



Research article

Peer pressure on the riverbank: Assessing catch-and-release anglers' willingness to sanction others' (bad) behavior

Meaghan L. Guckian^{a,*}, Andy J. Danylchuk^a, Steven J. Cooke^b, Ezra M. Markowitz^a^a Department of Environmental Conservation, University of Massachusetts Amherst, 160 Holdsworth Way, Amherst, MA 01003, USA^b Department of Biology, Carleton University, 1126, Colonel By Drive, Ottawa, K1S 5B6, Canada

ARTICLE INFO

Article history:

Received 20 October 2017

Received in revised form

24 April 2018

Accepted 29 April 2018

Keywords:

Recreational fisheries

Catch-and-release

Social sanctions

Steelhead

Cooperation

Conservation

ABSTRACT

Given the well-documented impacts of angler behavior on the biological fitness of angled and released fish, optimizing the conservation value of catch-and-release angling hinges on the extent to which anglers are willing to adopt recommended best practices and refrain from harmful ones. One potentially powerful mechanism underlying adoption of best practices is the social pressure anglers can apply to one another to enforce community norms and values. Past work in other domains demonstrates that forms of interpersonal communication—including social sanctioning—can foster context-appropriate social norms and increase cooperative behavior; yet to date, little research has examined these dynamics in the context of species conservation. We conducted in-person and online surveys to explore the role of social sanctioning in the context of an internationally renowned wild steelhead (*Oncorhynchus mykiss*) fishery in British Columbia, Canada. We investigated how diverse social-psychological and demographic factors influence anglers' past and future sanctioning propensity. Results highlight that perceived capacity to influence the angling practices of others and professed concerns about one's own reputation were strongly predictive of both past and future sanctioning. Furthermore, while anglers reported relatively low-levels of past sanctioning behavior, most anglers simultaneously expressed a strong desire to sanction others in the future. Identifying ways to increase the social desirability and visibility of sanctioning actions could assist resource managers in promoting adoption and maintenance of best practices. More broadly, our findings underscore a significant yet underappreciated role for wildlife users and enthusiasts in cultivating a shared conservation ethic to help ensure biological conservation.

© 2018 Elsevier Ltd. All rights reserved.

1. Introduction

Catch-and-release (C&R) angling constitutes the majority of recreational angling activity, as ~60% of the world's 47.1 billion fish caught annually are released (Cooke and Cowx, 2004). As our understanding of the fate of fish released by anglers has grown over the past few decades, a stark pattern has emerged illustrating how variability in angling behavior (e.g., air exposure, handling) plays a key role in determining the outcome of the angling event for the fish (Arlinghaus and Cooke, 2009; Cooke and Schramm, 2007; Cooke et al., 2013a; Muoneke and Childress, 1994). While general and species-specific tenets for C&R best practices have been recommended to optimize the survival and biological fitness of angled and released fish (for review see Brownscombe et al., 2017), a

strong limiting factor to the realized conservation value of C&R angling is the extent to which recreational anglers are willing to accept, adopt and engage in appropriate (best) practices and refrain from harmful ones. Put another way, C&R angling is a tool that relies on individual-level human decision-making to achieve conservation and management goals (Cooke et al., 2013c; Fulton et al., 2011). Indeed, more broadly speaking, “conservation means behavior” (Schultz, 2011).

Recreational C&R fisheries may be conceptualized as paradigmatic common pool resource dilemmas as competition for fish and the picture-perfect angling moment can fuel uncooperative and socially (as well as biologically) suboptimal angling behavior (Hardin, 1968; Ostrom, 2014). Individual motivation for compliance may be further attenuated by the lack of formal monitoring and enforcement capabilities common to expansive recreational fisheries (Sutinen, 1993). Thus, the transition to and adoption of C&R best practices will likely occur when the majority of recreational anglers meaningfully share and hold similar beliefs and values

* Corresponding author.

E-mail address: mguckian@umass.edu (M.L. Guckian).

(Arlinghaus, 2006; Biel and Thorgensen, 2007). Recent work by Chapman et al. (2018) and others suggest that one underappreciated mechanism to facilitate the broader adoption of C&R best practices, and ultimately, the cultivation of a shared conservation ethic, is anglers' willingness and ability to monitor and advocate for best practices within their angling community (Granek et al., 2008). This is important because prior research indicates that various forms of interpersonal communication, including informal social sanctions (e.g., admonishing bad angling behavior), can shift normative perceptions and shared values, and, in turn, can increase cooperative behavior (Balliet, 2010; Cialdini, 2009; Ostrom et al., 1992; Ostrom, 2014).

1.1. Interpersonal communication and cooperation

The importance of interpersonal communication, and social sanctioning in particular, in fostering cooperative behavior and facilitating situation-appropriate social norms has been illustrated in classic social dilemma and game theory experiments for decades (Balliet, 2010; Balliet et al., 2011; Ostrom et al., 1992; Ostrom, 2014). In fact, much of this research demonstrates that significant increases in cooperative behavior and total yield occur when participants are permitted to communicate (e.g., administer sanctions) between rounds of decision-making (Balliet, 2010; Ostrom et al., 1992). The communication of topic-relevant information relayed to defectors (or cooperators) can help establish social expectations and norms of cooperation (Ostrom, 2014) by realigning transgressors' behavior toward the acceptable norm (e.g., admonishment) or by reinforcing the appropriateness of a compliant action (e.g., praise). Nolan (2013) and others have extended this work in the context of environmental behavior, arguing that in order to achieve a culture of environmental conservation, concerned individuals must be willing to confront or sanction others' environmental transgressions (Maki and Raimi, 2017; Nolan, 2017; Swim and Bloodhart, 2013). For example, Swim and Bloodhart (2013) found that verbally admonishing individuals following elevator use increased the likelihood of subsequently using the stairs, while Schultz et al. (2007) demonstrated how impersonal expressions of disapproval can help above-average energy consumers reduce their consumption rates.

