

# Recreational angler satisfaction: What drives it?

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## Funding information

(AQUATAG, # 033W046A, German Ministry of Education and Research) (BODDENHECHT, # A MV-I.18-LM-004, State of Mecklenburg-Vorpommern, # B 730117000069, EU European Maritime Fisheries Fund).

## Abstract

Satisfaction is the reward that recreational anglers receive from their experiences, and it constitutes a relevant management target. Angler satisfaction also shapes preferences for regulations, compliance with rules and general angler behaviours. Because of its central role in recreational fisheries management, it is important to understand what drives angler satisfaction. Our objective was to study the catch and non-catch-related determinants of recreational angler satisfaction using a standardized literature search and synthesizing the literature using meta-analytical techniques. After identifying and screening 279 papers, we obtained  $K = 172$  effect sizes extracted from  $N = 23$  studies that met our inclusion criteria. A three-level random-effects model on Pearson's  $R$ , derived from studies relating component satisfaction to overall satisfaction assuming a sum-of-satisfaction model, was fitted. The aggregated effect sizes revealed that catch-related (i.e. catch rate, size of caught fish, fish harvest) and two non-catch-related components (i.e. access to fishing sites and crowding) were most related to angler satisfaction. Other non-catch components (e.g. environmental quality, facilities, perception of relaxation quality) also contributed to angler satisfaction but were of less importance, more variable across studies and in some cases not significant (e.g. perceived water quality, quality of social experience). We conclude changes to access to fishing sites, crowding and a reduction in catch qualities, will in many cases produce dissatisfied anglers. In the absence of local studies, focusing management attention on these components can be recommended if the aim is to satisfy anglers or avoid managerial or social issues that emerge from dissatisfied anglers.

## KEYWORDS

angler behaviour, human dimensions, motivation, satisfaction

## 1 | INTRODUCTION

Recreational fishing involves millions of people globally, generating billions of U.S. dollars in a range of sectors (Arlinghaus et al., 2019; FAO, 2012). In freshwater fisheries in industrialized countries,

recreational fishing is today the dominant form of exploitation of wild-living fish resources (Arlinghaus et al., 2002; FAO, 2012), and its importance is rising rapidly in coastal and marine fisheries traditionally dominated by commercial fisheries (Hyder et al., 2018; Ihde et al., 2011).

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The fact that millions of recreational anglers exploit natural ecosystems around the world suggests that a range of social, economic, ecological and evolutionary impacts is associated with the practice (Ditton et al., 2002; Lewin et al., 2006; Tufts et al., 2015). Biologically, anglers can induce structural and functional changes in fish communities and aquatic ecosystems through excessive or selective harvest, hooking mortality, the release of invasive organisms, litter and environmental disturbance (Altieri et al., 2012; Johnston et al., 2013, 2015; Lewin et al., 2006; Post et al., 2002). Socially and economically, recreational fishing contributes to the well-being of individual anglers and angler-dependent industries, funding fisheries management and fostering active engagement of civil society with natural processes and biodiversity conservation (Arlinghaus et al., 2019; Bate, 2001; Daedlow et al., 2011; Granek et al., 2008; Parkkila et al., 2010; Tufts et al., 2015). To navigate ecological sustainability while maximizing the social and economic benefits of recreational fisheries, dedicated management interventions are needed when the local angler density exceeds ecological thresholds (Arlinghaus et al., 2019; FAO, 2012).

Sustainable management of recreational fisheries depends on understanding the human dimension of anglers, particularly the behavioural dimension (Arlinghaus et al., 2017; Ditton, 2004; Fenichel et al., 2013; Hunt et al., 2013; Ward et al., 2016). This, in essence, implies knowing what anglers want from their fishing experience and how they react to changes in the environment, including how anglers respond to (i) biological responses of fish to harvesting; (ii) social and economic changes; and (iii) management interventions (Arlinghaus et al., 2017, 2019; Carruthers et al., 2019; Hunt et al., 2013; Johnston et al., 2010, 2013; Matsumura et al., 2019; Post et al., 2008). Human dimensions studies designed to understand the attitudes, norms and behaviours of anglers have developed since the 1970s in response to the realization by managers they are primarily managing people, not fish (Aas & Ditton, 1998; Arlinghaus, 2004; Ditton, 2004; Hendee & Potter, 1971; Hilborn, 2007; Orbach, 1980; Parkkila et al., 2010; Pollock et al., 1994).

## 1.1 | Overview about human dimensions of recreational fisheries

The field of the human dimensions of recreational fisheries encompasses a wide range of social science disciplines (Aas & Ditton, 1998). Perhaps the most visible ones are economic and social-psychology disciplines. Economic studies often focus on understanding the values and preferences and thereby the behaviours of anglers (Fenichel et al., 2013) whereas social-psychological studies have primarily focused on how anglers think and feel regarding fisheries resources and how to describe behavioural variation among anglers (Hunt et al., 2013; Wilde et al., 1998). Since the 1970s, the social-psychological branch to the human dimensions of anglers has unfolded its own subdiscipline codified in the production of textbooks (e.g. Decker et al., 2012; Manning, 2010) and journals (e.g. Human Dimensions of Wildlife, Journal of Leisure Research, Journal

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of Outdoor Recreation and Tourism) within the context of leisure and recreation studies. Based on psychological theories, such as the theory of planned behaviour (Ajzen, 1985) or the cognitive hierarchy (Fulton et al., 1996), the field of human dimension studies in fisheries tends to study behavioural antecedents, or the decisions that pre-empt behaviour, specifically values, value orientations, beliefs, attitudes and norms (Ajzen, 1985; Decker et al., 2012). The argument is that understanding the antecedents to behaviour will ultimately help to understand key behavioural decisions of relevance to management, including anglers' selection of fishing sites (Schramm et al., 2003), anglers' decisions to release or retain fish (Arlinghaus et al., 2007; Stensland & Aas, 2014; Sutton, 2003), angler motives (Fidler & Ditton, 1994; Finn & Loomis, 2001), anglers' response to regulatory changes (Beard et al., 2003; Hunt et al., 2013), how different angler types respond to social-ecological changes (Bryan, 1977; Chipman & Helfrich, 1988; Ditton et al., 1992; Fisher, 1997; Haab

et al., 2012; Kyle et al., 2007; Ward et al., 2013) and which conditions of a fishery, such as catch rate, aesthetics, environmental quality, would make anglers satisfied (Arlinghaus, 2006; Connelly & Brown, 2000; Golden et al., 2019; Graefe & Fedler, 1986; McCormick & Porter, 2014; Spencer, 1993).

Behavioural questions of anglers were also asked by resource and environmental economists following assumptions of utility maximization (e.g. Bockstael et al., 1989; Dabrowska et al., 2017; Hunt et al., 2019). The cross-fertilization and cross-citations of economists and social-psychologists—both studying aspects of individual angler behaviour—have, however, been slim, creating academic silos within the social sciences of recreational fisheries (Fenichel et al., 2013). Key reasons for these silos are the use of different concepts, theories and measurement approaches (including different measurement units). While economists mainly draw on utility theory to describe angler preferences and behaviours using decompositional approaches, social-psychologists mainly are inspired by compositional theories, such as the theory of planned behaviour or related theories such as the cognitive hierarchy (Parkkila et al., 2010). When viewed critically, both approaches assume that an individual angler behaves in a certain way (e.g. chooses a site or releases a fish) to satisfy expected benefits, which the economist calls utility (Hunt et al., 2019) and the social-psychologist calls expected psychological benefit (Driver et al., 1991; Manfredi et al., 1996) or satisfaction (Hendee, 1974; Holland & Ditton, 1992; Manning, 2010). Utility and satisfaction both relate either directly or indirectly to the quality that an angler receives from his or her angling experience (i.e. the individual reward that an angler receives or expects). Therefore, both economists and social-psychologists, often within the applied domain of recreation or leisure studies, have both paid significant attention to the components that make anglers satisfied. Our aim is to synthesize this research from a social-psychology research tradition, given that the economics research tradition has recently been reviewed elsewhere (Hunt et al., 2019).

## 1.2 | An overview on angler satisfaction

A focus on what satisfies anglers in research is understandable given the relevance of both utility and satisfaction for explaining angler behaviour or other relevant aspects to policymakers. For example, utility and the related concept of satisfaction can be perceived as a management objective (Johnston et al., 2010; Roedel, 1975; Royce, 1983). Therefore, learning what contributes to the rewards that an angler receives helps measure the performance of regulations or other fishery outcomes. Moreover, both utility and satisfaction are useful for measuring the preferences of anglers towards management tools (Arlinghaus & Mehner, 2005; Hunt et al., 2019), which can help predict behaviours in response to the regulations or other outcomes. For example, changes in the utility or the satisfactions expected by anglers following a new policy will motivate effort shifts by anglers searching for alternative fishing sites offering greater utilities or satisfactions (Arlinghaus et al., 2017; Matsumura

et al., 2019; Post et al., 2008). To account for these behavioural changes, it is important to consider multi-attribute angler behaviour in recreational fisheries models (e.g. Abbott & Fenichel, 2013; Beardmore et al., 2011; Carruthers et al., 2019; Johnston et al., 2013; Matsumura et al., 2019) rather than assuming that catch rates alone drive angler behaviour (e.g. Cox et al., 2003). This is because anglers can be continually attracted to fisheries for other reasons than high catch rates (e.g. due to a high scenic beauty or easy access) despite substantial declines to fish abundance and catch rates under liberal harvest regulations (Johnston et al., 2011), and this behaviour has the potential to collapse fisheries (Post et al., 2002; Stoeven, 2014). Therefore, the realized satisfaction of anglers is something to which managers respond strongly (van Poorten et al., 2011). In turn, there is an interest in better understanding how to achieve satisfied anglers, or relatedly to understand which environmental changes are most likely to lead to dissatisfaction (or significant utility loss, Hunt et al., 2019).

Recently, Hunt et al. (2019) reviewed how economists have approached the contributors to angler utility in a comprehensive meta-analysis of choice modelling studies. Choice models are a standard tool employed by economists where the preferences of people for attributes of the experience (e.g. angling), and in fact the relative importance of utility components, are derived from behavioural choices (either real—revealed—or hypothetical—stated—in survey experiments) that an angler expresses. The basic underlying theoretical assumption is that anglers are utility maximizers and hence they will choose opportunities that provide maximum utility. By studying the choices, the analyst can learn what influences anglers when making their choices. Hunt et al. (2019) reviewed 114 utility-based angler studies, revealing that costs, such as travel or license costs, were universally important to angler utility, while catch-related fishing quality also generally and positively influenced angler choices, thereby contributing positively to angler utility. The review also found that facility quality (e.g. boat launch presence), destination size (e.g. lake area) and measures of environmental quality (e.g. water quality) tended to positively influence choices of fishing sites by anglers. The review showed mixed results on whether congestion was important in site selection; it was important in hypothetical or stated choice studies and insignificant in models based on reported choices of fishing sites. One reason for this finding is methodological as it is difficult to model crowding effects in revealed preference studies because crowding is often confounded with other unmeasured attributes that can positively affect anglers' choices. Hunt et al. (2019) also revealed that a set of non-catch-related components, such as environmental quality, contributed to the utility of anglers, but other components that are known to positively affect recreational satisfaction (e.g. ability to relax in the outdoors) were not typically included in choice studies. It is an empirical question whether the determinants of angler satisfaction measured with other techniques than choice experiments agree with the meta-analysis of utility components. As realized utility and satisfaction are related concepts, one should expect that the determinants of a satisfied angling trip should agree with the key contributors to angler utility. In turn, one

would expect that catch and a few salient non-catch components of the fishing experience (e.g. crowding) should also be key determinants of angler satisfaction, but no global meta-analysis on this question exists.

