Aquatic Mammals 2025, *51*(6), 498-514, DOI https://doi.org/10.1578/AM.51.6.2025.498

Case Study: The Human Dimensions of Lahille's Bottlenose Dolphin (*Tursiops truncatus gephyreus*) Conservation

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Abstract

Nearshore and riverine cetaceans face heightened extinction risk, in large part due to human activities. But there are few success stories and fewer clear ways for cetacean conservationists to integrate approaches addressing the human dimensions of conservation into their work. Two meetings—"*Ex-Situ* Options for Cetacean Conservation" (2018) and "Human Dimensions of Small Cetacean Conservation" (2022)—brought together cetacean conservation practitioners to plot a new way forward. Eight representative cetacean taxa, each of which faces threats that are typical for species whose distributions overlap extensively with people, were discussed, leading to the development of a Human Dimensions Toolbox, which outlines 10 key social science-derived tools and how they can be used to support cetacean conservation. Considering the workshop recommendations, we present a case study on the use of human dimensions approaches in the conservation of the Lahille's bottlenose dolphin (*Tursiops truncatus gephyreus*). Through thematic analysis of interviews with six expert practitioners, we explored how a human dimensions perspective could be used to understand past and present conservation efforts and to identify future opportunities. Interviewees considered anthropogenic threats the top priority for Lahille's bottlenose dolphin conservation, with bycatch, overfishing, and pollution/habitat degradation chief among those. Despite this, relatively few social science tools were employed by practitioners, and with varying success. There was clear interest in further integrating human dimensions into Lahille's bottlenose dolphin conservation, and we describe how these efforts might be strengthened by social science specialists and tools that are currently underutilised in cetacean conservation. In particular, expertise in conflict prevention/mitigation, outcome-led engagement work, and opportunities to work as interdisciplinary teams are urgently needed. The Lahille's bottlenose dolphin example illustrates the many ways that social science approaches have informed past conservation. It also demonstrates how social science tools, approaches, and expertise can be integrated into cetacean conservation practice to more successfully address threats facing nearshore cetaceans.

Key Words: human dimensions, social science, conservation, case study, interviews, Lahille's bottlenose dolphin

Introduction

With 26% of all small cetacean species (dolphins, porpoises, and the smaller "toothed" whales) threatened with extinction (Braulik et al., 2023) and despite widespread public, scientific, and even political interest, conservation efforts have failed to adequately address threats to these species. Nowhere is this more apparent than for the nearshore or riverine taxa, with three of the seven freshwater cetaceans classified as "Critically Endangered" and three as "Endangered" (von Fersen et al., 2024). The riverine and coastal (hereafter signified as "nearshore") cetacean taxa have come under increasing pressure as coastal human populations have increased (Small & Nicholls, 2003), with pollution (Genov, 2021; Bartalini et al., 2022), habitat disturbance or loss (Jefferson et al., 2009; Duarte et al., 2021), and incidental capture in fishing gear (Read et al., 2006; Temple et al., 2021) posing particular anthropogenic risks for cetaceans, exacerbated by the changing

climate (Albouy et al., 2020). Conservation success stories for nearshore cetaceans are scarce, with the inexorable declines of species such as the vaquita (*Phocoena sinus*) and the extinction of the baiji (*Lipotes vexillifer*) illustrative of the poor progress conservationists have made in addressing these challenges (del Monte-Luna et al., 2025).

Despite widespread acceptance that the threats to these species are anthropogenic, conservation efforts have seldom integrated approaches from the social sciences that centre the "human dimensions" of these issues. Some efforts have been made to mitigate human impact, particularly in relation to bycatch (Kiszka et al., 2022), and to integrate local communities into conservation efforts. For example, the Omacha Foundation, working in the Colombian Amazon, collaborated with fishing communities to develop fishing agreements, which addressed the main problems facing the system. By working with people, through extensive discussion and consultation, communities and conservationists were able to implement a programme that has contributed to the recovery of the health of the Tarapoto lakes (Escobar et al., 2017). Similarly, by working with communities to understand and support their livelihoods, Yayasan Konservasi RASI (Indonesia) has helped communities to move away from unsustainable fishing practices and towards ecofriendly approaches. Simultaneous conservation initiatives for the *pesut* (Irrawaddy dolphin) have focussed on the development of ecotourism opportunities that benefit local people and support communities (Darmawan, 2024). Even the critically endangered vaquita porpoise has persisted at extremely small population numbers (fewer than a dozen) for almost a decade, with ongoing breeding through fisher-led adoptions of fishing technology without bycatch and those that increase the value of harvested fish, in concert with supporting vaquita protection enforcement efforts by the Mexican authorities (Pesca ABC, 2025). By centring community challenges, needs, and voices in this work, the participatory approach has resulted in a viable long-term conservation strategy for the *pesut*. However, examples like these are few and far between. Across small cetacean conservation, there has not been a concerted, unified, and holistic embrace of social science-derived approaches, nor adequate effort to use interdisciplinary teams or tools to inform small cetacean conservation efforts for most other species and areas.

In light of these concerns, the *Ex-Situ* Options for Cetacean Conservation (ESOCC) workshop was convened in 2018 (Taylor et al., 2020), followed in 2022 by the Human Dimensions of Small Cetacean Conservation (HDSCC) workshop (von Fersen et al., 2024). Together, these meetings inspired a cadre of the world's leading small cetacean conservationists in an attempt to advance and expand the dialogue about approaches for conservation of these species. One key recommendation from the ESOCC workshop was that mechanisms to incorporate the human dimensions of wildlife should be more widely adopted by the community of practice working on nearshore cetaceans. The ESOCC workshop also identified seven dolphin and porpoise species to which the Lahille's bottlenose dolphin (LBD) subspecies (*Tursiops truncatus gephyreus*) was later added because they were considered representative of the threats and challenges facing nearshore cetaceans. Building on these conclusions, the HDSCC workshop described a "toolbox" of 10 key approaches from the social sciences that would likely prove useful in the design and implementation of effective cetacean conservation plans. Additionally, the HDSCC workshop recommended that a small number of the representative taxa should be further developed into case studies by the workshop organisers and report editors, serving to explore and illustrate where social science-based approaches might historically have been useful for small cetacean conservation and how they might be incorporated more effectively in the future. Crucially, these case studies should shed light on the opportunities for incorporating human dimensions in a way that is both accessible and practical for time- and resource-poor conservation practitioners. Furthermore, these case studies are intended to assess the extent to which the proposed tools have been applied in practice and to investigate the underlying reasons for their adoption or lack thereof.

Of the candidate species, many exemplified complex cases with inherent human–wildlife conflicts involving fisheries, livelihoods, and incidental catch (e.g., the Franciscana [*Pontoporia blainvillei*] or Inia [*Inia geoffrensis*]; Iriarte & Marmontel, 2013). A case study provides more useful insight wherein there is deep expertise from a range of conservation practitioners who themselves have diverse experiences and backgrounds. Candidate taxa through which this long-term, nuanced reflection was possible were therefore also preferred in the case study selection. Reflecting on these selection criteria, and in light of the recent development of a *Five Year Action Plan* for conservation of the LBD, the subspecies was selected as an appropriate first case study.

