



Motivations of recreational fishers involved in fish habitat management

C. COPELAND

NSW Department of Primary Industries (Fisheries), Wollongbar, NSW, Australia

E. BAKER

Greenpigeon, NSW, Australia

J. D. KOEHN

Arthur Rylah Institute for Environmental Research, Heidelberg, Vic., Australia

S. G. MORRIS

NSW Department of Primary Industries (Fisheries), Wollongbar, NSW, Australia

I. G. COWX

Hull International Fisheries Institute, University of Hull, Hull, UK

Abstract This study profiled the motivations of recreational fishers involved in habitat management activities in Australia, USA, UK and Ireland. Fishers were surveyed using an online questionnaire. Primary motivations for involvement were social ('putting something back') rather than to increase fish numbers or improve fishing experience. Fishers were more likely to participate in habitat management if they were members of a club or organisation or self-rated their knowledge of various aspects of fish ecology as very good. Most activities undertaken were relatively simple tasks such as picking up litter and contacting government or the media. Fishers that did not take part in habitat management cited lack of time as the principal reason, but organisational issues (lack of contacts, funding and ideas) were also important. There are considerable opportunities for government agencies and recreational fishing organisations to increase the participation of recreational fishers in habitat management as well as their involvement in more complex tasks through targeted programmes providing contact points, ecological information and administrative support.

KEYWORDS: angling, engagement, fishing, habitat rehabilitation, participation, survey.

Introduction

Freshwater and coastal fish stocks support large recreational fisheries, with an estimated 10.5% of people in industrialised nations participating annually (Arlinghaus *et al.* 2014). These fisheries provide considerable social and economic benefits to both regional and national

economies (Hickley 1998; Cooke & Cowx 2004; Barwick *et al.* 2014). While harvest by recreational fisheries can impact fish stocks (Post *et al.* 2002; Cooke & Cowx 2004; Cowx *et al.* 2010), the main threats to freshwater fisheries targeted by recreational fishers are primarily due to habitat degradation (Dudgeon *et al.* 2006; Cowx *et al.* 2010; Welcomme *et al.* 2010; Koehn &

Correspondence: Craig Copeland, Aquatic Habitat Rehabilitation, NSW Department of Primary Industries (Fisheries), Bruxner Hwy, Wollongbar, NSW 2477, Australia (e-mail: craig.copeland@dpi.nsw.gov.au)

Lintermans 2012; Stendera *et al.* 2012). These large-scale habitat changes are also repeated worldwide in coastal areas (see, for example, FAO 2007; Waycott *et al.* 2009; Davidson 2014), with particular impacts on estuarine and near coastal fisheries.

Catch rates are often considered a key measure of angler satisfaction (Arlinghaus & Mehner 2005), and traditional fishery management approaches have largely targeted managing fish stocks through the use of fishery regulations or by stocking hatchery-produced fish (Arlinghaus *et al.* 2010; Cowx *et al.* 2010). Progressively, however, policy debates have turned to the need to increase efforts to rehabilitate and restore fish habitat structure and function (Arlinghaus & Mehner 2005; Cowx *et al.* 2010). Just as the level of community participation in citizen science programmes has increased markedly in recent decades (Lambert 2014), so too has the involvement of recreational fishers in such efforts. Recreational fishers in developed countries are beginning to contribute time, money and thought to protecting the remaining fish habitats in good condition, and restoring those that are degraded (Brown 2012). The need for an increasing role for recreational fishers in fish conservation has been argued (Cowx *et al.* 2010), and recreational fishers have been instrumental in a range of fishery management projects (Granek *et al.* 2008). In the Northern Hemisphere particularly, this has meant collectives of fishers operating on conservation projects at catchment and national scales. Examples include Trout Unlimited and the Coastal Conservation Association (USA), the Angling Trust, Wild Trout Trust and individual River Trusts (UK), and the Lough Sheelin Trout Protection Association and similar site-specific groups in Ireland. Despite this outward manifestation of recreational fisher engagement and support for fish habitat management activities, the proportion of fishers involved is unknown, but likely to be small. Given the potential increased contribution of labour and advocacy that recreational fishers could provide, an enormous opportunity exists to improve fisheries management internationally.

The recreational fishing community is diverse and motivations to fish have been widely studied (see, e.g., Fedler & Ditton 1994; Henry & Lyle 2003; Ormsby 2004; Schramm & Gerard 2004; Sutton 2006; Schirmer 2012; Arlinghaus *et al.* 2014). This work includes the social reasons that influence the attitudes, perceptions and motivations for engagement of recreational fishers in fishing. Human dimensions research relating to fisheries management options is more limited and mostly associated with harvest regulation and comparison of issues such as the stocking vs managing fish habitat debate (Arlinghaus & Mehner 2005). There has been no examination on social dimensions of recreational fishers' engagement in habitat management.

This study aimed to contribute to an understanding of what motivates recreational fishers to take part in fish habitat work, provide a profile of these fishers, and to determine why other fishers do not participate in such activities. This work compares and contrasts motivations and activities of fishers in four industrialised nations and provides a knowledge base to inform fisheries managers on how to engage recreational fishers in the management of their fisheries through habitat-orientated activities.