Motivation and satisfaction concepts are often used in social-psychological human dimension research in recreational fisheries to understand angler expectations or serve as predictors of behaviour (Arlinghaus, 2006; Fedler & Ditton, 1994; Holland & Ditton, 1992). Similar to the utility maximizer in economics, the concepts of motivation and satisfaction have their origin in the rational actor model, which states that rational expectations about desired end-states define what people seek and find important (Driver et al., 1991; Hende, 1974; Manfredo et al., 1996). In the example of recreational fisheries, anglers are assumed to be motivated to participate in recreational fishing to reach particular tangible outcomes (termed expected psychological outcomes) like catching or consuming fish or relaxing at the waterside (Atkinson, 1969; Driver & Knopf, 1976; Manfredo et al., 1996) and that angler will vary in the importance they attach to various catch and non-catch-related motives (Aas & Kaltenborn, 1995; Driver & Knopf, 1976; Fedler & Ditton, 1994; Wilde et al., 1998). Early social-psychological human dimensions research distinguished between activity-general (i.e. components of the recreational activity angling that maybe achievable also through other outdoor activities such as being outdoors or experiencing social company while recreating) and activity-specific motives (i.e. components of recreational fishing that is specific to that form of outdoor recreation, such as catching fish or developing skills while fishing) (Fedler & Ditton, 1994; Fisher, 1997). More recent research classifies attributes of the fishing experience into non-catch (e.g. being outdoors, enjoying nature) and catch-related (e.g. experiencing a challenging fight with a fish, catching a trophy fish) expected outcomes as a form of differentiating the various motives present in recreational angling (Aas & Kaltenborn, 1995; Arlinghaus, 2006; Hutt & Neal, 2010; Johnston et al., 2010).

### 1.3 | Differentiating motivations and satisfaction

Independent of the label, motivations-focused research was common in early recreational fisheries research, and most early research concluded that non-catch motives were more important to anglers than catch motives (Ditton & Fedler, 1989; Driver & Knopf, 1976; Moeller & Engelken, 1972, reviews Ditton, 2004; Fedler & Ditton, 1994). This finding has been misinterpreted by some fisheries biologists to imply that the introduction of harvest regulations would not affect the well-being of anglers (Matlock et al., 1988)—an aspect found to constitute a misinterpretation of motivations and satisfactions (Arlinghaus, 2006; Ditton & Fedler, 1989; Peyton & Gigliotti, 1989). Motivations and satisfactions are related concepts (e.g. you cannot be satisfied with a certain component of fishing if you are not motivated to experience it), but they are distinct concepts that refer to different points in time within a recreational fishing experience (Arlinghaus, 2006; Peyton & Gigliotti, 1989). The concept of satisfaction has its roots

in expectancy theory and theorizes that satisfaction is the difference between expectations (i.e. motives) and the experience (Burns et al., 2003; Holland & Ditton, 1992; Schreyer & Roggenbuck, 1978). Therefore, anglers are motivated to achieve physical, cognitive and psychological outcomes, and a satisfactory trip in turn depends on the fulfillment of these outcomes (Arlinghaus, 2006; Holland & Ditton, 1992). However, it is only satisfaction that constitutes the ultimate reward an angler experiences, not motives (Arlinghaus, 2006; Hende, 1974). Thus, examining what satisfies anglers from a social-psychological perspective and examining whether results agree with a recent utility review by Hunt et al. (2019) demand a focus on the determinants of angler satisfaction, not angler motivations. A focus on satisfaction, not motives, is important for another reason: while angler satisfaction is known to affect angler behaviours strongly (Arlinghaus & Mehner, 2005; Van Poorten et al., 2011), the behavioural relevance of general angler motives has not been convincing (Arlinghaus, 2006; Schramm et al., 1998).

Among some fisheries biologists not trained in the social sciences, there is often an apparent disconnect between motivation and satisfaction research that must be clarified to avoid further misunderstanding (Arlinghaus, 2006). As alluded to before, research on angler motivations often found that anglers rank non-catch-related motives as more important than catch motives. By contrast, both satisfaction (Arlinghaus, 2006; Hutt & Neal, 2010; Vaske & Roemer, 2013) and utility research (Hunt et al., 2019) suggest catch may be equally or even more important in driving the rewards an angler seeks than most non-catch components. To explain, anglers exert direct control over most non-catch dimensions of their trip, by choosing their fishing companions, sites and timing, including weather, and are thus able to satisfy most of their non-catch motivations without difficulty on most trips (Arlinghaus, 2006). For this reason, satisfaction with catch-related components of the fishing experience is consistently lower than satisfaction with non-catch dimensions (Arlinghaus, 2006; Hutt & Neal, 2010; Vaske & Roemer, 2013), and, therefore, the impact of unsatisfactory catch on overall angler satisfaction tends to be high (Arlinghaus, 2006). Framed differently: it is entirely possible that an angler expresses his or her primary motivations to be non-catch-related and still be dissatisfied with fishing mainly due to poor catch or harvest. Moreover, a basic principle of social-psychological research is the need for specificity among the antecedent of behaviour (e.g. motive) and the actual behaviour. Measuring a very general construct, such as a value or a general motive to recreate outdoors, therefore will have little predictive power for a concrete situation (e.g. how an angler responds to a local harvesting policy). Relatedly, if you measure a general angler motive (e.g. to be outdoors), it will likely have very little predictive power to a very concrete situation (e.g. how an angler responds to a local environmental change). Beardmore et al. (2011) showed that the relevance of catch motives was substantially larger when examined in a context-specific fashion—something that is rarely done in the literature and further contributed to the apparent disconnect among motivation and satisfaction in recreational fisheries (Arlinghaus, 2006).

While motives have not demonstrated a strong contribution to behaviours and antecedents of behaviour (Arlinghaus & Mehner, 2004, 2005; Schramm et al., 1998), satisfaction (Brinson & Wallmo, 2017; van Poorten et al., 2011) and utility have (Hunt et al., 2019; Lee et al., 2017). Angler satisfaction is a strong predictor of angler behaviour and the development of management preferences (Arlinghaus & Mehner, 2005; Van Poorten et al., 2011). Therefore, angler satisfaction, particularly satisfaction with catch, is of prime relevance for angler management. Also, angler satisfaction may serve as a suitable management objective for the elusive concept of optimum social yield (Johnston et al., 2010, 2013, 2015), which is a measure of the social benefits a recreational fishery provides to society (Malvestuto & Hudgins, 1996; Roedel, 1975). Because of the managerial relevance of satisfaction, understanding the relative contribution of various outcomes towards satisfaction across the world is important and will complement the utility-based meta-analyses conducted by Hunt et al. (2019).

## 1.4 | Review objectives and hypothesis

Social-psychological expectancy theory applied to outdoor recreation suggests overall satisfaction depends on satisfaction with individual components (i.e. catch, congestion, water quality), which in turn depends on the difference between what the individual expected and what occurred for a given dimension such as in relation to expected catch rate (Burns et al., 2003; Holland & Ditton, 1992). Two common approaches to identifying the relative importance of various determinants of satisfaction in the social-psychological literature are the sum-of-satisfactions approach (Pollock et al., 1994) and the gap-score approach (Burns et al., 2003). The sum-of-satisfactions approach assumes that total satisfaction is composed of individual satisfactions with components of the experience in an additive fashion. The typical operationalization is measuring both satisfaction with components and overall trip (or angling year) satisfaction on the same (typically ordinal) scale and using regression approaches of overall satisfaction ratings on the individual component ratings to understand the relative importance of individual satisfactions (for an example, see Arlinghaus, 2006). By contrast, the gap-score approach focuses on the difference between the importance placed on achieving certain expected outcomes against evaluations of their achievement of each component and uses the gaps as predictors of overall satisfaction (Baker & Crompton, 2000; Pollock et al., 1994). Both approaches can be applied on-site or off-site in surveys and they can involve self-reports (e.g. Arlinghaus, 2006; Hunt, 2012) or actual physical trip outcomes (e.g. catch rate) in relation to ratings of trip quality (e.g. Beardmore et al. 2015; Connelly & Brown, 2000; Graefe & Fedler, 1986; Greiner et al., 2016; Ivasauskas et al., 2017; Miko et al., 1995). In outdoor recreation, the sum-of-satisfactions approach is the most often used and considered the best predictor of overall satisfaction (Burns et al., 2003). However, most of the published satisfaction research appears limited to single-species fisheries or a specific context, which is problematic, considering

determinants of catch satisfaction can depend strongly on context (Beardmore et al., 2015). We thus do not know if catch-related outcomes are consistently a prime determinant of satisfaction across different contexts and angling cultures as no synthesis of the published literature is available. Addressing this knowledge gap using a meta-analytical approach is the objective of the present research. We hypothesized that catch-related dimensions of satisfaction (e.g. catch, harvest, and size of fish captured) would be the most important determinants of angler satisfaction across all contexts (e.g. put-and-take, country, species, etc.) and in all countries where studies exist, but that non-catch components of the experience would also contribute to angler satisfaction in certain conditions.

