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Introducing Relational Values as a Tool for Shark Conservation, Science, and Management

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Relational values (RV) are values that arise from a relationship with nature, encompassing a sense of place, feelings of well-being (mental and physical health), and cultural, community, or personal identities. With sharks, such values are formed by diverse groups that interact with these animals and their ecosystems, either physically or virtually, whether a scientist, student, fisher, or media-viewer. Further, these user groups may overlap or come into conflict over management plans, media portrayals of sharks, and their conservation status. Although scientists have not explicitly aimed to assess RV through sharks, qualitative studies of shark fishers, tourism operators, tourists, and the public, as well as historical and archeological accounts, can be interpreted through an analytical lens to reveal values which can also be defined as relational. To this end, this review considers studies capturing RV alongside those of economic value (increasingly, the value of a shark is appraised by their financial value in shark tourism) and the social and cultural roles of sharks. Based on these studies and the broader RV literature, we then outline a workflow for how RV can be leveraged in scientific inquiry, equitable resource management, and education. We conclude that via collaborative assessments of RV, with implicit inclusion of multiple values of sharks and by acknowledging their importance to all parties involved in user conflicts, the RV framework can lead to a constructive dialog on polarizing conservation and management issues. By illuminating shared values, and/or revealing dichotomies of values ascribed toward certain areas or objects, this framework can provide inroads to mediation, seeking to conserve or even restore relationships with nature, and their derived values as much as is possible. This approach can yield unexpected knowledge, solutions, and compromises in an increasingly complex conservation landscape.

Keywords: relational values, ecosystem services, well-being, sharks, elasmobranchs, conservation, management, values assessment

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INTRODUCTION

Why Value Sharks?

The human-nature relationship has been understood in a myriad of ways by various cultural and ethnic groups through time. Plants, animals, and their ecosystems are acknowledged to play significant ecological roles, while also playing a role in human societies – this latter role is more difficult to quantify and has typically been approached through an "ecosystem services" framing. Finding a way to intercompare these diverse

services from nature, from well-being and cultural importance to direct financial gain (e.g., from exploitation for industry) (Turner et al., 2003), is important for inclusive decision making and policy. For instance, in planning for development or conservation, such as through impact assessments and choosing among alternative courses of action (Nelson et al., 2009), and in addressing environmental degradation through equitable remediation, loss compensation, and resource allocation (Bladon et al., 2018). Throughout this paper, we refer to either values, ecosystem services, or both, depending on the context at hand. These terminologies are, in some respects, interchangeable in referring to human benefits from nature, but in certain policy-specific scenarios, it becomes important to use whichever term is collectively agreed upon by practitioners. We have elected to focus on the emerging framing of "relational values (RV)," or values from the human-nature relationship. This framing, which has gained momentum in academic and policy circles since its introduction in 2015 (Chan et al., 2016; Pascual et al., 2017), aims to improve upon prior value classifications which distinguished nature as something to be valued by humans, and in doing so, set humankind apart from what was thought of as "nature." Given the intractability of present and future human society from the world's ecosystems, the RV approach is a promising framework through which to interpret modern environmental problems which impact humans and non-humans alike.

Sharks and their relatives are a particularly threatened natural resource: of the 1041 species of sharks, skates, rays, and chimeras, one quarter are threatened by overfishing (Dulvy et al., 2014). In this paper, "sharks" is used to refer collectively to Chondrichthyan species – that is, sharks, skates, rays, and chimeras. Policy-makers and resource managers encounter many compounding barriers in attempting to conserve shark populations, spanning across aspects from ecological and biological to institutional, economical, and sociological (Chin et al., 2010; Bornatowski et al., 2014; Dulvy et al., 2017; Jabado, 2018). Although some "bright spots" of shark fishery management have emerged (Simpfendorfer and Dulvy, 2017), many populations are at risk of extinction due to historical over-exploitation, and a life-history pattern which lends to relatively slow recovery (e.g., larger sharks live relatively long, and reproduce small litters on a several-yearly basis) (Compagno, 1990; Field et al., 2010). Globally, 40% of shark catch originates from seven countries with low human development indices (Indonesia, India, Pakistan, Yemen, Tasmania, Nigeria, and Senegal), where sharks can be a source of both income and protein (Dulvy et al., 2017). Of these countries, a review of shark and ray conservation priorities found that India and Indonesia were some of the least likely countries to take conservation action (via fisheries management), despite hosting a high number of endangered and critically endangered species (as per The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species) (Dulvy et al., 2017). Implementing realistic, achievable, and sustainable conservation measures for sharks call for not only an investment of financial resources to monitor the shark populations in question, but also a significant investment of human capital to assess values derived by those individuals and communities who are implicated in conservation plans.

What Are Relational Values?

The RV framing is inclusive of all values that can arise out of a person's or society's relationship with nature (Chan et al., 2016). Past value frameworks, such as the "cultural values" section of the millennium ecosystem assessment (MEA), encountered difficulties because these values were not well defined, and challenging (even counterproductive) to conceptualize for monitoring or measurement, as part of a quantification-focused model (Kenter et al., 2011, 2015). RVs may help to facilitate a dialog over where or whether to draw the human-nature divide in the assignment of value, by embracing the intractability of human society and natural systems. Although studies explicitly aiming to assess RVs are as of yet few, such values have been assessed in other disciplines, or used different terms. Environmental values (Kempton et al., 1996; Satterfield, 2001; Schneller et al., 2013), emotional attachments (Nightingale, 2012), morals and values (Colding and Folke, 2001; Peterson et al., 2002; Daw et al., 2015), social and community identity (Stoffle et al., 2009; Mccright and Dunlap, 2015), and stewardship/conservation ethic or awareness (Lucy and Davy, 2000; Lynch et al., 2010; Whatmough et al., 2011; Shiffman and Hammerschlag, 2014) have all been assessed with either quantitative (e.g., economic assessments by academic researchers or non-governmental organizations, ecological indicators) or qualitative (e.g., sociological and anthropological methods such as interviews and participant observation, by academic researchers or conservation practitioners) means. Other studies have taken a broader view of "ecosystem services" (ES) which include relational, intrinsic, and instrumental values (Hicks and Cinner, 2014; Fischer and Eastwood, 2016; Lau et al., 2018).

This review will summarize and contextualize the nascent field of RV, with a focus on human interactions with elasmobranchs (sharks, skates, and rays), and how their value to society has been assessed and discussed. Given the predominance of economic valuations in the marine conservation literature, we will briefly outline the applications, and issues associated with this approach, contrast economic valuations with more holistic and mechanistic approaches, and introduce a "multi-pronged" approach to valuation of elasmobranchs which includes RVs. Our approach acknowledges the perceived ecological, spiritual, cultural, financial, academic, and recreational significance of elasmobranchs in human experience, and envisions how considering such pluralistic values when formulating conservation strategies or interventions might yield outcomes that are more equitable and effective for human and non-humans alike.

METHODOLOGICAL APPROACH

In our search of the literature, we defined RV as values that arise from a relationship with sharks (studying, fishing, and observing), encompassing sense of place, feelings of well-being (mental and physical health), and cultural, community, or

personal identities (Chan et al., 2016; Pascual et al., 2017). We took the view that such values were formed by different groups that interact with sharks, physically or virtually – whether scientist, student, fisher, or media viewer. Although scientists have not explicitly aimed to assess RV through sharks, qualitative studies of shark fishers, tourism operators, tourists, and the public, as well as historical and archeological accounts, can be interpreted through an RV lens to reveal values which can also be defined as relational as per Chan et al. (2016). To this end, we included studies capturing RVs, alongside those on economic value (increasingly, sharks' value is appraised by their financial value through shark tourism) and included sources to consider how RV can be leveraged in scientific inquiry, resource management, and education.

To guide interpretation of the literature, we addressed the following set of questions:

(1) How are RVs formed?
(2) How are values formed with respect to sharks?
(3) Do different shark "user groups" overlap or conflict in their "use" of sharks, and/or their perceptions of the value of sharks?
(4) How can RVs be harnessed as a tool for shark research and conservation?
(5) How can researchers and conservation/management practitioners conduct assessments that incorporate the RVs of sharks?

RESULTS AND DISCUSSION

How Are Values Formed?

