How Can Information from MPAs Be Used to Assess and Manage Fisheries?

Density ratios and other ideas

Alec MacCall

March 29-30, 2011

Outline

- The original "density ratio" proposal
- The MPA Science Integration follow-up
  - MSEs by McGilliard and Babcock
  - Independent development and MSE by Wilson
- Use of comparative compositions

How to Manage Small Fisheries?

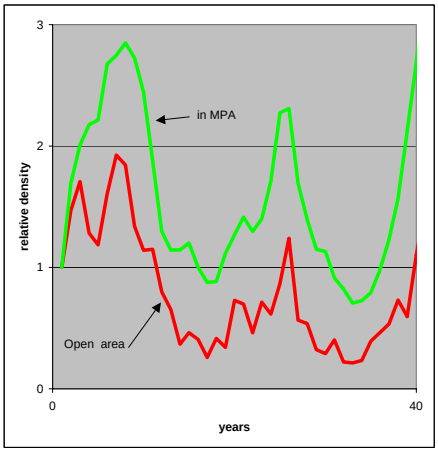
- Management is needed, even for small fisheries
  - Unless participation is severely limited
  - Localized resources can very easily be depleted
    - Especially if fleets are mobile
- Conventional approaches are problematic
  - Conventional data needs are the same, large or small
    - But not affordable for small fisheries
  - Catch-based management doesn't work locally
    - Geographic scale of conventional information doesn't match scale for local management
    - Micro-managing quotas is undesirable and maybe impossible

An MPA Reference-Based Approach for Data-Poor Fishery Management

Basic scheme:

- Use fish densities in MPAs as an index of potential unfished levels
- Compare with fish densities in fished areas
- Restrict fishing season (or TAC, if required) progressively as fish densities in the open areas decline relative to protected areas

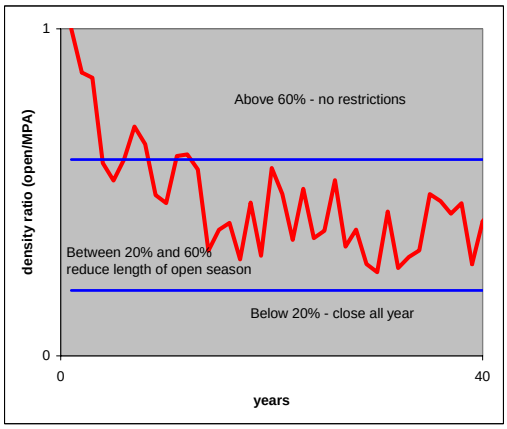
Open vs. Protected Areas



This is a cartoon – Not real data

- Density in each area is scaled to unit value ca. time zero
- Density is estimated annually in pairwise survey design
- If estimates are noisy, time-averaging may be helpful

Manage for Relative Density



- Track relative density in the fished area, with references
  - Here, references reflect California's 60-20 policy
  - Response is to vary season length
- Gentle phase-in
  - No initial restrictions on fishery (init above 60%)
  - MSEs by both McGilliard and Babcock showed some risk from initial effort displacement

Adaptive Management Policies

- Alternative management controls
  - Catch-based controls (e.g., TAC) tend to focus on single species and require expensive monitoring
  - Effort-based controls (e.g., length of open season, or effort quota in vessel-days) may be better for multiple species, and may be less expensive, but are less precise
  - As always, smaller fleets require less restriction
- Controls can be relative or absolute
  - MSEs by McGilliard and Babcock used relative controls
    - Increase fishing if above target, decrease if below target
    - Finds its way to the target, but tends to oscillate
  - Absolute control may be difficult to calibrate initially

Multispecies Management

- This can be a multispecies management system
  - Season closures apply to all fishing, and protect all species
  - Density index used to determine season closures would reflect a mix of species
  - This management system works only for “resident” species
- No exemption for separately-managed OY species
  - e.g., PFMC managed species
  - Would have to be taken only in the open season

Ad Hoc Follow-on Group

(Good use of left-over MPA Science Integration money)

- Initiated by MacCall's proposal that MPAs can be used directly for fishery management, in lieu of assessment
  - An alternative to conventional management
- An ad-hoc "Density Ratio Working Group" spontaneously formed to explore the idea
  - There was no formal membership or chairmanship
  - 1960's organizational model
  - Three meetings (UW Seattle, Santa Cruz, UCSB)
- Partial list of "core" participants (more than 1 mtg):
  - Beth Babcock, John Field, Rod Fujita, Kristen Honey, Meisha Key, Alec MacCall, Carey McGilliard, Jono Wilson

