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Robust Management, Risk and the Ecosystem Approach to Fisheries

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Abstract

Modern-day discussions of fishery governance and management revolve around a number of key ingredients – the goals of sustainability and resilience, the widespread presence of uncertainty and complexity, the corresponding directions of a precautionary approach and an ecosystem approach, and implementation of these through avenues such as robust management. This paper explores the links among these many ingredients. In particular, robust management mechanisms aim for reasonable success in meeting societal objectives of sustainability and resilience, even given high levels of uncertainty, limited understanding of the fishery and an imperfect capability to control exploitation. This draws on both a precautionary approach and an ecosystem approach, in what is, in fact, a form of risk management: risk is reduced through design measures that shift fisheries to become more robust to the inherent structural uncertainty. Managing risk, through robust management, is a key element of fishery governance in the context of the emerging Ecosystem Approach to Fisheries (EAF), and its joint pursuit of ecosystem health, sustainable resource use and human well-being.

1. Introduction: Uncertainty and Complexity in Fisheries

This is a personal and somewhat subjective essay on how an understanding of the prevalence of uncertainty and complexity in fisheries, together with a renewed pursuit of the goals of sustainability and resilience, has led to adoption of a precautionary approach and an ecosystem approach, and further, how this evolution has created its own implementation avenues, such as robust management, as well as its own risks. All of this has influenced major directions in fishery research, management and more broadly, fishery governance.

Uncertainty has been a major cornerstone of fisheries discussions for decades, and a reality I have explored elsewhere (Charles 1994, 1995, 1998, 2001, 2002a, 2007). This analysis has particularly related to *structural uncertainty*, the most fundamental form, reflecting a basic lack of knowledge about the nature of the fishery system, its dynamics and internal interactions.

Structural uncertainty is inextricably connected to complexity, since these uncertainties often relate to such ingredients as spatial complexity, the complexities of fish-fish or fish-environment interactions (e.g., multi-species effects and habitat impacts), the multiplicity of management goals and fisher objectives, and complex responses of fisher adaptations to regulation.

Structural uncertainty, and the underlying complexities in the fishery system, are surely dominating factors affecting outcomes of fishery management. Consider but three reasons for this. First, structural uncertainty differs in a very practical economic (and financial) sense from simple random fluctuations; one can insure against random fluctuations, for which the probabilities of occurrence are known, but this is much more difficult in the face of basic ignorance about the system. Second, while the effects of structural uncertainty are considerable, it is unclear, in many cases, to what extent such underlying uncertainties are reducible over time, given the 'complex adaptive system' nature of fisheries. Third, the combination of structural uncertainty and complexity can produce 'surprises' that fundamentally alter the fishery system (Holling 1978).

In a world of uncertainty and complexity, a natural question arises: what management and governance mechanisms can best move fisheries toward sustainability and resilience? These will be ones that embrace a precautionary approach, and incorporate a recognition of complexity through an ecosystem approach – or more broadly, a *fishery systems approach* (Charles 2005; Garcia and Charles 2007, 2008). But what form does management take, if it is indeed based on such approaches? How is the goal of sustainability and resilience to be achieved, in a world where the limitations on what is possible through fishery management are beginning to emerge clearly? These questions are explored below.

2. The Precautionary Approach and the Ecosystem Approach

The realities of uncertainty and complexity, in fisheries and other sectors, have been addressed in recent years through two major frameworks – the precautionary approach and the ecosystem approach.

Implementation of a *precautionary approach* (Garcia 1994; FAO 1995; Charles 2002a) guides decision making within a highly uncertain environment. This is a matter of balancing risks (e.g., risk of resource collapse, risk of lost economic benefits) – using some form of risk analysis and risk management – and in so doing, determining where the 'burden of proof' should lie. As De Young et al. (2008) note, "The Precautionary Approach… provides a policy and management framework for dealing with the various forms of uncertainty faced in fisheries management… Aspects of this range from appropriate risk assessments to robust and adaptive fishery management methods, to appropriate institutions capable of implementing such a management approach." On the latter point, the precautionary approach is often raised in the setting of TACs, effort limits and harvest rates, but De Young et al. (2008) emphasize that it is equally important to implement the precautionary approach at a policy and governance level. This deals with approaches underlying fishery decision making – and how to determine suitable 'rules' governing decision making (as opposed to decision rules *per se*).

