

What is a fish stock assessment? Is it a sound method? Can it be used to manage a commercial fishery?

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Abstract

Under Karl Popper's non-inductive theory of method arguments are never carried from data to advice as in a fish stock assessment. That is: a distinction or 'demarcation' has to be made between (i) a Lamarckian-like inductive argument involving *instruction* from the environment and (ii) a Darwinian-like selection by falsification involving *selection* by the environment. The absurdity that we should seek to manage the marine environment by looking for instruction from the data, instead of using our own intellect in the form of bold imaginative policies, results in a monism of 'scientific' ethics. I conclude a fish stock assessment is an unsound method. Its data-based inductive arguments have no problem-solving capacity and are to be held responsible for the collapse of some of the World's largest Gadoid fisheries. A deductive method capable of problem-solving would involve the selection of bold policies by falsification, given as error elimination (EE) in Karl Popper's trial and error heuristic. An example of policy selection by falsification would be the use of lobster landings (LL) as a negative feedback index by the 120+ year old inshore Maritime lobster fishery.

Keywords: Karl Popper; Fish stock assessment; Fisheries management; Fisheries collapse; Non-inductive theory of method

Introduction

I have always found it difficult to understand the methods used in the management of our commercial fisheries, methods generally referred to by fisheries scientists as fish stock assessments. Fortunately an easy to understand account has recently been placed on the World Wide Web by Fisheries and Oceans Canada (DFO, 2015) under the title: *The Theory of Stock Assessment*. The opening paragraph of this article explains the important

role played by stock assessment in maintaining the sustainability of our commercial fisheries and in maintaining the health of the marine ecosystem in general.

If you had to sum up in a few words what the process of fish stock assessment is all about, most science literature on the subject describes it as “turning data into advice.” One scientist who lives by such a dictum is Dr. Noel Cadigan, a researcher with Fisheries and Oceans Canada (DFO), working out of St. John’s, Newfoundland. The focus of his entire career has been stock assessment - trying to figure out as precisely as possible how many of which species of fish are in eastern Canadian waters. It is critical work, the results of which inform DFO about the health of the marine ecosystem in general, and more specifically, the status of specific commercial fish stocks from one fishing season to the next, and what are sustainable harvests (DFO, 2015).

We can summarize this account of a fish stock assessment in the form of an *a priori* methodological scheme involving a ‘decision-making’:

data → advice → decision-making *a priori* scheme

In this scheme management decisions are based *a priori* on data, improve the collection and analysis of the data and you improve the accuracy and certainty of the advice, which in turn has the potential to improve the making of decisions.

Solving problems by trial and error heuristic

To be contrasted with the *a priori* scheme of a fish stock assessment is my suggestion that the management of the inshore Maritime lobster fishery can be given as a ‘decision-taking’ version of a trial and error heuristic¹ as described by the British/Austrian philosopher of science, Karl Popper. This suggestion can be summarised as a problem solving scheme involving an *a posteriori* critical feedback:

$P_1 \rightarrow TD \rightarrow EE$ by LL $\rightarrow P_2 \rightarrow TD \rightarrow EE$ by LL... etc. *a posteriori* scheme

where P_1 = the initial problem requiring solution that includes the goal or objective to be pursued. For example: how do we achieve a sustainable lobster fishery? How do we obtain

