

## **TEN PRINCIPLES FOR MANAGING FISHERIES TO FACILITATE ADAPTATION TO UNCERTAIN EFFECTS OF CLIMATE CHANGE**

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### **ABSTRACT**

Climate change may cause significant changes in the distribution, abundance, and species mix of commercial fishery resources. In any given area stocks of some species may decline; stocks of other species may increase; and new species may appear in commercially significant volumes. However, it is difficult to predict what specific changes may occur or when they will occur. This paper suggests ten principles for managing fisheries in ways that facilitate adaptation to uncertain future effects of climate change. These are (1) Expect change; (2) Conduct research; (3) Disseminate research results; (4) Give managers flexibility; (5) Allow for change in allocation agreements; (6) Reconsider restrictions on mobility of fishermen and processors; (7) Consider defining long-term access privileges more broadly; (8) Consider alternative rights-based systems which may facilitate adjustment to change; (9) Create mechanisms for managing new fisheries; and (10) Plan responses to resource decline.

**Keywords:** climate change, uncertainty, fishery management

### **INTRODUCTION**

Climate change increases our uncertainty about future fisheries resources. How should fisheries management respond to increased uncertainty about future fisheries resources?

### **ASSUMPTIONS**

For purposes of discussion, I make two assumptions about climate change and its effects on fisheries resources. First, I assume that there is a significant probability that significant changes in climate will occur over the next few decades, beyond what we have historically experienced. The timing, extent and implications of future climate change are uncertain.

Second, I assume that climate change may bring about significant changes in the abundance, geographic distribution and species mix of commercial fisheries resources. These changes may also be outside the ranges of long-term historical experience. In any given area, stocks of some species may decline dramatically, while stocks of other species may increase dramatically. New species may appear in commercially harvestable volumes.

The effects of future climate change on fishery resources are highly uncertain. Our uncertainty about what changes in climate may occur is amplified by our uncertainty about how changes in climate may affect ocean conditions, and how these changes may in turn affect ecosystems and fisheries resources.

In summary, I assume that we should expect significant changes in fisheries resources—outside of the range of long-term historical experience—but we don't know what the changes will be.

### **A QUESTION**

If we expect significant but uncertain changes in future fishery resources, what does this imply for how we should manage our fisheries?

My goal is to stimulate thinking and discussion about this question. Note that much of the “climate-change” discussion among fisheries economists and other fisheries scientists has focused on specific observed or anticipated effects of climate change, such as increases or decreases in the volumes of specific fish stocks, and how management should respond to these specific observed or anticipated effects. My focus is on a different question: how should we respond if we expect changes, but don’t know what the changes will be?

## TEN PRINCIPLES

For purposes of discussion, below I suggest ten principles for how fishery managers should respond to increasing uncertainty about fisheries resources. By “principles” I mean ideas which policy-makers and managers should consider as they manage fisheries, in responding to increased uncertainty.

These principles are based on the assumption that long-term goals of fisheries management include:

- Optimizing harvests over time (not harvesting too much or too little)
- Optimizing investments over time in vessels, processing facilities and human capital (not investing too much or too little)
- Reducing economic risk for fishermen, processors and communities

These principles are based on simple reasoning. Clearly their relevance and feasibility may vary widely between regions and fisheries.

**1. Expect change.** We need to shift from the concept that the fisheries we manage are part of a stable ecosystem to the concept that they are part of a changing ecosystem. All fisheries management discussions should incorporate the possibility that resources may change significantly in the future.

**2. Conduct research.** We should seek to reduce uncertainty by conducting research about how climate change may affect future fisheries resources. However, we should also recognize the limits to what we can learn from research, given that the potential effects of climate change are extremely complex, research funding is limited, and the marginal benefit of research in reducing uncertainty may be limited

**3. Disseminate research results.** It is not sufficient for scientists to conduct research. They need to disseminate and interpret their research results to managers and industry—so that managers and industry make decisions (for example, about investments in permits, quota, boats, and processing facilities) based on the best available information. Even limited and uncertain information is better than no information. However, we should recognize that scientists don’t necessarily agree about the “best available information,” and that scientists may not be good at communicating what industry and managers need to know.

**4. Give managers flexibility.** If we expect change, we should give managers the flexibility to respond to change: the ability to consider and act on new information quickly. Management institutions need to be able to make decisions in months or weeks, not years.

**5. Allow for change in allocation agreements.** When allocating fishery resources between user groups or countries, incorporate provisions for how allocations would change in response to significant changes in resources (relative abundance and locations of stocks of different species).

**6. Reconsider restrictions on mobility of fishermen and processors.** Management policies in many fisheries restrict the mobility of fishermen and processors. Examples include requirements that fish be delivered to specific ports or processors, and that limit fishery access to “local” residents. These restrictions increase the vulnerability of fishermen and processors to changes in resource distribution, and reduce their options to adjust to changes in resource distribution. For example, Alaska policies promote land-based over floating processors by taxing land-based processors at a lower rate. The goal of these policies is to encourage community development. But land-based processors cannot follow the fish if the fish move elsewhere. If we believe that climate change increases the uncertainty about where fish stocks will be in the future, the relative benefits of onshore processing may be lower.

**7. Consider defining long-term access privileges more broadly.** As resource uncertainty increases there is greater risk associated with the future harvest opportunities conveyed by access privileges (limited entry permits, IFQs, etc.) for specific species in specific areas. Defining access privileges for broader groups of species and broader geographic areas would reduce this risk.

**8. Consider alternative rights-based systems which may facilitate adjustment to change.** If we expect that the mix of species in any given area may change significantly in the future, this increases the potential advantages of territorial use rights in fisheries (TURFs) in comparison with species-based rights, in terms of reducing risk to rights-holders and facilitating development of new fisheries.

**9. Create mechanisms for managing new fisheries.** We are more likely to benefit from new fish species which may appear in commercially viable volumes if we plan in advance for how we will manage them. For example, we should consider whether new fisheries should be “open unless closed” or “closed unless open;” when and how fishing privileges for new fisheries should be assigned; and how we should fund research and management for new species.

**10. Plan responses to resource decline.** If we expect significant declines in some fishery resources, we should plan in advance whether, how and to what extent we will assist or compensate individuals and communities affected by declines.

I offer these principles to stimulate discussion and thought. What principles should be removed, added, or stated differently? More broadly, how should we conceptualize the problem of “increasing uncertainty” and how to analyze it?