## 2 | METHODS

### 2.1 | Literature search and data extraction

#### 2.1.1 | Study selection

A selection criterion was applied to find relevant papers from the primary literature. We selected papers that measured satisfaction with components and satisfaction with the overall trip (or angling year) on the same ordinal scale or papers that related actual trip outcomes (e.g. catch rate) with an assessment of trip quality. We omitted all studies using a choice-based utility approach as this research is reviewed elsewhere and uses a different measurement approach (Hunt et al., 2019). Our systematic Boolean search used the following keywords in Web of Science, BioONE and BASE: *TITLE: angl\* or sportfish\* or recreational fish\* AND satisfaction or happiness or well-being*. We supplemented our literature search with personal literature, literature from the library of one of the pioneers of early human dimensions research in recreational fisheries Robert B. Ditton (deceased), citations from reference lists and a search in google scholar. These methods, combined, yielded 279 papers as of 4 March 2020 (Figure 1). Based on titles and abstracts, 78 papers were selected, and after a full-text reading, 23 papers were selected for data extraction that met our demands for reporting of details on sampling, sample size and effect sizes (Table 1). The 23 papers, containing 33 datasets, yielded 172 effect size estimates about the relationship of a component satisfaction (e.g. with catch or non-catch) and overall satisfaction (e.g. with trip, holiday, or angling year). A minority of studies were not in English (Norwegian, Korean). For these, automated translators were used, and no studies were rejected based on language. We only rejected studies if they did not meet the previously mentioned criteria (relating component satisfaction scores to overall satisfaction or relating actual outcomes to trip quality). We considered both self-reports and on-site satisfaction studies where anglers were intercepted on-site as well as diary-based studies. We also considered all forms of satisfaction ratings, trip-level, holiday-level and angling year and all types of fisheries, from wild to put-and-take-based fisheries. We used statistics to understand if there was variation



ROSES Flow Diagram for Systematic Reviews. Version 1.0

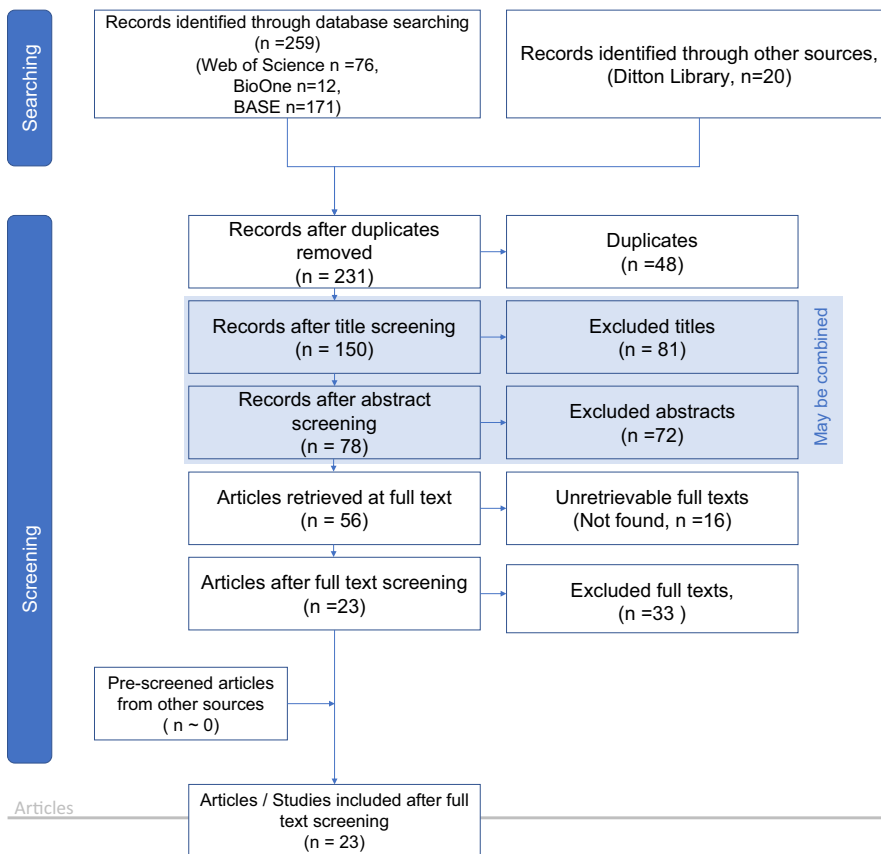


FIGURE 1 Flow diagram for systematic review

in the effect sizes as a function of moderators (species, country, satisfaction type, put-and-take status). Our search followed the ROSES framework for reporting systematic evidence syntheses in environmental research (Haddaway et al., 2018).

### 2.1.2 | Satisfaction subgroups and moderators

The specific determinants of overall satisfaction were classified into subgroups (or classes of satisfaction determinants) to measure their relative importance to explain overall angling satisfaction (Table 2). These subgroup classifications were motivated by the reviews by Hunt (2005) and Hunt et al. (2019), showcasing key attribute classes that influence angler fishing site selection. The authors found catch, cost, environmental quality, facility conditions, destination size, congestion and regulations were key sources of influence of angler site selection and relatedly angler utility, and we used the same classification for the determinants of satisfaction. We assigned each of the satisfaction determinants in the studies we reviewed to one of these classes (Table 2). We could not account for the importance of cost (distance or monetary) or regulations as they are rarely measured in satisfaction studies but is still crucial and very prominent in angler utility studies (Hunt et al., 2019). For catch components, similar to Hunt et al. (2019),

we accounted for the importance of harvest and size of fish. We also chose to measure three categories of environmental quality (aesthetics, social and water quality). Different from Hunt et al. (2019), we accounted for the relevance of the psychological importance of mastering and relaxation on angler well-being, which is prominent in satisfaction research but not covered in utility studies. Overall, the specific satisfaction subgroups in our meta-analysis were as follows: aesthetics, catch (e.g. catch rate or surrogates such as stocking rate), congestion, facilities, harvest, mastery, relaxation, fish size in the catch, social quality, destination space and water quality (Table 2).

We also collected information on possible moderators to answer the question of generality and to account for study or contextual influences on effect sizes. The potential moderators were country, species, put-and-take vs. wild fisheries and type of satisfaction metric used (trip, holiday, annual) (Table 1). The species groupings were motivated by the species investigated in satisfaction literature. Species was often defined as general, freshwater or saltwater. Only one specific species group, salmonids, had enough observations to warrant its own group. The moderators had the potential to influence the relationship between specific satisfactions or trip outcomes and overall satisfaction (e.g. Beardmore et al., 2015) and were thus included in specific moderator effect size analysis.

**TABLE 1** Characteristics of studies included in a correlational meta-analysis of angler satisfaction included studies. N = sample size. K = number of effect sizes

Citation	Country	Year	Species	Put-and-Take	N	Model type	Satisfaction approach	Satisfaction metric	Non-linear	Satisfaction Scale	K	Subdimension classes included
Arlinghaus (2006)	Germany	2002	Generic	Wild	474	Multiple regression	Sum of satisfaction	Year	No	10 point	12	Aesthetic, catch, facilities, harvest, mastery, relax, size, social, space, water quality
Arlinghaus et al. (2008) Berlin	Germany	2005	Fresh	Wild	239	Multiple regression	Sum of satisfaction	Year	No	10 point	14	Aesthetic, catch, congestion, facilities, harvest, mastery, relax, size, social, space
Arlinghaus et al. (2008) Brandenburg	Germany	2005	Fresh	Wild	873	Multiple regression	Sum of satisfaction	Year	No	10 point	14	Aesthetic, catch, congestion, facilities, harvest, mastery, relax, size, social, space
Balsman (2009)	USA	2006	Catfish	Stocked	49	Multiple regression	Trip outcomes	Trip	No	4 levels	2	Size
Balsman (2009)	USA	2006	Fresh	Stocked	946	Multiple regression	Trip outcomes	Trip	No	4 levels	1	Catch
Beardmore et al. (2015)	Germany	2007	Fresh	Wild	8,438	Ordinal Logit model	Trip outcomes	Trip	Yes	10 point	4	Catch, congestion, size
Connelly and Brown (2000)	USA	1994	Salmonid	Stocked	700	Multiple regression	Sum of satisfaction & trip outcomes	Trip	No	10 point	2	Catch, size
Fierro (2018)	USA	2015	Salmonid	Stocked	94	Chi-square test	Trip outcomes	Trip	No	5 point	1	Harvest
Golebie (2017)	USA	2015	Generic	Wild	43	Multiple regression	Sum of satisfaction	Year	No	5 point	7	Catch, harvest, mastery, size, water quality
Golebie (2017)	USA	2015	Perch	Wild	57	Multiple regression	Sum of satisfaction	Year	No	5 point	10	Aesthetic, catch, congestion, facilities, harvest, mastery, size, water quality
Golebie (2017)	USA	2015	Salmonid	Wild	248	Multiple regression	Sum of satisfaction	Year	No	5 point	16	Aesthetic, catch, congestion, facilities, harvest, mastery, size, social, water quality
Graefe and Fedler (1986) Delaware	USA	1982	Salt	Wild	599	Multiple regression	Sum of satisfaction	Trip	No	5 point	9	Catch, congestion, facilities, mastery, relax, social
Graefe and Fedler (1986) Maryland	USA	1983	Salt	Wild	326	Multiple regression	Sum of satisfaction	Trip	No	5 point	9	Catch, congestion, facilities, mastery, relax, social
Greiner et al. (2016)	USA	2009	Fresh	Wild	1,189	Logistic regression	Trip outcomes	Trip	No	Binary	2	Harvest, social
Hampton and Lackey (1976)	USA	1974	Generic	Stocked	100	Factor analysis	Sum of satisfaction	Trip	No	5 point	4	Catch, social
Henderson and Gigliotti (2015)	USA	2011	Fresh	Wild	34,097	Multiple regression	Season outcomes	Year	No	7 point	4	Catch, harvest

(Continues)

TABLE 1 (Continued)

Citation	Country	Year	Species	Put-and-Take	N	Model type	Satisfaction approach	Satisfaction metric	Non-linear	Satisfaction Scale	K	Subdimension classes included
Herrmann et al. (2002)	USA	1998	Generic	Wild	363	Probit model	Trip outcomes	Holiday	No	5 point	3	Catch, congestion, size
Hunt et al. (2012)	USA	2000	Catfish	Wild	490	Linear regression	Season outcomes	Year	No	5 point	14	Catch, congestion, facilities, harvest, size, social, space, water quality
Hutt and Neal (2010)	USA	2007	Generic	Stocked	1692	Multilogit regression	Sum of satisfaction	Year	No	5 point	12	Aesthetic, catch, harvest, mastery, relax, size, social, water quality
Hyman et al. (2016) lake	USA	2014	Salmonid	Stocked	5,239	Multinomial logistic	Trip outcomes	Trip	No	7 point	1	Catch
Hyman et al. (2016) river	USA	2014	Salmonid	Stocked	5,239	Multinomial logistic	Trip outcomes	Trip	No	7 point	1	Catch
Kainzinger et al. 2015	USA	2012	Salmonid	Wild	364	Multiple regression	Trip outcomes	Trip	No	5 point	4	Congestion
Matlock et al. (1991) 0–100	USA	1997	Salt	Wild	100	Multiple regression	Sum of satisfaction	Trip	No	0 to 100	4	Catch, mastery, relax, social
Matlock et al. (1991) 0–10	USA	1997	Salt	Wild	100	Multiple regression	Sum of satisfaction	Trip	No	0–10	4	Catch, mastery, relax, social
Matlock et al. (1991) 1–5	USA	1997	Salt	Wild	100	Multiple regression	Sum of satisfaction	Trip	No	1 to 5	4	Catch, mastery, relax, social
Matlock et al. (1991) line scale	USA	1997	Salt	Wild	100	Multiple regression	Sum of satisfaction	Trip	No	Line scale	4	Catch, mastery, relax, social
Matlock et al. (1991) open ended	USA	1997	Salt	Wild	100	Multiple regression	Sum of satisfaction	Trip	No	Open ended	4	Catch, mastery, relax, social
McCormick and Porter (2014)	USA	2013	Salmonid	Wild	1,073	Multinomial logistic	Trip outcomes	Trip	No	5 point	2	Catch, size
Mostegl (2011)	Canada	2005	Fresh	Wild	18,120	Tobit model	Season outcomes	Year	No	5 point	2	Catch, harvest
Patterson and Sullivan (2013)	Canada	2008	Salmonid	Stocked	440	Linear regression	Trip outcomes	Year	Yes	Binary	1	Catch
Pitman et al. (2018)	Canada	2013	Salmonid	Wild	1772	Ordinal Logit model	Trip outcomes	Trip	No	5 point	2	Catch, congestion
Rich (2016)	USA	2014	Salmonid	Wild	46	Linear regression	Trip outcomes	Trip	No	7 point	1	Aesthetic
Schultz and Dodd (2008)	USA	2006	Salmonid	Stocked	100	Linear regression	Sum of satisfaction	Trip	No	7 point	2	Catch, harvest