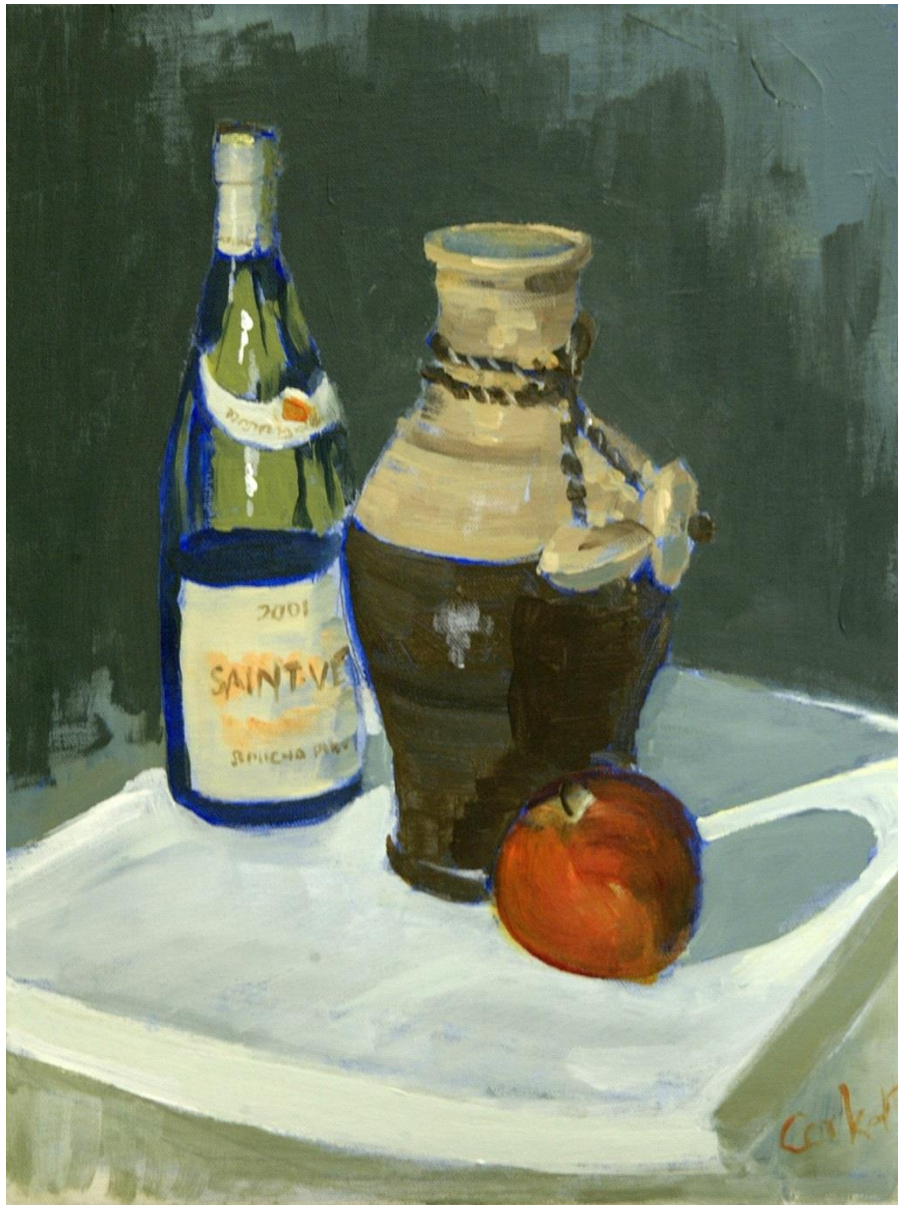


Figure 1 A still life painting in acrylics

further employment for our lobster fishermen and fish processors? *TD* = a tentative decision that reflects the chosen goal; *EE* = error-elimination by *a posteriori* negative feedback involving lobster landings (LL) by which the effectiveness of the policy in solving the initial problem P_1 is assessed; P_2 = the new problem that arises as the result of the decision taken; after which a new cycle begins. In the effort-managed Maritime lobster fishery, the historical record of lobster landings (LL in tons (t)) can be interpreted as a negative feedback index. A stable or continuously increasing index would indicate that the management policies were effective in solving problems, whereas a declining index would indicate that the policies were not effective (Corkett, 2011). The inshore Maritime lobster fishery is one of Canada's most regulated fisheries and some of these regulations have been in place for more than a century; for example: the protection of small lobsters and egg-bearing females was introduced in the 1870s.

