

COMISIÓN INTERAMERICANA DEL ATÚN TROPICAL
INTER-AMERICAN TROPICAL TUNA COMMISSION



BIOLOGY, ECOLOGY AND CLIMATE CHANGE: THE ROLE OF THE ACHOTINES LABORATORY IN SUPPORTING IATTC'S CLIMATE-RESILIENT FISHERIES

BIOLOGÍA, ECOLOGÍA Y CAMBIO CLIMÁTICO: EL PAPEL DEL LABORATORIO ACHOTINES EN EL SOPORTE DE LA PESQUERÍA RESILIENTE AL CLIMA DE LA CIAT

Yole Buchalla, Dan Margulies, Susana Cusatti, Eblin Pereira

WHY SMALL-SCALE PROCESS MATTER FOR FISHERIES MANAGEMENT?

POR QUE PROCESOS EN UNA ESCALA PEQUEÑA IMPORTAN PARA EL MANEJO DE LA PESCA?

- Climate/ environment
- Physiology and early life ecology
- Growth and survival
- Recruitment variability



- Monitor fish populations
- Estimate biomass
- Model recruitment
- Predict how stocks will change in the future



Management decisions

- Clima/ ambiente
- Fisiología y ecología de vida temprana
- Crecimiento y sobrevivencia
- Variabilidad de reclutamiento



- Monitoreo de poblaciones
- Estimación de biomasa
- Modelaje del reclutamiento
- Predecir como estoques cambiarán en el futuro



Decisiones de manejo

WHERE BIOLOGY AND ECOLOGY INFORM FISHERIES SCIENCE AND MANAGEMENT DONDE BIOLOGÍA Y ECOLOGÍA PUEDEN INFORMAR CIENCIA PESQUERA Y MANEJO

RECRUITMENT AND POPULATION DYNAMICS

- Reduce uncertainty in Recruitment estimates
- Identify drivers of Recruitment variability
- Early warning indicators

Cushing, 1990; Houde, 2008; Rijnsdorp et al, 2009; Margulies et al. 2007, 2016

ECOSYSTEM-BASED MANAGEMENT

- Parametrize ecosystem models
- Ecosystem-SDM models
- Food web and bioenergetic models

Lehodey et al. 2003; Pikitch et al, 2004; Nagelkerken et al. 2023



STOCK ASSESSMENT MODELS

- Environment covariates
- Improved recruitment estimates
- Interpretation of residuals

MacKenzie et al. 2012; Peck & Hufnagl, 2012; Marshall et al. 2019

MANAGEMENT STRATEGY EVALUATION (MSE)

- Inform Operational Models
- Define realistic recruitment scenarios
- Integrated Management Frameworks

Punt et al. 2016; Gaichas et al. 2016; Holsman et al. 2017

RISK AND VULNERABILITY ASSESSMENTS

- Climate vulnerability assessment (CVAs)
- Biological sensitivity scoring
- Identification of vulnerable life stages

