

Uptake of proven bycatch reduction fishing gear: perceived best practices and the role of affective change readiness

Lekelia D. Jenkins^{1,*}, Stephen Eayrs², Michael V. Pol³ and Katie R. Thompson⁴

¹Arizona State University, PO Box 875703, Tempe, AZ 85287-5603, USA

²Smart Fishing Consulting, 1/46 Broadwater Ave, Maroochydore, QLD 4558, Australia

³Responsible Offshore Science Alliance, PO Box 508, Onset, MA 02558, USA

⁴The Ocean Foundation, 1320 19th St, NW, Suite 500, Washington, DC 20036, USA

*Corresponding author: tel: +1 480-727-4521; e-mail: kiki.jenkins@asu.edu

This paper identifies, critiques, and offers suggestions for successful fisheries change initiatives to reduce bycatch. Through analysis of interviews and a workshop with fisheries change agents, we identified six themes. The first theme is that definitions of success varied between change initiatives. The other five themes relate to perceptions of best practices for change initiatives. They are the importance of (1) engaging diverse, motivated stakeholders in the initiative, in addition to fishers, (2) identifying and articulating clear benefits to fishers, (3) communicating with fishers early and throughout the initiative, particularly through face-to-face interactions and videos, (4) demonstrating positive change agent qualities, and (5) executing an appropriate and well-timed project. These best practices are widely recognized but have not consistently yielded widespread change. We hypothesize this is partly due to fisheries change agents being financially constrained, not measuring outcomes, and not having the proper training, such as knowledge of change management and human behaviour theories. We highlight one especially promising theory, change readiness, which includes cognitive and affective change readiness. We discuss the need to develop affective change readiness among fishers, given that change management research shows that emotions play an important role in the uptake of new ideas and changes.

Keywords: adoption, bycatch mitigation, bycatch reduction devices, fisheries extension, gear researcher.

Introduction

Substantial effort and resources have been devoted globally to bycatch reduction and conservation of non-target marine species using alternative commercial fishing technologies, fishing gears, and techniques (Walsh *et al.*, 2000; Werner *et al.*, 2006; Kennelly, 2007; Boopendranath, 2010; Eayrs and Fuentevilla, 2021). A recent global review of bycatch reduction research on bottom fish trawls yielded over 200 published papers investigating more than 140 species (Kennelly and Broadhurst, 2021). This and similar reviews, for prawn trawls (Broadhurst, 2000; Eayrs and Fuentevilla, 2021), long-lines and purse seines (Gilman *et al.*, 2020; Swimmer *et al.*, 2020), and gillnets (Jordan *et al.*, 2013), provide ample evidence that bycatch reduction continues to be a significant focus of research worldwide. A global working group of researchers from government, academia, private industry, and non-governmental organizations (NGOs) recently compiled several hundred planned, ongoing, and completed projects focusing on bycatch reduction (ICES, 2019). Much of this research is collaborative, occurring on commercial vessels and sometimes with fishers involved in project planning and execution.

Bycatch reduction initiatives proven successful through research at sea (Eayrs and Pol, 2019; Steins *et al.*, 2022) have an implicit goal of broad adoption by fishers. The task of achieving such adoption is often assigned to or assumed by the researchers themselves (ICES, 2015), despite some of them lacking training and expertise to effectively engage in fisheries extension work (Jenkins, 2006). We define fisheries change agents as those involved in facilitating a fish-

eries change initiative, such as gear researchers and fisheries experts. They can facilitate either regulatory implementation or voluntary adoption of fieldwork outcomes (Jenkins, 2015).

Many fisheries change agents have described methods for fostering and encouraging the acceptance of bycatch reduction outcomes by fishers, and in some cases, included models designed to elicit changes in fisher behaviour (Hall *et al.*, 2007; Watson, 2007; Eayrs *et al.*, 2015; Thompson *et al.*, 2016; Eayrs and Pol, 2019). Common threads in these models include participation by fishers in the design and testing of bycatch reduction devices, their active role as champions of the device, including the sharing of testing outcomes, and opportunities for fishers to test these devices themselves with low financial risk (Johnson and van Densen, 2007; Johnson, 2010). All of these models involve the retrospection of successful and unsuccessful initiatives and rely on the ability of those involved to be aware of critical factors that guide success outcomes (Cox *et al.*, 2007). However, Eayrs and Pol (2019) found that awareness of the essential factors, including the use of varying forms of incentive and multiple communication modalities, rarely if ever led to widespread voluntary adoption of proven fishing gears, including bycatch reduction devices. They speculated that an essential factor had been overlooked and seldom considered or evaluated: the readiness of fishers to adopt proven fishing gears, either voluntarily or in response to regulation. Consequently, they advocated for future change initiatives to assess the readiness of fishers to change to inform and guide efforts to enhance their adoption of proven fishing gears.

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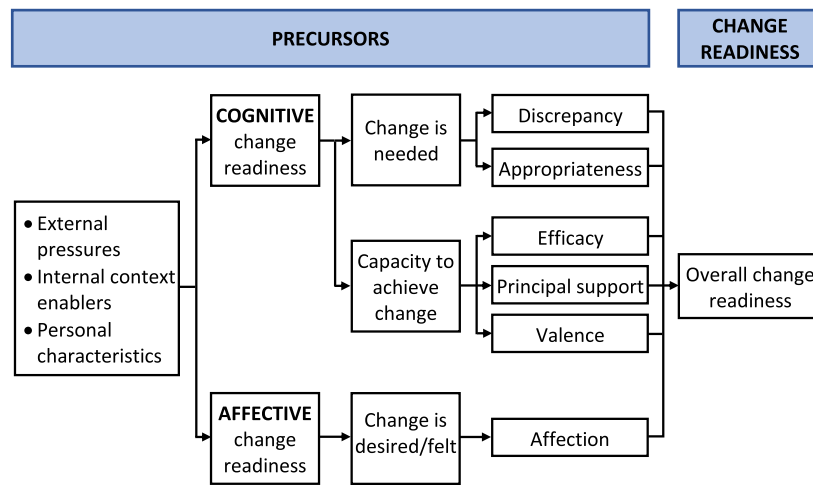


Figure 1. The precursors need to achieve change readiness. Adapted from Rafferty *et al.* (2013).