Valuations of services or benefits of natural resources is common practice in the policy and management space (Turner et al., 2003; Clifton et al., 2014; Luisetti et al., 2014; Arkema et al., 2015); however, recognizing that a value in itself might be meaningless, some researchers have applied post-hoc theoretical frameworks to explain either the underlying "drivers" of such elicited values, or how those values were formed by a person or group of people. The most relevant such framework may be the theory of "Emotional Affinity" with nature, introduced by Kals et al. (1999) which offers a conceptual framework for situating RVs and values toward nature in general. This notion is built on the notions of emotional bonds and ties with nature, which drives a person's desire to protect it (Vining, 1992; DiEnno and Thompson, 2013), and is couched not only in the importance of spending time in nature, but on sharing such positive experiences and feelings in nature with others (Kals et al., 1999; Curtin, 2005; Edwards et al., 2016). This is similar to the "biophilia" hypothesis that because their well-being is dependent upon it, human beings are inherently attuned to nature and this drives their desire to protect it (Kahn, 1997; Robinson, 2001). Collectively, these emotional and social ties around nature can heighten the perceived psychological cost of not acting to protect nature, even when one person's actions may seem insufficient in scale to solve the problems at hand. This framework provides a lens through which to interpret values from sharks, whether values are explicitly defined as "relational," or if situations are described in which RVs might emerge.

Another approach is the Value-Belief-Norm theory which originated from Stern et al. (1995) and Stern (2000). Value-Belief-Norm theory postulates a causal relationship among five variables which leads to a behavior: "values" (biocentric, altruistic, and egoistic) forming the base of this causal chain, leading to a set of beliefs – an ecological worldview, enabling the perception of risk to "valued objects," and a realization of one's own agency to reduce threats to that object of value. These beliefs, arising from the initial set of values, then precipitate a "sense of obligation to take pro-environmental actions," which manifest as behaviors such as activism, non-activist public sphere or private sphere behaviors, and behaviors within an organization (e.g., as part of an environmental group) (Stern, 2000). **Figure 1** shows how the Emotional Affinity and Value-Belief-Norm theory explain pro-environmental actions from similar yet distinct theoretical approaches.

How Are Values Formed With Respect to Sharks?

Cultural Identities: Sharks as a Symbol and a Resource

Indigenous relationships with the sea

Archeological records and oral histories of pre-colonial societies have shown sharks' dual role as a fishery resource and a cultural symbol related to personal and community identities, foreshadowing shared RV with modern shark fishers. Polynesian Māori arrived in New Zealand ∼ 1280 A.D. (Wilmshurst et al., 2008), where they practiced self-regulated shark fishing, enforcing penalties for fishing outside of permitted times. Sharks are represented in Māori folklore and oral history as both a dangerous predator and an example of strength to aspire to, as a symbol in artwork, and as a source of materials for tools and weapons. Similarly, archeological records from the Americas show a long (thousands of years) history of the use of sharks. Archeological sites of pre-Columbian indigenous societies, located in present-day Florida, yield shark teeth tools and weapons (cudgels), showing their instrumental value, and the wide presence of elasmobranch centra (vertebrae) in Floridan sites [e.g., 14,000 centra across 64 of 96 sites examined by Kozuch (1991)] emphasize the role of sharks as a multifaceted resource (Wing and Loucks, 1982; Walker, 2000). Through investigation of Mayan and Mexican sites, researchers have suggested shark teeth were used ceremonially (De Borhegyi, 1961), as well as for their instrumental value as food – shark liver oil being particularly high in vitamin A and D. Sharks may have been a highly valued nutritional resource in these societies (Kozuch and Fitzgerald, 1989). For Pacific societies such as the Maori or in the Gilbert Islands, ethnohistorical studies from the 1900s were able to describe fishing practices and the cultural role of sharks through interviews (Luomala, 1980). However, there were too few remaining members of indigenous groups in the Americas to provide these accounts, so hypotheses on the value of sharks must be based on physical evidence alone.

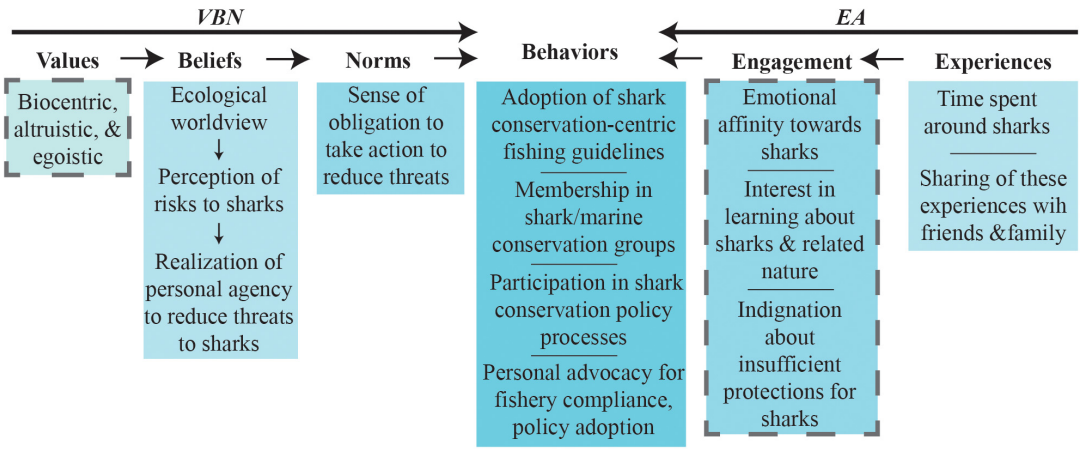

FIGURE 1 | Values have been explained in the context of theoretic frameworks leading to pro-environmental behaviors; here, we show how the Value-Belief-Norm and Emotional Affinity frameworks propose mechanisms leading to a behavior, in the context of sharks. Dashed lines indicate the component of the framework most similar/relevant to "relational values." This figure is based off of schematics from Stern (2000) and Kals et al. (1999).

In present-day New Zealand, Jøn and Aich argue that white sharks are perceived as at odds with fishing and beach tourism, yet beneficial for shark-associated tourism (Jøn and Aich, 2015). In French Polynesia, where sharks were also associated with warrior identities, fishing for sharks was a ritualized practice, including species-specific methods of fishing, and in some areas, self-enforced limits on catch (e.g., catching certain sharks or fishing in certain areas or times was seen as "taboo" given sacred associations with sharks, places, or times) (Torrente et al., 2018). Sharks appear in the identities and oral traditions of present-day "Saltwater People," a subset of indigenous and native islanders in northern Australia whose livelihoods and spirituality are dependent upon the marine environment (McNiven, 2004). Here, the Rrumburryia clan of the Yanyuwa people tells the story of "The Tiger Shark (Ngurdrungurdu) Dreaming," which conveys the journey of a shark throughout the northern region of the continent, interacting with humans and other land-bound animals along its way (The Yanuwa People, 2008). This story exemplifies how sharks are woven into the human-nature relationship, to the extent that the tiger shark in this story can represent an extension of the storyteller's identity in its retelling.

Eating sharks: What is the connection between sustenance and stewardship?

We focus this discussion largely on Hawaii and China, due to their predominance in the literature regarding historical culinary utilization of sharks, and because comparing these two regions demonstrates how specific ways of relating to sharks, enabled by geography and cultural trajectories, have persisted from prehistorical periods to the present day. In Hawaii, archeological evidence indicates that before European colonial contact, sharks were considered a "luxury" or elite food item, the consumption of which was synonymous with elevated high social status (Kirch and O'Day, 2003). In China, shark fin enjoyed a similar culinary status, as early as the Sung dynasty (AD 960–1279). A comparison of these two cultures suggests that the Chinese consumed sharks because of (a) a belief that the consumer would be imbued with the strength of the shark by association, and (b) shark fin (consumed in soup at present) was associated with wealth and prestige; whereas, in Hawaii (similar to Mâori and other Pacific-associated cultures), the shark held both a mythical, cosmological, and spiritual significance (Mokuau and Browne, 1994; Dell'Apa et al., 2014). Interpreting these different meanings behind shark consumption through a relational value lens, however, shows that all three traditional societies drew meaning and identity through their interaction (fishing, consumption) with sharks, versus utilitarian nourishment alone. Over time, however, the scale of consumption reached higher levels in China than either New Zealand or Hawaii, due to population growth as well as the fact that shark fin continues to be a symbol of wealth, status, and strength, within a trade infrastructure where sharks and shark fins are an economically viable product (Dent and Clarke, 2015). The Hong Kong SAR of China accounted for 44–59% of global shark fin imports in 2000, and although this proportion has since declined, the region is ranked as the top global trader of shark fins for 2000–2011 (Clarke, 2004; Dent and Clarke, 2015; Grimes, 2018). There are two further distinctions in valuation among these three regions: firstly, in China, consumption of sharks contributes to personal identity, whereas in Hawaii, sharks were both a "family god," *aumakua*, as well as being a "personal god," *akua* (Mokuau and Browne, 1994). Secondly, both New Zealand and Hawaii are more maritime oriented regions; while native Hawaiians regularly saw sharks in the wild, associating these interactions with mythical and spiritual meaning (Mokuau and Browne, 1994), and similarly, the Maori of New Zealand fished for sharks as part of a tradition linked with folklore and culture (Jøn and Aich, 2015), most Chinese consumers do not experience the same interaction and association with nature when consuming sharks.