Methodology

The survey

Recreational fishers from four comparable English-speaking, industrialised nations where recreational fisheries are prominent [Australia, Ireland, United Kingdom (UK) and United States of America (USA)] were surveyed to determine their motivations for being involved in fish habitat management. The term 'recreational fishers' is used throughout the study to refer to those who catch fish for leisure. It is inclusive of the term 'angler' used in some countries, but excludes subsistence, cultural and commercial fishers. The survey comprised 27 questions (Table S1). The first set of questions collected demographic data and was compatible with other major recreational fisher surveys (e.g. Henry & Lyle 2003; U.S. Department of the Interior *et al.* 2011; Brown 2012). The second set of questions was designed to profile fishers and determine their fishing experience, location, distance travelled and motivation to be involved. Again, where possible, these questions were attuned to those used in standard surveys of recreational fishers. The third set of questions was related to engagement, knowledge and motivation in relation to fish habitat issues. The development of these questions was informed by formal evaluation and informal feedback from recreational fishers and managers participating in capacity-building programmes in the Fish Habitat Network in Australia and the results of a pilot survey of recreational fisher knowledge about fish habitat issues in Northern NSW, Australia (E. Baker personal communication). The questions were then refined following interviews with fishers involved in habitat activities in the UK, Ireland and the USA to provide response options for each question. An option to answer 'Other' and give details was also provided. The survey was reviewed by recreational fishing organisations in each country for appropriate terminology, then piloted with a small group of recreational fishers in Australia to check that the purpose and wording were clear and accessible.

The survey was made available via the online service provider, Survey Monkey™, and respondents accessed

Table 1. Organisation used for distribution of the survey (direct and social media) membership numbers and number of survey participants for each country

Country	Direct	No.	Social media	No.	No. of survey participants
Australia	Fisheries Victoria	34 000	Fisheries Victoria	17 500	1110
	Sunfish	9500	Fish Habitat Network Facebook™	600	
	Recfishwest	34 000	Recfishwest Facebook™	34 000	
	Aust Fishing Trade Assn	700	Recreational Fishing Alliance	1000	
	Recfish SA	50 000			
	Recreational Fishing Alliance	3400			
Ireland	Inland Fisheries Ireland	5000	Inland Fisheries Ireland Facebook™	8700	660
UK	Angling Trust	400 000	Environment Agency Twitter™	249 000	587
			Environment Agency Facebook™	18 800	
USA	Keep America Fishing	1 051 000			3289
Total		1 587 600		329 600	5646

the survey via their own Internet portals and participated anonymously. The online provision of the survey enabled the position of the answer options in each multiple choice question to be automatically randomised. Invitations to participate were distributed by email and media release in early June 2014 through recreational fishing organisations and/or government fishing agencies in each country, and provided access to more than 1.5 million anglers (Table 1). The survey remained open for 1 month. Survey participants were given the option to be included in a prize draw and to be added to a database to be kept informed about fish habitat activities. Participants were directed via a hyperlink to a separate Survey Monkey™ survey to ensure there was no connection between their data and their email address. Participants were given a 'no thanks' option, or could opt in to a prize draw and/or subscription for additional information. Prize draws were offered separately in the UK, the USA and Australia.

Data analysis

An ordinal measure of involvement in fish habitat management was derived from the survey. Nominated activities were rated for their complexity and participants were assigned to a complexity class based on their habitat management activities during the previous year (see Table 2 for a list of simple and complex tasks): SIMPLE = nominated at least one simple activity, but no high complexity activities; COMPLEX = nominated at least one complex rated activity, but may have included simple activities. A series of cumulative logit models (Agresti 2002) were used to estimate the odds of a more complex activity being undertaken by a recreational fisher depending on the levels of several demographic factors of interest. The coefficients from each model

Table 2. Habitat management activity undertaken by recreational fishers and activity complexity classes: NIL, no activity nominated; SIMPLE, nominated at least one simple activity, but no high complexity activities; COMPLEX, nominated at least one complex rated activity, but may have included simple activities

Type and class of activity	No. of votes (% of respondents)	No. of respondents in class	% of respondents in class
Complex			
Control/Remove aquatic pests/weeds	475 (31)	903	16
Reinstate instream structure	291 (19)		
Improve quality of water entering waterways	212 (14)		
Weeded riparian area	201 (13)		
Replanted riparian area	168 (11)		
Fenced off riverbank or wetland	124 (8)		
Other	55 (4)		
Simple			
Cleaned up litter	1182 (78)	605	11
Contacted government or politician	697 (46)		
Contacted media	373 (25)		
NIL		4138	73

Nb: survey respondents were able to select multiple activities. The number of votes is therefore greater than the number of respondents. In terms of the number of respondents in each class if they carried out both simple and complex activities, this was marked as complex. The figure in brackets is the number of activities expressed as a percentage of the number of respondents in that class.

were used to estimate the odds ratio of higher-level complexity relative to an arbitrary established baseline level from within the set of options within the demographic factor of interest (Table 3). Thus, a coefficient >1 for a demographic group indicates that group to have

Table 3. Proportional responses and odds ratios of recreational fishers contributing to habitat management

