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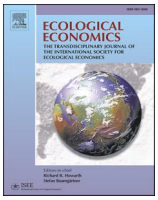

ANALYSIS

Investigating acceptance of marine tourism levies, to cover the opportunity costs of conservation for coastal communities

Hollie Booth [a,*], Susana Mourato [b], E.J. Milner-Gulland [a]

[a] The Interdisciplinary Centre for Conservation Science, Department of Zoology, University of Oxford, 11a Mansfield Rd, Oxford OX1 3SZ, UK
[b] Department of Geography and Environment and the Grantham Research Institute for Climate change and the Environment, The London School of Economics and Political Science, London, UK

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ABSTRACT

Marine tourism is promoted as a substitute economic activity to unsustainable fishing, which is compatible with conservation. However, benefits of marine tourism do not typically accrue in small-scale fisheries (SSFs), which often bear the costs of conservation; they accrue to tourists and tourist-focussed businesses. We explored how marine tourism levies could operationalise the beneficiary-pays principle and address these cost-benefit inequities using an online contingent valuation (CV) survey to measure international tourists' willingness-to-pay (WTP) towards community-based shark conservation (N = 1033). Levies were widely supported (96%), with median and Turnbull mean WTP of US$ 10–14.99 and $22.02 per person per day, respectively. We combined these results with data from two marine tourism hotspots in Indonesia – Lombok and Pulau Weh – to explore the feasibility of implementing tourism levies to incentivize pro-conservation behaviour in local SSFs. Our conservative estimates indicate that marine tourism levies in Lombok and Pulau Weh could respectively generate US$ 2.3–10 million and US$ 300,000–1.3 million annually – several times greater than the estimated costs of conservation incentives in local SSFs. The marine tourism industry offers an under-utilised revenue stream for marine conservation, which could support policy aspirations such as '*a sustainable and equitable blue economy*'.

1. Introduction

Human actions are driving large-scale degradation of biodiversity and ecosystems (Díaz et al., 2019). Transformative change is needed to 'bend the curve' on biodiversity loss within the next decade (Díaz et al., 2019; Mace et al., 2018). Importantly, this change must address the root socio-economic drivers of biodiversity loss, including issues of inequality and social injustice which can exacerbate, and be exacerbated by, environmental degradation (Mikkelson et al., 2007; Mirza et al., 2020).

Of the species and ecosystems that are threatened by human actions, large, long-lived marine species ('marine megafauna') – such as sharks, rays, turtles, and cetaceans – constitute some of the world's most threatened species groups (Dulvy et al., 2021; McClenachan et al., 2012). For example, it is estimated that at least 1 in 3 shark species (Class Chondrichthyes) are threatened with extinction, with population declines driven by overfishing, and exacerbated by poor governance and market forces (Dulvy et al., 2021; MacNeil et al., 2020; Pacoureau et al., 2021). In general, overexploitation is the single biggest threat to marine megafauna (Lewison et al., 2004; McClenachan et al., 2012), with people obtaining value from these taxa through consumptive use for economic and subsistence purposes.

Somewhat paradoxically, marine megafauna also have widespread public appeal, with significant socio-economic value attributed to non-consumptive uses, such as nature-based tourism (Gallagher and Hammerschlag, 2011; Troëng and Drews, 2004). On this basis it is often argued that marine megafauna is 'worth more alive than dead', due to the high economic value of marine tourism (e.g. Heinrichs et al., 2011). However, such arguments often fail to consider distributional issues, in terms of where and for whom these benefits accrue. In practice, there is often a mismatch. Those who benefit from non-consumptive use of marine megafauna (and therefore benefit from conservation) rarely bear the costs of conservation, and vice versa; those who benefit from consumptive use of marine megafauna (and therefore may be negatively impacted by conservation, in terms of restricted access to natural resources) rarely receive the benefits of conservation (Balmford and Whitten, 2003; Booth et al., 2021d; Mustika et al., 2020). This is particularly challenging in small-scale fisheries (SSFs) in biodiversity-

* Corresponding author.
E-mail address: hollie.booth@zoo.ox.ac.uk (H. Booth).

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rich ocean-dependent nations, where vulnerable coastal communities can face significant opportunity costs as a result of marine conservation efforts (Booth et al., 2021d; Jaiteh et al., 2016; Selig et al., 2018; Stevenson et al., 2013).

