


Comisión Interamericana del Atún Tropical
Inter-American Tropical Tuna Commission

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# SUMMARY OF MODELING WORK ON EVALUATING BIGEYE TUNA RECRUITMENT SHIFT HYPOTHESES

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**SAC-10 INF-G**

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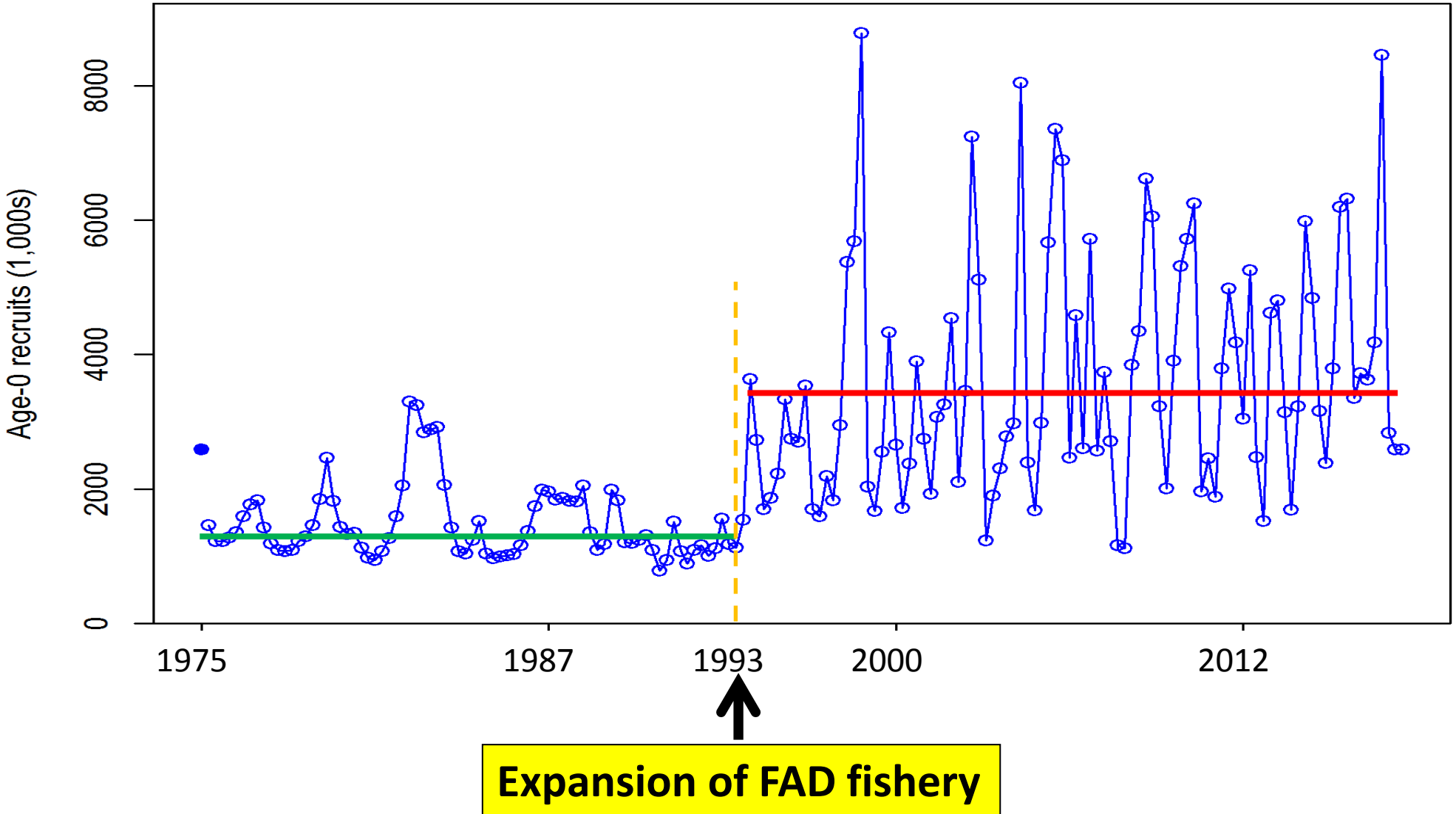
# Outline

- Motivation for this work
  - Resolve BET stock assessment model misspecifications (Recruitment shift)
    - Improve BET stock assessment
    - Develop more realistic operating models for ongoing Management Strategy Evaluation (MSE)
- Approach (alternative SS model runs under several hypotheses)
- Results
- Conclusions

