Report of the Workshop

Insights from Behavioural Economics to improve Fisheries Management

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Outline (taken from the application for funding)

Fisheries management operates under the inherent tension between the interests of the individual fishing business, e.g., making immediate profits, and the interests of society, e.g., limiting fishing to sustainable levels. Conventionally, fisheries management aims to modify the behaviour of fishers by laws and regulations. As with all other human beings acting under top-down control, fishers will naturally find loopholes in the regulations to promote their interests even if these jeopardize the societal aims. Behavioural Economics has uncovered a plethora of instances where human behaviour or preferences are systematically modified by different framing of the situation. Humans are 'predictably irrational' and perceive their interests differently, e.g., they become more inclined to sacrifice their immediate self-interest, under varied experimentally manipulated conditions. This knowledge is currently under-utilized in fisheries management. The objective of this project is to catalogue those findings from Behavioural Economics that can be applied in fisheries management settings and that may increase alignment of individual behaviour with societal aims. Fisheries scientists working in positions where they provide advice to fisheries managers may thus have an inventory of pragmatic, operational, and perhaps small institutional changes that may help to successfully align fisher behaviour with the demands of achieving sustainable resource exploitation.

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Participants, their affiliations and their backgrounds

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The Implementation of the Workshop

This workshop was proposed as a brainstorming workshop that would bring together fisheries scientists and behavioural economists and other behavioural scientists. It was thought essential that the participants come from different backgrounds and that at least some of the behavioural scientists were naïve regarding fisheries management and policy, so as to promote innovative ideas for exploration. The behavioural scientists would introduce insights from their respective fields to the fisheries experts. It was also thought to be essential that the fisheries-science participants were experienced, so maximizing impact on fisheries management.

Of the people who had been involved in writing the proposal, one social-ecological systems scientist, Maja Schlüter, and three experienced fisheries scientists, Hans van Oostenbrugge, Martin Pastoors, and Michael Sissenwine, were unable to attend the Workshop. In their place, three fisheries-naïve behavioural economists, Matteo Galizzi, Diogo Gonçalves, and Jeroen Nieboer, as well as fisheries scientist Katell Hamon were recruited. As anticipated in the proposal, social-ecological systems scientist Ingrid van Putten took the place of Elizabeth Fulton.

Two participants, convener Sarah Kraak and Mark Gibson, had participated in the Coursera MOOC (Massive Open Online Course) "A Beginner's Guide to Irrational Behaviour" by Dan Ariely from Duke University (https://www.coursera.org/course/behaviouralecon). Dan Ariely is a well-known scientist in the field of Behavioural Economics who has popularized the field through several books, one of them titled "Predictably Irrational", a title reflecting the discipline's view of human nature. A selection of videos from the course and some relevant papers were set as background research.

The Workshop consisted of three days, thus six half days. The first half day was devoted to introductions, and the last half day to future plans. In between we had four half-day sessions of the following structure: (i) In plenary, a member of the group gave an introduction to a topic; (ii) The participants then discussed the issue in separate break-out groups of 4 or 5 participants, the groups being different combinations of members each time, and 'stratified' by discipline; (iii) After that, each break-out group reported on their discussion in plenary, upon which further discussion ensued. All plenary sessions were chaired by the conveners and plenary discussions were recorded.

The structure of the report

The next section, Introductions, summarises the topics on which experts gave an introduction to the group. After that a section Ethical Aspects is given. Discussions on this topic recurred throughout the meeting and it appears important enough to have its own section. Next follows the section Discussions, which covers the main brainstorm discussions the group had. On the last afternoon plans for future studies were proposed, which are described in the section Future Plans. This section is followed by Conclusions, a Glossary of Behavioural-Economics terms and The Nudge Data Base. The report concludes with a section Deliverables and Outputs, which lists what we had promised in the proposal and how these promises were fulfilled. At the end References are given.

Introductions

According to Lichtenberg (2013), human beings differ from the classical economist's construct, "*homo economicus",* in two ways: (i) While "*homo economicus"* is fully rational, maximizing the fulfilment of his interests, human beings are often not rational. As a result of cognitive biases, emotional reactions, and volitional weaknesses, they often fail to act in their own best interest. (ii) Human beings also differ from "*homo economicus"* in the ends they seek; "*homo economicus"* is assumed to have ends only in terms of narrow, economic, self-interest; however, human beings may have other-regarding or altruistic preferences, called "social motivations". Behavioural economists and psychologists have called into question both of these "*homo-economicus"* assumptions about human beings.

This declaration about human nature resonates well with the findings and paradigms in the disciplines of Behavioural Biology and Behavioural Economics, and as such can be seen as the basis for the discussions in our Workshop. The introductory sessions of the Workshop therefore introduced these paradigms and disciplines, as well as gave an account of the science in support of fisheries management, to inform the participants who were naïve with regards to the respective disciplines.

Fisheries Management

The primary problems with fisheries, mainly seen from a European perspective, were outlined as managing the pressure, accounting for the state of the resource, lack of transparency in policy development, lack of clarity in objective setting, sometimes poor compliance with regulations, and difficulty in justifying the political decision-making required to negotiate trade-offs. In an EU context, the critical areas of breakdown were identified as insufficiently informed public debate and debate between the main players, institutional dysfunction, lack of understanding the reasons for poor compliance with the regulations, and the general poor communication of risks to the managers by the science community. Fisheries are heterogeneous across Europe in terms of scale, business models, and social dimensions but in an EU context they are managed with a common policy. This means that there is often unclear objective setting and an uneven "playing field" when it comes to enforcement. There was a call for trying not to oversimplify the "nature of fishing", and to deal with the reality that some fisheries are sustainable and well managed whilst others are not.

What can the study of social evolution tell us?

An important reason why top-down management is likely to fail is that the management agency and the fisher have very different goals in a fishery. The agency manages exploitation of a fish resource for the benefit of the (group of) state(s); the fisher is motivated by drivers that relate to his own activities and to those of his immediate household and community. This conflict between group and individual is an issue that has been studied by biologists. Work on natural selection in biological systems provides a conceptual framework with which to develop a better understanding of how

fishers can be nudged into fishing sustainably. Evolutionary theory demonstrates that across a hierarchy of organisation, selection acts at a number of levels simultaneously. When applied to a two-level hierarchy of organisation, such as a single cell and a multicellular organism, an equation derived by Price (1972) describes evolutionary change in the following way:

Total evolutionary change =

Group selection component [covariance (group fitness, group character)]

+

Individual selection component [average {covariance(individual fitness, individual character)}]

The balance between these two components determines whether group or individual interests predominate.

This formulation can be applied to social and economic systems where selection is taking place. The Price analysis can be used when there are variables caused by properties that are passed on from one generation to the next (e.g., Henrich 2004). For example in a fishery, catch weight, which will be correlated with catch value, might be a function of the hook size used, the number of hooks and the soak time. The fisher will alter these until he maximises value and the gear properties will be imitated and used by successive generations of fishers.

Using this approach it would be possible to produce a model of the fishery using the Price equation to determine which elements of the fishing process should be changed so as to achieve the desired harvesting level. The model would highlight the nudge-points available for behavioural change. One could ask what properties cause catch variation and that could be altered through behavioural economic measures to achieve sustainability.

The biology of altruism and cooperation

Biologists considering the evolution of altruism and cooperation within groups in animals and human beings use the model of the Prisoners' Dilemma (http://en.wikipedia.org/wiki/Prisoner%27s_dilemma). Here each of two participants is tempted to defect because whatever the opponent does, defection will give the highest pay-off. Tragically, this leads to defection by both, giving both players a lower pay-off than they would have had if both had cooperated. Theoretical biologists have established that in the Iterated Prisoners' Dilemma, where players meet again with finite probability but for an unknown number of future exchanges, reciprocal altruism ("if you scratch my back, I'll scratch yours") in the form of Tit-For-Tat is an evolutionarily stable strategy. This strategy is based on *trust*, because it instructs the player to cooperate on the first move; on *retaliation*, because it responds with defect if the opponent defected; and *forgiveness*, because it restores cooperation if the opponent cooperated after defecting. According to this paradigm, a 'psychology' or 'emotional response' of trust, retaliation, and forgiveness, may have evolved in some animal species (incl. humans). Trust, generosity, retaliation are hardwired in human biology. For example, a genetic polymorphism has been found to correlate with individual variation in levels of generosity (Knafo *et al.*, 2008); the satisfaction of mutual cooperation as well as of punishment is associated with activation in brain areas linked with reward processing (Rilling *et al.*, 2002; De Quervain *et al.*, 2004); administration of oxytocin in a controlled experiment affects the level of trust displayed

(Kosfeld *et al.*, 2005). Recent investigations have shown that subtle cues of being watched such as two stylized eye-like shapes on a computer screen suffice to change human behaviour and reduce selfishness; these eyeshaped cues seem to elicit unconscious hardwired reactions (Milinski and Rockenbach, 2007). Thus, human nature is both selfish and altruistic, depending on conditions. Anthropologist Robin Dunbar suggested a biologically determined, theoretical cognitive limit to the number of people with whom one can maintain stable social relationships, through extrapolation of primate brain and group sizes: the so-called Dunbar's number, between 100 and 250. With this number of people one can keep track of who did what, knowledge necessary for, e.g., (direct or indirect) reciprocity. Groups consisting of larger numbers than that generally require more restrictive rules, laws, enforced norms, rule-making bodies, and policing institutions. Many experimental and field studies corroborate that humans will be more likely to take collective action in situations of where the players know each other (Milinski *et al*., 2002a; b, Fehr and Fischbacher, 2003; Fehr and Rockenbach, 2004; Zak *et al.*, 2004; Nowak and Sigmund, 2005; Kraak, 2011).