To address marine biodiversity loss, and move towards a sustainable and equitable blue economy, there is a need for socio-economic and behavioural approaches to marine conservation, which can: 1) incentivize pro-conservation behaviour in fisheries, while 2) supporting social justice, and ensuring that conservation interventions respect the rights of indigenous people and local communities and improve wellbeing (Balmford et al., 2021; Bennett et al., 2021; Newing and Perram, 2019; Travers et al., 2021). One potential mechanism for achieving these goals is a beneficiary-pays approach to marine conservation, in which tourists or tour operators provide performance-based payments for conservation outcomes to coastal communities (i.e. payments for ecosystem services, PES) (Balmford and Whitten, 2003; Sommerville et al., 2009). This could involve collecting marine tourism levies (Gelcich et al., 2013; Peters and Hawkins, 2009; Schuhmann et al., 2019; Vianna et al., 2018) which are then invested into community-based conservation programmes (such as support for habitat protection or bycatch reduction), with conditionality based on either actions performed or outcomes achieved (Engel et al., 2008; Sommerville et al., 2009; Sykes et al., 2018). Despite their theoretical potential, few such mechanisms – which directly link marine tourism payments to measurable community-based conservation actions or outcomes – exist in practice (though there are several examples of marine conservation agreements which, for example, use tourism profits to buy out fishing rights in and around diving locations (Sykes et al., 2018)). One challenge is that the economic values of only a small proportion of endangered marine species have been estimated, and most willingness-to-pay (WTP) studies have been conducted on a site-specific basis, and in the global north (primarily the United States) (Lew, 2015). This hinders policy innovation and payment design, particular since mechanisms to reduce threats to marine biodiversity and improve environmental justice are most needed in global south countries (Balmford and Whitten, 2003; Selig et al., 2014, 2018). Additionally, most WTP studies do not go on to directly link estimated revenues from tourism levies to the potential for feasible, measurable conservation outcomes from real-world investments in fisheries management.

Our study aims to fill these gaps, by exploring how a beneficiary-pays approach for redistributing the costs and benefits of marine megafauna conservation could be operationalised. We conducted an online contingent valuation (CV) survey to estimate the WTP of international tourists (residing in OECD countries) towards community-based conservation for endangered marine megafauna, with a focus on Critically Endangered elasmobranchs (i.e., sharks and rays, hereafter 'sharks'). We then used regression models to validate our findings and construct a predictive model of WTP. This fills a policy-relevant research gap, by providing a generic (i.e., non-site-specific) estimate of, and predictive model for, the WTP of international tourists from wealthy countries towards community-based marine conservation for Critically Endangered elasmobranchs in small-scale tropical fisheries (SSFs). We then used these results in combination with qualitative and quantitative field data to assess the feasibility of implementing local-level beneficiary-pays financing mechanisms for marine conservation in two case study sites in Indonesia. In these sites, real marine tourism markets are in close proximity to SSFs in which Critically Endangered elasmobranchs are regularly captured, and where performance-based payments could support biodiversity and wellbeing outcomes (Booth et al., 2021c). As such, this study demonstrates a novel application of economic valuation to inform conservation practice - in terms of designing feasible, sustainable, and equitable marine conservation financing. It also offers a scalable open-access model, dataset, method and instrument (available via the Harvard Dataverse (Booth, 2021a)), which can be applied to other locations where mismatches between the costs and benefits of shark conservation need to be reconciled. These economic values and our predictive model can also be used to inform estimates of the non-consumptive value of sharks to society. In turn these values can inform wider policy-relevant analyses on trade-offs between multiple uses of marine resources (Lew, 2015; Sanchirico et al., 2013); and estimating compensation for damage to marine biodiversity caused during commercial activities (e.g. bycatch levies or marine offsets (Booth et al., 2021a; Jacob et al., 2020), which is increasingly important in the context of growing adoption of net outcome goals in government and private sector biodiversity commitments (Bull et al., 2020; CBD, 2020; Jacob et al., 2020).

2. Methods

2.1. Estimating international marine tourists' willingness-to-pay towards marine conservation

We adopted a stated preference approach – specifically, contingent valuation (CV) – to estimate and model international marine tourists WTP for conservation outcomes.

