Stephenson – Notes to accompany presentation

Perspective

I was asked to give an introductory presentation that would provide general context for the workshop. My presentation focuses on 1) the general issue (why examine stock structure), 2) a case study based on personal experience of herring, and 3) some general thoughts on the approach to the questions of the meeting.

The general issue

This meeting is about the assessment of marine populations and the evaluation and management of human activity in light of biological population structure. It inevitably will include discussion of a) biological (population) structure, b) assessment structure and c) management approach.

Biological (population) structure is ultimately linked to the genetic basis of populations, In the case of fish populations this is complicated by incomplete understanding of genetic structure (although that is an area of active research and considerable progress). Fish populations differ in their structure (complexity or 'richness'), and in the rigidity of that structure.

I use the following definitions:

- **Population discreteness** - refers to the degree of isolation of subpopulations
  - (Sinclair and Iles (1982) refer to ...the discreteness and discontinuity of gene pools, which are the essence of biological identity

- **Population integrity** refers to the tendency to remain discrete and to resist connectivity (idea of **rigidity** is also used)

- **Population connectivity** refers to the exchange of individuals among geographically separate subpopulations…' (Cowen et al 2007).

- **Population complexity/richness** - a measure of the diversity of subunits in the resulting pattern (e.g. 'biocomplexity' Ruzzante et al 2006)

It is important to differentiate between biological structure (in an evolutionary sense) and stock/population structure of relevance to management. They are on different time scales.

The Gulf of Maine/Scotian Shelf region has a long history of work on population structure and related issues. We have relatively well studied fisheries, two nations with

elaborate fisheries management schemes, early fisheries agreements/ management units based on bioloigical+political+pragmatic considerations (see Halliday + Pinhorn 1990).

Why consider stock structure?

1. Population structure is the basis for assessment and management. A 'unit stock' is assumed in most current modelling and management. Future management is likely to build on that with additional consideration of both productivity and within-species diversity.

2. Realization that management units (recognized as being compromise of ecological, political and practical considerations) may not be serving us sufficiently.

3. Specifically (and more recently) recognition of within unit structure (substructure…complex structure) and the possibility of erosion of structure within stocks. While not proven, subtleties of stock structure (complexity) is widely presumed to be linked to resilience.

4. Recent developments in management (Ecosystem Approach, Precautionary approach, etc have increased attention to biodiversity including within-species diversity (as it relates to resilience etc).

Stock structure is an ongoing challenge in fisheries assessment and management worldwide. Stephenson (2002) noted that it was an issue in 50 of 150 stocks evaluated by ICES in 1999.

The discrepancies between population and management units fall, generally, into two situations: a) movement or mixing between/among management units and b) complex stock structure within a management unit.

<u>Herring Case study</u>

Assessment and management of herring in area 4X evolved, following loss of the Trinity Ledge spawning to component, to include specific objectives, new approach to surveys and an in-season management approach in an attempt to prevent further erosion of stock complexity. This included agreement on a conceptualization of stock structure (together will list of evidence and assumptions) which formed the basis for objectives to maintain spatial and temporal range of spawning.

There is a spectrum of approaches to consideration of herring stock structure in the various management units of the western Atlantic, but increasing tendency to

consider/respect the temporal and spatial diversity of spawning groups (see presentation slides, Stephenson et al 1999, 2009)

General thoughts on the questions of this meeting:

I suggest it is important to differentiate the three aspects: **biological population structure**, **assessment structure** as it related to biological structure (including spatial and temporal aspects), and **management structure** as it relates to biology and assessment.

*Potential implications of inappropriate stock boundaries?*

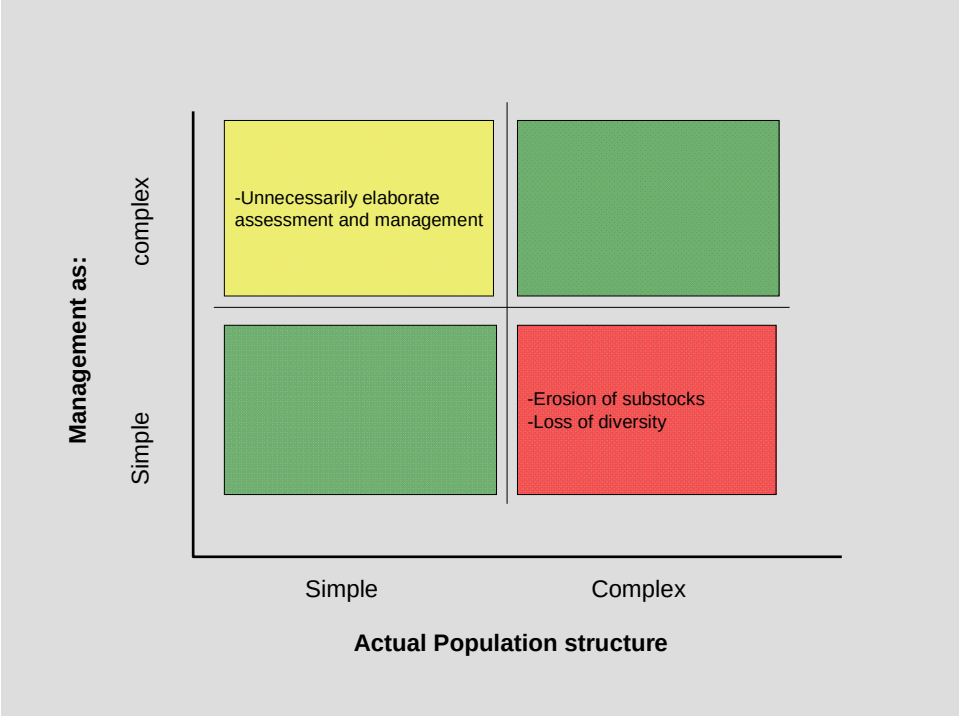
-mixing (immigration/emigration) will increase variability and error
-decrease effectiveness of management

*Potential implication of ignoring sub-stock structure?*

-erosion of subunits (reduced diversity), resulting in reduced spatial and temporal distribution, reduced productivity, and reduced resilience.

*Risks of being wrong?*

If a simple/single population is managed as complex population there will be unnecessary costs of complex spatial management. If a complex population is managed as a single population there is risk of erosion of subunits (and loss of diversity). This case has higher risk of greater harm (see fig):




*Potential advantages/disadvantages for both science and management of revising status quo?*

Science – potential advantage
-increased credibility of evaluations and advice
-reduced error in advice

Science – potential disadvantage
-requires research
-disrupts time series
-more complex assessments

Management – Potential advantage
-reduced risk
-increased success of management

Management – Potential disadvantage
-more onerous/complex management

A few references:

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Smedbol, R.K. and R.L. Stephenson. 2001. The importance of managing within-species diversity in cod and herring fisheries of the North-western Atlantic. J. Fish Biol 59 (Suppl A):109-128.

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