Behavioural Economics: Thinking, fast and slow (System 1 and System 2)

The dual-system theoretical framework established a foothold in cognitive and social psychology of the 1990s to explain why our judgments and decisions often do not conform to formal notions of rationality. System 1 consists of thinking processes that are fast, intuitive, automatic, experience-based, and relatively unconscious. System 2 is slow, reflective, controlled, deliberative, and analytical. Judgments influenced by System 1 are rooted in impressions arising from mental content that is easily accessible. System 2, on the other hand, monitors or provides a check on mental operations and overt behaviour—often unsuccessfully. System 1 is 'home' of the heuristics (cognitive shortcuts) we apply and it is responsible for the biases (systematic errors) we may be left with when we make decisions (Kahneman, 2011). System 1, for instance, processes influence when prior exposure to an (arbitrary) number affects subsequent judgments, e.g., about the price one is willing to pay for an item, as evident in the anchoring effects (Tversky and Kahneman, 1974). This theoretical account constitutes an intellectual revolution with profound implications for the way we look at society and economies. While economic rationality influenced other fields in the social sciences from the inside out, through Becker and the Chicago School, psychologists offered an outside-in reality check to prevailing economic thinking. Most notably, Amos Tversky and Daniel Kahneman published a number of papers that appeared to undermine ideas about human nature held by mainstream economics. They are perhaps best known for the development of prospect theory (Kahneman and Tversky, 1979), which shows that decisions are not always optimal.

Policy and behavioural economics

Policy-makers often pool together under the same 'behavioural-economics' umbrella a variety of policies which are conceptually distinct. It is useful to recall the definition by the Russell Sage Foundation Round Table for Behavioural Economics: '*Behavioral economics uses facts, models, and methods from … psychology, … sociology, anthropology, biology, and other fields … to establish descriptively accurate findings … for economic behavior*'.

'Conventional' economics, in contrast, relies on four main conceptual 'pillars':

1. We have a comprehensive set of preferences and a conscious, consistent representation of those preferences;
2. These preferences drive our behaviour and decision-making: we process all available information, rationally calculate the costs and benefits of different courses of actions, and deliberately pick the one that best matches our preferences;
3. Our rational behaviour best serves our own interests when interacting with others in markets: markets aggregate individual values and translate into prices;
4. Since we rationally act in our own best interest, public intervention is needed only when markets fail to correctly translate some costs/benefits values into prices.

Five main clusters of policies can be used to change behaviour: preference-based policies (e.g., comparison portals, menus of options); information-based policies (e.g., information release, labels); financial incentives (e.g., conditional rewards); regulation policies (e.g., taxes, subsidies); and 'nudges' (e.g., changing the choice architecture to change behaviour at an automatic level). It can be argued that the first four clusters of policies are closer in their conception to conventional, rather than behavioural, economics: only 'nudges' can be considered genuinely 'behavioural' policies.

Social preferences

One of the biggest sub-fields of behavioural economics is the study of social preferences. Social preferences mean that people care about others' outcomes, meaning that they are willing to forgo some of their own wealth or income to help someone else. Examples are the provision of public goods, sharing with others and giving to charity. This kind of behaviour does not necessarily have to be altruistic: it can spring from reciprocity ("I scratch your back, you scratch mine"), social norms, or a 'warm glow'. Knowing the origins of social preferences is important, as mechanisms used to change people's behaviour will depend on what motivates these people. Experimental research from public goods and common resource games shows that people are not strictly irrational: they act strategically and predict the long-term value of cooperation. They also respond more to sticks than to carrots. Their behaviour is strongly influenced by social norms, which may be harder to predict or quantify. Finally, the social distance between different actors in any kind of social dilemma has an effect on cooperation and sharing.

Crowding out / crowding in of social capital and intrinsic motivation

The crowding-out hypothesis states that the willingness to obey regulations voluntarily depends on whether one is controlled or not (Bowles, 2008; Richter and van Soest, 2012). Counterintuitively, the tendency to control undermines any intrinsic motivations to comply voluntarily. The reason is that control signals mistrust, which directly affects other motivational factors, such as reciprocity or being a good citizen. As a result, there is a hidden cost of control, as pointed out by Falk and Kosfeld (2006). The disturbing implication is that control can crowd out intrinsic motivations, calling for even stronger control, leading to a vicious cycle of mistrust and strong controls. Behavioural economics has established that regulations that are chosen by the individuals (for example via

voting) are obeyed more, as they are perceived to be more legitimate (Vyrastekova and van Soest, 2003). The notion that rules made by someone else are inherently disliked more than rules made by one self or one's group corresponds to the **IKEA** effect (see glossary), when invested effort in the production of something leads to inflated valuation of that product.

Compliance theory: from Becker to behavioural-economics insights

According to Becker's rational theory of crime human beings should base their decision to commit a crime on a rational weighting of the gains against the probability of being caught and the severity of the punishment. However, behavioural economics has come up with many cases of evidence that challenge Becker's theory. For instance, Mazar *et al.* (2008) propose and test a theory of self-concept maintenance that allows people to engage to some level in dishonest behaviour, thereby benefiting from external benefits of dishonesty, while maintaining their positive view about themselves in terms of being honest individuals. The results show that (1) given the opportunity to engage in beneficial dishonesty, people will engage in such behaviours; (2) the amount of dishonesty is largely insensitive to either the expected external benefits or the costs associated with the deceptive acts; (3) people know about their actions but do not update their self-concepts; (4) causing people to become more aware of their internal standards for honesty decreases their tendency for deception; and (5) increasing the "degrees of freedom" that people have to interpret their actions increases their tendency for deception. They suggest that dishonesty governed by self-concept maintenance is likely to be prevalent in the economy, and understanding it has important implications for designing effective methods to curb dishonesty.

Criminology has also identified numerous non-economic drivers of rule breaking. For instance, studies have indicated that people often obey the law because they believe it is legitimate, rather than because they fear punishment (e.g., Tyler 2006). This has also been supported by ethnographic research for small-scale fisheries (Gezelius and Hauck, 2011; Hauck, 2008). Conversely, a study among Danish fishers (Raakjær Nielsen and Mathiesen 2003) reported that they "feel they are taken hostage by an illegitimate management system, and thus feel it is morally correct not to comply". When we witness unethical behaviour, our own morality erodes (Ariely, 2012). Cheating can be socially contagious (Gino *et al*., 2009): as long as we see members of our own social groups behaving in ways that are dishonest, it is likely that we too will recalibrate our internal moral compass and adopt their behaviour as a model for our own. And if the member of the in-group happens to be an authority figure – a parent, senior manager, teacher, or someone else we respect – chances are even higher that we will be dragged along. For example, tax compliance varies widely across European countries and a high correlation has been found between perceived tax evasion and tax morale (Frey and Torgler, 2007). Individuals may even feel pride about breaking the rules, resulting in groups of people committing crimes because everyone is doing it.

Behavioural economics focuses on the ways people diverge from rational economic models of decision-making. For instance, Mazar *et al.* (2008) found that moral priming can reduce, and that non-monetary crime targets (i.e., property rather than money) can increase economically incentivized dishonesty in a laboratory setting. Similar laboratory studies by Mead *et al.* (2009) found that mental tiredness also increases cheating. These two studies suggest that violation of

fishing regulations could at least in part be exacerbated by a lack of moral reminders, the opportunity to steal a non-monetary asset (i.e., fish), and the mental tiredness of fishers. Other criminological theories identify non-economic causal mechanisms of crime, including low self-control (Gottfredson & Hirschi, 1990), social connections with criminal actors (Sutherland, 1947), informal social disorganization (Shaw & McKay, 1942), and the emotional response to not meeting one's goals (Agnew, 1992). None of these additional theories have yet been tested in the context of fisheries management.

Choice under risk, choice under uncertainty

Fishing involves making decisions under uncertainty, including under both risk and ambiguity. Risky situations are those where the probabilities of alternative outcomes (payoffs) are known, and ambiguity describes those where the probabilities are not known. Behavioural economics has shown that people deviate from the expected utility model in several important ways: they show lower risk aversion over gains than over losses (prospect theory, Kahneman and Tversky, 1979; Wakker, 2010). Further, rather than apply beliefs over unknown probabilities in ambiguous situations, people are additionally ambiguity averse. There are several related decision-making anomalies (Dawson *et al*., 2002):

- **Confirmation Bias** occurs when, while acquiring new information, people are more likely to seek and recall information that is consistent with prior beliefs/interests (see glossary **Confirmation Bias**);
- **Overconfidence Bias** occurs when people evaluate situations with uncertainty as if their judgment is more reliable than it objectively is (see glossary **Overconfidence**);
- **Illusion of Control** manifests when resolution of uncertainty is partly within one's control, and people act as if they will be able to get a better-than-objective outcome.

Policy practitioners are increasingly acknowledging the existence of these cognitive biases, and using them to address policy problems. For example, considering the fact that people display lower risk aversion over gains than losses, policy makers can use the way that options are described to influence behaviour. Also, the tendency of people to automatically interpret information in ways that support prior beliefs informs policy makers about the limited power of merely providing information. Thus, several of the biases people use when they rely on their automatic system of thinking to decide under conditions of uncertainty can be used by policy makers to help individuals and societies reach their goals.

Ethical aspects

Lichtenberg (2013), in her chapter entitled "Paternalism, Manipulation, Freedom, and the Good", makes points similar to those discussed in the Workshop. Lichtenberg's text is a chapter in the recently published book "The Behavioural Foundations of Public Policy" (Shafir, 2013). It is significant and reassuring that this type of discussion is occurring independently in the Workshop as well as among experts in the field.

The issue hinges upon the question of free will, which is in the philosophical domain. Is our behaviour controlled by our genes, our biological and psychological make-up, and external stimuli? Or are 'we ourselves' in control as autonomous beings? The discipline of Behavioural Economics is based on the idea that, at least to an extent, our behaviour is influenced by a combination of external conditions and inbuilt adaptive behavioural strategies, and that we are often not aware of this, and that even if we are aware of it, we often cannot help it. It is our nature.

The question then arises, is it ethical to manipulate people? In this report we will not attempt to answer this question. We will just report on the issues discussed.