Although the effectiveness of social sanctions in buttressing cooperative behavior are well-known, it is unclear how or if these behaviors will manifest in the context of recreational C&R fisheries. Prior research indicates angler-to-angler interactions as a primary channel through which communication about responsible angling practices occurs (Nguyen et al., 2012), while exchanges over social media represent another avenue to signal one's commitment to best practices (e.g., #Keepemwet Fishing; Danylchuk et al., 2018). Thus, there may be a clear opportunity to leverage preexisting communication channels among anglers. These oftentimes rudimentary and even transient interactions that exist between anglers can play a powerful role in shaping individual behavior and beliefs, particularly when expressing the approval or disapproval of others' actions or intentions. Nevertheless, realizing the potential benefits of angler-to-angler communication hinges on individuals' willingness to engage with one another, yet research has only recently begun to examine the determinants of such action (Chapman et al., 2018; Maki and Raimi, 2017; Nolan, 2013, 2017).

1.2. Predicting engagement

In recognizing the potential of interpersonal communication to cultivate and maintain the adoption of C&R best practices, Chapman et al. (2018) modeled anglers' intentions to sanction others in a golden dorado (*Salminus brasiliensis*) fishery on the

Juramento River in Argentina. Results revealed that younger anglers who expressed higher environmental concern compared to others, who identified angling as important to their lifestyle, and who were more open to engaging in zero air exposure angling events were the most willing to admonish other anglers' C&R transgressions (Chapman et al., 2018). Left unexamined by Chapman et al. (2018) are two other sets of factors previously identified as potentially important drivers of sanctioning behavior: perceived efficacy and contextually salient social factors (Nolan, 2013). When considering the question of what may motivate recreational anglers to express disapproval or approval of others' [in] appropriate actions or intentions, prior research indicates that particular emphasis should be given to the explicit social implications of engagement (e.g., perceived norms) as well as the degree to which individuals perceive the result of these socially costly behaviors—sanctioning and C&R best practices—as effective in achieving desired conservation outcomes (Nolan, 2013).

One critical factor that may influence the degree to which anglers sanction others is whether anglers maintain the belief that cooperative behavior and ecological outcomes can be improved by sanctioning and/or through evidence-based C&R best practices, respectively (Nolan, 2013; Noorgard, 2011). Research from a variety of fields suggests that individuals' willingness to take on a behavior is predicated on their perceived capacity to take action as well as their beliefs about the efficacy of the action in achieving desired outcomes (Bandura, 1986; Ajzen, 1991; Witte, 1992). Among a college sample, Nolan (2013) found that the perceived effectiveness of a sanctioning act significantly predicted individuals' willingness to impose a range of social sanctions on others' recycling behaviors. Thus, in the present context, if individuals perceive social sanctioning as an effective way to increase cooperative, evidence-based C&R angling behavior, they should be more willing to sanction. Likewise, a perception of evidence-based C&R best practices as an effective conservation angling practice in reducing threats to steelhead is also likely to increase sanctioning behavior.

Another factor that may influence individuals' willingness to sanction others in this context is a belief that their opinions about C&R best practices are shared by other anglers. Research on social norms reveals that people's behavior is often heavily influenced both by their understanding of what is socially acceptable (e.g., injunctive norms) and by what most other people are doing (e.g., descriptive norms; Cialdini, 2009). Social norms are instrumental in shaping environmental decisions (e.g., Schultz, 1999) and pro-social behaviors more generally (Krupka and Weber, 2009), and they have been recognized as influential in both the social dilemmas (Ostrom, 1990; Biel and Thorgensen, 2007) and recreational fisheries literature (van Poorten et al., 2011; Stensland et al., 2013; Bova et al., 2017; Danylchuk et al., 2017). Thus, we anticipate that anglers who perceive that the majority of other anglers are aware of and/or use C&R best practices should express a higher propensity to sanction. Sanctioning propensity may also be predicted by a somewhat distinct social influence: anglers' professed concern over their reputation within the angling community. Status motives have been demonstrated to increase pro-environmental behaviors, especially when behaviors are publically observable and costly (Griskevicius et al., 2010). Provided that interpersonal sanctioning offers individuals a means to publically express their commitment to C&R best practices (i.e., either by educating transgressors or else praising cooperators), anglers highly concerned about their own reputation should be more motivated to engage. In order to broaden our understanding of individuals' motivations to sanction for conservation, the factors introduced here and those previously identified by Chapman et al. (2018) and others were examined in the context of a highly revered, wild steelhead C&R fishery located in the Bulkley River in British Columbia (BC), Canada.

1.3. Study site and species

The Bulkley River has one of the most iconic wild steelhead fisheries remaining in the world, with an average run size of 20, 873 steelhead (MFLNRO, n.d.). From late August to early November, anglers from across the world converge on the river for the opportunity to angle for wild steelhead (*Oncorhynchus mykiss*). Given their physical characteristics, steelhead are highly revered by recreational anglers for their size (e.g., upwards of 120 cm, 25 kg) and formidable fight. The proximity of the Bulkley River to roadways and population centers, non-resident license access, dramatic scenery and wild steelhead runs, has situated the river, or 'steelhead paradise', as one of the most angled rivers in BC (MOE, 2010). During the 2010–2011 season, roughly 12,200 angler days were logged during the season (Beere, 2014). Various organizations are collectively responsible for managing the river, while access is open to resident, non-resident and First Nation peoples, whom secure an aboriginal right to harvest, primarily salmon, for dietary, social and ceremonial purposes on their territory (Muckle, 2007). For all other recreational anglers, provincial law has mandated since 1997 that all angled wild steelhead must be released (MFLNRO, 2016). Although co-migrating salmon are primarily harvest-oriented (e.g., catch limits), C&R angling is imposed as a regulatory tool for steelhead in order to maximize long-term socio-economic opportunity while minimizing mortality (MFLNRO, 2016).

Given the species' high vulnerability to human-induced changes to the environment, including habitat degradation (NRC, 1996), fishing pressure and fisheries interactions (Stewart and Lewynsky, 1988), native (wild) populations of steelhead have drastically declined (NOAA, 2016; Kendall et al., 2017). Native steelhead populations of the Skeena watershed (e.g. Bulkley) stand in contrast to the fate of the once iconic steelhead runs of the United States Pacific Northwest (PNW), which are now closed to recreational C&R angling due to population collapses. Twelve distinct populations of steelhead identified in the US PNW are listed as either threatened or endangered under the Endangered Species Act, or as a species of concern under the National Marine Fisheries Service (NOAA, 2016). Thus, sustaining the long-term viability of the Bulkley River's wild steelhead fishery has significant economic and socio-cultural value for both present and future stakeholders.