**TABLE 2** Sample sizes (the number of studies, *N*; the number of effect sizes, *K*) and examples for the classification of specific satisfaction subgroups in a correlational meta-analysis of angler satisfaction

Aspect	<i>N</i>	<i>K</i>	Satisfaction with...
Catch	27	39	Number of fish bites, number of fish caught, catch rate, fishing quality, amount of stocking, stock size, number of fish landed, catchability
Harvest	13	19	Number of fish harvested, number of fish that are allowed to harvest, eating size of fish captured, harvest by partner, harvest rate, size of fish allowed to be taken
Size	13	19	Average length of fish, average weight of fish, number of large fish, size of the largest, trophy fish quality
Aesthetics	8	11	Natural beauty of the lake, natural setting, level of hook scarring on fish, habitat conditions
Facilities	6	7	Condition of facilities, sufficient sites/parking, crew/captain quality, services in the area, amenities in the area
Congestion	10	14	Number of anglers nearby, number of anglers seen, competition for fishing spots, number of people on boat, crowding with boaters, crowding
Mastery	14	23	Angling-related challenges, fighting fish, competition, skill development
Relax	11	11	Opportunity to relax, experiencing relaxing outdoors
Social	15	15	Pleasant company, peacefulness, other activities in the area, quiet time, children brought
Space	5	7	Ability to reach water, sufficient sites/parking, access and fishing sites, number of fishing spots in the area
Water Quality	5	5	Water quality, cleanliness of water, cleanliness of sites

## 2.2 | Effect size calculation

We transformed every effect size found in our meta-analysis to Fisher's effect size (ES). This statistic reflects the standardized effect of specific satisfactions or catch outcomes on overall satisfaction with either trip or angling year. For studies that reported correlation coefficients, *r*, (e.g. between component satisfaction with catch rate and trip satisfaction), we transformed the coefficients to Fisher's *z* (Equation 1) and estimated variance based on sample size (Equation 2) (Borenstein et al., 2011). For studies that reported log odds (e.g. binary responses), we also transformed them from log odds ratio to Cohen's *d* (Equation 3), from Cohen's *d* to correlation coefficient (*r*, Equation 4) and then into Fisher's *z* (Equation 1) and estimated variance based on sample size (Equation 2) (Borenstein et al., 2011). A correction factor, (*a*, Equation 5), was included in the conversion from Cohen's *d* to correlation coefficient (Equation 4), in the case of different sample sizes. We reversed effect sizes when higher scores reflected worse outcomes (e.g. congestion) to compare all relationships in the same direction. For studies that reported chi-square scores, we transformed them into Fisher's *z* using the general formula for conversion (Equation 6; Rosenberg, 2010). Fisher's *z* scores and estimated variance were the inputs for the meta-analytical model.

### Correlation coefficient to Fisher's *z*

The transformation from sample correlation *r* to Fisher's *z*:

$$z = 0.5 \times \ln \left( \frac{1+r}{1-r} \right) \quad (1)$$

The variance of *z* (to an excellent approximation):

$$Vz = \frac{1}{n-3} \quad (2)$$

### Log odds to Fisher's *z*

Log odds ratio to Cohen's *d*:

$$d = \text{LogOddsRatio} \times \frac{\sqrt{3}}{\pi} \quad (3)$$

Cohen's *d* to correlation *r*:

$$r = \frac{d}{\sqrt{d^2 + a}} \quad (4)$$

Correction factor for when  $n_1 \neq n_2$ :

$$a = \frac{(n_1 + n_2)^2}{n_1 \times n_2} \quad (5)$$

### $\chi^2$ to Fisher's *z*

The general formula for conversion (Rosenberg, 2010) :

$$r = \sqrt{\frac{\chi^2}{nk}}. \quad (6)$$

## 2.3 | Hierarchical random-effects model

The main goal of a meta-analysis is to compute a summary effect for the treatment effect (i.e. effect size), which in general has higher statistical power than what can be achieved by individual studies. When the effect varies from one study to the next, meta-analysis

allows us to assess the reasons for the dispersion. Rather than compute one summary effect, we separated effect sizes into satisfaction subgroups because of our interest in the effect sizes of different determinants of angler satisfaction, broadly categorized into catch and non-catch components as in Table 2. To that end, we computed a pooled effect for each satisfaction subgroup using a random-effects model. Here, we used the restricted maximum-likelihood estimator, as it is the preferred option when the number of studies is small (Viechtbauer, 2005). We used the Knapp and Hartung (2003) adjustment to account for a low sample size.

By including multiple effect sizes from each study, the assumption of independent effect sizes that underlies classical meta-analytic strategies was violated (Lipsey & Wilson, 2001). To deal with the interdependency of effect sizes, we applied a multilevel random-effects model (Hox et al., 2017). A multilevel model approach accounts for the hierarchical structure of data by nesting effect sizes within studies to preserve all information in the studies and to achieve maximum statistical power (Assink & Wibbelink, 2016). A three-level model accounts for the three levels of variance: sampling variance (a), the variance between effect sizes extracted from the same study (b) and the variance between studies (c). The meta-analyses were conducted in R with the Metafor package (Viechtbauer, 2010), using syntax from Assink and Wibbelink (2016).

## 2.4 | Meta-regression

We also performed a meta-regression to assess the relationship between the study-level characteristics (i.e. country, species, type of satisfaction measure) and the effect size for each satisfaction subgroup. In meta-analytical research, it is common practice to test the potential moderating effect of multiple variables, such as a study, sample and research design characteristics (Borenstein et al., 2011). For example, we investigated if catch has the same importance in a put-and-take fishery than in a wild fishery, among different species, or among different countries. It is typical to deal with substantial multicollinearity in meta-regression analyses (Hox et al., 2017) because variables of interest are often correlated. It is, therefore, difficult to determine what effects are indeed relevant and deserve the most attention. Testing multiple moderators in a single model after potential moderating effects have been evaluated separately in univariate models is a reasonable strategy. We could not follow this approach, as the sample size of our meta-analysis was inadequate for such a model. Instead, we tested the effects of moderators in univariate models only and made limited conclusions based on these findings.

## 2.5 | Publication bias

Studies with high effect sizes are more likely to be published than studies with low effect sizes (Rothstein et al., 2005), leading to publication bias. We tested for publication bias by inspecting funnel plot asymmetry to see if studies with small effect sizes are missing from

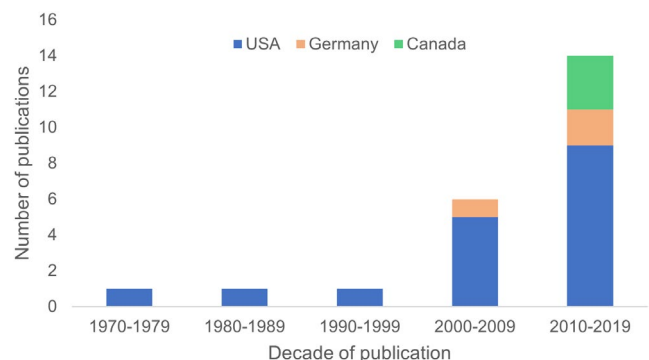
our meta-analysis. The asymmetry was measured using the Begg and Mazumdar rank correlation test, which uses the correlation between the ranks of effect sizes and the ranks of their variances (Begg & Mazumdar, 1994, p. 1088).

## 3 | RESULTS

Most satisfaction studies included in our analysis occurred in the United States (74%), and a few additional ones were from Germany (13%) and Canada (13%). Notably, no studies from Asia, South America, Australia or Africa were included in our meta-analysis. United States studies were distributed throughout the country and were not concentrated in one area. The first study in our meta-analysis was published in 1976. Since then, the frequency of satisfaction studies has increased steadily (Figure 2). All studies prior to the 2000s were published in the United States (Figure 2). Half of the studies included in the meta-analysis used a sum-of-satisfaction approach (50%) and half of them related satisfaction to trip or season outcomes (50%) (Table 2). An overwhelming majority followed a regression-based study design (91%), but only two studies (8%) accounted for potentially non-linear relationships.

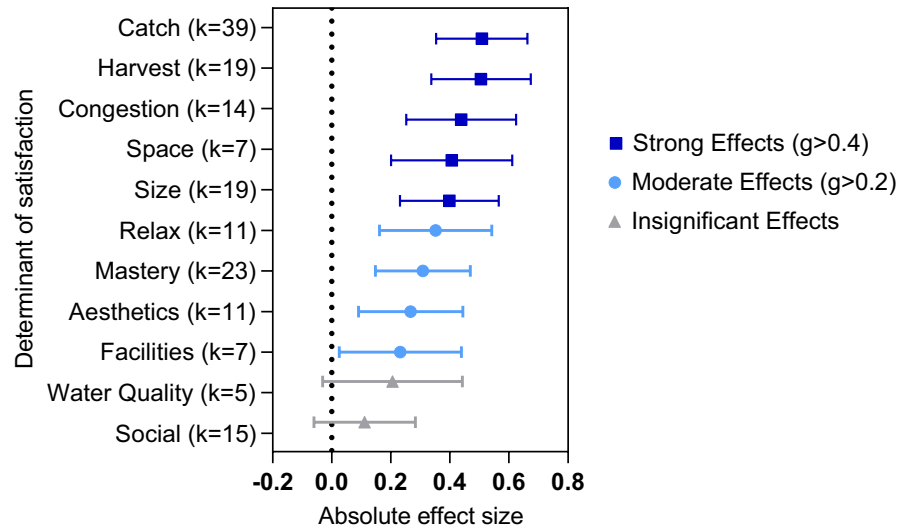
### 3.1 | Determinants of angler satisfaction

To understand which components of an angling experience were most important to anglers, we measured the correlational effect size between 11 components with overall satisfaction in an analysis (Figure 3). The effect sizes for the catch-related components of satisfaction (catch, harvest, size of fish) were among the largest effect sizes and significant. Two non-catch-related components, space and congestion, also had strong significant effects on overall satisfaction. By contrast, three non-catch subgroups had moderate but still significant relationships with overall satisfaction: relaxation, facilities and aesthetics, while mastery joined as a further catch-related aspect with a moderate and overall significant effect size. By contrast, social quality and perceptions of water quality, two non-catch aspects, did not have a significant relationship with overall satisfaction across studies.



**FIGURE 2** The decade of the publication date and countries of studies included in the meta-analysis of angler satisfaction

**FIGURE 3** Mean ( $\pm 95\%$  CL) absolute value of the correlational effect size between 11 components and overall satisfaction. Effect sizes are colour-coded by strength. Non-significant effect sizes overlap zero. Figure appears in colour in the online version only



### 3.2 | Contextual influences on angler satisfaction

To understand how social–ecological context might affect the importance of certain dimensions for affecting angler satisfaction, we included four moderator variables (species, country, satisfaction measure and put-and-take status) in four separate univariate meta-regression models (Figure 4). Three of the four moderator variables were significant in univariate models: species, country and satisfaction measure. Put-and-take status was not a significant moderator, meaning that it did not explain any differences in the importance of satisfaction subgroups relative to satisfaction measured in wild, natural fisheries.

