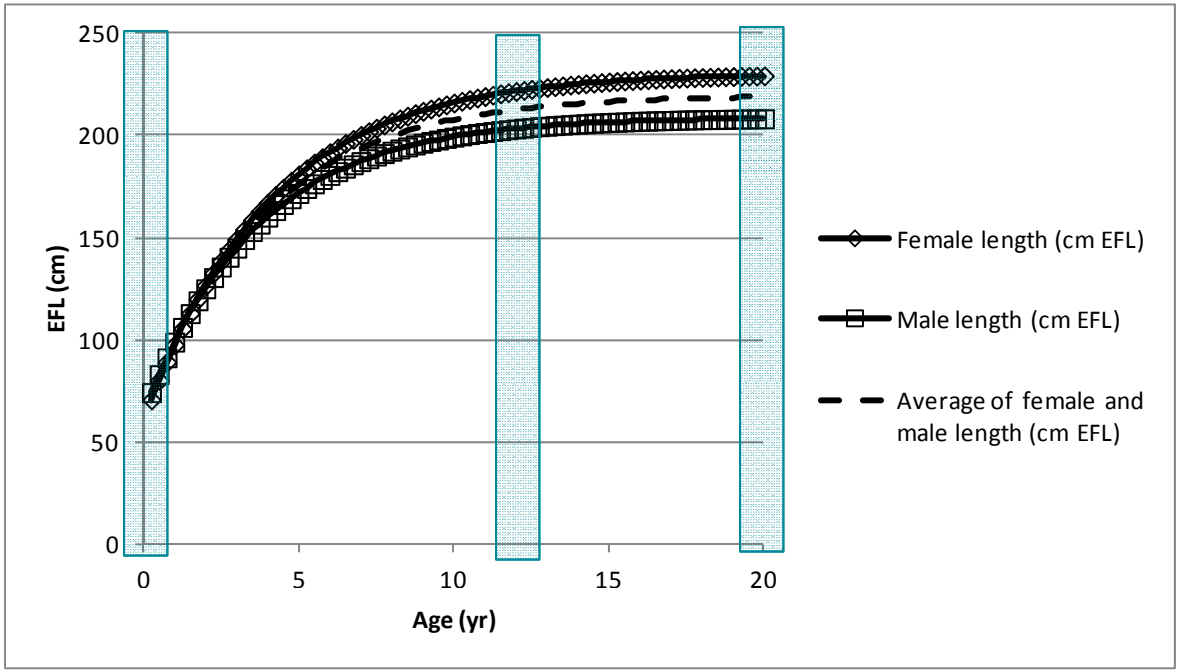
Model parameters	Operational Central Pacific Females	Operational Central Pacific Males
L_{∞} (cm)	230.5 (EF) +- 3.94 (se) n = 712	208.9 (EF) +- 5.60 (se) n = 580
κ	0.246 +-0.019	0.271 +- 0.034
t_0 (yr)	-1.24 +- 0.167	-1.37 +- 0.259
Max age (yr) in analysis (CNP)	12	11
Max length (cm EFL) in analysis	259	229
Max age (yr) exploratory (NWP)	21	13

Uchiyama J. H. and R. L. Humphreys Jr. 2007. citing: De Martini et al. (2007)

$$EFL_t = EFL_{\infty}\left(1 - e^{-k(t-t_0)}\right)$$

$$W(kg) = aEFL^b$$

- Growth rates differ by sex
- But no sex specific length comps
- => Used combined sex model



Sensitivity to Internally Estimated Growth

- The independent data used to estimate growth were presumably collected from size-selective fisheries, and therefore might be biased toward faster growing fish
  - von Bertalanffy growth (VBG) estimated internally within SS
  - While taking into account the size-selectivity of the fisheries which were estimated simultaneously