The discussion by Lichtenberg (2013) distinguishes between inducing people to act in their own best interests and act in the interests of society (*cf* the divergence described earlier between group and individual interests). This distinction blurs when we distinguish our immediate (often emotional) interests and our future (often rational) interests (e.g., I want to eat this cake *versus* I want to stay slim; I want to catch fish now *versus* I want to catch fish in the future). Furthermore, Lichtenberg (2013) defines *classical, or hard, paternalism* as 'forcing people by law or some other form of regulation to act in their own best interests' and *libertarian, or soft, paternalism* (from Sunstein and Thaler, 2003 – reference in Lichtenberg, 2013) as 'attempts to influence the choices of affected parties in a way that will make choosers better off, without forcing them to do something or refrain from doing something'.

Given that fisheries management currently uses law and regulation to force people to act according to objectives that are at least intended to be good for a larger group of individuals collectively (fishers, future fishers, citizens, future citizens), using deliberate 'nudges' would extend this paternalism from hard to soft. One of the objections to this may be that people will be conscious of the coercion by laws and regulations (and can 'freely' choose to oppose them and accept the consequences), whereas the influence by nudges will happen automatically and unconsciously and this influence may not be accessible to our 'free will' or autonomous control in an attempt to oppose it. Some people find the latter unethical.

One response to this objection is that there is no neutral design, we are always influenced by some or other external setting. A famous example is the phenomenon that countries ask their citizens whether they want to be organ donors after death usually in one of two ways: (i) the default is not to donate and one can opt-in, or (ii) the default is to donate and one can opt-out; the resulting number of people consenting to organ donation differs widely between these two. Behavioural economists have been discussing what makes a good (neutral) default. A no-default setup with forced choice between options is also possible, but might not always be feasible when choices are

non-binary and/or complicated. Nevertheless, if neutrality is indeed impossible, manipulation may be reduced if policy makers were required to reveal more clearly how they attempt to influence decisions, so that agents could more easily resist their influence if they so chose – although awareness and knowledge are not always enough (Lichtenberg, 2013).

Other issues, such as "what *is* good for me/all/society/fishers, and who decides that?", are of course not specific to the soft version of paternalism. These issues must be, and are being, dealt with in any case, but are beyond the scope of this workshop. Nevertheless, one of the factors that act as an important influence on human behaviour is of course whether the objectives are agreed on, and whether they have been phrased by authorities (top-down) or by the people involved (bottom-up). So this then brings the issue into our remit.

Discussions

Several current issues and problems in fisheries management were discussed and attempts were made to understand the nature of these problems in the light of the insights from the biology of social behaviour and behavioural economics. In this section, discussions of several interlinked issues are reported in turn.

Trust and mistrust, social capital and intrinsic motivation

Fisheries systems can be characterized by mutual mistrust, between fishers and regulators as well as between fishers and scientists. Usually fishers are not expected to voluntarily take action to fish more sustainably. Often the institutional set-up is such that fishermen are perceived as the antagonists. The key challenge for European fisheries is not to prevent the erosion of social capital, since there may be very little left – if it was there in the first place. Instead, the key question is how one can crowd *in* desirable behaviour by establishing a trusting relationship. The problem seems to be how to make the transition from the current institutional dysfunction and inertia. Rebuilding of mutual trust is likely a key issue, but this cannot be done simply.

Several possible explanations for the lack of trust were discussed:

- Crowding out, the phenomenon that top-down control undermines any intrinsic motivations to comply voluntarily (see Introductions).
- The mismatch between the aims of management instituitions and the aims of fishers. This generates antagonism between members of the two groups who see each other as 'the enemy'.
- Large group size and anonymity. Social capital and intrinsic motivation to cooperate tends to be higher in small groups of people who regularly interact with each other in non-anonymous ways (Dunbar number, see Introductions – The biology of altruism and cooperation).
- Fishers may have lost respect for the rules and regulations because many of them do not seem to make sense, seem contradictory, or seem to provide perverse incentives.
- Lack of credibility of science (see below).

Counterexamples:

- The Canadian offshore scallop fishery where seven companies (mostly small scale and family owned, but also including at least 2 large ones) have in the past set quotas lower than those advised by science.

- When fishers live and work in local communities, they will build up social networks and individual allegiances. For example, in the heyday of the ports of Hull and Grimsby in the UK, many fishers worked off Norway and Iceland but because they all lived in the same locality they had home-based loyalties which created social capital.

- There may also be lessons to be learned from areas / systems where fishermen do trust the scientists such as in Australia and on the West Coast of the USA. While in New England, on the East Coast of the USA, the perception is more that the fishermen do not trust the scientists, on the West Coast (states of California, Oregon, Washington and Alaska), the fishing industry seem to consider that it has been well served by following the scientific advice. The differences between the East and West coasts of the USA may be due to the personalities involved both in the industry and in the scientific communities, to the history of fishing being considerably longer on the East Coast, to the scale of the fisheries, generally smaller (except for Alaskan fisheries) on the West Coast, and possibly also to the cultural background of the fishing communities, with Scandinavian heritage on the West coast and a more Southern European one on the East coast.

- Especially in Europe there seems to be very little trust towards regulation among the fishers because of the structure of EU fisheries management. There seems to be more room for self-decision and co-decision in the US (co-decision here meaning between regulators and fishers): on the east coast the groundfish fisheries have collective quota programs, and on the west coast fishers pool their quota (Holland and Jannot, 2012). These groups can set their own rules, not necessarily encoded in law, which means rules can more easily be changed. These people were not necessarily connected in communities before; they came together because they have a common problem that can best be solved by collective action. For example, in mixed fisheries where vulnerable bycatch species effectively become the choke species, it is profitable to join in groups and share the individual small bycatch quota. In the case of New England the fishers could choose their group, whereas in Alaska they were assigned to one.

Possible solutions:

- Behavioural economics has established that regulations that are chosen by the individuals (for example via voting) are obeyed more, as they are perceived to be more legitimate (Vyrastekova and van Soest, 2003).

- Several economic experiments have established that group choice is a key point to facilitate cooperative behaviour. If individuals can self-select into groups, there is a larger tendency to act in the group's interest and also to coordinate on a common cooperative strategy (Brekke *et al.*, 2011; Gurerk *et al.*, 2006).

- The in-group/out-group setting of industry versus managers (or scientists or NGOs) may explain why fisheries representatives need to follow the 'party line' and 'fight to the last tonne' in consultations, whereas autonomous individuals could be more flexible. Institutional inertia or "group think" can be a big impediment to achieving common

objectives of sustainability. In the current system, fishermen can be disempowered and victims of institutional forces from above that are trying to control them. In order to increase social capital, it can be much more effective to bring the dialogue to the individual level. The philosopher of the late 19th and early 20th century, Mary Parker Follett[1], eloquently elaborated on processes that help support the goal of the "integrated solution". Her ideas suggest that the individuals of different stakeholder groups should sit at the same table and express their interests and preferences in iterative rounds. This way, the individuals with different interests 'get a face' and these individual expressions may trigger other individuals to re-evaluate their conditions, perhaps leading to greater areas of consensus.

- It should be possible to promote crowding-in by creating the correct balance of incentives and punishments, which may encourage the adoption of fisheries practices which achieve not only societal but individual goals. We discussed the idea of rewarding 'good behaviour' and punishing 'bad behaviour', where this could be measured in terms of (partial) fishing mortality exerted by the group of fishers, or some other ecological impact caused by fishing. The time horizon for assessing good and bad behaviour was initially proposed to be 5 years, but it was objected that such a length of time may be too long for fishers who operate under financial pressures and uncertainties. The reward and the punishment would be given as, respectively, a bigger or a smaller 'slice of the national quota pie' in terms of quota or licences. The advantage of this approach is that it uses the carrot (reward) and the stick (punishment) at the same time. The system is reminiscent of the innovations implemented in the European cod plan: groups of fishers committing to a plan to reduce cod mortality can get access to higher effort levels than the default plan. However, the reward/punishment was given in advance, and it turned out to be problematic to measure the 'good behaviour'. In addition, fishers did not buy in to the system because it was bureaucratically complicated and perceived as top-down (Kraak *et al.*, 2013). In contrast, the Alaska pollock managers assign a collective allowance of Chinook salmon prohibited species catch (distinct from bycatch because it may not be landed by this fleet) to three cooperatives, with direction to minimize salmon take. The cooperatives have designed separate, but similar, Incentive Plan Agreements to reward individual vessels who fish cleanly, allowing them to partially bank avoided salmon to later years, when avoidance may be harder (e.g., Gruver 2014). These programs have been very successful, perhaps in part because they are designed and run by the cooperatives rather than managers; the role of the managers is simply to set the aggregate accountability measure. Management of chum salmon prohibited species catch extends this concept by creating a tournament among cooperatives, rewarding those that catch less chum than the fleet average by exempting them from salmon hotspot spatial closures that apply to the rest of the fleet (NPFMC 2014, section 2.1.1).

