Theory & Practice Of Risk Communication

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BC-WA Chapter of AFS
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Outline

• Introduce 2 conceptual maps
  • Types of risk assessment
  • Types of presentation

• Go through 2 examples and link them back to the concepts maps
  • Loss of hatchery brood in a conservation program
  • Fraser Sockeye harvest rule simulations
Concept Map 1: Types of Risk Assessment
Components of Risk: 4 Big Questions

- **How Likely?** (Probability)
- **How Bad?** (Severity)

**What’s the Risk?** (Expected Loss)

**How sure are we?**

(Uncertainty in estimates of probability and severity)
<table>
<thead>
<tr>
<th>Assessment Approach</th>
<th>Components of risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quant</td>
<td>Probability only</td>
</tr>
<tr>
<td>Qual</td>
<td>Probability and Severity</td>
</tr>
</tbody>
</table>
In Theory: Quantify all the components

Components of risk

Assessment Approach

<table>
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In Practice – Published Research


### Components of risk

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<th>Assessment Approach</th>
<th>Probability only</th>
<th>Probability and Severity</th>
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</thead>
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<tr>
<td>Quant</td>
<td>68%</td>
<td>20%</td>
</tr>
<tr>
<td>Qual</td>
<td></td>
<td>12%</td>
</tr>
</tbody>
</table>

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**Components of risk**

- **Assessment Approach**
  - Quant
  - Qual

- **Probability only**
  - Probability and Severity

- Most are probably in this box
Concept Map 2: Types of Presentation
Types of Presentations

Lecture
Convey a body of knowledge

Sales Pitch
Trigger a course of action in the audience

Decision Support
Neutral packaging of information
Types of Presentations

**Lecture**
Audience obligation to grasp material

**Sales Pitch**
Filter content based on anticipated audience reaction

**Decision Support**
Introduce decision - support tools, point out key results and major sources of uncertainty
Types of Presentations

Lecture
1 day seminar on restoration techniques for salmon habitat

Sales Pitch
5 min pitch to solicit funding for a specific salmon habitat restoration project

Decision Support
30 min intro to an interactive tool for prioritizing habitat restoration projects in a watershed
Example 1: Loss of Hatchery Brood in a Conservation Program
Background

• Community-operated hatchery program as key part of a recovery effort, coordinated by a multi-stakeholder round table

• Power failure in February resulted in total loss of hatchery juveniles

• Short time window to decide whether to trap wild fry and either:
  • Rear and release larger juveniles
  • Rear as a captive brood until adult stage

⇒ Tech team wanted to communicate the pro/con for each option.

⇒ Only project in 15yrs that neatly fit the textbook decision tree (3 options, 4 outcomes each)
Where Does It Fit?

Components of risk

Probability only
Probability and Severity

Assessment Approach

Qual
Quant

Lecture
Sales Pitch
Decision Support
Example 3: Decision Tree

Loss of hatchery brood in a conservation program

(February 2005)

No intervention

• No financial costs
• Some risk if survival is poor
• Significant harvest reduction may be required in 3 to 5 years

Trap/ Rear/ Release

• Opportunity costs (can’t do other work)
• Some risk due to handling fry
• Not expected to increase abundance of spawners

Captive Brood

• $200,000 over 4 years
• Affects only 1% of wild fry, but risk genetic impacts in next gen.
• Reduces need for significant harvest reduction
No intervention

Captive Brood

Example 3: Decision Tree

- **Best**
  - Low exploitation (40%)
    - High marine survival (80%)
      - Low exploitation (40%)
        - High marine survival (80%)

- **Worst**
  - Low exploitation (40%)
    - High marine survival (80%)
      - Low exploitation (40%)
        - High marine survival (80%)

- Good marine survival (0.9%)
- Poor marine survival (0.4%)
Example 3: Decision Tree

No intervention

- Captive Brood

- Good marine survival (0.9%)
  - Low exploitation (40%)
    - 1,800 adults (wild)
      - 1,080 spawners (wild)
    - High exploitation (80%)
      - 1,800 adults (wild)
        - 360 spawners (wild)
    - Low exploitation (40%)
      - 800 adults (wild)
        - 480 spawners (wild)
  - Poor marine survival (0.4%)
    - High exploitation (80%)
      - 800 adults (wild)
        - 160 spawners (wild)
Example 3: Decision Tree

No intervention

Captive Brood

good marine survival (0.9%)

poor marine survival (0.4%)

Low exploitation (40%)

High exploitation (80%)

1,800 adults (wild)
1,080 spawners (wild)

1,800 adults (wild)
360 spawners (wild)

800 adults (wild)
480 spawners (wild)