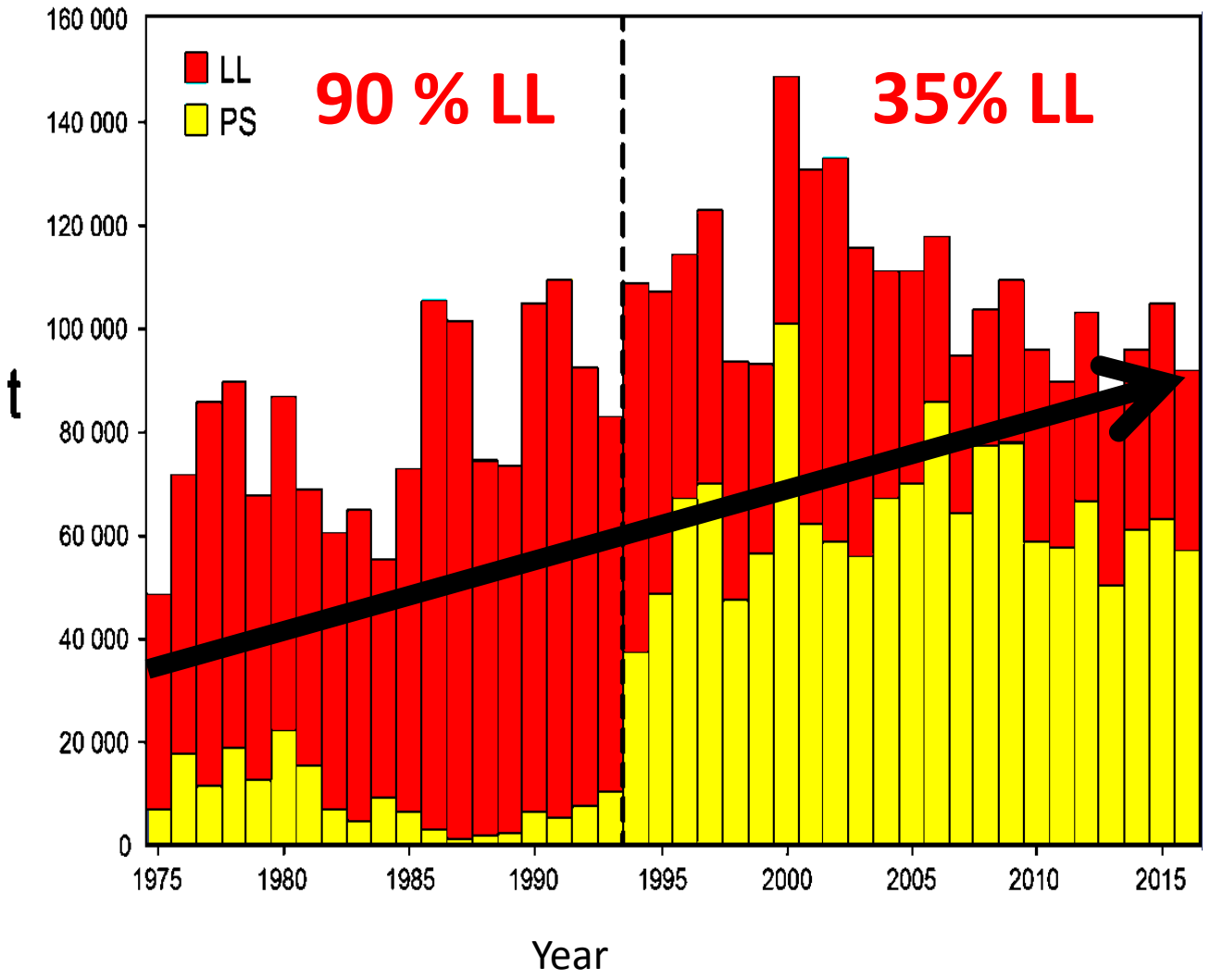
# Motivation for this work – Motivación del trabajo