In this paper, we present the results of a structured analysis of oral history interviews [the interviews were briefly mentioned and cursorily summarized by Eayrs and Pol (2019)] and a facilitated workshop of fisheries change agents describing their experiences with fisheries change initiatives, including aiding the voluntary and involuntary adoption of proven fishing gears by fishers. We also compare core concepts of change readiness, as defined by Rafferty *et al.* (2013) and others, to what fisheries change agents perceived as best practices for successful fisheries change initiatives. While other studies of the adoption of bycatch reduction devices have focused on fishers' perceptions (Jenkins, 2006; Barz *et al.*, 2020; Calderwood *et al.*, 2021; Steins *et al.*, 2022), our study focused on the perceptions of change agents, who have not been well-studied. Given the critical role that change agents often fulfill as the architects and implementors of fisheries change initiatives, it is vital to understand what views are shaping their approach in promoting the adoption of proven fishing gears by fishers.

Theoretical framework

Change readiness is the extent to which an individual, group, or organization is cognitively and emotionally inclined to accept, embrace, and adopt a plan for deliberate change (Holt *et al.*, 2007; Rafferty *et al.*, 2013). Two primary components that influence an individual's change readiness are cognitive and affective change readiness (Figure 1), defined respectively as a state of mental and emotional preparedness for change.

Cognitive change readiness includes an individual's belief that a proposed change is needed, for example, the mandatory introduction of a bycatch reduction device or other proven fishing gear. This belief is underpinned by a sense that the status quo is inappropriate or lacking (*discrepancy*) and the proposed change will improve outcomes (*appropriateness*). Cognitive change readiness also includes an individual's belief that capacity exists to achieve a proposed change. This capacity consists of the individual's perceived capability to implement the change (*efficacy*) and that it will provide them with improved outcomes or benefits (*valence*). Further, this capacity includes a perception that change agents will give them the necessary information and resources to support the proposed change and that they have support from their peers (*principal support*).

Affective change readiness reflects an individual's emotions, moods, and temperament in response to a proposed change, for example, concern, fear, and uncertainty (Figure 1, Rafferty *et al.*, 2013). Affect is known to have a critical influence on the change readiness of individuals (Kark Smollan, 2006; McKay *et al.*, 2013; Helfrich *et al.*, 2018), yet change agents and scholars of change have paid relatively little attention to an individual's emotional response to a proposed change (Rafferty *et al.*, 2013). This oversight is critical because emotions and attitudes lead to behaviours that influence outcomes. In a fisheries context, cognitive and affective change readiness can therefore be considered precursors to the cognitive and affective behaviours by fishers in association with their support or otherwise of a particular change initiative, such as the adoption of proven fishing gears. Examples of the application of this model in a fisheries context are available in Eayrs (2021, 2022).

Methods

This research aimed to identify and categorize circumstances and approaches that led to both the successful and unsuccessful introduction of change initiatives in fisheries, including bycatch reduction devices. We conducted this research at the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB) meeting in Nelson, New Zealand, in April 2017. The directive of the WGFTFB is to investigate all aspects of the design, planning, and testing of fishing gears, including selective fishing gears for bycatch and discard reduction. Typically, WGFTFB attendees are involved in research to improve fishing gear performance, including bycatch reduction, and many act as fisheries change agents through outreach efforts to facilitate the uptake of proven fishing gear. Thus, the attendees at the WGFTFB meeting provided a practical yet appropriate sample frame for this preliminary study.

To achieve our research objective, we collected oral history interviews from attendees of the WGFTFB meeting. During this meeting, we also gathered input from participants in a one-day WGFTFB workshop on change management in fisheries (facilitated by author Jenkins). Interview subjects and workshop participants included fisheries consultants, government personnel, fisheries representatives, university researchers, and non-profit organization staff resid-

ing in Australia, New Zealand, Denmark, Italy, The Netherlands, and the United States. As an ICES-FAO working group, WGFTFB does not usually include the participation of active commercial fishers, but some attendees are former fishers who now work in gear development. Several of the interviewees, including author Eayrs, are former commercial fishers, and many of the fisheries consultants who participated in this study work for the fishing industry. The perspectives of commercial fishing were therefore represented in this study.

The sampling frame was any attendee of the WGFTFB's meeting in 2017. We began with a purposive sample of attendees identified for the oral histories because of their experience with fisheries change initiatives, including efforts to reduce unwanted catches. We then solicited volunteers and conducted a snowball sample in which interviewees recommended other attendees to interview (Bernard and Ryan, 2010). We conducted 13 oral history interviews, which covered the following questions: (1) Tell us about a successful fisheries change initiative that you were involved with; (2) Why do you think this initiative was successful? (3) What do you believe could have made it more successful? (4) Over the course of your career, have you developed any tips, techniques, approaches, etc., that you believe contribute to successful change initiatives? If so, tell us about them; and (5) Is there anything else that you would like to share with us, or is there any question that you would have liked us to ask? Questions 2 and 3 were targeted to help assure that success would be covered as part of the oral history. With the consent of the interview subjects, we took notes and audio recorded the interviews, which were later fully transcribed. We analysed the transcripts using a grounded theory approach to text analysis to develop themes (Corbin and Strauss, 2014). Grounded theory applies inductive reasoning through an iterative coding process, grouping related codes to yield concepts, and further high-order grouping of concepts to produce theories or themes. In the interviews, 11 of the 13 interviewees referred to fisheries change initiatives that focused on improving gear selectivity and reducing discards or bycatch. Many of these initiatives were attempts to improve compliance with mandated fishing gears. There was much uniformity in the beliefs of interviews, with most interviewees offering statements that contributed to each of the themes presented in the "Results" section.

