



Bayesian network – a flexible tool to integrate multidisciplinary knowledge

FISHERIES and ENVIRONMENTAL MANAGEMENT GROUP

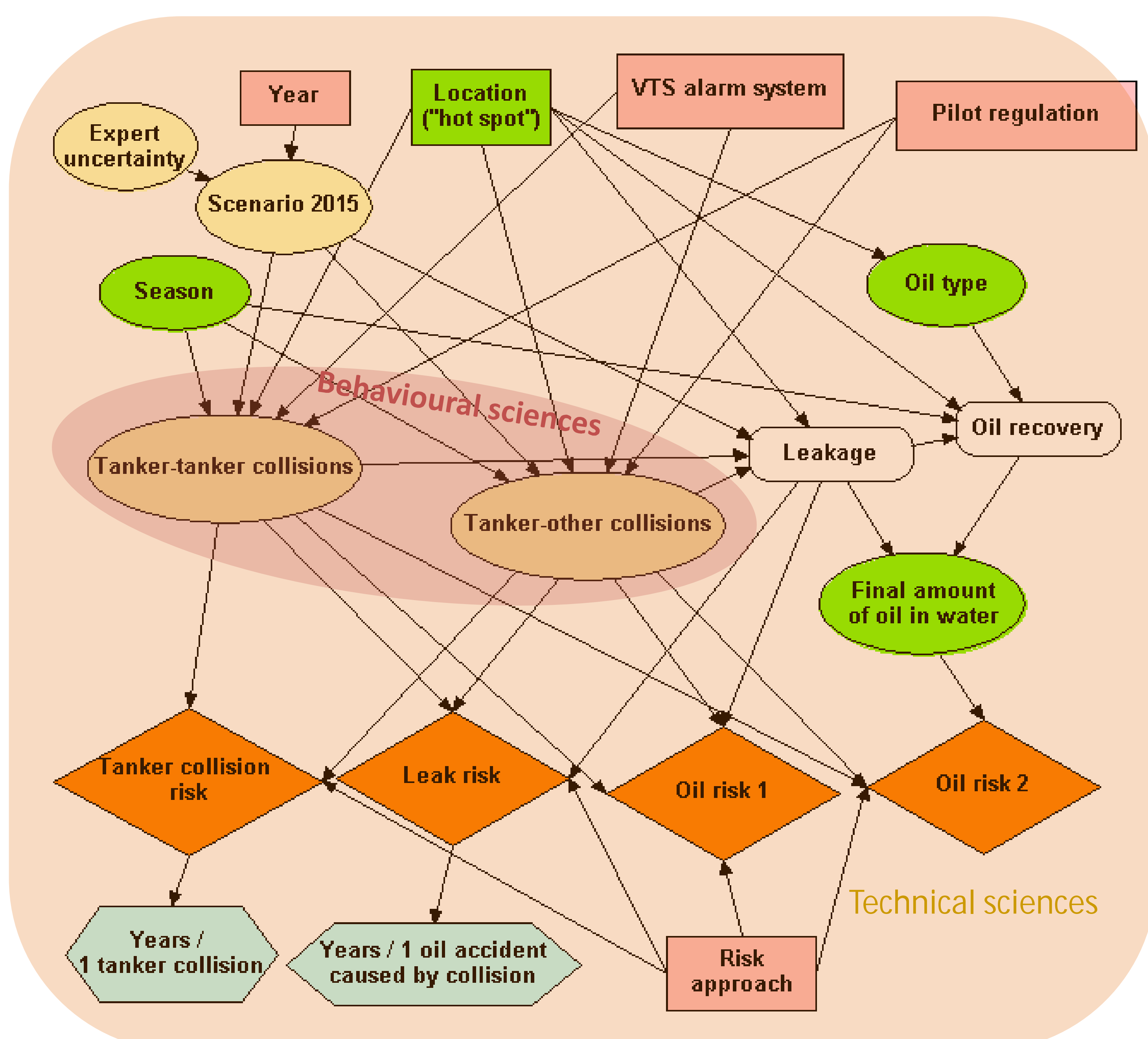
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The drivers of environmental change are typically complex and knowledge about them is usually incomplete. The key problems tie together biological processes, human activities and technical solutions. A large gallery of stakeholders, experts, and managers is often involved in the environmental disputes. Moreover, major uncertainties are often related to the causal dependencies driving environmental change, as well as to stakeholders' reactions to management actions. Both the problem and the cure are multidimensional, sending out a plea for multidisciplinary science to provide comprehensive analysis and justification for robust decisions.

Bayesian networks provide an effective toolbox to synthesize multidisciplinary knowledge. Most importantly, they allow each component of the entire problem to be analyzed by the methods and concepts most applicable to that particular case. In this way, Bayesian approach appreciates the tradition of any scientific domain. Bayesian modelling techniques have several features that make them useful in many real-life data analysis and management questions. They provide a sound way to handle uncertainty and missing data, and they can be easily combined with decision analytic tools to aid management.