Hare et al., 2016

SCENARIO PLANNING

ECO-BIOLOGY RESEARCH SUPPORTING CLIMATE RESILIENT FISHERIES

INVESTIGACIÓN EN ECO-BIOLOGÍA APOYANDO PESQUERÍA RESILIENTE AL CLIMA

Nagelkerken et al. 2023

PLOS CLIMATE

The effects of climate change on the ecology of fishes

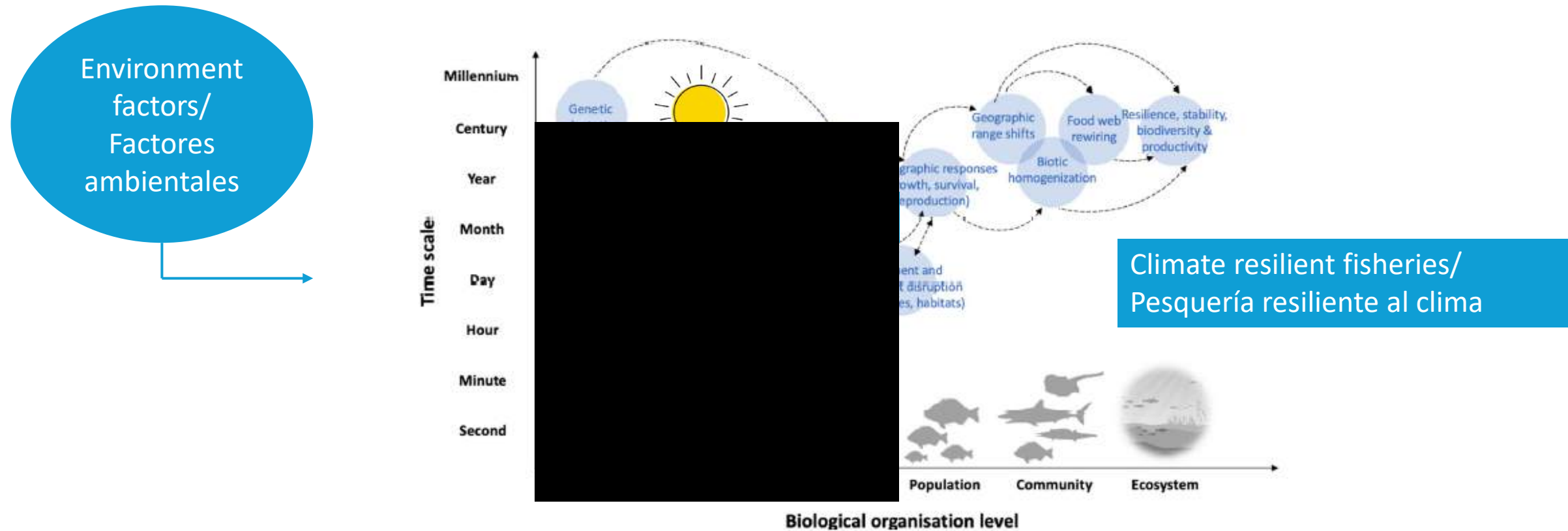


Fig 3. Conceptual diagram showing key processes that underpin the responses of fishes to climate change at different levels of biological organisation and response times. The graph highlights how the different levels and processes are potentially interconnected (arrows).

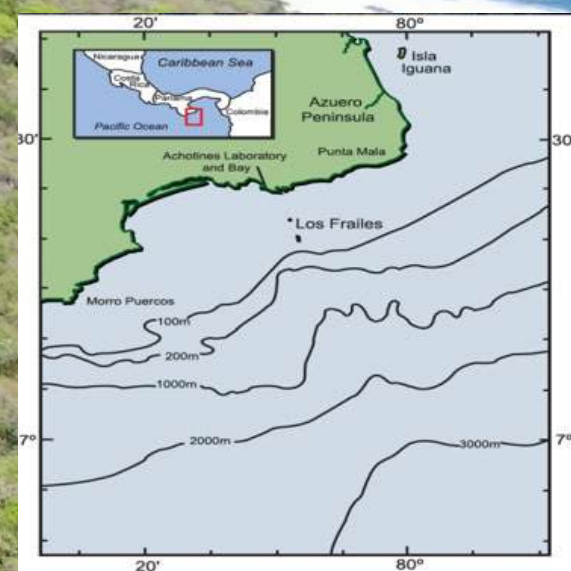
<https://doi.org/10.1371/journal.pclm.0000258.g003>

IATTC's ACHOTINES LABORATORY

LABORATORIO ACHOTINES DE LA CIAT

- Early Life History Group (ELHG)- Research on biology and ecology of tropical tunas for nearly 40 years
- Captive population of yellowfin tuna (YFT) continuously spawning for over 30 years
- Several studies about reproductive biology and biotic and abiotic factors affecting pre-recruitment life stages (eggs, larvae, juveniles)

- Grupo de Historia de Vida Temprana (ELHG)- Investigación en la biología y ecología de atunes tropicales por cerca 40 años
- Población de atún aleta amarilla (YFT) en cautiverio desovando continuamente por 30 años
- Diversos estudios sobre la biología reproductiva y factores bióticos y abióticos afectando estadio de vida pre-reclutamiento (huevos, larvas, juveniles)



IATTC's ACHOTINES LABORATORY AND RESEARCH ON CLIMATE CHANGE

LABORATORIO ACHOTINES DE LA CIAT E INVESTIGACIÓN EN CAMBIO CLIMÁTICO

2011 IATTC's ELHG Research and collaborators on the effects of ocean acidification (OA) on yellowfin tuna

2011 Investigación de CIAT- ELHG y colaboradores en los efectos de la acidificación de los océanos (OA) en el atún aleta amarilla