Species was a significant moderator, and it had a moderating effect on the importance of aesthetics ( $p = .015$ ), mastery ( $p = .005$ ), relaxation ( $p = .001$ ), space ( $p = .001$ ) and social context ( $p = .042$ ). Aesthetics were more important to overall satisfaction for freshwater species than for “generic” and salmonid species, but satisfaction with aesthetic components of fishing was significantly important for all species contexts measured. Species did not have a significant moderating effect on the importance of catch, size or harvest, meaning satisfaction with catch-related components was equally important to all angler types independent of target species. There were no differences in the importance of congestion for anglers of different species. Mastery and relaxation were both significantly more important to freshwater anglers than to other angler types. Space was significantly less important to “generic species” anglers than it was to freshwater anglers.

The type of satisfaction metric was a significant moderator for catch ( $p = .041$ ), congestion ( $p = .028$ ), mastery ( $p = .047$ ), relax ( $p = .033$ ), size ( $p = .002$ ) and social ( $p = .001$ ). All six of these subgroups were more important when satisfaction for the year was measured, than satisfaction with a trip. Harvest was important when measured for both trip and year-long satisfaction. Catch was important for both trip and year-long satisfaction but was significantly more important when measured for year-long satisfaction.

The country of the study was an important moderator for the importance of aesthetics ( $p = .034$ ), facilities ( $p = .023$ ), mastery ( $p = .022$ ), relaxation ( $p = .020$ ) and social ( $p = .003$ ). In all five cases, these subgroups were more important in German studies than in the United States or Canada. Catch was just as important towards overall satisfaction no matter which country the study was conducted, with a strong and significant effect in all three countries. When the moderator of “country” was included, the size of the fish captured was only important in German studies, but the difference between German studies and U.S. studies was not significant. This discrepancy is likely due to more variance due to smaller sample sizes. When the “country” moderator was not included, size had an overall significant relationship with overall satisfaction.

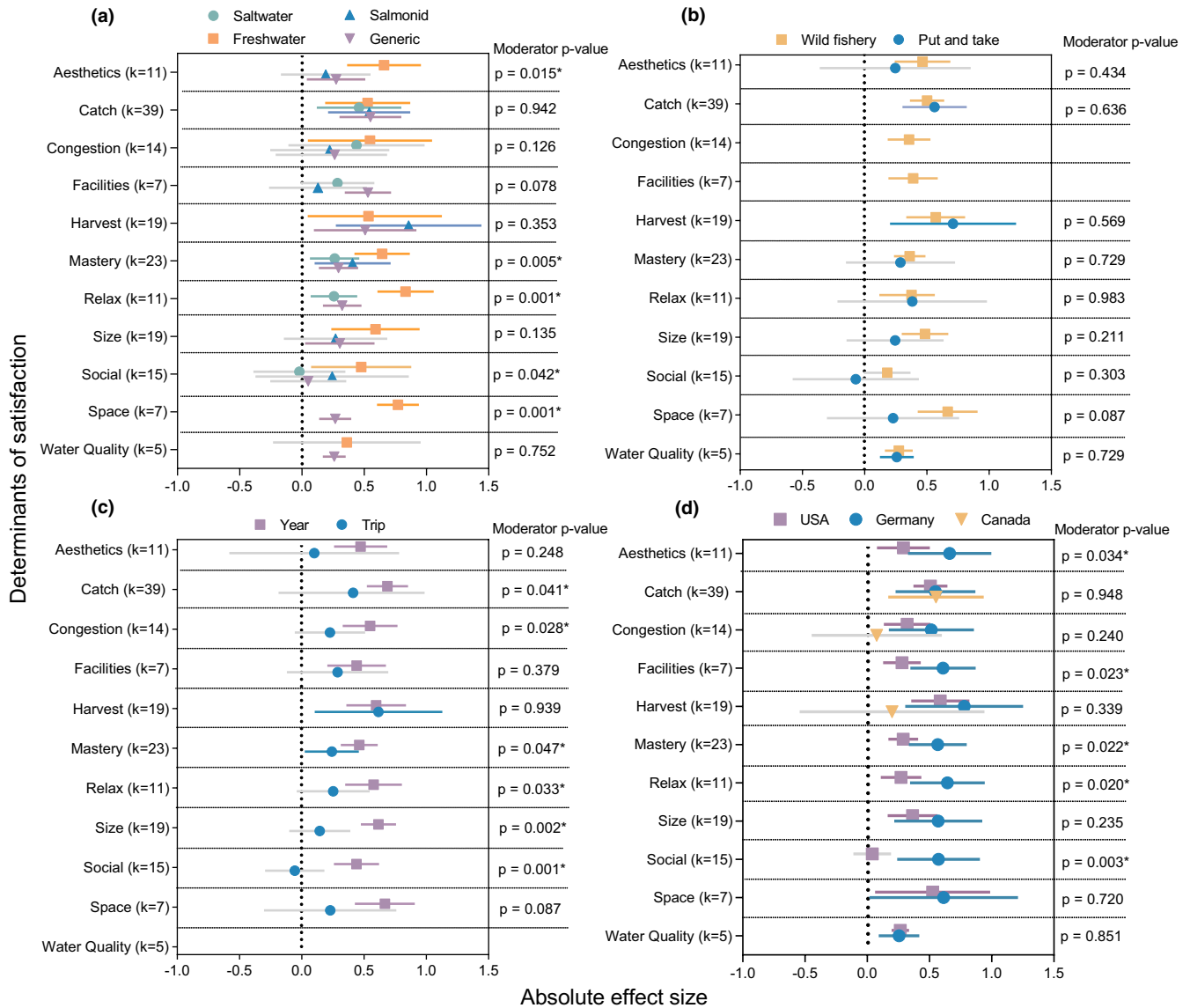
Our sample size limits our ability to test the effect of the moderating variables together. Nevertheless, we conclude that species, satisfaction metric and country were all important moderators to include in our analysis.

### 3.3 | Publication bias

To understand the impact of publication bias on our findings, we created a funnel plot (Figure 5). The plot did not have significant asymmetry, meaning there was no significant evidence for publication bias in our analysis ( $p = .356$ ; Kendall's tau = 0.487).

## 4 | DISCUSSION

Our meta-analysis confirmed that angling is a multiple satisfactions experience (Hendee, 1974), with both catch and non-catch-related components of the experience being important to anglers. Although the three most important determinants were catch-related (catch, harvest, and size of fish captured), space and congestion, both non-catch-related components, also had

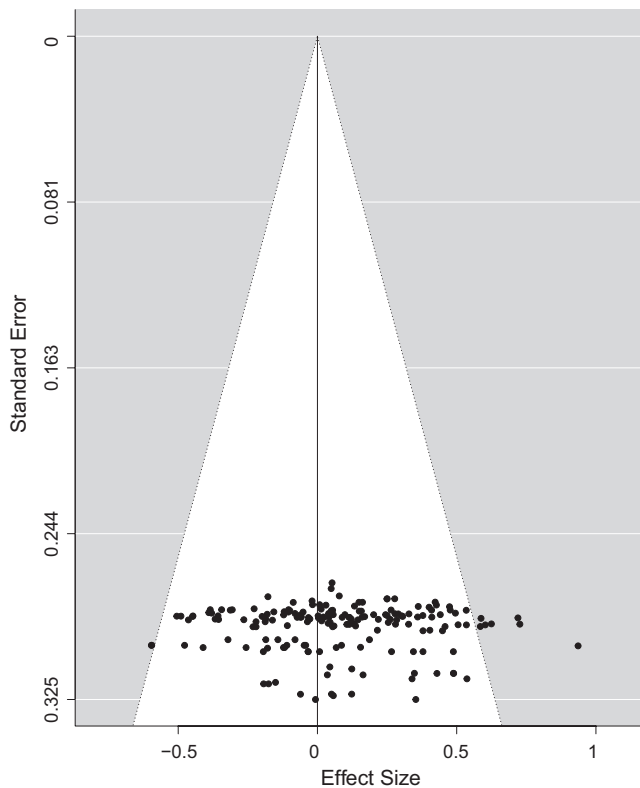


**FIGURE 4** Absolute effect size (Hedge's g) between overall satisfaction and 11 specific satisfactions for anglers across (a) species, (b) wild and stocked fisheries, (c) satisfaction measurement and (d) country. Bars are 95% confidence intervals. Moderator p-value measures whether the moderator had a significant moderating effect on the importance of the satisfaction subgroup. Figure appears in colour in the online version only

substantial effects on overall satisfaction. Aesthetics and facilities as non-catch-related components, and opportunity for mastery as a catch-related aspect, were also significant determinants of angler satisfaction across all reviewed studies, while water quality and social context were not generally related to angler satisfaction. The findings imply that angler satisfaction originates from many different components of the fishing experience and that a reduction in quality of catch or non-catch components will reduce angler satisfaction and could result in conflict and affect angler behaviour. A limitation of these conclusions is that the reviewed studies were overwhelmingly from Western countries and particularly from the United States. We thus cannot state that our results hold for most or all angler populations globally.

### 4.1 | Catch-related determinants of satisfaction

Catch is a fundamental component of fishing and it encompasses multiple dimensions such as catch rate, catch size, trophy catch and harvest, which differ in importance by angler type and fishery (Anderson et al., 2007; Beardmore et al., 2015; Dabrowska et al., 2017; Dorow et al., 2010). Catch is also strongly related to angler utility (Hunt et al., 2019), and lack of catch often constrains fishing activities and limits effort (e.g. Freudenberg & Arlinghaus, 2009; Post et al., 2008; Stensland et al., 2017). In line with previous case studies (e.g. Arlinghaus, 2006; McCormick & Porter, 2014), catch was a key determinant of satisfaction across all reviewed studies. By contrast, motivation research often suggests that catch-related outcomes are less important than non-catch-related outcomes



**FIGURE 5** Funnel plot testing for publication bias in meta-analysis

(Ditton, 2004; Fedler & Ditton, 1994). Satisfaction is the ultimate reward experienced by anglers and this literature shows that catch is of very large and consistent importance to anglers. The apparent disconnect between the importance of catch in motivation vs. satisfaction research is related to the fundamental conceptual differences between motivations and satisfaction that are easily confused if one is not trained in the social sciences (Arlinghaus, 2006). There is differential ease in satisfying activity-general (i.e. aesthetic quality) and activity-specific components (i.e. catch) of the fishing experience as anglers have more control over the activity-general components than they do over the activity-specific components (Arlinghaus, 2006). For this reason, an angler may not be strongly motivated by catch, but given the difficulty of controlling catch outcomes as opposed to non-catch outcomes, catch-related outcomes are often the limiting factor in overall satisfaction (Arlinghaus, 2006; Hutt & Neal, 2010; Vaske & Roemer, 2013).