2.1.1. Data collection

We used an online survey to gather data on international tourists' travel behaviours, demographic variables, environmental attitudes, and willingness-to-pay (WTP) for community-based conservation of endangered sharks in SSFs (Supplementary Materials, S1). The survey and scenario design was based on initial scoping research in the case study tourism sites/SSFs (Section 2.2) and consisted of 26 questions in total, organised into nine main sections (excluding survey information and consent), as follows: travel preferences, last holiday, marine activity preferences, perceptions of marine animals, willingness-to-pay (CVM), perception of the scenario, environmental attitudes and behaviours, demographic information, prize draw (willingness-to-pay (revealed preferences)) (Supplementary Materials, S1). The target population for the survey was people with an interest in, or prior experience of, marine-focussed international tourism. The survey was written in English, designed in Jisc, and distributed via Prolific. We targeted people with a general interest in travel and did not publicise the survey as environmental or conservation research to minimise selection bias for people with pre-existing environmental values. No other a-priori sampling decisions were applied, due a lack of reliable data on the demographics of international marine tourists (e.g. Kieran, 2019). We acknowledge that web surveys such as this can introduce coverage and selection biases relative to the general population, however this is acceptable for the purposes of an exploratory study of a sub-group which is not a priori characterised by particular demographic variables (Bethlehem, 2010; Lehdonvirta et al., 2021; Wardropper et al., 2021). In particular, based on these design choices, our sample was limited to English-speaking respondents residing in countries which support the Prolific platform (i.e., most OECD nations and South Africa (Prolific Team, 2022)).

2.1.2. Contingent valuation

We used CV to measure respondents' WTP for community-based shark conservation. CV is a well-established stated preference method to determine individuals' preferences for the provision of non-market environmental goods or services, or for hypothetical public policies (Carson and Hanemann, 2005; Hoyos and Mariel, 2010). It has been widely used for estimating the economic value of biodiversity and ecosystem services, especially in nature-based tourism contexts (Lew, 2015; Majumdar et al., 2011; Vianna et al., 2018).

For the CV question we presented participants with a detailed hypothetical scenario in which they had taken a beach holiday to a tropical destination and were participating in a marine tourism activity. We explained that a small fishing village existed nearby, where endangered sharks are often caught for food and income, as is the case in our case study sites (Section 2.2) and many other marine tourism destinations in the tropics (e.g., Glaus et al., 2018; Mustika et al., 2020; Tyabji et al., 2020). The respondents were then asked their willingness-to-pay a

marine conservation fee (in addition to the price of the tourism activity) to support shark conservation in the local fishing village, by directly and conditionally compensating fishers for reducing their catches of endangered shark species (Supplementary Materials, S1). This design was informed and validated by in-depth scoping and field data collected in the case study sites (Section 2.2).

We used the payment card method to increase the information elicited from each respondent, and thus survey efficiency (Atkinson et al., 2018). We designed the CV question and payment card to reduce common biases by: 1) conducting scoping work with tourists and tour operators in Indonesia (Section 2.2) to explore the bounds of WTP, and design a realistic scenario; 2) piloting payment card increments, to optimise efficiency and accuracy of responses while minimising cognitive burden and visual complexity; 3) including a cheap talk script and follow-up questions on perceived consequentiality, to reduce hypothetical bias; 4) including follow-up questions on zero responses, to separate true zeros from protest zeros (Carson and Hanemann, 2005) (Supplementary Materials, S1). We conducted an initial pilot with 12 postgraduate students, then conducted a further pilot survey via Prolific ($N = 25$). This ensured payment card bid ranges were sufficiently sensitive to different preferences whilst not being cognitively burdensome and provided feedback on scenario design and survey clarity. The final CV question used a payment card with 18 WTP categories in US dollars, ranging from zero to US$300 (Supplementary Materials, S1). Respondents were asked to select their maximum WTP, allowing measurement of the lower and upper bound of respondent WTP.

An experimental element was added to the CV question whereby 50% of participants were exposed to an 'informational intervention' treatment before giving their WTP. Treatment participants were presented with some text and a 60-s video on the threats facing sharks and the socio-economic challenges of shark conservation in SSFs (Supplementary Materials, S1). Control participants were given no background information. Our aim was to test whether simple informational interventions at the point-of-sale might influence tourists' WTP.

Finally, we measured participants' revealed WTP for shark conservation through a prize draw, in which survey participants had a 1 in 100 chance of winning US$20 for participating in the survey, then could choose to donate a proportion of the prize to a real community-based shark conservation project in Indonesia (Supplementary Materials, S1). We note that the purpose of the prize draw component of the study was to validate the stated preference model (i.e., to confirm that the socio-demographic and attitudinal predictors in the stated preference model and revealed preference models were similar (see 2.1.3 Analysis and validation) rather than to calculate the magnitude of revealed WTP, since the expected value of the prize draw was low.

2.1.3. Analysis and validation

We derived the median bid interval and the Turnbull lower bound on mean WTP (Carson and Hanemann, 2005; Turnbull, 1976), and compared these WTP estimates with other similar studies (Vianna et al., 2018) and field data (Section 2.2).