- Examples from initiatives of quota allocation in the eastern US, indicate that groups can perform effectively with a shared common interest; a European analogue could be producer

[1] http://en.wikipedia.org/wiki/Mary_Parker_Follett

organisations. It would seem therefore that a key principle of eliciting positive behaviour in the regulation of fisheries could be effected by organising fishers in effective groups, and promoting interaction between the managers and the fishers at this group level. It is apparent from the work of Ostrom that self-imposed rules work better (Ostrom, 2009); this is one of the principles which could be leveraged when trying to promote compliance through an appropriate group structure in fisheries

Credibility of science

Although mutual mistrust is discussed above, this section separately discusses the issue that fishers may often distrust scientists (and *vice versa*). The possible explanations and solutions given above may also apply here. But several additional possible explanations for this specific issue are given below:

- Stock assessments change from year to year based on technical scientific arguments that are not made transparent to the industry and may not correspond to what the industry sees on the water.
- 'Promises' made by science (e.g., that certain measures would lead to increased yields) do not always materialize, further weakening the fishers' confidence in the scientific advice.
- Scientists, on their side do not seem to trust that fishers will set sustainable limits if left to themselves and tend to treat catch data sceptically assuming it to be a "minimum out-take".
- There may be a misperception by the general public of the role of science in fisheries management. The general public (as well as fishers and managers) expect that science is able to resolve all fisheries related questions (Kraak *et al.*, 2010). However, science is rather a methodology of objective, impartial, analytic thinking than a generator of answers. Many of the issues in fisheries management relate to trade-offs which have never been made explicit. Thus, while there may be a single decision that can be made in a trade-off, there is not a single scientific answer. Moreover, these trade-offs are between social, economic and biological/environmental objectives. The challenge of credibly and convincingly 'quantifying' these trade-off in terms of the same unit (e.g., $) is no mean feat! So not only the single scientific answer is in question but also the single measurement unit.
- Institutions providing fisheries advice, like ICES, are often asked to provide certainty where it is not warranted or even advisable. A concrete example of this is the annual fisheries advice delivery in Europe where often a single number, usually without any explicit confidence intervals and with 3-5 significant digits, is given as advice. This notion of hypercognition of the fishery system leading to hyperprecision in the total allowable catch (TAC) advice invites stakeholders and users to 'invent' their own uncertainty around the number. Jeroen van der Sluijs, now a new professor at the University of Bergen, has actively worked on this front in climate and environmental science, applying the methodology

"NUSAP" which stands for numeral, unit, spread, assessment and pedigree. Dankel *et al.* (2012) describe NUSAP in a fisheries context, and why it is essential to make uncertainty the centre of attention to uphold scientific credibility and legitimacy.

- Scientists and fishermen are differently affected by uncertainty, and this difference may be exacerbated by behavioural phenomena that affect the perception of uncertainty (see more below). For example, risk perceptions and attitudes affect the perception of uncertainty in scientific stock assessments. Scientists apply the precautionary approach—reflecting infinite ambiguity aversion—to maximize the probability of maximum stock sizes, but loss-averse harvesters put relatively little value on small increases in average outcomes, instead focusing on the increased likelihood they do not make enough money to meet personal and business expenses—go bankrupt.

Counterexamples:

- Fishermen would have greater trust in science if they saw science as being helpful to them rather than being the bearer of bad news. Industry-science collaborative projects could be set up (building mutual trust) in which fishers could try new practices and scientists explore the consequences. The School for Marine Science and Technology of the University (SMAST) of Massachusetts has set up a cooperative program with scallop fishermen to allow them to reduce their yellowtail flounder by-catch (yellowtail flounder is a so-called "choke" species whose very low TAC was preventing the scallop fishery to catch its full TAC). In this program (http://www.umassd.edu/smast/bycatch/) individual fishing vessels provide more or less real-time information on their by-catch of yellowtail flounder. SMAST compiles the information and provides to the fleet maps of hot-spots to avoid. Also in Europe various initiatives are arising where fishers share information, for example on bycatch rates of species that need to be avoided and/or CPUE hotspots, so that fishers can catch their quota at lower impact to the ecosystem. (See also the EU funded GAP2 programme bringing scientists, fisheres and policy makers together to solve common problems – gap2.eu)

- When facilitated, the fishing industry can create fishery management plans which comply with management policies in spirit as well as in principle. The perspective of the industry to risk given the environment of low trust is interesting. A good example is the creation of the management plan for western horse mackerel in the Northeast Atlantic. The Pelagic Advisory Council (PAC) had experienced high volatility in the TAC for western horse mackerel in the early years of this century. The volatility of the TAC was driven primarily by the assessment that had insufficient information to scale the assessment consistently. The PAC subsequently began to work with a handful of scientists to formulate a plan which would satisfy the policy for sustainable fishing, whilst at the same time addressing the industry's need for stability in fishing opportunities, high yield and addressing the lack of trust they had in the stock assessment. The result was a plan which had a Harvest Control Rule (HCR) based on the change in the stock as measured by a triennial survey. For a given biological risk this HCR did not yield as high catches on average as a rule based on the

assessment, however it did stabilise yields by effecting an element of banking and borrowing through TAC inertia which was in the properties of the rule formulation; nonetheless the industry offset the potential future loss in yield against the increased trust they held in the survey rather than the assessment as a means of measuring the abundance of the stock. At the same time it could be observed that the gains in the assessment-based HCR were manifest at a point in the future greater than three years away, so it was also apparent that there was some discounting of future gains, which probably reinforced the group decision to go with the poorer performing (in terms of yield) HCR. This state of affairs can be seen as an example of the IKEA effect (see glossary **IKEA**).

- An Australian example of the IKEA effect (see glossary) is where fisheries research corporations (which fund research from industry levies) have commissioned research projects aimed at modelling commercial fish stocks. These models may subsequently be used to update or improve the stock assessment models used by government scientists who advise on TACs. This is not dissimilar from what happens in the Netherlands where fishing organisations have started to hire ex government scientists to help them check the assessments and advice. As a natural development as the fishing industry becomes more engaged with interacting in a constructive way in fisheries management such developments should be encouraged.

Possible solutions:

- The industry, or for example the EU (Regional) Advisory Councils (RAC, now AC), modelled after regional structuring in the United States, could play a key role here. A step in that direction may be to let the AC, where the industry is well represented, do the annual (update) stock assessment while, in the European context, ICES would do the benchmark assessments, for example, every 5 years.

- The science of stock assessment, for example, could be made more credible by transparently integrating fishers' knowledge or data, or by facilitating fishers to have assessments conducted by their own scientists. Starting from the premise that 'there is no one right scientific answer', it is important for scientists and fishermen to collectively understand the role of statistical models to help guide TAC advice. There would likely be greater support by the industry, if the "black box" of stock assessment was opened to them (i.e., the ICES Training Course "Opening up the box" that encourages stakeholder knowledge building).

- Alternatively, rather than advising only one TAC, scientists could experiment with giving a choice between several alternatives. The new policy of the EC is that scientists give single-species advice as a range around MSY, from which managers can pick a value that they deem suitable in the multi-objective context. Dankel, Vølstad and Aanes (in prep) are also working on a manuscript that quantifies the probability distribution around a point estimate from a stock assessment model. The interactive point here is that stakeholders and managers can then choose how much uncertainty risk they are comfortable with, and then

derive the appropriate TAC from the harvest control rule (Figure 1). By applying a CI-HCR (Figure 1), some elements of inherent uncertainty are more in focus and stakeholders have a responsibility of explicitly choosing how much risk is most appropriate for their needs. This is done in a straightforward and transparent way.

- The behavioural economists in the group saw some potential improvements by investigating scientifically the benefits of such stakeholder interactions. Typically, stakeholder involvement is largely path-dependent, and largely based on a combination of trial and error and accumulation of individual, rather than institutional social capital. A useful method to analyse what works and what does not work, seems randomized trial experiments, as commonly used in economics (Burtless, 1995).

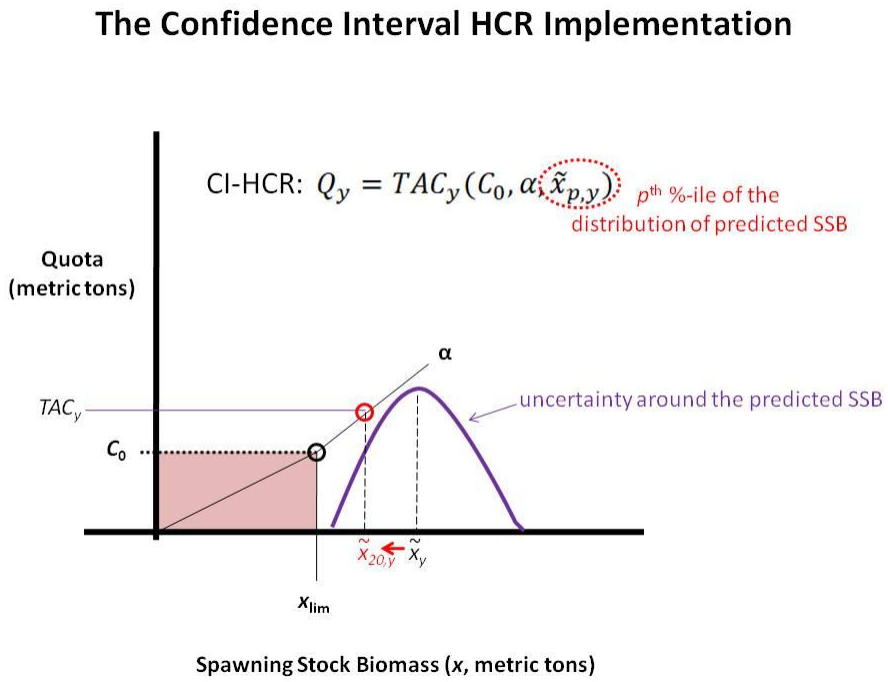

Figure 1. The "Confidence Level Harvest Control Rule" (CI-HCR) where the quota in year, y, (TAC_y, y-axis) is derived only after a percentile of the probability distribution around the point estimate ($\sim x_y$, x-axis) in year, y . Figure from Dankel, Vølstad and Aanes, in preparation. In this example, x_{lim}, C_0 and α are fixed parameters of the harvest rule algorithm, and the chosen percentile is 20%.

Voluntary compliance

A leading issue in the marine conservation arena is the global and large-scale nature of illegal fishing. In most countries, the standard approach to obtaining fisher compliance is to deter rule violations through investments in enforcement activities, including at-sea patrols, dockside monitoring, and observer programs (Figure 2). Investments are made up to the point that an 'optimal' compliance is achieved given available resources. This approach is built on the assumption that fishery offenses are solely a function of the likelihood and penalties of detection,

and the perceived costs and benefits of an offense. However, modern criminology (e.g., Tyler, 2006) and behavioural economics (Mazar *et al.*, 2008) recognizes that many people comply with rules, either in part or full, because they believe it is the right thing to do.