The influence of C&R angling and angler behavior are of primary concern on the Bulkley River, as is the sustainability of the steelhead population. In 2013, the Bulkley River Angling Management Plan (BRAMP) was introduced to address longstanding concerns of overcrowding, quality of experience, abundance of jet boat use and general lack of angler etiquette (Dolan, 2008; MOE, 2010; MFLNRO, 2013). Upon recommendations from the plan, the province adopted regulations that imposed new time and area restrictions on anglers, particularly non-resident anglers (e.g., weekday access unless guided). Despite these regulations, concerns over access, pressure and etiquette remain contentious in the region.

1.4. Present research and objectives

The present study examines individuals' self-reported sanctioning propensity within the context of an internationally renowned wild steelhead C&R recreational fishery and in particular illustrates the value of identifying how and to what extent various social-psychological factors and angler characteristics shape engagement. We draw on recent domain-specific (i.e., Chapman et al., 2018) and domain-general (i.e., Nolan, 2013) research to guide item selection in constructing the survey instrument used. In addition to items that emerged as important predictors in the preliminary Chapman et al. (2018) work—age, years fishing, management familiarity, fishing significance, and anglers' concern

about fishery—we also include contextually salient social factors (e.g., reputational concern, normative perceptions) and perceptions of efficacy. Based on prior research (Griskevicius et al., 2010; Nolan, 2013), we suspect that recreational anglers' sanctioning propensity will largely be determined by their perceptions of others' beliefs and practices, a concern for their reputation, and the extent to which they believe that cooperation and/or conservation value is likely to increase as a result of both interpersonal sanctioning and implementation of evidence-based C&R best practices.

The present research also focused on multiple context-dependent predictors that we anticipate would influence recreational anglers' sanctioning propensity in this C&R recreational fishery. These included relevant angler characteristics (e.g., age, fishing experience, fishing avidity, angling club membership; Fisher, 1997; Gigliotti and Peyton, 1993; Oh and Ditton, 2006), as well as key social-psychological constructs, such as perceptions of angler threat, familiarity of management practices and concern for steelhead populations (Stern et al., 1999; Nguyen et al., 2013). The present research also examined recreational anglers' self-reported past sanctioning behavior, which has not previously been studied. Thus, the present study investigated both anglers' future intentions as well as their engagement in such behavior in the past.

2. Method

2.1. Sampling frame and distribution

The target population included recreational anglers age 18 and older who were active in the Bulkley River steelhead fishery (i.e., angled at least one season). Survey recruitment and distribution occurred from September 27 to November 30, 2016 and coincided with a systematic research study that examined how wild steelhead respond to C&R angling events, which aimed to identify species-specific best practices (Twardek et al., unpublished). Opportunistic in-field intercept sampling, local social media and fishing reports were used to recruit respondents. Anglers were recruited to participate at popular walk-in fishing sites, boat launches and a fishing outfitter located in Smithers, BC. Respondents who completed the survey in-person used a portable electronic tablet. Due to time restraints and in recognition of anglers' primary motivation to be on river, an identical online survey was distributed via a regional non-profit organization's Facebook page and a local online fishing report. The survey was administered using the QuestionPro platform. The study was approved by the University of Massachusetts Amherst Institutional Review Board (Protocol ID: 2016–3318).

2.2. Survey instrument and key study measures

The questionnaire included a series of close- and open-ended questions investigating a range of social-psychological constructs and angling segmentation characteristics of Bulkley River steelhead anglers. Survey item selection was broadly informed by Chapman et al. (2018), with new measures generated to assess perceived efficacy, social influences and items specifically relevant to the Bulkley River steelhead fishery.

Eight items assessed respondents' past sanctioning behavior and future sanctioning intentions. Exploratory principle components analysis revealed a two-component structure. As expected, the four items that measured anglers' frequency of past sanctioning behavior over the past angling season hung together and were combined into a composite measure ($\alpha = .78$; e.g., "Made a comment on social media (e.g., Facebook, Twitter, Instagram) addressing an individual's inappropriate post-catch handling practices"; 1 = never, 7 = all the time). The four items that assessed

future sanctioning intentions also formed a reliable composite measure ($\alpha = .74$; e.g., “If researchers were able to develop species-specific catch-and-release best practices for Bulkley River Steelhead based on solid scientific research, would this make you more or less likely to approach and educate others who do not adopt Steelhead specific catch-and-release best practices?”; 1 = *much less likely*, 4 = *neither less nor more likely*, 7 = *much more likely*). It is important to note that while past sanctioning was assessed on the recalled frequency of prior engagement in such actions, future sanctioning intent was measured conditional on evidence-based best practices. As a result, caution should be taken in making direct comparisons between respondents' responses to these two sets of related yet distinct items.

Seven items gauged anglers' perception of threats to Bulkley River steelhead (1 = *not at all*, 7 = *extremely*). Exploratory principle components analysis revealed a three-factor solution, however one item was dropped from the first factor for not meeting the critical loading value (e.g., ‘Illegal harvesting’). The factors included (1) angler threat (e.g., “Overfishing from recreational anglers”, “Inappropriate angling and handling practices”) (2) human-induced environmental threats (e.g., “Impacts of climate change”, “Habitat degradation and pollution from industrial activities”), and (3) other catch threats (e.g., “Overharvesting [bycatch from commercial salmon fishing]”, “Gillnetting practices”). Given our interest in predicting anglers' willingness to impose sanctions on others' potentially harmful handling practices, only *perceived angler threat* was included in final analyses ($r = .565$). Full item descriptions, descriptive statistics, zero-order pairwise correlations, exploratory principle components analyses assessing sanctioning propensity and perceptions of threat are reported in the Supplementary Information.

One item assessed level of *perceived concern* for steelhead populations compared to other anglers (“Compared to most recreational anglers, would you say that you are less or more concerned about the Bulkley River Steelhead population?”; 1 = *much less concerned*, 4 = *neither less nor more*; 7 = *much more concerned*). A single item measured self-reported *management familiarity* (“How familiar are you with management techniques and approaches used to make decisions about the Bulkley River Steelhead fishery?”; 1 = *not at all familiar*, 7 = *extremely familiar*). Three items assessed anglers' belief in science (e.g., evidence-based C&R practices). A three-item composite measure for *belief in science* was calculated ($\alpha = .88$; e.g., “How confident are you that research-based catch-and-release best practices can help maintain and preserve Bulkley River Steelhead populations?”; 1 = *not at all confidence*, 7 = *extremely*). One item assessed the importance of fishing to anglers' lifestyle (e.g., “How important is recreational angling as part of your lifestyle?”; 1 = *not at all important*, 7 = *extremely important*).