Occurring in the shallow coastal waters from southern Brazil to Argentina, the LBD frequents bays, lagoons, and estuaries along the coastline (Vermeulen et al., 2019). It is distinct from the common bottlenose dolphin (*Tursiops truncatus*) in terms of both its morphology (Hohl et al., 2020) and genetics (Fruet et al., 2017) and is recognised as a distinct subspecies and ecotype (International

Whaling Commission [IWC], 2018). As a strictly coastal taxon with a restricted population numbering not more than 600 individuals, LBDs are at heightened risk of anthropogenic impact, chiefly from pollution, overfishing, and incidental catch in fishing gear (Vermeulen et al., 2019). The LBD was taken to be broadly representative of some threats faced by nearshore cetaceans and the efforts by which conservation practitioners have attempted to mitigate these threats. In addition, the century-old artisanal fishery in southern Brazil in which net-casting fishers and wild LBDs benefit by working together is one of the rare instances where human–dolphin cooperative fishing is known (Cantor et al., 2024). In this case study, we explore how a human dimensions lens can be used to understand the threats to LBDs and how conservation efforts have incorporated social science-based approaches. Making use of the action element tools typology described by von Fersen et al. (2024), we further explore how human dimensions tools have been and might be used to further improve LBD conservation efforts and the obstacles which inhibit further integration of these approaches.

Methods

Key Informant Recruitment and Data Collection

Based on the HDSCC workshop organiser/editor team's familiarity with the actors involved in LBD conservation and existing professional networks, we identified all known individuals with extensive, long-term knowledge of LBD conservation efforts. In total, six key informants were identified and contacted by a member of the case studies team to participate by taking part in a semi-structured, mixed-methods interview; all invitees agreed to participate. Each of these key informants were either citizens of one of the three countries where the LBD is found or have worked there extensively over many years.

An interview protocol containing 17 questions was developed by the research team (see the Supplemental Appendix for this article. This appendix is available on the *Aquatic Mammals* website); this protocol was designed to provide an overall structure while allowing for flexibility as appropriate for each interview. Within this protocol were 13 open-ended questions exploring the history of LBD conservation, the ongoing challenges practitioners experience, and the involvement of social science in these efforts. There were a further four closed-ended questions, all of which were scored on a 10-point rating scale (1 = not at all to 10 = completely). (**Note:** Closed-ended questions are a type of survey question or interview question that offer predefined answer options. They limit respondents to choose from specific responses such as "yes" or "no," multiple-choice options, or rating scales. These questions are designed to elicit quick and concise answers, making data analysis more straightforward and efficient.)

Interviews were conducted between November 2024 and January 2025. Each interview was carried out online via video call by the same interviewer and lasted between 45 and 120 minutes. To ensure interviewees felt comfortable expressing their views, interview sessions were not recorded, but extensive notes were taken. Following each interview, these notes were written up and circulated back to the interviewee. This feedback process served to achieve two key aims:

1. Any information gaps that were identified as part of the write-up were addressed with supplementary questions. Interviewees were invited to respond to these questions and/or provide additional information as needed.

2. Interviewees were given the opportunity to correct any errors in the notes or reframe their replies if desired. This process provided additional confirmation that the interview notes accurately reflected the views and experiences of the interviewees.

Data Analysis

Through this process, we sought to explore four key questions:

1. Can a human dimensions lens help us to better understand the main threats to LBDs?

2. To what extent have human dimensions approaches played a role in LBD conservation efforts?

3. How have the tools described in the social science toolbox affected previous LBD conservation efforts, and how can they be used to better support future conservation efforts?

4. What are the main challenges to integrating human dimensions into LBD conservation efforts?

Using these framing questions, a codebook was developed to inform the allocation of relevant content units to each code. Interviews were manually coded by a single analyst, and content units were allocated to one or more themes. Where relevant, tables were compiled to better present the data, but analysis was primarily thematic in relation to the above questions. Closed-ended questions (n = 4) were analysed using simple summary statistics.

Each of the four questions above required different analytical processes and were optimised to reflect meaning and, therefore, were not standardised; this means that scores are only directly comparable within the relevant analytical section, rather than between questions.

The action element tools typology described by von Fersen et al. (2024) was used to frame the different components of a Human Dimensions Toolbox that practitioners might use to support their conservation efforts (see Figure 1, adapted from von Fersen et al., 2024). This toolbox describes 10 key tools that have been used by practitioners to incorporate the human dimensions into their conservation work. The toolbox was used to interpret previous work and to understand potential future opportunities for social science to advance conservation work for the LBD. Throughout the results write-up, key quotes from individual interviewees are used to illustrate the points made. The attributions of these quotes are not highlighted in text to ease the narrative flow, but all in-text quotes are drawn from the expert interviews. All interviewees agreed to be quoted anonymously.

Results

1. Can a human dimensions lens help us to better understand the main threats to LBDs?

Key informants identified nine distinct threats to the LBD (Table 1), with five of the six interviewees describing bycatch, overfishing, and pollution/habitat degradation as the key threats. Four interviewees also considered human disturbance to be critical. Other, less commonly identified threats included natural population stochasticity, skin disease, urban development, and a lack of political or community interest in supporting LBD conservation. It was noted by one participant that the interaction between these manifold threats is perhaps the more important issue as is the case for many nearshore cetaceans. Although most threats were articulated