The workshop included ten participants, of which five participants also gave oral history interviews. On individual post-it notes, each participant listed responses to two questions: (1) Based on your experiences, what are circumstances and approaches that led to the successful introduction of change initiatives in fisheries? (2) Based on your experiences, what are circumstances and approaches that led to the unsuccessful introduction of change initiatives in fisheries? To represent the ideas of interview subjects who could not participate in the workshop, the facilitator supplemented these responses with preliminary themes that arose from notes taken during the collection of oral histories. The preliminary themes resulted from a preliminary analysis, which consisted of deep reading and constant comparison, that author Jenkins conducted during the WGFTFB meeting. The participants then conducted a consensus process in small groups using an iterative pile sorting exercise (Bernard and Ryan, 2010) to create thematic groupings from the responses. The workshop participants then engaged in a consensus process of whole group discussion, small break-out groups, and a report-out session to explicitly identify the logic behind each thematic grouping,

further develop the theme, and categorize and label the themes more specifically. Authors Eayrs and Pol compiled the outputs of the workshop into a PowerPoint presentation and report (Eayrs and Pol, 2017) that we then further analysed to yield the results described below. The consensus themes from the workshop were validated, which is a step in grounded theory analysis, by being reported to, questioned by, and accepted by the WGFTFB in 2017 through its report acceptance process conducted for all WGFTFB activities.

Results

Interview results

Based on the interviews and workshop, we identified six themes (Box 1); five of them focus on best practices (BP) for successful change initiatives in fisheries.

Box 1: Themes:

1. Definitions of success varied in change initiatives.
2. Engage diverse, motivated, stakeholders in the initiative, in addition to fishers.
3. Identify and articulate clear benefits to the fishers.
4. Communicate with fishers early and throughout the initiative, particularly through face-to-face interactions and videos.
5. Demonstrate positive change agent qualities.
6. Execute an appropriate and well-timed project.

Definitions of success varied in change initiatives

Many interviewees considered a change initiative successful if a fishing gear is proven by passing trials (i.e., achieved research project goals), there was the adoption of it by at least some of the fishing fleet, or there were high levels of bycatch reduction. There was a range of responses on how much of the fleet had to implement the change to be considered a success. For example, one interviewee said, "I've got an 80/20 rule: get 80 percent of the people over the line, reduce bycatch by 80 percent... So, I don't strive for the perfect world." Another interviewee also acknowledged that:

"...being 100 percent successful is something I'm not sure I've ever actually really achieved...you might get partial adoption of new gear...but there will be a lot of other people that aren't making that change. And so, do you consider that a success? Well, on the one hand yes, on the other hand, not quite."

Most interviewees did not include measurable goals in their definitions of success. Instead, nearly all interviewees focused on how engagement with fishers is a crucial part of the process to achieve success, no matter how success is defined.

Engage diverse, motivated stakeholders in the initiative, in addition to fishers (BP)

Many interviewees highlighted that successful change initiatives involved the close engagement of fishers motivated to implement the change. According to one interviewee, engagement generates a feeling of fishers' ownership over the process and reduces their resistance to the change.

Interviewees also perceived the importance of members of the fishing industry playing the roles of "champions", "inno-

vators”, or “evangelists” who lead the adoption of the change. These fishers are typically the first to try the gear and demonstrate what benefits the gear can provide to other fishers.

A strategic, proactive business environment on the part of the fishing fleet, for example, support from the corporate level, is also an essential characteristic of successful change initiatives. Interviewees stated that this top-down support for change clears the way for fishers to implement the change. This support may also include financial resources to aid fishers in implementing the proposed change.

Interviewees highlighted a need for involvement by other stakeholder groups in the change initiative, including designers and builders of fishing gear, fishery managers, NGO representatives, government officials, other researchers, and ministry/agency representatives. They discussed the value of starting this engagement at the onset or early in the change initiative process. They reported that the involvement of other stakeholder groups increases buy-in and allows for more creativity in the initiative’s project-design process, including the actual design of the gear. Other factors that workshop participants perceived as significant were a customer-driven focus from researchers towards fishers and social license (i.e. the level of approval from the community for an enterprise, such as a fishery, to operate) for change agents and stakeholders to conduct their work.

Many interviewees commented on the importance of having a mechanism that incorporates all stakeholders’ feedback on the outcomes of the change initiative and for reporting these findings back to the stakeholders. They perceived that this feedback mechanism was crucial for effective engagement with the stakeholders. It is particularly important to incorporate the feedback of fishers on how gear could be designed or modified, how it functions in trials, and then update the fishers and other stakeholders on progress. This feedback keeps everyone invested in the trial and implementation process. One interviewee described this process as “closing the loop”:

“You need to get the solution that’s being developed...to the people who had the problem in the first place. And you need to advertise it and get it back into the mindsets of the people who develop the solution the first place.”

Interviewees also noted the importance of testing with commercial fishing gear on commercial fishing vessels.

When asked what could have made a change initiative they were involved in more successful, several interviewees regretted not involving a larger diversity of stakeholders, specifically NGOs, and that engagement with the stakeholders should have occurred earlier in the process. Stakeholder engagement, particularly with fishers, led many interviewees to describe fisheries change initiatives as a “long game”. Interviewees stressed that it is important to be patient and persistent because those overseeing the change initiative “often underestimate how much time is needed for a change”. Original deadlines for change initiatives can sometimes be just months. Still, interviewees noted that the change process could take years, offering examples ranging from 4 to 7 years.

Identify and articulate clear benefits to the fishers (BP)

Many interviewees stressed that the change initiative should try to benefit fishers, such as increasing their efficiency or catch rate or reducing costs, and that the benefit should be commu-

nicated to fishers. Rather than an altruistic one (e.g. helping the environment or common good), this economic driver was perceived as a stronger incentive for fishers to implement a proposed change. Fear of economic loss acts as a strong incentive to change, as described by one interviewee:

“The quota owners were concerned about the value of their quota, so it was an economic driver, not an altruistic removal of sea lions [as a] driver...it was a “we’re gonna lose, we’ve got x million dollars’ worth of squid quota, and we’re gonna have no access to it because we can’t stop catching sea lions.”