	%	OR	Education	%	OR	Country	%	OR	Locality description	%	OR
Gender											
Female	8.3		Did not attend school	0.2	1.8	Australia	19.6		A city or its suburbs	49.2	
Male	91.7	1.49*	Primary school	0.8	0.6	UK	10.4	3.0*	A regional or rural town	35.6	1.4*
Years of Fishing			Part finished junior/grade 10	3.8	0.6	USA	58.3	1.0	A rural/remote locality	15.2	1.8*
<5	3.1		Graduated from high school	22.7	1.0	Ireland	11.7	2.1*			
5–10	4.2		Diploma or certificate	19.3	1.0				Distance Travelled		
>10	92.7	1.5*	Bachelor degree	24.6					0–10 km	16.9	
Fishing Practice			Higher degree	15.2	1.4*	Knowledge of Habitat Issues			11–20 km	18.1	1.0
I keep what I catch	5.0	0.5	Trade qualifications	13.4	1.0	Very Good	42.0	4.8*	21–60 km	29.5	0.9
I catch what I need for food, then stop	11.0	0.8	Fishing Frequency			What juveniles need: survive/grow			61–150 km	21.6	1.0
I catch for food, then catch & release	44.2	1.1	Nearly every day	5.3	4.0*	What adults need: thrive	48.8	4.9*	>150 km	13.9	0.9
I only catch & release	34.3	1.7*	About once or twice a week	37.8	2.9*	What is needed: breed successfully	38.0	4.1*			
Catch & release, but keep trophy fish	5.5		About once or twice a month	47.2	1.8*	Fair/Reasonable			Fishing Location		
Reasons for going Fishing			About once or twice a year	9.7		What juveniles need: survive/grow	47.0	2.1*	Freshwater rivers/streams	22.9	2.4*
To relax and unwind	29.6	0.8	Club/Organisation Member			What adults need: thrive	43.7	2.1*	Estuary	6.7	1.8*
To be outdoors	19.5	0.9	Yes	43.2	4.3*	What is needed: breed successfully	44.6	1.9*	Freshwater natural lakes/ponds	23.8	1.7*
For the challenge	14.9		No	56.8		Not Good/Poor			Freshwater impoundments/dams	10.3	1.6*
To spend time in natural areas	14.3	1.5*	Abundance of Native Fish			What juveniles need: survive/grow	11.0		Coastal shore-beach/rocks	9.9	
To be with family	7.9	0.6	More native fish around now	13.3	1.3*	What adults need: thrive	7.5		Inshore marine boat fishing (<3 km)	15.5	1.0
To be with friends	4.6	0.7	Fewer native fish around now	56.4	1.5*	What is needed: breed successfully	17.4		Offshore marine boat fishing (>3 km)	10.9	1.1
To obtain food	3.8	0.8	About the same	30.3							
For solitude	3.5	1.0									
To compete	1.9	1.9*									

OR, odds ratio.

*Significant association with 95% confidence limit compared with arbitrarily defined benchmark indicated by blank space in OR column.

greater odds of complex activity than the baseline, while a coefficient <1 indicates that the demographic group had lower odds. Groups were defined as significantly different from the baseline when the 95% confidence interval for the odds ratio excluded the value of 1. All data analyses were conducted in the R environment (R Core Team 2015). Due to low-frequency responses to the question on fishing experience, the two less experienced groups (5 and 5–10 years) were merged so that there were only two classes: <10 years and >10 years.

Results

A total of 5646 recreational fishers responded to the survey, 58% from USA, 20% from Australia, 10% from the UK and 12% from Ireland (Table 1).

Involvement in habitat activities

Twenty seven percent of recreational fishers who responded were involved in a volunteer habitat

management activity in the 12 months prior to the survey (Table 2). The majority of the activities undertaken by recreational fishers were relatively simple, such as picking up litter (the most common activity – 78%; or contacting government or the media – 46%; Table 2). Fewer respondents undertook complex activities, such as instream works and weed management, which required design planning approvals and funding. The bulk of the respondents (90%) who carried out a complex activity had also all undertaken one or more simple tasks.

Profile of recreational fishers

The majority of survey respondents were male (92%) who had completed high school education and had further trade or tertiary qualifications (72%). Despite distributing the survey through fishing organisations, the majority of respondents did not belong to a fishing club or organisation (57%), but had been fishing for >10 years (93%) and fished more than once per month (90%). The greatest proportion of fishers lived in a city or suburbs (49%), compared with a regional urban centre or rural town (36%) or rural or remote localities (15%). Respondents fished in a variety of localities with freshwater areas predominant (57%) and they generally travelled <60 km to fish (64%), with 29% travelling 21–60 km (Table 3).

The fishers self-rated their knowledge of the habitats of the fish they catch as either fair or reasonable (>32%) or very good (>29%), with only <11% rating their knowledge as poor. Most fishers also carried out some form of catch-and-release fishing (84%) and generally fished for relaxation, being outdoors or to be in nature (63%). The highest proportion of fishers thought that there were fewer fish now than in the past (56%) and that the most effective activities that could be undertaken to improve catches of fish related to fish habitat issues: (1) restoring fish habitat; (2) protecting waterways from the effects of urban development; and (3) improving water quality (Fig. 1).