Just as the risks arising from pervasive uncertainty in fisheries have been 'attacked' through institutional adoption of the precautionary approach (as well as methods of risk analysis, etc.), so too has the reality of complexity in fisheries been addressed through the recent convergence toward the Ecosystem Approach to Fisheries (EAF) as a framework for managing fishery systems holistically and in relation to their natural and human environments (Charles 2001; FAO 2003). In particular, the EAF takes a comprehensive perspective on fisheries issues, jointly incorporating pursuit of ecosystem health, sustainable resource use and human well-being.

De Young et al. (2008) note that "The link between the precautionary approach and the ecosystem approach is a logical one: the first calls for suitable use of precaution in decision making, while the second calls for suitable breadth in what is considered within the decision making. Together, the two approaches imply a significant challenge – to assess and manage a set of uncertainties and risks, but at a broader scale and with a broader scope, covering a range of possibilities larger than what would have been considered in conventional fishery management." A key benefit of this combination lies in the inherent desirability of integrating approaches for addressing uncertainty and complexity together.

3. Linking Risk and the Ecosystem Approach to Fisheries

De Young et al. (2008) have noted that in the context of EAF implementation, the precautionary approach implies a need to take into account "a broad set of risks, including (a) those that might arise in fishery use, in terms of environmental impacts, (b) those posed by aspects outside the fishery, such as other sectors, but which might impact negatively on the fishery, and (c) those that arise in EAF implementation itself, such as the risk of possible negative social or economic impacts from changes initiated for EAF goals." For example, applying an ecosystem approach in a highly uncertain environment, with a lack of information on most ecosystem and human components, could lead (with minimal precaution) to a high risk of resource collapse and long-term loss, or (with maximal precaution) to a similarly high risk of short-term losses in economic activity, livelihoods, and/or food security.

Risks arise as well in the distributional impacts of implementing institutional change such as the EAF (Charles & De Young 2008). Who receives the benefits and who incurs the costs of that implementation? How do the potential benefits and costs arise across the wide range of time scales in the evolution of the fishery? How do those benefits and costs occur across spatial, geographical or administrative scales (e.g., local, national, international)? There may, for example, be a benefit that is international in scale (e.g. increased existence value of conserved biodiversity) and a corresponding cost that is local in scale (such as a negative impact on displaced fishers near an MPA), or any other combination could arise.

Incentives are needed to support EAF implementation (De Young & Charles 2006), for example to counter the distributional impacts discussed above. These incentives may take the form of legal incentives (e.g., effective legislation to create positive incentives, and significant penalty structures with enforcement capability), economic incentives (e.g., win-win measures, such as the use of excluder devices in fishing gear, to reduce both fishing costs and by-catch), social incentives (e.g., community-based institutions that create peer pressure to comply) or institutional incentives (e.g., participatory governance arrangements that induce support from

stakeholders). Risks can arise with respect to each of these possible incentive arrangements – for example, the risk of undesirable responses to the incentives, or of unexpectedly high costs incurred in putting the incentives in place.

The broader scope of management involved in the EAF requires increased coordination, cooperation and communication between relevant sectors (agriculture, tourism, commercial- and non-commercial fisheries, communities etc.) and regulatory institutions (ministries, etc.), in order to manage fisheries effectively. Similarly, if EAF management, and its inherent move to participatory approaches, leads to devolution of decision-making and management responsibility to local levels (which can improve compliance and the cost-effectiveness of management, by making use of traditional practices), this will require inter-community coordination to account for ecosystem boundaries (FAO 2003). There are also risks that devolution to lower levels of administration could fail if there is a lack of appropriate human and financial mechanisms, and of suitable capacity-building among local decision-makers.

Moving to EAF management not only requires more information on species interactions, critical habitats, etc., but also on how different sectors and stakeholders benefit from and impact on ecosystem services. To incorporate a broader range of ecosystem factors into the management process, without a complete information set, will require the ability to manage resources within a context of increased uncertainty, and to incorporate these uncertainties into the decision-making process.

As an increased management scope requires a broadened stakeholder definition, mechanisms to allow for their inclusion into the management process will be necessary to improve its effectiveness. A participatory approach may create risks of cost increases (e.g., from an increase in the number of meetings held), and an increased number of stakeholders means an increased number of objectives and interests. In order to reconcile multiple objectives/interests, mechanisms for conflict resolution may be necessary.

4. Robust Management

I have argued elsewhere (Charles 1998, 2001, 2002a, 2004) that a key element of a suitable fisheries strategy is the design of a management framework best able to cope with the fundamental problems of structural uncertainty, and the associated risks. A key feature of the management system should be the capability to achieve ‘reasonable’ success in meeting societal objectives, even if (a) our current understanding of the fishery (e.g., the status of the resources), its environment and its processes of change, turns out to be incorrect, and/or (b) the actual capability to control fishing activity is highly imperfect. This quality I have referred to as *robust management* (Charles 2001, 2004).