Overall, most interviewees viewed financial incentives (e.g. paying fishers a subsidy for gear adoption, offering free trials of new gear, and rebates for gear purchase) as a possible strategy to adopt new gear. They noted, however, that fishers did not view such incentives as important as the fear of catch loss or increased fishing costs. Interviewees thought that cash incentives and rebates could be helpful but need to be high enough while not attracting non-genuine engagement by fishers, such as those motivated only by the incentive and thus may misuse the gear or stop using the gear after a short time.

Communicate with fishers early on and throughout the initiative, particularly through face-to-face interactions and videos (BP)

Interviewees and workshop participants perceived early communication with fishers about the change initiative (i.e. why it is needed and what it involves) as a vital step. The change agent should develop a communication strategy that showcases progress and success. This communication can occur via various means such as in-person, social media, websites, letters, and reports. They perceived face-to-face communication and videos as particularly valuable in garnering support for the initiative and conducting outreach to raise awareness and share results and outcomes. As stated by one interviewee:

“Turning science into something that makes sense... You can have all the science in the world, but a video of only three squids swimming out of a hole, that’s the only image we gave them [and all that was needed]. Just good images they can latch onto. So, actually tailoring any data you collected for each of the audiences.”

The language used to communicate should be plain, easily understood without jargon, appropriate, and empathetic. One interviewee described the need to know how to “talk to industry”, “be empathetic”, and “be a good people person” to relate to the fishers at their level and “come across a lot, a lot better”.

In addition, communication should be persistent because repetition is important to ensure that fishers receive, understand, and retain the message. The communication strategy should raise awareness by including a blend of engagement options, such as port visits, sea trials on commercial vessels, communication feedback loops between the change agent and fishers, and follow-up to enquiries.

Demonstrate positive change agent qualities (BP)

Workshop participants agreed that the qualities of the change agent played an important role in successful change initiatives. These qualities included respect, care, and concern for change recipients and persistence, active participation, expe-

rience, and credibility. Achieving respect and demonstrating care and concern for fishers and their circumstances requires the facilitator to have substantial experience in the fishery. Ideally, they should have engaged in the fishery for a long time and have spent time on the water getting to know fishers, their fishery, and related issues and concerns. This interaction fosters closer engagement with fishers and helps build empathy and trust. Stakeholders need to consider the change agent to be credible. This credibility is supported by a perception of honesty and demonstration of the qualities listed above. Active participation by the change agent shows a high level of motivation and commitment in achieving a successful outcome. The change agent needs to be a highly personable spokesperson, have strong leadership skills, and can find opportunities and overcome threats. Change agents can achieve these capacities through education and being empowered.

Execute an appropriate and well-timed project (BP)

The execution of a successful change initiative requires considerable preparation, the accomplishment of appropriate tests and trials, measurement of effects, and follow-up. Workshop participants deemed the timing of change initiatives vital because of its relationship with planning. Engaging early with stakeholders helps change agents to prepare accordingly. Planning needs to be tactical, strategic, and focused on outputs and outcomes, including results, extension, and adoption of the change. Preparation includes clear identification of the roles of participating individuals, information requirements and flows, and alignment of expectations by all participants. This preparation is followed by tests and trials, usually by placing scientists and data collectors on commercial fishing vessels, and providing appropriate incentives to engage fishers. Subsequently, measuring the project's effects requires using appropriate metrics and clearly identified measuring practices and protocols. Finally, workshop participants deemed that follow-up activity is essential, especially to seek validation from fishers or others that the initiative is having the desired impact, collect feedback on performance and improvements, maintain a channel of communication, sustain interest, and plan for further implementation.

Discussion

A goal of this paper was to identify BPs in facilitating change in the commercial fishing industry based on the collective experience and wisdom of fisheries change agents from around the world. In this way, we hoped to identify critical components applied across multiple fisheries that have resulted in a successful change initiative, particularly the successful adoption of bycatch reduction devices or other proven fishing gear. The interview and workshop analyses yielded six themes. The consistency of statements that contributed to these themes across research participants suggests that these themes are widely held beliefs in the community of fisheries change agents. Five of the themes spoke to what fisheries change agents perceive as BPs for success in fisheries change initiatives. The remaining theme (definitions of success varied in change initiatives) lends itself to a recommendation for clear metrics of success, which we discuss more below. This recommendation is not yet widely implemented nor did the

research participants explicitly suggest it, so is not included as a current BP.

The interviewees and workshop participants did not view any one theme on its own as a sufficient condition to bring about change in fisheries. The interviewees all mentioned several practices that contributed to the various best-practice themes, and the workshop participants constructed a schematic (Eayrs and Pol, 2019) that showed how all the workshop themes interacted with each other. Thus, all the interviewees and workshop participants drew on an assortment of practices, indicating that they did not believe that there is a single practice that could bring about fisheries change on its own.

BPs to facilitate change and challenges to implementation

Despite the deep thought and knowledge that the interviewees brought to this effort and the commonality among their experiences, the five BPs themes (Box 1) identified in this study are not new ideas and instead are already well-established. For example, Broadhurst *et al.* (1996) and Hall *et al.* (2007) reported that fisher cooperation and involvement were necessary because of their deep knowledge of fishing, ability to identify practical solutions, act as champions of change, and facilitate acceptance of research outcomes by other fishers. In another example, all 182 projects reviewed by Eayrs and Pol (2019) included a description of efforts to regularly communicate research outcomes to fishers, the majority doing so through presentations at industry meetings, articles in industry literature, and project reports.

In the past, no combination of these themes has consistently led to the adoption of research outcomes by fishers (Jenkins, 2006; Eayrs and Pol, 2019). Many experienced fisheries change agents cannot describe ways that repeatedly resulted in fishers changing their behaviour, even when fishers were engaged in the research and had economic or other benefits (Eayrs and Pol, 2019). The fisheries change agents who participated in this study also described and used the same basic roadmap, yet still admitted to the challenges associated with facilitating change.

