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Differences in Information Use and Preferences Among Recreational Salmon Anglers: Implications for Management Initiatives to Promote Responsible Fishing

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British Columbia salmon fisheries are encouraging anglers' adoption of responsible and selective fishing methods to avoid or live-release vulnerable non-target species. Promoting adoption of responsible fishing will require that managers understand angler motivations and fishing behavior. During interviews with Fraser River recreational salmon anglers, we found that their most common information channel on responsible fishing was the Internet and interpersonal interaction while fishing. These did not necessarily align with their preferred information sources. Latent-class cluster analysis identified three patterns of anglers' current and preferred information sourcing. We found traditional (35% of sample), investigative (33%), and networking (32%) anglers, who were differentiated by their preferences for obtaining information via in-person communication, regulation handbooks, media, and the Internet. Heterogeneous communication preferences imply that fisheries managers need a mix of outreach approaches to effectively engage all anglers in responsible fishing practices, even when anglers are targeting the same species in a reasonably discrete geographic location.

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Introduction

Stakeholder engagement is critical for successful recreational fisheries management and conservation (e.g., Arlinghaus et al., 2007; Granek et al., 2008). Engaging an informed and knowledgeable community should ultimately lead to a more productive relationship between stakeholders and managers, and help increase stakeholder support for conservation and management efforts (e.g., Gray & Jordan, 2010; Li, Sutton, & Tynan, 2010). Engaging informed stakeholders, such as fishers, is relevant for fisheries around the world, especially those seeking to promote "responsible fishing." A "responsible fishery" is conducted to *benefit all the people involved in the fishery without causing unacceptable changes in fish populations and their ecosystems* (Plate, Bocking, English, & Rae, 2009, p. 3). Responsible fishing often includes fisher involvement with management initiatives such as catch-and-release fishing and special handling procedures that help ensure the survival of vulnerable stocks and species.

In the case of the Canadian salmon fishery in British Columbia (BC), a selective fishing approach is used to address mixed-stock harvesting that mandates fishers to avoid and release non-target species (e.g., undersized, juveniles, vulnerable stocks and species; Department of Fisheries and Oceans [DFO], 2001). Ensuring that those fish destined for release after capture are handled in a manner that minimizes injury, stress, and mortality requires consideration of fish physiology (Cooke & Suski, 2005; Cooke & Schramm, 2007) and angler behavior (e.g., fishing techniques and gear choice), both of which influence the biological outcomes of catch-and-release fishing. It is important for managers to understand, communicate, and take measures that encourage responsible fishing behavior that reduces stress and mortality for non-target species. An important first step is to understand where anglers engage with information about responsible fishing practices, and how information could be more effectively disseminated.

Some recreational angler typology studies have examined angler specialization (e.g., Fisher, 1997; Kyle, Norman, Jodice, Graefe, & Marsinko, 2007), or angler support for different types of fisheries management measures or policies (e.g., Arlinghaus & Mehner, 2003, 2005). None, to our knowledge, have examined angler typology based on communication preferences. Communication and awareness-building exercises that are meant to encourage responsible fishing practices may not lead to the desirable conservation outcomes if information dissemination is ineffective. We use the Lower Fraser River recreational salmon fishery as a case study to explore communication preferences by assessing different communication sources and channels associated with informing anglers about responsible fishing.

Methods

Between July 30 and August 26, 2010, we conducted semi-structured, face-to-face interviews with recreational anglers targeting sockeye (*Oncorhynchus nerka*) salmon in the Lower Fraser River. During 311 interviews completed at fishing sites and boat launches (as part of a broader study), we specifically asked open-ended questions regarding anglers' responsible fishing information sourcing and preferences in 71 of the interviews (see Table 1 for questions). Our focus was on anglers' current channels of information regarding

Table 1
Themes raised by respondents ($N = 68$) regarding current information channels and suggested distribution channels for responsible fishing information

Current information channels ("As of today, where would you go to find more information about appropriate handling and release techniques?")	Label	Frequency of responses (%)
Internet websites	Internet	55.4
Talking with other anglers on fishing sites	Other anglers	12.2
Tackle shops	Tackle shops	6.8
Printings (e.g., magazines, books, handouts)	Printings	6.8
Media (e.g., television, videos, radio)	Media	4.1
Fishing clubs	Fishing clubs	2.7
Other (mainly comprised of word-of-mouth from family and friends)	Other	12.2
Suggested information channels ("What is the best way for DFO to distribute this kind of information?")	**Label**	**Frequency of responses (%)**
Internet websites	Internet	12.3
Dedicate pages from regulation book for conservation and species identification	Regulation book	11.1
Media	Media	9.9
Leaflets and printings	Handouts and printings	8.6
Tackle shops (i.e., staff and bulletins)	Tackle shops	7.4
Educational seminars	Seminars	7.4
Mandatory tests to obtain license	Mandatory tests	6.2
Other (e.g., signs at boat launch and beaches, printed on fishing license, promotion through fishing clubs, and word-of-mouth)	Other	14.8

fish handling and release practices that may improve fish survival, and on the best way for the federal management agency, the Canadian DFO, to distribute information about responsible fishing practices.