Reputation concern was assessed with two items and averaged together to create a single composite measure ($r = .462$, e.g., “Are you concerned that other recreational anglers might view you negatively if you inappropriately handled a steelhead post-catch?”; 1 = *not at all concerned*, 7 = *extremely concerned*). Two items assessed anglers' normative perception of the pervasiveness of C&R best practices within the Bulkley River steelhead fishery. Respondents were asked to indicate the percentage of anglers (e.g., 0–100 percent) who they believed know about steelhead C&R best practices as well as the percentage of anglers who they believed currently practice C&R best practices. The two-items were averaged together to create a composite measure of *normative perception* ($r = .755$). Respondents also indicated the extent to which they perceived sanctioning as effective. A single item measured *perceived sanctioning efficacy* (e.g., “I feel that I can help protect steelhead populations by informing anglers that their post-catch

handling practices might impact steelhead well-being.”; 1 = *strongly disagree*, 4 = *neither disagree nor agree*, 7 = *strongly agree*). Finally, respondents indicated their age (continuous), years spent fishing on the Bulkley River (continuous), their country of residence (Canadian vs. non-Canadian) as well as whether or not they belonged to an angling club (yes or no).

2.3. Analytical approach

Two ordinary least squares (OLS) linear regression models were run to predict anglers' past sanctioning behavior and future sanctioning intentions. Model 1 included a subset of relevant predictors highlighted in Chapman et al. (2018), as well as individuals' membership to angling clubs and/or organizations, which has previously been identified as a useful angler segmentation characteristic (Gigliotti and Peyton, 1993). Model 2 consisted of the same parameters, plus the variables identified through extant research in other fields as potentially critical determinants of anglers' sanctioning behavior and intentions (e.g., perceptions of efficacy). Parameter characteristics are highlighted by *lmg* relative importance, a calculation of the contribution of each parameter in the regression model that reflects the partitioning of the model's R^2 ; higher *lmg* metrics indicate greater contribution to the R^2 (Grömping, 2007). Model quality and comparison are indicated with Akaike information criteria (AIC; Akaike, 1973). To address for potential model overfitting, least absolute shrinkage and selection operator (LASSO, Tibshirani, 1996) linear regression was also performed (see Supplementary Information). All analyses were performed in R version 3.3.1 (R Core Team, 2016). Additional survey materials can be accessed at <https://osf.io/64c3d/>.

3. Results

3.1. Survey sample description

A total of 197 surveys were completed with a 65.2% completion rate. The majority of participants completed the survey online (89.8%) compared to on tablets in the field (10.2%). In addition to basic demographic and angling characteristics presented in Table 1, specific information related to angling experience, self-reported knowledge, and communication behaviors were collected. Most anglers reported that the majority of their recreational angling is C&R (97.3%, 5 or above) and voluntary (98%, 5 or above). Further, 93.3% of participants indicated a high level (5 or above) of understanding of general C&R best practices and species-specific C&R best practices for steelhead (98%; 5 or above). Additionally, 55.4% of participants reported regularly communicating with friends or acquaintances about C&R practices for steelhead in the past few months, while 52.8% reported that other recreational anglers have informed their angling practices (5 or above). Only 22.8% (5 or above) of respondents indicated that they use social media platforms (e.g., Facebook, Instagram, Twitter) to share C&R-related experiences.

3.2. Descriptives

Participants reported low engagement in past sanctioning behavior ($M = 3.21$, $SD = 1.38$), but relatively strong future intentions to sanction others ($M = 4.97$, $SD = 1.20$). Perceived concern for steelhead populations was high ($M = 5.79$, $SD = 1.05$), while participants' familiarity with management practices ($M = 4.29$, $SD = 1.66$) and belief in science or evidence-based C&R angling were slightly above the midpoint ($M = 4.91$, $SD = 1.54$). Perceptions of angler threat ($M = 4.57$, $SD = 1.40$), reputation concern ($M = 4.53$,

Table 1
Socio-demographic and angling characteristics for Bulkley River anglers.

Age (n = 194)	M = 51.84, SD = 14	Yrs fishing on Bulkley River (n = 197)	M = 13.02, SD = 10.64
Gender (n = 196)	%	Country of residence (n = 184)	%
Female	13	Canada	62
Male	182	Other	38
Prefer not to say	2	Primary handler post-catch (n = 197)	
Gear type (n = 197)		Yes	179
Fly fish	170	No	18
Conventional tackle	5	Education (n = 191)	
Use both	22	Grade 8 or less	
Member of angling club (n = 194)		Some high school	2
Yes	92	Graduate high school	12
No	102	Some college or tech. school	62
River license access (n = 196)		Graduate college	69
Guided lodge access	14	Post-graduate	46
Non-canadian unguided access	59	Time on Bulkley this season (n = 195)	
British Columbia resident	95	A few days	28
Non resident canadian access	19	A week	58
Other	9	A couple weeks	56
Yrs fishing rod and reel (n = 195)		A month	15
Less than a year		Full season	38
1-5 years	3	Angled for steelhead in other locations	
6-10 years	2	California	27
11-15 years	9	Great Lakes	27
16-20 years	5	Idaho	45
21 or more years	176	Oregon	86
		Washington	84

$SD = 1.88$), and normative perception ($M = 51.12$, $SD = 22.52$) were all similarly endorsed. Participants reported strong perceptions of sanctioning efficacy ($M = 5.26$, $SD = 1.47$). For importance of fishing to anglers' lifestyle ($M = 6.55$; $SD = .67$), 65% of respondents indicated 'very important'. Due to severe skew and ceiling effect, this item was removed from further analysis. Additionally, analyses revealed no observable difference among anglers whom completed the survey in the field versus online; thus, this factor was not considered in subsequent analyses. Zero-order pairwise correlations among all key variables are reported in Supplementary Information.

