Bycatch, Biodiversity Mitigation, and Ecosystem Management

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How to “put it all together”

- This audience does not need commercials for either why biodiversity mitigation is important or what the ecosystem approach to management is.
- However, as a mix of economists and ecologists, our exposure may be to different parts of these broad concepts
- SO you get a quick tour of the issues and ecosystem perspective to (hopefully) get us on the same page.
- From this may emerge a context in which to place bycatch mitigation that so it is more than just a policy goal in itself, but also a consequence of other goals we have.

Background big picture

Why do we fish?

- To produce protein to feed people
- To make profit (or pleasure)

Why do we conserve biodiversity?

- To ensure the flow of benefits from its use
- Because we are a moral, ethical society

All four cannot be maximized simultaneously

How do we get a common objective to guide planning and operations?

Historically we have used conceptual "approaches"

- Each has been sequentially presented as a general idea, endorsed as "the solution", developed, found imperfect, and subsumed by another approach
- Mid 1980s - Sustainability
- Mid 1990s = Precautionary Approach
- 2000s – Ecosystem Approach
- 2010s (emerging) =Valuation of Goods and Services?

The “Ecosystem Approach”

Four classic pillars - Fisheries managers should:

- Take account of external drivers on stock dynamics
- Be accountable for the full footprint of a fishery
- Take an inclusive approach to governance& outcomes
- Integrate fishery needs and footprint with other sectoral uses of the sea

Relevant messages for management generically?

1. Include all the key ecosystem pieces in planning and managing
2. Take account of how the pieces all link together
3. Humans (and other users) are part of ecosystems

When the approach is applied in fisheries, main concerns are

Taking account of drivers

- Environmental forcers
- Impacts of other changes to envt (usyally human)

Being responsible for footprint

- Habitat impacts of gears
- Bycatches and discards
- Changes to food web relationships

Inclusive governance

- “stakeholder engagement
- Who has what role(s) in participatory decisions

Fitting in with other uses of the ecosystem

- Marine spatial planning and Integrated management

Relevant messages for managing bycatch specifically?

For 1 & 2 there is no *ecological* difference between "catch" and "bycatch". All differences are post-catch.

For 1 we know a lot about "catch" and how to use it.

- How to measure it
- What happens when it is quantified poorly
- How to combining catch data and "calibration" information into relative and absolute trends in biomass/ abundance and incremental mortality
- Adding bycatch to reported/landed catch use improves accuracy of data and its uses
- Adding bycatch to "zero catch" still allows all the established tools to be used

What else can be imported from "stock" management for 1 & 2?

We know a lot about how to establish sustainable benchmarks for species that are "catch"

- The most robust methods (and benchmarks)data demanding
  - Using these methods pretending you have good data is worse than moving to simpler methods better matched to data
- Reliable methods and benchmarks can be developed with life history information and "some" data.
- Even "reliable" ones can have high probability of sustainability if used in "strong" management systems
- Even "most robust" ones may fail to support sustainability if management system is weak.
  - "Strong" and "weak" management does not necessarily equate to "top-down" and "bottom-up" (drifting into message 3)

Some cautions can be imported as well

We can easily make the problems so hard we can't solve them, even for just "pure" catch (moving into 2).

- We KNOW there are lots of functional relationships in ecosystems (the "links")
- We rarely know their functional forms
  - And they may not be continuous (even S-R)
- **Knowing a relationship exists does not mean it should go into your dynamic models**
  - The uncertainty ABOUT the relationship should, but
  - There are several ways to add the uncertainty, and a wrong representation of the form is often not the best

Moving beyond the single species world

Multispecies issues possibly more important in bycatch because management goals for "catch" **necessarily** include:

1. Maintaining productivity of target species
2. Maintaining ecosystem functions play by the target species
3. **Provision of economic and social benefits**

But for bycatch, 3 is not relevant whereas it is the main driver for target species mgmt goals.

Lessons of using multispecies linkages in assessment and management

SOME experts believe it is possible to do so dynamically in stock management; many do not.