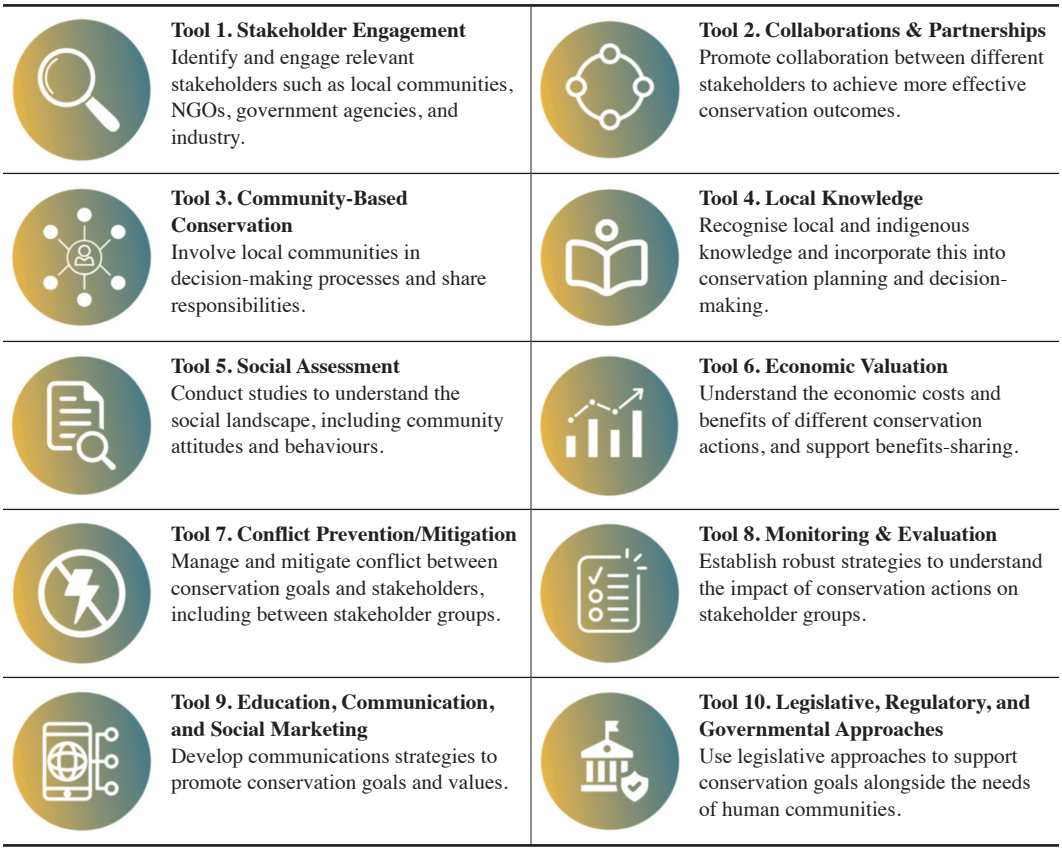

Figure 1. The 10 action elements of the social science "toolbox" developed at the HDSCC workshop. Note that the tools are not necessarily placed in an intended sequential order of operations. Adapted from von Fersen et al. (2024).

Table 1. Key threats to the LBD as mentioned in response to the open-ended questions, with "1" indicating that a threat was mentioned by the interviewee, and "0" indicating no mention. Colour coded by frequency, with darker colours at higher frequency

		Interviewee							
Threat	Description	#1	#2	#3	#4	#5	#6	Total	Key quotes
Bycatch	Incidental catch of LBDs, typically in gillnets but also in beach seines and trammel nets	1	1	1	1	1	0	5	"Animals stranded with evidence of entanglement in nets" "High incidence of mortality through incidental capture"
Overfishing	Overexploitation of key fish stocks, reducing prey availability	1	1	1	1	1	0	5	"Overexploitation of . . . species that were prey for [the] LBD" "[There is] a lack of fish."
Pollution & habitat degradation	Chemical or physical degradation of the natural environment	1	0	1	1	1	1	5	"Runoff is likely a very big issue, but it is hard to document or prove conclusively, and even harder to change behaviour around farming."
Human disturbance	Disturbance, including recreation, noise pollution, and intentional disturbance	1	0	1	1	0	1	4	"The region is far too busy." "Recreation boats, jet skis, and kite surfers scared away the dolphins."
Stochasticity	Natural population flux exacerbated by small population size	0	1	0	0	1	0	2	"Extremely limited population, so stochastic effects could [be] significant"
Skin disease	Specific but little understood health condition in the LBD	0	0	1	0	1	0	2	"There is a lot of skin disease in [REDACTED] area.
Urban development	Habitat conversion or urban development	1	0	0	0	0	0	1	"There are lots of development projects."
Lack of community interest	Long-term community support for LBD conservation	0	1	0	0	0	0	1	"Communities need to take ownership of the [LBD] in order for it to be protected long-term."
Lack of political will	Political disinterest in pursuing conservation goals for the LBD	1	0	0	0	0	0	1	"Politicians don't care about the environment and biodiversity."

clearly, this was not the case for all regions, with one interviewee suggesting that "the key threats [in certain locations] are still so uncertain."

Although the connection with people was apparent for most of the identified threats, there was disparity in the perceived importance of a human dimensions-based resolution to these issues. In some cases, resolving the anthropogenic drivers of these threats was considered to be extremely challenging or impossible (e.g., "[it is] even harder [than] to change behaviour around farming practices"). Conversely, two interviewees argued that the diversity of threats prevented a clear focus on human dimensions as had been necessitated for other nearshore cetacean species:

> *With the Franciscana, the interaction with fisheries and the nature of the threats forced researchers to integrate [human dimensions] because so much of the threat is to do with incidental catch. . . . This isn't the case with the Lahille's, so there has been less imperative to work with fishers.*

Both interviewees identified this as an issue for LBD conservation and suggested that a greater focus on the social sciences would be beneficial. One closed-ended interview question addressed this theme directly, asking interviewees to quantify on a 10-point scale the extent to which they believe that the conservation challenges for the LBD revolve around human dimensions. Interviewees

reported a very strong perception that key threats are human dimensions-related ($\bar{x}$ = 8.92 ± 1.59), with one participant saying, "humans are the problem but also part of the solution."

2. To what extent have human dimensions approaches played a role in LBD conservation efforts?

The conservation activities described by interviewees fell into eight categories (Table 2). Of these, outreach and education (n = 6), biological research (n = 6), and protected area formation and zoning regulations (n = 5) were the most commonly cited as significantly included in recent/ongoing conservation efforts.

Unsurprisingly, outreach and education activities were mentioned by all interviewees as a key part of LBD conservation efforts given that "communities need to take ownership of wildlife and [their] environment in order for it to be protected long-term." Many of these efforts focussed on engaging with children, perhaps through school-based or extracurricular lessons, or materials such as information posters or books. Some activities also focussed on adult audiences, with organizations providing information to communities on, for example, sustainable practices or changes to local environmental regulations. Many interviewees shared a strong perception that "education, and its impact, are key." Most of the outreach activities described in interviews provided general environmental or conservation education, with no clear connection to conservation outcomes. None of the interviewees identified explicit links between education and behaviour change, and while specific outcomes such as "reinforcing the cultural value of [the] LBD" or "encouraging sustainable fishing practices" were suggested as the overall goals of outreach work, interviewees were not aware of any programmes that had measured their long-term impact on community attitudes, knowledge, or behaviour, or evaluated their efficacy. Multiple interviewees voiced an interest in evaluation approaches for outreach work, but these plans had not been put into action.

Biological research on, for example, LBD population demographics, strandings and bycatch, or habitat use and behaviour was also mentioned by all interviewees as part of the conservation efforts for the LBD. While numerous examples

Table 2. Conservation activities for LBDs: All activities that interviewees described as contributing to the current LBD conservation efforts, including those carried out by other organizations. A "1" indicates that a conservation activity was mentioned by the interviewee, and a "0" indicates no mention. Colour coded by frequency, with darker colours at higher frequency.