3.3. Model results

Results of the linear regression analyses are presented in Table 2. For past sanctioning intentions, Model 1, which included a subset of social-psychological and angling segmentation parameters, explained 23% of the variance (adj. $R^2 = 0.20$). Concern for steelhead populations contributed the most to the model's R^2 ($lmg = 0.067$) compared to other factors, followed by age ($lmg = 0.062$) and perceived angler threat ($lmg = 0.039$). Model 2 accounted for 41% (adj. $R^2 = 0.37$) of the variance in past sanctioning behavior. Perceived sanctioning efficacy emerged as the predictor with the greatest relative importance ($lmg = 0.121$),

Table 2
Results of linear regression predicting past sanctioning behavior and future sanctioning intentions.

Model	Predictor	Past Sanctioning Behavior				Future Sanctioning Intentions			
		b	t	p	lmg	b	t	p	lmg
1	Age	-0.029	-3.66	.000	0.062	-0.006	-0.90	.370	0.002
	Perceived concern	0.345	3.48	.001	0.067	0.217	2.46	.015	0.052
	Angler threat	0.179	2.36	.020	0.039	0.320	4.71	.000	0.137
	Management familiarity	0.094	1.42	.157	0.026	0.008	0.14	.892	0.002
	Yrs Bulkley	0.012	1.15	.253	0.009	0.006	0.64	.523	0.004
	Country of residence	0.333	1.55	.122	0.025	0.152	0.80	.428	0.006
	Club membership	0.094	0.46	.645	0.002	0.201	1.10	.271	0.010
		$R^2 = .23$; Adj. $R^2 = .20$ df (7,152)				$R^2 = .21$; Adj. $R^2 = .18$ df (7,152)			
2	Age	-0.032	-4.45	.000	0.073	-0.009	-1.59	.114	0.005
	Perceived concern	0.241	2.62	.010	0.044	0.067	0.90	.371	0.026
	Angler threat	0.003	0.03	.973	0.016	0.120	1.87	.063	0.064
	Management familiarity	0.134	2.23	.027	0.033	0.041	0.84	.403	0.005
	Yrs Bulkley	0.013	1.40	.165	0.010	0.009	1.15	.252	0.005
	Country of residence	0.273	1.41	.160	0.022	0.097	0.62	.540	0.005
	Club membership	-0.114	-0.61	.540	0.002	0.020	0.14	.893	0.004
	Sanction efficacy	0.311	4.60	.000	0.121	0.408	7.39	.000	0.256
	Belief in science	0.127	1.76	.081	0.026	0.066	1.13	.262	0.044
	Norm perception	0.002	0.36	.718	0.002	-0.004	-1.09	.277	0.012
	Reputation concern	0.148	2.79	.006	0.061	0.134	3.10	.002	0.065
	$R^2 = .41$; Adj. $R^2 = .37$ df (11,148)				$R^2 = .49$; Adj. $R^2 = .45$ df (11, 148)				

Note. Regression analysis was completed on complete pairwise observations (n = 160). Country of residence referent (1 = Canada; 0 = non-Canadian); Club membership referent (1 = Yes; 0 = No).

almost double the second largest contributor in age ($lmg = 0.073$). In addition, reputation concern ($lmg = 0.061$), perceived concern ($lmg = 0.044$), and management familiarity ($lmg = 0.033$) emerged as significant predictors. Model comparison using AIC indicated that Model 2 ($AIC_{past2} = 500.2$) was the best fitting model for past sanctioning behavior compared to Model 1 ($AIC_{past1} = 534.9$).

In contrast to past sanctioning behavior, the models predicting future sanctioning intent revealed a different structure, particularly for Model 2. Model 1 accounted for 21% of the variance in future sanctioning intentions (adj. $R^2 = 0.18$). Both perceptions of angler threat ($lmg = 0.137$) and perceived concern ($lmg = 0.052$) emerged as significant predictors of future intent. Compared to Model 1, Model 2 explained 49% of the variance (adj. $R^2 = 0.45$) in future sanctioning intentions. Perceived sanctioning efficacy contributed over half of the model's R^2 ($lmg = 0.256$), followed by reputation concern ($lmg = 0.065$) and perceived angler threat ($lmg = 0.064$). AIC model comparison indicated that Model 2 ($AIC_{future} = 435.2$) outperformed Model 1 in predicting future sanctioning intentions ($AIC_{future} = 497.3$).

4. Discussion

Human decision-making can present pervasive challenges to natural resource managers due to negative impacts on ecosystems and species, yet resource users can also contribute positively to conservation management outcomes in unexpected ways. In the present research, we examined one potentially powerful pathway to maximize the conservation value of the C&R management approach: leveraging interpersonal communication, and social sanctioning in particular, to encourage uptake and proliferation of C&R best practices. Consistent with our predictions, greater perceived capacity to influence the angling practices of others and professed concerns about one's own reputation were strongly predictive of both past and future sanctioning. In fact, perceptions of sanctioning efficacy contributed over half of the predictive power of the model when predicting future sanctioning intentions. These results are consistent with past work demonstrating the effect of social influence on behavior (Bamberg and Möser, 2007) and further highlight the role that anglers have to play in perpetuating the adoption of C&R best practices.

One of the more intriguing findings of the present work is the high level of endorsement we observed for future sanctioning behavior. This is particularly interesting given the way in which future sanctioning items were framed: anglers reported their intention to act relative to a conditional, if-then scenario that communicated the existence of and subsequent transgression against an evidence-based C&R best practice. Based on prior research suggesting that the presence of a formal sanctioning system (e.g., mandatory recycling program) may support the informal sanctioning of non-cooperators (Nolan, 2017), these preliminary but suggestive findings suggest that future research should examine whether the presence (or knowledge of) evidence based C&R best practices (or formal policies) influences anglers' willingness to sanction non-compliant anglers. In addition, though it is clear that the future sanctioning items were endorsed more strongly than the past sanctioning items, we cannot draw strong inferences based on the present work because the two sets of items were (intentionally) constructed in different ways. Still, the observed differences suggest a need for additional future exploration using parallel measures.

