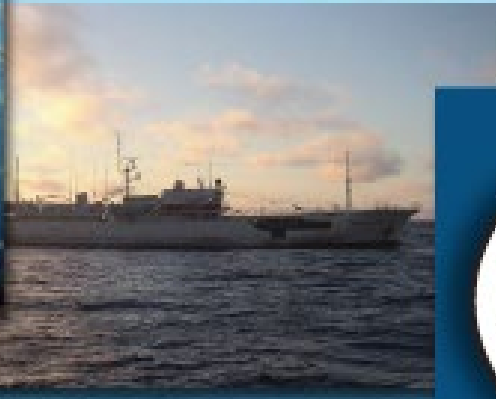


Comisión Interamericana del Atún Tropical  
Inter-American Tropical Tuna Commission



**EVALUATING INCONSISTENCIES IN THE YELLOWFIN ABUNDANCE INDICES**  
Carolina Minte-Vera, Mark N. Maunder, Alexandre Aires-da-Silva, and  
Haikun Xu

# Outline

- Issues with the assessment
- Hypotheses to explain inconsistency in indices
- Model runs investigating hypotheses
- Conclusions

# Issues

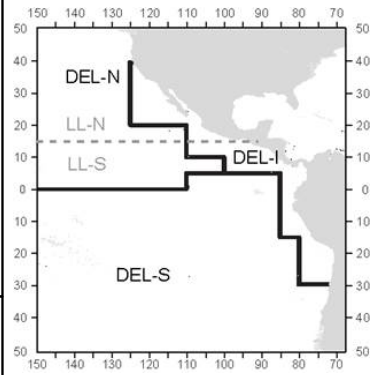
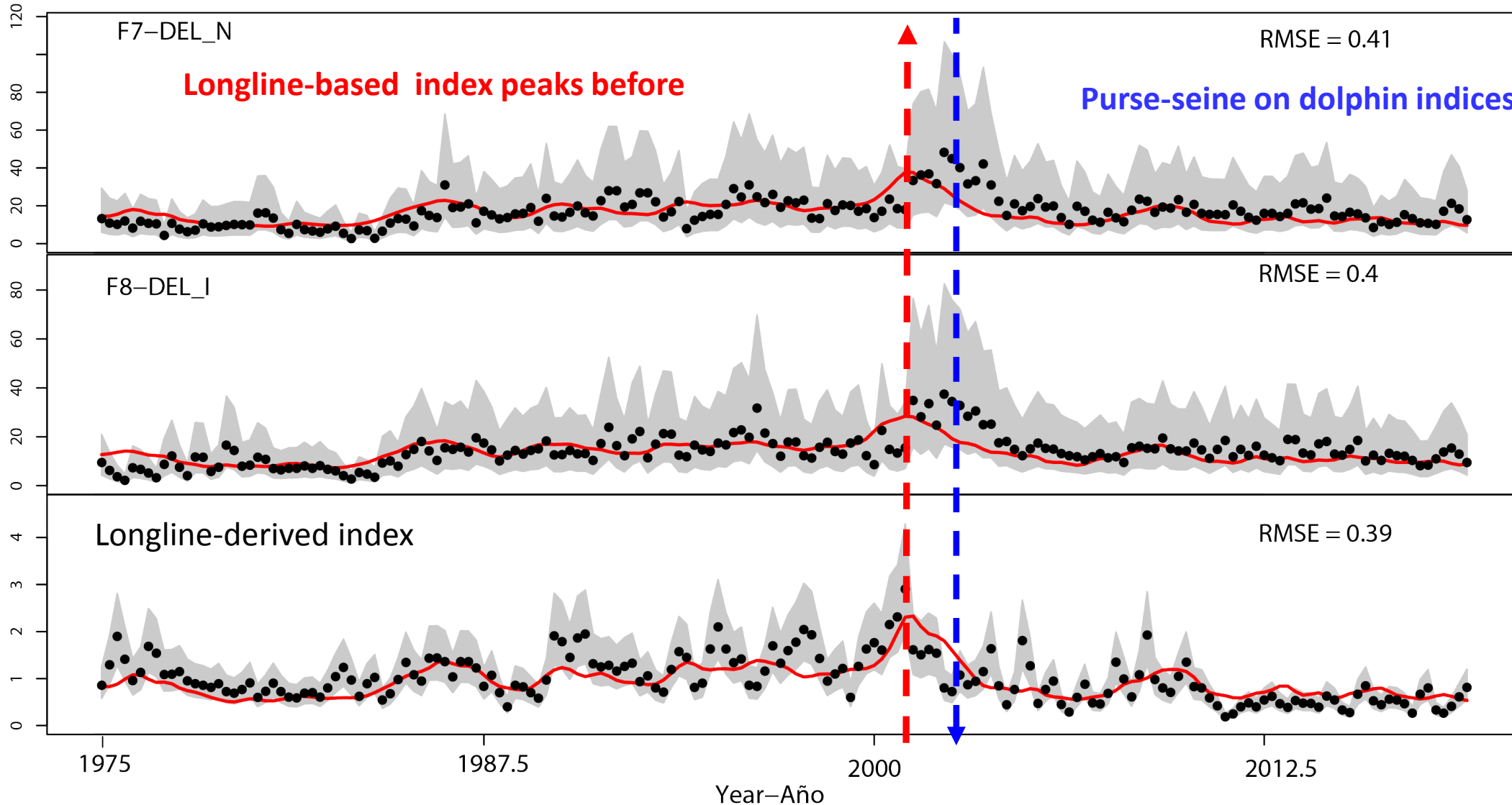
- The management quantities are sensitive to the inclusion of the 2018 data for the longline index of abundance.
- Inconsistencies between Japanese longline index and the dolphin-associated purse-seine index
- Changes in the length composition for the longline fishery