Sensitivity to Internally Estimated Growth

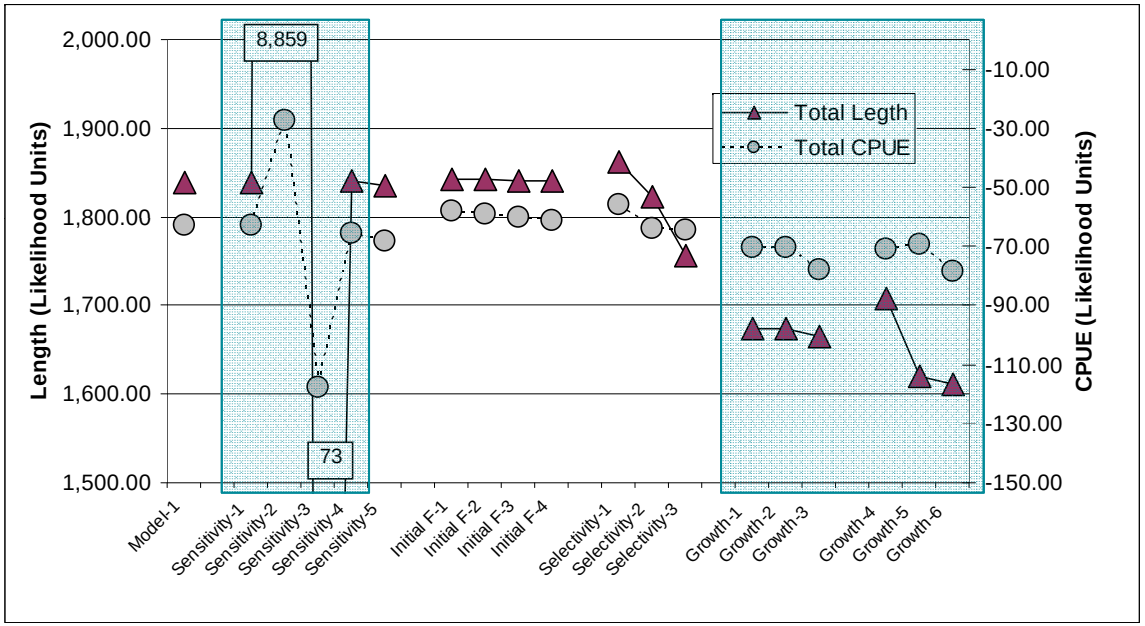
- Estimated growth within SS
  - Combined sex model
    - k, L_{a_min} (Growth-1)
    - k, L_{a_min}, L_{a_max} (Growth-2)
    - k, L_{a_min}, $L_{a\_max,}$ time blocks (Growth-3)
  - Separate sex model
    - k, L_{a_min} (Growth-4)
    - k, L_{a_min}, L_{a_max} (Growth-5)
    - k, L_{a_min}, $L_{a\_max,}$ time blocks (Growth-6)

Sensitivity to Internally Estimated Growth

- Model sensitivity

- Estimated growth
  - Combined sex
    - k, L_{a_min}
    - k, L_{a_min}, L_{a_max}
    - k, L_{a_min}, $L_{a\_max,}$ time blocks
  - Separate sex
    - k, L_{a_min}
    - k, L_{a_min}, L_{a_max}
    - k, L_{a_min}, $L_{a\_max,}$ time blocks

- Length composition variance adjustment
  - VarAdj* input N
  - 0.01*VarAdj* input N