Odds ratio analysis indicated that fishers who reside in the UK were three times more likely to undertake fish habitat management activities than Australian and US fishers (Table 3); Irish fishers were 2.1 times more likely to do so than the latter group. Fishers who self-rated their knowledge of habitat issues as very good were almost five times more likely to undertake habitat management activities than those who self-rated their knowledge as poor, with those rating their knowledge as fair/reasonable (between 43.7 and 47% of respondents) being over twice as likely as fishers who self-rated their knowledge as poor. Fishers who were more likely to have participated in habitat management in the previous

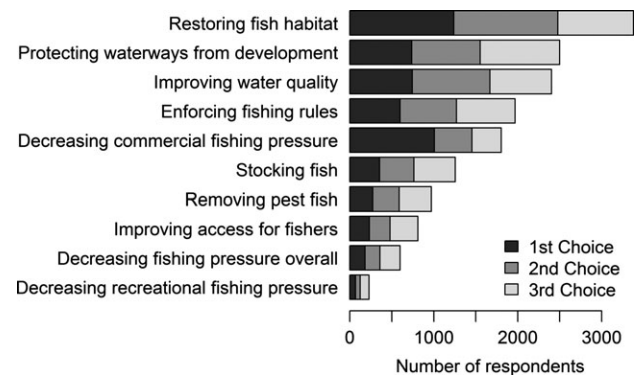


Figure 1. Responses (first, second and third choice) to the question 'If you wanted your catch to improve, which three of the following activities do you think would be the most effective?'

12 months were also male; aged between 64 and 81 years of age; have a postgraduate degree; do not live in a city; fish nearly every day; catch and release their fish; and are members of fishing clubs or organisations. Fishing location was also a predictor of participating in a habitat management activity with freshwater and estuarine fishers between 1.6 and 2.4 times more likely to volunteer than coastal or offshore fishers (Table 3). One factor that did not contribute to involvement in habitat activity was the distance travelled to fish. In addition, fishers that thought there were more fish around now and fishers who thought there were less fish around were both more likely to undertake habitat activity than those who thought there about the same amount of fish around.

Motivation of recreational fishers involved in habitat activities

Of the 27% of recreational fishers in this survey who undertook habitat management, 73% get involved in fish habitat management activities to 'put something back into their sport'. This primary motivation is more than twice as likely as the next most popular reason, 'an organisation helped me get involved' at 31% (Table 4) and was not statistically different between countries. Fishers involved in habitat activities experienced a wide range of benefits from being involved in those activities with the primary reason being that it was 'satisfying to put something back into their sport' (72%; Table 4). The activities carried out by recreational fishers were predominantly organised by recreational fishing clubs or organisations (54%) and then by individuals (41%), with other environmental groups, government agencies, friends and schools playing relative minor roles (Table 4). There was a lack of difference in issues of motivation, benefit and organisation between countries.

Table 4. Responses to survey questions relating to participation in habitat activities

What influenced your decision to get involved*	Benefits experienced from being involved in habitat activities* %	Who organised the activities* %	Reason for not participating in habitat management activities from those who chose nil activity in the survey %	All countries %				
				Australia %	Ireland %	UK %	USA %	
Saw an opportunity to put something back	73	72	54	35	33	22	37	37
An organisation helped	31	58	41	18	18	25	17	17
Received information connecting habitat and fishing	19	54	16	14	17	19	8	12
Saw changes in catch with better habitats	15	47	11	11	10	12	11	12
Respected peer involved	13	41	8	6	6	6	6	6
Influential/high profile person involved	3	39	1	5	5	4	5	4
		32		4	3	6	5	4
		26		2	2	1	2	2
		26		2	2	2	2	2
		22		2	1	1	1	2
		12		2	2	2	4	2
				1	1	1	1	1

* Respondents could nominate more than one benefit so responses are not mutually exclusive.

The majority of respondents to the survey (73%) indicated that they had not participated in any habitat activity in the previous 12 months. These recreational fishers who did not volunteer cited 'Don't have time' as the main reason for not taking part (35%; Table 4) with 'Don't know who to contact', 'Don't know how' and 'The money to do what is needed isn't available' other prominent reasons. These reasons were similar across all four countries in proportion and order except in Ireland where 'Don't know who to contact' was the main reason not to take part in habitat management activities.

Discussion

Recreational fishers across all four countries participated as volunteers in a range of habitat management activities. The primary influence determining whether recreational fishers get involved in habitat management was the 'opportunity to put something back' to their sport (73% of respondents). It was expected that better fishing or improved catch would be the primary motivators for involvement in habitat management by recreational fishers, but these factors were rated lowly in this survey (22% and 15%, respectively), and this contradicts personal communications from many recreational fishers in all countries (Copeland 2013). These findings are consistent, however, with the assumption that recreational fishers constitute a social group (Granek *et al.* 2008) and that some of the key factors that facilitate a sense of community in social groups are a shared emotional connection and integration and fulfilment of needs (McMillan & Chavis 1986). Furthermore, the three actions recreational fishers thought to be the most effective in improving fish stocks were all environmental: habitat restoration; protection from development; and water quality improvements (Fig. 1). This is consistent with other surveys (e.g. Department of Primary Industries (Fisheries) Victoria 2010; Brown 2012; Garlock & Lorenzen 2016) and shows recreational fishers perceive habitat factors to be the most important issues facing the future of their sport. This suggests a shift in thinking of recreational fishers is now well underway: from management approaches driven by stocking to enhance fisheries, towards habitat improvement-based measures. This shift may, in part, be an artefact of the proliferation of intensively stocked, artificial water bodies that initially satisfied the needs of those recreational fishers wanting increased catch rates (North 2002; Cowx *et al.* 2010) but whose views have now evolved to include more holistic, longer-term solutions to improving their fishery. This includes recreational fishers now wishing to contribute collectively to a more sustainable management

approach to recreational fisheries (following Arlinghaus & Mehner 2005).