# MSY and related quantities

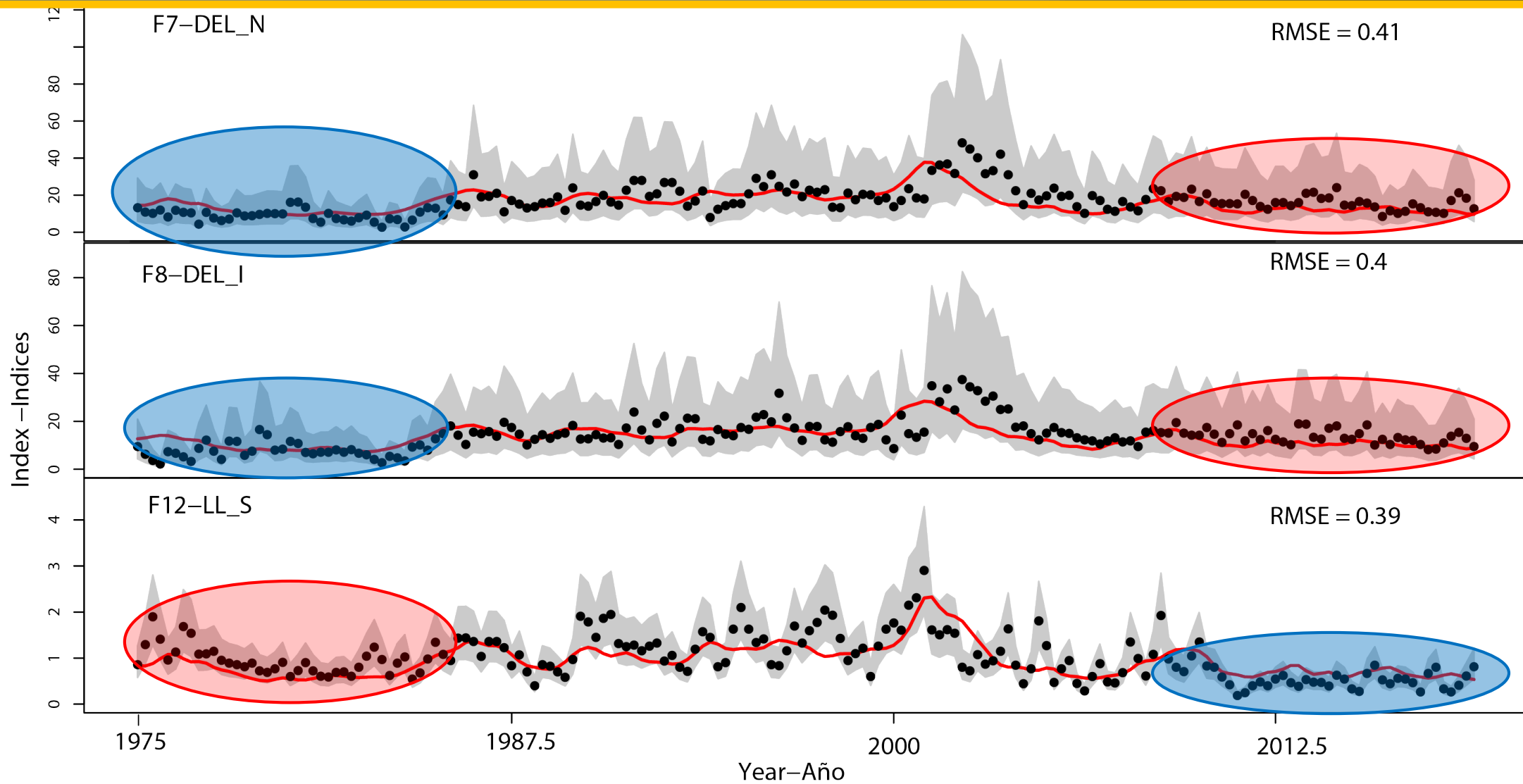
YFT	SAC 9 Base case Caso base	SAC 10 Base case Caso base	SAC 10 Base case except update LL_S
MSY-RMS	264,283	254,975	254,872
$B_{MSY} - B_{RMS}$	376,696	371,787	372,247
$S_{MSY} - S_{RMS}$	3,634	3,638	3,642
$B_{MSY}/B_0 - B_{RMS}/B_0$	0.31	0.31	0.31
$S_{MSY}/S_0 - S_{RMS}/S_0$	0.27	0.27	0.27
$C_{recent}/MSY - C_{reciente}/RMS$	0.85	1.00	1.00
$B_{recent}/B_{MSY} - B_{reciente}/B_{RMS}$	1.35	0.84	1.03
$S_{recent}/S_{MSY} - S_{reciente}/S_{RMS}$	1.08	0.76	0.99
$F$ multiplier-Multiplicador de $F$	0.99	0.89	1.00

- Results driven by the update in the longline-based index of abundance
- The rest of the new (or updated) data:
  - ✓ Do not show indication of increase in fishing mortality
  - ✓ Decline in biomass not so strong

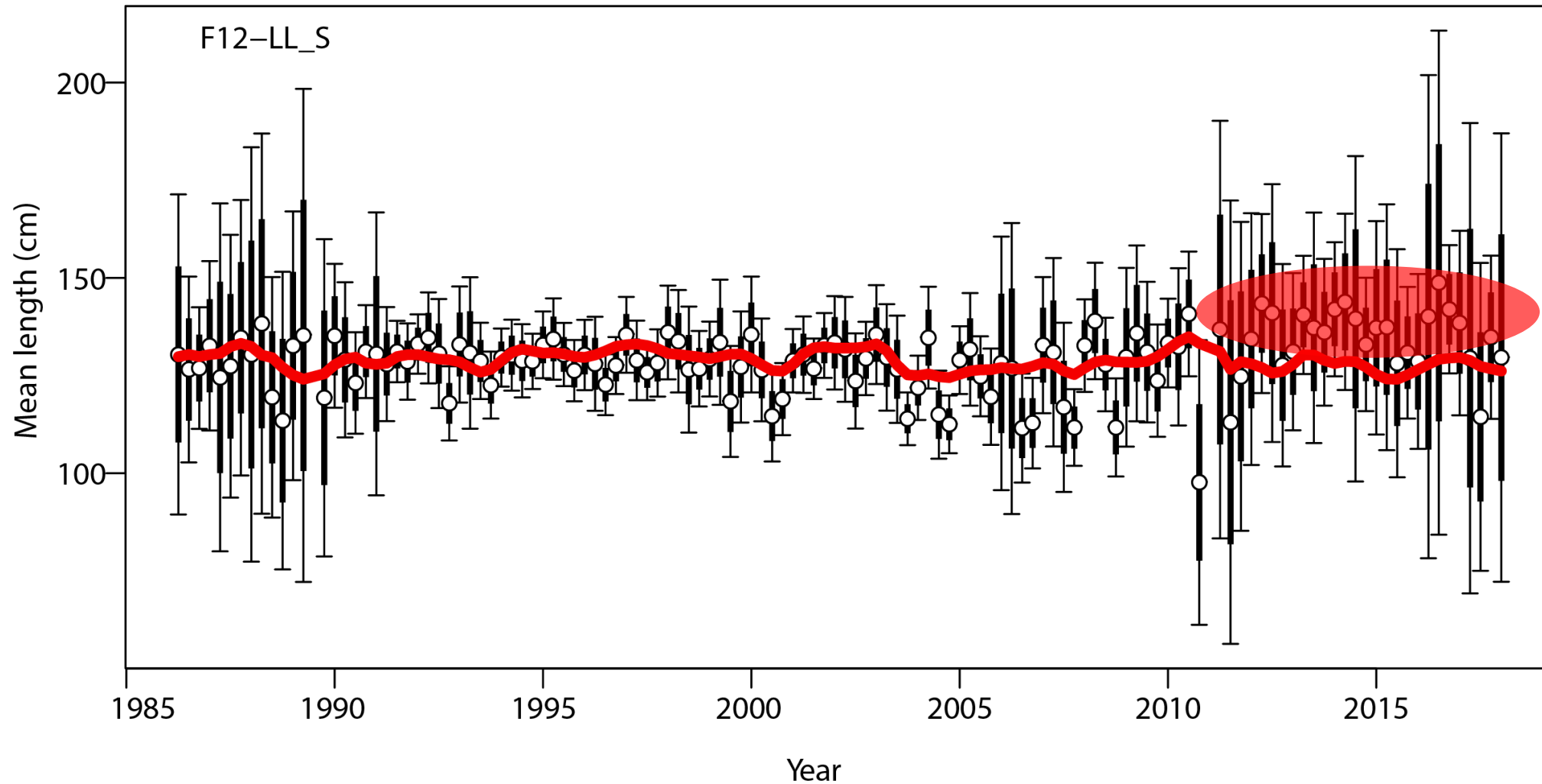
# Inconsistencies among indices



# Inconsistencies among indices



# Change in longline length composition



# Hypotheses for index inconsistencies

- **Change in fishing behavior (e.g. targeting) by the longline fishery**
- **Mis-specified growth**
- **Inadequate consideration of spatiotemporal correlations in the indices of abundance**
- **Spatial structure in the population**