		Interviewee						
Conservation activity	Description	#1	#2	#3	#4	#5	#6	Total
Outreach and education	Connecting with communities through education or other activities where information is transmitted from scientists or conservation actors to local communities	1	1	1	1	1	1	6
Biological research	Research on the LBD, including ongoing population and bycatch monitoring	1	1	1	1	1	1	6
Protected area/ exclusion zoning	Designation of protected areas, including zoning and restrictions to fishing or recreation in LBD range	1	1	1	1	1	0	5
Strategic planning	Development of strategic conservation plans (e.g., the Conservation Management Plan)	1	0	1	1	0	1	4
Social research	Human dimensions studies, including economics, attitudes, or other studies for which information is collected about the communities	1	0	1	0	1	0	3
Community conservation	Fostering community involvement in conservation programmes, where planning and activities are undertaken in collaboration with communities	1	0	1	0	1	0	3
Advocacy, legislative or policy tools	Support in the development of legal tools to increase protection for LBDs, including advocacy but excluding protected areas and zoning regulation	1	0	0	0	1	0	2
Fostering conservation dialogue	Connecting the existing network of researchers and conservationists working on LBDs	1	0	0	0	0	0	1

were given of situations in which this biological research was critical for informing other conservation measures (e.g., "mortality rates have decreased, which is a strong argument in favour of the exclusion zone"), most interviewees reflected a sentiment that research alone is not advancing LBD conservation. There was a general consensus that, while "it is not realistic to proceed with conservation without this basic research," there was a danger for many practitioners that "all their energy is on research, so there is nothing left for conservation." As one participant observed, "at what point are you just documenting extinction?"

A variety of legal and policy tools were considered important for LBD conservation. Formation of protected areas and zoning to regulate and restrict the use of critical habitat was particularly important and mentioned by five interviewees. Numerous examples were given across a range of locations whereby zoning or protected area formation had helped protect LBD populations, with many interviewees suggesting that these areas are now "probably safer for the animals." Specifically, restrictions on the use of gillnets were thought to confer a "great positive impact." Two interviewees suggested that other legislation-focussed approaches could be important for LBD conservation, specifically mentioning the role of advocacy in support of legal protections, and local or national heritage status as tools to help ensure that LBD conservation is prioritized by the relevant authorities. Four interviewees identified strategic planning as an important factor in these conversations, with particular support for the LBD Conservation Management Plan as a critical tool to advance both national and international protections for LBDs and to promote transboundary conservation efforts.

Social research and community conservation were each mentioned by three interviewees as significant actions needed for future successful conservation. These interviewees suggested that an understanding of the needs and challenges experienced by fishers—particularly the "social landscape," economic costs and benefits from LBD, and the impact of changes to fishing regulations—was important to inform future conservation efforts and to avoid "unintended social consequences." The same three interviewees also described the importance of community conservation and "ways to integrate people more thoroughly into LBD conservation." Although some specific examples of shared conservation efforts were described, for the most part, community-based conservation activities were suggested as a goal for the future rather than an ongoing component of LBD conservation work. One interviewee described the situation thus:

> *The communities have not yet been really worked into the LBD conservation plan so far, but [the project] is looking to integrate them going forwards. . . . There is no way to succeed in the conservation process if you can't involve the community.*

Finally, fostering conservation dialogue was suggested by one interviewee as a critical activity that has advanced the goals of LBD conservation across the network, saying "connecting people [is] helping these networks to be effective."

Compared to many species of nearshore cetaceans, interviewees' perception was that relatively little concerted effort has been devoted to LBD conservation to date, with one suggesting that "there hasn't been too much [conservation effort]." Of the eight categories of conservation activity, three (outreach and education, social research, and community conservation) had an explicit human dimensions focus. Interviewees scored the efficacy with which social science tools and approaches have been used for LBD as only 4.75 (± 1.41) out of 10, indicating a general consensus that social science has not been used as extensively as the situation demands to support LBD conservation.

3. How have the tools described in the social science toolbox strengthened previous LBD conservation efforts, and how can they be used to better support future conservation?

The interview data reflected a clear sense that, to date, social science methods have not been used as effectively as possible to support LBD conservation. Moreover, there was strong support for the idea that LBD conservation practitioners are ready and willing to integrate social science into their future conservation efforts, with a score of 7.83 (± 1.77) out of 10. The need for better integration of human dimensions being both overdue and necessary to make tangible conservation progress was a sentiment echoed by many of the interviewees. One respondent noted that advancing LBD conservation "requires social scientists, not just biologists." Of the tools described in the Human Dimensions Toolbox, only stakeholder engagement was mentioned by all six interviewees. Education, communication, and social marketing, along with conflict prevention and mitigation also emerged as key themes and areas in which greater social science support might prove particularly valuable. Across the interviews, each tool had different historical strengths and weaknesses, and offered different opportunities looking forwards (Table 3).

Stakeholder Engagement—Engaging with stakeholders, particularly fishing communities, was seen as a priority for LBD conservation, and it was

Table 3. Human Dimensions Toolbox (adapted from von Fersen et al., 2024): For each tool, we recorded the frequency with which it was mentioned in each interview, allowing calculation of the range and mean number of mentions across the data. We also recorded the number of interviews in which the tool was discussed. Interviewees described prior or current use of tools and/or suggested options for future use of the tool in question; both counts were recorded separately and were colour coded by frequency, with darker colours at higher frequency.

Tool name	Definition	Example	Total # of mentions: Prior or current use	Total # of mentions: Potential use	# interviews where mentioned
Stakeholder Engagement 	Identify key stakeholder groups and/or enter into discussion with stakeholders to develop mutual understanding and build trust.	"[We] made connections across the community." "It is key to listen to people, talk to people." "[We] haven't yet reached out to these fishers to engage with them as stakeholders."	21	8	6
			$\bar{x} = 4.67$ per interview		
Collaborations & Partnerships 	Develop formal or informal partnerships with stakeholders, and promote collaborative activities (e.g., citizen science).	"The project works with the fishers to maintain good records." "We are looking to integrate [communities] going forwards."	10	3	5
			$\bar{x} = 2.17$ per interview		
Community-Based Conservation 	Support conservation efforts either led by communities or heavily involving communities in the decision-making process.	"[The solution] has to come from communities." "[We] need to make a more shared management process."	1	3	3
			$\bar{x} = 0.67$ per interview		
Local Knowledge 	Incorporate local or traditional ecological knowledge into conservation planning and decision-making.	"There are huge amounts of TEK in these communities." "We must be willing to learn from them."	5	3	1
			$\bar{x} = 1.33$ per interview		
Social Assessment 	Systematically collect data to understand communities and the social landscape, often as a baseline or preliminary investigation. Data may be qualitative or quantitative.	"General human dimensions research" "[We] took a snowball approach to interviewing people." "[We] know these fishermen well."	11	1	3
			$\bar{x} = 2.00$ per interview		
Economic Valuation 	Explore the economic implications of conservation activities or living with wildlife. Identify and/or support income generation activities or approaches which financially benefit local communities.	"Where money can't be given, [we] explore opportunities to give materials." "There may be some costs (e.g., additional fuel)." "Consequences for the local economy"	8	6	4
			$\bar{x} = 2.33$ per interview		