China provides another example of distancing the act of consumption from the action and experience of catching; as the world's top producer of wild seafood, more of this catch

comes from outside China's waters than within (Mallory, 2013). Thus, RV in China toward sharks might not have relevance to a nature conservation or sustainability framing unless consumers and traders can form this association through targeted education and outreach (Tsoi et al., 2016). Underscoring the importance of establishing these links, a recent genetic study on the origin of shark fins in the Hong Kong retail market by Fields et al. (2018) found that less than 10 of 76 species identified were associated with sustainably managed fisheries, and approximately one third of species were at risk of extinction as defined by the IUCN Red List of Threatened Species. One challenge, however, of conservation initiatives focusing on shark consumption, is that many consumers may be unaware they are eating a shark species – whether they do not recognize the name of the product as indicating a shark (e.g., 77.5% of survey respondents who had eaten "tollo" meat did not know they had eaten shark meat, which this name refers to), or, a seafood product can be mislabeled, so that a consumer inadvertently buys shark meat for consumption (Jacquet and Pauly, 2008).

Value Formation Through Physical Interaction: Tourism and Fishing

Fishing for sharks: A source of values and conflicts

The practice of fishing can contribute to mental well-being through self-actualization (challenge, adventure, and independence), to the extent that some fishers will not choose alternative livelihoods offered by government incentives aiming to reduce fishing pressure (Pollnac et al., 2006, 2015). By fishing for a living, or as a pastime, individuals can form personal identities which include the ocean (e.g., see themselves as "a part of the sea," or the sea as "a part of them") (Nightingale, 2012; Voyer et al., 2015). This identity is echoed in studies of recreational shark fishers and operators (Barrowclift et al., 2017). Notably, many fishers saw their own knowledge and perceptions of shark population trends as being at odds with regulations, and by extension those regulations as an unmerited challenge to their ability to fish (Lynch et al., 2010; Shiffman and Hammerschlag, 2014; Shiffman et al., 2017). Studies of recreational shark fishers in Florida and Australia found that fishers generally displayed pro-conservation behaviors and attitudes; for instance, most were aware that "catch-and-release" fishing, where the shark is released instead of taken, serves to maintain the functional role of sharks in their environment (Lynch et al., 2010; Shiffman and Hammerschlag, 2014; Heard et al., 2016). In some cases, fishers had some understanding that certain shark species were less likely to survive after catch and release fishing, and tried to release sharks in a good condition to improve their chances of survival (Lynch et al., 2010), while in others, these attitudes were not accompanied by fishing gear to improve shark survival (Heard et al., 2016). In many cases, people fishing for sharks as part of their livelihoods (e.g., commercial or industrial fishing, depending on the terminology used, or recreational fishing businesses), are not doing so as part of a "target" shark fishery; instead, they are seeking other species, such as tuna, but also catch sharks, which they might then turn into a commodity (e.g., if there is a market or dealer to whom they can sell shark meat or fins, whether or not it is legal to do so) (Jabado et al., 2015). Recreational fishing businesses may market several different species-focused expeditions, one of which may be sharks (Shiffman and Hammerschlag, 2014). Indonesia represents one of the few directed/targeted shark fisheries; where sharks play a significant role in Indonesian fishing communities, there is greater economic significance from the fluctuations of local shark populations (Jaiteh et al., 2016a,b, 2017). From a values assessment perspective, to these communities, sharks' economic value may be of great importance, whereas in other communities where sharks are of less relative financial importance versus other fishery species, other values from the shark fishing activity, such as RVs, might be more apparent than the economic value.

In regions where fisheries monitoring data is limited or lacking, fishers can be a source of knowledge for long-term population trends; this knowledge has been recognized by researchers through the surveys of traditional or local ecological knowledge (TEK or LEK). In the Gulf Region of the United Arab Emirates, artisanal or industrial fishers have for decades been catching sharks for some part of their income, which was leveraged by Jabado et al. (2015) through LEK surveys to establish baseline information on the abundance and sizes of sharks. Similar to other long-term users of marine areas (Suman et al., 1999; Gray et al., 2010; Nayak, 2017), participating fishers felt that their knowledge was not sufficiently consulted during management planning, which in turn affected their ability to access fish (sharks and otherwise).

Given that fishing is important for sustaining their livelihoods, way of life, and well-being (all of which entail RV through the act of fishing) these individuals are motivated allies of conservation and planning. Complementary to the positivistic nature of most academic fisheries, knowledge provided by fishers is "interdisciplinary" by nature, as they make decisions - such as where to fish – based upon a combination of meteorological, oceanographic, biological, and social information (Thorlindsson, 1994). When designing management plans or performing values/ES assessments, one way of implicitly including RV can be by considering what "success" means to a fisher (e.g., a good catch, having sources of information on where to fish), versus a scientist (e.g., publications, scientific discovery) (Thorlindsson, 1994). However, the value of this partnership may go unacknowledged by fishery managers, presenting an untapped resource for gathering ecological data, while fostering stewardship through acknowledging the expertise of fishers. In developing nations, researchers associated with academic institutions are gathering experiential knowledge such as shark abundance, size trends, and market values through questionnaires, interviews, or by employing community members as data collectors (Jabado et al., 2015, Jabado, 2018; Jaiteh et al., 2016a; Humber et al., 2017). These findings are shared with the academic community and others with access to scientific journals, however, pathways on how to use this in management are not explicit. There is an emerging awareness of the importance of knowledge brokering with decision makers in order to reach conservation goals (Cvitanovic et al., 2016); accordingly, scientists might consider their role in fostering knowledge exchange as feasible when gathering experiential data. Researchers have served this role in using local knowledge

to initiate management action, although social, economic, regulatory, and cultural constraints can dampen efforts; in a successful instance, Heyman et al. (2001) used an extensive visual survey to investigate reports of a whale shark aggregation in the Gladden Spit area of Belize, an aggregation associated with important spawning events of reef fish. These results led to the establishment of a marine protected area to protect the spawning fish (Drew, 2005).

Diving with sharks: Harnessing emotion and social interaction for value formation

There is preliminary evidence from Apps et al. that stewardship values could be fostered through shark diving tourism: here, cage diving with white sharks was associated with an increased desire to contribute to shark conservation efforts, particularly when strong emotions were experienced during the shark-human interaction (Apps et al., 2018). However, another study of shark diving tourism participants found that although knowledge of sharks increased, pro-environmental attitudes did not shift from pre- to post- dive (Smith et al., 2014). Both cases suggest that short-term tourism experiences featuring shark interaction (e.g., over the course of 1 day) might increase knowledge or awareness of sharks and associated conservation challenges, particularly if the diving experience is paired with teaching or a presentation by guides (see also Apps et al., 2017). However, attribution of value formation to these experiences is unclear: expansion of qualitative methods (oral histories, participant observation, interviews) and the consideration of more user groups (tourism guides and business owners) are needed to establish pathways from participation to value formation – for instance, diving participants may be predisposed to have biocentric worldviews, to the extent that any "increase" may not be expected or measurable by a questionnaire, particularly over a short period of time (1 day) (Smith et al., 2009). Curtin (2005) and Patterson et al. (1998) offer two practical avenues of establishing values through (shark) tourism: (1) the shared experience (e.g., reflecting with other members of a group partaking in the shark dive) can form lasting memories, and perhaps increase the likelihood of value formation through social connection and recalling of personal narratives, and (2) wildlife tourism can offer the traveler to experience "existential authenticity" by giving them an area they are free to explore and project their own personally constructed notions of nature onto. In the latter, the tourist can create their own "sense of place" in the area they explore (potentially encompassing sharks), which may be quite different than their "home" environment where urbanization has led to an increased distance between humans and what is perceived as "authentic" nature. Several studies, however, have suggested a "ceiling effect" with shark tourism, in that the attendees already display pro-environmental attitudes and behaviors, knowledge of sharks, and a strong conservation ethic (Apps et al., 2015; Sutcliffe and Barnes, 2018). While these instances do not denigrate the value of diving with sharks in inciting emotional responses and facilitating the formation of RVs around sharks, they do emphasize the importance of not judging the value of a shark-diving experience by its impact on behaviors, knowledge, or attitudes.