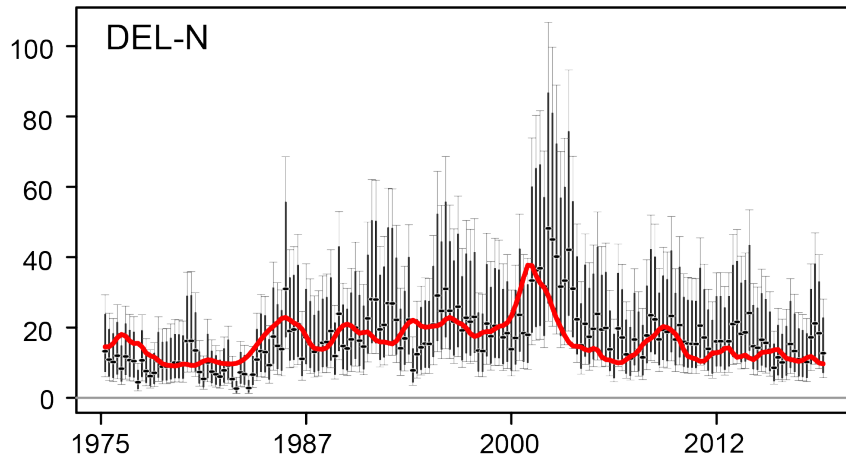


# Model runs to investigate the hypotheses

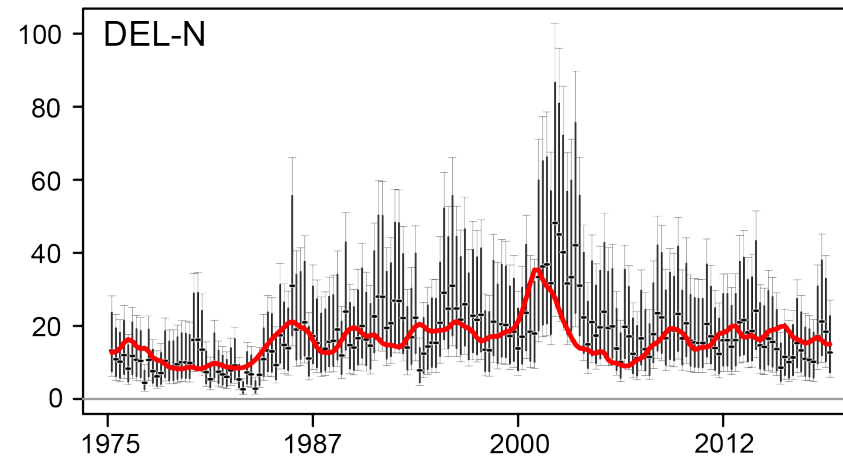
- **Change in fishing behavior (e.g. targeting) by the longline fishery**  
Estimate change in selectivity and catchability in 2010
- Mis-specified growth
- Inadequate consideration of spatiotemporal correlations in the indices of abundance
- Spatial structure in the population

# Change in fishing behavior

Base case–Caso base



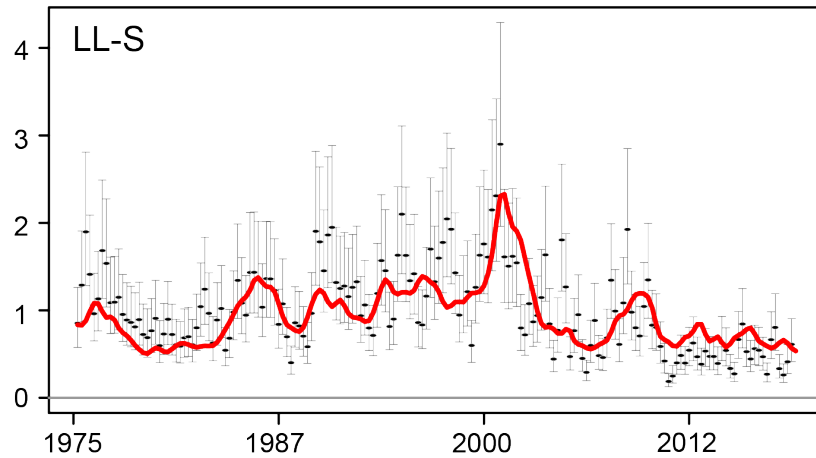
Change–Cambio (S + C)



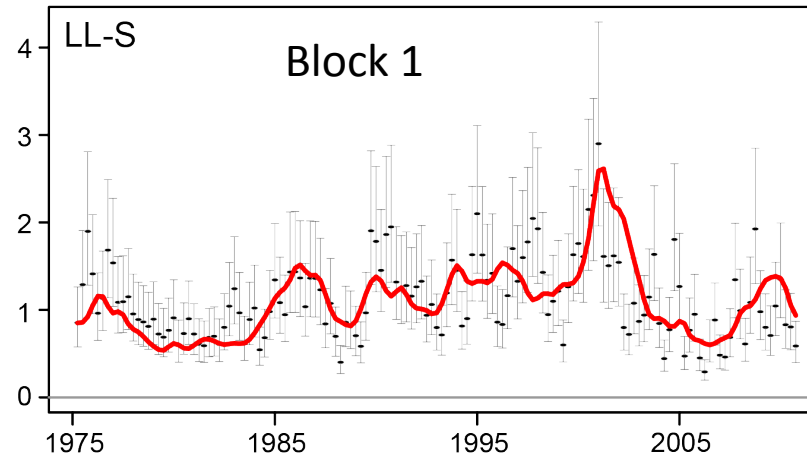
Model: Time-block in selectivity and catchability in 2010