'Helping the environment' is an important motivation for people volunteering in conservation and natural resource management fields (Ryan *et al.* 2001; Bruyere & Rappe 2007; Asah & Blahna 2013), but only when participation meets volunteers' desires to feel good about themselves, interact socially and build their community (Asah & Blahna 2012, 2013). This type of contribution also provides a mechanism for their involvement in other management issues and aligns recreational fishing with conservation objectives (Cowx *et al.* 2010; Koehn 2010). Similarly, 'doing rewarding work' and 'enjoying social interactivity' within limited time commitments were also key motivations of sports volunteers (Taylor *et al.* 2006).

Major benefits of participation in habitat management activities are the contribution to a sense of community through meeting 'a social obligation', 'changing how other people think of fishers' and 'being part of the club or organisation's activities'. These social factors are symptomatic of recreational fishers working together to develop a shared history and identity. These benefits contribute to collective purpose, provide opportunities for social interaction and reinforce group norms. These benefits also reinforce the idea that factors other than catch are more important in determining recreational fishers' decisions about taking active stewardship roles, as previously indicated by Bruskotter and Fulton (2007). The additional benefits associated with involvement in habitat management activities were consistent with motivations for going fishing in general (Henry & Lyle 2003), that is being outdoors and being active. These motivations of recreational fishers are in line with other disciplines and provide opportunities for voluntary, non-monetary approaches that are present in many areas of conservation (Santangeli *et al.* 2016), which could be incorporated into recreational fisheries management.

Recreational fishers who were a member of a fishing club or organisation were four times more likely to participate in habitat management. This is consistent with the general literature that indicates that organisations are important in supporting volunteerism and that organisation and support needs have to be met before other personal and social satisfactions are realised (e.g. Ryan *et al.* 2001). The majority of respondents in the current survey indicated that the habitat management activities in which they volunteered were organised by a fishing club or organisation (54%), with an additional 27% being supported by environmental or community groups and government agencies (11%). This highlights the importance of clubs and volunteer organisations coordinating habitat or other fishery improvement programmes

to facilitate the inherent desires of those recreational fishers wishing to be engaged in fisheries habitat management activities. This result is despite the majority of activities that respondents engaged in being not necessarily dependent on organisational support, for example picking up litter or contacting media or government. There was, by contrast, a much lower level of involvement in activities that are more complex and/or require technical expertise, permits and funding, such as reinstatement of instream habitat structures or remediation of riparian zones. This was to be expected as these resource-intensive activities are very dependent on organisational support and require a level of commitment and financial administration.

Participation by recreational fishers in habitat management varies considerably between countries. Fishers in Ireland and the UK are much more likely to be involved (two and three times, respectively) than in the USA and Australia. The principal reason for this is likely to be the social context and regulatory differences relating to waterway access. In the UK and Ireland, waterways are to a large extent privately owned with access leased to fishing clubs at significant cost, whereas waterways in Australia and the USA are publically owned. This is likely to reduce fishers' sense of ownership and responsibility with these attributes often being drivers of stewardship (Bramston *et al.* 2011; Winfield 2014). Volunteering is often encouraged by a personal connection with issues where the volunteer has a personal interest (Seng & White 2007) and promoting the option for Australian and USA fishing clubs to 'adopt a river reach' where they undertake habitat works provides opportunities for increased involvement. This approach incorporating a range of community groups and agencies has been successful for actions to rehabilitate to enhance fish populations in Australia (Koehn & Lintermans 2012; Koehn *et al.* 2014). It is also likely that the size of the country and proximity to fishing locations influence participation in such activities. The UK and Ireland are small countries with high population densities that have closer access to rivers and lakes to undertake habitat improvement works.

The profile characteristics of recreational fishers who are more likely to have participated in habitat management activities, with probable reasons (parentheses), are as follows: male; between 64 and 81 years of age (potentially more free time); have obtained a postgraduate degree (potentially more financial resources); do not live in a city (closer connection to a river, stream or dam); fish nearly every day (committed to their sport); fish freshwater or estuarine areas and streams rather than offshore (again more closely connected to the environment that is affecting their target fish); self-assess their

knowledge of juvenile/adult fish and breeding as fair/reasonable or very good (informed on matters that might affect their target fish); catch and release their fish (be committed to looking after fish populations); be members of fishing clubs or organisations (working within a community with common goals and with resources to support activity); and fish competitively (may be an overlap with fishing frequency) or fish to be in a natural environment (committed to making the place that is fished in good condition). This information will be useful for targeting education and capacity-building initiatives by recreational fishing organisations and government agencies, and further research would assist in better understanding motives and drivers of participating recreational fishers.