Normative explanations for compliance would suggest that the costs of obtaining a particular level of fisheries compliance through enforcement activities could be reduced through complementary investments in activities that increase voluntary compliance. For example, it might be expected that the red and black curves in Figure 2 would shift downward as voluntary compliance increases, thus permitting managers to achieve the previously determined 'optimal' level of compliance with less enforcement effort.

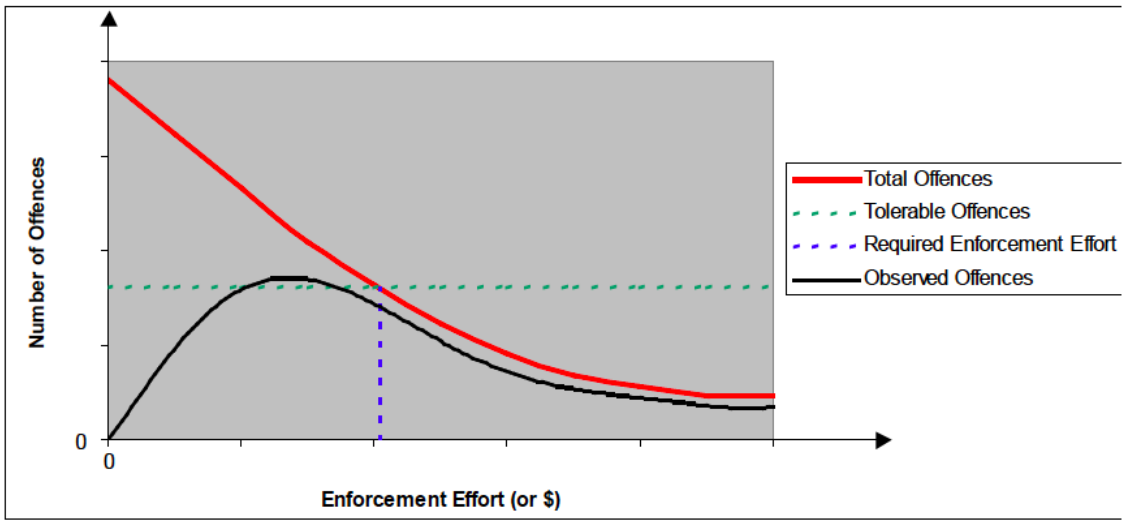

Figure 2: Hypothetical depiction of the standard deterrence approach to fisheries compliance (Green & McKinlay, 2009)

Some possible methods of increasing voluntary compliance were discussed:

- In the eastern US, an idea has been trialled which draws on the the effect of actors in a system knowing each other which may have a positive impact on compliance. In this trial fish products (in this case lobster) marketed and sold locally to the production area carry a Quick Response (QR) code which gives information about the catcher. In this way the actual seafood item sold is directly linked to the harvester. In other markets (meat products), this form of information promotes trust from the consumer, but in the fisheries case it may also promote compliance from the fisher by instilling in them a greater sense of ownership of the final product.

- Studies (e.g., Mazar *et al.*, 2008) have indicated that honesty can be enhanced by asking people to sign a statement in which they declare their commitment to honesty before taking part in a task rather than after. In fisheries this finding could be applied by making fishers sign the logbook at the top / in the beginning. The e-log system could have a confirmation screen (requiring a digital signature, e.g., maybe a 'selfie' of the fisher filling out the form

with a date stamp) before each electronic return on the system, which requires the operator to acknowledge that they are filling the form out accurately. A picture of "watching eyes" could be displayed on that confirmation screen as a reminder of the penalties for incorrect submissions (see Introductions – The biology of altruism and cooperation).

- The generation of voluntary compliance has been identified as central strategy to achieving compliance in Australian Commonwealth fisheries. Various documents on the National Compliance Program indicate that Australian Fisheries Management Authority (AFMA) implements this strategy through activities related to: education (e.g., informing fishers as to the nature and content of the rules with presentations, educational materials, and timely communications); transparency (e.g., communicating with fishers regularly on the management authorities actions via newsletters and other media); participation (e.g., ensuring that fishers have some opportunity to provide input to the management process); recognition (e.g., publicly identifying fishers for both good and bad behaviours); and responsiveness (e.g., periodically surveying fisher satisfaction with management and responding appropriately) (AFMA, 2014; AFMA, 2013a; Australian National Audit Office, 2013).

Surveys of fisher compliance

The weakness of official law enforcement statistics is widely acknowledged in the US and other developed countries, and can be attributed to the widespread lack of resources for fisheries management, high cost of traditional compliance surveillance methods, and ease with which fishers can evade detection by many surveillance methods. Research indicates that surveys might be used to address this weakness with "self-report" data for both fisheries and Marine Protected Area (MPA) management (Arias & Sutton, 2013; Bergseth *et al.*, 2013; Blank & Gavin, 2009; St. John *et al.*, 2010). This is supported by over half a century of survey use in the field of criminology that has shown that surveys are a valuable tool for obtaining information on respondents actual behaviours (Pepper & Petrie, 2004).

Discussion revealed that, in spite of their apparent utility, fisher compliance surveys are rarely employed in fisheries management. One example, however, comes from Australia:

- Since 2009, Australia has deployed compliance risk perception surveys among fishery stakeholders as a central component of its biennial compliance risk assessment for Commonwealth fisheries. Stakeholders are provided with fishery specific surveys that they use to rate potential risks according to their likelihood and perceived consequence (AFMA, 2013b). It could be reasoned the risk and consequence perceptions of stakeholders are not simply based on their observation of others, but reveals their own behaviours through the false consensus effect (FCE). The FCE is a response bias that may be encountered in perception data, where individuals tend to estimate the prevalence of a socially unacceptable activity based on the degree to which they participate in that activity (Petróczi, Mazanov, Nepusz, Backhouse, & Naughton, 2008; Ross, Greene, & House, 1977).

Choice under risk, choice under uncertainty

Theory from behavioural economics suggests that there is likely to be overconfidence (see glossary **Overconfidence**) in fisheries where the catch is very variable. Some demersal fisheries in Europe where even the sum of the TACs utilised by the vessel can be volatile from year to year, exhibit classical overconfidence in the actions of fishers. Some of these represent situations of high uncertainty, and yet fishers make investment decisions that do not reflect the actual uncertainty in economic return.

We discussed ways that harvesters manage the risk of securing their annual income, how management and institutional settings facilitate or constrain this, and possible ways of alleviating such constraints.

- One way that harvesters manage risk of annual income is to diversify by participating in a range of fisheries, so they are not subject to natural or market fluctuations in any one stock. For example, Kasperski and Holland (2012) show lower income variation of more highly diversified fishermen in the US Pacific. Individual quota systems lock harvesters into fisheries at their level of historic participation, limiting their ability to react across fisheries, and making such systems less appealing to harvesters than conventional models appreciate. The US West Coast Groundfish Trawl ITQ program is an example of this, where individualizing quota for a rarely encountered rockfish species led to individual allocations of less than one fish. An unlucky tow could shut down a fisher for the season, or throw him into a thin quota market where few would want to sell their allocation, exposing themselves to shut down risk. In this case the downside risk is significant, and loss averse fishermen were very concerned about how much they could vary their "participation" in the rare rockfish fishery. To cope with this risk, harvesters formed voluntary risk pools that pooled their bycatch quota, allowing participants to access enough quota to insure against bycatch encounters, so long as they were following best practices. While it is at face value puzzling that these harvesters converted an individual property right—itself designed to solve a common pool resource problem—into a common pool, from the perspective of behavioural risk coping, it makes sense.

- In the Ecuadorian Pomada Shrimp fishery operating in the Gulf of Guayaquil, vessel owners pay part of their crew's salaries with in-kind gifts of bycatch. This permits the vessels to operate with tighter margins, as such bycatch is typically not later sold by the vessel owners. Crew members, however, usually give this bycatch to their family members to sell in the local market. A downside of this, however, is that there is then a disincentive to bycatch reduction. This is a common feature of industrial shrimp fisheries throughout the tropics.

- Collective allocation avoids allocating a quota to any one harvester, which will cause harvesters influenced by overconfidence bias to think they are being constrained; their overconfidence may make collective allocation more successful because they believe they will be more successful in getting a bigger share within the co-op. Allocation of effort shares (e.g., Individual Transferable Effort, ITE, of Total Allowable Effort, TAE) would have the

same effect of allowing overconfident harvesters to believe that they will be more successful in getting a bigger catch (as in, e.g., the Western Australian lobster fishery, Penn *et al.*, 2015).

- In the New England groundfish fishery, 17 self-identifying sectors were established, each receiving a collective share of the scientifically determined TACs corresponding to the catch history of its members. Elinor Ostrom's enabling conditions for successful co-management (Ostrom, 2009) are satisfied in this case because self-identification allows groups to be more homogeneous than the fishery as a whole, and to facilitate trust and reciprocation within groups. Further, the central manager solves the politically hard problem of allocation for each group (in Ostrom's terms, the central guidelines of the program establish the resource boundaries), positioning the harvesters to cooperate to harvest most efficiently rather than competitively. The Chignik salmon co-op is an extreme example of this (Knapp 2008), where the co-op voluntarily reduced fishing capacity by about 80%, in an effort to increase harvesting efficiency and the economic benefits to the co-op as a whole; highliners and non-fishing vessels all received equal profit shares.

We discussed various ITQ systems as they are implemented worldwide and their sometimes unanticipated consequences.

- In New Zealand, multispecies fisheries are managed using individual transferable quotas (ITQs). Prior to 2001 the main system for managing bycatch was through (permanent and lease) quota trading trade. A regime of so-called "deemed values" was introduced to encourage fishers to balance catches with their annual catch entitlements (ACE). Under a deemed value system, fishers who do not hold ACE for their catch must pay a deemed value (Marchal *et al*, 2009). It is now no longer a criminal offence to catch fish for which the fisher has no ACE, but if deemed values are not paid the fishing permit is suspended. In order to provide a behavioural incentive for the fisher to cover bycatch with ACE, the deemed value should be higher than the marginal value of the ACE for the stock in addition to covering the transactions costs of obtaining ACE. When set at this level, deemed values should also remove incentives to intentionally take catch in excess of ACE holdings. For certain high value species such as paua or rock lobster that can be returned to the sea live (and which are not really bycatch species) there is no real justification for using deemed values. However, to create deterrent and avoid providing an incentive for these high value stocks to become intentional bycatch, deemed values should be set very high. In addition, the deemed value should be higher with greater species overharvests in a quota managed system.