- Current levels and predictions of OA for short and long-term scenarios in the Pacific Ocean
- Higher atmospheric levels of CO₂- higher absorption of CO₂ from the oceans- increase in pCO₂ - decrease in pH
- Treatments in triplicate
- 10 first days of larval development



Achotines Laboratory larval experimental area
Área experimental larvaria del Laboratorio Achotines

- Niveles actuales y predicciones de OA para escenarios de corto y largo plazo en el Océano Pacífico
- Niveles de CO₂ atmosférico más altos- más absorción de CO₂ por los océanos- aumento de pCO₂- disminución de pH
- Tratamientos por triplicado
- 10 primeros días de desarrollo larvario

IATTC's ACHOTINES LABORATORY AND RESEARCH ON CLIMATE CHANGE

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Journal of Experimental Marine Biology and Ecology 569 (2023) 151949

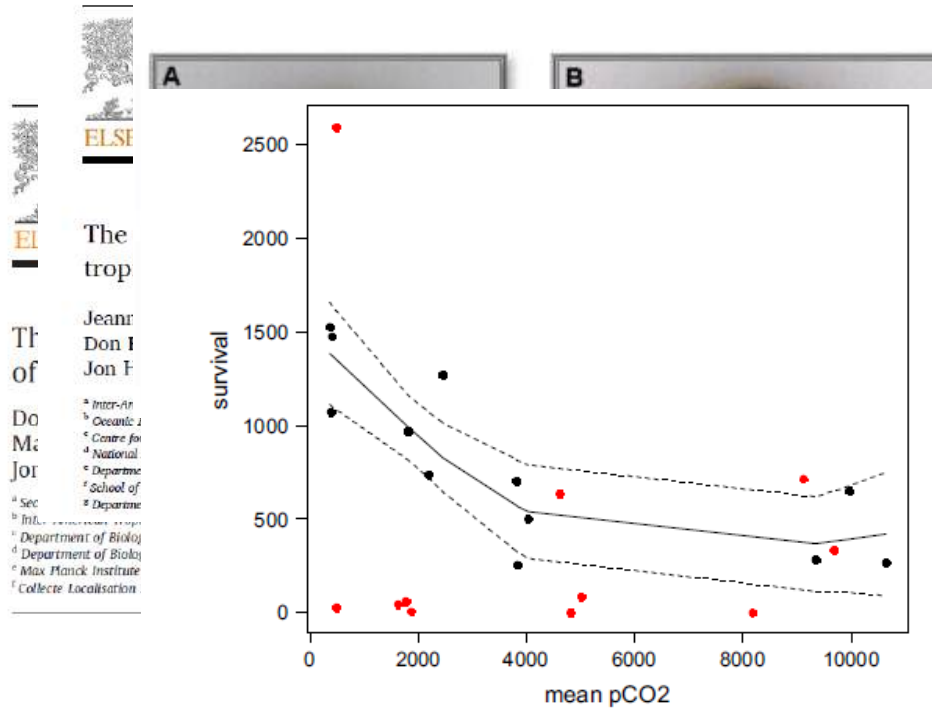


Fig. 5. Predicted relationship between mean pCO₂ and larval survival after 7 days of growth (Trial 1, black line) (Trial 2, red line). Dashed lines represent 95% confidence intervals; points indicate the data used to fit the models. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