One motivation to undertake habitat management activity that was ranked comparatively low by recreational fishers (19%) was '*received information connecting habitat and fishing*'. However, if fishers self-rated their knowledge of the habitat needs of the species they catch as 'very good', then they were almost five times more likely to participate in habitat management activities than those who rated their knowledge as poor. Knowledge gain is known to support broader participation in environmental activities (Kollmuss & Agyeman 2002) and the fact that the majority of recreational fishers surveyed indicated 'putting something back' as the most important motivator, suggests that the dynamic between acquired knowledge and participation is worth exploring further. The provision of readily accessible knowledge regarding fish ecology, especially coupled with activities aimed at beneficial outcomes for fish and fishing, may be a way of engaging fishers more effectively in fish habitat.

The principal reason that recreational fishers do not participate in habitat management activities is '*lack of time*', and this is consistent with the social science literature, which cites lack of time as one of the more common reasons for not volunteering (Sundeen *et al.* 2007; Weaver 2015). This reason may, however, conceal other motives, such as a lack of interest or other priorities and these, as well as poor health, has been previously noted (Sundeen *et al.* 2007). While lack of time can be seen to be restrictive, the next three most selected reasons – '*Don't know who to contact*', '*Don't know how*' and '*The money to do what is needed isn't available*' – all provide mechanisms for engagement. Government agencies, recreational fishing and other community organisations can provide information, contacts, opportunities, technical guides and potentially funding. If such information is provided to recreational fishers, some of these bottlenecks to participation in habitat management could be addressed.

This survey needed to collect data in a cost-effective manner from a large number and broad range of fishers who had or had not undertaken habitat management, to provide insight into their motivations for participation. To achieve this, the electronic survey was sent out via general fishing organisations and fishing agencies. This potentially targeted those fishers that already cared enough to sign up for further information. In doing so, this form of 'self-selection' may have potentially overestimated the proportion of fishers that took part in habitat management. Hence, the result of only 27% of recreational fishers taking part in habitat management may have been even less, leaving plenty of scope for improved engagement and on ground outcomes. It is also well recognised that while web surveys are a very cost-effective way to collect social data, like any method they have their biases (e.g. age, self-selection) (Couper *et al.* 2007), but additional consequences on the results of this study are not considered to be significant.

There are significant issues facing recreational fisheries throughout the world, and recreational fishers are participating in actions that support their fisheries. To further increase their involvement in fisheries management activities, programmes need to target the fishers' motivations for engagement. They must include development of fishers' 'sense of community' rather than just 'to catch more fish', and habitat programmes can play an important role here. The agencies and recreational fishing organisations involved in such programmes could play an even greater role in restoration through encouragement of those individuals and community organisations currently not engaged. The use of 'fishery habitat' coordinators that promote and facilitate activities among recreational fishers can facilitate successful, longer-term engagement (Koehn & Lintermans 2012; Hames *et al.* 2014). Involvement by the public in habitat projects offers an opportunity to increase their awareness of environmental issues, participate and understand scientific research and foster local stewardship (Gillett *et al.* 2012). There is a growing recognition of the need to improve communication between fishery scientists, managers and anglers, and working on habitat projects together provides an excellent mechanism for this to occur (Dedual *et al.* 2013).

Participation rates in angling in industrialised nations are generally on the decline with increasing levels of alternative leisure opportunities (Arlinghaus *et al.* 2014), and dedicated marketing intervention has been suggested to reverse this diminishing interest (Aprahamian *et al.* 2010). Angler involvement in fish habitat restoration programmes may also be a mechanism to achieve this. The involvement of recreational fishers in habitat management activities also provides an opportunity for

constructive dialogue between fisheries agencies, the general community and recreational fishers, providing a platform to build consensus on what otherwise may be potentially conflicting conservation/fishery-related issues (Cowx *et al.* 2010; Koehn 2010). It should be noted, however, that these types of initiatives are likely restricted to countries where environmental obligations, such as the European Union Water Framework Directive, facilitate drives towards habitat restoration.

This study provides an improved understanding of the social drivers that can lead to the greater understanding of, and more effective participation by, recreational fishers in habitat management activities. The ultimate outcome apart from improved habitats and fish populations is that recreational fishers can be seen as guardians of a resource rather than just merely a harvesting sector.

Acknowledgements

The authors wish to thank all the survey participants for providing their time. The survey was assisted by United Kingdom – Angling Trust and Environment Agency, Ireland – Inland Fisheries Ireland, United States of America – Keep America Fishing, and Australia – Recfishwest, Recfish SA, Recreational Fishing Alliance (NSW), Council of Freshwater Anglers (NSW), Sunfish (Qld), Amateur Fishermen's Association Northern Territory (AFANT), Fisheries Victoria, Arthur Rylah Institute and DPI Fisheries (NSW). Prizes in Australia were provided by Australian Fishing Trade Association and Pure Fishing. Support for the survey and information to underpin the survey questions was provided while one of us (CC) was on a Churchill Fellowship. Kasey Stamation (ARI) provided useful editorial suggestions as did two anonymous reviewers.