To select the study sites, we used opportunistic sampling and visited fishing sites and boat launches primarily between the towns of Mission and Hope on the Lower Fraser River. On site, we approached every second angler along the river to ensure random sampling and avoid other anglers overhearing participants' responses. With angler consent, we audio-recorded responses, then subsequently transcribed and coded them following standard qualitative research protocol (e.g., Strauss, 1987; Creswell 2009). Responses were coded by the lead interviewer according to emergent themes based on keywords, phrases, and topics raised by anglers. Consistencies between codes (similar meanings or pointing to

a basic idea) revealed categories that identified current and suggested information sources and channels on how to better handle and release fish.

Emergent themes on anglers' current and suggested information sources were subsequently used as indicator variables in the latent class (LC) cluster analysis (Vermunt & Magidson, 2002) to characterize patterns of communication regarding responsible fishing practices. LC models can identify similar response patterns regarding information use and preferences within a sample by statistically analyzing a set of observed indicator variables (i.e., themes based on interview keywords, phrases, and topics). The methodology systematically separates sub-segments within which patterns of indicators are statistically similar and are a proxy for true underlying class membership (e.g., Morey, Thacher & Breffle 2006; Ward, Stedman, Luloff, Shortle, & Finley, 2008). Essentially the LC expectation-maximization (EM) algorithm matches the observed and expected frequencies of anglers' responses as closely as possible.

We used the Akaike Information Criterion (AIC) to inform model selection. The model with the number of latent classes which minimized AIC was chosen as the most parsimonious. We tested for redundancy between indicators using bivariate residual (BVR) statistics. Significant BVRs ($x^2 > 3.84$, $df = 1$, $p < .05$) signify local dependence, or direct relationships, between variables (Hagenaars, 1988) and functionally mean that two or more indicators provide redundant information for the clustering process. As such, we sequentially dropped indicators with the highest number of significant BVRs until all significant local interactions were eliminated. Latent Gold software (Vermunt & Magidson, 2005) was used to estimate all LC models.

After identifying latent classes that varied significantly in current and suggested communication patterns, we tested for significant attitudinal and demographic predictors of LC membership patterns (i.e., gender, age, ethnicity, education, occupation, income, fishing club membership, centrality of fishing to lifestyle, and management knowledge) with a series of Bonferroni-adjusted Chi-square tests (Magidson & Vermunt, 2005). "Centrality (i.e., importance) of fishing to lifestyle" was measured on a 5-point scale (1 = least important to 5 = most important) and perceived "management knowledge" was assessed on a 3-point scale (1 = not familiar to 3 = very familiar).

Results

Sixty-seven of 71 respondents provided useful data for our analysis. When asked where they currently obtain information about responsible fishing, respondents revealed information channels that fell into seven themes (Table 1). Respondents most frequently identified "Internet websites" (55%), "talking and asking others on fishing sites" (12%), and "other sources" (12%), which mainly comprised of word-of-mouth from family and friends as their sources of fishing information. When asked about where they would prefer to get their information, respondents identified information channels that fell into nine themes (Table 1). The most frequently suggested information channels were: "having officers and managers in person at the fishing sites" interacting with anglers (22%); via "the Internet" (12%), and "other sources" (15%) such as signs at boat launches and beaches, printing on fishing licenses, through fishing clubs, and via word-of-mouth.

In our model of angler communication preferences, the AIC was minimized with three classes. Anglers were differentiated based on their current and preferred communication channels (Figure 1), suggesting that in this small sample, three distinct classes to which all anglers in the sample belonged. Within each class, patterns of information use and preference were indistinguishable but, between classes, patterns were statistically distinct.