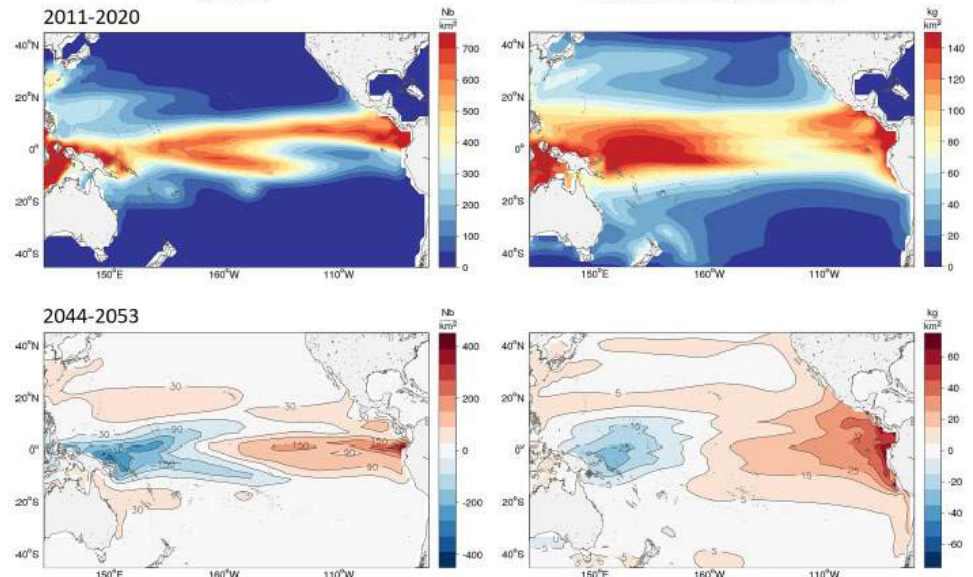
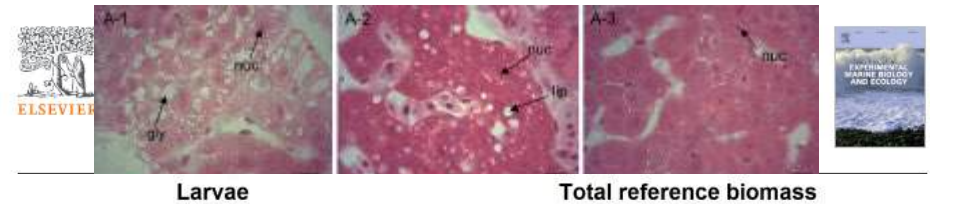


FIGURE 3 | Maps of average distribution from the ensemble simulation of (top-left) yellowfin larvae in Nb/sq. km and (top-right) total unexploited (without fishing) biomass (top-right) in mt/sq.km predicted by SEAPODYM in 2001-10. The color maps for 2050 (2044-53) show the average biomass change since 2015 (in respective density units) projected to occur under the high emissions scenario RCP8.5.



IATTC's ACHOTINES LABORATORY AND RESEARCH ON CLIMATE CHANGE

LABORATORIO ACHOTINES DE LA CIAT E INVESTIGACIÓN EN CAMBIO CLIMÁTICO

2024 -2026 ELHG Research on effects of increased water temperatures on yellowfin and Pacific bluefin tuna larvae

Investigación del ELHG en los efectos del aumento de temperaturas en larvas de atún aleta amarilla y atún aleta azul del Pacífico



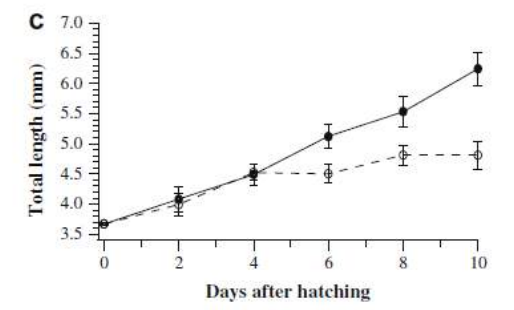
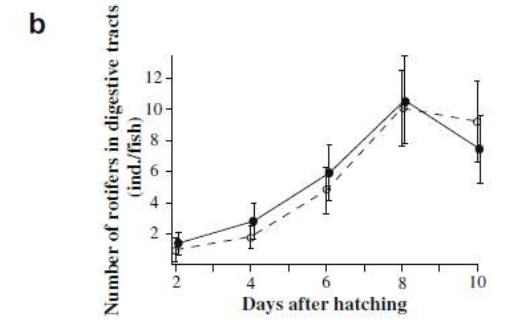
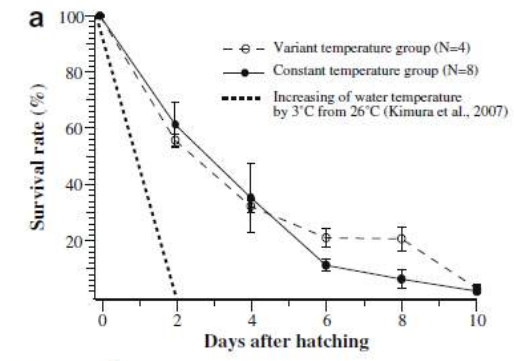
Kindai University, Japan