References

- Agresti A. (2002) *Categorical Data Analysis*, 2nd edn. Hoboken, NJ: Wiley Interscience, 720 pp.
- Aprahamian M.W., Hickley P., Shields B.A. & Mawle G. (2010) Examining changes in participation in recreational fisheries in England and Wales. *Fisheries Management and Ecology* **17**, 93–105.
- Arlinghaus R. & Mehner T. (2005) Determinants of management preferences of recreational anglers in Germany: habitat management versus fish stocking. *Limnologica* **35**, 2–17.
- Arlinghaus R., Cooke S.J. & Cowx I.G. (2010) Providing context to the global code of practice for recreational fisheries. *Fisheries Management and Ecology* **17**, 146–156.
- Arlinghaus R., Tillner R. & Bork M. (2014) Explaining participation rates in recreational fishing across industrialised countries. *Fisheries Management & Ecology* **22**, 45–55.

- Asah S.T. & Blahna D.J. (2012) Motivational functionalism and urban conservation stewardship: implications for volunteer involvement. *Conservation Letters* **5**, 470–477.
- Asah S.T. & Blahna D.J. (2013) Practical implications of understanding the influence of motivations on commitment to voluntary urban conservation stewardship. *Conservation Biology* **27**, 866–875.
- Barwick M.J., Koehn J.D., Crook D., Todd C.R., Westaway C. & Trueman W. (2014) The future for managing recreational fisheries in the Murray-Darling Basin. *Ecological Management and Restoration* **15**(S1), 75–81.
- Bramston P., Pretty G. & Zammit C. (2011) Assessing environmental stewardship motivation. *Environment and Behaviour* **43**, 776–788.
- Brown A. (2012) *The National Angling Survey 2012: Survey Report*. Report prepared by Substance for the UK Angling Trust. Available at: www.resources.anglingresearch.org.uk (last accessed 30 June 2015)
- Bruskotter J.T. & Fulton D.C. (2007) The influence of angler value orientations on fisheries stewardship norms. In: B.A. Knuth & W.F. Siemer (eds) *Aquatic Stewardship Education in Theory and Practice*. American Fisheries Society Symposium 55, Bethesda, MD: American Fisheries Society, pp. 157–168.
- Bruyere B. & Rappe S. (2007) Identifying the motivations of environmental volunteers. *Journal of Environmental Planning and Management* **50**, 503–516.
- Cooke S.J. & Cowx I.G. (2004) The role of recreational fishing in global fish crises. *BioScience* **54**, 857–859.
- Copeland C. (2013) *Recreational Fishers and Fish Habitat: Towards a new Paradigm for Australia*. 2012 Churchill Fellow Report. Available at: <https://www.churchilltrust.com.au/fellows/detail/3698/craig+copeland> (last accessed 3 February 2016)
- Couper M.P., Kapteyn A., Schonlau M. & Winter J. (2007) Noncoverage and non-response in an Internet survey. *Social Science Research* **36**, 131–148.
- Cowx I.G., Arlinghaus R. & Cooke S.J. (2010) Harmonizing recreational fisheries and conservation objectives for aquatic biodiversity in inland waters. *Journal of Fish Biology* **76**, 2194–2215.
- Davidson N.C. (2014) How much wetland has the world lost? Long-term and recent trends in global wetland area. *Marine and Freshwater Research* **65**, 934–941.
- Dedual M., Sague Pla O., Arlinghaus R., Clarke A., Ferter K., Geertz-Hansen P. *et al.* (2013) Communication between scientists, recreational fishers, fishery managers and recreational fishers: lessons learned from a comparative analysis of international case studies. *Fisheries Management and Ecology* **20**, 234–246.
- Department of Primary Industries (Fisheries) Victoria (2010) *Recreational Fishing Survey 2009 – Report Of Overall Results*. Available at: <http://agriculture.vic.gov.au/fisheries/policy-and-planning/publications-and-resources/fisheries-reports/recreational-fisher-survey-results/recreational-fishing-survey-2009> (last accessed 2 December 2016).
- Dudgeon D., Arthington A., Gessner M.O., Kawabata Z.I., Knowler D.J., Lévêque C. *et al.* (2006) Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews* **81**, 163–182.
- FAO (2007) *The World's Mangroves 1980-2005*. Rome: FAO Forestry Paper 153, 77 pp.
- Fedler A.J. & Ditton R.B. (1994) Understanding angler motivations in fisheries management. *Fisheries* **19**, 6–13.
- Garlock T.M. & Lorenzen K. (2016) Marine angler characteristics and attitudes toward stock enhancement in Florida. *Fisheries Research* **186**, 439–445.
- Gillett D.J., Pondella D.J. II, Freiwald J., Schiff K.C., Caselle J.E., Shuman C. *et al.* (2012) Comparing volunteer and professionally collected monitoring data from the rocky subtidal reefs of Southern California, USA. *Environment Monitoring and Assessment* **184**, 3239–3257.
- Granek E.F., Madin E.M.P., Brown M.A., Figueira W., Cameron D.S., Hogan Z. *et al.* (2008) Engaging recreational fishers in management and conservation: global case studies. *Conservation Biology* **22**, 1125–1134.
- Hames F., Townsend A., Ringwood G., Clunie P. & McPhail J. (2014) Effective engagement of the Native Fish Strategy is delivered by coordinated and contextual effort. *Ecological Management and Restoration* **15**(S1), 13–27.
- Henry G.W. & Lyle J.M. (eds) (2003) *The National Recreational and Indigenous Fishing Survey*. Canberra: Australian Government Department of Agriculture, Fisheries and Forestry, 188 pp.
- Hickley P. (1998) Recreational fisheries- social, economic and management aspects. In: P. Hickley & H. Tomkins (eds) *Fish, Sustainability and Development*. Oxford: Fishing News Books, pp. 137–157. Available at: <http://www.pescaricreativa.org/docs/No.%2066%20-%20Recfish%20book%20chapter.pdf>.
- Koehn J. (2010) Conservation and utilisation: harnessing forces for better outcomes for native fishes. *Ecological Management and Restoration* **11**, 86–87.
- Koehn J.D. & Lintermans M. (2012) A strategy to rehabilitate fishes of the Murray-Darling Basin, south-eastern Australia. *Endangered Species Research* **16**, 165–181.
- Koehn J.D., Lintermans M. & Copeland C. (2014) Laying the foundations for fish recovery: the first 10 years of the Native Fish Strategy for the Murray-Darling Basin, Australia. *Ecological Management and Restoration* **15**, 3–12.
- Kollmuss A. & Agyeman J. (2002) Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research* **8**, 239–260.
- Lambert J. (2014) *Citizen Science for Flora and Fauna Conservation: Ensuring Success*. UNSW Masters of Environmental Management. IEST5004 Research Internship Final Report. Available at: <http://www.bmwhi.org.au/wp/citizen-scientist-project-report/#more-1800> (last accessed 3 February 2016)