Conflict Prevention & Mitigation 	Prevent, mitigate, or manage conflict as it arises between people and wildlife, or between stakeholders with different positions.	"Modifying national-level legislation [is] a complex, multi-stakeholder process with significant levels of conflict." "There was a significant amount of community backlash."	19	3	6
			$\bar{x}$ = 3.67 per interview		
Monitoring & Evaluation 	Engage in ongoing measurement and evaluation of the impact conservation activities have on key stakeholders, including direct and indirect consequences.	"There has not been as much systematic data collection and evaluation as [we] would like."	5	1	3
			$\bar{x}$ = 1.00 per interview		
Education, Communication, and Social Marketing 	Conduct education and outreach activities to communicate key messages, including information about conservation. Develop social marketing approaches where appropriate to encourage behaviour change.	"Produc[ing] signage for tourists visiting the area" "Education and outreach to create strong community support for . . . conservation" "Talks, outreach materials, workshops in public schools, or science fairs"	20	3	5
			$\bar{x}$ = 3.83 per interview		
Legislative, Regulatory, and Governmental Approaches 	Ensure that appropriate conservation legislation is developed with relevant stakeholders consulted and their needs considered and incorporated.	"Strengthen fishers' voices and local agency." "Regulation created unintended social consequences." "This exclusion zone was not built with the community in mind or involved."	8	4	5
			$\bar{x}$ = 2.00 per interview		

mentioned in all interviews (n = 6) and at a comparatively high emphasis value ($\bar{x}$ = 4.67; i.e., interviewees mentioned stakeholder engagement an average of 4.67 times per interview). This was the most commonly emphasised theme across the study (see Table 3). However, as one interviewee observed, "there has been less imperative to work with fishers directly" because LBDs do not cause direct conflict. This is illustrative of the perception that stakeholder engagement is seen as optional or desirable rather than necessary. Regardless, interviewees generally perceived that this type of engagement "help[ed] to build trust" and was a productive activity in which to engage. One interviewee suggested that his process was particularly easy where cooperative fishing takes place, suggesting these symbiotic fishing practices were a "good tool to engage with fishers . . . because it is a mutually positive interaction."

Despite broad interest in stakeholder identification and engagement, it has not been carried out in a strategic manner: interviewees described *ad hoc* engagement with no formal stakeholder engagement plan or behaviour change strategy. Interviewees suggested that a systematic approach was not undertaken either due to financial constraints or because the systematic approach was not believed to add value to the engagement process. In some instances, efforts to engage with stakeholders were implied rather than articulated as a clear part of the conservation process. Outreach and communication work, for example, must, by necessity, involve some form of stakeholder engagement, but this was not clearly articulated or perhaps viewed as part of the outreach process by all interviewees. In some instances, interviewees expressed an interest in undergoing a more comprehensive stakeholder identification and engagement process in the future, if the right tools and resources are available to support meaningful engagement. As one interviewee said,

"building trust is the most important thing. There is no law that is better than trusting relationships."

Collaborations & Partnerships—Interviews reflected a notable absence of true collaboration and partnership with stakeholders, with a mean of 2.17 mentions per interview (Table 3). While efforts had been made across the board to engage with partners (see "Stakeholder Engagement" section), developing actual collaborative work—a more involved, shared effort than purely collecting data or working to understand stakeholders—was uncommon. Where collaboration was described, this was often in the context of opportunities for future work, with numerous partners expressing a desire to develop these collaborations going forwards. Where partnerships were already in place, this was predominantly to do with monitoring LBD populations, with communities often benefitting from employment or other types of material support in exchange. As one interviewee noted, "what we feel is missing is a more direct approach with the fishers"—in other words, more meaningful collaboration.

Community-Based Conservation—Similarly to what was found in the "Collaborations & Partnerships" section above, community-based conservation was infrequently mentioned throughout the interviews, with only three interviewees raising the topic. In total, only four distinct mentions were made across the dataset, with three of these focussing on the desire for a "more shared management process" in the future.

Local Knowledge—Only one interviewee mentioned local or traditional ecological knowledge (TEK); however, it was a key theme for the community work described by that interviewee, who stated that

> *scientists identify dolphins with good photos of the dorsal fin, whereas fishers use personality, movement patterns, behaviour. They are totally different ways of thinking. If we ask fishers to ID photos of the animals, they can't do it, and they don't look like they have much knowledge. But this isn't reality. The reality is that we are asking the question wrong, and missing out on the deep knowledge they have.*

This willingness to incorporate and learn from local knowledge, as exemplified by this respondent, can be a great strength in building conservation approaches that genuinely listen to local people. While this may not always be possible, and levels of local knowledge about wildlife can vary substantially, there was surprisingly little attention paid to this approach across the interviews. It may be the case that, looking to the future, "we need to be more open about descriptive knowledge, not just statistics."

Social Assessment—Interviewees typically had a strong sense of the local fishing communities in their area, including their needs and concerns, but only three of the six described specific data collection that had been carried out to understand these stakeholders. In the absence of a systematic approach being used by interviewees to engage with communities, featuring either qualitative or quantitative methods, it was challenging for us to evaluate the depth of this anecdotal knowledge. Where systematic work to "understand the social landscape" was described, this was in all cases work in progress rather than formative research carried out in the early stages of a project. Some projects had "extensive community data on a range of social attributes," but for all three interviewees who mentioned social data, this had yet to be used strategically to inform conservation practice. However, all three participants emphasised the value of approaches such as direct interviews with stakeholders in informing their future practices, with one saying that "these interviews have brought really amazing insight into the challenges people face."

Economic Valuation—Four interviewees discussed economics in the context of human dimensions work for the LBD. Of these, one interviewee reported that, for their study site, "an economic study wouldn't be particularly interesting or useful" given the relatively limited implications for fishers of changes to LBD protection in the local area. Further, "there is no baseline data . . . therefore comparing the cost or opportunity cost to fishers is next to impossible." While one interviewee had carried out "extensive bioeconomic modelling," for the most part, interviewees' understanding of the economic situation appeared to emerge out of informal, ongoing dialogue with communities.

While extensive data-driven research into the economic implications of living with wildlife is not always relevant or necessary, all the interviewees who mentioned economics appeared to "think a lot about how to make [community members'] lives better" through economic instruments. Indeed, while the costs of living with LBDs may be negligible, there was widespread consensus among the interviewees that fishing communities were highly marginalised, and that bringing better economic prospects to these areas would benefit conservation. In one region, there was some evidence to indicate that "the most economically vulnerable fishers" posed the greatest threat to the LBD, reinforcing this point. All four interviewees who mentioned economic aspects of human dimensions had given some thought to future

opportunities, including "way[s] to monetize the wildlife," how "carbon credit might offer an opportunity," or "ecotourism . . . as a cooperative, managed by fishers." There was a general consensus that, in many locations, "it is time that the fishers see something change . . . something with tangible social and economic benefits."

Conflict Prevention & Mitigation—While all interviewees felt that "LBDs don't create losses" for fishermen, there was a strong sense that "there has been, and *is*, a significant conflict with the fishers": all six interviewees mentioned conflict (emphasis value $\bar{x} = 3.67$; Table 3), with only one suggesting that it was minimal in their region. Of the five remaining interviewees for whom conflict was a concern, this often revolved around a small number of high-conflict issues, including gillnet restrictions, habitat zoning, and recreational fishing. These conflicts were long-term, with long-term ramifications. For example, in the process of revising national-level regulations around gillnetting, one interviewee observed that "industrial fishers are very powerful, which meant that artisanal fishers didn't really get a voice" in the revisions process. Elsewhere, legal changes to fishing zones, compounded by "environmental police [who] were active in pursuing those who were fishing in the wrong areas," served to amplify pre-existing conflict between the authorities and fishing communities.