Why are change agents still widely using this same roadmap despite an apparent lack of consistent success? In the absence of empirical studies to answer this question, we posit several core reasons that may contribute to this outcome:

- (1) *Fisheries change agents are often financially constrained in their ability to inspire change as a research outcome.* The involvement of these individuals in any change initiative, to test a bycatch reduction device or other fishing gear, relies upon project funding to sufficiently capture the costs of their engagement. Frequently, however, such projects do not pan out as expected, given their exploratory and risky nature. Fieldwork or other costs are also often higher than anticipated. With a finite budget, overspending compromises the ability of change agents to inspire change because less funding remains for planned extension activity (Eayrs and Pol, 2019). Then, once the project concludes, funding is usually not available for these agents to continue extension activity, thus momentum is lost and any fishers that were engaged in the research are left to continue this activity alone. Funding also limits

the ability to employ social scientists or other specialists with skills and knowledge of extension BPs.

- (2) *Fisheries change agents often do not have the proper training to inspire change.* Fisheries change has traditionally been conducted more as a practice than a discipline. Fisheries change agents may usually be, as is the case in our study, gear researchers by training and as their primary professional role, with little or no knowledge or training in change management and influencing behavioural change in humans. Their attempts to bring about change are thus primarily *ad hoc* and frequently rely on one or more methods of commonly applied knowledge transfer, such as face-to-face meetings, industry workshops, and videos. Further, they are typically based on an implicit assumption that fishers are equally ready to change and that provision of factual evidence alone will lead them to adopt research outcomes (Eayrs and Pol, 2019).
- (3) *The outcome of project extension activity is often not documented or evaluated.* Fisheries change agents are seldom held accountable for the efficacy of project extension activities, as long as they report achievement of project outputs as described in the research proposal (Eayrs and Pol, 2019). While many such agents work hard to extend project outputs to fishers (and others), the academic ethos of “publish or perish” constrains others such that the adoption of research outcomes by fishers may not be considered essential. Employers may also not require some change agents to engage in extension activity. So, these change agents only do so because it is a requirement of the funding body. In addition, others simply do not perceive it to be an activity that requires or merits their involvement.

Funders also often appear less interested in achieving outcomes than in the delivery of project outputs, and they seldom require supporting evidence of such outcomes. We define project outputs as activities and products that inform fishers of project findings, results, and achievements. Outcomes are the developments and achievements that stem from knowledge of project outputs. The outputs of project extension activity are easily measured and include the number of industry meetings attended, videos produced, or the number of fishers contacted. Funding bodies often focus on such outputs to evaluate project success and the performance of the change agent. Such a focus is a poor metric of project outcomes, and it also risks limiting support for future activity, particularly if the response by fishers to project outputs is negligible, non-existent, or unknown. It also means the efficacy of extension activity is not measured or evaluated, which perhaps explains why change agents repeatedly apply the same extension activities despite their limited success.

Metrics to measure the outcomes of extension activity, such as the adoption rate of a new bycatch reduction device, are poorly defined and inconsistent. In our study, the interviewees' measures of success were inconsistent with each other's. Most implied, overtly or otherwise, that adoption of research outcomes by the entire fleet was an unrealistic measure of success unless enforced by regulation. Most accepted that some fishers are highly reluctant to change, while others are less so. Only one individual provided a numerical target to evaluate success. The rest were seemingly satisfied if a handful of fishers changed behaviour or retroactively defined success based

on the most favorable outcomes from the initiatives, such as a better relationship with fishers. Without a clearer definition or expectation, measuring the success of a change initiative is difficult (Barz *et al.*, 2020).

Assuming that these four hypotheses are largely correct, we recommend a theory (change readiness), extension practices, and evaluation approaches that could help address these deficits, which we discuss further below.

Change readiness

None of the study participants mentioned their deliberate consideration of fishers' cognitive or affective readiness to change before commencing a bycatch reduction or other change initiative. Neither did they take deliberate steps to evaluate fishers' readiness to change, despite such initiatives involving their close collaboration with fishers. No evidence demonstrating an evaluation of change readiness in the commercial fishing industry has been found in the salient literature, either as part of efforts to introduce bycatch reduction devices or any other change affecting commercial fishers.

Research into change management from other fields indicates that consideration of change readiness provides deeper insight into the change process and areas for improvement in change initiatives in fisheries. The cognitive component of the Rafferty *et al.* (2013) model appears to capture most of the typical approaches of fisheries change agents engaged in bycatch reduction. For example, by sharing their research findings, fisheries change agents build knowledge and understanding in fishers (and others) to increase their cognitive awareness, and thus, their change readiness (Figure 1). Change agents that communicate a justification or rationale for their research are building an awareness of a need to change (*discrepancy*), while sharing descriptions of a bycatch reduction device and its performance can be considered an attempt to convince fishers that their adoption is a necessary course of action (*appropriate*). This information serves to inform fishers and hopefully persuade them that they can install and use these devices (*efficacy*), and it helps their consideration of the potential benefits and costs to their fishing operation (*valence*). It also informs fishery managers, fishing company managers, peers, and others who can contribute knowledgeably and support efforts by fishers to adopt these devices (*principal support*). Importantly, consideration of change readiness helps identify where and why readiness is lacking. Such knowledge is important because it can be leveraged to guide improved, focused outreach activity.

Extension programmes may elicit affective responses in fishers to a greater or lesser extent (Jenkins, 2015). Still, we know of no deliberate attempts by fisheries change agents to evaluate the affective change readiness of fishers to bycatch or any other change initiative. The workshop results support this claim. Discussion around ownership of a change initiative and motivation of fishers was similarly devoid of affective elements, even though this theme is where, arguably, one would most expect to see a discussion of affective elements. Likewise, project execution only included appropriate methodologies to test and evaluate bycatch reduction devices, all designed to confirm that change is necessary (*appropriate*), and no consideration was given to the application of methods to affectively prepare fishers for change or evaluate their level of change readiness. Workshop participants described care, concern, and empathy for fishers as crucial qualities and attributes

of a change agent, as well as understanding the culture of the fisheries and an ability to build personal connections in the fisheries community. These are affective attributes of the agent and would be part of a skill set that would allow them to evaluate the level of affective change readiness. However, absent in these responses was the consideration of the affective readiness of fishers and resulting supportive actions to address any identified shortcomings in affective readiness. Thus, we found no evidence of fisheries change agents working to increase the affective readiness of fishers during any change initiative.