Another reason that catch-related outcomes are important to angler satisfaction is they have more specific anchor points (i.e. the quantity of fish expected) than non-catch outcomes (i.e. what water quality or type of nature experience is expected). The higher specificity of anchor points leads more directly to contrast effects, as the angler is better able to compare outcomes and expectations (Gale, 1987; Spencer & Spangler, 1992; Williams, 1989). For non-catch-related outcomes, with less specific expectations, it is more likely that the angler assimilates their expectations to the outcome (Williams, 1989). The lower the specificity of an attribute, the more likely an angler is to bend their expectations to meet the experience,

**TABLE 3** Description and sample size of moderators recorded in a correlational meta-analysis of angler satisfaction

Moderator	Levels	Sample Size	Definition
Species	Generic	5	Fish species was not defined
	Freshwater	10	Fish species defined as all species in freshwater location
	Saltwater	7	Fish species defined as all species in saltwater location
	Salmonids	11	Salmon, trout, steelhead, etc.
Country	USA	26	Study conducted in the United States
	Canada	3	Study conducted in Canada
	Germany	4	Study conducted in Germany
Satisfaction	Trip	21	Satisfaction measured for the trip
	Year	11	Satisfaction measured for the year
	Holiday	1	Satisfaction measured for the holiday
Put-and-Take	Stocked	10	Fishing took place with a stocked fish population
	Wild	23	Fishing took place with a wild fish population

in turn making that attribute less important to angler satisfaction. The outcomes of a fishing experience range in specificity, with some non-catch attributes having specific outcomes (i.e. congestion and destination size). However, in general, the lower specificity of non-catch-related anchor points, in combination with the relative ease of controlling their outcomes, contributes to their lower importance for overall satisfaction (Arlinghaus, 2006; Hutt & Neal, 2010; Vaske & Roemer, 2013).

Catch, whether it be actual catch rates or correlates of catch expectations such as stocking rate (Arlinghaus et al., 2014), had the greatest correlation with the overall satisfaction of any determinant in our analysis. This finding is consistent with evidence from studies on aggregated angling effort dynamics in response to changes in fish abundances (e.g. Mee et al., 2016; Post et al., 2008; Wilson et al., 2020) and is also supported by research showing that catch is very important to most anglers when choosing a fishing site (Hunt et al., 2019). Catch satisfies many different aspects of the fishing experience. Firstly, catching fish rewards the skill and commitment of an angler. When individuals are in a challenging situation and have the ability or expertise to meet the challenge, they can enter a flow experience (Csikszentmihalyi, 1990). Flow is characterized by enjoyment, environmentally directed attention and lack of self-awareness,

and flow experiences are proven to increase overall well-being (Csikszentmihalyi, 1988). Furthermore, catching fish leads to more present-minded behaviour, preventing rumination or a “wandering mind,” which is shown to negatively influence individuals’ well-being (Killingsworth & Gilbert, 2010). Under the right circumstances (i.e. large enough fish, large waves, fast current, dangerous/challenging environment), catching a fish may also provide a sensation-seeking experience (Zuckerman, 2007), where anglers forego the risk in search of the reward (i.e. catch). One obvious further benefit of catching fish is that it provides anglers with a physical good (harvest) that generates essential physiological benefits (Cooke et al., 2018). Yet, catching different fish species in different environments is a collection experience, without the need to physically harvest the fish as fish can also be released alive. Research shows that collectors are drawn to collecting as a means of bolstering the self by setting up goals that are tangible, attainable and provide the collector with concrete feedback of progress (McIntosh & Schmeichel, 2004). In terms of collecting, the “hunt” for the collectible is frequently considered the most enjoyable aspect of the process (Olmstead, 1991). Although angling does not provide a physical collection (unless taxidermy is involved), there is still a mental collection and social media/photographs that one can use to receive “post-acquisition benefits” such as linking to enjoyable experiences, or affirming the self, or being seen as a valuable member of the angling community (Brower, 2005).

In our analysis, the importance of catch was moderated by satisfaction type. Catch was more important when overall satisfaction was measured on a year-long scale rather than a trip scale. This result arises because catch is less under the control of the angler (Baccante, 1995; Seekell, 2011), so anglers understand that they cannot expect a fish on every trip. Since catch is less predictable for the anglers, they perhaps tolerate trips with less catch but are less tolerable of lack of catch over a long timeframe. This is supported by work showing that anglers place more importance on catching fish when they have been deprived of catch (Finn & Loomis, 2001). Catch was just as important to put-and-take anglers as it was in wild fisheries, which seems odd as put-and-take fisheries may be perceived as strongly catch-oriented. Yet, motivation research by Ross and Loomis (2001) has previously shown that motives of anglers in put-and-take fisheries are similar to the ones in wild fisheries, and put-and-take fishing will also, similar to an experience in the wild, tie into both catch and non-catch-related motives of angling. For example, recreating in artificial or entirely built systems, such as small put-and-take fisheries, still contribute to a nature experience and “get away from it all” as the type of nature experience shifts baselines (Arlinghaus & Mehner, 2003; Hendee, 1969; Manfredo et al., 1996).

Our work did not examine the specific functional relationship between catch and satisfaction (e.g. whether increasing catch rate is linearly or non-linearly related to satisfaction). Past studies have suggested that catch rate can be non-linearly related to angler satisfaction for both put-and-take (Patterson & Sullivan, 2013) and wild fisheries (Beardmore et al., 2015). In other words, there is a threshold for catch rate, after which satisfaction ceases to increase. Similarly, some utility studies suggest that increasing catch rates result in a

diminishing marginal return for the angler (e.g. Carter & Liese, 2012; Lawrence, 2005).

Harvest was also strongly correlated with overall satisfaction in our meta-analysis. Recreational fishing is a leisure activity that has nutritional benefits, leading to an overlap of “fun and food” (Cooke et al., 2018). In some countries, harvesting fish for food is the direct justification for recreational angling (Arlinghaus et al., 2007). Even in cultures where food is not a direct justification for angling, it is a valuable benefit of fishing (Cooke et al., 2018). Indeed, harvested fish are more valuable to certain anglers or angler cultures than are released fish (Askey et al., 2013; Olausson, 2016), and this supports our finding that harvest is essential to angler satisfaction across the world. Harvest provides more than just nutrition. It provides the additional experience of cleaning, cooking, sharing and eating meat that anglers harvested for themselves (Tidball et al., 2013). Bans or severe constraints on harvest can and most likely will result in sharply reduced fishing pressure in many of the more consumptive fisheries (Beard et al., 2003; Haglund et al., 2016; Johnston et al., 2011) and increased conflict among anglers and managers is likely (Matlock et al., 1988; Matlock et al., 1991). Harvest is also important to the utility of anglers (Hunt et al., 2019), with increasing harvest rates being positively associated with anglers’ choices of fishing sites. While we did not find any significant moderators, suggesting that harvest is generally important to anglers, Cooke et al. (2018) showed that the propensity to harvest varies strongly across cultures, locations, species and fisheries. For example, anglers have developed strong voluntary catch-and-release ethics in largemouth bass (*Micropterus salmoides*, Centrarchidae) fisheries in the United States (Myers et al., 2008) or bonefish (*Albula vulpes*, Albulidae) in the Caribbean (Danylchuk et al., 2007). Therefore, our findings may not apply to all localities and conditions.

The size of fish captured was also strongly correlated with overall satisfaction in our meta-analysis. Size can either be understood as catching on average larger fish (which may provide more meat per fish) or as an increased probability of catching an exceedingly large trophy. In this meta-analysis, the studies predominantly measured the average weight and length of fish, with only two studies measuring the importance of trophy size. Size is important to angler satisfaction because, like catch, it involves many aspects of the fishing experience and was previously found to be associated with anglers’ choices of fishing sites (Hunt et al., 2019) and be exponentially related to angler satisfaction (Beardmore et al., 2015). Increasing the size of a fish will thus magnify the benefits of catch. A larger fish rewards the angler for their skill as it is more exciting to share a larger fish on social media or in friend networks, it will feed more people and it has the long-lasting effect of becoming a “personal best” (PB), tapping into the “collector” benefits of angling. Beardmore et al. (2015) concluded that while there is a diminishing marginal return on catch rates, there is none for size, where satisfaction increases with the size of the caught fish.

The opportunity for mastery is one reason that anglers desire larger fish, but mastery can also be expressed in challenging fishing



situations or using challenging gear. In our study, the opportunity for mastery had a moderate effect on overall satisfaction. Mastery was measured as satisfaction with meeting angling-related challenges, fighting fish, competition and skill development. Previous work states that goal attainment, mastery and harvest in consumptive activities are fundamental to satisfaction, supporting our finding (Arlinghaus, 2006; Beggs & Elkins, 2010; Schroeder & Fulton, 2013). Mastery can also relate to gender issues as fishing is a male-dominated activity (Arlinghaus, 2004; Bissell et al., 1998). Through fishing, men can confirm their masculinity by controlling nature, eliciting deference from others and proving their worth by catching fish (Adkins, 2010). Catching abundant fish or trophy fish helps confirm masculine pride, indirectly relating satisfaction with mastery to catch-related outcomes (Bull, 2009). In our analysis, mastery was more important to year-long satisfaction than it was to trip satisfaction. This result is likely due to its relationship to catch. Importantly, mastery was just as important for wild fisheries as it was for put-and-take fisheries. One would expect mastery to be more important for wild fisheries because it is often perceived as more "challenging" or "authentic," but this was not confirmed in our work, perhaps because different angler types are directed at put-and-take vs. wild-type fisheries. Mastery was also more important to freshwater anglers than it was for any other species type—a finding that perhaps related to the larger diversity of fishing styles that freshwater fishing entails. Finally, mastery was more important to German anglers than to U.S. anglers, though due to a small sample size, it is difficult to attribute this result to any cultural difference.

## 4.2 | Non-catch-related determinants of satisfaction

One of the most important and thoroughly investigated sources of dissatisfaction in recreational fisheries is the effect of congestion (e.g. Beardmore et al., 2015; Herrmann et al., 2002; Kainzinger et al., 2015). Congestion was strongly and negatively correlated with overall satisfaction in our analysis. While for some social anglers, congestion may increase satisfaction (e.g. small-bodied cyprinid anglers in the study of Beardmore et al., 2015), this result appears to be the exception. The negative effects of congestion are well known and are present in economic-based research of angling (e.g. Hunt et al., 2019; Schuhmann & Schwabe, 2004). There is an indirect association between catch and congestion through exploitative competition for fish and perhaps interference competition, but research shows that congestion may even affect catch satisfaction (i.e. catching fish in crowded sites is perceived as less enjoyable than catching fish in non-crowded sites, Beardmore et al., 2015). When anglers experience congestion at a fishing site, they are more constrained in where they fish, possibly leading to lower catch rates. Also, congestion can lead to overfishing of sites, making fish less catchable through learning (Arlinghaus et al., 2017; Cox & Walters, 2002; Koeck et al., 2019). Other research has shown that catch rates are lower in parties (Miranda, 2005), potentially showing the effect of congestion on catch rates. Non-anglers can also congest a fishing

site, creating interference competition or other non-pleasurable conditions (Meyerhoff et al., 2019). Congestion at a fishing site may also increase the opportunity for social comparisons, which could influence how satisfied individuals are with their catch. People are likely to evaluate their own success relative to the success of others (Medvec et al., 1995), so the catch of other anglers could have a significant impact on angler satisfaction. Congestion may also interrupt non-catch-related components of a fishing experience, like the ability to relax or the perceived aesthetic quality of a site (Vaske & Shelby, 2008). The importance of congestion was not moderated by species, country, type of satisfaction measure or type of fishery. These results signify that congestion, with few exceptions, is generally negatively associated with satisfaction.