To verify internal consistency and construct validity we: 1) explored the relationship between stated WTP and real donations; 2) modelled determinants of stated WTP and real donations – using linear and interval regression models with log(WTP) as the response variable – to test and verify correlations other widely-accepted demographic, attitudinal and behavioural constructs. We expected positive coefficients for indicators of wealth (such as income and holiday budget), education level and existing pro-environmental attitudes/behaviours (Liebe et al., 2011). The informational intervention (treatment Y/N) was also included as an explanatory variable, to test for significance and effect size. Explanatory variables were tested for co-variance, and models were fitted using all meaningful combinations variables, via lm and survreg functions in RStudio (RStudio Team, 2020). We used backwards selection and $\triangle$AIC to identify an optimal, statistically significant model, which can be used to explain and predict WTP.

2.2. Assessing the feasibility of a real-world beneficiary-pays financing mechanism: two case studies

We applied our results to explore real-world application of tourism levies in two case study marine tourism sites in Indonesia: Lombok (West Nusa Tenggara Province) and Pulau Weh (Aceh Province), which – as described in the CV scenario – are in proximity to two SSFs where endangered sharks are regularly caught: Tanjung Luar (West Nusa Tenggara) and Lhok Rigaih (Aceh) (Fig. 1). We estimated the economic feasibility of adopting tourism levies in Lombok and Pulau Weh, as a beneficiary-pays financing mechanism for marine conservation outcomes in Tanjung Luar and Lhok Rigaih. We also explored tourist and industry perceptions regarding implementation.

2.2.1. Study sites

Lombok Island in West Nusa Tenggara is a popular marine tourism destination that attracts scuba-divers, snorkelers, surfers, and beachgoers. Over 1-million international tourists visited Lombok in 2015, with the majority being European and Australian, and 22% of visits motivated by water sports (Horwath, 2017). Tanjung Luar is a small-scale semi-commercial targeted shark fishery on the east coast of Lombok. Vessels typically spend 10–20 days at sea, travelling to offshore fishing grounds, where they frequently capture large, mature Critically Endangered hammerhead sharks (*Sphyrna* spp.) and wedgefish (*Rhynchobatus* spp.), as well as other charismatic species such as mobula rays (*Mobulid* spp.) (Yulianto et al., 2018). As the only targeted shark fishery on Lombok Island, and in relative proximity to marine tourism hotspots, it is well-known and somewhat controversial. The fishery is legal, and challenging to manage due to fishers' high economic dependence on shark catches, and the limited availability of sustainable and equally-profitable alternatives (Booth et al., 2021d; Milner-Gulland et al., 2020).

Pulau Weh is a smaller and less well-known tourism destination in Aceh Province, which primarily attracts scuba-divers and beachgoers. An estimated 29,827 international tourists visited Pulau Weh in 2018 (Sabang Culture and Tourism Agency, 2019). Lhok Rigaih is a small-scale gill net fishery, located south-east of Pulau Weh, in which juvenile hammerhead sharks and wedgefish are frequently caught as incidental catch (Simeon et al., 2020). While elasmobranch catches are secondary, they hold economic and subsistence value, with a lack of incentives for fishers to avoid capture and promote release (Booth et al., 2021b). Lhok Rigaih is representative of other similar SSFs along the South-West coast of Aceh, though thought to be the largest SSF landing site in the area.

2.2.2. Data collection

We gathered qualitative and quantitative data from the marine tourism sector in Lombok and Pulau Weh (tourists and tour operators) to 1) design, ground truth and validate our online CV based on real-world priorities and industry insights regarding implementation feasibility; and 2) apply the WTP data to these real-world case studies. Data were collected using semi-structured interviews, focus group discussions (FGDs) and structured surveys with marine tourism companies and marine tourists who operate in/have visited Lombok and Pulau Weh (Supplementary Materials S2, S3). Questions focused on perceptions of the state of and threats to the marine environment, potential solutions, the role of marine tourists and the tourism sector in delivering these solutions, willingness to participate in and pay marine tourism levies, preferences for different causes and institutional arrangements, and basic demographic variables of tourists (Supplementary Materials S2, S3). FGDs and interviews/surveys were led by the lead author, and included interactive listing and ranking, problem tree analysis, and conceptual and timeline mapping (CMP, 2020; Newing et al., 2010) (Supplementary Materials S2, S3). In total we gathered insights from 10 marine tourism operators and 196 tourists.