- Recruitment shift ($R_{shift}$) in the bigeye assessment



# Motivation for this work – Motivación del trabajo

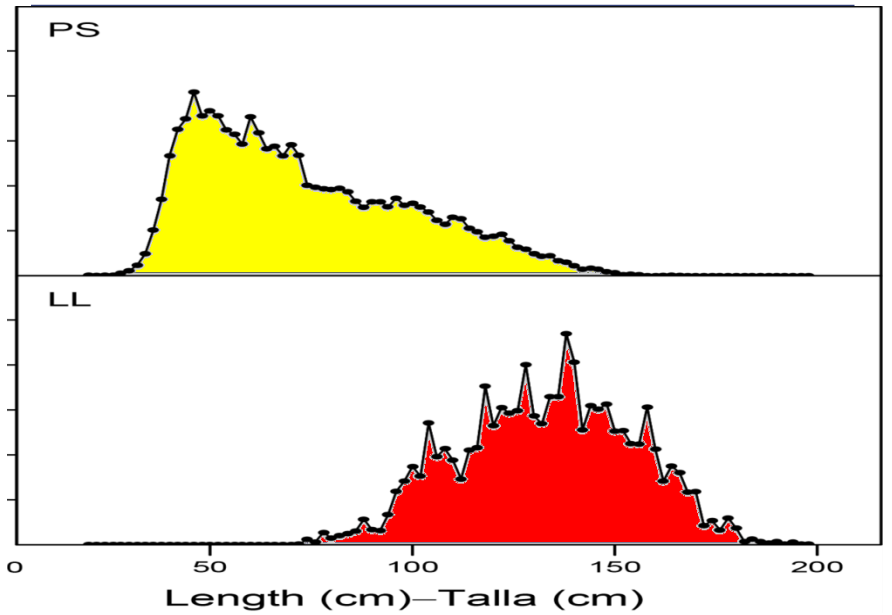
## Expansion of FAD fishery




Expansion of **Purse Seine** fishery

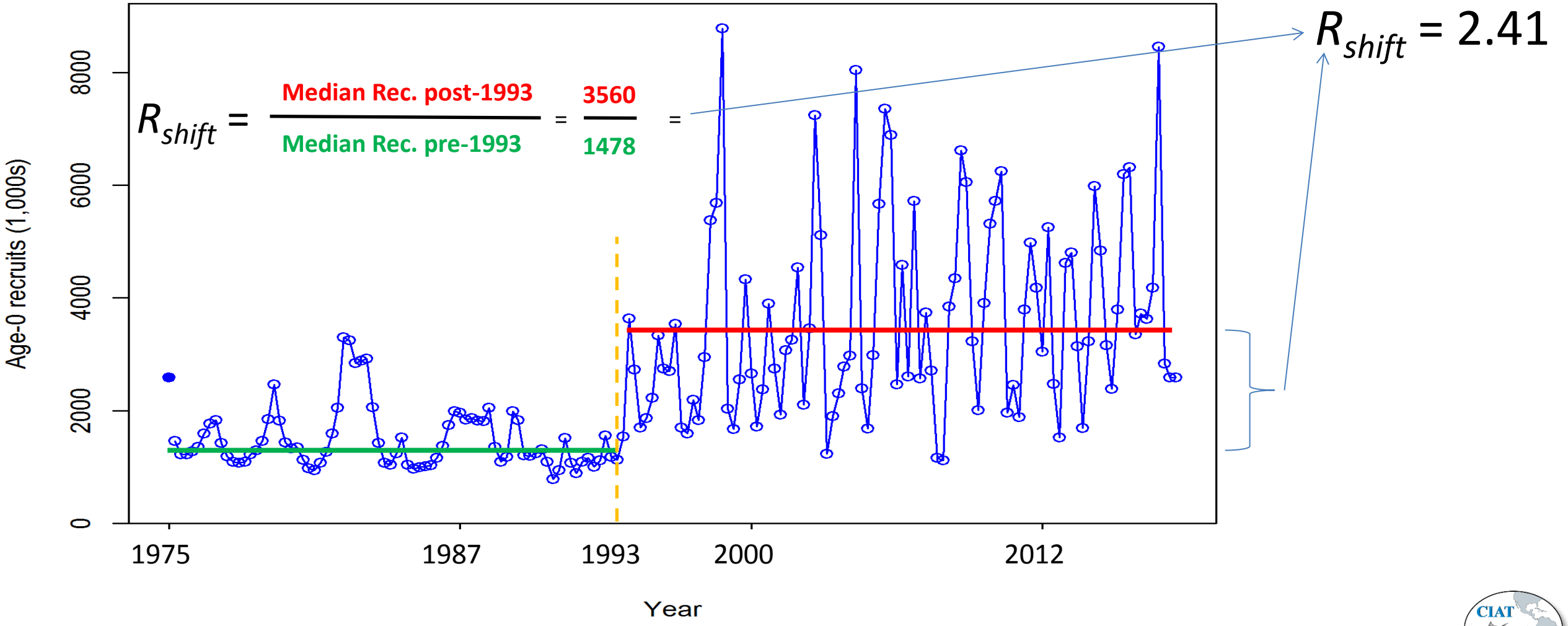
Increased **TOTAL** catch

Smaller fish in **Purse Seine** fishery



# Approach – Metodología

- Recruitment shift ($R_{shift}$) in the bigeye assessment



# Approach – Metodología

- Alternative SS model runs under several hypotheses, including:
  - Higher natural mortality
  - Alternative Growth
  - Dome-shaped selectivities
  - Historical catches

  **Presented here**

  - Spatial mismatch
  - Density-dependent growth
  - Length-Weight relationship misspecification
  - Catchability misspecification
  - Problems in the longline CPUE standardization
  - Issues with estimation of FAD catches
  - Changes in migratory patterns

  Presented elsewhere


Valero et al. 2018. Exploratory spatial stock assessment of Bigeye tuna (*Thunnus obesus*) in the EPO. SAC-09-08

Valero et al. 2018. Exploratory spatial stock assessment of Bigeye tuna in the EPO. CAPAM spatial stock assessments workshop, La Jolla, CA, USA, Oct. 1-5, 2018.

Valero et al. 2019. Spatial stock assessment model options for bigeye tuna (*Thunnus obesus*) in the EPO and beyond. 2nd Bigeye Assessment Review. La Jolla, California (USA), 11-15 March 2019.

Valero et al. 2019. Investigating potential causes of misspecification-induced regime shift in recruitment in the EPO bigeye tuna (*Thunnus obesus*) assessment. 2nd Bigeye Assessment Review. La Jolla, California (USA), 11-15 March 2019.

Punt et al. 2019. Report of Meeting. 2nd Bigeye Assessment Review. La Jolla, California (USA), 11-15 March 2019.

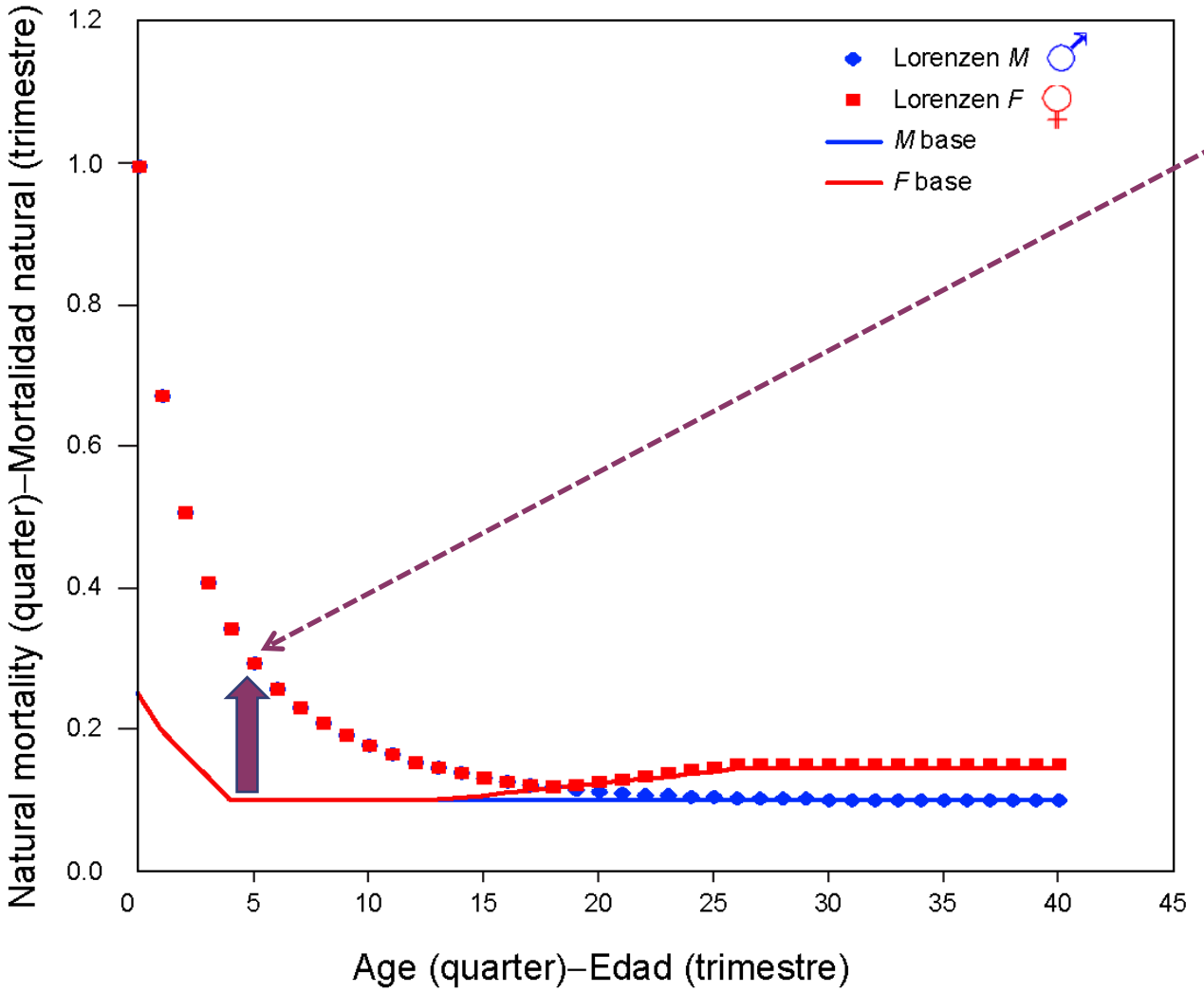
Valero et al. 2019. Summary of modeling work on evaluating bigeye tuna recruitment shift hypotheses. SAC-10 INF-G

