

# INCLUDING BIODIVERSITY CONSIDERATIONS IN FISHERIES MANAGEMENT

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# Four Features of Ecosystem Approach

- The Natural Ecosystem
  - Ecosystem Inputs - Effects of Environmental Forcing (physical & biological) on Stock Dynamics & Sustainable Exploitation
  - Fishery Outputs - Effects of the Fishery on the Ecosystem
- The Governance System
  - Integrated Planning & Decision-Making
  - Inclusiveness, Transparency & Stewardship

# Ecosystem Tasks – General

- Both impossible to do COMPLETELY
- Will never know ALL the ways that:
  - Biological rates respond to ocean physics
  - Species interact as predators, prey, competitors
  - Fish depend on attributes of marine habitats
  - Fishing gears alter the seabed
- Rarely even know CATCH accurately
- INCREMENTAL PROGRESS POSSIBLE

# Ecosystem Inputs - Recruitment

- Explain and forecast recruitment variation \*\*\*
- Retrospective explanations sometimes good
- Forecasting power usually weak, BUT
  - More mechanisms known so predictions may improve
  - Growing focus on getting BIG anomalies correct
- Still risk of errors in recruitment forecasts
  - Positive False Alarms – damage stock
  - Negative False Alarms – damage credibility
  - Misses – same as *status quo*

# Ecosystem Inputs - Growth

- Newer, not glamorous, great potential
  - Temperature (& salinity) affect growth & mat.
  - Yield = # at age x wt at age x % recruited
  - Growth fast when % recruited is changing
- Speed up growth – some increase in yield
- SLOW DOWN GROWTH – several effects
  - Less yield per individual
  - Longer time at discarded sizes
  - Misses have played big role in over-fishing as yield overestimated AND taken from existing population

# Ecosystem Inputs – Decadal-scale Variation

- Newer but potentially most important
  - Pacific Decadal Oscillation & North Atlantic Oscillation well documented in physics
  - Biological linkages becoming clearer – alter productivity of whole system and individual species
  - Links to management mostly tentative
- Regime shifts  $\Delta$  sustainable exploitation rate
  - Much bigger effect on  $F_{lim}$  than on  $B_{lim}$
  - Misses have played BIG role in collapses (Canadian Atlantic, Eastern Boundary Current systems)

# Biological Interactions - General

- Marine food webs highly connected
  - Each predator eats many prey
  - Each prey supports many predators
  - Some species in critical role (“wasp-waists”)
- Predation as part of “Natural Mortality” = constant
- VERY difficult to manage one predator for improved status of SPECIFIC prey.
  - No guarantee the benefits will go where they are desired.
  - BAD idea unless information VERY good.

# Ecosystem Inputs – Total Predation

- “TOTAL” predation mortality quantifiable with multispecies models:
  - For small sizes of predators & all sizes of “forage species”
  - “Natural Mortality” = Predation Mortality + other
  - Dynamic with sizes of predator populations
  - Variation in predation mortality is conveyed into single species models of the prey
  - Rarely predator productivity also altered

# Ecosystem Inputs – Fisheries on Forage species

- Forage species are crucial in ecosystems
- Make first allocation of biomass to their dependent predators (Target ESCAPEMENT)
- Result is EXPLOITATION RATE is variable,
  - (For many species management uses target  $F$ )
- Can use predator feeding success as index of population size
- Environment forcing often strong at these nodes
  - Integrate physics, biology & management.

# Ecosystem Inputs – Size-based Approaches to Feeding

- Promising management-oriented research
- Feeding in the sea is Size-based
- Slices of ecosystem like “Fish” have linear size-abundance relationships (10-150 cm)
  - “Size spectrum” integrates feeding interaction
  - Slope responds to exploitation & management
- Promising but not yet in use –
  - Better support for management advice than multi-species-based models

# Fishery Outputs – Bycatch Reduction

- First-order benefits for Biodiversity
- Proven Tools include:
  - Gear modifications
  - Time & area closures (long and short term)
  - Bycatch caps
  - Handling protocols
  - Managing bycatch of most vulnerable species
- All require OBSERVERS or accurate reporting of TOTAL catch

# Fishery Outputs – Spatial Management

- Closed areas & times long-used tool
- MPAs have passionate adherents but not a solution to many problems
  - Excellent for habitat features (good mapping)
  - Good for SOME kinds of species
- Real-Time spatial management as function of catch characteristics
- Usage of zoning on longer term
  - Make use of historic aggregation of fishing effort

**GOOD NEWS**

# THINGS WE CAN DO (1)

- Recruitment forecasting
  - Attempts – Iberian Anchovy, North Sea cod,
  - Methods codified in WGPRISM Report (ICES)
- Growth
  - Hindsight – Canadian cod, North Sea plaice
  - Methods codified in WGROMAT (ICES)
- Decadal Scale regime changes
  - Baltic & Benguela are largely ready, basis for some in Barents Sea & northeast Pacific (esp salmon)

# THINGS WE CAN DO (2)

- Predator reduction (culls)
  - Successfully RESISTED in Atlantic Canada, South Africa / Benguela
- Dynamic Quantification of Predation Mort.
  - Routine in North, Baltic, Barents Sea, Iceland
  - Partial in Bering Sea, several other systems
  - Several operational models (MSVPA, GADGET)
- Forage species management
  - ┌ Widespread and long history
  - ┌ CCAMLR (Antarctic seas) leading

# THINGS WE CAN DO (3)

- Size-based Management “under development”
  - Will require different thinking about management – AND BIODIVERSITY
- Bycatch Reduction well advanced
  - Gear requirements common (ex. exclusion devices)
  - IPOAs on seabirds, sharks; plans for cetaceans
  - Caps & handling protocols for species at risk
- Spatial Management – widespread
  - └ MPA (mixed), Closed areas common tool
  - └ Real-time spatial management underutilized
    - Atlantic Canada small fish protocols

# WILL IT BE ENOUGH?

## Biologically – WGECO thought experiment

- If all fisheries complied with Reference Points
  - Bycatch Still at Risk
  - Habitat Damage Still at Risk
  - Dependent Predators Still at Risk
  - Scavengers could increase to harmful levels
- All can be fixed with more Single-factor R.P.s
- Would any ECOSYSTEM-SCALE (emergent) PROPERTIES still be at risk?
  - NONE could be demonstrated 2001 (or since)

**BAD NEWS**

# SEVERE GEOPOLITICAL ISSUES

- Nearly All Examples from Developed Countries
- Governance component of Ecosystem Approach is crucial
- Small scale fisheries have different problems (and strengths)
- CHALLENGES OF FOOD SECURITY AND LIMITED CAPACITY TO MANAGE NOT ADDRESSED HERE

# DOING FAR TOO LITTLE WITH WHAT WE DO KNOW

“Incremental Approach”  
MUST have bigger increments

# ALL IS NOT WELL

## With the Science advice

- Uncertainty will INCREASE with EAF
  - More relationships to consider / model
  - More parameters to estimate & relate
  - Increase is artefact but will LOOK real to decision-makers and managers
- IF MANAGEMENT IS NOT RISK-AVERSE THEN AN EAF WILL MAKE BIODIVERSITY STATUS WORSE

# ALL IS NOT WELL with Management actions

- Considering Ecosystem Approach and Biodiversity means harvesting LESS
  - Allow for environmental uncertainties
    - Already take the benefits – just change schedule
    - NOW have to allow for risk of costs
  - Direct reduction in bycatch, harvest of prey
- Science has RARELY convinced users to reduce catch for DIRECT future yield benefits
- Why will users reduce catch for benefits to ecosystem? NO CAUSE FOR OPTIMISM