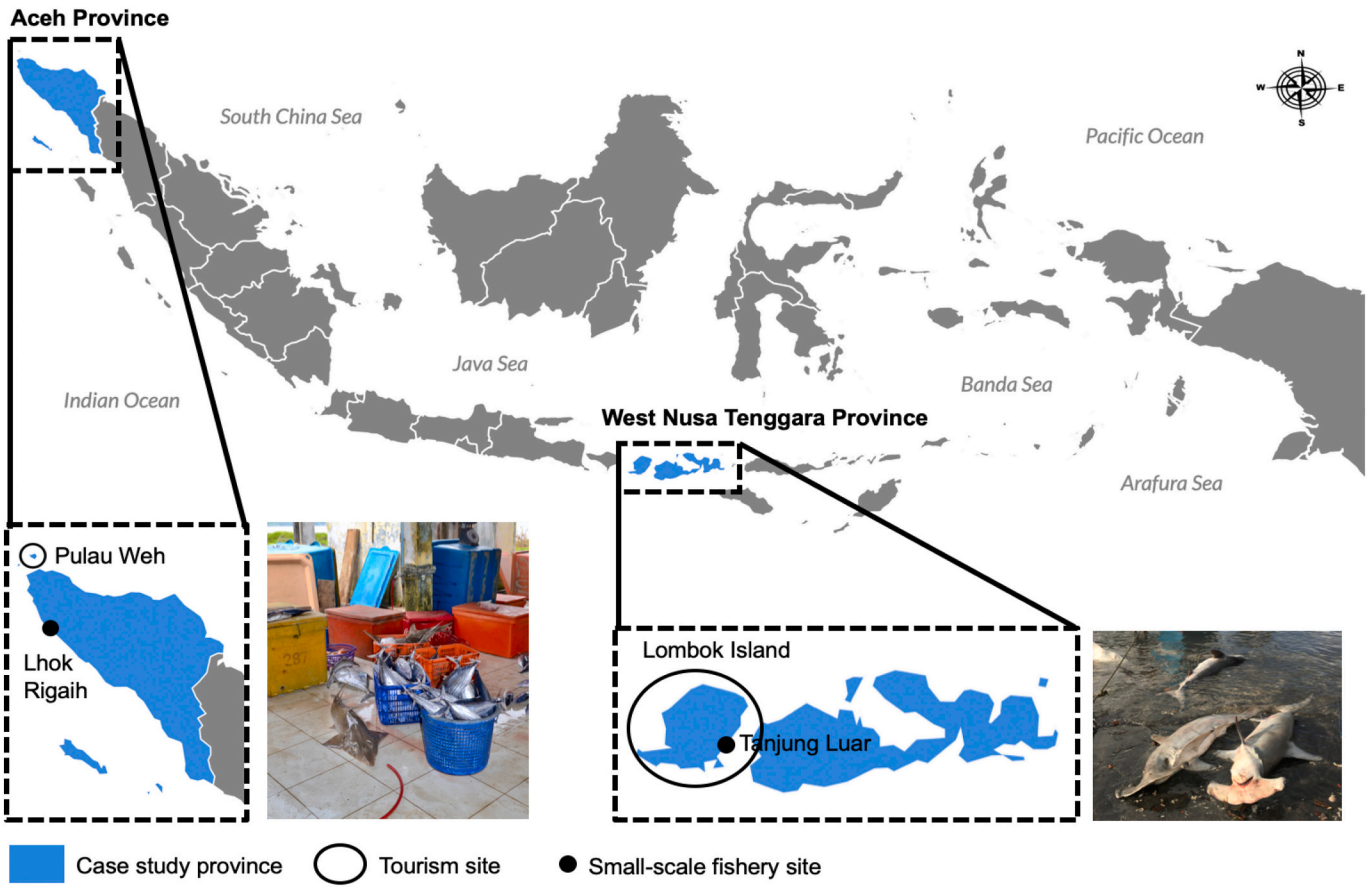

Fig. 1. A map of Indonesia, showing the case study provinces, tourism sites and small-scale fishery sites, with photographs showing examples of a wedgefish landing in Lhok Rigaih and a hammerhead shark landing in Tanjung Luar.

2.2.3. Analysis

We conducted thematic and descriptive analysis of the qualitative data using coding and grouping (Supplementary Materials, S3), with insights and preferences used to design the online CV instrument described in Section 2.1 and validate the results.

We then combined available statistics on annual international marine tourists in Lombok and Pulau Weh (Q) (Horwath, 2017; Sabang Culture and Tourism Agency, 2019) with estimates of WTP per person-day calculated from the online CV survey (P) to estimate a plausible range of potential total annual revenues (R) for marine conservation from tourism levies in both Lombok and Pulau Weh (where R = Q*P). For values of P, we used the upper and lower bounds of the median WTP bid interval and the Turnbull lower bound on mean WTP. We then compared these estimates of annual revenues for each tourism site with available data on the estimated annual costs of compensatory performance-based payment schemes to halt catches of hammerheads and wedgefish in Tanjung Luar and Lhok Rigaih (Booth et al., 2021c).