Although recreational fisheries are context-dependent and function at the intersection of site-specific socio-cultural, economic, political and ethical factors (Arlinghaus, 2006), our results suggest that more generalizable social psychological factors and

angler segmentation characteristics play a critical role in shaping anglers' willingness to engage in behaviors that may promote C&R fisheries health. The results highlighted here suggest that in addition to perceptions of concern and typology (e.g., age), contextually salient social factors (e.g. reputation) and perceptions of efficacy may also be critically important in shaping anglers' sanctioning propensity. Our findings may be particularly useful to fisheries managers seeking to identify 'soft' approaches that may increase the involvement of anglers in the conservation management process and achieve conservation objectives.

What might this look like in practice? First, managers should identify context-appropriate ways to increase the social desirability of adopting C&R best practices. Because anglers' propensity to sanction is partially explained by their own professed concerns about their reputation, fisheries managers could increase the saliency and public visibility of "doing or communicating the right thing". The promotion of such "see something, say something" campaigns or programs could be enticing to individuals who are both concerned about anglers' threat to steelhead and their own reputation within the community. Still, concerns over the dynamics of the interaction need to be addressed, including the associated real and perceived costs (e.g., social and physical) that may deter engagement (Steenjtes et al., 2017). Perhaps more importantly, fisheries managers should be encouraged by our results suggesting that anglers' efficacy beliefs strongly motivate their future sanctioning intentions. Thus, encouraging individuals to advocate for C&R best practices—and letting them know that their voices matter—within their angling communities may go a long way towards increasing cooperative angling. Given the lack of monitoring and enforcement capabilities common to recreational fisheries (Sutinen, 1993), this belief and alternative framework offers an encouraging and cost-effective means to promote valuable and necessary conservation practices.

Together, the various forms of interpersonal communication highlighted here could help overcome notable human dimensions obstacles nested within recreational fisheries (and other conservation settings more broadly), including the lack of shared values (Arlinghaus, 2006) and feelings of personal inefficacy to effect positive change. Although it is important to consider traditional avenues to accurately foster anglers' knowledge and adoption of C&R best practices, various forms of interpersonal communication may enable anglers to develop a deeper understanding and appreciation of C&R best practices, by conveying strong social norm messages about what is both socially appropriate and commonly practiced by the greater angling community. Fortunately, channels between anglers represent a dominant communication pathway (Nguyen et al., 2012) and furthermore, social networks are pervasive in recreational fisheries. Angling clubs, online forums and social media platforms constitute an array of existing arenas through which individuals can spread critical conservation information and create a context wherein the consequences of inappropriate angling behavior carry salient, potentially costly, social implications. Given the well-established gap between intentions and actual behavior (for review see Sheeran, 2002), it remains unclear whether anglers' observed endorsement of sanctioning in the future will translate into actual behavior. This remains an important question for future research, and assessing the practical implications of interpersonal sanctioning in the context of conservation management.

With the popularity of recreational angling increasing worldwide and the associated negative impacts of anglers' handling practices, identifying and facilitating meaningful opportunities for anglers' direct involvement in the conservation process could help reduce stressors to fish (Cooke et al., 2013b). Such alternative, participatory-based institutions, ranging from anglers' direct

involvement in advocacy and monitoring to research and management design, have been shown to positively impact fisheries (Granek et al., 2008). While continuing to examine what regulates anglers' propensity to engage is important, further research is needed to explore the downstream implications of such engagement, including both influences on the receiver (e.g., changes in behavior) as well as the communicator (e.g., impacts to reputation and perceived self-efficacy). In particular, future research should examine what messages are most effective in inducing cooperation, how these processes may influence anglers' sense of stewardship across fisheries, and whether sanctioning may spillover into other forms of engagement. There is also a clear and pressing need to examine the dynamics uncovered here in other conservation and resource management contexts (e.g., forestry, hunting).

5. Conclusion

In isolation, C&R best practices and other user-management guidelines intended to mitigate humans' negative impacts on ecological systems are likely to fail as people rarely have the incentive to act alone. While C&R angling offers recreational fisheries managers a sustainable alternative to the traditional catch-and-harvest model, maximizing the conservation potential of this approach is largely dependent on anglers' voluntary adoption of C&R best practices. Forms of interpersonal communication that can leverage the power of social norms and social influence—including social sanctions—offer a potentially powerful yet low-cost avenue through which to increase cooperative behavior and persuade individuals to act in socially responsible ways. Although limited research has explored this role for resource-users to date, managers should consider how this framework manifests and can be applied to other conservation management contexts, particularly those that rely on voluntary compliance and which operate with limited enforcement capabilities.

Acknowledgements

Our project was endorsed by the Wet'suwet'en First Nation and the Fish and Wildlife Branch of the BC Ministry of Forests, Lands, Natural Resources, and Rural Development. Funding for this project was provided by Freshwater Fisheries Society of BC, The Steelhead Society of BC Northern Branch, Native Fish Society, Wild Steelhead Coalition, and Patagonia, Inc., as well as several anonymous donations. In-kind support was provided by Costa Inc., Yeti, Inc., and Umpqua Feather Merchants, Inc. We would also like to thank the in-kind support received from the Bulkley River community of anglers and guides, as well as the Bulkley River Lodge (Missy Moure & Dave Whitey Evans), Oscars Fly & Tackle and MoldyChum.com.

Appendix A. Supplementary data

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.jenvman.2018.04.117>.