Space was strongly correlated with overall satisfaction in our meta-analysis. The category of space is directly related to congestion and relates to the availability of fishing sites. The fact that they both had strong effects as non-catch-related attributes reinforces the idea that anglers want sufficient space from which to choose their specific fishing sites. The importance of space to anglers is often studied in economics as a preference for destination size. In a recent utility-based review in recreational fisheries (Hunt et al., 2019), destination size was very often (80%) associated with a positive and significant effect on anglers' choices of fishing sites. It is a critical and often-overlooked non-catch-related site attribute in economics-based research and an often-overlooked determinant of satisfaction. Space is likely valuable to anglers because it provides freedom of choice and may allow anglers to find sites to meet catch and non-catch experience preferences (e.g. find a shaded place or a spot where there is likely abundant fish). For the same reason that anglers feel constrained by congestion, they are satisfied when they have sufficient space to manoeuvre. Space can also be correlated with factors such as fish species diversity (Magnuson, 1976), potentially increasing the catch quality available for anglers. Empirical models of boating activity note positive relationships between total fishing activity and lake size (e.g. Bossenbroek et al., 2007; Muirhead & MacIsaac, 2011), and attitude research has shown that constraining site access (e.g. through no-take protected areas) usually results in strong negative reactions by anglers (Salz & Loomis, 2005). Space was more important here for freshwater anglers than for generic anglers, perhaps because many lakes and rivers are constrained physically and therefore crowding occurs more quickly.

Aesthetics, primarily measured as natural beauty, was moderately correlated with overall satisfaction in our meta-analysis. The finding that aesthetics are important to anglers is supported by findings from economic-based research of anglers (Hunt et al., 2019) and motivation research (Fedler & Ditton, 1994). Aesthetics may be important to angler satisfaction for multiple reasons. First, spending time in natural environments produces positive psychological benefits (Bowler et al., 2010); therefore, more aesthetic environments may create more psychological benefits (Ulrich, 1983). Second, more aesthetic environments create more attractive photos or memories for anglers to share with others or to reflect upon, creating long-term satisfaction (Routledge et al., 2013). Although important to

anglers, aesthetics is a more subjective measure than catch, which could explain why it is considered less important in satisfaction research and varies more among studies. The lack of specific anchor points can lead to a lack of contrast effects (as discussed earlier). Aesthetics were more important to German than to U.S. anglers' satisfaction. This result could be due to a cultural difference in preferences or reflect the fact that Germany is particularly densely populated and urban fisheries are more common than in the United States (Arlinghaus et al., 2008; Arlinghaus & Mehner, 2004).

Although closely related to aesthetics, perceived water quality was not significantly correlated with overall satisfaction. Water quality was primarily measured as the cleanliness of water and shoreline. One possible explanation for the lack of importance to overall satisfaction is that good water quality might be bad for fishing (i.e. limited nutrients that leads to clearer water may reduce fish catch; Downing et al., 1990). It may also be the case that good water quality makes the lack of fishing success more apparent, whereas an angler in less clear water may believe there are still fish to be caught. Other reasons for the lack of significance stem from methodological issues. First, water quality is a vague term and will thus be evaluated differently by different anglers in self-reporting surveys, adding noise to the answer patterns. Second, anglers may simply choose to fish in areas with better water quality, so the correlation between water quality and overall satisfaction did not emerge given the self-sorting properties of the sample. Our results should not be misinterpreted that water quality is irrelevant to anglers. Indeed, in a review of anglers' choices of fishing sites (Hunt et al., 2019), water quality (i.e. water chemistry, water clarity, flow, or general quality) was positively related to the choices that anglers make about where they fish. There also exists research showing that litter is one of the most common dissatisfiers for anglers (Arlinghaus & Mehner, 2003; McCool & Petersen, 1982). Therefore, one should not conclude that having clean sites is irrelevant to anglers, but rather that the systematic relationship of clean water (in the sense of nutrient-poor water) and angler well-being is more complex than is often believed.

Relaxation quality was of moderate, yet significant importance to angler satisfaction in our meta-analysis. A growing body of evidence suggests that time spent in natural environments improves the psychological health and well-being of participants (e.g. Bowler et al., 2010). Furthermore, physical activity in nature is associated with enhanced mood (Hartig et al., 2003), improvements in attentional capacity (Berman et al., 2008), improvements in cognitive capacity (Berman et al., 2012) and many other benefits (Lee & Maheswaran, 2011). For these reasons, a relaxing fishing experience contributes to overall satisfaction. Relaxation is also a key motive for anglers (Driver & Knopf, 1976), but one that is easily satisfied, as it is under the control of the angler (Arlinghaus, 2006). The importance of relaxation was moderated by species, type of satisfaction measure and country. Relaxation was more important to freshwater anglers than to other angler groups. Marine angling is a challenging experience with the potential for dangerous conditions. Therefore, anglers might less likely expect a relaxing marine fishing experience than they would for a freshwater trip close to their home at a small lake. Marine

angling also often requires more time, money and equipment (e.g. a boat) compared to freshwater fish. Therefore, anglers with a desire for a relaxing fishing outing are perhaps better able to do this by choosing a freshwater trip due to fewer constraints to participation. Relaxation was more important for year-long than trip satisfaction, likely because anglers generally desire relaxing trips, but it is less important in the short-term. Relaxation was more important to German anglers than U.S. anglers. This result might relate to the fact that German fisheries might be situated in more crowded, urbanized and densely populated areas compared to U.S. fisheries, causing relaxation to be more constrained and, therefore, more important to German anglers.

Facility quality was also significantly and overall moderately associated with overall satisfaction in our meta-analysis. Depending on the location and activity, facilities can be an essential part of the angling experience and ultimately affect satisfaction. There are two reasons why the importance of facility quality might be suppressed in satisfaction research. First, facility quality is easier to satisfy than other components of the fishing experience (e.g. anglers choose locations with facilities). Second, the quality of facilities (e.g. boat slip infrastructure) likely varies less across fisheries, leading to lower potential for contrast effects as compared to catch. Yet, facility quality is an important and often-overlooked attribute in research on anglers' choices of fishing sites (Hunt et al., 2019; Post et al., 2008). The significance of facility quality on angler site selection likely depends on the characteristics of the specific fishery. For example, facilities likely matter more for put-and-take or charter boat fisheries than for fishing in a wild fly fishing stream. We did not find any significant moderators on the importance of facility quality in our meta-analysis. Instead, facility quality was generally important to angler satisfaction in fisheries where facilities matter. This finding might arise from the small sample size of studies.

Social context was not significantly associated with overall satisfaction in our meta-analysis, which may simply reflect greater among study variance relative to other factors. In some fisheries, social experience matters; in others, it does not, or may even harm catch (Miranda, 2005). Moreover, the social context subgroup contained a wide array of conditions, ranging from satisfaction with companions to satisfaction with alternative recreational opportunities in the area, which may have also induced more variance compared to other subgroups we studied. Social components should be included in future satisfaction analyses as social issues matter to anglers in a range of studies (Arlinghaus et al., 2008; Hampton and Lackey, 1976; Hunt et al., 2013; Matlock et al., 1991) and our work should not be misread to suggest that social domains are irrelevant to angler satisfaction.

### 4.3 | Study limitations

Six general limitations exist with our analysis. First, despite attempting a global analysis, the systematic retrieval of primary studies revealed a bias towards a few Western countries. Therefore, it is unclear whether the generalized determinants of

satisfaction that we report mainly for the United States, Canada and Germany hold for other recreational fisheries. Recreational fishing is emerging as a critical social and economic sector in many transitional economies (e.g. Argentina, Brazil, China, India; Bower et al., 2020), and thus, insights about components that influence angler satisfaction in these understudied areas are needed. Second, cost is an essential aspect that influences angler behaviours and utility (Hunt et al., 2019). Researchers, however, have seldom included a cost component when studying anglers' satisfaction. This lack of insight makes it difficult to compare results between economic-based and satisfaction studies of angling regarding the relevance of cost. Third, the entire pool of studies included in the meta-analyses overwhelmingly used a sum-of-satisfaction (78%), regression-based (91%) study design and were generally small in number. Our results thus reflect this research tradition. It is unclear whether the same determinants of satisfaction would be recovered in other measurement and modelling approaches (e.g. gap-score approach, models with interactions). Also, given the low sample size, we had a limited ability to draw insights about the effects of moderators on satisfaction. A fourth limitation of our meta-analysis is that given the many different ways to measure satisfaction (LaPage 1983; Noe, 1987; Williams, 1989), it is difficult to account for the effects of different methods as most of the studies we synthesized used linear and additive models where satisfaction with components of fishing was assumed to form overall satisfaction. Thus, there was no opportunity to review and study interaction effects where, for example, satisfaction with a certain component of fishing depends on the satisfaction level achieved with another component. Also, only rarely (e.g. Beardmore et al., 2015) did researchers assess the presence of non-linear associations between certain components of the fishing experience, such as catch rates, and general angler satisfaction. Non-linearities, however, are critical for determining management thresholds (e.g. minimum levels of catch rates that make anglers reasonably satisfied (e.g. Patterson & Sullivan, 2013)). Fifth, we have studied satisfaction with fishery properties directly, but not satisfaction with wider involvement of anglers in governance and management (e.g. how satisfied one is with the opportunity to express voices in decision making, the perceived fairness of management decisions, etc.). Clearly, these aspects also contribute to satisfaction (Brinson & Wallmo, 2017), but were outside the scope of this paper. Finally, many studies differ in their use of data type (e.g. panel vs. cross-sectional sampling methods), data collection locations (e.g. on-site vs. off-site) and type of satisfaction (catch vs. experience-related satisfaction). Limiting the methodological differences between satisfaction studies would provide more comparable results.