In such a situation, we seek to achieve at least some minimal level of success whatever the true state of the natural and human world (as long as this lies within a ‘plausible’ range). Like ‘sustainable development’, robust management is not easily achieved, but rather reflects a desirable attribute to move toward in managing any highly uncertain system. Indeed, it should be possible to move in the appropriate direction by choosing management approaches that are relatively less sensitive to uncertainty and less demanding in terms of control measures.

The pursuit of robust management addresses two major problems faced by many fishery management systems and which I have addressed elsewhere as having been pervasive in Atlantic Canada's groundfish fisheries (Charles 1995, 2001, 2007) and a significant influence on their dramatic collapse:

- *Illusion of Certainty.* Some management systems exhibit a tendency to ignore major elements of uncertainty, so that far from recognising and working within the bounds of this uncertainty, management may create an illusion of certainty that leads to the opposite result.

- *Fallacy of Controllability.* The fishery is a good example of a system that can be only partially, and imperfectly, controlled. Unfortunately, this is by no means universally recognised - a fallacy of controllability is often in place, reflecting a sense that more can be known, and more controlled, in fisheries than can be realistically expected.

A key point is that the complexities and uncertainties inherent in fishery systems make it risky to rely on management methods that are sensitive to highly uncertain variables or which depend on high levels of controllability.

Moving to robust management requires both a re-thinking of the philosophy of fisheries management, and adoption of new structural and decision making tools. Such measures are incorporated into new and emerging frameworks such as Adaptive Co-management (Armitage et al. 2008; Charles 2007).

One of the key ingredients lies in processes of learning about the fishery system over time, through suitable monitoring, together with timely adaptation to unexpected circumstances, so that conservation goals are not compromised. This *adaptive management* is a fundamental tool for living with uncertainty, based on the recognition that in fishing, operating plans must be particularly flexible, to allow for the highly uncertain nature of the most crucial input, the fish. A flexible, adaptive approach is one in which fishing plans, and individual 'fishery business plans', are designed to adapt to unexpected changes in the natural world (Charles 1995, 2001).

5. Implications for Governance and Policy

Implementing the Ecosystem Approach to Fisheries provides a comprehensive mechanism for better embracing the complexity and breadth of fishery systems, while at the same time providing a forum for adopting a precautionary approach. However, there are new uncertainties inherent in the broadened context of the EAF, and to deal with these, a number of risk-reducing governance and policy directions may be desirable. Some of these directions have been presented in the discussion above, and three further examples are as follows:

- A 'portfolio' of multiple management measures is needed in fisheries, since excessive reliance on any one management tool is unlikely to produce acceptable results all the time. This management portfolio is best placed within a context of self-regulatory institutions and appropriate rights over fishery use and management; by building a participatory and well-accepted governance framework, we reduce the risks of non-compliance and illegal fishing.

- In an uncertain and ecosystem-oriented management world, not only must the conception of necessary science be broadened, so too must better use must be made of traditional ecological knowledge held by fishers and coastal communities. A policy implication is the need to counter the risks of losing this knowledge base, by ensuring that – particularly in small-scale fishery settings – those with the most intimate connection to the resources and their environment, typically those living in adjacent coastal communities, have secure access to the local fishery through suitable rights arrangements (Charles 2002b).
- While the EAF focuses on the fishery sector, a risk reduction strategy should also include livelihood diversification, by creating employment alternatives outside the fishery and supporting a diversity of occupational options in coastal communities, to complement fishing activities. This poses a major policy challenge in jurisdictions lacking governance mechanisms for dealing in an integrated manner with the multiple human activities (fishery-related and beyond) within specific geographic areas.

In conclusion, there has been a remarkable evolution in fisheries management over the past decade or two. From a narrow, deterministic and mechanistic 'fish and fleet' perspective, we have seen growth into thinking about fisheries as broader systems, linked to their natural and human environments. Indeed, we are moving to a focus on governance of complex adaptive systems – not an easy task, but one that better reflects the reality of the fishery system. There can be no single formula to manage within such a world, and the risks remain daunting. However, we are gradually developing a 'roadmap' into the future, one that is based on 'living with uncertainty' and 'embracing complexity', one in which the precautionary approach, the ecosystem approach, and robust management approaches serve as guiding signposts along the way.

