FISHERY SCIENCE: FACT, FICTION, AND DOGMA

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In response to the symposium theme, I shall discuss fishery science in the context of fact, fiction, and dogma. The fact will be a definition of fishery science. The dogma will set forth the corrective actions that will be required if, in fact, our assertion that dynamic progress in fishery science is a fiction is correct.

The Fact

A fishery involves the extraction of fish from their habitat. This extraction is a socio-economic process with biological constraints. The study of this process, then, cannot simply involve isolated studies of biology, economics, or sociology. The study must involve an integrated examination of all of these. It is clear that such an integrated examination is necessary to provide the analysis required for better fishery decisions and it is further clear that owing to contemporary increased resource use, we have a greater responsibility to focus our talents on these issues and indeed make dynamic progress in fishery science.

The Fiction

If our notion that dynamic progress in fishery science is a fiction is correct, then, we must be making dynamic progress in:

—Developing the bio-socio-economic strategies of fisheries.

—Dealing with overfishing and the root causes of overfishing.

—Modifying the institutions that nurture open access and unlimited entry into the fisheries.

—Materially increasing our understanding of the most fundamental of biological fishery problems —the problem of stock and recruitment.

—Understanding the costs and benefits associated with pollution as it relates to the fisheries.

—Developing the bio-socio-economic theory of multiple species fishing (for example, if we can catch 10 tons of species A and 20 tons of species B, can we, in general, catch 30 tons of species A and B?).

—Stimulating the fisheries community, scientists, industry, and administrators, to participate in rational management and actually to be held accountable for fishery mismanagement or irrelevant or low quality research.

—Understanding of ocean-fish interaction. There has been very little marginal increment in our understanding of ocean-fish interactions over the past few decades. Although there are many correlations between the abundance and distribution of fish and some index of what is happening in the ocean, these correlations seldom hold over a period of time in the future. This indicates the lack of a fundamental understanding of the cause and effect relations between the fish and the oceans. Without this fundamental understanding we will never be able to make successful predictions based on measuring ocean variables.

—Developing biological and economic theory that deals with short term fluctuations in abundance (Nearly all population dynamics models are long term, equilibrium, or "on the average models." We need to predict what is going to happen next year and this cannot be efficiently obtained from long term averages. Again, we have to examine cause and effect mechanisms and develop a body of knowledge that deals with short range events. At the outset this will require a probabilistic approach rather than a deterministic approach).

—Developing information systems which deal with storage and retrieval of fisheries and ocean information (There are many highly sophisticated and efficient methods of dealing with information; in fisheries we have barely scratched the surface in utilizing these new methods).

—Developing algorithms for allocation of fisheries stocks in the time-stream. We need to replace maximum sustainable yield which is not, among other things, an economically-sensible fisheries criterion. For example, MSY is a theory that suggests a constant catch every year which does not respond to changes in price. A constant yield every year cannot, in general, have any built-in discount factor.

Dogma

If we agree that dynamic progress in fisheries is a fiction, then it would seem appropriate, according to the theme of this symposium, to formulate a dogma that will make our progress dynamic. I believe this will involve:

1. Modification of existing institutions and creation of new ones that can explicity focus their resources on the bio-socio-economic fishery problem. I am not convinced that we have institutions that are presently capable of focusing on fishery resource problems in a way that is compatible with the acceleration of the complication of our decision problems in the fishery area.

2. Recognition that we have only a finite amount of time and budget in an environment of accelerating decision complexity. We cannot work on all problems; we need to examine our objectives and alterna-

tive ways of achieving these objectives more carefully. Most important, perhaps, we should look at the criteria by which we select these alternatives. This is not only a problem which applies to fishery organizations, but to individuals as well. Each individual has a finite amount of time. Given a climate of increased social responsibility, we need to judge how best to allocate our time and financial resources to making better resource decisions.

3. We need to recognize that it is no longer sufficient for a responsible scientist to provide simply a shopping list of problems. The responsible fishery scientist, in addition to providing a list of problems, must also indicate which of these problems is most important. We must ask, "Why are we doing what we do?"

4. We need to allocate much greater effort toward investigating cause and effect mechanisms and much less effort toward developing correlations. The limited success in fishery oceanography and stock and recruitment studies results from a heavy reliance on a correlational approach.

5. We need to challenge the assumption that universities are providing people with the skills and background to cope with contemporaneous fishing resource problems. We have a new set of questions today and I think we have to ask our universities whether they are providing graduates with the skills needed to handle these problems.

6. This will involve the direct development of new techniques as well as the application of techniques already existent in other fields but not used in fisheries. For example, most of the mathematics used in fisheries rely almost totally on applied statistics and calculus. Indeed we have had substantive contributions to our knowledge from the application of statistics and calculus to fisheries problems. Unfortunately, statistics and calculus are not (with a few minor exceptions) helpful in answering the most critical fisheries question: "Who gets what?" How do we allocate resources in space and time to harvesters and processors? The general class of problem is also important from a biological point of view. To take one example, "How are prey allocated among the predators? What objective function do predators have?" There is a body of mathematical techniques that is applicable to these problems. It is called mathematical programming. It is curious that such powerful mathematical techniques for the study of allocation have not really been applied in the area of fisheries or aquatic sciences, and yet the application of these techniques may give us new and broad insight into these critical questions. This is, of course, but one example of available methods which could be applied to help us make our progress in fisheries more dynamic.

In conclusion, I have given my view of the fact, fiction, and dogma of fishery science. I do not think that our progress is totally fictional; on the other hand there are significant and material planning actions that have to be undertaken if we are to adequately face our responsibilities as we accelerate our progress toward making fishery decisions in an environment of increasing complexity.

FISHERY SCIENCE: FACT, FICTION, AND DOGMA PANEL DISCUSSION

Frey: Gentlemen, are there any additional thoughts concerning fishery science: Fact, Fiction, and Dogma?

Isaacs: Brian, in your particular shopping list problem, I didn't hear you express your priorities, or did you do what I did, assume your whole list a set of number one priorities and sent it by freight?

Rothschild: You are right, I did not indicate any priority mainly because I thought all these were number one. The second reason is that it is a very bad thing nowadays to think in priorities. The reason is illustrated by the story I frequently tell about the shopping list that has a cadillac, a beef roast, and shoe laces, and you ask anybody what their priority is and to rank them in that order. When I say, "Oops! you only have a budget of $27," the beef roast suddenly becomes number one, shoe laces number 2, and the cadillac number three. The answer is, if you tell me how much money you have I can give you my priorities.

Frey: Question regarding fishery allocations. Do you think this is the fishery scientist's job or do you feel this is a decision that should be left to politicians?

Rothschild: That is a real good question. It is a decision that should be left to politicians. However, the problem is that one reason we may not have been making as good decisions as we might is because politicians frequently make their decisions on more or less ad hoc kinds of information. It is the job of the scientist to present to the politician a menu of alternatives, and to provide for the people who make the decisions the consequences of the kinds of decisions they make. I think we can see this in nuclear power plant siting. I think it is the job of the scientist to present the new alternatives and the consequences.

Isaacs: Take one case, one I already referred to, excluding the porpoise from the catch. The scientists were not presented any freedom of alternatives. The politicians presented the scientists with a task and as far as I can find out, the scientists didn't even start to