In recent decades, there has been a shift in sharks' public image as "man-eaters" to conservation icons, which has coincided with growing interest to observe sharks in their natural environment. Discourse analysis of a popular Australian diving magazine showed that from 1953 to 2006, there was a shift of "danger-seeking hunter" to "nature-seeking observer" ascribed to shark interactions (Whatmough et al., 2011), although an analysis of newspaper articles concerning sharks showed that both American and Australian outlets reported on the risks sharks pose to humans, more so than the risks human activities pose to many shark populations (Muter et al., 2013). Leveraging sharks for tourism has risen in popularity, although value assessments of this industry have focused largely on financial benefits, for areas including Fiji (Vianna et al., 2011), the Bahamas (Haas et al., 2017), Palau (Vianna et al., 2012), and Australia (Huveneers et al., 2017). Indeed, shark tourism has been proposed as an alternative livelihood in areas where fishing pressure overlaps with shark populations, based on economic valuations which demonstrate how tourism income could supplement loss of fishing income, and assume that a transition from fishing to "non-use" tourism will aid conservation of shark populations (Bentz et al., 2014; Garla et al., 2015; Pires et al., 2016). However, such a proposal must be made on a strictly case-by-case scenario, including evaluation of (1) feasibility of establishing a sustainable tourism business, and (2) whether the amount of fishing pressure in question would have a significant impact on shark populations in question (e.g., species may be highly migratory, and local fishing pressure may be low), and (3) whether increased visitation from growth in tourism could lead to other environmental issues, such as waste management and pollution (Partelow and Nelson, 2018). Records of conflict between shark tourism and fishing businesses (Anderson and Ahmed, 1993; Bentz et al., 2014), and with members of the public concerned about beach safety (Neff, 2014a), point to a need for qualitative studies which capture RV and policy preferences of each stakeholder group, in order to acknowledge and address as many interest groups as possible in the policy creation and implementation process – particularly in areas such as Palau where entire small-island economies are becoming reliant on tourism income (Vianna et al., 2012).

Value Formation Through Media: Emotional Responses and Conservation Ethic

Although shark attacks are extremely infrequent given how often humans use beaches (West, 2011), popular media has instilled and perpetuated a fear of sharks through such fictional movies as Jaws in 1975 (Simpfendorfer et al., 2011; Neff and Hueter, 2013), and the subsequent Jaws 2 (1978), Jaws 3 (1983), and Jaws The Revenge (1987). Although interaction with sharks, whether physical or virtual, presents the opportunity to form RVs, fear-centric media and dialog is likely not conducive to forming RVs around sharks. In this framing, the shark is cast as a villain that challenges human well-being (Muter et al., 2013; McCagh et al., 2015; Sabatier and Huveneers, 2018), rather than part of a positive experience that builds emotional bonds with nature. As recently as 2014, action by politicians in Australia were linked to the fear-based Jaws narrative to mobilize a shark culling (targeted killing) policy despite a lack of empirical

evidence for efficacy (Neff, 2014b; McCagh et al., 2015). Neff and Hueter (2013) have explored origins of the "man eater" image of sharks, an image which may influence RV humans form with respect to sharks. Recently, Pepin-Neff and Wynter (2018) surveyed attitudes toward sharks in Australia, issuing surveys close to the time of shark attacks. They found that an individual's relative feelings of pride, fear, and perception of an attack were intentionality associated with whether the individual was supportive of shark control policies; namely, levels of pride mediated whether or not fear affected policy preference. For instance, at high levels of pride, fear had little effect on policy preference, while the combination of low pride, high fear, and perception of intentionality, was associated with preference for lethal over non-lethal control policies. Simmons and Mehmet (2018) demonstrate the complex effects of implementing policies and monitoring strategies in Australia which address public safety. A survey of social media responses to various non-lethal shark control measures, including those communicating the locations of sharks to the public (e.g., helicopters, shark location-sharing technology) showed that individuals expressed relief or comfort from the knowledge of sharks being monitored, yet also, fear from increased awareness of shark movements. Similarly, Gibbs and Warren (2015) surveyed perceptions of shark control measures in the same region, finding that members of the public were wary of the financial costs of monitoring and controlling sharks for public safety, and were exercising personal agency in taking steps to reduce probability of shark encounters.

In a conservation ethics context, individuals who identify or empathize with the natural environment (or with an animal in that environment), a view which might have been fostered through emotional or shared social experiences in nature may more likely treat that environment or animal as they would treat themselves and other humans – in other terms, extending moral values toward non-humans (Milton, 2002; Nightingale, 2012; Clayton and Susan Opotow, 2013), and displaying behaviors indicating stewardship. For instance, one individual may experience sharks only through media exposure (fictional, news, or documentaries) that depicts sharks attacking humans, describes sharks using negative or criminalizing language, or melodramatically villainizes sharks as menacing through the employment of ominous soundtracks or leitmotifs. (McCagh et al., 2015; Nosal et al., 2016b; Fraser-Baxter and Medvecky, 2018; Sabatier and Huveneers, 2018). In alternative scenarios, an individual may experience sharks through scuba diving (Whatmough et al., 2011; Apps et al., 2015, 2018) and recreational fishing (Lynch et al., 2010; Mcclellan Press et al., 2015; Heard et al., 2016; Shiffman et al., 2017) which engender a familiarity with sharks in the wild; or through documentaries and aquarium exhibits which frame sharks in a positive, non-threatening way (Gendron, 2004; Nosal et al., 2016b; Pepin-Neff and Wynter, 2018). Experiences via contact in the wild or in educational settings where sharks are positively framed are more likely to lead to emotional attachments which engender RV such as stewardship, whereby the individual may be more predisposed to support policies or projects for sustainable shark populations. Although the Emotional Affinity interpretation of value-formation through nature does include such emotions as indignation and anger, these emotions foster a connection in a context of anger for lack of conservation action, for instance, or indignation at environmental degradation (Kals et al., 1999). For sharks, this could be through films showing these animals being killed by fishers, inciting emotions of anger that build a feeling of affinity with sharks and fostering RVs such as stewardship.

Indeed, sharks have risen as an icon of conservation; many species are large and charismatic, prolific in global popular culture, hold human fascination, and are often-touted as symbols and stewards of healthy ocean ecosystems (Simpfendorfer et al., 2011). This popularity has led to campaigns around shark conservation, and are supported by an array of non-governmental organizations, individuals, and other actors. Although shark conservationists have not been specifically studied as a group, looking for scholarship in the environmentalism movement can shed light on the formation or strengthening of RVs through engaging in the shark conservation movement. Some individuals might identify as an environmentalist through simple day-to-day actions such as recycling, and feel a sense of social/collective identity with other environmentalists as a result of their actions (Markle, 2014; Mccright and Dunlap, 2015; Nelms et al., 2017). Companies may institute "eco-friendly" policies or practices to capitalize on positive social associations with environmentalism (Wry and York, 2017). Non-governmental organizations, petitions to decision makers and companies, and now social media, are avenues for individuals to engage with scientists and decision makers (Yang, 2005; Leeder, 2007). With respect to sharks, a "shark conservationist" environmentalist social identity is likely to be facilitated by similar forms of engagement to exercise agency. For instance, individuals who identify as part of a conservation group can score higher on measures of emotional connection with nature, potentially showing a "positive feedback" effect through engagement in conservation action (Kals et al., 1999). Social media in particular is emerging as a powerful tool for education professionals and scientists to communicate with the public, to translate the engagement of "environmentalist" identifying individuals into conservation outcomes (Parsons et al., 2014b).

Education: Has Knowledge Provisioning Led to Stewardship?

For many, aquariums can offer a more accessible location than the wild to form RV through the observation of sharks, even though they are in a human-created rather than natural environment. Over time, aquariums have increasingly framed sharks as objects of conservation concern and ecological importance, although a few retain the element of "sensationalizing" them to draw interest from visitors (Gendron, 2004). For example, "Shark Dive Xtreme" at Melbourne Aquarium in Australia, which offers visitors the chance to swim with sharks, could be interpreted as sensationalizing the notion of human-shark interaction; others, though, present the opportunity to swim with their sharks in a more neutral manner, like "Sea Swim" at the Florida Aquarium in the United States. Indeed, it is difficult to make generalizations

regarding aquarium exhibits of sharks and their impacts; a self-reporting questionnaire in the United Kingdom found aquarium attendance to be associated with positive attitudes toward sharks (Friedrich et al., 2014), while another study found that although childhood visitors identified the utilitarian value of sharks in their environment, pre-existing notions about sharks attacking humans, and sharks being an extractable "resource" to be harvested (e.g., an instrumental valuation) persisted throughout the visit (Correia das Neves and Rocha Monteiro, 2014).