# Approach – Metodología

- Alternative SS model configurations

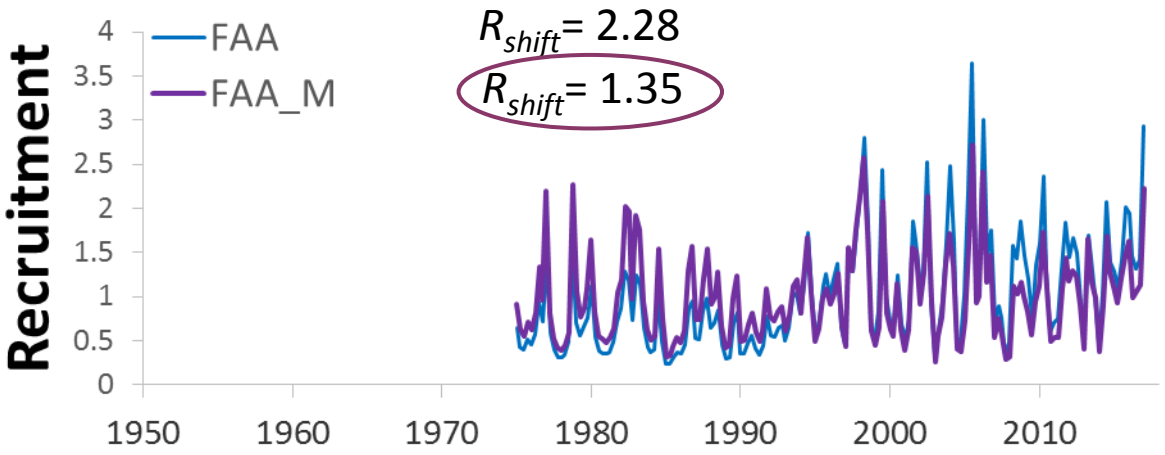
| | 2018 BC | FAA (This work) |
|---|---|---|
| SS Version | 3.23b | 3.30.12 |
| Years and time step | Years (1975-2018) as Quarters (1-172) approach | |
| Ages | Max age 40 quarters (10 years) | |
| Sexes | 2-sex model | |
| Length bins (data) | 2 cm | 10 cm |
| Length bins (population) | 2 cm | 2 cm |
| Area configuration | Defined in SAC 07-05a | Defined in WSBET-02-02 |
| Fleets | 27 | 20 |
| Indices of abundance (LL) | 2 | 5 |
| Fleets with length compositions | 15 | 13 |
| Northern area (Hawaii) included? | Yes | No |
| λ Length comps | 0.05 | 1 |
| Includes discards? | Yes | No |
| Includes LL training vessel data? | Yes | No |