The Density Ratio Idea

- Resource status can be tracked by ratio of density outside vs. inside MPAs
  - Requires initial and ongoing monitoring
  - Can use industry cooperative research
    - Conventional fishing gear – maximum relevance
    - Live fish capture technology could minimize impact
  - Alternatively, can use visual methods
- Requires a pre-agreed management policy
  - Relates observed ratios to harvest controls
  - Can be single species or multispecies

Two Recent Papers

- Carey McGilliard examined performance of a density ratio control rule for single-species management in a variety of habitat and movement scenarios

ICES Journal of Marine Science (2011), 68(1), 201–211. doi:10.1093/icesjms/fsq151

Can information from marine protected areas be used to inform control-rule-based management of small-scale, data-poor stocks?

Carey R. McGilliard[1]*, Ray Hilborn[1], Alec MacCall[2], André E. Punt[1], and John C. Field[2]

Two Recent Papers

- Beth Babcock examined performance of a density ratio control rule for multi-species management

How useful is the ratio of fish density outside versus inside no-take marine reserves as a metric for fishery management control rules?

Elizabeth A. Babcock and Alec D. MacCall

Can. J. Fish. Aquat. Sci. **68**: 343–359 (2011)

Jono Wilson had independently developed a similar approach

- A "decision-tree" approach incorporating MPA comparisons

A Management Strategy for Sedentary Nearshore Species that Uses Marine Protected Areas as a Reference

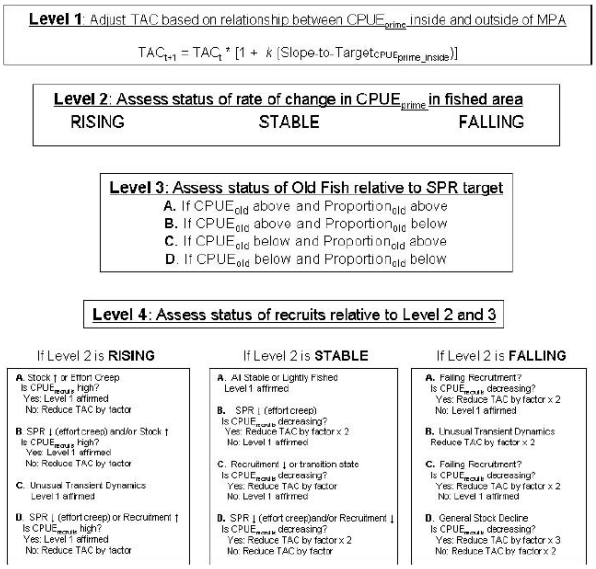
JONO R. WILSON*
Bren School of Environmental Science and Management, University of California–Santa Barbara, Santa Barbara, California 93106-5131, USA

JEREMY D. PRINCE
Biospherics, Post Office Box 168, South Fremantle, Western Australia 6162, Australia

HUNTER S. LENIHAN
Bren School of Environmental Science and Management, University of California–Santa Barbara, Santa Barbara, California 93106-5131, USA

Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science 2:14–27, 2010

Wilson et al's Decision Tree



Another MPA Approach

- Length or age compositions can be compared inside vs. outside MPAs
  - Related to the "Transitional SPR" approach of 1990's, but solves the drift problem
- Initial simulations show strong ability to estimate both F and M from this information
- Currently being worked on by Kristen Honey and Xi He
  - Rumors suggest that other people are also investigating this or similar approaches

Where We Stand

- There is interest in use of these approaches
  - Central California
    - Desire for local management
  - Caribbean Fishery Management Council
    - Extremely data-poor
    - Problems with transboundary stocks
- Unclear if and how to initiate the change
  - Requires MPAs and commitment to monitoring
    - Is it cost-effective?
  - Requires dedicated access privileges
  - Control rules may be difficult to reconcile with federal management requirements (ACLs etc.)

How Long Would It Take?

- Composition-based approaches should require less than 1 generation time
  - Time depends on fishing intensity outside
  - My guess: 5 years would be sufficient in most cases
- Density-based approaches will take longer
  - Density response takes closer to 1 or more generation times
  - MSEs indicate10 or more years may be required
- Approach has a natural phase-in, unlike most fishery regulations
  - Be wary of initial depletion due to effort displacement