Index-Index

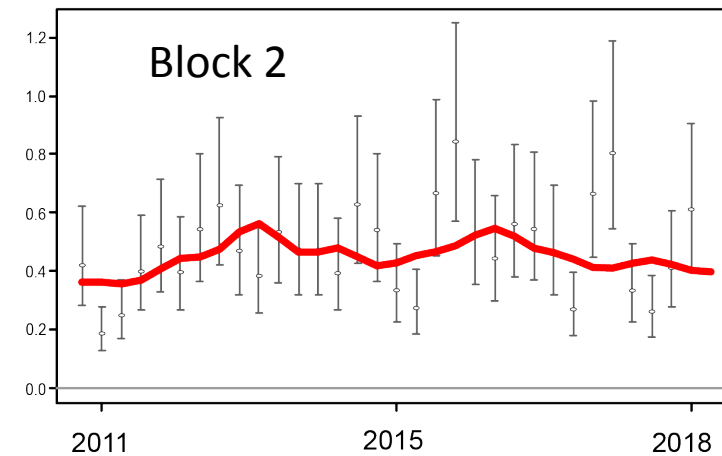
LL-S



LL-S

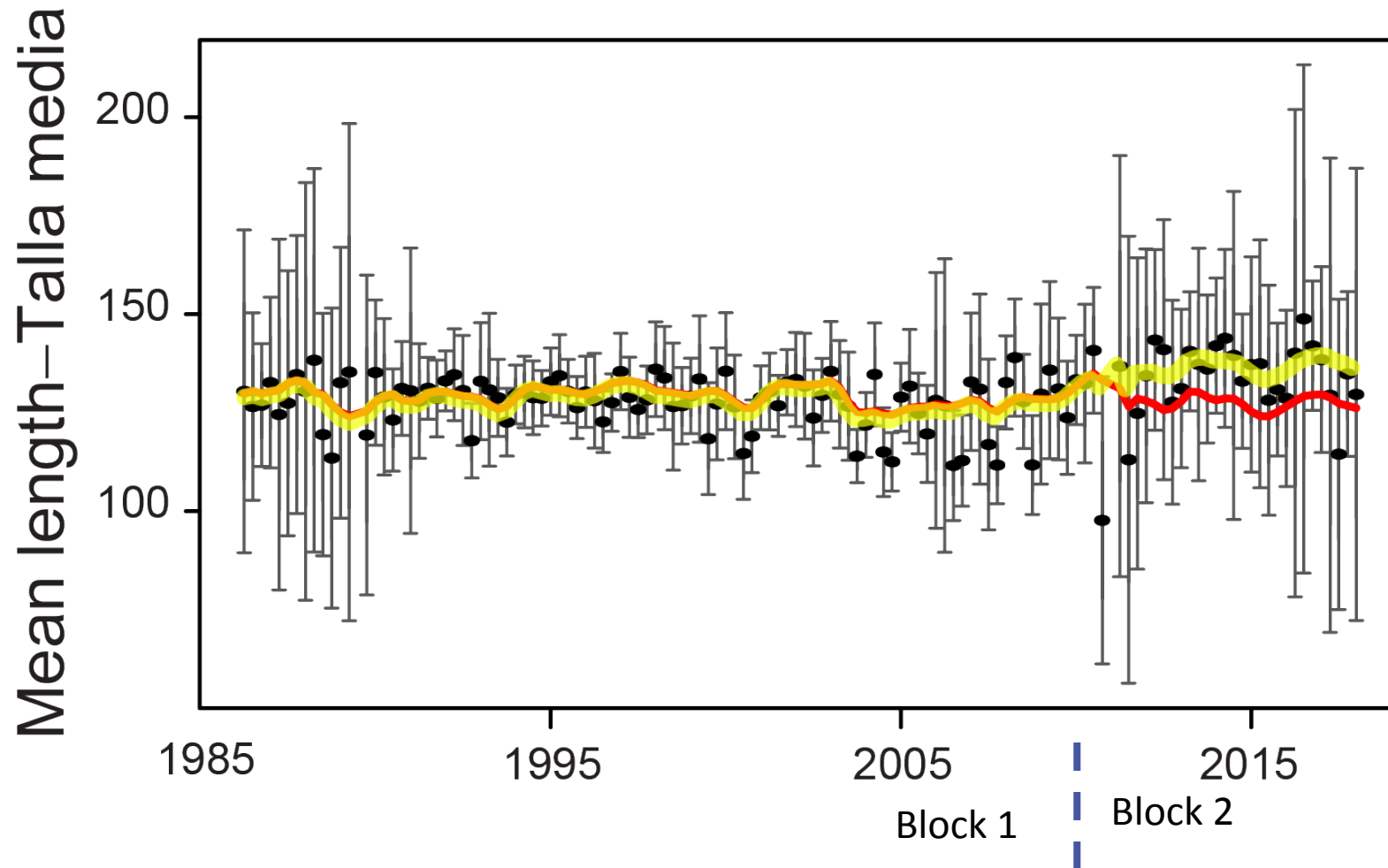


Block 1

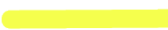



Block 2

# Change in fishing behavior



Model: Time-block  
in selectivity and  
catchability in 2010

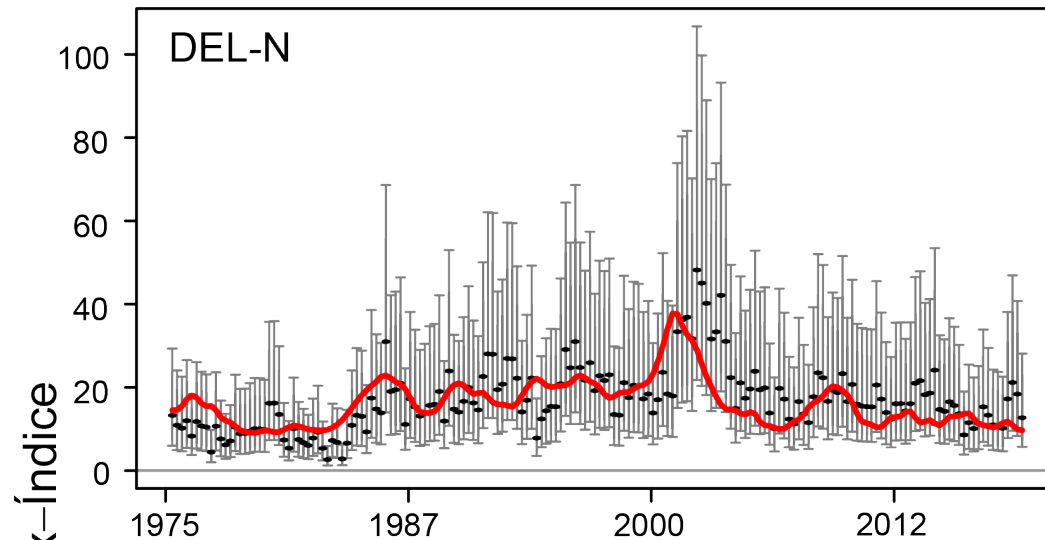
Change-Cambio (S + C)   
Base case-Caso base 