- In the Gulf of St. Lawrence snow crab fishery, before ITQ's were introduced, crew members were co-adventurers and remunerated on a share basis. At the time, this was a competitive fishery where captains needed to catch as much as they could as fast as they could before the fishery was closed because the TAC was reached. With the introduction of ITQ's, each captain / boat owner has a reasonable guarantee that they would catch their share. This, combined with the Canadian federal government employment insurance scheme, led to the undesirable result that crew members were no longer given a share of the proceeds from

the catch but were paid a minimum wage. Their work in the fishery gave them access to employment insurance compensation for the rest of the year.

- In the Tasmanian rock lobster fishery network analysis showed that investors (who don't fish themselves but lease quota out) own increasingly large shares of quota. Investors are a heterogeneous group and include processors as well as individuals who own a small amount of fish quota to make up their investment portfolios. Anecdotally it would seem that owning a small amount of fish quota as part of an investment portfolio was subject to fashion trends. At the opposite end of the spectrum active fishers who own very little or no quota and have to lease most of their quota, so having to catch more fish to cover lease costs, are also increasing in number (see van Putten *et al,* 2012).

Other ideas

In the course of the brainstorm discussion several ideas and issues came up that may be worth mentioning, although they do not fit in any of the themes discussed above.

- Studies in behavioural economics have shown that if an individual is able to see the electricity bill of their neighbours then they become more focussed on energy-saving (Schultz et al. 2007). Maybe this idea could be applied in fisheries, but it is not immediately clear in what way.

- If a footballer's pay was positively correlated with the number of team wins, rather than on the individual's own abilities, cooperation might be enhanced. Maybe this idea could be applied in fisheries. The Marine Stewardship Council (MSC) certification system appears to operate on on such a basis: a fishery applies for certification as a whole and all individual fishers benefit if the fishery acquires and keeps the certification due to sustainable fishing. Similarly, the Dutch individual quotas are managed by co-management groups, and the quotas they get to share may depend on how well they respected the quotas in the past (Salz, 1996).

- According to Ariely (http://bigthink.com/videos/dan-ariely-zappos-and-the-offer) the company Zappos paid interviewed job applicants $3000 to NOT accept a job offer so that those who chose to accept the offer were foregoing a short-term monetary reward. This was taken to imply that the firm employed only people with a strong desire to work for them. Moreover, owing to cognitive dissonance[2] the choice to forego the monetary reward may

[2] Cognitive dissonance is the mental stress or discomfort experienced by an individual who holds two or more contradictory beliefs, ideas, or values at the same time, or is confronted by new information that conflicts with existing beliefs, ideas, or values. According to the theory of cognitive dissonance humans strive for internal consistency. When inconsistency (dissonance) is experienced, individuals tend to become psychologically uncomfortable and they are motivated to attempt to reduce this dissonance, as well as actively avoiding situations and information which are likely to increase it. (from Wikipedia)

even increase the commitment to the job. Maybe this commitment-enhancing technique could be applied in fisheries, but it is not immediately clear in what way.

- Fisheries management could set up a structure in which several levels of organisation are offered to which one can opt-in; each levels has its benefits and costs, but because the individuals can choose themselves, there would be greater acceptance of the disadvantages of the chosen setting. This idea is similar to the notion of fisheries managers giving fishers the choice: Form a group, then we give your group a quota to manage yourselves; otherwise we manage it for you.
- Industry-led science should be checked by government scientists. Should the science be public?
- What is the relation between individual shares, such as I(T)Qs or TURFS, and the endowment effect or loss aversion (see glossary)?
- In the Dutch Postcode Lottery, one's postcode is the ticket number, and hence even if not participating one may still find out that one would have won had one played. Research shows (Zeelenberg and Pieters, 2004) that this particular feedback influences the anticipated post-decision regret, and moderates the influence that anticipated regret has on lottery participation. Application of this notion may be possible in fisheries management; for example, one's vessel ID is the ticket number but one is only eligible to get the prize under a certain condition such as operating a sustainable fishery.
- Tournaments set up in the right way may also be used to enhance sustainable fishing behaviour.
- People often evaluate what they have/do relative to what peers have/do rather than using absolute reference points. This notion may also be useful for fisheries management. Fisheries management could encourage a few fishermen to behave well and report widely on the results.

Future plans

One of the main claims to novelty of the discipline of Behavioural Economics is that it does experiments to determine how people behave when faced with decisions rather than making the classical-economics assumption that people are rational decision makers. The group discussed several possible studies and experiments that could be undertaken, by some or all individuals of the group. These will be briefly outlined here.

As a general 'health warning', to ourselves, we note the following.

- Experiments are only of scientific value if they are set up properly, e.g., controlling for everything other than the factor(s) under consideration, and addressing whether results can be extrapolated, e.g., from lab to field.
- Care should be taken that the conducting of experiments does not destroy trust. For example, survey questions should rather be framed as, e.g., "we need your information to get things better" than "we need your information to punish you better", recognising that the latter may nevertheless occur.

The 'you are being watched' experiment

One possible experiment would be to conduct a study of the effects of modifying how the authorities communicate with fishing vessels employing VMS or AIS (Automatic Identification System). Such a study is suggested by an *ad hoc* compliance intervention conducted by Australia in 2010 with vessels found to be transiting through protected areas (AFMA[3]). Though it was generally not possible to determine if fishing was also taking place from the available VMS, a novel program notifying vessels of their known whereabouts and asking for clarification on their activities in areas closed to fishing led to a major reduction (>90%) in transiting through protected areas. It is possible that fishers modified their behaviour as the knowledge that they were being watched was more salient (i.e., supervision effect, see Introductions – The biology of altruism and cooperation), and because there was a greater psychological cost as noncompliant vessels would have to more actively lie about their activities.

From this case study, a controlled experiment might be conducted of how vessels elsewhere respond when they either receive the treatment or do not. Under the treatment captains, when there is VMS proof of having passed through closed areas, would receive a simple and factual letter or email summarised here as "We saw you were in the closed area on [insert VMS date/time here]. Can you kindly tell us what you were doing in the closed area at that time?" This simple intervention may result in increased compliance to closed areas. We have already contacted Mario Lopes dos Santos who is Deputy Head of Unit for Operational Coordination Unit at the European

[3] http://www.afma.gov.au/managing-our-fisheries/compliance-activities/the-domestic-compliance-program/

Fisheries Control Agency about collaboration in setting up an experiment. Details and ethical guidelines and restraints still must be discussed and finalized, but we see potential in replicating an intervention such as the low cost/high efficiency method the Australians used.

The 'transparency about uncertainty' experiment

We talked about the hypothesis that uncertainty in the advice should be presented to make it more credible, but in an intelligent way that increases, not reduces, credibility (Dankel *et al*., 2012). We decided to test this in an experiment, using Canadian fishermen (non-ICES stakeholders and therefore experimentally 'naïve' to the treatment), who would be presented with fictitious catch advice based on the standardised ICES advice communication framework. We plan on showing different ways of communicating uncertainty in advice and then assessing how the fishermen perceived the credibility, salience and legitimacy of the advice. We would use data and results for stocks and areas in which the fishermen are not involved to avoid fishermen making choices based on the outcome. A drawback is that the responses thus measured will be responses in a 'non-emotional' state, while it cannot be known to what extent the conclusions can be extrapolated to the situation where subjects are emotionally involved (the 'hot-cold empathy gap', see glossary **Empathy**). In a second step, a similar experiment could be conducted with European fisheries not managed by the EU.

The 'self-chosen monitoring' experiment

The group discussed a potential experiment to test whether compliance would be increased if fishers had chosen the monitoring methods themselves, from among a set of methods that would be "equal" from a management/science point of view. The control group would not be allowed to choose but be monitored the same way as the experimental group had chosen to be monitored. Such an experiment would test for the effect on compliance of autonomy/bottom-up versus top-down control. The group went on to discuss whether this experiment should be done in the field or in the lab, for example in the form of a Common Pool Resource Game (Ostrom, 1994). However, lab results cannot necessarily be extrapolated to the field. Nevertheless, a link between lab and field conditions can be estimated by a lab setup where individuals play several different games (for example a Dictator Game and a Common Pool Resource Game) and the correlation between the behaviour in the two games within individuals is measured. This correlation may then be an indicator for the degree to which the lab behaviour is correlated with behaviour in different domains, in the lab and in the field.

Measuring compliance using the False Consensus Effect

The group discussed a potential experiement to gather fishery compliance information through fisher surveys. The proposed surveys would make use of the false consensus effect (FCE)

mentioned above (Discussions – Surveys of fisher compliance) . The relationship between self-involvement and the overestimation of population-wide prevalence of a socially unacceptable activity has been previously demonstrated in individuals who partake in smoking, drinking, use of illegal drugs and use of performance-enhancing drugs, among other activities (e.g., Lai, Ho, & Lam, 2004; McCabe, 2008; Petróczi *et al*., 2008; Suls, Wan, & Sanders, 1988). In this experiement, the surveys would ask fishers their perceptions of noncompliance with fishery management rules, and then compare the data with available official law enforcement statistics or other compliance estimates, such as those obtained from audits of market data. Thus, if fishers overestimate the prevalence of fishing in closed areas according to official statistics, it is possible that they themselves fish in violation of closed area rules. The surveys can also be used to help understand why fishers break the rules, asking questions specifically designed to evaluate the perceived expected benefit of different fishery offenses, the moral stigma attached to illegal fishing, and the belief that illegal fishers have no choice.