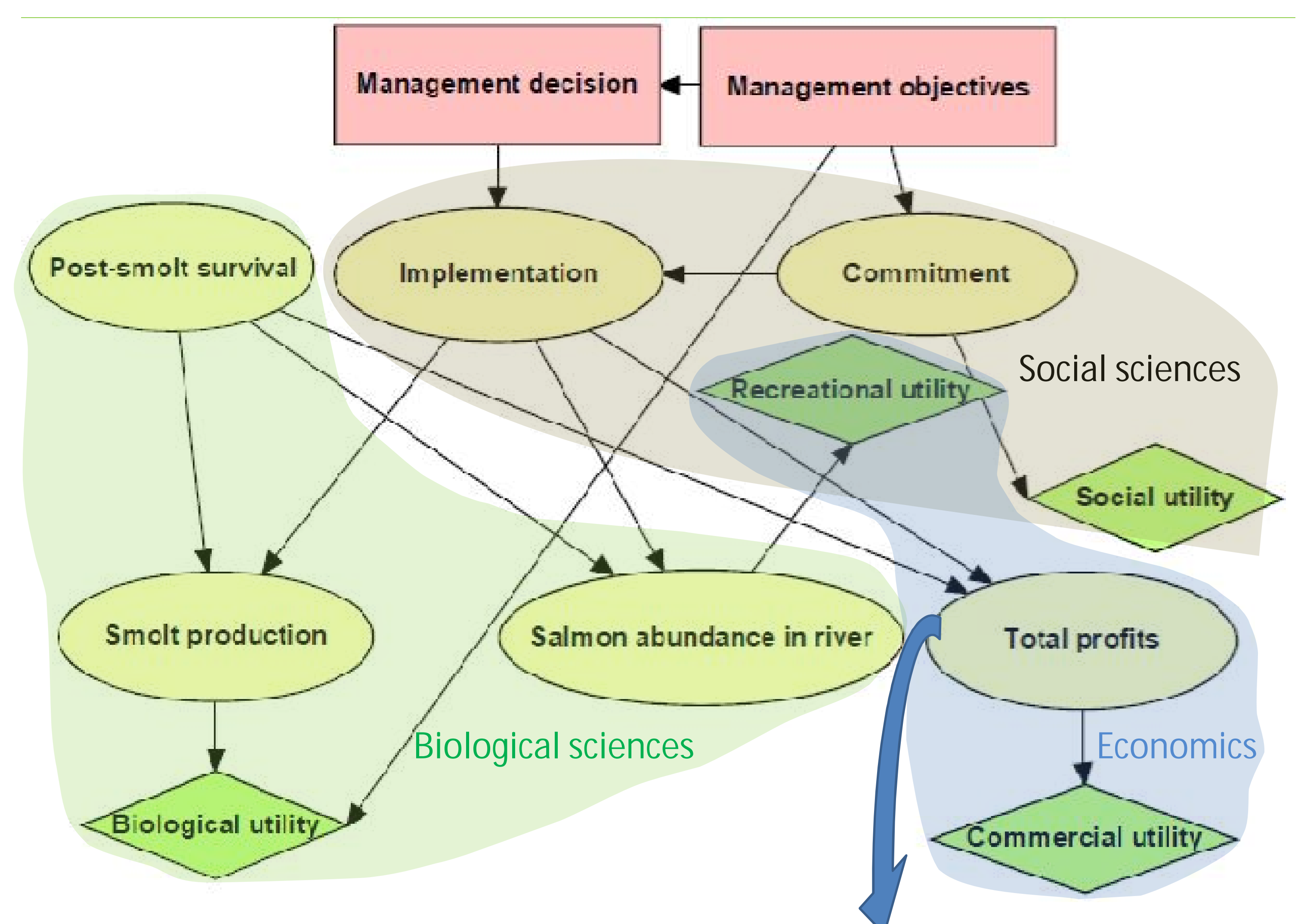
Case 1: Minimizing the ecological risks of maritime oil transportation in the Gulf of Finland

The volume of maritime traffic has grown rapidly in the Gulf of Finland recently and is still growing. An interdisciplinary, probabilistic approach serves as an effective analysis tool to merge uncertainty, risks, and management actions in a rigorous framework. Environmental risks are escalating in synchrony through direct environmental effects of oil transportation and by higher accident probability. The oil spill risk can be effectively decreased by influencing the probability of occurrence of human errors in the maritime traffic. The approach highlights the risks and potential environmental damage linked to inert policies.



Case 2: Interdisciplinary management plans for the Baltic Sea salmon fishery

A Bayesian network synthesizes the findings of three separate studies linked to evaluation of potential long-term management plans for Baltic salmon stocks: a biological stock assessment with integrated economic analysis of the commercial fisheries, an evaluation of recreational fisheries, and a sociological study examining fishers' commitment to alternative management objectives. Fisher's commitment is the key to effectively implement the management plan. The analysis, relying on prior knowledge, views the outcomes of management decisions from different perspectives and anticipates the consequences of actions.



The conditional probability of total profit (€) depending on implementation of management as fishing effort reductions, and on post-smolt survival (low or high).

	No reduction		25% reduction		50% reduction		75% reduction	
	high	low	high	low	high	low	high	low
Negative returns	0.000	0.006	0.000	0.003	0.000	0.002	0.000	0.002
0-5 M€	0.013	0.046	0.018	0.065	0.035	0.107	0.176	0.365
5-10 M€	0.054	0.124	0.090	0.176	0.202	0.340	0.547	0.528
10-15 M€	0.122	0.218	0.200	0.300	0.319	0.333	0.228	0.097
> 15 M€	0.811	0.606	0.692	0.456	0.444	0.218	0.049	0.008

References

- Klemola et al. 2009. World Review of Intermodal Transportation Research.
- Helle et al. 2011. Journal of Hazardous Materials.
- Levontin et al. 2011. ICES Journal of Marine Science.