References

- Ajzen, I., 1991. The theory of planned behavior. *Organ. Behav. Hum. Decis.* 50 (2), 179–211.
- Akaike, H., 1973. Information theory and an extension of the maximum likelihood principle. In: Petrov, B.N., Csaki, F. (Eds.), *Proceedings of the Second International Symposium on Information Theory*. Akademiai Kiado, Budapest, pp. 267–281.
- Arlinghaus, R., 2006. Overcoming human obstacles to conservation of recreational fishery resources, with emphasis on central Europe. *Environ. Conserv.* 33 (1), 46–59. <https://doi.org/10.1017/S0376892906002700>.
- Arlinghaus, R., Cooke, S.J., 2009. Recreational fisheries: socioeconomic importance, conservation issues and management challenges. In: Dickson, B., Hutton, J., Adams, W.M. (Eds.), *Recreational Hunting, Conservation and Rural Livelihoods: Science and Practice*. Blackwell Publishing, Oxford, pp. 39–58.
- Balliet, D., 2010. Communication and cooperation in social dilemmas: a meta-analytic review. *J. Confl. Resolut.* 54 (1), 39–57.
- Balliet, D., Mulder, L.B., Van Lange, P.A., 2011. Reward, punishment, and cooperation: a meta analysis. *Psychol. Bull.* 137 (4), 594. <https://doi.org/10.1037/a0023489>.
- Bamberg, S., Möser, G., 2007. Twenty years after Hines, Hungerford, and Tomera: a new meta-analysis of psycho-social determinants of pro-environmental behaviour. *J. Environ. Psychol.* 27 (1), 14–25.
- Bandura, A., 1986. The explanatory and predictive scope of self-efficacy theory. *J. Soc. Clin. Psychol.* 4 (3), 359–373.
- Beere, M., 2014. Steelhead Stock Status Review British Columbia. Available at: www.slideplayer.com. Retrieved February 2018.
- Biel, A., Thøgersen, J., 2007. Activation of social norms in social dilemmas: a review of the evidence and reflections on the implications for environmental behaviour. *J. Econ. Psychol.* 28 (1), 93–112.
- Bova, C.S., Halse, S.J., Aswani, S., Potts, W.M., 2017. Assessing a social norms approach for improving recreational fisheries compliance. *Fish. Manag. Ecol.* 24 (2), 117–125.
- Brownscombe, J.W., Danylchuk, A.J., Chapman, J.M., Gutowsky, L.F., Cooke, S.J., 2017. Best practices for catch-and-release recreational fisheries—angling tools and tactics. *Fish. Res.* 186, 693–705.
- Cialdini, R.B., 2009. *Influence: Science and Practice*, fifth ed. Pearson.
- Chapman, D.A., Gagne, T.O., Ovitz, K.L., Griffin, L.P., Danylchuk, A.J., Markowitz, E.M., 2018. Modeling Intentions to Sanction Among Anglers in a Catch-and-release Recreational Fishery for golden Dorado (*Salminus Brasiliensis*) in Salta, Argentina. *Hum. Dimens. Wildl.* pp. 1–8.
- Cooke, S.J., Cowx, I.G., 2004. The role of recreational fishing in global fish crises. *BioScience* 54 (9), 857–859.
- Cooke, S.J., Donaldson, M.R., O'Connor, C.M., Raby, G.D., Arlinghaus, R., Danylchuk, A.J., Suski, C.D., 2013a. The physiological consequences of catch-and-release angling: perspectives on experimental design, interpretation, extrapolation and relevance to stakeholders. *Fish. Manag. Ecol.* 20 (2–3), 268–287. <https://doi.org/10.1111/j.1365-2400.2012.00867.x>.
- Cooke, S.J., Lapointe, N.W.R., Martins, E.G., Thiem, J.D., Raby, G.D., Taylor, M.K., Cowx, I.G., 2013b. Failure to engage the public in issues related to inland fishes and fisheries: strategies for building public and political will to promote meaningful conservation. *J. Fish. Biol.* 83 (4), 997–1018.
- Cooke, S.J., Schramm, H.L., 2007. Catch-and-release science and its application to conservation and management of recreational fisheries. *Fish. Manag. Ecol.* 14 (2), 73–79. <https://doi.org/10.1111/j.1365-2400.2007.00527.x>.
- Cooke, S.J., Suski, C.D., Arlinghaus, R., Danylchuk, A.J., 2013c. Voluntary institutions and behaviours as alternatives to formal regulations in recreational fisheries management. *Fish. Fish.* 14 (4), 439–457.
- Danylchuk, A.J., Tiedemann, J., Cooke, S.J., 2017. Perceptions of recreational fisheries conservation within the fishing industry: knowledge gaps and learning opportunities identified at east coast trade shows in the United States. *Fish. Res.* 186, 681–687. <https://doi.org/10.1016/j.fishres.2016.05.015>.
- Danylchuk, A.J., Danylchuk, S.C., Kosiarski, A., Cooke, S.J., Huskey, B., 2018. Keep-emwet Fishing—an emerging social brand for disseminating best practices for catch-and-release in recreational fisheries. *Fish. Res.* 205, 52–56.
- Dolan, A., 2008. Draft Angling Management Plan, Skeena Quality Waters Strategy Report Prepared by Alan Dolan and Associates for the Ministry of Environment, Smithers, B.C.
- Fisher, M.R., 1997. Segmentation of the angler population by catch preference, participation, and experience: a management-oriented application of recreation specialization. *N. Am. J. Fish. Manage.* 17 (1), 1–10. [http://doi.org/10.1577/1548-8675\(1997\)017<0001:SOTAPP>2.3.CO;2](http://doi.org/10.1577/1548-8675(1997)017<0001:SOTAPP>2.3.CO;2).
- Fulton, E.A., Smith, A.D., Smith, D.C., van Putten, I.E., 2011. Human behaviour: the key source of uncertainty in fisheries management. *Fish. Fish.* 12 (1), 2–17. <https://doi.org/10.1111/j.1467-2979.2010.00371>.
- Gigliotti, L.M., Peyton, R.B., 1993. Values and behaviors of trout anglers, and their attitudes toward fishery management, relative to membership in fishing organizations: a Michigan case study. *N. Am. J. Fish. Manage.* 13 (3), 492–501.
- Granek, E.F., Madin, E.M., Brown, M.A., Figueira, W., Cameron, D.S., Hogan, Z., Kristianson, G., de Villiers, P., Williams, J.E., Post, J., Zahn, S., 2008. Engaging recreational Fishers in management and conservation: global case studies. *Conserv. Biol.* 22 (5), 1125–1134. <http://doi.org/10.1111/j.1523-1739.2008.00977.x>.
- Griskevicius, V., Tybur, J.M., Van den Bergh, B., 2010. Going green to be seen: status, reputation, and conspicuous conservation. *J. Pers. Soc. Psychol.* 98 (3), 392.
- Grömping, U., 2007. Estimators of relative importance in linear regression based on variance decomposition. *Am. Stat.* 61 (2), 139–147.
- Hardin, G., 1968. The tragedy of the commons. *Science* 162, 1243–1248.
- Kendall, N.W., Marston, G.W., Klungie, M.M., 2017. Declining patterns of Pacific Northwest steelhead trout (*Oncorhynchus mykiss*) adult abundance and smolt survival in the ocean. *Can. J. Fish. Aquat. Sci.* 74 (8), 1275–1290. <https://doi.org/10.1139/cjfas-2016-0486>.
- Krupka, E., Weber, R.A., 2009. The focusing and informational effects of norms on pro-social behavior. *J. Econ. Psychol.* 30 (3), 307–320.
- Maki, A., Raimi, K.T., 2017. Environmental peer persuasion: how moral exporting and belief superiority relate to efforts to influence others. *J. Environ. Psychol.* 49, 18–29.
- Ministry of Environment (MOE), 2010. Ministry of Environment Response to Working Group Recommendations for Skeena Angling Management Plans.