- McMillan D.W. & Chavis D.M. (1986) Sense of community: a definition and theory. *American Journal of Community Psychology* **14**, 6–29.
- North R. (2002) Factors affecting the performance of stillwater coarse fisheries in England and Wales. In: I.G. Cowx (ed) *Management and Ecology of Lake and Reservoir Fisheries*. Oxford: Blackwell Science, pp. 284–298.
- Ormsby J. (2004) *A Review of the Social, Motivational and Experiential Characteristics of Recreational Anglers From Queensland and the Great Barrier Reef Region*. Research Publication No. 78. Townsville: Great Barrier Reef Marine Park Authority (GBRMPA), 110 pp.
- Post J., Sullivan M., Cox S., Lester N., Walters C., Parkinson E. et al. (2002) Canada's recreational fisheries: the invisible collapse? *Fisheries* **27**, 6–17.
- R Core Team (2015) *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. URL <http://www.R-project.org/>.
- Ryan R.L., Kaplan R. & Grese R.E. (2001) Predicting Volunteer Commitment in Environmental Stewardship Programmes. *Journal of Environmental Planning and Management* **44**, 629–648.
- Santangeli A., Arroyo B., Dicks L.V., Herzon I., Kukkala A.S., Sutherland W.J. et al. (2016) Voluntary non-monetary approaches for implementing conservation. *Biological Conservation* **197**, 209–214.
- Schirmer J. (2012) *Understanding the Social Dimensions of Recreational Fishing in South Australia*. Canberra: University of Canberra: Centre for Research and Action in Public Health, 73 pp. Available at: www.eaa-europe.org/files/rec-fish-pres-nov8th-au2_7931.pdf (last accessed 5 December 2016).
- Schramm H.L. & Gerard P.D. (2004) Temporal changes in fishing motivation among fishing club anglers in the United States. *Fisheries Management & Ecology* **11**, 313–321.
- Seng P.T. & White G.M. (2007) Measures of aquatic stewardship from a fisheries perspective. In: B.A. Knuth & W.F. Siemer (eds) *Aquatic Stewardship Education in Theory and Practice*, American Fisheries Society Symposium **55**. American Fisheries Society, Bethesda, MD, pp. 137–144.
- Stendera S., Adrian R., Bonada N., Cañedo-Argüelles M., Hugueny B., Januschke K. et al. (2012) Drivers and stressors of freshwater biodiversity patterns across different ecosystems and scales: a review. *Hydrobiologia* **696**, 1–28.
- Sundeen R.A., Raskoff S.A. & Garcia M.C. (2007) Differences in perceived barriers to volunteering to formal organizations: lack of time versus lack of interest. *Nonprofit Management & Leadership* **17**, 279–300.
- Sutton S.G. (2006) *An Assessment of the Social Characteristics of Queensland's Recreational Fishers*. CRC Reef Research Centre Technical Report No. 65. Townsville: CRC Reef Research Centre, 151 pp.
- Taylor T., Darcy S., Hoye R. & Cuskelly G. (2006) Using psychological contract theory to explore issues in effective volunteer management. *European Sport Management Quarterly* **6**, 123–147.
- U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau (2011) *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. 172 pp. Available at: <https://www.census.gov/prod/2012pubs/fhw11-nat.pdf> (last accessed 3 February 2016)
- Waycott M., Duarte C.M., Carruthers T.J.B., Orth R.J., Dennison W.C., Olyarnik S. et al. (2009) Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences* **106**, 12377–12381.
- Weaver D. (2015) Volunteer tourism and beyond: motivations and barriers to participation in protected area enhancement. *Journal of Sustainable Tourism* **23**, 683–705.
- Welcomme R.L., Cowx I.G., Coates D., Béné C., Funge-Smith S., Halls A. et al. (2010) Inland capture fisheries. *Philosophical Transactions of the Royal Society of London B* **365**, 2881–2896.
- Winfield I.J. (2014) Biological conservation of aquatic inland habitats: these are better days. *Journal of Limnology* **73**(s1), 120–131.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Survey questions.