# Model runs to investigate the hypotheses

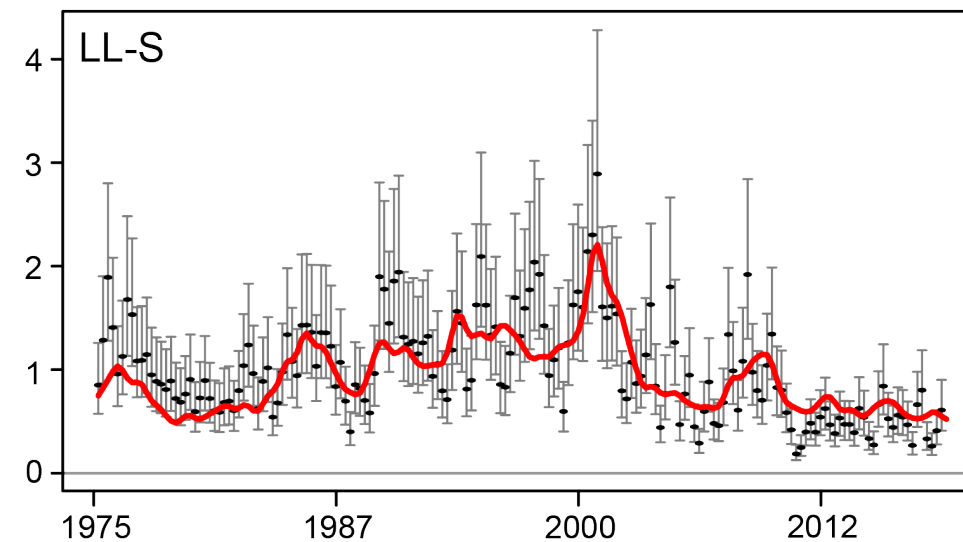
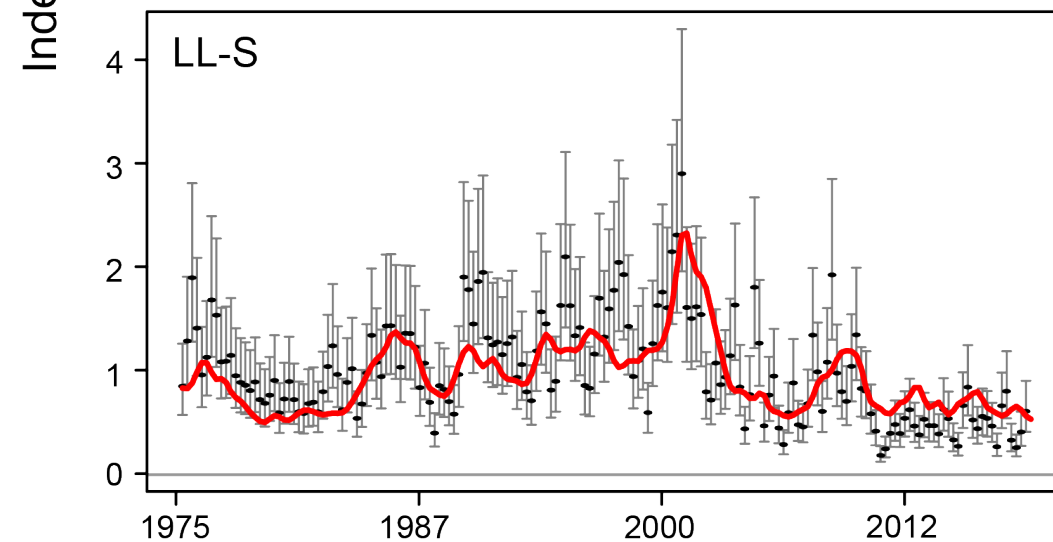
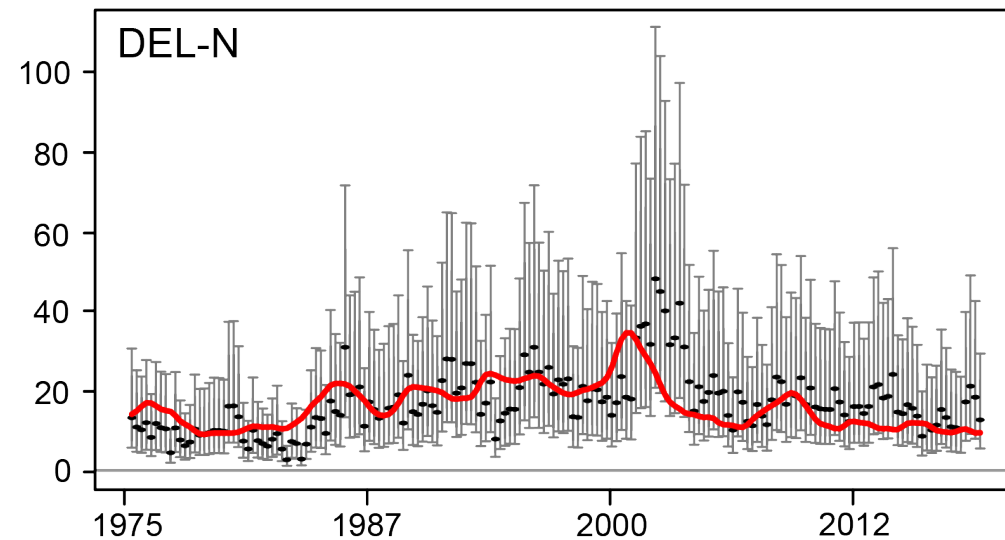
- Change in fishing behavior (e.g. targeting) by the longline fishery  
Estimate change in selectivity and catchability in 2010
- **Mis-specified growth**  
Estimate growth parameters
- Inadequate consideration of spatiotemporal correlations in the indices of abundance
- Spatial structure in the population