While the specifics of different conflict foci varied, the key theme that emerged across these examples was a lack of trust between stakeholders and a gradually worsening situation. This was demonstrated by one interviewee who noticed that fishers were "becoming less open, less willing to engage"—a strong signal of worsening conflict. In many cases, it was felt that nongovernmental organizations (NGOs) or conservation actors had made conflict worse, with fishers "painted as the bad guys" by these groups and "a bad relationship . . . between conservationists and the community." In many locations, it was argued that "we have reached a point of not returning. Fishers do not trust in scientists [and] scientists do not trust in fishers."

For conflict prevention and mitigation—more than any other tool—interviewees called for greater support from social scientists. There was a perception that "traditional conservation scientists are not the right people" to manage these conflicts. Indeed, reflecting on previous work, two interviewees observed that not enough effort was made to bring social scientists into these efforts during the initial stages of the programmes:

> *I believe that the involvement of social scientists since the beginning of the process . . . would have been very positive and the process would have gone more smoothly.*

This early involvement "would also have reduced the possibility for conflicts to emerge later." The prevalence with which conflict was mentioned, and the absence of any discussion of conflict resolution techniques, suggests a profound need for greater support from human dimensions practitioners on this issue, both today and into the future. For the LBD, and for many other nearshore cetaceans, "different groups have different interests, so there is always going to be conflict unless this is handled very carefully."

Monitoring & Evaluation—Very little monitoring and evaluation had been carried out to understand the impact of conservation programmes on communities. Three interviewees mentioned the concept but only in passing or as a challenge they had not yet resolved. As one interviewee said, "there needs to be a concerted effort to understand whether perceptions have changed, or any other long-term impacts of the programme," but this had not yet been carried out. On one site, anecdotal evidence suggested some level of outreach programme efficacy, but more effort should be exerted, across the board, to generate suitable, long-term datasets through which to understand the social impacts of conservation activities.

Education, Communication, and Social Marketing—Education and outreach were some of the most widely discussed conservation activities, with five interviewees mentioning their work on this theme and at a relatively high frequency ($\bar{x} = 3.67$ mentions per interview; Table 3). A range of engagement activities were conducted, including "talks, outreach materials, workshops in public schools, or science fairs." Elsewhere, programmes used "arts to engage with people" or "led talks in the fishing communities which helped to communicate the new regulations." A diversity of specific engagement activities were aimed at children in fishing communities (or their teachers), with a smaller but still notable proportion focussing on women in these communities, tourists visiting certain areas, or fishers directly.

Numerous interviewees felt that engagement, particularly with fishing communities, was a critical endeavour that supported increased knowledge of local biodiversity (including the LBD), with one interviewee saying that "education, and its impact, are key." While knowledge gain was widely considered to be a priority, a smaller number of the interviewees connected this outreach work with promoting wildlife values and a connection with nature. Ultimately, many of these engagement activities were intended to "create strong community support for the ecosystem's conservation, including the LBD," but

it was not clear if a theory of change connecting knowledge gain or engagement to changing attitudes or behaviours had been developed for many of these programmes, with a general "raising awareness" goal described for some of these programmes. Although outreach efforts had not been explicitly evaluated, there was a consistent sense from interviewees that outreach was "one of the most effective conservation tools" and that "people seem to understand better the conservation issues facing [the] LBD" because of these efforts.

Legislative, Regulatory, and Governmental Approaches—Legislation and regulatory approaches were mentioned by some interviewees, but only twice per interview on average. For the most part, the human dimensions and implications of regulation were not the forefront of these conversations, with far more emphasis on the value of policy tools for higher-level support. While this is inherently useful for conservation, as part of a Human Dimensions Toolbox, it is integral to consider the impact these regulations might have, or how stakeholders can be supported as new regulations—which directly impact them—are developed and put in place. As one interviewee said, there has been historic "modification of legislation which didn't have the right input from some stakeholders [and] led to conflict." It was suggested that many of the new PAs or fishing regulations "created unintended social consequences," at least in part because key stakeholders were not suitably involved in the development of these plans. It was suggested that often these changes are "not 100% fair and . . . improvements could be made, considering a more participative plan."

4. What are the main challenges to integrating human dimensions into LBD conservation?

Interviewees expressed clear support for the idea that better integrating social science into LBD conservation efforts would, for the most part, be beneficial. There was also great clarity across the interviews regarding the main barriers or challenges that prevented this from happening, which fell into four main categories.

As is so common across conservation, access to funding was considered a major barrier to integrating the social sciences into LBD conservation. Interviewees cited multiple examples wherein insufficient funds prevented the inclusion of social science methods. In some cases, this was because a larger team would be needed to collect social data, with one interviewee saying, "they need more hands." Interviewees found that, even where there was a clear desire to include human dimensions in a project, there was "no money to pursue these plans."

Community relations also proved a barrier in some instances, with multiple interviewees mentioning that there was "a cultural barrier" between conservationists and communities. There was widespread recognition that, for example, "strategies moving forwards . . . must involve fishers," but that this can be challenging where there are poor pre-existing relationships with communities. Building these relationships takes time, and as with so many marginalised communities, there is a distrust of external parties. One interviewee said that, in their experience, "lack of trust—that is the most important thing for so many reasons." Further exacerbating these issues, there is an intersection between funding constraints and community relations such that "if funding goes, then you can break trust with your partners."

Lack of training for biologists in the social sciences was commonly identified as a root cause of many of the challenges with integrating human dimensions into conservation work. Interviewees lamented that "we aren't trained in these skills as biologists" and that "skills, knowledge, and a lack of experience" with social science methods were barriers to success. Interviewees rated their comfort with social science tools and approaches on a 1 to 10 scale at only 6.42 (± 2.21), indicating relatively low knowledge, and there was substantial variation across the sample (Figure 2, Q4). These capacity limitations are a significant shortcoming, and it was suggested that "scientists need to be trained" and that "training at the university level would help." As one interviewee said, "most cetacean scientists have a shallow understanding of the social sciences, and it isn't deep enough to really support conservation efforts meaningfully."

Improving biologists' capacity for the social sciences is clearly a priority, but so too is improving interdisciplinarity. In many instances, "connect[ing] with the right people from across disciplines" may be more effective than training biologists, and many interviewees suggested that promoting interdisciplinary sharing was an urgent need. Interviewees advised that "they need different fields" to be involved in LBD conservation, and "there is a significant need for social scientists." Desire for prolonged contact with social scientists and for them to be involved in LBD conservation was apparent, as was the "necessity to create interdisciplinary teams." While there are various impediments or challenges to integrating social scientists in this work, and "it is easy to stay in your comfort zone," more should be done to involve these disciplines.