Aquaculture Research Institute, Oshima Station, Wakayama



Impacts
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and rec)

Shingo Kimura



and
bluefin
tuna

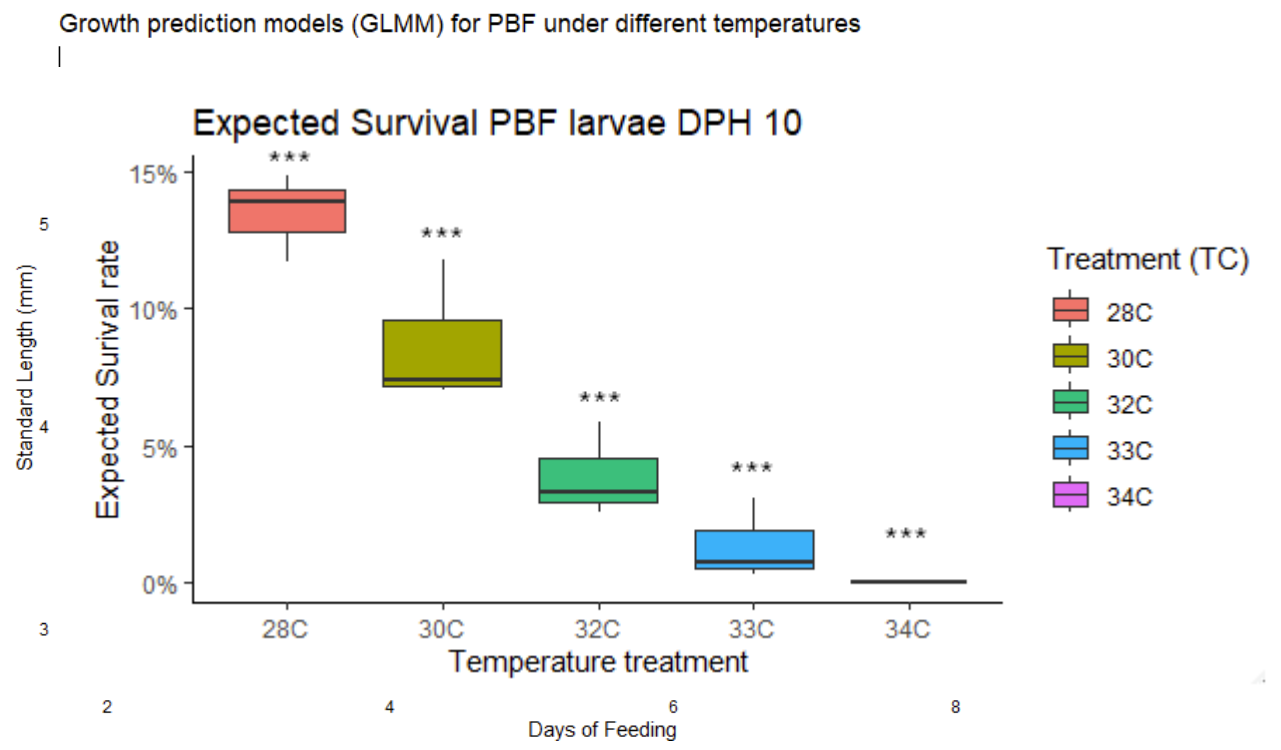
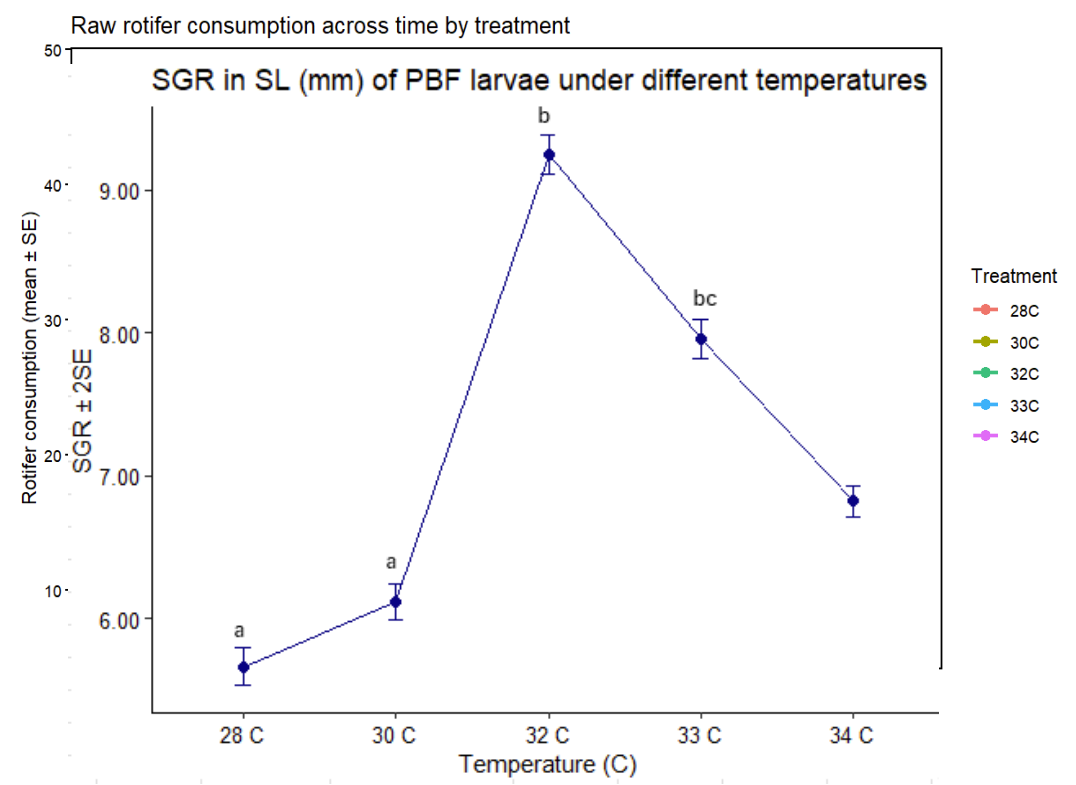
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GROWTH, SURVIVAL PREY CONSUMPTION, GROWTH