# Higher natural mortality (*M*) – Mortalidad natural

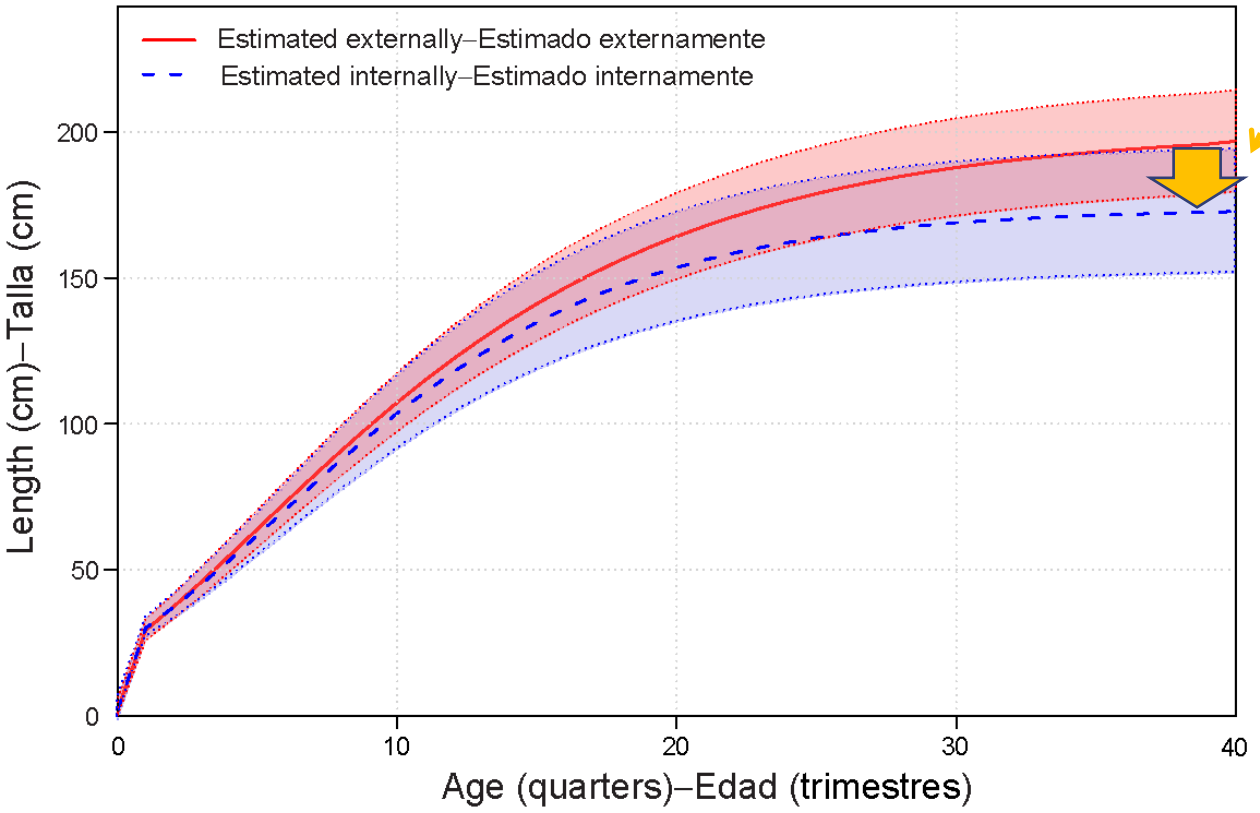



Using a Lorenzen *M* schedule:

- Higher *M* for juvenile BET
- Reduces $R_{shift}$

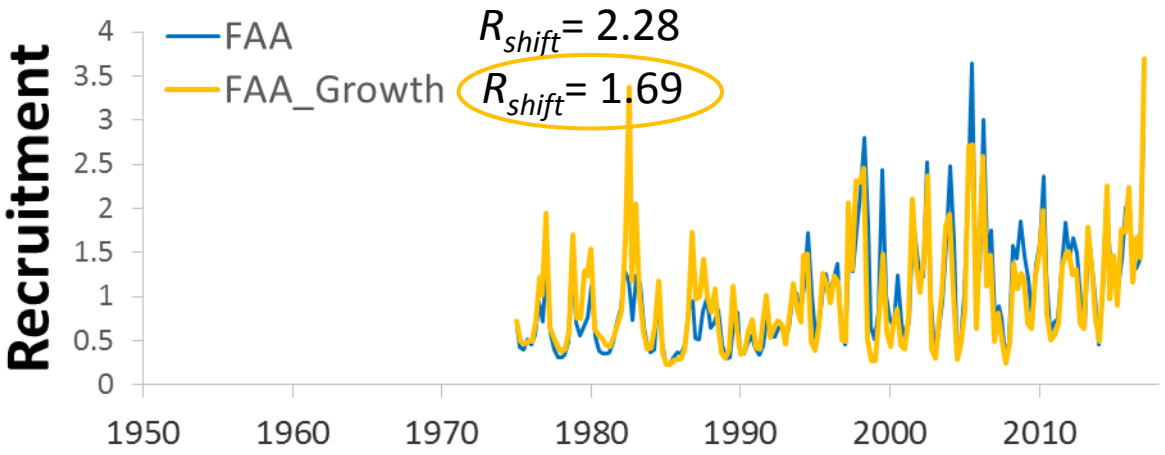


# Alternative Growth – Crecimiento alternativo

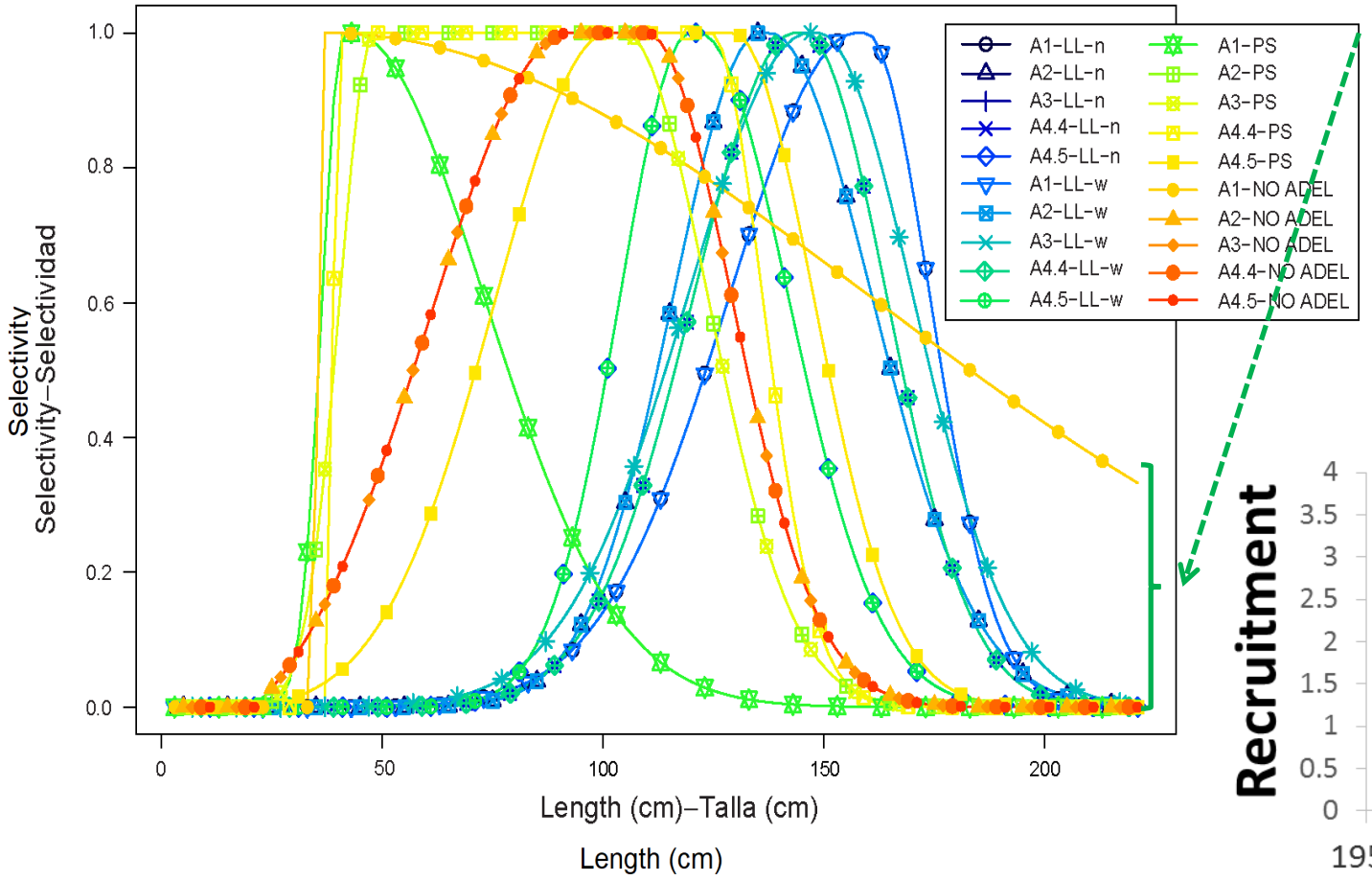



Estimating growth inside the SS model

- Smaller average size of oldest BET
- Reduces $R_{shift}$



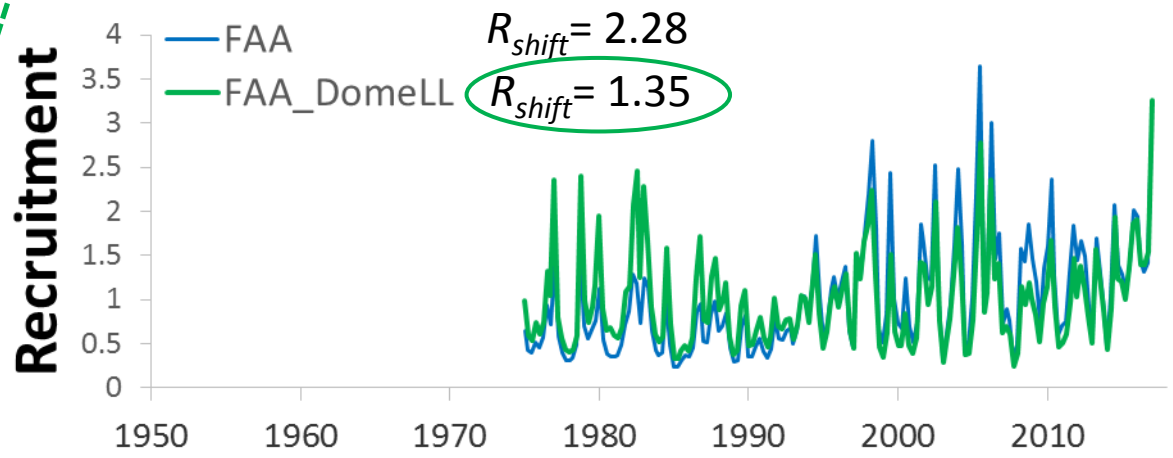
# Dome-shaped selectivities – Selectividades domo