While this concept may have been overlooked in the past, there is growing evidence that emotions and affective change readiness are as important (Rafferty and Minbashian, 2019), if not more important, as cognitive change readiness (Lawton *et al.*, 2009). For example, the Elephant and the Rider allegory popularized by Heath and Heath (2010) posited that humans are driven primarily and unknowingly by difficult to control emotions rather than their rational selves. However, it remains unclear which emotions are essential in a specific change initiative or how they differ between initiatives, although several other well-known models of human behaviour imply fear and uncertainty. For example, prospect theory posits that human decision-making is based on evaluating risk, and that individuals “weigh up” their circumstances prior to making a judgement about the perceived outcome of a decision (Kahneman and Tversky, 1979). Fundamental to this theory is that humans value or fear loss more than they value a gain of equal magnitude and that a loss presents a relatively greater emotional impact. Similarly, the notion that individuals resist change due to fear of perceived outcomes is central to the concept of competing commitments by Kegan and Lacey (2011). A competing commitment occurs when an individual states support for a change initiative but inexplicably and sometimes unwittingly acts in ways that undermines the initiative. Competing commitments are a form of self-protection and barrier to change, and are supported by an individual’s “big assumptions”, which are deep-rooted beliefs about their and others’ roles and places in the world around them.

Overcoming “negative” emotions such as fear and uncertainty is clearly vital to improving affective readiness and realizing a successful change initiative. It is also likely that “positive” emotions play an important role in building support for change. For example, Rafferty and Minbashian (2019) suggest that joy, happiness, and exhilaration can unleash an almost unbridled enthusiasm to change, while intrigue, excitement, and wonder can drive a desire for action, to investigate, and participate in new experiences. By not considering the emotions of change recipients, either negative or positive, their emotions cannot be harnessed and leveraged to secure their willingness and commitment to change (Rafferty *et al.*, 2013). Unfortunately, we believe fisheries change agents have almost exclusively overlooked or ignored affective change readiness, and this oversight may help explain the lack of success in the uptake of bycatch reduction devices or other proven fishing gear by fishers.

Recommendations for future extension and evaluation

Our results re-emphasize that current practices, models, and perceptions of change are not achieving the desired ends in adopting bycatch reduction gears. Consequently, we contend

that a series of changes are needed to improve outcomes, and if implemented, they should be rigorously evaluated. These recommendations, which are discussed below, are often overlooked measures that could profoundly impact levels of adoption and the structure of adoption programmes. We acknowledge that these proposed measures may still be insufficient to achieve consistent adoption, but implementing and evaluating these measures will reveal what other steps are needed to solve the adoption puzzle.

In order to facilitate a future study of success factors for fisheries change practices, fisheries change agents (gear researchers themselves or those responsible for extension) must consider the readiness of fishers for change, preferably using the model by Rafferty *et al.* (2013). This model requires change agents to ask fishers multiple questions regarding their readiness to change, an obvious but seldom applied approach by change agents. It also serves to categorize fishers’ responses so that extension programmes can be adapted and tailored to inform and address their concerns and improve the likelihood of successful uptake of proven fishing gear.

Change agents must also set well-defined and measurable metrics of success. These metrics should not focus on outputs (e.g. research reports) but instead should focus on outcomes (i.e. actual improvements in the target problem), such as a quantified reduction in bycatch or adoption of a new bycatch reduction device by a certain percentage of fishers. Our results show that in the absence of a clear definition, participants commonly define success into more readily achievable or already-achieved outputs. Thus, the current funding and research should require the quantification and measurement of adoption and encourage success to be defined in these terms. Change initiatives also must consistently conduct formal evaluations that track these metrics of success. We recognize that these recommendations require more funding that is often unavailable. Still, the poor track record of initiatives justifies advocating for funding to evaluate future initiatives.

Most fisheries change agents have a primary role as gear researchers and do not have the training needed to improve adoption. Generally, they lack awareness that outreach is a discipline itself, that there already exist papers on adoption by fishers, or even that change management is a current and developing field with its own journals, conferences, and knowledge base. Opportunities to increase adoption or progress in the field are lost because of this lack of awareness of relevant knowledge from other disciplines. It is time to modernize the training of fisheries change agents to recognize that fisheries issues are interdisciplinary problems and require interdisciplinary knowledge and expertise, including an understanding of human behaviour and decision-making. These change agents should be incentivized and supported to learn this knowledge, and funding organizations should provide training. Interdisciplinary collaborations are another avenue through which needed expertise can be brought to bear (Macher *et al.*, 2021), although it is vital to consider affective elements in such fisheries collaborations (Jenkins, 2015).

Funding bodies must also modernize and recognize the importance of focusing on the outcomes of bycatch reduction research. A traditional focus by them on more readily attainable outputs, such as completion of bycatch research and associated report, is inadequate and limiting. Such outputs serve only to satisfy funders that change agents have achieved a body of work. While such work is a necessary foundation, it

does little in the absence of extension activity to inform and, if appropriate, inspire the voluntary uptake of new gear.

One could argue that the solution to the issue of limited adoption is to always rely on mandatory implementation of bycatch reduction practices through legislation. Mandates might be perceived to avoid the complexity of human behaviour and reaction to change, including affective readiness, prospect theory, and competing commitments. However, studies show that engagement and participation of fishers are important for ensuring compliance even when a gear is mandated (Jenkins, 2006). Notably, the lessons learned from the successes described by study participants were derived primarily from attempts to improve compliance with mandated fishing gears. Whether a fishing gear is voluntary or not, overlooking or ignoring the complexity of human behaviour could result in high levels of non-compliance and wasted time and effort on poor extension programmes. Future research can deepen and expand how human behaviour is incorporated into fisheries change efforts by investigating the thoughts and beliefs of fishers on these topics.