Field work was conducted under a foreign research permit for the lead author (No. Surat Izin: 407/E5/E5.4/ SIP/2019), with ethical review and approval from the University of Oxford Medical Sciences Interdivisional Research Ethics Committee (MS IDREC, ref. R66416/RE001).

3. Results

3.1. Tourist willingness-to-pay

1033 respondents completed the online marine tourism survey (Booth, 2021b). 74 nationalities were represented, with the majority from Europe and Northern America (80%) (Supplementary Materials, S4). The mean age was 30 (SD = 11), and the median income bracket was $35,000 to $49,999. Females were slightly over-represented at 58% of the sample (Supplementary Materials, S4).

Most respondents found the scenario realistic, credible (95%) and likely to happen to them in real life (88%) (Supplementary Materials, S4). The 12% of respondents who reported otherwise were removed from the final sample for WTP calculation. Of this dataset (N = 884), median WTP fell within the US$10 - US14.99 per person per day interval, while the Turnbull lower bound on mean WTP was $22.02 (Table 1, Supplementary Materials, S5). The cumulative distribution of bid responses dropped off relatively quickly (Fig. 2), though several respondents had WTP > $100 and three were willing to pay $300, the highest bid offered on the payment card. Thirty-nine people (3.8% of all respondents) reported zero WTP, with most (N = 17) stating they could not afford it ("*We travel very economically*", "*I'm not a rich person*"), and others disagreeing with some aspect of the scenario (e.g., "*There would be a lot of corruption*", "*There are far more important problems in the world*") (Supplementary Materials, S4).

The validation model of determinants of WTP (Table 2) showed that holiday budget and pre-existing environmental behaviour were

Table 1
Contingent valuation summary statistics.

	Estimated WTP (USD) from online survey	Estimated WTP (USD) from case study tourists
N	1033	196
% of zeros	3.8% (N = 39)	7.6% (N = 15)
Median interval	10–14.99	15–19.99
Turnbull lower bound	22.02	33.74

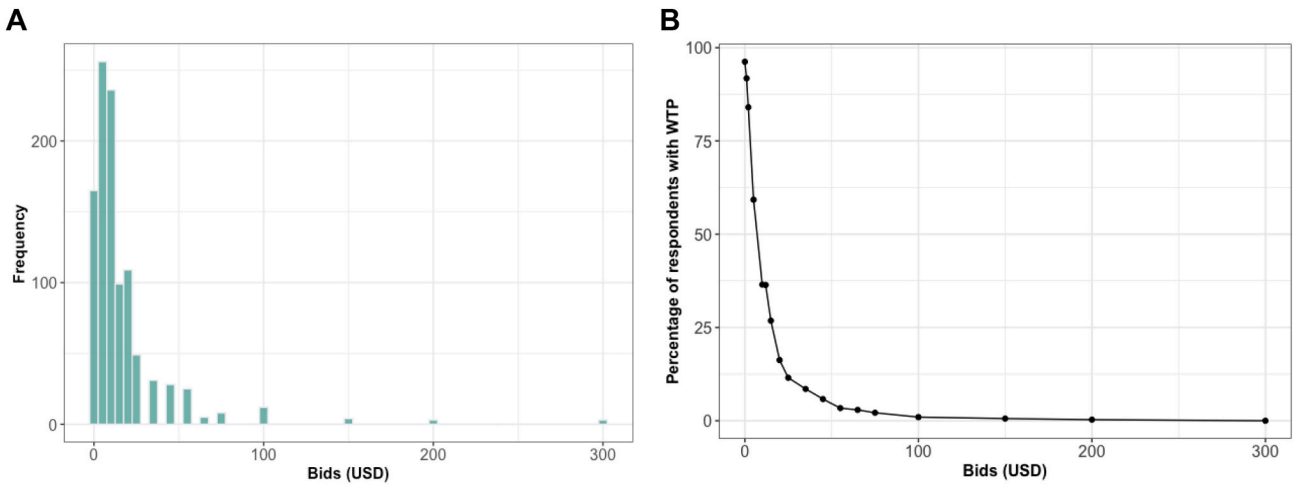

Fig. 2. Histogram (bin width = $5) (A) and cumulative distribution (B) of WTP responses showing the frequency and percentage (respectively) of respondents who were willing to pay the amount specified by each bid.