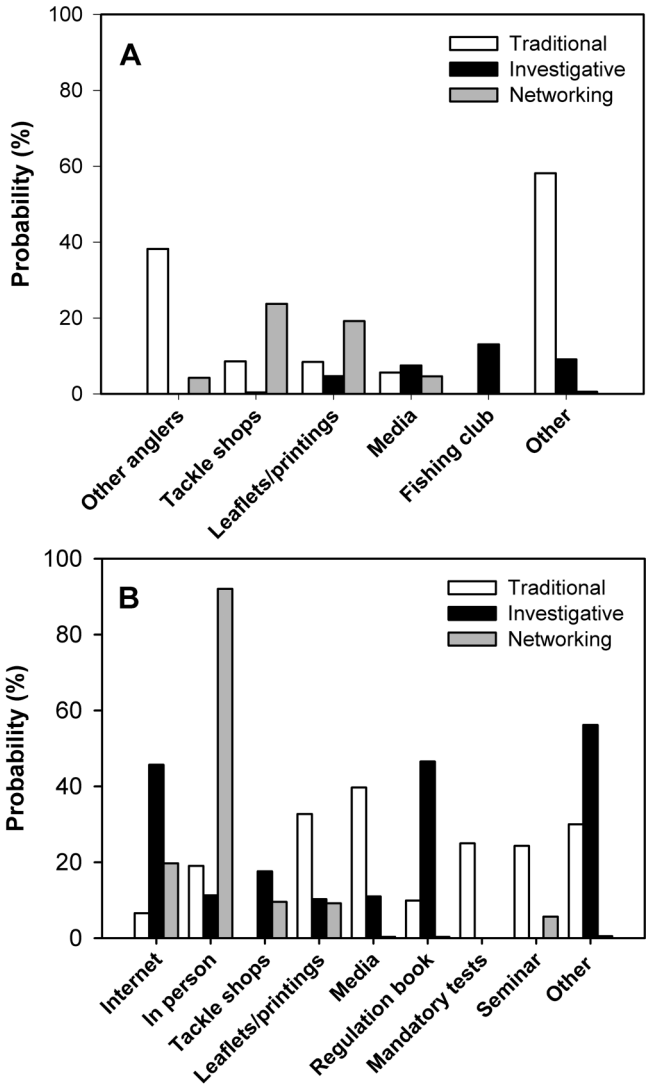

Figure 1. Latent-class membership profile for 3-class communication preference model: (A) current sources of responsible fishing information and (B) suggested distribution channels for information.

Only one indicator, Internet as current information channel, was dropped from the analysis because it provided redundant information. That is, the Internet did not play a role in differentiating patterns of current use of information channels among sample respondents.

Anglers in Class 1 (35% of the sample) most commonly received information via word-of-mouth at fishing sites, and via their social network, but did not often use the Internet. They preferred to receive responsible fishing information in a structured form (e.g., handouts) or in formal settings (e.g., seminars, as part of mandatory angler testing). We refer to respondents in this class as *traditional* anglers as they tended to prefer established methods of communication. Anglers in Class 2 comprised 33% of the sample. These *investigative* anglers preferred to obtain their information via the Internet or from a regulation book,

had diverse ideas regarding alternative communication channels, actively sought information, and tended to be active in the angling community (i.e., fishing club membership). *Networking* anglers (42% of the sample) in Class 3 relied largely on tackle shops and publications (e.g., leaflets) for current information and would strongly prefer to obtain information through interactions and networking with other people (e.g., anglers, fishery officers, DFO managers, fishing shop staff). Interestingly, a majority of respondents did not necessarily receive information about responsible fishing that they would like via their preferred channels or in their preferred forms (i.e., there are disparities between current and preferred information channels shown in Table 1). Although the Internet was most frequently identified as current information channel among participants, Internet access was not a preferred source of information for either *traditional* or *networking* anglers.

After identifying the three distinct communication patterns, we found no demographic predictors of LC membership patterns (i.e., gender, age, ethnicity, education, occupation, income, fishing club membership, centrality of fishing to lifestyle, and management knowledge). That is, for this relatively small sample, we distinguished three statistically distinct patterns of information use and communication preference but it was not possible to predict what class an individual angler belonged to based on demographic characteristics or self-reported attitudinal variables about respondents' management knowledge or the centrality of recreational fishing to their lifestyle.

Management Implications

Our relatively small sample size and the opportunistic sampling approach cannot be scaled up to provide inferences about the entire population of BC recreational salmon anglers. Nevertheless, our latent class approach did identify *differences* in anglers' information use and communication preferences. Even if the classes would differentiate on somewhat different lines with a much larger sample, we believe that the distinctiveness in communication preferences for these three groups would remain an important factor characterizing anglers in the fishery. The existence of the three classes identified in this study cannot be ignored, and should be of importance to fisheries management because the findings alert them of the need to customize methods of disseminating information about responsible fishing, and it highlights the importance of using different methods of communication for different types of anglers.