Conclusions

One of the impediments to more effective fisheries management is intra-institutional dysfunction. Addressing this is beyond the scope of this workshop, and yet awareness is the first step in this process. This workshop would conclude that future efforts need to focus on broadening the scope of the science base used to underpin fisheries management decisions. In that regard boundary projects should be initiated to foster co-operation between the control and enforcement agencies and the natural and social sciences. Such boundary projects should seek to explore the principles of and develop strategies for engendering trust between and among all the major players in the fisheries domain. Examples of such boundary projects could be the ones discussed under Future Plans.

Scientists cannot learn a new discipline in three days. This is only the start of a journey. We, the participants, feel we are only 'teenagers' in the new field of "Behavioural-Science Applications to Fisheries Management". We as well as the field need to mature.

Glossary of Behavioural-Economics Phenomena

Many phenomena arise from the fact that people often think with their 'System 1' (see introductory session), especially when they are emotionally involved. Below is a glossary of those phenomena that featured in the discussions. Unless otherwise stated, the definitions are taken from Samson (2014) (and references in the definitions are also in Samson (2014)).

Anchoring (heuristic)

Anchoring is a particular form of priming effect whereby initial exposure to a number serves as a reference point and influences subsequent judgments about value. The process usually occurs without our awareness (Tversky & Kahneman, 1974), and sometimes it occurs when people's price perceptions are influenced by reference points. For example, the price of the first house shown to us by an estate agent may serve as an anchor and influence perceptions of houses subsequently presented to us (as relatively cheap or expensive). These effects have also been shown in consumer behaviour whereby not only explicit slogans to buy more (e.g., "Buy 18 Snickers bars for your freezer"), but also purchase quantity limits (e.g., "limit of 12 per person") or 'expansion anchors' (e.g., "101 uses!") can increase purchase quantities (Wansink, Kent, & Hoch, 1998).

Availability heuristic

Availability is a heuristic whereby people make judgments about the likelihood of an event based on how easily an example, instance, or case comes to mind. For example, investors may judge the quality of an investment based on information that was recently in the news, ignoring other relevant facts (Tversky & Kahneman, 1974). Similarly, it has been shown that individuals with a greater ability to recall antidepressant advertising estimate the prevalence of depression to be higher than those with low recall (An, 2008), while less knowledgeable consumers use the ease with which they can recall low-price products as a cue to make judgments about overall store prices (Ofir, Raghubir, Brosh, Monroe, & Heiman, 2008). The availability of information in memory also underlies the representativeness heuristic.

Certainty/possibility effects

Changes in the probability of gains or losses do not affect people's subjective evaluations in linear terms (see also prospect theory and zero price effect) (Tversky & Kahneman, 1981). For example, a move from a 50% to a 60% chance of winning a prize has a smaller emotional impact than a move from a 95% chance to a 100% (certainty) chance. Conversely, the move from a 0% chance to a 5% possibility of winning a prize is more attractive than a change from 5% to 10%, for example. People over-weight small probabilities, which explains lottery gambling—a small expense with the possibility of a big win.

Choice architecture

This term was coined by Thaler and Sunstein (2008) and refers to the practice of influencing choice by changing the manner in which options are presented to people. For example, this can be done by setting defaults, framing, or adding decoy options.

Choice overload

Also referred to as 'overchoice', the phenomenon of choice overload occurs as a result of too many choices being available to consumers. The application of heuristics in decision making becomes more likely with a greater number or complexity of choices. Overchoice has been associated with unhappiness (Schwartz, 2004), reduced self-control due to decision fatigue (Vohs *et al.*, 2008), going with the default option, as well as choice deferral—avoiding making a decision altogether, such as not buying a product (Iyengar & Lepper, 2000).

Confirmation bias

Confirmation bias occurs when people seek out or evaluate information in a way that fits with their existing thinking and preconceptions. The domain of science, where theories should advance based on both falsifying and supporting evidence, has not been immune to bias, which is often associated with people trying to bolster existing attitudes and beliefs. For example, a consumer who likes a particular brand and researches a new purchase may be motivated to seek out customer reviews on the internet that favor that brand. Confirmation bias has also been related to unmotivated processes, including primacy effects and anchoring, evident in a reliance on information that is encountered early in a process (Nickerson, 1998).

Decoy effect

Choices often occur relative to what is on offer rather than based on absolute preferences. The decoy effect is technically known as an 'asymmetrically dominated choice' and occurs when people's preference for one option over another changes as a result of adding a third (similar but less attractive) option. For example, people are more likely to choose an elegant pen over $6 in cash if there is a third option in the form of a less elegant pen (Bateman, Munro, & Poe, 2008).

Default (option)

Default options are pre-set courses of action that take effect if nothing is specified by the decision maker (Thaler & Sunstein, 2008), and setting defaults is an effective tool in choice architecture when there is inertia or uncertainty in decision making (Samson, 2014). Requiring people to opt-out if they do not wish to donate their organs, for example, has been associated with higher donation rates (Johnson & Goldstein, 2003).

Diversification bias

People seek more variety when they choose multiple items for future consumption simultaneously than when they make choices sequentially, i.e., on an 'in the moment' basis. Diversification is non-optimal when people overestimate their need for diversity (Read & Loewenstein, 1995). In other words, sequential choices lead to greater experienced utility. For example, before going on vacation I may upload classical, rock and pop music to my MP3 player, but on the actual trip I may mostly end up listening to my favorite rock music. (See also projection bias).

(Hot-cold) Empathy gap

It is difficult for humans to predict how they will behave in the future. A hot-cold empathy gap occurs when people underestimate the influence of visceral states (e.g., being angry, in pain, or hungry) on their behaviour or preferences. In medical decision making, for example, a hot-to-cold empathy gap may lead to undesirable treatment choices when cancer patients are asked to choose between treatment options right after being told about their diagnosis. Even low rates of adherence to drug regimens among people with bipolar disorder could be explained partly by something akin to a cold-to-hot empathy gap, while in a manic phase, patients have difficulty remembering what it is like to be depressed and stop taking their medication (Loewenstein, 2005).

Endowment effect

This bias occurs when we overvalue a good that we own, regardless of its objective market value (Kahneman, Knetsch, & Thaler, 1991). It is evident when people become relatively reluctant to part with a good they own for its cash equivalent, or if the amount that people are willing to pay for the good is lower than what they are willing to accept when selling the good. Put more simply, people place a greater value on things once they have established ownership, which is especially true for goods that wouldn't normally be bought or sold on the market, usually items with symbolic, experiential, or emotional significance. The endowment effect is an illustration of the status quo bias and can be explained by loss aversion.

Framing effect

Choices can be worded in a way that highlights the positive or negative aspects of the same decision, leading to changes in their relative attractiveness. This technique was part of Tversky and Kahneman's development of prospect theory, which framed gambles in terms of losses or gains (Kahneman & Tversky, 1979). Different types of framing approaches have been identified, including risky choice framing (e.g., the risk of losing 10 out of 100 lives vs the opportunity to save 90 out of 100 lives), attribute framing (e.g., beef that is 95% lean vs 5% fat), and goal framing (e.g., motivating people by offering a $5 reward vs imposing a $5 penalty) (Levin, Schneider, & Gaeth, 1998).

Herd behaviour

This effect is evident when people do what others are doing instead of using their own information or making independent decisions. The idea of herding has a long history in philosophy and crowd psychology. It is particularly relevant in the domain of finance, where it has been discussed in relation to the collective irrationality of investors, including stock market bubbles (Banerjee, 1992). In other areas of decision making, such as politics, science, and popular culture, herd behaviour is sometimes referred to as 'information cascades' (Bikhchandi, Hirschleifer, & Welch, 1992).

Heuristic

Heuristics, which are commonly defined as cognitive shortcuts or rules of thumb that simplify decisions, represent a process of substituting a difficult question with an easier one (Kahneman, 2003). Heuristics can also lead to cognitive biases. There are divisions regarding heuristics' relation to bias and rationality. In the 'fast and frugal' view, the application of heuristics (e.g., the recognition heuristic) is an "ecologically rational" strategy that makes best use of the limited information available to individuals (Goldstein and Gigerenzer, 2002). Furthermore, while heuristics such as affect, availability, and representativeness have a general purpose character, others developed in social and consumer psychology are more domain-specific, examples of which include brand name, price, and scarcity heuristics (Shah & Oppenheimer, 2008).

IKEA effect

While the endowment effect suggests that mere ownership of a product increases its value to individuals, the IKEA effect is evident when invested labor leads to inflated product valuation (Norton, Mochon, & Ariely, 2012). For example, experiments show that the monetary value assigned to the amateur creations of self-made goods is on a par with the value assigned to expert creations. Both experienced and novice do-it-yourselfers are susceptible to the IKEA effect. Research also demonstrates that the effect is not simply due to the amount of time spent on the creations, as dismantling a previously built product will make the effect disappear. The IKEA effect is particularly relevant today, given the shift from mass production to increasing customization and co-production of value. The effect has a range of possible explanations, such as positive feelings (including feelings of competence) that come with the successful completion of a task, a focus on the product's positive attributes, and the relationship between effort and liking. The effort heuristic is another concept that proposes a link between perceived effort and valuation (Kruger, Wirtz, Van Boven, & Altermatt, 2004).

Inequity aversion

Human resistance to inequitable outcomes is known as 'inequity aversion', which occurs when people prefer fairness and resist inequalities. In some instances, inequity aversion is disadvantageous, as people are willing to forego a gain, in order to prevent another person

from receiving a superior reward. Inequity aversion has been studied through experimental games, such as dictator, ultimatum, and trust games (Fehr & Schmidt, 1999), and the concept has been applied in business and marketing, including research on customer responses to exclusive price promotions (Barone & Tirthankar, 2010).

Inertia

In behavioural economics, inertia is the endurance of a stable state associated with inaction and the concept of status quo bias (Madrian & Shea 2001). In social psychology the term is sometimes also used in relation to persistence in (or commitments to) attitudes and relationships.

Intertemporal choice

Intertemporal choice is a field of research concerned with the relative value people assign to payoffs at different points in time. It generally finds that people are biased towards the present (see Present bias) and tend to discount the future (see Time discounting).

