The Sir Hugh Fish Memorial Lecture IFM 2014

Fisheries Science in the Ecosystem Age

Nigel Milner

APEM Ltd
www.apemltd.co.uk

& Bangor University, School of Biological Sciences
Fisheries Science in the Ecosystem Age

1. Fisheries Science: origins, nature and scope

2. New contexts and trends.

3. Unfinished business. What might we do better?
Does Fisheries Science exist?

- Who are the fishery scientists?... where are they? what do they do?

- Is it just an activity for harvest fisheries in the sea and large freshwaters?
Early focus on marine fishing

- Hjort (1914) Norwegian herring, 1904 year class, early seminal example

- Preoccupation with fishing as the primary factor governing stocks

  - Baronov (1918); Beverton and Holt (1957); Ricker (1958); Hilborn and Walters (1992)
  - Stocks had potential Maximum Sustainable Yield, to be estimated by rigorous Stock Assessment

  - Traditionally, fisheries management and the science underpinning it was distorted by its "narrow focus on target populations and the corresponding failure to account for ecosystem effects leading to declines of species abundance and diversity“ (Hilborn, 2003)
...meanwhile, in freshwater

- Anadromous fisheries decline by mid-1800s
  - Over-fishing, pollution, dams, abstraction, habitat destruction, logging

- Smaller scale, heterogeneous habitats make environmental and ecosystem effects obvious

- Fisheries differences (recreational-harvest, artificial, manipulated, welfare)

- Science priorities
  - Population dynamics and processes (census based methods feasible)
  - Density dependence, behaviour and movements
  - Environmental impacts: WATER supply, quality, barriers and habitats
  - Aquaculture and introductions
  - Diseases
Environmental factors are more important than fishing mortality in most freshwater fish stocks

Gary Larson
What is Fisheries Science?

Fisheries Science is the study of fish, fisheries, fishers and of their interactions with the environment and other parts of the ecosystem. Its outcomes are: fisheries evaluation, advice and practical guidance on managing fisheries and the environment, and the benefits and risks of various options.
Fish do only 3 things…

1. Survive / die

2. Breed

In order to:
- maximise **fitness**
- extend **range**
- maximise **population**

Delivered by life cycles

3. Disperse
Status of Fisheries Science

"The conditions under which we work, against time, in the midst of controversy, and with everything about us insecure, are so worrying and laborious, so different from the conditions under which scientific work ought to go on, that the toil and responsibility are greatly increased."

D'Arcy Thompson, an academic and fisheries scientist, in a letter written in 1902
(with thanks to John Ramster, Cefas)

Disciplinary Disintegration in Biology (Van der Steen 1993)

The naturalists are dying off (Anderson, 1996)

Rethinking the role of ecological research… (Hart and Calhoun 2010)

Fishing for truth (Ruse 1995)

Freshwater ecological science in the UK: last rites or a new dawn? (Raven 2005)

Productive Biology in the UK: is it downhill all the way? (Hildrew 2005)

Why are quantitative relationships between environmental quality and fish populations so elusive? (Rose, 2000)

Fisheries science and sustainability in international policy: a study of failure in the European Union’s Common Fisheries Policy. (Daw and Grey 2007)

4. Deficiencies of fisheries science

Not all of the blame for ineffective conservation policies can be attributed to the politicians and fisheries who receive the advice. Some of the reasons may be found in the nature of fisheries science, specifically its lack of certainty, its limited scope, and its remoteness from fisheries.
Trends (general)

- Conventions and Legislation (Rio, HD, WFD)
  - Biodiversity and conservation
  - Ecosystem and Precautionary Approaches
  - Ecosystem Services
  - Environmental Impact Assessment

- Organisation and capacity
  - Resources
  - Reorganisation around “ecology”, loss of sectoral strength
  - 3rd sector rise
  - Less training of fisheries scientists?
  - Coastal marine fisheries, MPAs
Trends (scientific)

- Sophistication through new techniques and concepts
  - Genetics
  - Behaviour: dispersal, reproduction and habitat relationships – telemetry and tracking
  - Life histories and evolutionary biology
  - Ecosystem emergent properties: resilience, stability, recovery
  - Climate science

- These align with Ecosystem Science
The ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries.

**FAO Guidelines 2003**

*Within this lies the Precautionary approach*… Lack of scientific certainty should not prevent taking actions to protect resources from serious harm, + (NASCO) indicators, Biological Reference Points and sustainable productivity.

NB *Ecosystem Approach* is different from *Ecosystem science*
Explaining widespread population decline, e.g. trout in Afon Conwy, North Wales

- Major trophic web changes (regime shifts?)
- Acidification, salt effects
- Climate
- Diffuse pollution, moorland drainage
- Allee effects?
- WFD failure, but few data, few studies
- Fundamental ecosystem science to understand these fishery changes
Habitat – the Cinderella of Fisheries Science?

Why evaluate Habitat?

• Template to which life histories adapt and around which ecosystems are structured
• Habitat-fish relationships are the basis for much fisheries science and management
• Explains variance, predicts what should be there, integral to ALL fishery targets
• Degraded or fragmented habitat is a major cause of fish decline worldwide

What is involved?

• You need a validated model, giving a range of numerical or (less good) qualitative predictions.
• Model = habitat data + fish data
• Without this combination, habitat description methods are just … descriptions
One model: HABSCORE

• System for measuring and evaluating the quality of salmonid stream habitat
  – In-stream habitat and catchment features used to predict fish populations
  – based on empirical statistical models
  – Detailed documentation, guidelines and training available

• Models from data in ‘pristine sites’
Detectable difference between sub-catchments (0+ salmon)

- Without HABSCORE
- With HABSCORE
- 50%
Is HABSCORE worth the effort?

- Without HABSCORE
- With HABSCORE
- 50%

Save 31%
Habitat – source to sea

- “Habitat” and all its influence apply to all waters – and so should habitat assessment
- Marine biotopes influence distribution and abundance of diadromous fish
National Channel Habitat Inventory

- Spatially explicit, quantitative models covering ALL channel area, GIS platform
- Many complementary, compatible data collection methods
- Framework in place (e.g. RFHI), huge literature, it’s feasible
- Several starts, no completion
- Would benefit all branches of aquatic ecosystem science and management
- Fisheries targets: e.g. CLs, SAC condition, WFD, EIA
Habitat – the FIRST thing to measure!
Renaissance

- Fisheries Science is a discrete discipline
- Numerical fishery assessment practices are still needed, modernised and now enhanced by conservation and ecosystem science – which are not new for Fisheries Scientists
- Fisheries Science is the epitome of Ecosystem Approach
- Complete the unfinished business: e.g. CLs, Monitoring, Habitat, Channel Habitat Inventory, implement previous reviews
- Strengthen professional identity
- Coordination and strategy for Fisheries Science
- Representation and Leadership?