Knowledge, or information provisioning alone, is often insufficient to build an individual's conservation ethic, or their drive to preserve natural resources for future generations; the information presented may be incongruent with personal ideologies or mental models of how the world works, as with climate change denial (Sterman, 2008; Jacquet et al., 2014), or an experiential complement may be necessary, in which the individual directly interacts with the natural environment or animal they are learning about (Otto and Pensini, 2017). Education practitioners have recognized the importance of "experiential education" – educational programming in nature (Stern et al., 2008) or "hands-on" learning opportunities in the field (Manzanal et al., 1999) which has the potential to enhance comprehension of subject matter, and increase pro-environmental attitudes among students. The relative contributions of experience and knowledge are intractable, whether in an ecotourism (experience-focused) (Ballantyne and Packer, 2002; Powell and Ham, 2008) or educational (knowledge-focused) setting, however, strengthening their combination appears more likely to engender RV than one component alone (Pepin-Neff and Wynter, 2018), particularly when there are "follow-up" activities after the initial experience (Hughes et al., 2011; Behrendt and Franklin, 2014).

Shark Researchers: Science as a Practice to Form Relational Values

Scientists hold a pivotal role in generating knowledge for the valuation of sharks, whether economic (evaluating financial costs and benefits from different uses of sharks for livelihood support), intrinsic (demonstrating ecological importance which encompasses sharks in an eco-centric ideology), or relational (demonstrating the complexity of sharks' behavior to contrast "man-eater" perceptions, and generation of knowledge in collaboration with fishers). Apart from a scientist's well-being relating to sharks by employment to conduct research, the act of studying sharks and disseminating this knowledge may contribute to personal and community identities (the scientist and the scientific community). As an interesting duality, scientific knowledge has itself been discussed as a type of socio-cultural ES (Costanza et al., 1997). While no studies have aimed to investigate RVs of scientists, an historical overview of shark researchers and institutions reveals that their research has evolved in parallel with how sharks are used (and viewed) by society – from expendable resources of the sea (Salviani, 1554; Castro, 2014) to a threat to human ocean users (Klimley, 1974; Zahuranec, 1975; Gilbert, 1977) to a potentially critical species for maintaining ecosystem functionality (Heithaus, 2001; Navia et al., 2014) to icons for marine conservation (Simpfendorfer et al., 2011; Whatmough et al., 2011) to critical elements of socio-economic systems. If scientists have developed an "emotional affinity" for their study subjects, and are more likely to display pro-environmental behavior in the context of elasmobranch conservation measures, it is important for them to examine whether this presents a personal bias toward certain management measures, and make an effort to examine all possible management options rather than what is perceived as the "best" management option from their own lens (Kiik, 2019). The progression of elasmobranch research has occurred within a broader social context, including changes in the philosophy of science and the structure of academic institutions, revolutions in scientific understanding, and larger societal events that influenced funding of research (Kuhn, 1970; Kindi, 1995). Each particular researcher undertakes their investigations from the lens of a certain worldview, being influenced by a unique combination of mentors, colleagues, ideas, and environments. The present status of elasmobranch science, as with any field of research (social science being the most self-reflexive in the published literature, e.g., Hammersley and Gomm, 1997; Hammersley, 2005, 2006; Wilholt, 2009), is a result of this dynamic and complex set of interactions. Given the wealth of research tools and methodologies, and emergence of interdisciplinary teams of researchers to tackle complex conservation issues, elasmobranch scientists are well-positioned to evaluate the most effective investment of human and financial capital, to pursue socially and ecologically impactful research questions versus being bound to taxonomic or methodologically biases (Huveneers et al., 2015).

Roots of shark science with the beginnings of natural history

The acceleration of shark research over the past century is preceded by millennia of human inquiry of the natural world. Through the value of their flesh, liver oil, and skin, elasmobranchs have been a resource of food and raw materials for humans for thousands of years (e.g., instrumental and economic value). In European writing of sharks from the 1500s, these animals were portrayed as irritable, purportedly harassing of fishers who would dive for their catch of non-elasmobranch species (Salviani, 1554; Castro, 2014). The first records of elasmobranchs in the realm of natural science appeared around 384 B.C.E. in the writings of Aristotle (Castro, 2014), namely aspects of anatomy and development (including the first exposition on animal embryology), and behavior. Continuing through the 20th century, elasmobranchs were studied and described from these instrumental and biological positions: several men educated in the medical arts would contribute to the written knowledge of elasmobranchs, including illustrations and texts thereof as part of larger works. Ippolito Salviani, in his "Aquatilumanima" (Salviani, 1554) describes not only the species' appearance, but also culinary preparations – suggesting that these fish were utilized for subsistence and/or as an economic resource, and that the natural scientists at the time considered this knowledge important to convey. The concept of a "natural history" is thought to have begun with Pliny the Elder (A.D. 21/24 – 79), who opined that nature was present to serve man. When composing the natural history of a region, he included not only animals and plants, but also geological and cosmological aspects

(Jashemski and Meyer, 2002). It may follow that natural scientists (and natural historians) were compelled to describe how animals were useful to humans given that was their reason for existence, demonstrating their instrumental value alongside biological or ecological observations.

Shark research co-evolves with the institution of science

As scientific inquiry as a whole evolved to become systematic, so did observations of elasmobranchs. Technological advances and societal expansion led to more elasmobranchs being discovered, and the 1900s saw a drastic increase in shark studies in the United States, while they were both used as a human commodity, and the capacity grew to specifically seek out sharks in their natural environment. With World War II, the US Navy began funding research to prevent shark attacks, providing considerable resources and an impetus for scientists to systematically study sharks and develop the basis for present day institutions and research (Castro, 2017). This research continued after the war, with the US Navy's interest in understanding how to protect their personnel from sharks providing financial backing for much foundational research in shark behavior and sensory biology (Tester and Kato, 1963; Gruber et al., 1975). In fact, these efforts led to the inception of the first collaborative shark research group, the AIBS Shark Research panel. Scientists had identified that ". . .if better methods for protection against shark attack are to be developed, a broad program of basic scientific research will have to be instituted," also noting that out of the 350 species at the time, "only two dozen are considered to be dangerous, and a still smaller number are listed to be regularly dangerous" (Aronson and Gilbert, 1958). During the 1958 panel meeting, members stated the need to improve species identification (basic morphology and traits), knowledge of ecological and geographic preferences, and scientifically rigorous observations of behavior. With respect to the latter, there was an urge to adopt systematic methods of animal behaviorists rather than putting forth suggestive statements in papers without sufficient evidence. The AIBS Shark Research Panel convened until 1970, producing more than 100 studies. While the guiding premise of this group was protecting humans from sharks, there was an undeniable side effect of vastly expanding the scientific body of knowledge on elasmobranchs. Since the 1970s, shark research has seen vast growth through an influx of governmental and non-governmental financial support.

Research on shark population management, whether for sustainable extraction or recovery, is commonly performed by government agencies (such as the U.S. National Marine Fisheries Service (NMFS) arm of the National Oceanic and Atmospheric Administration (NOAA) which oversees fisheries management planning), affiliated academic institutions (such as the Virginia Institute for Marine Science which conducts shark population surveys in coordination with NOAA), and projects carried out at academic institutions or research centers with governmental and non-governmental financial support. Other avenues of shark research have been important in shaping opinions of sharks as more sophisticated than mere "man-eaters" (Simpfendorfer et al., 2011); for instance, the discovery of sharks' ability to learn tasks (Clark, 1959), navigate long distances through smell and magnetic-field perception (Klimley, 1993; Nosal et al., 2016a), and their support in small-island economies (Anderson and Ahmed, 1993; Vianna et al., 2012).

Harnessing RVs in Research and Conservation

Fostering Stewardship Through Education

If the goal of an aquarium or educational program is to foster positive attitudes toward sharks, more targeted exhibits and curricula focusing on conceptual change and knowledge restructuring should be considered, with ongoing evaluation of how these strategies affect visitors' or students attitudes (Thompson et al., 2002). Although it is important to demonstrate the ecological, instrumental, and intrinsic values of sharks, aquariums can engineer opportunities to form RV, such as through the Value-Belief-Norm or Emotional Affinity frameworks and based on the environmental psychology literature. For instance, through shark-centric activities and events which involve socializing in groups, reflecting on shared experiences or impressions of sharks through writing, emotional engagement through art (Edwards et al., 2016) and storytelling (Woodhouse, 2011), or emphasis on the "natural beauty" of sharks and the ecosystems they support (Zhang et al., 2014).