Conclusions

The interview and workshop analyses yielded six themes (Box 1), five of which spoke to what fisheries change agents perceive as BPs for success in fisheries change initiatives. We found that definitions of “success” varied between change initiatives. We found widespread agreement that BPs include fishers being involved in a change initiative from the beginning to help inform, guide, and drive the initiative (BP2). We found regular communication with fishers to also be vital (BP4), including information that describes the economic or other benefits of adopting the outcomes of the initiative (BP3). For similar reasons, the engagement of other stakeholders in all stages of the research was also necessary (BP2). Other essential factors include promoting ownership and motivation, proper project execution, attention to project timing (BP6), and facilitator qualities, including affective elements such as empathy towards fishers (BP5).

The five BP themes identified in this study are not new ideas but rather are well-established and typically applied to some degree in fisheries change initiatives. No combination of these themes, however, consistently leads to or guarantees adoption. We hypothesized that this lack of success is partly due to fisheries change agents being financially constrained and not having the proper training to inspire change. There is also a lack of consideration, measurement, and documentation of the outcomes from extension activities.

We recommend that fisheries extension builds beyond the widely known and used “best” practices to involve a suite of techniques developed from understanding fisher behaviour and motivation. The theory of change readiness holds great promise and is not yet being applied for fisheries extension. We recommend broader consideration of this theory and its application, mainly as it draws attention to where a readiness to change is lacking, including affective elements. Only then will we better understand its utility and relevance for inspiring change in the fishing industry; until then, it awaits further testing and evaluation.

Typical extension programmes already unknowingly address some components of cognitive change readiness, but these efforts should be more intentional and systemic to develop cognitive change readiness fully. Extension programmes

have also not yet taken steps to develop affective change readiness among fishers, even though change management research shows that emotions play a vital role in the uptake of new ideas and changes. Thus, change agents need to be supported for capacity-building in change management and change readiness, especially affective change readiness. This would require a renewed commitment by funders, scientists, and institutions to fisheries change and encouraging closer engagement with experts in human behaviour. This exploration of a new approach must also include better evaluation practices. Change agents should consistently compose extension plans, set success metrics, and evaluate outcomes from a change initiative. Monitoring and evaluation will give the field of fisheries extension much-needed data to determine which of the currently accepted BPs and promising new practices, such as around change readiness, are necessary and contribute to change and in what context.

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References

- Barz, F., Eckardt, J., Meyer, S., Kraak, S. B. M., and Strehlow, H. V. 2020. ‘Boats don’t fish, people do’—how fishers’ agency can inform fisheries-management on bycatch mitigation of marine mammals and sea birds. *Marine Policy*, 122: 104268.
- Bernard, H. R., and Ryan, G. W. 2010. *Analyzing Qualitative Data: Systematic Approaches*. Sage Publications, Inc., Thousand Oaks, CA. 451pp.
- Boopendranath, M. R. 2010. Bycatch reduction technologies. *In* Coastal fishery resources of India: conservation and sustainable utilisation. Ed. by B. Meenakumari and Society of Fisheries Technologists (India). Society of Fisheries Technologists, Cochin, pp. 269–295.
- Broadhurst, M. K., Kennelly, S. J., and Isaksen, B. 1996. Assessments of modified codends that reduce the by-catch of fish in two estuarine prawn-trawl fisheries in New South Wales. *Fisheries Research*, 27: 89–111.
- Broadhurst, M. K. 2000. Modifications to reduce bycatch in prawn trawls: A review and framework for development. *In* *Reviews in Fish Biology and Fisheries*, 10, pp. 27–60, doi: 10.1023/A:1008936820089.
- Calderwood, J., Pedreschi, D., and Reid, D. G. 2021. Technical and tactical measures to reduce unwanted catches in mixed fisheries: do the opinions of Irish fishers align with management advice? *Marine Policy*, 123: 104290.
- Corbin, J., and Strauss, A. 2014. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Sage Publications, Inc, Thousand Oaks, CA: SAGE.