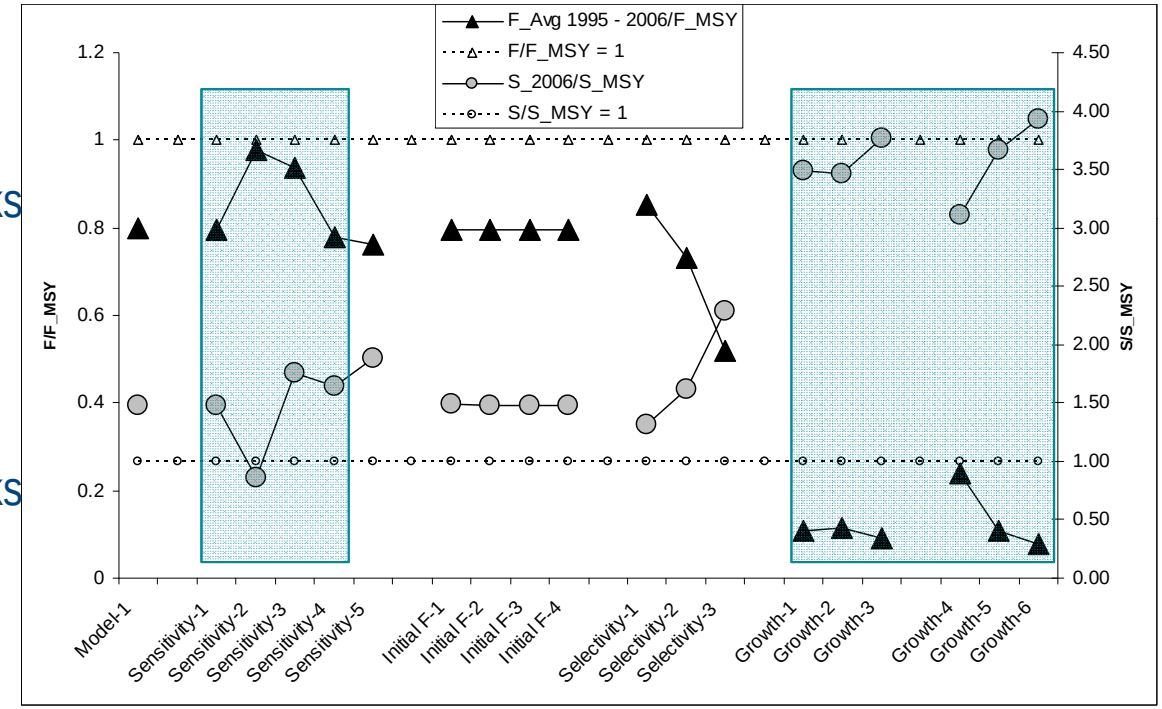


Sensitivity to Internally Estimated Growth

- Model sensitivity

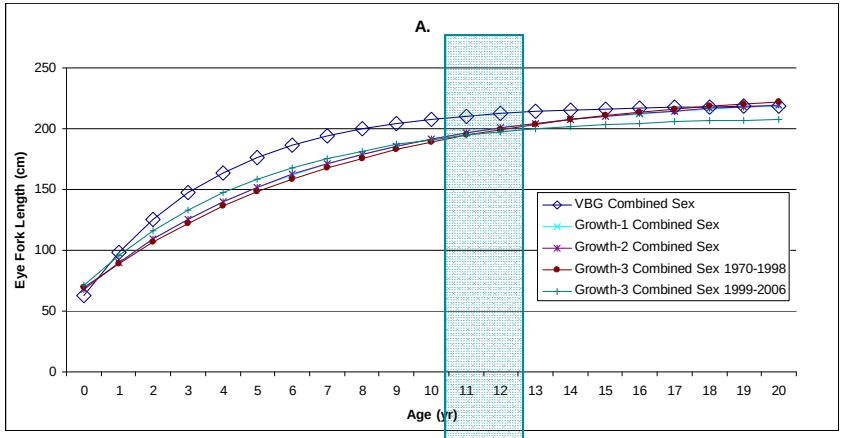
- Estimated growth
  - Combined sex
    - k, L_{a_min}
    - k, L_{a_min}, L_{a_max}
    - k, L_{a_min}, $L_{a\_max,}$ time blocks
  - Separate sex
    - k, L_{a_min}
    - k, L_{a_min}, L_{a_max}
    - k, L_{a_min}, $L_{a\_max,}$ time blocks