A painting as an interpretation of the 'facts'

A painting is an interpretation of the 'facts' and in Figure 1 I have reproduced a still life painting. The wine bottle in the painting contains a label and the question arises how detailed should this label be reproduced in the final rendition of the painting. If the label was to be reproduced in microscopic detail so that every word could be read it would be out of place with the rest of the painting. The detail in the label has to remain in context with the rest of the painting. That is: the label has to 'be convincing' as my old Art Master would have said.

Observations and data as interpretations of the 'facts'

From a common sense point of view it would appear that a theory in the form of advice should be based on the 'facts' in the form of data (as in the *a priori* scheme). However, just as reproducing the label on the bottle in microscopic detail for its own sake does not make for a better painting (Figure 1), so collecting and analysing data in a way that is accurate and certain does not make for better advice. Problems ($P_1, P_2 ..$ in the *a posteriori* scheme) are solved by bold imaginative policies that are selectable by error elimination (EE), problems are not solved by basing advice on data that is accurate and

certain! Just as a painting is an interpretation of the 'facts' so observations and data are interpretations of the 'facts'; that is: an interpretation or an expectation in the form of theory is logically prior to the 'facts' as data. In the effort managed Maritime lobster fishery this theory takes the form of bold imaginative policies that are selectable by *a posteriori* negative feedback in the form of lobster landings (LL). In the traditional management of this 120+ year old inshore Maritime lobster fishery, decisions, policies and advice have never been based *a priori* on estimates of abundance or biomass as in the Atlantic groundfish fisheries.

Discussion

Under Karl Popper's non-inductive theory of method arguments are never carried from the 'facts' or data to theory or advice as in a fish stock assessment. That is: a fundamental distinction or 'demarcation' has to be made between (i) a Lamarckian- like ⁱⁱ inductive argument involving *instruction* from the environment and (ii) a Darwinian-like selection by falsification ⁱⁱⁱ involving *selection* by the environment, given as error elimination (EE) in the trial and error heuristic. The absurdity that we should seek to manage the marine environment by looking for instruction from the 'facts' in the form of data, instead of using our own intellect in the form of bold imaginative policies ^{iv}, results in a monism ^v of 'scientific' ethics (Corkett, 2005).

Conclusion

1. I conclude a fish stock assessment is an unsound 'scientific' method. Its Lamarckian-like *a priori* arguments have no problem-solving capacity and are to be held responsible for the collapse of some of the World's largest Gadoid fisheries.
2. A method capable of solving problems requires a Darwinian-like selection by falsification, given as error elimination (EE) in Karl Popper's trial and error heuristic.

3. In the case of an input ^{vi} managed fishery an example of error elimination (EE) would be the use of lobster landings (LL) as a negative feedback index by the 120+ year old inshore Maritime lobster fishery.
4. In the case of an output ^{vii} managed fishery an example of error elimination (EE) would be the use of a catch-per-unit (CPU) as a negative feedback index by the early management (1932-1957) of the Pacific halibut (see Corkett, 2014, his Figure 1(a)).

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End Notes

ⁱ A heuristic is an argument or procedure for solving problems especially by trial and error methods.

ⁱⁱ Lamarckism is a theory of evolution that asserts environmental changes can cause structural changes in animals and plants that are transmitted to offspring.

iii Corkett (2009) illustrates a falsification by the contradictoriness or falsifiability between two propositions both of which cannot be true.

iv An example of a bold policy would be the identification and closure of spawning areas to harvesting before they can be found and targeted by fishermen.

v A monism is a single premised argument (see Corkett 2014, his Table 1).

vi Input controls are restrictions put on the intensity of the use of gear used to catch fish (including shellfish) such as controls on the number of fishing traps deployed.

vii Output controls are direct limits put on the amount of fish or shellfish coming out of a fishery such as a Total Allowable Catch (TAC).