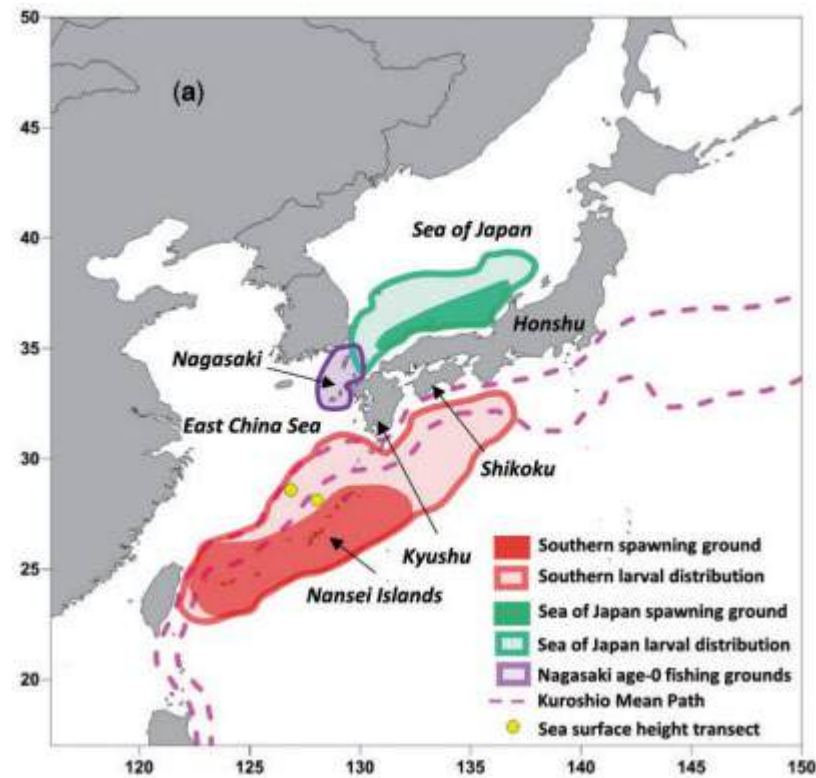
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MANAGEMENT TOOLS