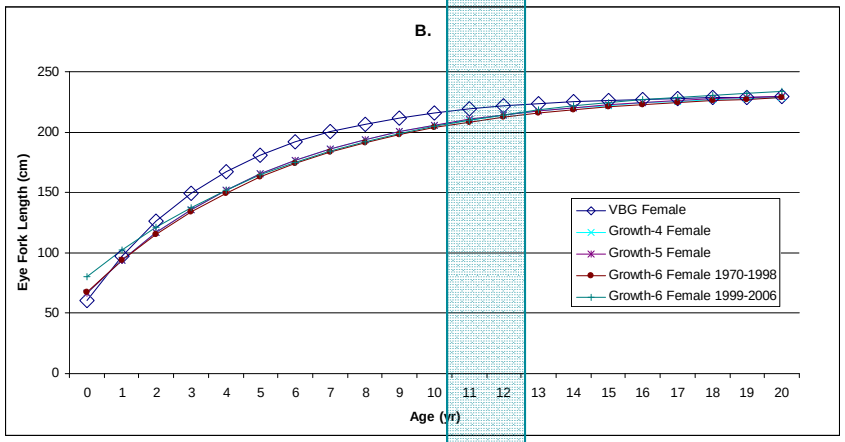
- Length composition variance adjustment
  - VarAdj* input N
  - 0.01*VarAdj* input N

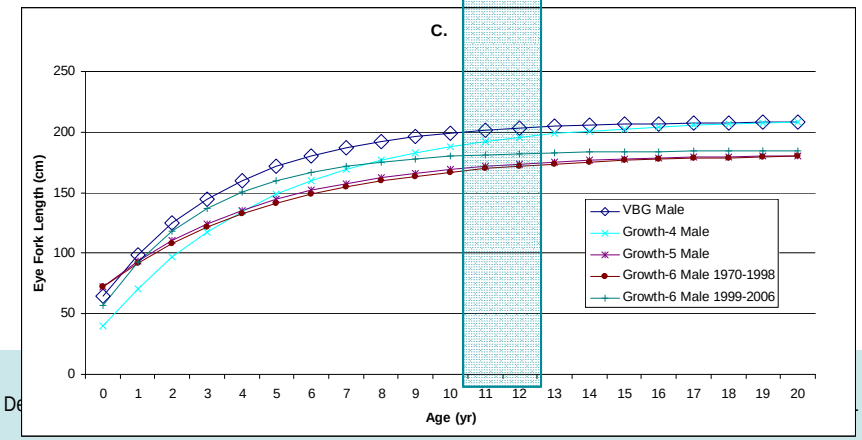


Sensitivity to Internally Estimated Growth

- All estimated growth curves were lower (indicating slower growth) than the independently estimated growth curve from the Central North Pacific for ages 2 – 14.