In any educational setting, it is important to impart the role of sharks to society as well as to natural ecosystems, so that conservation attitudes are well informed and not counter-productive. For instance, students taught about the whale hunting practices of the Makah Tribe in Washington State (United States) did not learn of the cultural importance of whale hunting, and were imparted with negative attitudes toward the tribe (Marker, 2006). Rather, educators can use these opportunities to foster sensitivity and awareness of the diversity of worldviews, cultures, rather than a "protect at all costs from other users" approach to conservation.

Engagement with sharks by virtue of their iconic appeal may present a "gateway" to engagement with environmental issues, apart from overfishing, which are affecting sharks. For instance, climate change, habitat degradation, and marine pollution are pressing and challenging issues in global marine conservation (Parsons et al., 2014a), which could be illustrated in an educational setting through their direct effects on sharks. However, we must caution against a one-dimensional "flagship species" approach that marginalizes other, less charismatic species, which are at equal or greater risk of extinction (Dulvy, 2013; Liordos et al., 2017; Curtin and Papworth, 2018). Rather, such a "gateway" approach to educational programming might begin with sharks, and end with broader impacts to other species, ecosystems, and human communities.

Quality of Life Through Restoring "Lost Connections" to Values

The importance of recognizing linkages among culture, and mental and physical well-being are underscored by contemporary challenges in improving health measures in Aboriginal groups worldwide [e.g., Canada (Bennett et al., 2018) and Australia (Burgess et al., 2005), or see Stephens et al., 2006; Axelsson et al., 2016 for global reviews]. Ahead of colonialization,

the dependency of these groups upon a healthy environment was reflected in a strong stewardship ethic, via active management of their natural resources. When this role was adopted by a colonial government, and now the present-day administration, these indigenous groups lost a critical cultural connection through the curation of their support systems, which were linked to not only sustenance but cultural identities and mental well-being (Burgess et al., 2005). By documenting these losses of access and rights, present-day scientists, managers, conservation practitioners, and policy-makers can identify entry points for improving well-being along with resource management, by way of restoring these "lost connections" to values, as much as is possible in the current social and ecological context.

Reflexivity in the "Natural Sciences"

At present, while shark research activities span the global oceans, the United States, Australia, and the United Kingdom host the majority of academically associated research institutions (**Figure 1**). Elasmobranch research, rather than a discipline in itself, borrows from fields such as fisheries science, physiology, behavior studies, biological oceanography, and many others. As such, paradigms of these other fields, as well as general evolutions in science and its philosophy, permeate elasmobranch research and its practitioners. In the social sciences, the implicit bias of humanity is acknowledged through the concept of reflexivity. However, the need for self-reflection to overcome human biases is unique to no field of study, given that humans administer the research, and a history of any discipline will show transformations of paradigms and modes of thought (Kuhn, 1970). Acknowledging this tendency through the practice of reflexivity can allow researchers to innovate their approaches to institutionally instilled modes of inquiry.

Conflicts Among Resource Users: Using Relational Values as a Pathway to Mediation

A common theme that emerged from commercial fishers is that they are perceived as the "enemy" of tourism or he recreational fishing of sharks (Anderson and Ahmed, 1993; Shiffman et al., 2017). Numerous publications are available to appropriately critique cumulative impacts of shark fisheries (and shark bycatch); these studies show that while overexploitation is associated with population declines, appropriate management can lead to rebounding or sustained shark populations, and sustainable shark fisheries (Campana et al., 2006; Dulvy et al., 2014; Peterson et al., 2017; Simpfendorfer and Dulvy, 2017). The idea that shark fishing and shark products can provide all or (more commonly) a portion of an individual's income (Jabado et al., 2015; Jaiteh et al., 2017), was supported by a survey of shark researchers, as long as the fishing was sustainably managed (Shiffman and Hammerschlag, 2016). Further to these points, shark fishing likely contributes to the fishers' identity and other non-financial aspects of well-being; accordingly, based on this review, we suggest that effective negotiation for sustainable management of shark populations necessitates an open-minded stance toward the perceptions and values of individual commercial fishers, and cautions against generalizing all commercial efforts as detrimental, or assigning blame at the individual level. This type of approach is similar to "moral relativism," in which moral judgements are formed by a group of people (i.e., fishers, managers, scientists, etc.), and those collectively held moral positions "make sense only in relation to and with reference to one or another" (Harman, 1975).

In fact, assigning blame or framing shark conservation as a fishery-led problem may be counterproductive in effecting policy for shark population recovery or sustainability, in part due to this framing not considering the full suite of values derived from sharks. Healthy fish/shark populations are supported by both "environmentalists" and fishers, however, "Fishers find it difficult to relate to environmental movements because they are the ones cast as the problem" (Nightingale, 2012). In reality, the current state of a given shark population is the result of large-scale, complex and historically precipitated geopolitical and economical dynamics (Finkbeiner et al., 2017). A more constructive dialog acknowledges the importance of sharks to all parties involved, and if reduced fishing pressure is needed, seeks to conserve relationships and their derived values as much as possible. This collaborative approach can yield unexpected knowledge, solutions, and compromises (Klain and Chan, 2012; Daw et al., 2015; Oteros-Rozas et al., 2015).

Groups with conflicting views tied to values or morals (e.g., managing for tourism versus for commercial fishing, unqualified support for banning shark fishing from environmental groups versus supporting sustainable shark fishing as a source of income), can lead to a polarizing dialog, and barriers to negotiation and enforcement of policy for managing the resource (sharks) (Biggs et al., 2017). Convening stakeholders to find areas of common ground, such as around shared values of sharks, as part of a collaborative, iterative, and transparently evaluated process, can build trust and provide a pathway for mediating conflicts (Kahane, 2012) and charting a course for sustainability which accounts for the multi-faceted value of sharks.

How Can Assessments Incorporate Relational Values From Sharks?

Value Definition for Clarity in Decision Making and Knowledge Exchange

To facilitate the incorporation and recognition of RVs, it is important to have a common language of what constitutes value types in general. While there have been no lack of studies on the economic (financial) values of sharks, these economic values are sometimes referred to as "social" benefits. However, monetary values, particularly if focused on a specific industry (e.g., scuba diving), are not a substitute for other values a society derives from sharks. We suggest a simple terminology following Small et al. (2017), where a value or ES falls under one (or several) of the following framings:

(1) Ecological: Non-anthropocentric, functional role in the ecosystem (e.g., nutrient cycling, algal grazing)
(2) Economic: Monetary or financial (e.g., contingent valuation, economic benefit, revenue)
(3) Socio-cultural: Non-monetary benefits, practices, and goods, which may be categorized as:

- Instrumental: Of direct use to humans (e.g., a coral reef for recreational use)
- Intrinsic: Of value in and of itself (e.g., pristine coral reefs)
- Relational: Resulting from a relationship with nature

A Workflow for Conducting Holistic Values Assessments

Rather than advocating for one type of valuation over another, we aim to show that non-monetary values of elasmobranchs and their associated coastal ecosystems can complement monetary valuations of sharks which have emerged in the literature. The most effective combination of value types in a given assessment/valuation is context-dependent, and each value type has its own merit. In this vein, we propose a flexible, inclusive, and outcomes-focused workflow for eliciting and incorporating values around shark conservation issues, from the scale of local communities to international negotiations (**Tables 1**, **2**), similar to Pascual et al. (2017). Assuming a commonly held goal of sustainably managed shark populations, economic values by themselves are often insufficient, or even misleading and detrimental, in the quest to achieve this goal. Valuations or assessments of an elasmobranch resource - whether a local population, fishery, or associated dive industry – should instead take a bottom up approach that allows for all subjective values, including economic values if appropriate for the scenario.

Methods to Elicit RVs

Taken alone, surveys or questionnaires may be insufficient to elicit RVs, however these methods can be part of an

TABLE 1 | Across increasing demographic scales, examples of methods to elicit holistic values of individuals and groups, and specific considerations for assessments at that demographic scale.

Scale	Example assessments or methods	Specific considerations
Individual – community	Ethnography, "deliberative methods" (discussion groups, workshops)	Create "opportunities for individuals to express, exchange, reflect, negotiate, and develop their views and evidence in response to those of others"; consider intergenerational dimensions of values
Community – region	Key stakeholder interviews paired with surveys/questionnaires	Heterogeneity of norms among communities, yet critical for revealing conflicts; time/resource intensive to compose holistic indicators for scaling
Regional – national	United Kingdom National Ecosystem Assessment	Incorporate indicators from finer-scale assessments, or perform case studies for scaling (allow for time/resource intensive process)
International	Millennium Ecosystem Assessment (MEA), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)	Heterogeneity of norms toward and definitions of ES, prioritization of ES, and buy-in among assessment leaders, users, and parties being assessed; caution with generalizing results between socio-cultural contexts and demographic groups

TABLE 2 | Guiding workflow to conduct a holistic values assessment, whether as an independent study, or as a component of a longer-term planning/implementation process.