Licensing effect

Also known as 'self-licensing', the licensing effect is evident when people allow themselves to do something bad (e.g., immoral) after doing something good (e.g., moral) first (Merritt, Effron & Monin, 2010). Well-publicized research in Canada asked participants to shop either in a green or a conventional online store. In one experiment, people who shopped in a green store shared less money in a dictator game (see Game theory). Another experiment allowed participants to lie (about their performance on a task) and cheat (take more money out of an envelope than they actually earned) and showed more lying and cheating among green shoppers (Mazar & Zhong, 2010).

Loss aversion

Loss aversion is an important BE concept associated with prospect theory and is encapsulated in the expression "losses loom larger than gains" (Kahneman & Tversky, 1979). It is thought that the pain of losing is psychologically about twice as powerful as the pleasure of gaining, and since people are more willing to take risks to avoid a loss, loss aversion can explain differences in risk-seeking versus aversion. Loss aversion has been used to explain the endowment effect and sunk cost fallacy, and it may also play a role in the status quo bias. The basic principle of loss aversion is sometimes applied in behaviour change strategies, and it can explain why penalty frames are sometimes more effective than reward frames in motivating people (Gächter, Orzen, Renner, & Starmer, 2009). The website Stickk allows people to commit to a positive behaviour change (e.g., give up junk food), which may be coupled the fear of loss—a cash penalty in the case of non-compliance.

Optimism bias

People tend to overestimate the probability of positive events and underestimate the probability of negative events, a phenomenon known as optimism bias. For example, we may underestimate our risk of being in a car accident or getting cancer relative to other people. A number of factors can explain unrealistic optimism, including self-serving biases, perceived control, being in a good mood, etc. A possible cognitive factor that has been identified in optimism bias is the representativeness heuristic (Shepperd, Carroll, Grace & Terry, 2002).

Overconfidence (effect)

The overconfidence effect is observed when people's subjective confidence in their own ability is greater than their objective (actual) performance. It is frequently measured by having experimental participants answer general knowledge test questions. They are then asked to rate how confident they are in their answers on a scale. Overconfidence is measured by calculating the score for a person's average confidence rating relative to the actual proportion of questions answered correctly. Overconfidence is similar to optimism bias when confidence judgments are made relative to other people. A big range of issues have been attributed to overconfidence, including the high rates of entrepreneurs who enter a market despite the low chances of success (Moore & Healy, 2008). The planning fallacy is another example of overconfidence, where people underestimate the length of time it will take them to complete a task, often ignoring past experience (Buehler, Griffin, & Ross, 1994).

Present bias

The present bias refers to the tendency of people to give stronger weight to payoffs that are closer to the present time when considering trade-offs between two future moments (O'Donoghue, &, Rabin, 1999). (See also Time discounting.)

Priming (Conceptual)

Conceptual priming is a technique and process applied in psychology that engages people in a task or exposes them to stimuli. The prime consists of meanings (e.g., words) that activate associated memories (schema, stereotypes, attitudes, etc.). This process may then influence people's performance on a subsequent task (Tulving, Schacter, & Stark, 1982). For example, one study primed consumers with words representing either 'prestige' US retail brands (Tiffany, Neiman Marcus, and Nordstrom) or 'thrift' brands (Wal-Mart, Kmart, and Dollar Store). In an ostensibly unrelated task, participants primed with prestige names then gave higher preference ratings to prestige as opposed to thrift product options (Chartrand, Huber, Shiv, & Tanner, 2008). Conceptual priming is different from processes that do not rely on activating meanings, such as perceptual priming (priming similar forms), the mere exposure effect (repeated exposure increases liking), affective priming (subliminal

exposure to stimuli, evoking positive or negative emotions) (Murphy & Zajonc, 1993), or the perception-behaviour link (e.g., mimicry) (Chartrand & Bargh, 1999).

Reciprocity

Reciprocity is a social norm that involves in-kind exchanges between people—responding to another's action with another equivalent action. It is usually positive (e.g., returning a favor), but it can also be negative (e.g., punishing a negative action) (Fehr & Gaechter, 2000). Reciprocity is an interesting concept from the perspective of BE, because it does not involve an economic exchange, and it has been studied by means of experimental games (see Game theory). Charities often take advantage of reciprocity when including small gifts in solicitation letters, while supermarkets try to get people to buy by offering free samples. Reciprocity is also used as a social influence tool in the form of 'reciprocal concessions', an approach also known as the 'door-in-the-face' technique, which occurs when a person makes an initial large request (e.g., to buy an expensive product), followed up by a smaller request (e.g., a less expensive option), if the initial request is denied by the responder. The responder then feels obligated to 'return the favor' by agreeing to the conceded request (Cialdini, Vincent, Lewis, Catalan, Wheeler, & Darby, 1975).

Time (temporal) discounting

Time discounting research, which investigates differences in the relative valuation placed on rewards (usually money or goods) at different points in time, by comparing its valuation at an earlier date with one for a later date (Frederick, Loewenstein, & O'Donoghue, 2002), shows that present rewards are weighted more heavily than future ones. Once rewards are very distant in time, they cease to be valuable. Delay discounting can be explained by impulsivity and a tendency for immediate gratification, and it is particularly evident for addictions such as nicotine (Bickel, Odum, & Madden, 1999). Hyperbolic discounting theory suggests that discounting is not time-consistent; it is neither linear nor occurs at a constant rate. It is usually studied by asking people questions such as "Would you rather receive £100 today or £120 a month from today?" or "Would you rather receive £100 a year from today or £120 a year and one month from today?" Results show that people are happier to wait an extra month for a larger reward when it is in the distant future. In hyperbolic discounting, values placed on rewards decrease very rapidly for small delay periods and then fall more slowly for longer delays (Laibson, 1997).

The nudge data base

This is a list of empirical 'nudges' and their sources with a particular emphasis on those sourced from academic papers. It is updated regularly.
http://economicspsychologypolicy.blogspot.dk/2013/03/nudge-database_3441.html

Deliverables and outputs (as promised in the proposal)

In this section we copy the list of Expected Achievements and Outputs from our proposal, and report *in italics* what we achieved with regards to each point.

- The workshop will provide a **forum** for the development of thinking within ICES on the future of ICES advice. In particular how ICES advice on the exploitation of marine resources can develop to include consideration of other dimensions of fisheries management such as economics and fisher behaviour. Such developments will be important in maintaining the relevance and credibility of future ICES advice in the context of fisheries management.

The (informal) forum has been established during the Workshop. A LinkedIn group has been created (BehavFish Working Group) to give a home to further discussion and development.

- We will write one or more peer-reviewed **paper**(s). We aim to reach several audiences: fisheries scientists; fisheries managers and policy makers; environmental policy scientists such as those taking part in climate change and emission negotiations; behavioural and ecological economists. We could aim at a journal that services all those groups, or alternatively write several, targeted, publications. For at least one paper the lead applicant will take the lead. Other members may take the lead for additional papers.

Following the present report we will start writing a Food for Thought paper in which we share our new insights and experiences to the wider audience of fisheries scientists. We have not yet decided whether we submit this to the ICES Journal of Marine Science or Fish and Fisheries. Experiments, surveys, and other studies are being planned by the group (or a subset of the group), of which papers will be written for the peer-reviewed literature.

- One of the reasons for choosing high-profile, senior, fisheries scientists, is that they are **directly** involved as advisors of fisheries management and policy, at national and/or EU level and/or globally; most of them are senior scientists as well. Therefore we can incorporate our new insights into our work as advisors and project leaders. We envisage that recommendations entail modifications to fisheries management plans and instruments, to the decision-making process and governance, to communication between stakeholders and to research projects.

This process will take place automatically (and unavoidably?). One participant reported on having discussed with a colleague, already the day after the Workshop, the inclusion of our insights into a modelling exercise, and another participant communicated some of the insights in a report of an advisory committee.

- We will propose plans for a **strategic** initiative of ICES. This could include future working group meetings, an ASC theme session and a symposium.

With regards to future working group meetings, see last bullet point on WGMARS. We are contemplating theme sessions at the ICES ASC and the annual meeting of IIFET (International Institute of Fisheries Economics & Trade), both for 2016 (because the deadlines for 2015 have already

passed); this gives us ample time to decide on the details. We plan a 'fun session' for an evening at the ICES ASC 2015 in Copenhagen. We have communicated this with SCICOM and the ASC organisers.

- Starting with a list of issues which will be of direct use to other ICES initiatives such as SISAM, we can begin the development of a **protocol** of 'behavioural principles' for fisheries management, covering issues such as how to frame and communicate regulations, how to promote cooperation, etc. Such behavioural interventions can offer low-cost, non-invasive policy options, which have recently shown substantial success in a variety of policy settings. Current management agencies have a set way of doing their job. Our protocol will suggest ways in which a transition to a new way of acting can be implemented in a way that helps overcome this institutional inertia and implements a new pattern based on the latest understanding of human behaviour.

Because our new interdisciplinary endeavour has not matured yet (we are still 'teenagers'), such a protocol has not materialized yet.

- We will generate future **collaborations** between the participants (and others) to further develop this potentially important aspect of ICES advice. We will establish areas of common interest to catalyze interdisciplinary research teams to pursue follow-up research. Economist collaborators would benefit from access to detailed behavioural data (which may yield yet-undiscovered behavioural phenomena!) and fishery scientists from thinking in more structured and accurate ways about how and why people make the decisions they do.

Immediately after the Workshop a flurry of emails has ensued about collaborations for field experiments. Design of such experiments is ongoing.

- We will closely collaborate with ICES' most transdisciplinary group, **WGMARS** (through Chair Dorothy J. Dankel), in relation to bridging the gap of marine science with economics, social, and behavioural studies. This is a chance for our proposed consortium to interact with a group who has a firm position in the ICES framework.

In 2015 WGMARS will formulate the Terms of Reference (ToR) for 2016-2018. WGMARS Chair Dorothy Dankel who attended the Workshop is interested in the incorporation of the topic into those ToR.

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