800 adults (wild)
160 spawners (wild)
Example 3: Decision Tree

No intervention

Captive Brood

- good marine survival (0.9%)
  - Low exploitation (40%)
    - 3,281 adults (1,500 CB)
    - 2,568 spawners (58% CB)
  - High exploitation (80%)
    - 3,281 adults (1,500 CB)
    - 1,856 spawners (81% CB)
- poor marine survival (0.4%)
  - Low exploitation (40%)
    - 2,291 adults (1,500 CB)
    - 1,975 spawners (76% CB)
  - High exploitation (80%)
    - 2,291 adults (1,500 CB)
    - 1,658 spawners (90% CB)
Example 3: Decision Tree

- No intervention
- Captive Brood
  - Good marine survival (0.9%)
  - Poor marine survival (0.4%)

% contribution from Captive Brood originate from 1% of fry

- Low exploitation (40%)
  - 3,281 adults (1,500 CB)
  - 2,568 spawners (58% CB)
  - 3,281 adults (1,500 CB)
  - 1,856 spawners (81% CB)
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  - 2,291 adults (1,500 CB)
  - 1,658 spawners (90% CB)

- High exploitation (80%)
  - Low exploitation (40%)
  - High exploitation (80%)
Example 3: Decision Tree

No intervention

Captive Brood

Cost = $0

Cost = $200,000
Over 4 years
Example 2: Fraser Sockeye Harvest Rule Simulations
Background

• Long-running process & model to forward simulate alternative harvest strategies

• Many options to test:
  • Different types of harvest strategy
  • Different specifics for each type of strategy

• Many alternative assumptions to test:
  • Population dynamics (19 stocks)
  • Harvest dynamics

• Many random trajectories into the future

=> Each variation is a branch on the decision tree

=> Many, many, many branches on that tree
Where Does It Fit?

Components of risk:
- Probability only
- Probability and Severity

Assessment Approach:
- Qual
- Quant

Lecture
Sales Pitch
Decision Support
Communication Challenge

How to show the difference in expected future patterns for many individual parts and groupings?

- Choice of key variables:
  - 19 stocks, 11 fishery groups
  - Spawners, run size, catch

- Choice of performance measures:
  - Avg vs range vs. variability
  - Time window (3 Gen Avg? Annual Pattern?)

- Choice of scenarios to compare:
  - Different strategies
  - Different assumptions
Lessons Learned (The Hard Way)

• Process vs. Information -> iterative!
• Analysts and Participants learning from each other
  -> Talk by Ann-Marie Huang
• Different plots for different phases of the process
• For a single meeting, try to pick 1 type of plot and stick with it!
• Less is more?
  -> Depends (Decision Support vs. Sales Pitch)
First Hurdle: Summarizing trajectories

Stock A

Prob(Low Spn) 3 Gen

Avg 3 Gen
Avg All Yrs
Low Spn
~ “Severity”
Illustration 1

- changing **1 setting**, show effect on **1 metric**

![Graphs for Stock A, Stock B, Stock C, Stock D showing the effect of changing a setting on a metric.](image)
Illustration 2

• Compare **9 variations** of harvest strategy
• Show effect on **2 metrics**

Stock A – Cycle Line 1 – 3 Gen

![Graph with points and lines indicating variations and metrics](image)
Conclusions

• There is no single magic plot!
• Process, process, process
• As analysts:
  • Need to find a balance between the 3 types of presentations (sometimes in the same workshop)
  • Listen to process participants and learn from their frustrations
• As participants:
  • Be patient, and please play along if the analysts are trying to get creative (Marbles!).
  • Provide sound constructive criticism on the process and the communication.
Appendix: Extra Slides
Implicit Assumptions

Probability only => assume equal consequences

• “risk of extinction”
• works well for similar cases (different harvest strategies)
• serious pitfalls when comparing diverse cases (species at risk)
Implicit Assumptions

**Probability and Severity => assume equal quality of information for both**

- Typically not true
- Difficult questions of scope (i.e. which consequences) and distribution (i.e. who suffers the consequences) and trade-offs
- Estimates of severity can differ by many orders of magnitude
- Methods for estimating probability more established, and more defensible in public debate

**Quantitative => assume sufficient information & resources**

- Holds true only for large-scale/high-priority issues (Columbia River salmon recovery plans)
- Not feasible for majority of day-to-day operational decisions
Text Book Example: 2 Possible Outcomes

Risk = Sum (Probability * Severity)

= (70% * $0) + (30% * $100) = $60 ± ?

Probability

100%

50%

0%

No Change

Bad Outcome

Severity
Typical: Range of Outcomes

Risk = \int f(\mu, \sigma) = \text{function of peak and spread}