FACTSHEET

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Smart Fishing Initiative

UNCERTAINTY: ACCOUNTING FOR WHAT WE DON'T KNOW

"THERE ARE KNOWN KNOWNS. THESE ARE THINGS WE KNOW THAT WE KNOW. THERE ARE KNOWN UNKNOWNS. THAT IS TO SAY, THERE ARE THINGS THAT WE KNOW WE DON'T KNOW. BUT THERE ARE ALSO UNKNOWN UNKNOWNS. THERE ARE THINGS WE DON'T KNOW WE DON'T KNOW." **DONALD RUMSFELD, U.S. SECRETARY OF DEFENSE FROM 2001 TO 2006 UNDER PRESIDENT GEORGE W. BUSH.**

What is Uncertainty?

Uncertainty is concisely defined as "The incompleteness of knowledge about the state or process of nature" (FAO/Govt. of Sweden 1995). For our purposes, uncertainty is simply information that we do not know about for a fishery that could affect the risk of breaching a Limit Reference Point (LRP). There are several sources of uncertainty that should be considered when calculating Reference Points and in the evaluation of stock status relative to these reference points. There are five main types of uncertainty that can arise from imprecise or incomplete knowledge or information about the state of a fishery.

1. Uncertainty due to Measurement Error and Bias

Measurement error and bias can result from incomplete or inaccurate data collection of catch, fishing effort, or biological samples (e.g.,length/weight of catch, age and maturity of fish). Standard statistical problems of sample size and representativeness also complicate this kind of uncertainty. Misreporting in logbooks and other reporting documents can lead to bias. Also, effort creep, or undetected increases in fishing power due to fisherman learning new techniques and technological change, can further create substantial errors and bias in understanding the catch-effort relationship.

2. Process Uncertainty

Process uncertainty relates to how we understand the natural world and can occur over short or long time scales. Environmental variability, a large source of process errors, usually manifests itself as recruitment variability. Recruitment variability can lead to large fluctuations in the amount of fish biomass available to catch depending on the species. Because of the difficulty in predicting environmental conditions and the subsequent response of fish populations to those conditions sufficiently far into the future to be useful for management, recruitment variability is often treated as stochastic (or random).

3. Model Uncertainty

Model uncertainty relates to the inability to perfectly capture the true behaviour of fish populations (and how they interact with fishing) with mathematical and statistical models that are used to conduct stock assessments. This type of uncertainty can arise from unknown errors in the assumptions of variables used in equations designed to calculate stock dynamics. Model error can be examined to some extent by evaluating multiple models for the same resource, but this often cannot be exhaustive due to a lack of data or resources (expertise, computation time, funding).

4. Estimation Uncertainty

Estimation errors occur because the data and the processes being modelled are never perfect. Estimation errors that result from unknown biases or trends in input variables may be very difficult to detect or describe, but can lead to large overall errors in a stock assessment. One dramatic example is the systematic bias that can result in estimates of stock abundance when using the common approach of modelling a population by following individual cohorts through time (so-called "retrospective bias").

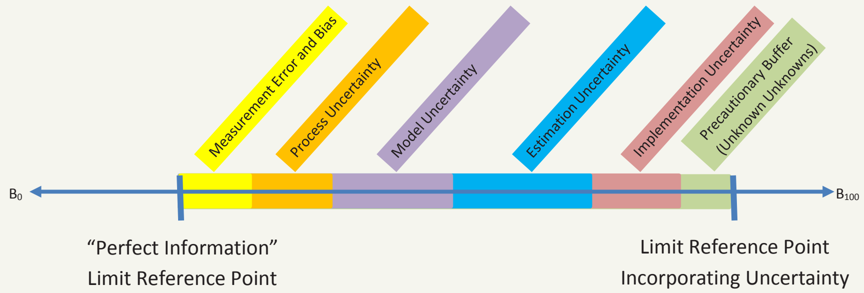
5. Implementation Uncertainty

Implementation uncertainty generally lies outside the scientific component of uncertainty, representing unknowns related to the fact that management decisions are never implemented 'on the water' perfectly. This largely consists of a failure to control exploitation by the Monitoring, Control and Surveillance (MCS) measures that have been adopted. These failures may include poor surveillance and enforcement, lack of concern by the judiciary when cases are heard, failure of participants to support measures due to lack of opportunity for input during their development, or simply disagreement with the measures enforced. Unfortunately, this kind of uncertainty can represent a major cause for the failure to conserve stocks despite excellent stock assessments.

These are the main types of uncertainty that are inherent to fisheries science and management. Each type can exist independently or concurrently with the other types, but it is important to remember that all types of uncertainty are cumulative in their effect.

How to Deal with Uncertainty

Uncertainty in information the leads to management decisions can increase the risk that something "bad" could happen despite managers best efforts to properly manage the fishery. While managers can work to reduce uncertainty through the use of better data, enhanced models, or improved implementation, they can never completely eliminate uncertainty. Thus, it is most important to acknowledge the key sources of uncertainty and be precautionary in addressing uncertainty by allowing an effective buffer around a Reference Point – thus taking the "unknown" sources as well as the quantifiable sources of uncertainty into account.



Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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