Chinook salmon – Ocean phase
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Using classification trees to capture a manager's interpretation of Bayesian projections

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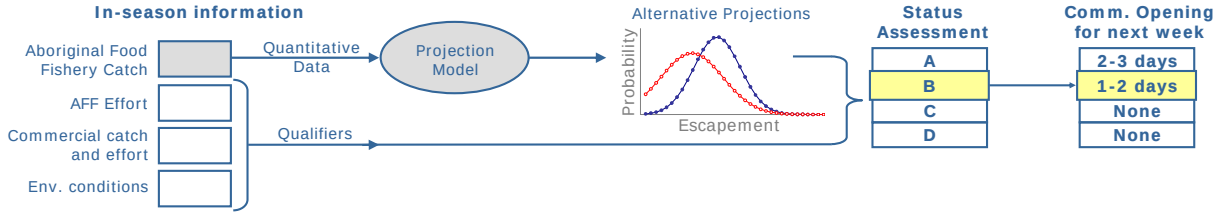
Introduction

The approach presented here establishes an effective format for constructive collaboration between analysts and managers. This project was descriptive, not prescriptive. The emphasis was on documenting what an experienced manager actually does, rather than exploring what a theoretical manager should do.

Fisheries science continues to develop ever-more sophisticated tools, but it remains a challenge to understand how these tools fit into manager's decision processes. Only close collaboration during model development and on-going technical support can help bridge the gap to intended end-users. For models to be used correctly, the decision-makers need to be (1) comfortable with their understanding of the model and its output, and (2) able to explain the link between information that stakeholders are familiar with and the model output.

Example: In-season management of Atnarko chinook salmon

Terminal fisheries targeting Atnarko River, British Columbia, chinook salmon (*Oncorhynchus tshawytscha*) are managed based on weekly projections of total escapement to the spawning grounds. A projection model using Bayesian updating was developed with the local manager in 2001, and has been used since the 2002 fishing season.



Approach: Work through scenarios and fit classification trees to responses

We presented the manager with observed and simulated sets of in-season data, elicited his assessments of stock status based on the model output, and fit a simple classification tree of binary choices to the responses. The resulting classification trees capture both the characteristics of the quantitative projection model and the subjective judgments of the fisheries manager (e.g. choices of prior assumptions, approach to reconciling projections based on alternate model structures, decisions based on a range of projections relative to management reference points).

1. **Create scenarios**
   Each scenario consisted of a simulated or observed sequence of cumulative catch in the aboriginal food fishery. Simulated sequences were included to increase sample size and provide more contrast (i.e. previously unobserved scenarios).
2. **Discuss interpretation and management responses**
   For each week, the fisheries manager classified stock status into one of four categories (A to D), by entering the data from all previous weeks into the Bayesian projection model, interpreting the output, and providing a verbal explanation.
3. **Estimate management benchmarks (C&RT)**
   Fit classification trees based on trade-off between complexity (i.e. number of break-points) and expected loss (i.e. cost of misclassification, prior probability of different ranges).
4. **Develop decision-support tools**
   Collaboratively identify robust break-points and revise model interface based on narrative provided during Step 2.

Classification and Regression Trees

Classification trees are a versatile tool for summarizing expert knowledge into simple decision guidelines. A classification tree consists of a series of binary choices (e.g. yes-no, if-then), which split a set of observations into discrete categories and identify the appropriate class for a new observation.

Classification and Regression Tree (C&RT) analysis is one of several statistical methods for fitting classification trees. C&RT models fit the tree structure by recursively partitioning the observations into smaller, more homogeneous sets in a 1-step look-ahead procedure. Partitions are chosen to maximize reductions in some measure of heterogeneity (e.g. proportion of misclassifications).

The assumptions underlying C&RT models are less stringent than for regression or discriminant analysis. (i.e. complex interactions, outliers, missing values).

Background and examples at **www.solv.ca/CART**

Benefits

- C&RT can reduce a substantial amount of expert judgment into a simple decision aid (700+ posterior distributions into 1 table)
- Manager becomes familiar with the model and its output, and will more likely use the model for day-to-day operations.
- Manager's running commentary triggers discussions about qualitative indicators and provides opportunity to clarify any misunderstandings.
- Manager can also use the decision tables to improve communications with non-technical stakeholders.

Indicator: Cumulative catch in the aboriginal food fishery				Classification of stock status	Expected escapement for these benchmarks
May	June				
Week 22	Week 23	Week 24	Week 25		
>510	>860	>1100	>1300	A	23,000 to 25,000
>280	>480	>530	>700	B	17,000 to 18,000
170 or less	>250	>320	>380	C	10,000 to 13,000
				D	

Expected commercial opening in June			
Week 23	Week 24	Week 25	Week 26
1-day assessment	2 days	2-3 days	2-3 days
1-day assessment	1 day	1-2 days	1-2 days
1-day assessment	1 day possible	No opening	No opening
1-day assessment possible	No opening	No opening	No opening

Future Work

The two-step approach of eliciting assessments of stock status from agency staff and then fitting classification trees to their responses can be applied in a wide range of fisheries settings. In small fisheries, like this example, it can document the acquired experience of a single individual and document it in a simple decision aid. In more complex settings, this approach can facilitate the communication between the technical teams responsible for providing assessments of stock status, and the committees responsible for choosing appropriate responses to these assessments.