Gray and Jordan (2010) also observed diversity in marine recreational anglers in the United States with regards to their use of information about fishery management. They found anglers obtained information from fishery trade magazines (53% of sample), fishing shops (49%), online sources (40%), and informally through other anglers (33%). These roughly corresponded with our top communication channels (Table 1). Our results are also in relative agreement with findings from Cardona-Pons, Morales-Nin, and Sutton (2010), who found that most anglers in their sample heard about a tagging project through other anglers (57%), leaflets (46%), or information provided at fishing competitions (30%).

The *traditional* anglers in our survey obtained most of their information informally through other anglers at fishing sites and via their social network. While we cannot generalize and say that 35% of all Fraser River anglers belong to the *traditional* class, it is likely that a sizeable proportion of recreational anglers fall into that category. The identification of this *traditional* class has implication for fisheries managers as anglers in this class would likely not receive or benefit from online information. As one respondent stated, "We don't know much about computers, and they keep changing it daily—it's really confusing." In addition, information about fish handling found in regulatory guides of many

natural resource agencies are inconsistent with science-based best practices (Pelletier, Hanson, & Cooke, 2007). Given the many *traditional* anglers who rely on this source for information about responsible fishing practices, it is essential that the fish handling information is accurate in guides and on licenses. Furthermore, *traditional* anglers rely heavily on word-of-mouth communication with other anglers for information, as have anglers in other regions (e.g., Cardona-Pons et al., 2010). Another respondent said: "For the most part, when you fish on the River you get tips from guys around. You watch the guy next to you and so forth. It's word-of-mouth and there is good communication here." Communication via social networks and word-of-mouth could be an influential tool for natural resource management (Pretty, 2003). Clearly, the costs of differentiated information dissemination strategies to fisheries management will differ substantially. The approaches suitable for reaching traditional anglers appear to be costly, for example, relative to simple dissemination of information via the Internet.

Investigative anglers are more likely than other anglers to get information from fishing clubs, to independently and actively seek out information, and suggest more unique communication alternatives than other anglers, possibly reflecting their breadth of knowledge and awareness as fishing club members (e.g. Cardona-Pons et al., 2010). One respondent stated that: "Most guys who are part of a fish and hunting club are pretty well educated. DFO should go through fishing clubs to increase public education." This group may be the easiest and least costly for managers to reach given their openness to obtaining information across a variety of sources.

Networking anglers obtained much of their current information on responsible fishing from tackle shops and by reading printings (e.g., leaflets). They had very strong preferences for seeing more DFO (i.e., managers and conservation officers) personnel walking the beach, interacting with fishers, and engaging them with regard to responsible fishing behaviors. For this segment, managers may need to look into more collaborative work with fishing shops and invest in more interactive and social ways to promote awareness. This group of anglers would require more effort and be more costly to reach because of the limited channels through which they receive information and their reliance on interpersonal interactions with fishing shop staff, managers, and officers.

Identifying distinctive behavior- and preference-based angler segments within the broader population can provide insights for fishery managers regarding effective communication strategies and awareness-building initiatives. Collaboration between managers and stakeholders, and the provision of information through these trusted sources can represent cost-effective communication (Peters, Covello, & McCallum, 1997) and promote integrity and trust, important factors that influence the likelihood of whether a message is accepted or rejected (Trettin & Musham, 2000). The reliance of anglers on information by word-of-mouth and personal contact (e.g., other anglers, fishing club members, fishing shop and DFO staff) highlights the potential of using social capital and norms to shape behavior affecting resource use and the transaction costs of management (Rudd, Folmer, & van Kooten, 2002; Pretty 2003).

Our research revealed three distinct angler types, implying that, irrespective of which communication programs are considered, fisheries managers will need a mix of outreach approaches to effectively reach all anglers. As our sample was small, it may well be that there exists additional angler types who may vary in other aspects of information use and communication preferences. Still, our key message, that recreational fishery managers need to be prepared to spend time and resources to reach anglers of different types using different means, remains valid. Different strategies of communication and engagement are likely to involve a relatively complex mixture of direct (e.g., communication materials, field staff

time) and transaction (e.g., managerial time, planning, revising policies) costs that are often not accounted for in economic analyses of recreational fisheries (Rudd et al., 2002). From a biological perspective, it is not yet clear what the specific benefits of various responsible fishing practices are for fish survival. That is, are different information provision and communication strategies equally effective in reducing mortality of fish that are captured and released? Managerial choices regarding the optimal mix of communication and engagement strategies may be improved by better understanding fishers' communication preferences. Still, empirical investigations of the benefits, the ultimate impacts of various strategies on release mortality, and on the direct and transaction costs of various alternatives, are required to fully understand and predict benefits and consequences of management options. This requires close collaboration between social scientists, fishery ecologists, and fish physiologists in interdisciplinary research efforts. We believe that our case study on information provision and communication preferences in the Fraser River is one important step in that direction.

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