# Mis-specified growth

Base case–Caso base



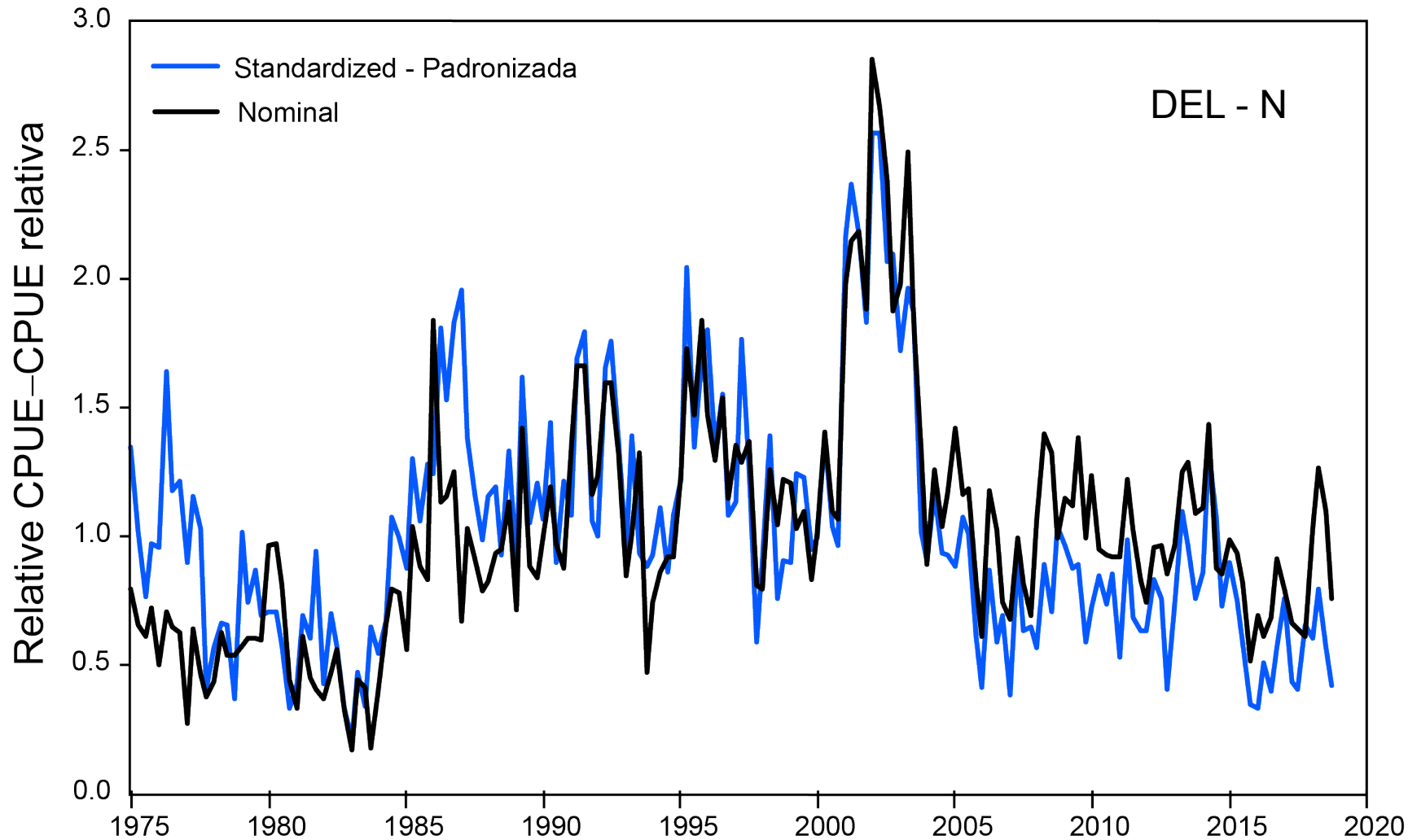
Estimated growth—Crecimiento estimado



# Model runs to investigate the hypotheses

- **Change in fishing behavior (e.g. targeting) by the longline fishery**  
Estimate change in selectivity and catchability in 2010
- **Mis-specified growth**  
Estimate growth parameters
- **Inadequate consideration of spatiotemporal correlations in the indices of abundance**  
Use spatiotemporal model for dolphin associated indices
- **Spatial structure in the population**

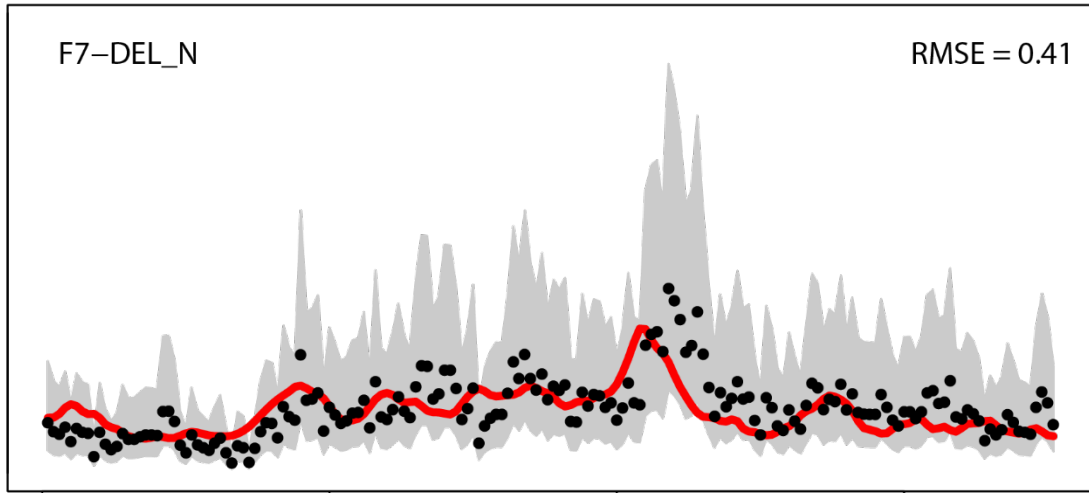
# Inadequate consideration of spatial structure in the indices of abundance



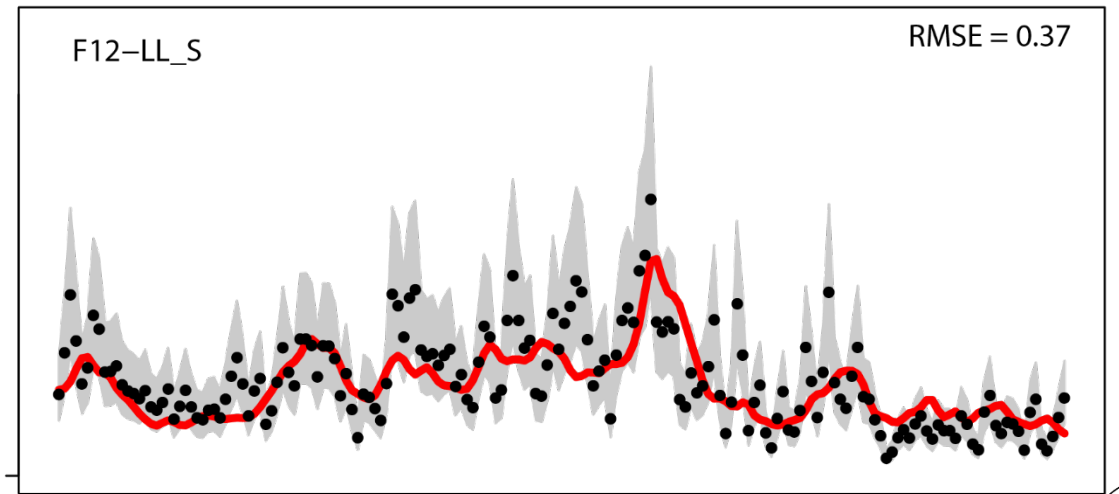
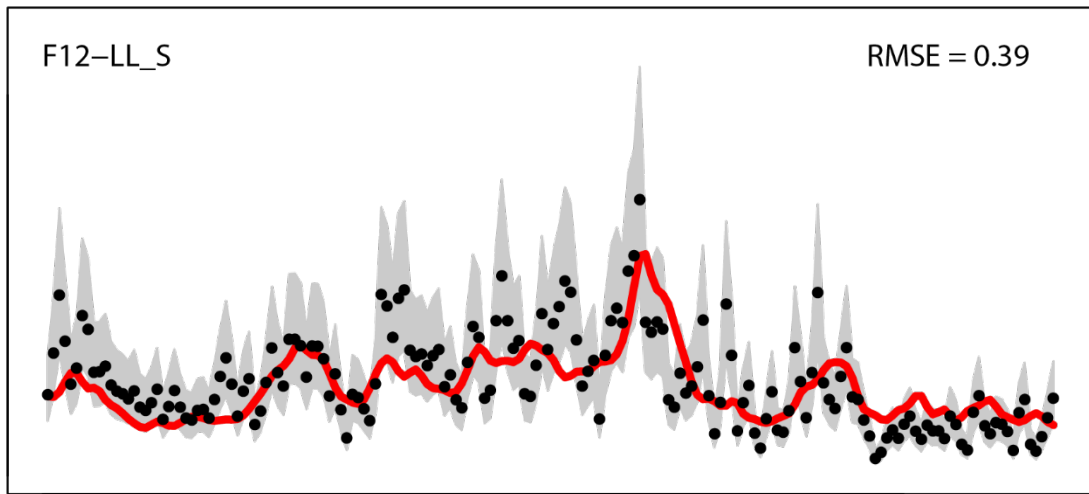
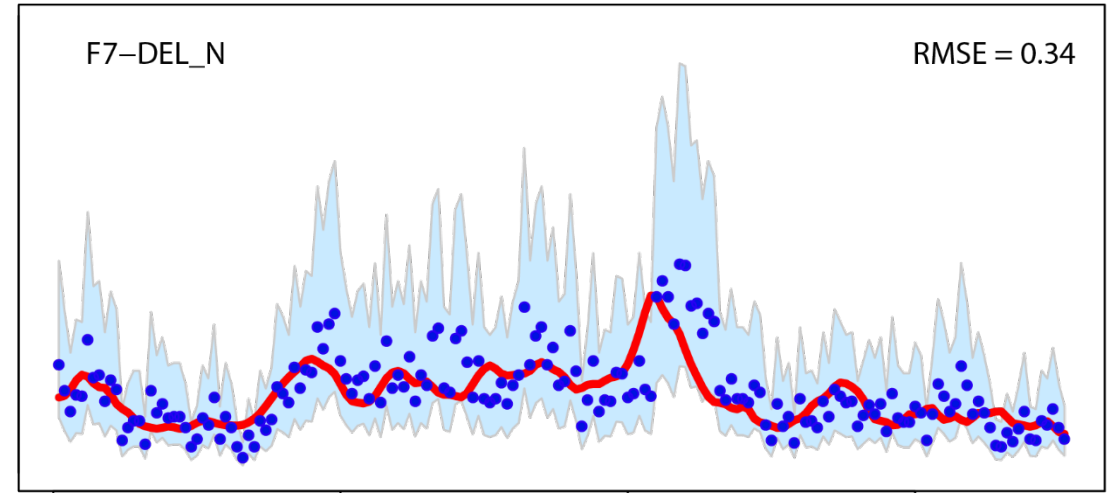
Standardization:  
Spatiotemporal model  
(Xu et al, 2019)  
"VAST"