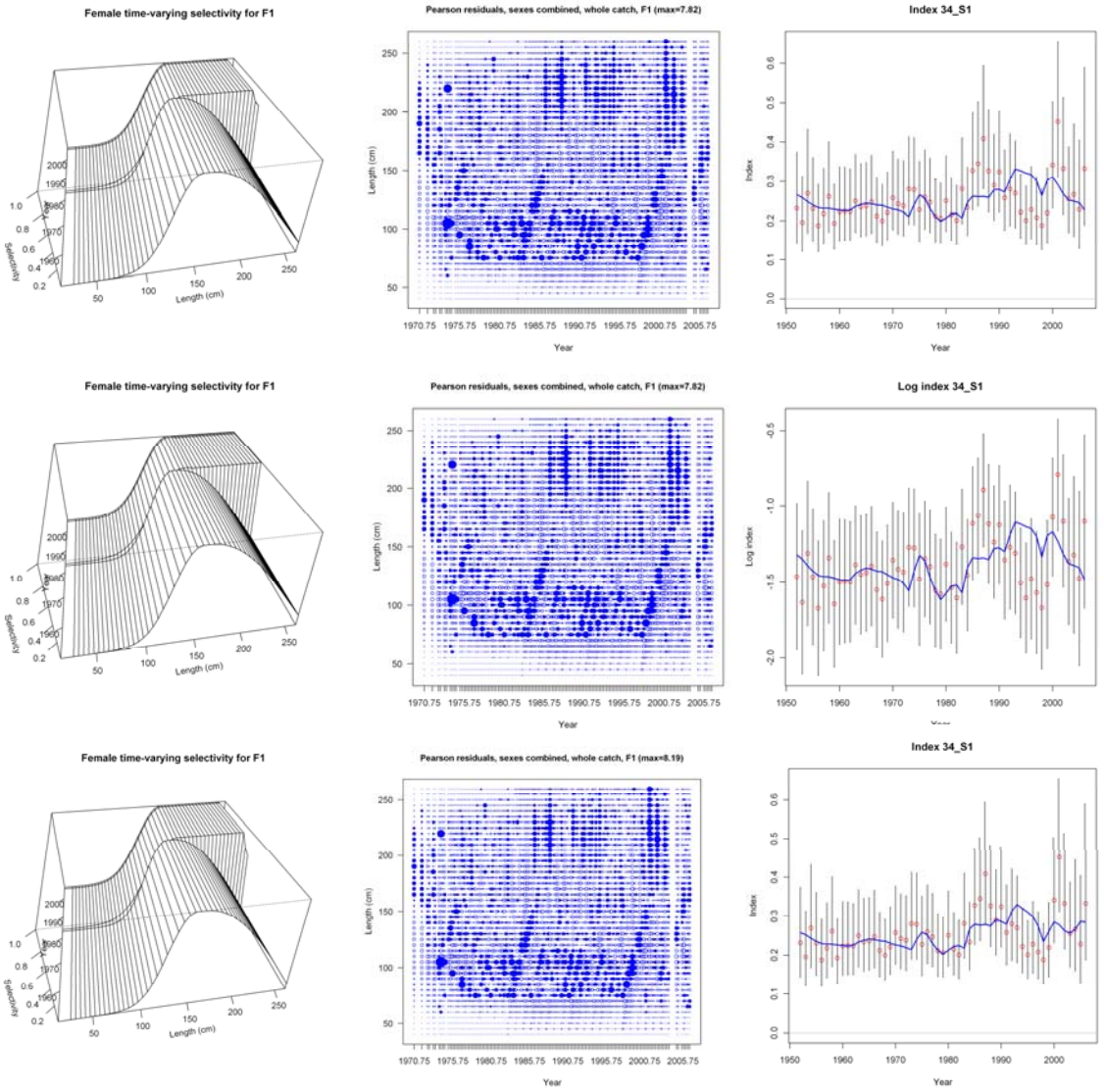


Sensitivity to Internally Estimated Growth

- Estimated growth within SS

Combined sex model

- k, L_{a_min}
- k, L_{a_min}, L_{a_max}
- k, L_{a_min}, L_{a_max},
- time blocks

