Shifting baselines and memory illusions – What should we worry about when inferring trends from resource user interviews?

Commentary on O'Donnell, Pajaro & Vincent (2010) How does the accuracy of fisher knowledge affect seahorse conservation status?

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O'Donnell et al. report attempts to infer long-term trends in seahorse abundance, from fisher interviews and logbooks. Stitching together such different data sources is often the only way to infer trends when no consistent historical data exists, and aims to counteract the 'shifting baseline syndrome' (Pauly, 1995). The paper highlights the potential impact of assumptions made by researchers (either implicitly or explicitly) in using resource user knowledge. In this case, different assumptions led to wildly differing assessments of extinction risk.

The key issue is not so much the accuracy of fisher knowledge, but the existence and significance of a range of biases in the use and manipulation of quantitative catch data from fisher interviews, and how should they be handled. To answer this, we need a better understanding of how humans perceive and recall environmental change, a question with relevance to conservation and resource governance in general.

Papworth et al (2009) have provided a useful definition and typology of the 'shifting baseline syndrome', which can be applied to O'Donnell et al's work. A range of different mechanisms exist that can mask or exaggerate perceived trends at a community or individual level. For example, the observation that the longest-serving fisher perceived the greatest decline, might suggest 'generational amnesia', as observed in fisheries elsewhere (e.g. Saenz-Arroyo et al., 2005), while 'memory illusion', which *exaggerates* the extent of trends may also have been caused by the influential memory of extreme catches.

The extensive logbook data highlight the highly variable and skewed nature of individual catches, which are typical in fisheries catch data, and have important implications for how humans perceive trends. Van Densen (2001) has demonstrated how variability limits the statistical power of individuals to perceive trends, while the effect of skewness has been less carefully considered. Scientists commonly normalise catch per unit effort (CPUE) data with a log transformation before analysing trends, so that statistics are not overly influenced by extreme values. Can the human brain operate a similar cognitive mechanism? Or are qualitative perceptions and memories so influenced by the psychological and emotional impact of atypical bumper catches that general trends cannot be perceived? Reliable logbook, or landings data could help to understand and unpick these complexities, and it is unfortunate that logbooks were not available to make direct comparisons with fisher interview data.

Beside issues around long-term memory, O'Donnell et al. also refer to problems of inferring population trends from CPUE, and the assumption that the catchability (the

proportion of the population caught for each unit of effort) is constant. CPUE is affected by problematic issues of hyperdepletion, hyperstability, technical creep, and competition and interference between fishers (Hilborn & Walters, 2004). One factor not discussed by O'Donnell et al is whether trends in total effort levels (e.g. the number of fishers operating), may have affected the catchability of seahorses.

Table 1 lists some of the many potential biases which may exaggerate or mask trends when inferring them from resource-user memories. Decisions need to be made about which of these are relevant in any given case. Biases affecting CPUE can be evaluated with detailed knowledge on the nature and evolution of the fishery (often based on fisher knowledge), but we are poorly equipped to evaluate or account for individual perception biases. O'Donnell et al. conclude with sound prescriptions to avoid overly simplistic assumptions in the use of resource user knowledge, and some methodological approaches might help reduce the impact of such biases. For example relying on qualitative rather than quantitative recall, asking questions such as "When was the last time you caught/saw..." (e.g. Lavides et al 2009); or explicitly asking fishers about variability using questions about 'good', 'poor' and 'normal' catches (Daw et al. In Press).

Such approaches may help to reduce biases, or to be more explicit about assumptions, but evaluating whether, and in which circumstances perception biases significantly affect inference requires new interdisciplinary research. Psychological research (e.g. Kahneman et al. 1982; Balcetis and Dunning, 2007) may help to understand the cognitive dimensions of how humans experience and perceive non-normally distributed events over time. Meanwhile, empirical analysis of large comparative datasets of objectively measured events, and subjective experiences of these over a range of timescales could help distinguish between sources of bias that are negligible, and those that seriously affect our inference and require more research. This would be a considerable improvement on assumptions (particularly implicit assumptions) about the nature and existence biases.

The issues raised by this paper have relevance beyond the practical application of species monitoring. Local perceptions of change reflect resource users' subjective experience of environmental change, and its effect on their lives. If the lived 'reality' of resource users differs from scientific assessments, conflicts over management measures are likely, as frequently observed in fisheries (e.g. Gray et al 2009), or in conflicts over larger scale environmental issues such as climate change (Hulme, 2009). We need a better understanding of psychological aspects of memory and perception to make better use of resource user knowledge, but also to better understand conflicts in conservation and resource governance.

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Table 1. Possible sources of bias in perceptions of population trends from catch rates. (Directions of bias are for a situation in which effort is increasing and population is declining). The terms 'Memory illusion', 'individual amnesia' and 'generational amnesia' are used as defined by Papworth et al (2009)

Bias mechanism	Affects	Effect on perception of trend
Technological or expertise creep (increasing efficiency of fishers)	Catch per unit effort	Masked
Technological or health decline or ageing		Exaggerated
Expansion of range of fishers		Masked
Crowding/interference		Exaggerated
Decline in catchability due to varying levels of susceptibility to capture within the population		Exaggerated
Switching behaviour of fishers (due to economic incentives or availability of other species)		Either masked or exaggerated
Shifting baseline (short timeseries of data)	Scientific perceptions	Masked
'Memory illusion'		Exaggerated
'Individual amnesia'	Individual perceptions	Masked
'Generational amnesia'		Masked
High catch variability		Masked