#### 4.4 | Future research needs

There are multiple areas that future satisfaction research could or should address moving forward. The first research area is within the

social domain of anglers. Because the research tradition has been less focused on studying angler expectations within a gap-score approach and knowing that expectations are of fundamental importance for satisfaction (Gale, 1987; Spencer & Spangler, 1992), it is suggested to focus attention here. Several positive feedback cycles among changes in situational variables, shifting expectations and effects on satisfaction are possible that demand a better understanding of angler expectations. Research has demonstrated that expectations are subject to change over time and are normative (Kuentzel & Heberlein, 2003). The expectations that anglers hold may either shift because they are injunctive norms (i.e. anglers shift their expected catch rate based on recent experiences) or because they are descriptive norms (i.e. anglers shift their expected catch rate to match what everybody else is catching). Research is needed to systematically study how anglers form and adapt expectations for different components of the fishing experience, how expectations are reinforced through communication and information (e.g. Schramm et al., 1998), the network dynamics present within angler networks and comparing the flexibility of expectations of across angler types. There is a relevant need to study how anglers evaluate their own experiences, which needs improvement in the study of new survey scales, comparing different assessment methods and determining what the individual is truly evaluating. A related research area is to study how rapidly anglers adjust expectations and satisfaction when environmental conditions shift (e.g. Kuentzel & Heberlein, 1992; Kuentzel & Heberlein, 2003). For example, if a marine-protected area constrains access to a classical fishery, will anglers be able to find alternative locations or shift expectations while maintaining satisfaction levels in new conditions? It is suggested to establish panel research designs (e.g. using online panels) and to expose different anglers to different forms of information (e.g. about expected catch rates on local fisheries or exceptional catches) in an experimental before-after-control-impact research design to truly learn how new information is evaluated, how expectations are formed and altered and how the satisfaction levels are altered, while controlling for the person who is providing the satisfaction rating. In short, there is a strong need for experimental studies and tracking of the same individuals over time in satisfaction research.

Further work is needed testing alternative methods to measure angler satisfaction (e.g. assessing the number of complaints (Wagar, 1974), picture-based analysis of facial expressions (Mauss & Robinson, 2009), social media analysis of text (Snelson, 2016) or the use of physiological measures such as hormone levels, heart rate as a measure of revealed satisfaction with an experience (e.g. Niedermeier et al., 2017)), rather than the classical five or ten-point satisfaction scale in self-reports. Actual physiological measures, such as brainwave activity, blood pressure or cortisol, are so far not used in recreational fishing studies but could also be used to measure the socio-psychological effects fishing has on an individual. Another improvement would be to move from associative studies, often from cross-sectional surveys or on-site surveys common in past satisfaction studies, to experimental intervention using a panel research design that allows researchers to draw more concrete

conclusions about relationships between different components of fishing or information and satisfaction. Modern technology (e.g. apps; Venturelli et al., 2017) could be used to acquire instantaneous measures of satisfaction, which have been shown to record a more accurate measure of experience, while retrospective measures are more predictive with future behaviour (Wirtz et al., 2003). The peak and end rule (Fredrickson, 2000) states that individuals rate an experience largely based on two moments, the peak intensity and the end, and they will largely tune out the other moments of a trip. This phenomenon can help explain why retrospective measures are more accurate in predicting future behaviour.

A related research area within the social domain is assessing interactions and moderating effects as well as non-linear relationships of determinants of satisfaction and overall satisfaction. Research in economics has also shown that people might be in a satisficing mode rather than in a search for optimal conditions. Meaning that individuals will choose an experience that meets or exceeds specified criteria, rather than searching all the options and choosing the best one (Caplin et al., 2011; Simon, 1955). For example, anglers, following a satisficing rather than optimizing role (varies by individual), will accept catch rates at a certain level and not take the time to choose the site with the greatest catch rates available to them. Research is also needed to understand better the behavioural feedbacks of how changes in angler satisfaction affect angler behaviour and in turn how this behavioural change affects the fish populations and ecosystems. Ideally, experimental manipulations that track angler responses and ecosystem effects would be employed to study the links among the social and ecological compartments (Carruthers et al., 2019). Future research could address how these shifts occur in a heterogeneous angling population and describe the mechanisms behind them (cognitive dissonance, assimilation bias, etc.). Furthermore, we are not sure how angling satisfaction influences anglers' behaviour. Leisure is known for its integral role in psychological well-being and life satisfaction (Newman et al., 2014), perhaps anglers participate in fishing to increase life satisfaction, which is more stable over time (i.e. low catch rates are less likely to influence life satisfaction), thereby diminishing the causal relationship between angler satisfaction and behaviour.

Research is also needed to understand how angler satisfaction feeds back to influence managers and how they respond to angler satisfaction. The relationship of what anglers express and how managers behave has been proclaimed repeatedly in modelling papers (Cox et al., 2003; van Poorten et al., 2011) or based on anecdotal reports (Royce, 1983), but little quantitative research exists on how relevant angler satisfaction is in management decision making. If managers wish to use angler satisfaction as a management target and as a measure of performance of local fisheries, there is a need to improve on the measurement scales. Issues exist with the construct validity of the ordinal satisfaction scales (Manning, 2010; Schroeder et al., 2018; Williams, 1989) that need to be addressed. Firstly, in the classic question forms ("how satisfied are you with ...?"), it is difficult to know if the user is evaluating the self, the management agency or

the situation. In many instances in recreation, the consumer is the producer (Roberts et al., 1988), and the extent to which the provider (i.e. fishery manager) is held responsible for "performance" is uncertain. It is often the situation (i.e. the weather or other people) that anglers find undesirable, which is largely outside management control (Peterson, 1974). Secondly, there are concerns over the rational actor model's limitations in assessing satisfaction, such as issues emerging from assimilation bias and cognitive dissonance (Heberlein & Shelby, 1977). Dissatisfied anglers may encounter cognitive dissonance when their experience does not meet their expectations (Festinger, 1957), and they may seek to alleviate the cognitive dissonance by either altering their expectations (Heberlein & Shelby, 1977) or by rationalizing their experience (Shelby et al., 1988). Third, satisfaction is a relative concept that is subject to substantial interpretation not only by individuals but also by managers (Graefe & Fedler, 1986). Should managers act when the satisfaction level drops from an average of 7.5 to 7.0 on a ten-point scale, or should we only be concerned when the average satisfaction rating drops below 5? Different people will have different answers to this issue, reducing the value of satisfaction ratings for management.

Ultimately, satisfaction may not be an ideal performance measure as it might be less under managerial control than more "objective" performance measures such as fish density. Further complicating matters, satisfaction is a fluid, self-produced experience that varies intra-individually and over time (Williams, 1989), and anglers may constantly be in a satisficing mode where perfect performance may not be achieved (Vaske et al., 1982). If this is the case, satisfaction is mainly independent of the rational preferences for attributes and it is mostly a product of emotional and symbolic meaning, stories, and self-identity (Williams, 1989), and may then lose its power as an objective management target. Recent trends in leisure and tourism research, such as "co-creation" (e.g. Binkhorst & Dekker, 2009) and "the structured experience" (e.g. Ellis et al., 2020), view recreational experiences through the lens of an experience economy (Pine & Gilmore, 2011) rather than the classical consumer experience, thus placing more emphasis on the internal experiences of the individual than the attributes that an experience provides. Future research on the angling experience could benefit from these alternative perspectives.

## 5 | CONCLUSIONS AND IMPLICATIONS

Angler satisfaction, which is the reward an angler gets from his or her experience and affects how anglers behave, continues to be an important objective and consideration for recreational fisheries managers. Although the specific effect sizes varied by species, country, and the type of satisfaction measures used in the primary research, our results imply that changes to fishing site availability, crowding as well as reductions in catch qualities will produce dissatisfied anglers. Therefore, in the absence of local information and studies, managers are advised to pay particular attention to maintain access, control or direct crowding and preserve and improve catch and harvest aspects, including the size of the fish in the stock, and

to view these aspects as general guideposts in recreational fisheries management, particularly if the aim is to produce satisfied anglers or avoid issues that emerge from dissatisfied anglers.

A word of caution, however, is needed. While satisfaction is the ultimate product of an angling experience for the individual participant (Royce, 1983), it may not be the ultimate management objective (Ølander, 1977). Satisfaction is the difference among expectations and the performance as judged against expectations (Holland & Ditton, 1992), and it is particularly the latter that might shift and be adapted to past experiences (Arlinghaus, 2004; Gale, 1987; van Poorten et al., 2011; Spencer & Spangler, 1992). Yet, by omitting the gap-score approach and focusing on the sum-of-satisfactions, the research community has largely overlooked the expectation component of angler satisfaction, both in terms of the potential for systematic expectations shifts in line with new experiences in the long-term (e.g. exceptional catch rates, called the positivity effect in psychology, van Poorten et al., 2011), but also in terms of the potential of anglers to self-rationalize experiences (Shelby et al., 1988) and adapt expectations (Heberlein & Shelby, 1977) retrospectively in the short-term. If expectations are as dynamic as we assume (Gale, 1987), the measure of satisfaction might lose its power as a management target by being resilient to change as anglers either shift their effort from low-satisfaction fisheries elsewhere (and then are no longer intercepted in local surveys) or readjust their expectations. Indeed, due to the potential for rising expectations with improvements in fisheries management and associated catch rates, it is possible that over time satisfaction will not increase or may even decrease if fisheries management success might not be maintained—a pattern described as the paradox of satisfaction (Arlinghaus, 2004). Specifically, anglers may never be able to be fully satisfied because they will continue to shift expectations (Gale, 1987). An alternative is to find satisfaction thresholds, where outcomes are “good enough” for the angler (e.g. Patterson & Sullivan, 2013) rather than trying to achieve optimal or maximum satisfaction. Satisfaction thresholds (e.g. for sufficiently good catch rates) can be determined by assessing whether non-linear relationships exist between catch and non-catch-related components and satisfaction (e.g. Patterson & Sullivan, 2013)—an issue so far rarely studied. Note, however, that thresholds for sufficiently good satisfaction might be hard to identify in creel surveys because non-satisfied anglers drop out from the sample, which can explain why past studies using on-site satisfaction surveys have often reported high resiliency of average satisfaction ratings and little among-sample variation in satisfaction among visitors (Manning, 2010). Such patterns reduce the value of monitoring on-site satisfaction for management. As an alternative, long-term panel surveys might be designed that monitor regional patterns of satisfaction (e.g. Kuentzel & Heberlein, 2003) and allow drop-outs to be repeatedly sampled and asked for the performance assessment of local fisheries. Such panel design may be costly, but perhaps the future and would allow the repeatedly assess the same people and thereby be able to track changes in the mood and satisfaction of a sample of anglers as they travel through time and space.

## ACKNOWLEDGEMENTS

We thank Phillip Czaplá for his help with the early collection of studies for the meta-analysis. Funding was received through the project AQUATAG—Leisure Activities on Inland Waters: Dynamics, Ecological Impact, Social Significance and Sustainable Management, funded by the German Federal Ministry of Education and Research under the grant number: 033W046A. RA received further funding through the BODDENHECHT project (MV-I.18-LM-004, B 730117000069), funded 75% by the EU, with funds from the European Marine and Fisheries Fund (EMFF), and 25% from national funds by the State of Mecklenburg-Western Pomerania (Ministry for Agriculture and Environment Mecklenburg-Western Pomerania). We thank Dan Taillon, Liz Hilton, and reviewers for their excellent feedback on this manuscript.

## CONFLICT OF INTEREST

There is no conflict of interest.

## DATA AVAILABILITY STATEMENT

The datasets generated during and/or analysed during the current study are available from the corresponding author upon request.

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**How to cite this article:** Birdsong M, Hunt LM, Arlinghaus R. Recreational angler satisfaction: What drives it?. *Fish Fish*. 2021;00:1–25. <https://doi.org/10.1111/faf.12545>