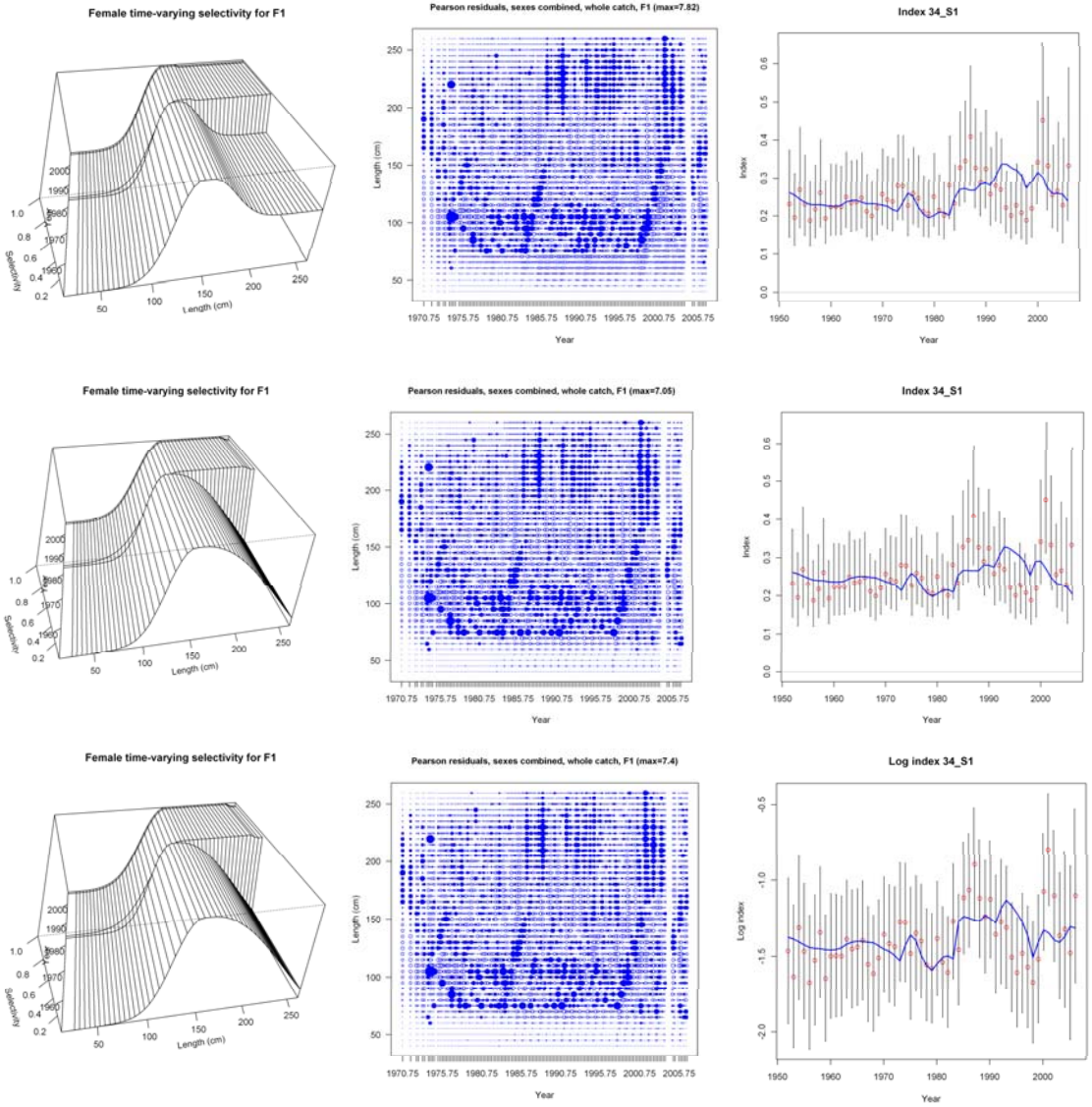


Sensitivity to Internally Estimated Growth

- Estimated growth within SS

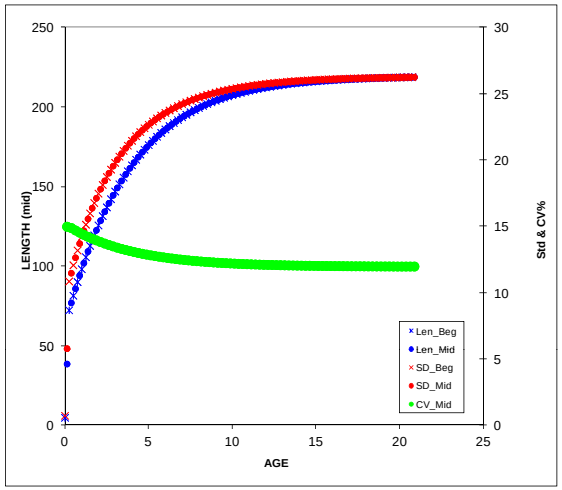
Two sex model

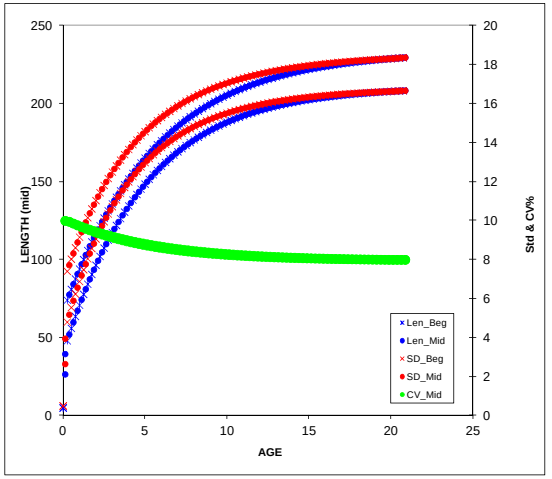
- k, L_{a_min}
- k, L_{a_min}, L_{a_max}
- k, L_{a_min}, L_{a_max},
- time blocks



Caveats of the Application

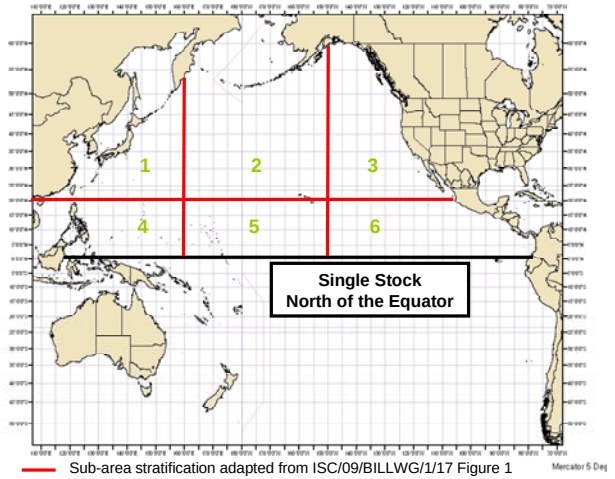
- Internally estimated growth sensitivity (not shown):
  - Assumed CV of length at age
    - Example combined sex
      - 15% for young fish to 12% for old fish
    - Example two sex
      - 10% for young fish to 8% for old fish
  - Recruitment timing
    - Quarter of year assigned to recruitment
  - Natural mortality
    - Estimated externally