# Inadequate consideration of spatial structure in the indices of abundance

Base-case model



VAST (DEL-N and DEL-I)



1975 1987 2000 2012  
Year-Año

1975 1987 2000 2012  
Year-Año

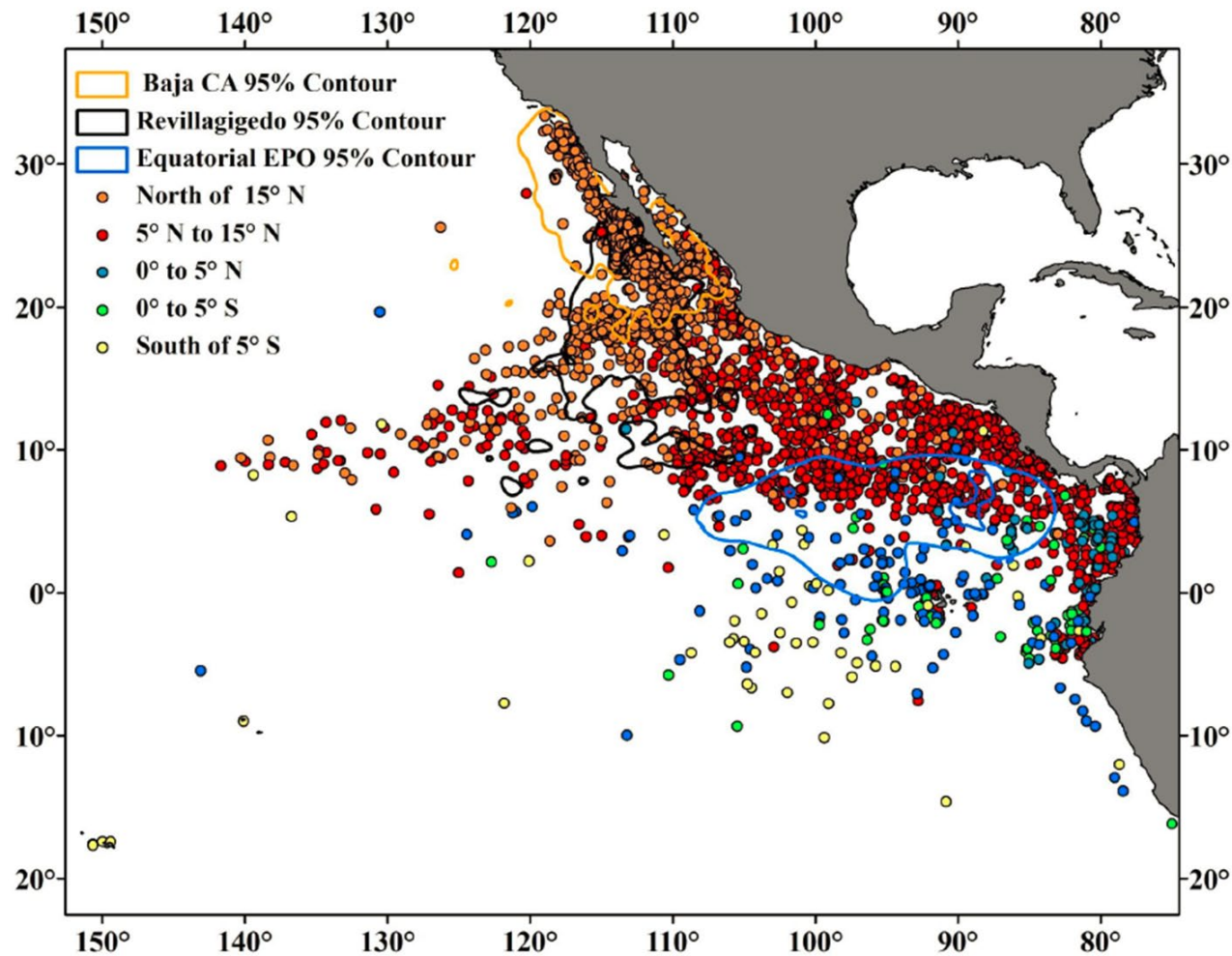


# Model runs to investigate the hypotheses

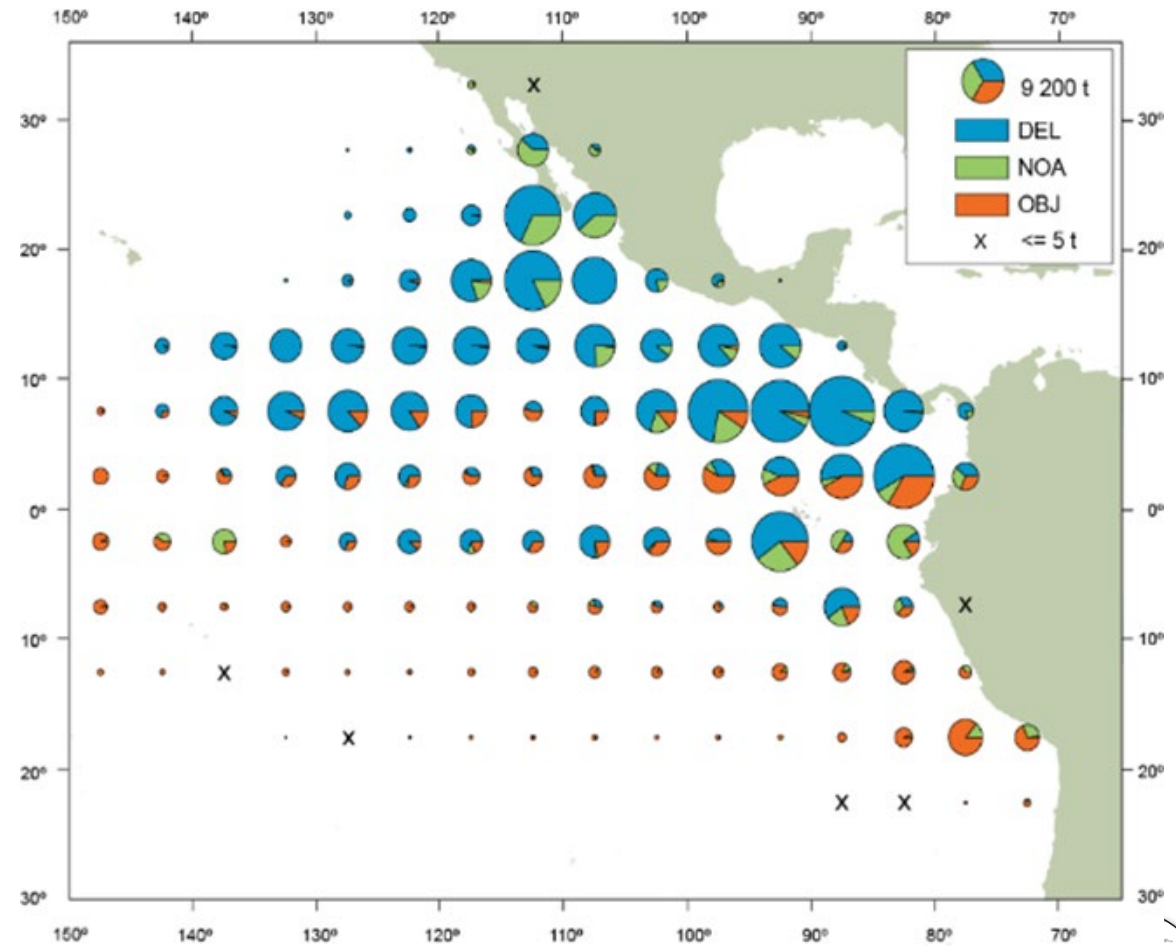
- **Change in fishing behavior (e.g. targeting) by the longline fishery**  
Estimate change in selectivity and catchability in 2010
- **Mis-specified growth**  
Estimate growth parameters
- **Inadequate consideration of spatiotemporal correlations in the indices of abundance**  
Use spatiotemporal model for dolphin associated indices
- **Spatial structure in the population**  
Not investigated

# Spatial structure in the population of YFT

## Tagging data



## Purse-seine catches



The following maps are produced from speed filtered conventional tag data for two separate time periods, 1960 – 1981 ( $n=11,371$ ) and 2000 – 2015 ( $n=1,589$ ). I have decided to not

PS 2012-2016



# Impact on management quantities

YFT	Sensitivity analyses - Análisis de sensibilidad				
	Base case	No longline CPUE update	H1: Change in selectivity and catchability	H2: Estimate growth	H3: Spatio-temporal DEL indices
	Caso base	Sin CPUE palangrera actualizada	H1: Cambio en selectividad y capturabilidad	H2: Crecimiento estimado	H3: Indices DEL espaciotemporales
MSY-RMS (t)	254,974	254,872	248,890	306,849	254,960
$B_{MSY} - B_{RMS}$ (t)	371,787	372,247	371,206	477,413	371,460