Assessment stage	Guiding questions
1. Goal-setting	• What are the researchers' goals of the assessment or valuation?
2. Preliminary scoping of stakeholders	• Are there local conservation or government/management initiatives operating on the same resource or issue? How do their goals or actions complement/contrast with those of the researchers? • Who will be receiving results of the assessment? Is the assessment part of a long-term conservation/management planning and implementation process, or could it provide added value to an existing similar process? • Resource users: how do people use the resource themselves? how do they think others use it? • Perceived value types: do they think it is important for themselves or the community – why or why not? has it been valuable in the past? how do other people talk about the resource?
3. Values elicitation	• Semi-structured interviews, oral histories, focus groups, or participatory mapping activities to elicit and record all perceived values of all relevant stakeholders. Address: role of the resource in identity and sense of place, social activities, emotional attachments, well-being • If appropriate, economic valuation of the resource (potentially restricting to certain user groups to avoid detrimental effects of assigning monetary values)
4. Synthesis, application, and communication	• How do stakeholders relate to the resource? Do different groups have different value framings (i.e., economic versus relational)? • Have there been any changes in "value" over time? Are there disparities among user groups (tourism operator, fisher, other local resident) or by demographic categories (gender, income level)? • If part of a longer-term planning/implementation process, consider how "indicators" of value or well-being could be repeated in future monitoring studies. • Based on goal-setting, deliver results of the assessment to relevant institutions and individuals – results can be framed with respect to the goals and ideologies of the recipient by emphasizing the most relevant value types.
5. Long-term monitoring (if applicable)	• If part of a longer-term planning/implementation process: repeat indicator/value/service assessments. • Consider: how are stakeholder groups evolving over time? (e.g., relative size, influence, access to resources, access to livelihood diversification)

TABLE 3 | Cases from the literature which assessed or described the "value" of elasmobranchs to a community, and/or elicited relational values toward a coastal marine resource.

Values (given)	Value type(s)	Method(s) to elicit values	Stakeholder group(s)	Region	Species/ Ecosystem	Reference
Non-elasmobranch focus						
Well-being	SC-R	Questionnaire for self-assessment of "well-being" (definition and drivers)	Commercial fishers	Queensland, Australia	Fisheries of Cooktown, Port Douglas, Innisfail, Townsville, and Bowen	Marshall and Marshall, 2007
Non-monetary/ intangible/ cultural, and monetary value	SC-IC, SC-IL, SC-R, E	Semi-structured interview (identify values), mapping values (monetary and non-monetary) and threats (indicate location)	Fishers, managers ("marine reliant professions")	Northern Vancouver Island, Canada	N. Vancouver Island seascape	Klain and Chan, 2012
Ecosystem services: fishery materials, habitat, coastal protection, sanitation, recreation, bequest, education, cultural	SC-IC, SC-IL, SC-R	Questionnaire (ranking importance of coral reef ecosystem services, suggestions for improvement of services)	Fishers, fish traders, fish factory workers	Madagascar, Tanzania, Kenya, Seychelles	Coral reefs of W. Indian Ocean	Lau et al., 2018
Conservation values and behavior, willingness to pay for conservation	E	Questionnaire (impact of educational content on values/ behavior, contingent valuation)	Park visitors	Queensland, Australia	Turtles of Mon Repos Conservation Park	Tisdell and Wilson, 2002
Indigenous cultural values, moral principles around nature	SC-IC, SC-IL, SC-R	Media review, literature review	Makah tribe members, media, Port Townsend students, teachers, parents	Washington, United States	Whales in traditional fishery	Marker, 2006
Intrinsic, instrumental, new ecological paradigm, and relational values	SC-IC, SC-IL, SC-R	Questionnaire (response to different value frames: intrinsic, instrumental, new ecological paradigm, and relational values)	NE United States public, Costa Rican farmers, tourists to Costa Rica	NE United States, Costa Rica		Klain et al., 2017
Environmental attitudes and non-use values (willingness to pay for conservation)	E, SC-IC, SC-IL	Questionnaire (contingent valuation, new ecological paradigm)	Random sample of state residents	Maine, United States	Peregrine falcons, shortnose sturgeons	Kotchen and Reiling, 2000
Willingness to pay for sustainable seafood	E	Questionnaire (contingent valuation, environmental attitudes and beliefs, trust of certification, use of ecosystem)	Fishers (reef anglers)	Florida, United States	Florida Reef tract	Harper, 2015
Well-being, work/ income, job satisfaction, social networks (SC-R)	SC-R, SC-IL, E	Oral history (interview)	Commercial/ professional fishers	Maine, Massachusetts, Rhode Island, New York, and New Jersey, United States		Colburn and Clay, 2012
Cultural values, life themes: relationships with people, and with nature, spiritual and religious beliefs	SC-R, SC-IL, SC-IC	Oral history (interview)	Female elders (kupuna)	Oahu, Hawaii, United States	Coastal Hawaii, United States	Mokuau and Browne, 1994

(Continued)

TABLE 3 | Continued

Values (given)	Value type(s)	Method(s) to elicit values	Stakeholder group(s)	Region	Species/ Ecosystem	Reference
Social importance: interactions, hunting, use of parts, stories/legends, beliefs, conservation attitudes	SC-IC, SC-IL, SC-R	Questionnaire via interview (closed and open-ended questions) administered in group setting	Villagers (residents and leaders)	Andaman Coast, Thailand	Dugongs and associated mangrove/seagrass ecosystems	Hines et al., 2005
Job satisfaction, well-being, self-actualization	SC-R	Semi-structured interview, questionnaire	Commercial fishers	Northeast United States	Fisheries o NE United States	Pollnac et al., 2015
Community, kinship, crew connections, adventure and money	SC-IL, SC-R	Oral history, social network analysis	Commercial fishers	Newport, Alaska, United States	Fisheries of Newport and Kodiak, Alaska	Package-Ward and Himes-Cornell, 2014
Place attachment (identity and dependence)	SC-R	Self-administered questionnaires	Coastal community residents (<10 and >10 miles from various marine reserves)	Oregon, United States	Marine coast of Oregon, United States	Perry et al., 2014
Cultural ecosystem services, well-being, "the good life"	SC-IC, SC-R	Participant observation, interviews, participatory workshop	Fishing community residents	Lofoten Islands, Norway		Kaltenborn et al., 2017
Fishing dependency/importance of fishing: economically, socially (identity, sense of community)	SC-IL, SC-R	Open ended interviews, "contextual" and historical background information	Fishers (commercial and recreational), individuals with businesses related to fishing, community officials and leaders	Galveston Bay Complex, United States	Fisheries near Galvelston Bay, San Antonio Bay	Jacob et al., 2010
Elasmobranch focus						
Willingness to pay, willingness to donate for conservation	E	Questionnaire (contingent valuation, attitudes and beliefs toward wildlife, prior donation behavior)	Tourists (domestic and international)	Galapagos Islands, Ecuador	Scalloped hammerhead sharks, sea turtles	Cárdenas and Lew, 2016
Biocentrism	SC-IC, SC-IL	Questionnaire (knowledge and biocentrism), two treatments (with/without educational talk)	Tourists	New South Wales, Australia	Gray nurse sharks	Smith et al., 2014
Cultural, ecological	SC-IC, SC-IL	Archaeology (archived shark weapons, museum collection for regional marine species), literature review (historical texts)	Gilbertese Islanders	Republic of Kiribati, Central Pacific	Shark communities near Gilbert Islands	Drew et al., 2013
Customs and beliefs toward sharks	SC-IC, SC-IL, R	Interviews, historical texts	Gilbertese Islanders	Republic of Kiribati, Central Pacific	Gilbert Islands	Luomala, 1980
Perceived ecological value of sharks and protected areas, concern/emotions toward declining shark populations	SC-IL, SC-IC, SC-R	Interviews (guided by questionnaire)	Fishers, non-fishing community members (cultural leaders, teachers, shop owners, traditional healers, leaders of community organizations)	Raja Ampat, Indonesia	Shark fisheries of West Papua, Papua and Maluku provinces, Indonesia	Jaiteh et al., 2016b

(Continued)

