

# Research Issues for Tunas and Billfishes in the eastern Pacific Ocean

Related to PFRP priorities from

- 1992 PFRP Planning Workshop
- 2003 Request for Proposals

# Selected Issues from Fisheries

oceanography/biology working group (merged with those of the Fisheries stock assessment group)

- Stock structure (both)
- Fish movement (fishery interactions)
- Habitat definition; Behavior and other response to changes in habitat/environment (environment effects on CPUE, biological productivity)
- Reproductive dynamics (biological productivity)
- Schooling patterns (spatial changes in abundance, fishery interactions)
- Food chain ecology (biological productivity)

# Stock structure and Fish movement

- Not in 2003 PFRP but has been important in the past (though see tuna aggregation below)
- IATTC current interests in stock structure for all billfish species.
  - Need for further genetic studies
  - Research potential of genetic tagging of billfishes
- IATTC tuna interest for movement in the tropical areas: bigeye
  - Need for Pacific-wide conventional and archival tagging study, multi-year, concurrent in the East and West Pacific continuous across the Pacific
  - Experimental design for the study is needed

# Behavior and other response to changes in habitat/environment

- PFRP current priority is more in the dynamic of tuna aggregation (covered later)
- Estimation of effective longline fishing effort
  - Current habitat-based methods are now generalized to statistical habitat weightings.
  - Will better tagging data improve the empirical estimates?
  - Can estimates of ocean shear etc improve estimates?

- Effective purse seine fishing effort
  - Is the “habitat” for FAD’s simply temperature and current driven?
    - What other features define “habitat” (more later)
- Where are tunas in relation to environment for dolphin-associated and free school fisheries
  - Are eddies and fronts important structures
    - How do we incorporate them in testable models?

# Other responses to environment

- Effect of environment on recruitment
- Laboratory experiments show turbulence an important factor for larval survival of YFT
  - How to translate the lab result into a testable
- Some suggestion of correlation in year-class strength between YFT, SKJ, and BET but at staggered lag times
  - Is this an environmental effect. How to test?
  - Does having information about factors effecting recruitment aid management?

# Reproductive dynamics

- Is spawning stock size important?
  - Current reference points emphasize the current spawning biomass in relation to that which produces MSY
    - What is the steepness of the relation of S&R?
    - Does steepness change over time (or carrying capacity)?
    - Are all eggs equal?
    - How variable is recruitment?
    - Are growth rates year-class specific

# Schooling Patterns

- Major area of PFRP current interest is the dynamics of tuna aggregation
- IATTC interests in many areas related to “schooling patterns”
- Need to research fine-scale and temporal dynamics of skipjack schooling behavior around FADs to find differences in their behavior with other tunas, importantly bigeye, to find opportunities to catch SKJ without BET and other non-target species

- Research on FAD associated through acoustic detection of BET, SKJ, YFT to provide species specific estimates of abundance. Again as a potential technique to avoid bigeye catches
- Research on association of dolphins to yellowfin. PIT tagging may provide an opportunity for multiple measurements of dolphins in the back-down channel. Would help address numerous questions, eg school fidelity, interaction with the fishery, home range, migration, ...
  - Is PIT tagging a potential technique for tunas?

- Research to estimate effective effort for fisheries on schooling fishes
  - FAD effective effort: integrate dynamics of FADs, dynamics of movement & behavior of fishes w.r.t FADs, dynamics of fleet behavior
  - Effective effort for dolphin-associated fishing: calculate time searching and correct for changes in vessel efficiencies
  - What is relationship of school size to abundance of population? And how does effective effort at the level of a school translate to population.

# Food Chain Ecology

- Ecosystem-based fishery management is a priority research area for PFRP including ecosystem modeling
- Current research at IATTC in collaboration with PFRP funded project:
  - Compare food web in EPO to C&WPO, define trophic structure, detect large-scale tuna movement, define ecosystem linkages, ...
- Need for integration of ecosim-type models with current management to begin to quantify affect of current management measures on future ecosystem structure
  - Related research to see how single-species reference points work when placed in an ecosim model to empirically alter them to reduce ecosystem effects, eg trophic cascading. See for example Walters et al 2005 shows  $.7 * F_{msy}$  works.

- Important part of ecosystem studies is effect of tuna fishery on protected species
  - Research on adaptation of integrated statistical models, eg those for fisheries, to protected species
    - Some progress through PFRP & IATTC collaborative project by Maunder and Hoyle
    - Lesson learned with this and others is the need to educate more scientists on modern methods through collaborative studies and teaching of short courses
      - Further provide opportunities for interaction with lesser quantitative trained scientists to help them do the kinds of analyses that will further our knowledge of by-catch species dynamics