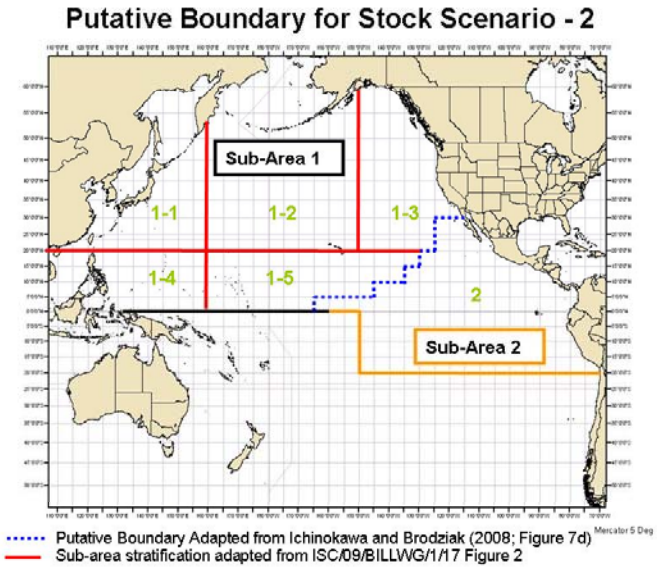




Caveats of the Application

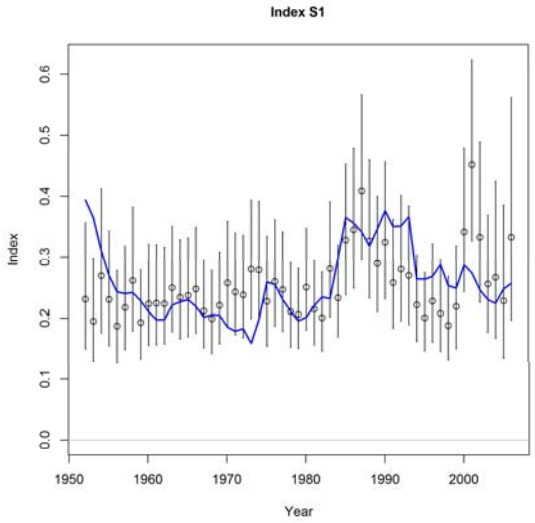
- Based on preliminary model (stock structure)
  - Preliminary model
    - One stock (NP)
  - Final model
    - Two stock (WNP)



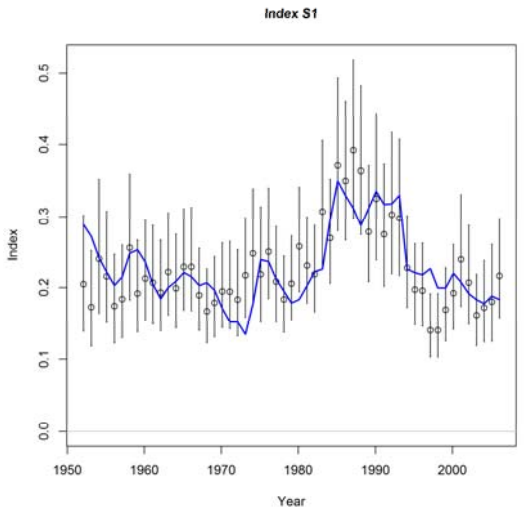


Caveats of the Application

- One stock (NP)
  - Data conflict length comp and CPUE resulted in poor fit to CPUE



- Two stock (WNP)
  - Data conflict reduced
    - CPUE more consistent with that expected based on the length comps



Conclusions

- Model sensitive to internally estimated growth
  - likelihood components
    - (e.g., Length comp and CPUE)
  - Stock status
    - (e.g. relative to F/F_{MSY} and S/S_{MSY})

- Caveats (preliminary model)
  - Data conflicts (CPUE vs length comp)
    - Down weight length comp to improve fit to CPUE
    - Data conflict reduced in two stock model

Thank you

Billfish Working Group for International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific

			K	t_0	L_inf
VBG	Combined Sex		0.26	-1.31	219.66
Model -1	Combined Sex		0.26	-1.31	219.66
Growth-1	Combined Sex		0.15	-2.38	226.59
Growth-2	Combined Sex		0.15	-2.39	227.45
Growth-3	Combined Sex	1951-1998	0.13	-2.70	234.42
Growth-3	Combined Sex	1999-2006	0.20	-2.08	210.32

			K	t_0	L_inf
VBG	Female		0.25	-1.24	230.50
VBG	Male		0.271	-1.37	208.9
Growth-4	Female		0.18	-1.89	233.75
Growth-4	Male		0.20	-1.03	211.03
Growth-5	Female		0.18	-1.86	234.15
Growth-5	Male		0.22	-2.34	181.88
Growth-6	Female	1951-1998	0.17	-2.01	233.93
Growth-6	Male	1951-1998	0.20	-2.56	182.09
Growth-6	Female	1999-2006	0.15	-2.73	242.15
Growth-6	Male	1999-2006	0.33	-1.12	184.72