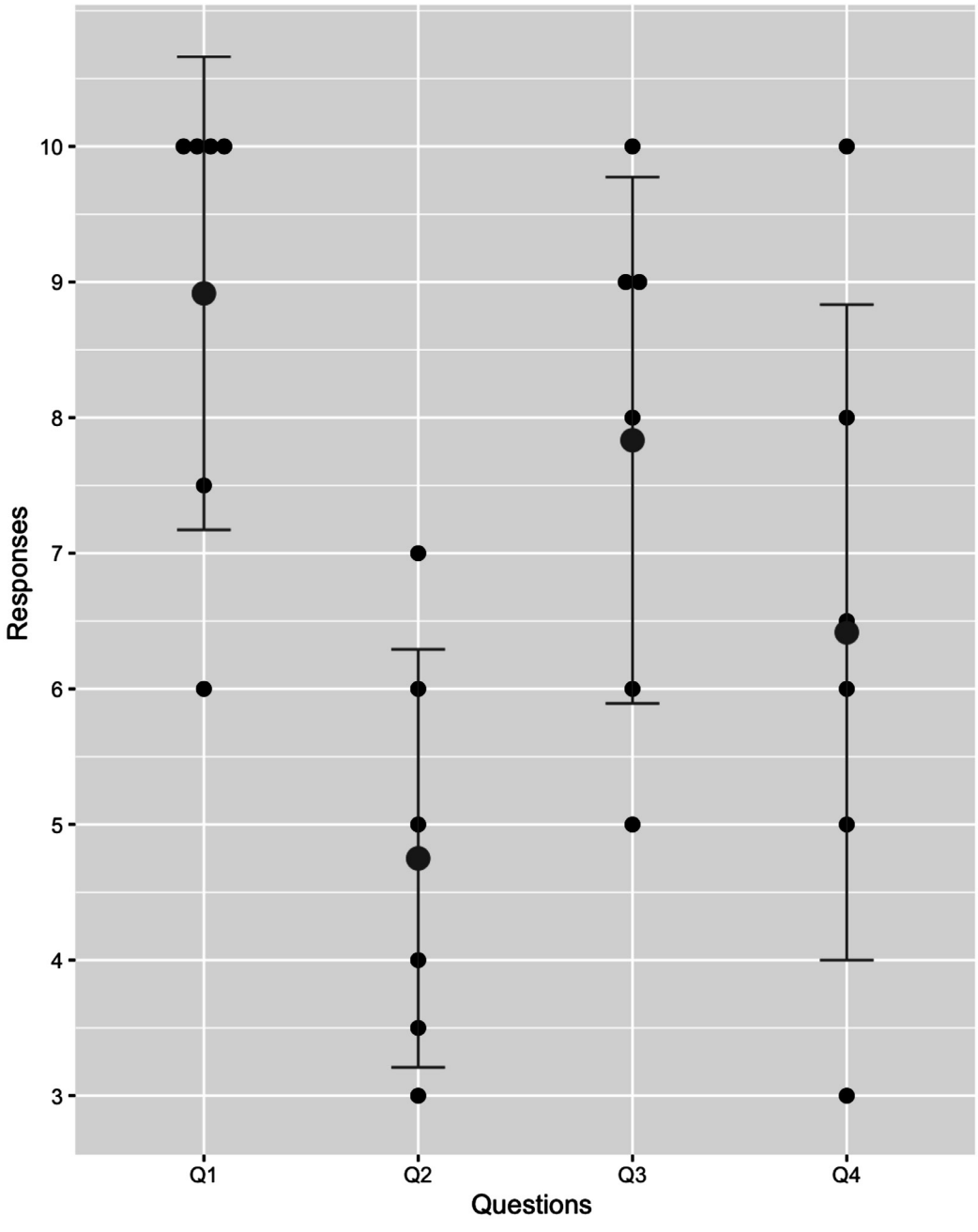

Figure 2. Scores in response to closed-ended interview questions: These were conducted across all interviews ($n = 6$), and all were scored on a 10-point scale, with 1 = "not at all" and 10 = "completely." Black bars show mean ± standard deviation. Q1: To what extent do you think that the conservation challenges facing LBDs are to do with human dimensions? Q2: How effectively do you think that social science tools and approaches have been used as part of LBD conservation efforts? Q3: Overall, how ready and willing do you think LBD conservation practitioners are to integrate social science into their future conservation efforts? and Q4: How comfortable do you personally feel using social science tools and approaches?

Discussion

Incontrovertibly, human activities emerged as the main source of threats to the LBD. These threats were sometimes direct (e.g., entanglement in fishing gear) and sometimes indirect (e.g., agricultural runoff and toxic pollution), but, nevertheless, they were abundant across the LBD's range. Of the threats named by experts, only natural population stochasticity and skin disease could not be directly ascribed to human origins; these potentially non-anthropogenic threats were considered to be less serious than bycatch, overfishing, habitat degradation, and pollution, although the potential contribution of anthropogenic factors to increasing levels of skin disease—such as pollution, water quality degradation, or increased UV exposure—has not been addressed. There was broad agreement among the interviewees that the main conservation challenges facing the LBD primarily relate to the human dimensions. This echoes the sentiment reflected in both the ESOCC and HDSCC workshops whereby anthropogenic threats—particularly the use of gillnets—were considered to be the most profound threats to most if not all nearshore cetaceans (Taylor et al., 2020; von Fersen et al., 2024).

In addition to describing the threats, interviewees also explained the conservation activities that had previously or were currently taking place for the LBD. Relatively few of these conservation actions specifically addressed human dimensions. Of the eight types of activity, only three (outreach and education, social research, and community conservation) explicitly focussed on the human dimensions. While these three were mentioned moderately often, traditional biological conservation tools (e.g., conducting primary population research or monitoring, establishing or extending protected areas, and carrying out conservation planning) were mentioned far more often. This likely reflects the predominantly natural sciences background held by many field conservation practitioners. In particular, all interviewees described the collection of biological data, including population and bycatch monitoring, as a key conservation activity. Although these data were regarded as necessary by all the interviewees, there was some concern that too much emphasis was placed on population monitoring and not enough on conservation action, with multiple interviewees worrying that "all their energy is on research, so there is nothing left for conservation," and that scientists run the risk of "just documenting extinction." As other conservation practitioners have pointed out, overemphasis on monitoring may distract from the conservation actions and leadership that are needed to avoid a downwards spiral to extinction (Martin et al., 2012).

Alongside biological research, education and outreach were the most commonly mentioned facets of LBD conservation efforts to date. While connecting with communities through education has been thoroughly integrated into LBD conservation practice, there was a disconnect between many of the activities described and the corresponding behaviour change outcomes practitioners hoped to see. Education was often framed as a way to either promote local conservation values or to incite behaviour change. This reflects a commonly held misconception among many conservation practitioners predicated on the knowledge deficit model (Miller, 1983), which suggests that lack of knowledge is the primary reason for certain behaviours—for example, the use of fishing strategies that negatively impact LBDs. Abundant research demonstrates that providing education or information is insufficient to change people's behaviours (e.g., Knapp et al., 2021); therefore, a tighter focus on concrete theories of change may be necessary to align these education and outreach programmes with distinct conservation goals.