Table 2
Outputs of final interval model of determinants of log(WTP).

Explanatory variable	Description	Co-efficient	Std Error	Value est. ($) (e^coeff)	Error margins (e^std. error)	*p*-value	Signif
(Intercept)		2.060	0.137	7.85	1.15	$<2.00e^{-16}$	***
Last holiday budget (US$ 1000)	Continuous	0.023	0.005	1.02	1.01	$6.30e^{-06}$	***
Age (years)	Continuous	−0.001	0.003	1.00	1.00	0.688	
Gender – male (vs. female)	Categorical	0.005	0.070	1.01	1.07	0.937	
University education - yes	Binary (Y/N)	0.030	0.072	1.03	1.07	0.681	
Pro-environmental behaviour - yes	Binary (Y/N)	0.174	0.069	1.19	1.07	0.011	*
Seen sharks - yes	Binary (Y/N)	0.227	0.081	1.25	1.08	0.005	**
Attitude to shark protection	Five-point scale (−2 to +2)	0.176	0.053	1.19	1.05	0.001	**

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1.
Gaussian distribution.
Loglik(model) = −1568.4 Loglik(intercept only) = −1596.
Chisq = 55.23 on 7 degrees of freedom, p = 1.3e-09.
Number of Newton-Raphson Iterations: 3.
N = 670 (89 observations deleted due to missingness).

significantly correlated with WTP ($p < 0.001$ and $p < 0.01$, respectively), as expected. Converting the model coefficients (log values) to dollars suggests that for every additional $1000 of holiday budget people are typically willing to pay $1.02 more per day towards marine conservation, while people with pre-existing pro-environmental behaviour are typically willing to pay $1.19 more per day (Table 1). Income also significantly correlated with WTP ($p < 0.001$) but was not included in the final model due to co-variance with holiday budget, and holiday budget being better at explaining the data (Supplementary Materials, S6). People with pre-existing positive attitudes towards shark protection, and people who had already seen sharks in the wild also had significantly higher WTP ($1.19; $p < 0.01$ and $1.25; $p < 0.05$, respectively) (Table 2). Positive but non-significant coefficients were associated with age and university-level education, while negative but non-significant coefficients were associated with male participants (Table 2). The model intercept (coefficient = 2.060, estimated value = US$7.85), theoretically gives the WTP at zero holiday budget and reference/zero levels for all other predictors.

Stated WTP also correlated strongly with and was a significant predictor ($p < 0.001$) of real donations (Supplementary Materials, S6). Linear regression models of determinants of donation amount yielded similar predictors, with pre-existing charitable behaviour and positive attitudes towards shark conservation both significant predictors of donation amount ($p < 0.001$ and $p < 0.01$, respectively) (Supplementary Materials, S6). Stated WTP from the online CV survey was also roughly in line with stated WTP of tourists who had visited the case study sites, though the online CV may have produced more conservative results, with the median bid category for tourists who have visited Lombok and Pulau Weh falling at US$15–19.99 and a Turnbull mean of US$33.74 (Table 1).

We also found some differences in WTP between different nationalities, on average (Supplementary Materials, S6), however these variables dropped out of the full model, as they were not significant when controlling for other variables. The informational intervention was not a significant determinant of WTP and was not included in the final model (Supplementary Materials, S6).

3.2. *Assessing the feasibility of beneficiary-pays financing mechanisms in two sites*

Marine tourism operators in Lombok and Pulau Weh confirmed that marine megafauna (notably: sharks, rays, turtles, and marine mammals) were important for healthy marine ecosystems and thriving marine tourism businesses, along with pelagic and reef fish and coral reefs (Supplementary Materials, S3). The perceptions of tourists who have visited Lombok and Pulau Weh aligned with this, with reef sharks being the most frequently reported marine animal that tourists were "most excited to see" overall (Fig. 3). However, marine resources were also recognised as degraded and threatened, particularly in Lombok: just 35% of tourist respondents who had visited Lombok felt the marine environment was in a positive condition (Fig. 3). Of the environmental issues tourists noticed, damaged reef was the most common (65%) as well as too much pollution (55%) and too few fish/marine animals (43%). Tour operators also ranked overfishing as the biggest threat to