- Cox, T. M., Lewison, R. L., Źydelis, R., Crowder, L. B., Safina, C., and Read, A. J. 2007. Comparing effectiveness of experimental and implemented bycatch reduction measures: the ideal and the real. *Conservation Biology*, 21: 1155–1164.
- Eayrs, S., Cadrin, S. X., and Glass, C. W. 2015. Managing change in fisheries: a missing key to fishery-dependent data collection? *ICES Journal of Marine Science*, 72: 1152–1158.
- Eayrs, S., and Pol, M. 2017. Interim Report of the ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICES Document CM 2017/SSGIEOM: 13. 194pp.
- Eayrs, S., and Pol, M. 2019. The myth of voluntary uptake of proven fishing gear: investigations into the challenges inspiring change in fisheries. *ICES Journal of Marine Science*, 76: 392–401.
- Eayrs, S., and Fuentevilla, C. 2021. Advances and best practices in bycatch reduction in tropical shrimp-trawl fisheries. FAO Fisheries and Aquaculture Technical Paper. FAO, Rome. 142pp.
- Eayrs, S. 2021. Progress in bycatch reduction in trawl fisheries: are the findings, outcomes, and recommendations from FRDC funded bycatch reduction projects acted upon? Project No. 2019/082. Fisheries Research and Development Corporation, Canberra.
- Eayrs, S. 2022. A road-map to change: application of a comprehensive change management model to guide and inspire fishers to reduce bycatch. *ICES Journal of Marine Science*, doi: 10.1093/icesjms/fsac085.
- Gilman, E., Chaloupka, M., Bach, P., Fennell, H., Hall, M., Musyl, M., Piovano, S. *et al.* 2020. Effect of pelagic longline bait type on species selectivity: a global synthesis of evidence. *Reviews in Fish Biology and Fisheries*, 30: 535–551.
- Hall, M. A., Nakano, H., Clarke, S., Thomas, S., Molloy, J., Peckham, S. H., Laudino-Santillán, J. *et al.* 2007. Working with fishers to reduce by-catches. In *By-catch Reduction in the World's Fisheries*, pp. 235–288. Ed. by S. J. Kennelly Springer, Dordrecht. http://link.springer.com/10.1007/978-1-4020-6078-6_8 (Accessed 10 August 2021).
- Heath, C., and Heath, D. 2010. *Switch: How to Change Things When Change is Hard*. Broadway Books, New York.
- Helfrich, C. D., Kohn, M. J., Stapleton, A., Allen, C. L., Hammerback, K. E., Chan, K. C. G., Parrish, A. T. *et al.* 2018. Readiness to change over time: change commitment and change efficacy in a workplace health-promotion trial. *Frontiers in Public Health*, 6: 110.
- Holt, D. T., Armenakis, A. A., Harris, S. G., and Feild, H. S. 2007. Toward a comprehensive definition of readiness for change: a review of research and instrumentation. In *Research in Organizational Change and Development*, pp. 289–336. Ed. by W. A. Pasmore and R. W. Woodman Emerald Group Publishing Limited. Bingley, [https://doi.org/10.1016/S0897-3016\(06\)16009-7](https://doi.org/10.1016/S0897-3016(06)16009-7) (Accessed 2 November 2021).
- ICES. 2015. Second Interim Report of ICES-FAO Working Group on Fishing Technology and Fish Behaviour (WGFTFB). ICES Document CM 2015/SSGIEOM: 22. 183pp. <https://www.ices.dk/sites/pub/PublicationReports/Forms/DispForm.aspx?ID=38196>, (Accessed 27 January 2022).
- ICES. 2019. Working group on fishing technology and fish behaviour (WGFTFB). *ICES Scientific Reports*, 1: 363–363.
- Jenkins, L. D. 2006. *The Invention and Adoption of Conservation Technology to Successfully Reduce Bycatch of Protected Marine Species*. Duke University, Durham, NC.
- Jenkins, L. D. 2015. From conflict to collaboration: the role of expertise in fisheries management. *Ocean and Coastal Management*, 103: 123–133.
- Johnson, T. R., and van Densen, W. L. T. 2007. Benefits and organization of cooperative research for fisheries management. *ICES Journal of Marine Science*, 64: 834–840.
- Johnson, T. R. 2010. Cooperative research and knowledge flow in the marine commons : lessons from the Northeast United States. *International Journal of the Commons*, 4: 251–272.
- Jordan, L. K., Mandelman, J. W., McComb, D. M., Fordham, S. V., Carlson, J. K., and Werner, T. B. 2013. Linking sensory biology and fisheries bycatch reduction in elasmobranch fishes: a review with new directions for research. *Conservation Physiology*, 1: cot002–cot002.
- Kahneman, D., and Tversky, A. 1979. Prospect theory: an analysis of decision under risk. *Econometrica*, 47: 263–291.
- Kark Smollan, R. 2006. Minds, hearts and deeds: cognitive, affective and behavioural responses to change. *Journal of Change Management*, 6: 143–158.
- Kegan, R., and Lahey, L. L. 2011. The Real Reason People Won't Change. In *HBR's 10 Must Reads on Change Management*. pp. 119–136. Harvard Business School Publishing Corporation, Cambridge, MA.
- Kennelly, S. J. 2007. *By-Catch Reduction in the World's Fisheries. Methods and Technologies in Fish Biology and Fisheries*. Springer, Dordrecht.
- Kennelly, S. J., and Broadhurst, M. K. 2021. A review of bycatch reduction in demersal fish trawls. *Reviews in Fish Biology and Fisheries*, 31, 289–318.
- Lawton, R., Conner, M., and McEachan, R. 2009. Desire or reason: predicting health behaviors from affective and cognitive attitudes. *Health Psychology*, 28: 56–65.
- Macher, C., Steins, N. A., Ballesteros, M., Kraan, M., Frangoudes, K., Bailly, D., Bertignac, M. *et al.* 2021. Towards transdisciplinary decision-support processes in fisheries: experiences and recommendations from a multidisciplinary collective of researchers. *Aquatic Living Resources*, 13, 34. <https://doi.org/10.1051/alr/2021010>.
- McKay, K., Kuntz, J. R. C., and Näswall, K. 2013. The effect of affective commitment, communication and participation on resistance to change: The Role of Change Readiness, 42: 12.
- Rafferty, A. E., Jimmieson, N. L., and Armenakis, A. A. 2013. Change readiness: a multilevel review. *Journal of Management*, 39: 110–135.
- Rafferty, A. E., and Minbashian, A. 2019. Cognitive beliefs and positive emotions about change: relationships with employee change readiness and change-supportive behaviors. *Human Relations*, 72: 1623–1650.
- Steins, N. A., Mattens, A. L., and Kraan, M. 2022. Being able is not necessarily being willing: governance implications of social, policy, and science-related factors influencing uptake of selective gear. *ICES Journal of Marine Science*. <https://doi.org/10.1093/icesjms/fsac016>.
- Swimmer, Y., Zollett, E., and Gutierrez, A. 2020. Bycatch mitigation of protected and threatened species in tuna purse seine and longline fisheries. *Endangered Species Research*, 43: 517–542.
- Thompson, K. R., Heyman, W. D., Peckham, S. H., and Jenkins, L. D. 2017. Key characteristics of successful fisheries learning exchanges. *Marine Policy*, 77: 205–213.
- Walsh, S. J. S. J., Engås, A., Ferro, R. S. T., Fonteyne, R., and van Marlen, B. 2000. Improving fishing technology to catch (or conserve) more fish: the evolution of the ICES fishing technology and fish behaviour working group during the past century. *ICES Marine Science Symposium*, 215: 493–503.
- Watson, J. 2007. Reconciling fisheries with conservation through programs to develop improved fishing technologies in the United States. In *By-Catch Reduction in the World's Fisheries*, pp. 23–36. Ed. by S. J. Kennelly Springer Netherlands, Dordrecht. http://link.springer.com/10.1007/978-1-4020-6078-6_2. (Accessed 10 August 2021).
- Werner, T., Kraus, S., Read, A., and Zollett, E. 2006. Fishing techniques to reduce the bycatch of threatened marine animals. *Marine Technology Society Journal*, 40: 50–68.