HIERRAMENTAS PARA MANEJO

Muhling et al. 2019 – Temperature variability and prediction of Pacific bluefin tuna recruitment

Muhling et al. 2019- Variabilidad de temperatura y predicción de reclutamiento de atún aleta azul del Pacífico



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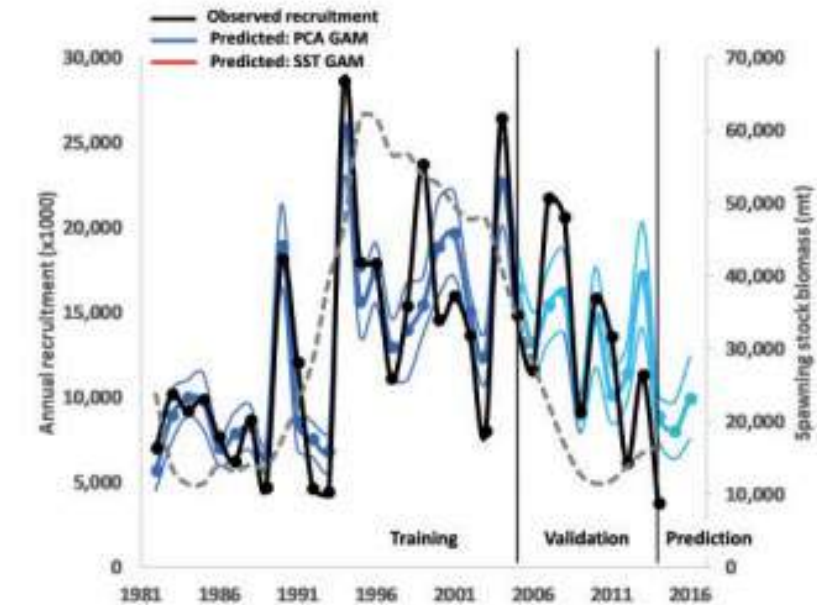
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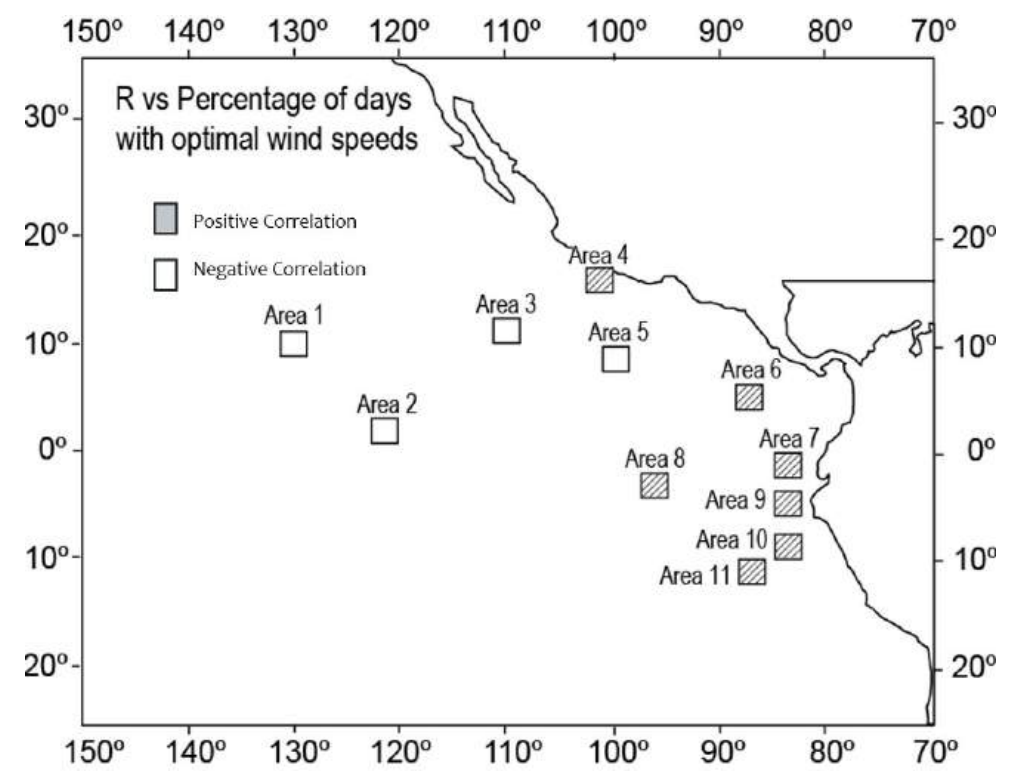
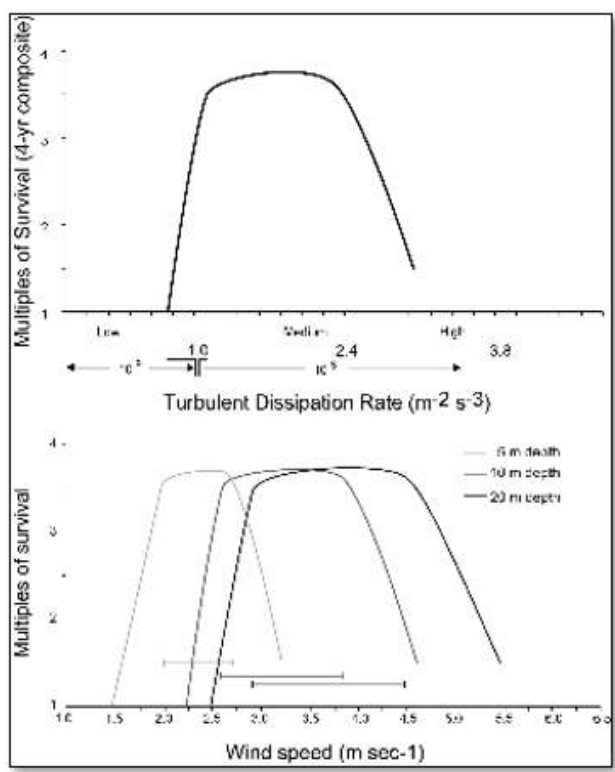
- 70% historical recruitment variability was explained by SST
- Modeling training/validation/prediction of recruitment through correlative relationships
- 70% de la variabilidad en reclutamiento histórico fue explicado por temperatura
- Entrenamiento/validación/predicción de reclutamiento con modelos a través de relación correlative