$S_{MSY} - S_{RMS}$ (t)	3,638	3,642	3,660	7,752	3,638
$B_{MSY}/B_0 - B_{RMS}/B_0$	0.31	0.31	0.31	0.31	0.31
$S_{MSY}/S_0 - S_{RMS}/S_0$	0.27	0.27	0.27	0.29	0.27
$C_{recent}/MSY - C_{reciente}/RMS$	1	1	1.04	0.83	1
$B_{recent}/B_{MSY} - B_{reciente}/B_{RMS}$	0.84	1.03	1.12	1.33	0.73
$S_{recent}/S_{MSY} - S_{reciente}/S_{RMS}$	0.76	0.99	1.08	1.36	0.64
$F$ multiplier-Multiplicador de $F$	0.89	1	1.14	1.63	0.83

# Conclusions: Hypotheses for index inconsistencies

- Change in fishing behavior (e.g. targeting) by the longline fishery

**Does not resolve inconsistencies**

- Mis-specified growth

**Does not resolve inconsistencies**

- Inadequate consideration of spatial structure in the indices of abundance

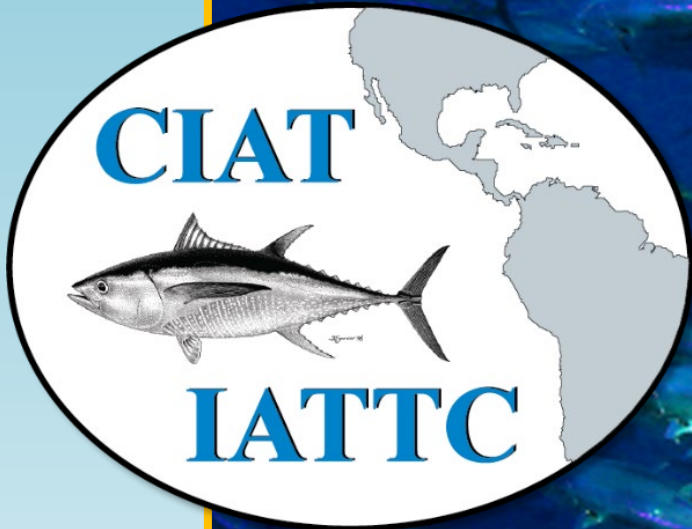
**Does not fully resolve inconsistencies**

- Spatial structure in the population

**Not evaluated**

# Conclusions

- Management quantities are sensitive to the inclusion of the 2018 longline index data, as for bigeye tuna in 2018.
- Inconsistencies between longline index and the dolphin-associated purse-seine indices
- Length composition changes in longline fishery:
  - used for representing catches and index
  - Contains information on mortality rates and absolute biomass (catch-curve process)
  - Should be correctly modeled (*e.g.* selectivity, growth, recruitment, and time changes)
- Four hypotheses to explain inconsistencies
- None of the evaluated hypotheses solved the inconsistencies
- Workplan has been developed to address these research needs



Thank you!