- If possible ONLY for most data rich species
- Must have relevant data on predator diets and current data on predator & prey populations.
  - Points about pretending you have adequate data when you don't for single species assessment are amplified here, because you know the functional forms even more poorly
  - Means data needed to screen more bad models, not just parameterize good ones.

To avoid chasing noise in assessment and benchmarking

We reason backwards about 2 [linkages]?

- Existing communities are product of centuries of past co-evolution
  - SOME degree of co-adaptation of relationships must exist (at least before fishery collapses)
  - So the historical mixes of life-history strategies in a community must have been sufficient to maintain relationships within resilient variance bounds
  - Work on life history mixes in a community in size-based approaches and “portfolio” approaches.

Implications of this thinking

- So a tractable version of maintaining linkages is maintaining all the life histories and/or portfolio sizes in an exploited system
- This (unexpectedly to me) gets us right back to balanced harvesting
  - Without quantifying every relationship just try to keep adjusting harvests so no player declines by too much or too long (judged by life history too)

May not even be wise to TRY to estimate how to use the feedbacks

- Neutral model analysis of stabilization of portfolio effect with North Sea IBTA data
  - Functional groups with large number of species did have significantly lower CVs than functional groups with fewer species (strong relationship)
  - When species' time series sorted randomly into groups of same membership size and variances calculated over time, ALL the stabilization can be accounted for by Law of Large Numbers
- NO within group compensatory RESPONSES needed to explain data.
- Ecosystem doesn't care which members in a group are doing well or poorly; only how big the group is.

Can we deal with [3] (the humans in ecosystem) with this viewpoints as well?

- It does work fishing for PROTEIN
  - Several papers (Forage Fish Symposium and elsewhere) have done MSE-like simulations comparing BH and other strategies
  - BH commonly found to result in less total yield than some other strategies
  - Higher yield alternatives sacrificed some parts of ecosystem to permanent depletion
  - If all parts of ecosystem are being kept within SBL (at least not knowingly violated), BH gives most yield
  - Addresses the ranging “Bmsy not achievable for all stocks at once” debate.

Does NOT work as well for economic dimension

- If fishing for PROFIT want to minimize cost of fishing AND maximize value of catch
- Ecosystem-friendly harvesting asks for:
  - Increased effort towards species with low catchability (work harder to catch these kgs of fish)
  - Costly fine-tuning of effort in mixed stock fisheries
  - Taking large catches of species of potentially low value
  - Reducing proportionate effort at high value species.
- All these factors go counter to profit maximization
- All these factors are driven by market forces coping with ecological realities

May work as poorly at SOME parts of social dimension

- Fishing for *livelihoods* does map well onto the ecological issues and approach.
- Fishing to AVOID species of high society value will NOT
- Most aspects the same as economic considerations, just human values replace market values;
  - Still requires significant effort to fish in ways that avoid catch or bycatch of certain species/areas
  - Increases costs to fish without increase in revenue;
  - Can decrease revenue if valuable species are prohibited
  - Penalties may amplify effect, certification may buffer

These should not be insurmountable challenges

If we view market and social value effects as distortions of outcomes from ecosystem processes, change the distortions with well-designed incentives. But:

- Track record of artificial incentives working exactly and only as expected is far from perfect
- Win-Win outcomes usually come in (large?) part by defining parts of the 3-D problem out of the equation (ecological valuation & sunken billions)

- Doesn't mean there are no solutions. Does mean the fruit does not hang low.
  - Lessons from Technology – Behaviour in IPCC AR 4 & 5

Wrap-up

- Ecologically catch and bycatch just components of F, and familiar tools and lessons all apply.
  - Well structured and well parameterized simple methods can be more effective than poorly formed and poorly parameterized complex models
- Ecological approaches to harvest does well when fishing for protein
- Those approaches can be severely weakened when fishing for profit or fishing to social preferences
  - Both market and social preferences can badly distort what is ecologically optimal
  - We can discuss the costs, how they are distributed, and if we want to pay (or can avoid paying) for them