MANAGEMENT TOOLS

HIERRAMENTAS PARA MANEJO

Margulies et al. *in prep*– Wind speeds and yellowfin tuna (YFT) recruitment in the EPO

Margulies et al. *in prep* – Velocidades de vientos y reclutamiento del atún aleta amarilla (YFT) en el PO



Levels of microturbulence on larval tanks- Optimum wind speeds for survival of YFT larvae- correlation with historical recruitment estimates in the EPO

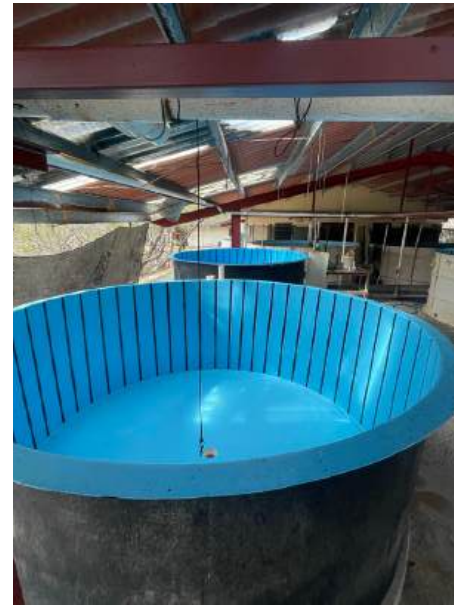
Niveles de micro turbulencia en tanques larvarios – Velocidad de vientos optimas para sobrevivencia de YFT- correlación con estimativas históricas de reclutamiento en el PO

Historical yellowfin tuna recruitment estimates and ENSO events in the EPO
Estimativas históricas de reclutamiento del atún aleta amarilla y eventos ENOS en el PO



IATTC's Stock Assessment Group
Grupo de Asesoramiento de Poblaciones de la CIAT

WE WANT MORE!
¡QUEREMOS MAS!



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Thank you!
¡Gracias!