- Victoria, B.C.
 Ministry of Forest, Lands, and Natural Resource Operations (MFLNRO), 2013. Bulkley River Angling Management Plan. Victoria, BC.
- Ministry of Forest, Lands, and Natural Resource Operations (MFLNRO), 2016. Provincial Framework for Steelhead Management in British Columbia. Victoria, BC.
- Muckle, R.J., 2007. The First Nations of British Columbia: an Anthropological Survey, second ed. UBC Press, Vancouver.
- Muoneke, M.I., Childress, W.M., 1994. Hooking mortality: a review for recreational fisheries. *Rev. Fish. Sci.* 2 (2), 123–156.
- National Oceanic and Atmospheric Administration (NOAA), 2016. Steelhead Trout (*Oncorhynchus mykiss*). <http://www.fisheries.noaa.gov/pr/species/fish/steelhead-trout.html> (Accessed 25 7 2017).
- National Research Center (NRC), 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academies Press, Washington, D.C.
- Nolan, J.M., 2013. Creating a culture of conservation: willingness to confront environmental transgressors. *Ecopsychology* 5 (1), 3–8.
- Nolan, J.M., 2017. Environmental policies can buttress conservation norms. *Soc. Natur. Resour.* 30 (2), 228–244.
- Noorgard, K.M., 2011. *Living in Denial: Climate Change, Emotions, and Everyday Life*. MIT Press.
- Nguyen, V.M., Rudd, M.A., Hinch, S.G., Cooke, S.J., 2012. Differences in information use and preferences among recreational salmon anglers: implications for management initiatives to promote responsible fishing. *Hum. Dimens. Wildl.* 17 (4), 248–256.
- Nguyen, V.M., Rudd, M.A., Hinch, S.G., Cooke, S.J., 2013. Recreational anglers' attitudes, beliefs, and behaviors related to catch-and-release practices of Pacific salmon in British Columbia. *J. Environ. Manage* 128, 852–865. <http://doi.org/10.1016/j.jenvman.2013.06.010>.
- Oh, C.O., Ditton, R.B., 2006. Using recreation specialization to understand multi attribute management preferences. *Leis. Sci.* 28 (4), 369–384.
- Ostrom, E., 1990. *Governing the Commons*. Cambridge University Press, Cambridge, UK.
- Ostrom, E., 2014. Collective action and the evolution of social norms. *J. Nat. Res. Pol. Res.* 6 (4), 245–252.
- Ostrom, E., Walker, J., Gardner, R., 1992. Covenants with and without a sword: self governance is possible. *Am. Polit. Sci. Rev.* 86 (02), 404–417.
- R Core Team, 2016. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Australia. <http://www.R-project.org/>.
- Schultz, P.W., Nolan, J.M., Cialdini, R.B., Goldstein, N.J., Griskevicius, V., 2007. The constructive, destructive, and reconstructive power of social norms. *Psychol. Sci.* 18 (5), 429–434.
- Schultz, P.W., 1999. Changing behavior with normative feedback interventions: a field experiment on curbside recycling. *Basic Appl. Soc. Psych.* 21 (1), 25–36.
- Schultz, P., 2011. Conservation means behavior. *Conserv. Biol.* 25 (6), 1080–1083.
- Sheeran, P., 2002. Intention—behavior relations: a conceptual and empirical review. *Eur. J. Soc. Psychol.* 12 (1), 1–36.
- Stentjes, K., Kurz, T., Barreto, M., Morton, T.A., 2017. The norms associated with climate change: understanding social norms through acts of interpersonal activism. *Glob. Environ. Chang.* 43, 116–125.
- Stensland, S., Aas, Ø., Mehmetoglu, M., 2013. The influence of norms and consequences on voluntary catch and release angling behavior. *Hum. Dimens. Wildl.* 18 (5), 373–385.
- Stern, P.C., Dietz, T., Abel, T., Guagnano, G.A., Kalof, L., 1999. A value-belief norm theory of support for social movements: the case of environmentalism. *Hum. Ecol.* 6 (2), 81–97. <http://doi.org/10.2307/2083693>.
- Stewart, R.W.J., Lewynsky, V.A., 1988. Report: Interactions of Steelhead trout (*Salmo Gairdneri*) in the Indian Fishery of the Fraser River, September through November, 1986. Ministry of Environment and Parks, BC.
- Sutinen, J.G., 1993. Recreational and commercial fisheries allocation with costly enforcement. *Am. J. Agr. Econ.* 75 (5), 1183–1187.
- Swim, J.K., Bloodhart, B., 2013. Admonishment and praise: interpersonal mechanisms for promoting proenvironmental behavior. *Ecopsychology* 5 (1), 24–35. <http://doi.org/10.1089/eco.2012.0065>.
- Tibshirani, R., 1996. Regression shrinkage and selection via the Lasso. *J. R. Stat. Soc. Ser. B(Methodological)* 58 (1), 267–288.
- van Poorten, B.T., Arlinghaus, R., Daedlow, K., Haertel-Borer, S.S., 2011. Social ecological interactions, management panaceas, and the future of wild fish populations. *P Natl. A. Sci.* 108 (30), 12554–12559.
- Ward, H.G.M., Allen, M.S., Camp, E.V., Cole, N., Hunt, L.M., Matthias, B., et al., 2016. Understanding and managing social–ecological feedbacks in spatially structured recreational fisheries: the overlooked behavioral dimension. *Fisheries* 41 (9), 524–535. <http://doi:10.1080/03632415.2016.1207632>.
- Witte, K., 1992. Putting the fear back into fear appeals: the extended parallel process model. *Commun. Monog* 59 (4), 329–349.