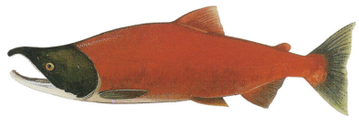
Sockeye salmon – Ocean phase

ICES CM 2009/O:34



Sockeye salmon – Male in freshwater phase

Sequential Elimination:
Using a combination of data and process to choose robust harvest control rules for Fraser River sockeye *(Onchorhynchus nerka)*

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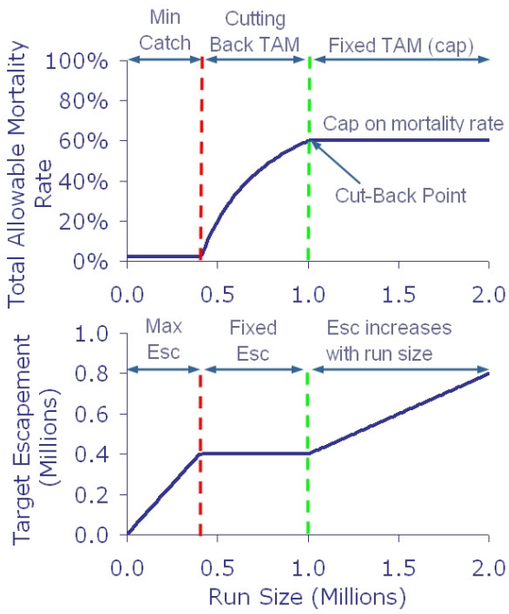
Introduction

The expanding mandate of fisheries management keeps introducing ever more complex objectives. Purely quantitative optimization approaches become intractable and unwieldy for stakeholder processes characterized by highly diverse participants with competing ecological and socio-economic objectives. A practical approach for this setting is to:
(1) Develop a hierarchy of goals, each expressed as a performance measure, benchmark, and risk tolerance.
(2) Apply resulting constraints in sequence, rather than simultaneously.
This is a collaborative equivalent of hierarchical goal programming.

Decision Setting

Sequential elimination has been successfully applied in the collaborative development of robust harvest control rules for Fraser River sockeye (*Oncorhynchus nerka*):
- Extensive process (7 years, 30+ people,14 workshops)
- Lots of data (275 sites, 19 stocks, 4-6 mgmt groups)
- Complex simulation model
- All aspects evolved throughout the process (e.g. shape of control rule)



Challenge: Pick a Cut-Back Point

Example: Summer Management Group
- 4 stocks managed as 1 aggregate
- 5 to 7 distinct conservation units
- 2 of the stocks follow strong 4-year abundance cycles
- Use Larkin model (year-class interactions)
- Productivity set to half of past observations
- Disregard overlap constraints across mgmt groups
- Other details (mortality during up-river migration etc.)

Discussion

This approach showed several procedural benefits:

• Progressively narrows the options, so participants see explicitly when and how their stated goals influence the outcome.

• Avoids the confrontational step of assigning weights to different objectives (as in a multi-objective value function), but still allows participants to express priorities through the order in which constraints are applied.

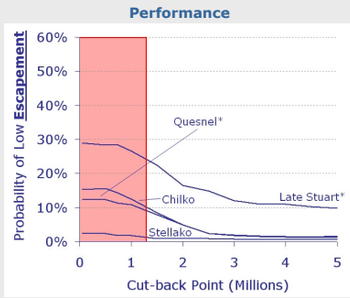
• Goal hierarchies tend to be quite shallow, because many aspects of socioeconomic objectives can be mapped as different benchmarks on the same fundamental performance measures.

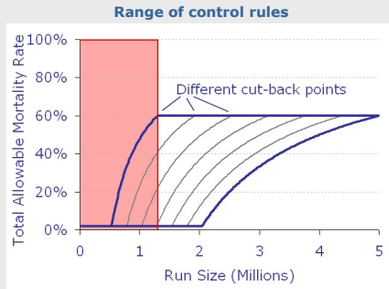
• Discussions shift from trying to identify targets for competing objectives to establishing common ground on outcomes to avoid (i.e. benchmarks).

Sequential Elimination

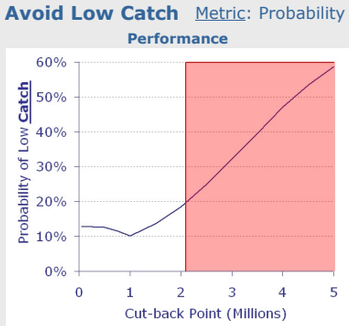
One example is to eliminate all options which are not expected to achieve stock-specific minimum abundance goals, then eliminate from the remaining options any with high year-to-year variability in total allowable catch, and finally work through a facilitated debate on the trade-offs associated with the remaining options.

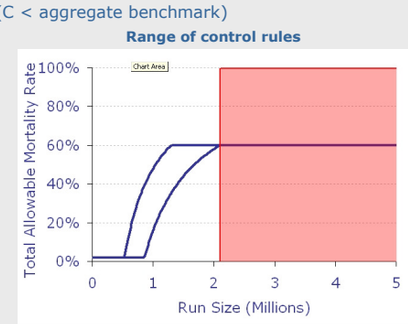
1 Avoid Low Escapement Metric: Probability (4yr avg < stock–specific benchmark)



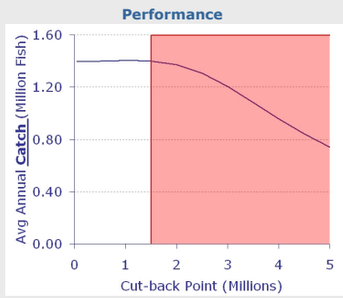


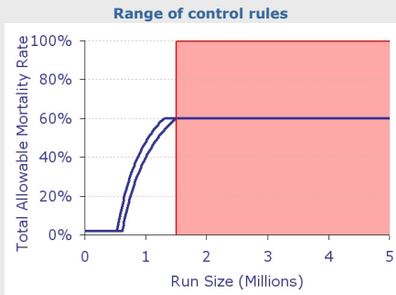
2 Avoid Low Catch Metric: Probability (C < aggregate benchmark)



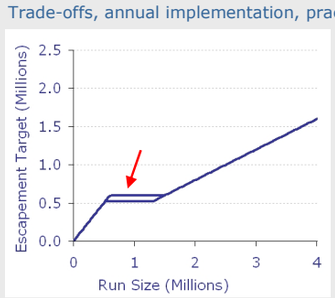


3 Maximize long-term catch
Metric: Avg. annual catch

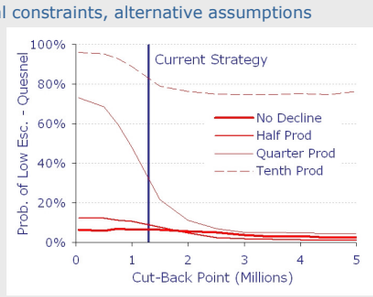




4 Facilitated debate
Trade-offs, annual implementation, practical constraints, alternative assumptions



Small difference over long-term, but potentially substantial implications in a particular fishing season.



Explore sensitivity to different productivity declines

Further Reading

DFO (2009) *Integrated Fisheries Management Plan for Salmon – South Coast*
DFO (2009) *Fraser Sockeye Escapement Strategy 2009*
DFO (2009) *Fraser River Spawning Sockeye Initiative Overview*

All available at www.pac.dfo-mpo.gc.ca under Consultations > Fisheries Management > Salmon