Viewing LBD conservation efforts through a human dimensions lens provided useful insight into the broad types of activity in which practitioners were engaged; applying the human dimensions toolbox to these activities provided an even deeper understanding of the approaches that had—or had not—been used, and where practitioners felt the most urgent need to adopt these tools. Of the 10 tools described in the toolbox, there was substantial variation in the number of practitioners who mentioned a given tool and the extent to which those tools were incorporated into their work. The most-used tools, stakeholder engagement ($\bar{x} = 4.67$ mentions per interview; number of interviewees = 6) and education, communication, and social marketing ($\bar{x} = 3.83$, $n = 5$) were used far more abundantly than the least-used tools (community-based conservation [$\bar{x} = 0.67$, $n = 3$] and local knowledge [$\bar{x} = 1.33$, $n = 1$]), which were barely discussed. These usage discrepancies might reflect differences in the usefulness of said tools, but they more likely indicate different levels of practitioner experience and competency with the tools. Confidence with their ability to use social science tools was low among the interviewees, further evidencing the idea that these differences reflect skills shortages rather than lack of interest.

For even the most widely adopted tools, descriptions of their use reflected the biological sciences background and training of most conservation practitioners. While stakeholder engagement was described by all interviewees, it was never approached in a strategic manner, nor was any comprehensive stakeholder mapping process

undertaken. Similarly, as described above, the outreach activities described often did not connect messaging or education to conservation outcomes, and there was little or no measurement of the impacts of education programming. Exploring options for sharing expertise or working with social science practitioners who have more extensive formal training and practical experience with these tools may be valuable for many practitioners. Based on the conservation actions described, this might, for example, help to develop some of the general education programmes into behaviour change campaigns with measurable outcomes.

Conflict prevention and mitigation were widely regarded as crucial tools, but those with which many LBD practitioners had little expertise. Mitigating conflict between fishers and other stakeholders, building trust, and preventing conflicts from deepening were key themes, but practitioners often expressed discomfort with these approaches and called for support from social scientists. Conflict resolution is a highly technical discipline and draws from many different social sciences; it is clear there is both the desire and need to work with relevant experts to explore how these conflicts might be resolved. By contrast, efforts to understand the communities living with wildlife—through social assessment, monitoring and evaluation, and economic valuation—were relatively poorly incorporated into LBD conservation, and there was less demand from the interviewees who participated in this process for support to integrate these approaches. Although practitioners recognized the importance of, for example, conducting monitoring and evaluation to understand the impact of engaging with communities, this was seldom seen as an urgent priority. While responding to conflict may be urgent and immediate, developing the capacity to understand the needs of stakeholders provides the long-term tools for avoiding conflict; however, this cannot be achieved when practitioners are caught in cycles of "firefighting" urgent issues.

Four key barriers to the better integration of human dimensions into small cetacean conservation were identified. As in most areas of conservation practice, a lack of long-term, reliable funding created a barrier to incorporating many social science tools. Funding instability or restrictions prevented experts with social science backgrounds from being brought on to support or advise as needed, or existing project members from being trained in the relevant disciplines. Funding shortages also hampered efforts to build trust with communities, with unreliable funding or the inability to provide meaningful support to communities often undermining partnerships. The pervasiveness of barriers associated with funding is a particularly important result as it highlights a structural barrier that continues to limit the integration of social sciences in species conservation. The difficulty in securing funding for human dimensions work underscores the broader issue that the value of social science approaches is still not fully recognized by many institutions and funding bodies that support conservation efforts. Despite a growing awareness of the importance of engaging local communities and understanding socioeconomic contexts, the acceptance of social science as a critical component of conservation planning is far from guaranteed.

Alongside funding, the challenge of building trust with relevant partners was identified as an important barrier. Trust or at least the ability to build trust is a critical building block for many of the social science approaches described. Thus, difficulties in building trust with marginalised fishing communities imposes a barrier to better integration of human dimensions-based approaches.

Through all six interviews, it was clear that conservation practitioners recognised the limits of their skills and expertise. None of the interviewees identified themselves as true social scientists, with many describing learning human dimensions approaches "on the job." The interviewees articulated a clear need and willingness to work with social science experts to overcome many of the problems facing the LBD—from conflict resolution to developing viable alternative livelihoods or suitable behaviour change programmes. Providing resources to guide practitioners towards social scientists with relevant skills, or to support cetacean conservationists in developing these skills, may be a key opportunity for progress. It is encouraging to see practitioners recognizing the value of social science expertise and expressing a willingness to engage with this approach. Given the difficulties in learning a completely new discipline, the solution should not lie primarily in training biologists to become social scientists. Instead, true interdisciplinary collaboration is likely a more effective and efficient alternative—that is, bringing experts from different fields together to address complex conservation challenges. The same principle applies to conflict resolution for which navigating sociopolitical dynamics often requires specialized knowledge and experience that extends beyond the biological sciences.

Nearshore cetaceans need urgent conservation action, and it is evident that these efforts must include people. Conservation approaches that fully incorporate human dimensions tools, either by bringing in outside expertise or by building capacity within the cetacean conservation community, will be critical to avert the disaster that has struck many coastal and riverine cetacean species.

While the reasons underlying the decline of the vaquita are many and contentious, most practitioners agree that challenges in working with complex stakeholder groups, incorporating the needs of communities, and reconciling harsh socioeconomic realities were contributory factors (del Monte-Luna, 2025). While attempts were made to incorporate social science approaches into vaquita action plans when it became clear that these efforts could not succeed without them, much like "paper protected areas" with no enforcement, they were blocked or ineffectively implemented. Although there have been several recent successes in these efforts with vaquita, alternative gears, alternative livelihoods, value-added pricing for sustainably sourced seafood, and "vaquita-safe" marketing were all suggested early and often, but they were not supported by the government or fisheries agencies involved at the time (Rojas-Bracho et al., 2006, 2024; Jaramillo-Legorreta et al., 2016; Taylor et al., 2020; Sanjurjo-Rivera et al., 2021).

Cetacean conservation practitioners have the opportunity now to learn from these missteps and incorporate human dimensions approaches into the conservation plans for other nearshore cetacean species. As with the Lahille's bottlenose dolphin conservation efforts explored in this case study, there are many opportunities to use these tools to build a brighter future for the small cetacean species with which we share our coastlines.

Note: The supplemental appendix for this article is available in the "Supplemental Material" section of the *Aquatic Mammals* website: https://www.aquaticmammalsjournal.org/supplemental-material.

Acknowledgments

The authorship team would like to thank all the interviewees who so generously volunteered their time for this process. We would also like to thank Nuremberg Zoo, the Verein der Tiergartenfreunde Nürnberg e.V., and the Organization for the Conservation of Latin American Aquatic Mammals – YAQU PACHA e.V. for their valuable support.

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