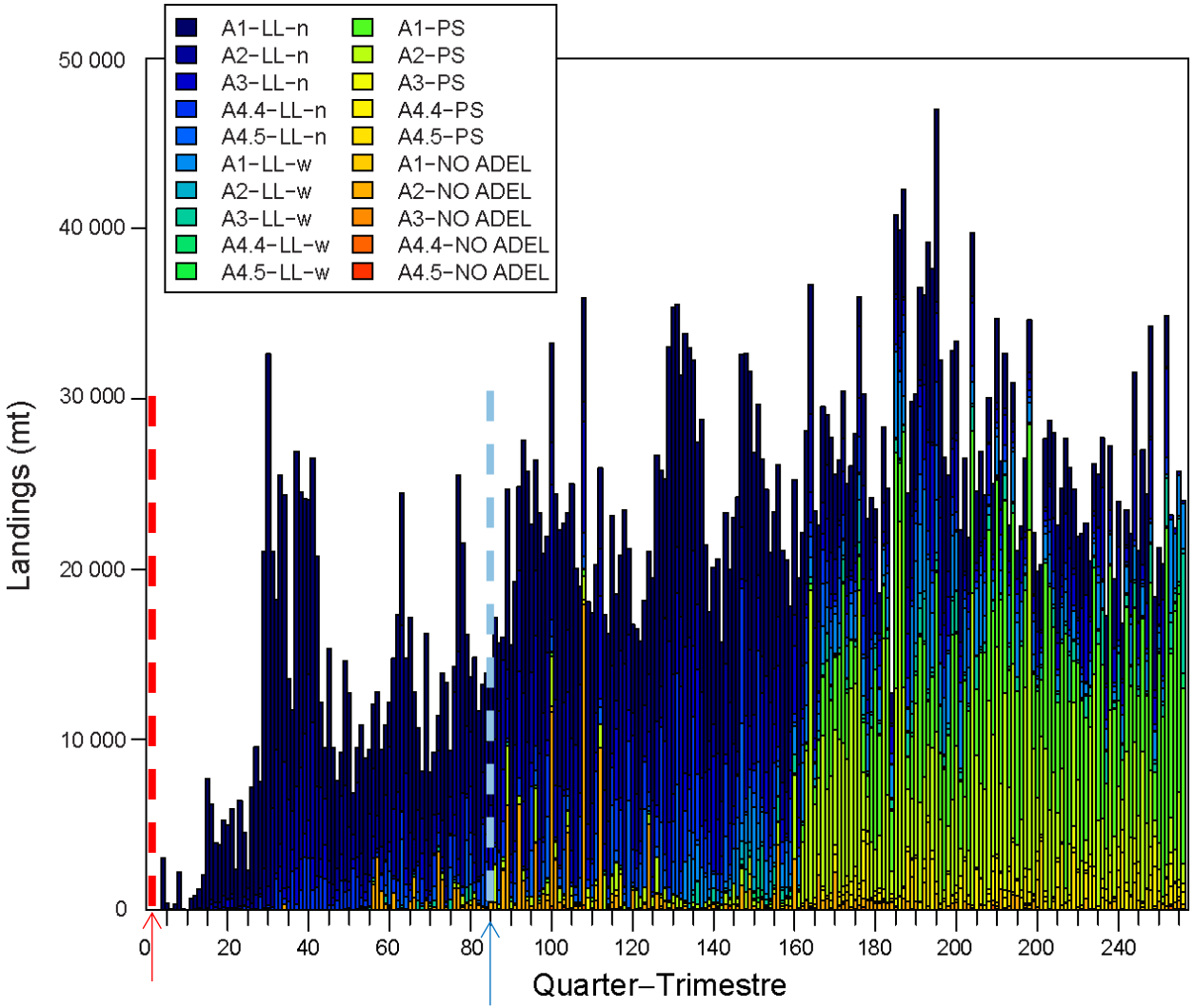

2018 BC assumes asymptotic selectivities for longline.

Estimating dome-shaped selectivities for all fisheries

- Reduces $R_{shift}$



# Historical catches – Capturas históricas

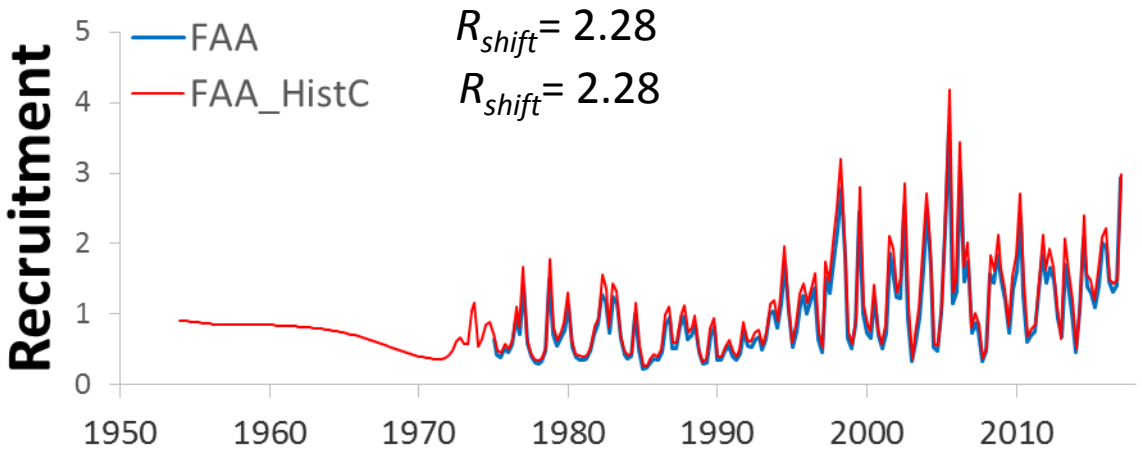



**1954**
**Historical models**

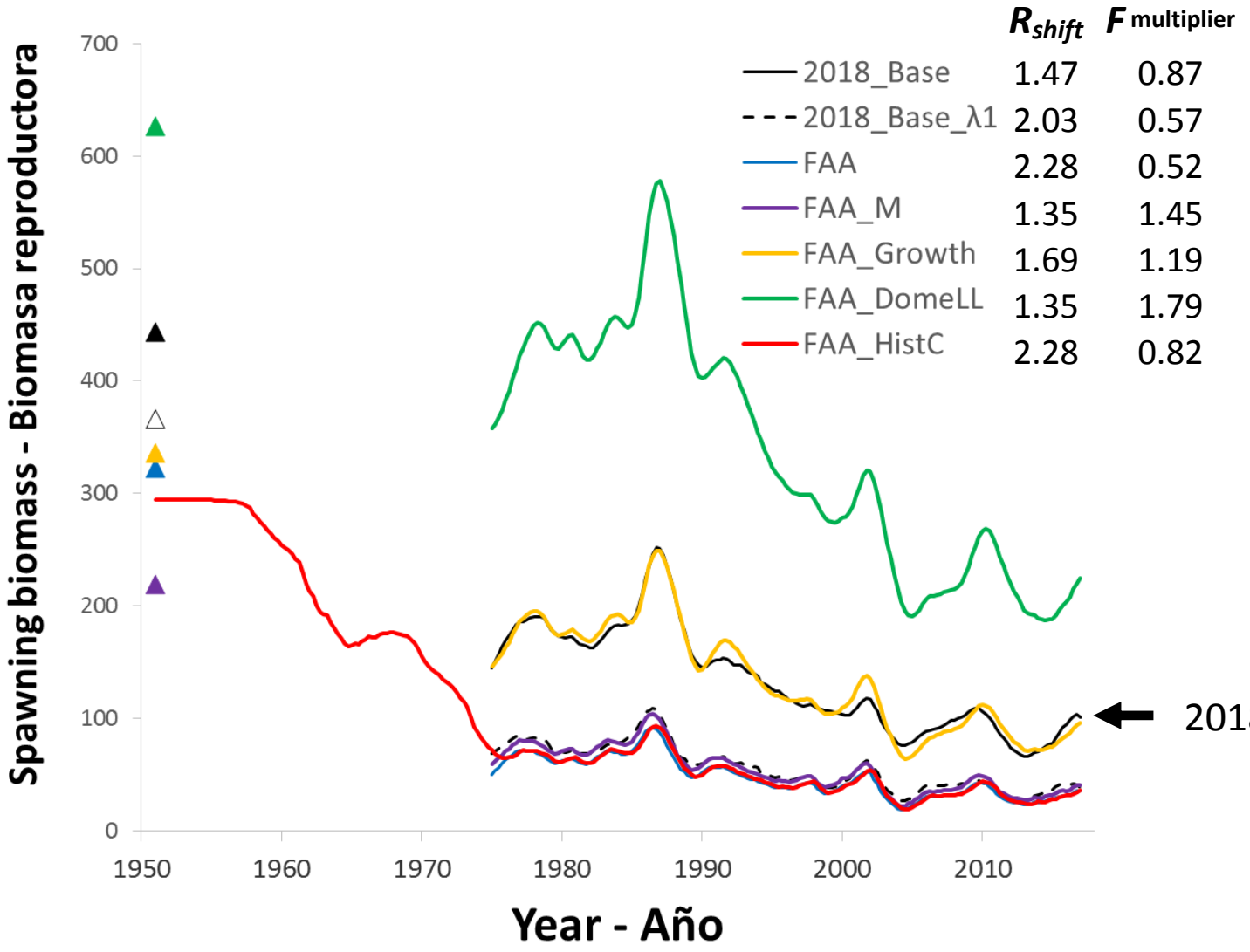
**1975**
**Base models**

Using historical catches

- Reduces $R_{shift}$ , depending on other model assumptions



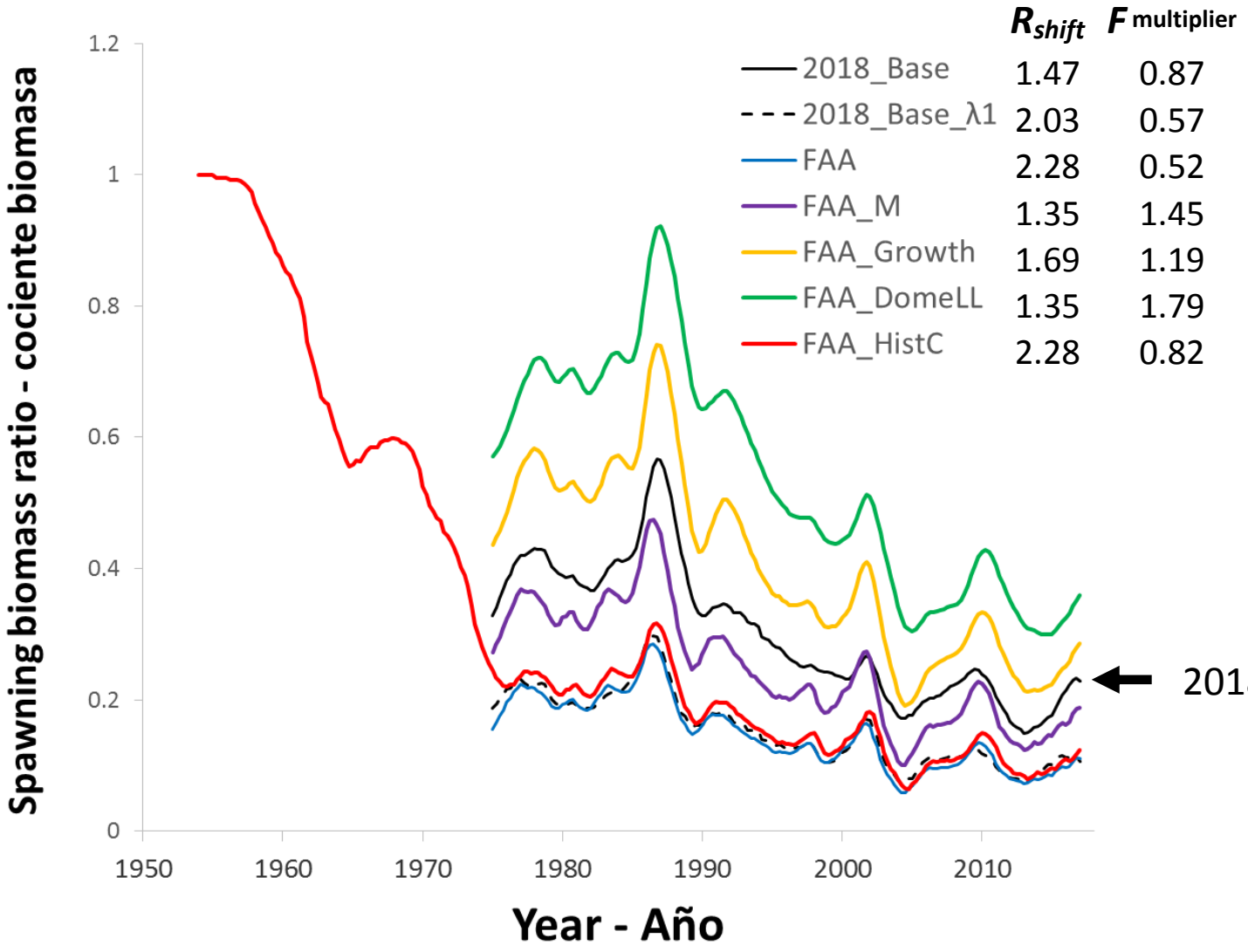
# Summary of results – Resúmen de resultados




- FAA model similar to 2018 Base with λ= 1, both estimate lower biomass than 2018 Base
- Wide range of *F* multipliers (0.52 to 1.79)

2018 Base model

# Summary of results – Resúmen de resultados




| | $R_{shift}$ | $F$ multiplier |
|---|---|---|
| 2018_Base | 1.47 | 0.87 |
| 2018_Base_λ1 | 2.03 | 0.57 |
| FAA | 2.28 | 0.52 |
| FAA_M | 1.35 | 1.45 |
| FAA_Growth | 1.69 | 1.19 |
| FAA_DomeLL | 1.35 | 1.79 |
| FAA_HistC | 2.28 | 0.82 |

- FAA model similar to 2018 Base with λ= 1, both estimate lower biomass than 2018 Base
- Wide range of *F* multipliers (0.52 to 1.79)

← 2018 Base model

# Conclusions

- Spatial models with no movement do not reduce the $R_{shift}$, some models with movement reduced the $R_{shift}$ but highly sensitive to movement rates or general movement patterns for adult bigeye which are unknown.
- Models with higher juvenile *M*, or estimating growth internally, or estimating dome-shaped selectivities reduced the $R_{shift}$ and estimate similar population trends as the 2018 base case but with different scale.
- Including historical catches reduced the $R_{shift}$ for the 2018 Base model but it did not reduce the FAA model $R_{shift}$. Further investigations into the initial conditions are warranted.
- The range of *F* multiplier is wide (0.52 to 1.79). **None of the models summarized in this report are being considered as a potential new base case for EPO bigeye tuna**, results should be treated with caution in any management context.

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# ¿Preguntas – Questions?