TABLE 3 | Continued

Values (given)	Value type(s)	Method(s) to elicit values	Stakeholder group(s)	Region	Species/ Ecosystem	Reference
Livelihood perceptions: financial viability	SC-IL, E	Interviews (guided by questions), participant observation	Shark fishers (active and retired), non-fishing community members, fishing bosses	Eastern Indonesia	Shark fisheries of Osi, Dobo and Pepela, Indonesia	Jaiteh et al., 2017
Value of sharks to dive tourism industry: economic benefits, welfare (income)	E	Questionnaire (contingent valuation)	Dive operators and tourists	Republic of the Maldives	Dive sites of the Republic of the Maldives	Zimmerhackel et al. (2018)
Value of shark diving industry to finance marine protected area	E	Questionnaire (contingent valuation)	Dive tourists	Semporna, Malaysia	Dive sites near Semporna	Vianna et al., 2017
Value of shark diving: local income, GDP, taxes	E	Scoping interviews, questionnaires (financial expenditure)	Divers, dive operators, dive guides, local fishers	Republic of Palau	Dive sites near Republic of Palau	Vianna et al., 2012
Economic value of shark diving tourism	E	Questionnaires (financial expenditure)	Dive tourists	Australia	Whale sharks, white sharks, gray nurse sharks, reef sharks	Huveneers et al., 2017
Perceived ecological and economic importance (value)	SC-IL	Questionnaires, website content analysis	Shark fishing charter boat operators	Florida, United States	Coastal FL	Shiffman and Hammerschlag, 2014
Economic value of sharks and rays through tourism, media, research, conservation	E	Structured interviews with dive operators, questionnaires (financial expenditure), online surveys (filming or research expenditures)	Dive operators, dive tourists, media groups, researchers/research organizations	Bahamas	Bahamas coastal and surrounding marine areas	Haas et al., 2017
Social and economic benefits from sharks (via tourism, fishing, taxes, and fees)	E	Questionnaires (financial expenditure, interest in seeing sharks)	Tourists, restaurant owners, dive operators, photographers, dive guides, fishers, environmental management authorities	Fernando de Noronha, Brazil	Archipelago of Fernando de Noronha	Pires et al., 2016
Value of shark diving for emotional engagement, conservation behavior, knowledge	SC-R, SC-IL, SC-IC	Questionnaires	Dive tourists	Neptune Islands, South Australia	White sharks	Apps et al., 2018
Economic benefits from conservation measures	E	Questionnaires (contingent valuation)	Tourists at marine resort	Yasawa Islands, Fiji	Reef manta rays	Murphy et al., 2018
Social and economic importance of shark fishery to community	E, SC-IL	Semi-structured interviews, questionnaire, participant observation	Shark fishers, shark fin collectors	Toliara, Madagascar	Fisheries of Soalara, Beheloka, Maromena, Befasy	McVean et al., 2006
Beliefs and attitudes around shark tourism	SC-R, SC-IC, SC-IL	Questionnaires with open ended questions (theory of planned behavior)	Shark diving tourists	Neptune Islands, Australia	White sharks	Apps et al., 2016
Educational and conservation benefits of shark tourism	SC-IL, SC-IC	Questionnaires (perceived ecological and economic value, knowledge of sharks and conservation issues)	Tourists and residents of Fernando de Noronha	Fernando de Noronha, Brazil	Archipelago of Fernando de Noronha	Garla et al., 2015

(Continued)

TABLE 3 | Continued

Values (given)	Value type(s)	Method(s) to elicit values	Stakeholder group(s)	Region	Species/ Ecosystem	Reference
Value of shark diving to tourism industry	E	Questionnaires (financial revenue, motivation for visit, shark knowledge, dive experience)	Tourists of Azores	Azores archipelago	Dive sites near the Azores	Torres et al., 2017
Shifting value of shark fishing (annual price per kilogram)	E	Fishery data from central auction house and Azores commercial fishery authority	Commercial shark fishery	Azores archipelago	Azores Exclusive Economic Zone	Torres et al., 2016
Monetary value of sharks through tourism	E	Questionnaire (influence of sharks in decision to dive, financial expenditures)	SCUBA dive operators, tourists (divers and non-divers)	Moorea, French Polynesia	Sicklefin lemon sharks of "Opunohu" dive site	Clua et al., 2011
Values and attitudes underlying attitudes to policy	SC-IC, SC-R	Social media (sentiment analysis), Focus groups (coded by "affect," or emotion, toward capacity, propriety, value, composition, normality)	Surfers, swimmers, lifesavers, small business owners, tourism operators, conservationists, anglers	New South Wales, Australia	New South Wales coastal marine ecosystem	Simmons and Mehmet, 2018
Knowledge and attitudes toward sharks: pride, blame, fear	SC-IC, SC-R	Questionnaire following 1 of 3 priming "treatments" (pre and post aquarium visit)	Aquarium attendees (shark exhibit)	☐SEA LIFE Sydney Aquarium, New South Wales, Australia	New South Wales coastal marine ecosystem	Pepin-Neff and Wynter, 2018

Values are listed as described in the study, whether the value types fall under the socio-cultural-intrinsic (SC-IC), -instrumental (SC-IL), relational (SC-R), or economic (E), framings as described by Small et al. (2017).

integrated approach; for instance, at the scoping stage of an assessment: (1) to gather socio-economic data such as income, occupation and age; (2) by asking participants about interactions with other members of the community, to identify key stakeholders or "knowledge brokers" for in depth interviews; and (3) if snowball sampling is desired, by including a field that indicates other stakeholders to include in the assessment (Nayak, 2017). Snowball sampling, where participants identify further individuals or groups which are relevant to the study (Atkinson and Flint, 2001), is useful to expand the scope of the assessment, and reveal social networks through peer to peer recommendations. Any sampling methodology, however, has inherent limitations, so researchers may consider integrating multiple sampling strategies to account for varied groups of participants or stakeholders, including targeted sampling where populations might be entirely missed by traditional methods (Watters and Biernacki, 1989), thereby minimizing bias in the study. Importantly, scoping can identify barriers to an inclusive assessment (e.g., institutional, cultural, capacity) at the early stages, allowing the researchers time to refine their methods. Large-N surveys or questionnaires can also be used after values have been elicited from in-depth interviews or focus groups, to (1) gauge whether the same values are recognized on a larger scale, (2) whether framing conservation messaging in the language of the elicited RV is more or less resonant than other framings (Kusmanoff et al., 2016; Klain et al., 2017), or (3) gauge preferences of stakeholders for alternative conservation plans, with these alternatives based on the initial values assessment (Etxano et al., 2015). **Table 3** compiles the methods for (1) eliciting RV of marine resources, and (2) assessing values of sharks, relational and otherwise.

Combining Value Frameworks in an Assessment

While all value frames present different perspectives on the same "issue," and are not necessarily intercomparable, it can be important to asses all points of view to realize and communicate tradeoffs in management decisions or consequences of resource declines, and also in appealing for behavior change and buy-in to the results and application of the assessment (locals, policy makers, other stakeholders). If values are reflective of underlying motivational goals, as outlined by Schwartz and Bardi (2001), it is only by allowing full expression of values by a person or group that underlying motivations of behavior toward a resource – now and in the future – can be understood. Alternatively, it may be responsible to restrict certain forms of valuation from an assessment in order not to alter relationships with nature in the course of that valuation.

As the scale of a valuation/assessment increases, so does the range of the values spectrum; although these differences could be perceived as a conflict, and practitioners may choose to

focus on areas of agreement rather than disagreement, cataloging these differences in assigned value or relative importance is an important role of ES assessments (Schwartz and Bardi, 2001). Including temporal and intercultural scales in an assessment can be very revealing; for instance, identifying which values are most resonant over time and among different cultures can highlight shared principles or framings which are both important to emphasize and acknowledge in international negotiations, and appropriate to incorporate in large-scale assessments.

CONCLUSION

From its introduction in 2015, explicit studies of RV have become more common, however, the field remains limited in scope. To gain traction in values assessments, and recognition of their importance in conflict resolution around natural resources, RV must become more accessible as a concept and a tool. The concept of people deriving values from a relationship with nature, and these values being important for their well-being, is intuitive yet abstract. This abstraction can be shifted to clarity through the sharing of case studies of RV across contexts – whether fishery, coastline, or forest management; urban or rural setting; and for any number of outcomes from spatial design of a protected area, increasing compliance with existing management measures, or simply to monitor stakeholder attitudes. These examples can allow practitioners in academic and non-academic spheres to visualize how RV might be leveraged in their work, in new and perhaps unexpected ways.

AUTHOR CONTRIBUTIONS

RS led the conceptualization, research, and composition. All authors contributed substantially to the framing, writing, and editing of the text.

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