References

Armitage, D., R. Plummer, F. Berkes, R. Arthur, A.T. Charles, I. Davidson-Hunt, A. Diduck, N. Doubleday, D. Johnson, M. Marschke, P. McConney, E. Pinkerton, and L. Wollenberg. In press, 2008. Adaptive co-management for social-ecological complexity. *Frontiers in Ecology and the Environment*.

Charles, A.T. 1994. Towards sustainability: The fishery experience. *Ecological Economics* 11:201-211.

Charles, A.T. 1995. The Atlantic Canadian groundfishery: Roots of a collapse. *Dalhousie Law Journal* 18:65-83.

Charles, A.T. 1998. Living with Uncertainty in Fisheries: Analytical Methods, Management Priorities and the Canadian Groundfishery Experience. *Fisheries Research* 37: 37-50.

Charles, A.T. 2001. *Sustainable Fishery Systems*. Blackwell Science, Oxford UK, 384p.

Charles, A.T. 2002a. The Precautionary Approach and 'Burden of Proof' Challenges in Fishery Management. *Bulletin of Marine Science* 70:683-694.

Charles, A.T. 2002b. Use Rights and Responsible Fisheries: Limiting Access and Harvesting through Rights-based Management. In: *A Fishery Manager's Guidebook. Management Measures and their Application*. (Cochrane, K., editor) FAO Fisheries Technical Paper, No. 424, Food and Agriculture Organization of the United Nations, Rome Italy, 231p.

Charles, A.T. 2004. Sustainability and Resilience in Natural Resource Systems: Policy Directions and Management Institutions. *Encyclopaedia of Life Support Systems (EOLSS)*. Developed under the auspices of the UNESCO. Eolss Publishers, Oxford, UK [www.eolss.net].

Charles, A.T. 2005. Toward Sustainable and Resilient Fisheries: A Fishery-System Approach to Overcoming the Factors of Unsustainability. In: *Overcoming Factors of Unsustainability and Overexploitation in Fisheries: Selected Papers on Issues and Approaches. International Workshop on the Implementation of the International Fisheries Instruments and Factors of Unsustainability and Overexploitation in Fisheries. Siem Reap, Cambodia, 13-16 September 2004*. (J. Swan and D. Greboval, eds.), p.221-233. FAO Fisheries Report. No.782. Food and Agriculture Organization of the United Nations, Rome Italy.

Charles, A.T. 2007. Adaptive Co-Management for Resilient Resource Systems: Some Ingredients and the Implications of their Absence. In: *Adaptive Co-Management* (D. Armitage, F. Berkes and N. Doubleday, eds.) UBC Press. Vancouver, Canada.

Charles, A.T., and C. De Young. In press, 2008. Benefits and Costs of Implementing the Ecosystem Approach to Fisheries. In: *The Ecosystem Approach to Fisheries* (G. Bianchi and H.R. Skjoldal, eds.) CAB International.

De Young, C. and A.T. Charles. 2006. *Creating Incentives for the Ecosystem Approach to Fisheries Management: A Portfolio of Approaches for Consideration in the Benguela Current Large Marine Ecosystem*. Prepared for the 3rd Regional Workshop of BCLME EAF Project, Cape Town, 30 October to 3 November 2006. Food and Agriculture Organization of the United Nations. Rome, Italy.

De Young, C., A.T. Charles and A. Hjort. In press, 2008. *Human Dimensions of the Ecosystem Approach to Fisheries: An Overview of Context, Tools and Methods*. Fisheries Technical Paper No. 489. Food and Agriculture Organization of the United Nations, Rome Italy.

Food and Agriculture Organization (FAO). 1995. *Precautionary approach to fisheries. Part 1: Guidelines on the precautionary approach to capture fisheries and species introductions*. FAO Fisheries Technical Paper No. 350, Part 1. FAO, Rome, Italy.

Food and Agriculture Organization (FAO). 2003. *The ecosystem approach to fisheries*. FAO Technical Guidelines for Responsible Fisheries No. 4 (Suppl. 2). Food and Agriculture Organization, Rome, Italy, 112 p.

Garcia, S.M. 1994. The precautionary principle: Its implications in capture fisheries management. *Ocean and Coastal Management* 22:99-125.

Garcia, S.M., and A.T. Charles. 2007. Fishery Systems and Linkages: From Clockwork to Soft Watches. *ICES Journal of Marine Science* 64:580-587.

Garcia, S.M., and A.T. Charles. 2008. Fishery Systems and Linkages: Implications for Science and Governance. *Ocean and Coastal Management* 51:505-527.

Holling, C.S. (ed.). 1978. *Adaptive Environmental Assessment and Management*. Wiley, New York, U.S.A.