SAC-07-07b
Ecosystem considerations in the eastern Pacific Ocean

Leanne Duffy and Robert Olson

7ª Reunión del Comité Científico Asesor
7th Meeting of the Scientific Advisory Committee
Summary: update of ecosystem considerations

Trophic interactions
- Global analysis of yellowfin, bigeye and albacore trophic patterns (international collaboration: CLIOTOP WG31)

 Aggregate indicators
- Mean trophic level of organisms taken by the purse-seine fisheries in the EPO

Ecological risk assessment (ERA)
- Ecosystem Specialist to join IATTC staff in August 2016
- Review modifications made to the Productivity and Susceptibility Assessment (PSA) in 2015 – proof of concept
- Summarize available data for fisheries operating in the EPO (SAC-07-INF C(d))

1 Climate Impacts on Oceanic Top Predators, Working Group 3: Trophic Pathways in Open-Ocean Ecosystems
Food-web structure and function

- Ecological research at the IATTC largely focused on the structure and function of the pelagic food web in the EPO

- Effects of tuna fisheries on ecosystem
  - Direct effects: e.g. bycatches of non-target species (some sensitive)
  - Indirect effects: e.g. predator-prey connections and competition via the food web

- Anticipating changes induced by fishing requires understanding of food web structure and function

- Diet studies are necessary for investigating pathways of energy flow in exploited ecosystems

- Knowledge of trophic position and linkages is essential for informing ecosystem models

- Knowledge of pelagic food webs is still rudimentary, in many aspects
Trophic interactions

• A new book chapter reviews current understanding of bioenergetics and feeding dynamics of tunas on a world-wide scale: “Bioenergetics, trophic ecology, and niche separation of tunas”

• Novel classification tree methodology developed for analyzing complex diet data

To date: 4 papers have been published using this approach and another paper was recently submitted to Deep-Sea Research II

• CLIOTOP\textsuperscript{1} Working Group 3 (WG3): Trophic pathways in open-ocean ecosystems – Companion papers

  • Global trophic ecology of yellowfin, bigeye and albacore tunas: can spatial analyses be used to hypothesize predation changes in a warming ocean?

  • Global comparative analysis of marine trophodynamics inferred by stable isotopes in yellowfin, bigeye and albacore tunas

\textsuperscript{1} Climate Impacts on Oceanic Top Predators
Trophic interactions: global tuna-diet study (CLIOTOP WG3)

Data compiled for 14,185 yellowfin, bigeye and albacore tunas

Objectives:
• Examine the importance of spatial, biological, and environmental variables on diet composition and diet diversity
• Can any variables be used as a proxy to predict the effects of long-term ocean climate variability on pelagic food webs
Generalized Additive Models

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Conclusions: classification tree analysis (global tuna-diet study)

- Global and ocean basin differences were detected

- Spatial variables were more important than biological and environmental variables in explaining diet composition and diet diversity

- Spatial patterns in diversity of YFT were consistent with theories that predict an inverse relationship between primary productivity and species richness

- Results suggest current expansion of warmer, less productive waters may alter foraging opportunities of YFT

- Due to the larger depth range across which BET and ALB forage, these species are less likely to be affected by changes in environmental processes within the surface and mixed layer

- Results support maintenance and development of long-term tuna feeding studies as an approach to monitor effects of climate variability on micronekton communities
Aggregate indicators: trophic levels and a simplified food-web diagram in the EPO
Aggregate indicators: yearly mean trophic level of the catches

Mean trophic level – useful metric of ecosystem change and sustainability
Ecological Risk Assessment (ERA)

- Dr. Shane Griffiths to join IATTC staff as an Ecosystem Specialist in August 2016

- Dr. Griffiths is an expert in ERA and has worked on several approaches:
  - **Qualitative** – Likelihood-Consequence Analysis, Scale Intensity Consequence Analysis (SICA)
  - **Semi-quantitative** attribute-based methods (e.g. PSA)
  - **Quantitative** models – Sustainability Assessment for Fishing Effects (SAFE), and stock assessment models (not often used)
Ecological Risk Assessment (review): vulnerability of non-target species

Goal – Develop a tool for determining vulnerability of a species/stock to a fishery

- **Vulnerability**: potential for the productivity of a stock to be diminished by direct and indirect fishing pressure. **PSA**: vulnerability is combination of a stock’s productivity and its susceptibility to the fishery.

- **Productivity** – capacity to recover if stock is depleted (function of life history characteristics)

- **Susceptibility** – degree to which a fishery can negatively impact a stock (propensity of species to be captured by and incur mortality from a fishery). Can differ by fishery.

Ecological Risk Assessment: Proof of concept
review of modifications to the EPO PSA for the purse-seine fishery

- Created alternate concepts for computing susceptibility tailored to EPO purse-seine fishery

- The susceptibility values for each fishery (set type) were combined to produce one overall susceptibility value for each species

- The use of bycatch and catch information in the formulation of susceptibility was modified (created 2 alternate susceptibilities)

1. Current catch information used in the formulation of susceptibility
2. Long-term catch trend information used in the formulation of susceptibility
Approach 1 combined susceptibility: $s_j^1 = \sum_k s_{jk}p_k$
Ecological Risk Assessment: review of comparing vulnerability
DESCRIPTION OF REPORTED CATCH DATA FOR NON-TARGET SPECIES: DOES SUFFICIENT DATA EXIST TO PRODUCE A COMPREHENSIVE ECOLOGICAL RISK ASSESSMENT?

Leanne Duffy, Cleridy Lennert-Cody, Nickolas Vogel, Joanne Boster, Joydelee Marrow
Two main shortcomings in the reported catch data were identified.

(1) Information on retained and discarded catches of non-target species for fisheries other than large purse seiners is incomplete and/or is of limited use for an ERA:
   • It is not clear if catch of non-target species is fully reported.
   • Problematic for ERA (outcomes will be compromised because excluded species will erroneously appear unaffected by a particular fishery).

(2) The fundamental basis for ERA is a comprehensive list of all species that are impacted by the activities of individual fisheries:
   • Catch data is sometimes provided by pooled groups (e.g., “sharks”).
   • Problematic for ERA (species within an aggregate group can have very different life history characteristics and/or susceptibility traits to a particular gear).

Lack of fundamental information on species composition and total catches severely compromises our ability to produce a comprehensive EPO ERA.
Questions

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