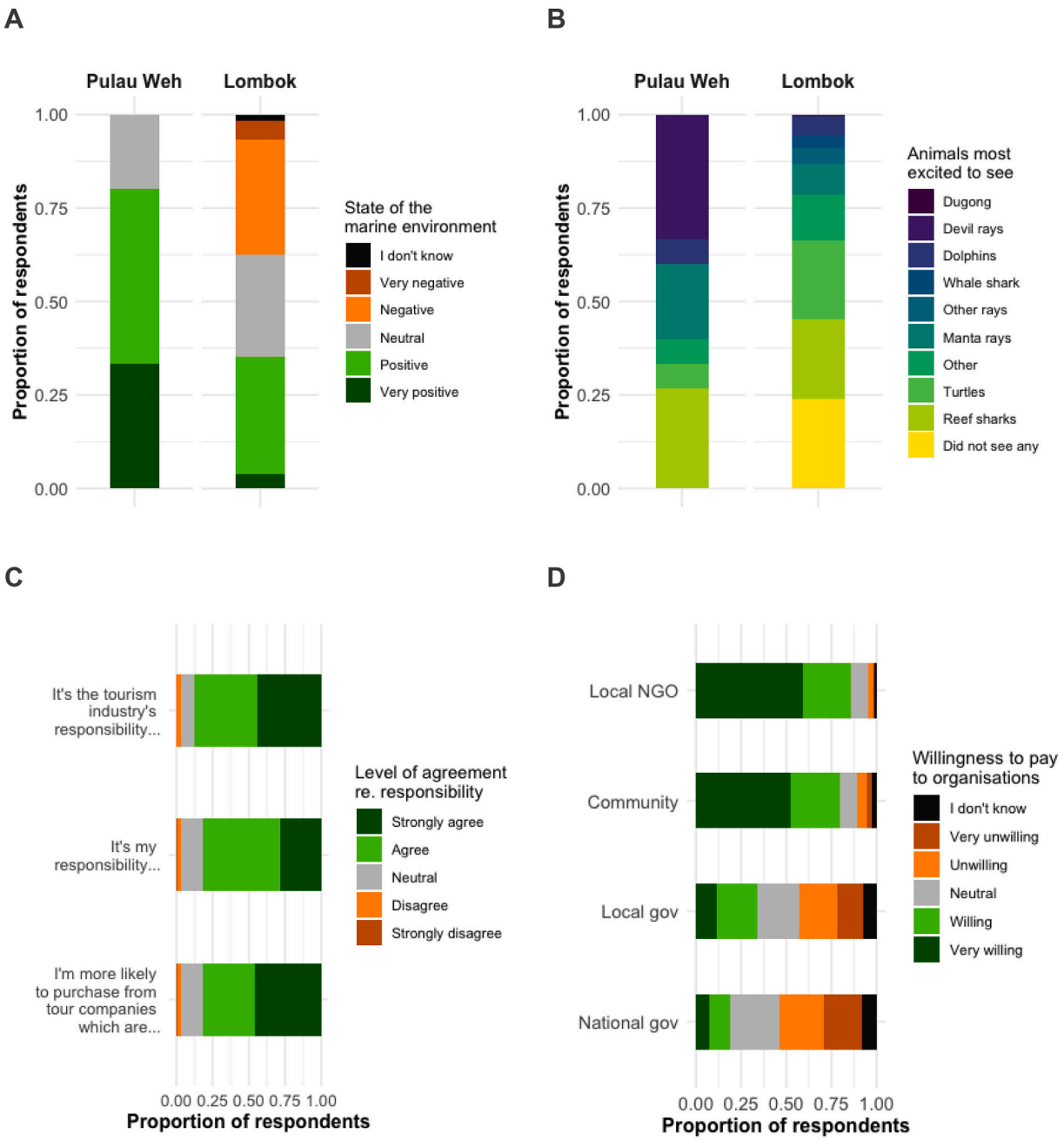

Fig. 3. Summary of key tourist perceptions, including a) perceived state of the marine environment in Pulau Weh and Lombok, b) animals which tourists were most excited to see c) attitudes regarding responsibilities and preferences for tackling environmental issues, d) attitudes regarding which institutions should be funded.

sharks (Supplementary Materials, S3). They perceived threats to derive from local communities (e.g., those fishing for food), tourists, and inexperienced tourism operators (e.g., tourists treading on corals, or poor operator practices such as dropping anchor on coral) (Supplementary Materials, S3).

Practical solutions suggested by tour operators included outreach and engagement, fishing restrictions (including marine protected areas (MPAs)), and livelihood-based interventions for communities; training and codes of conduct for tour operators; and habitat restoration, such as coral and mangrove planting. All interviewed marine tour operators exhibited a willingness to contribute towards marine conservation and felt it could support their businesses. All tour operators also agreed they were interested in incorporating tourism levies into their operations, provided payment schemes were transparent and the money was spent locally.

Similarly, most tourists agreed that tourism companies and tourists themselves had a responsibility to tackle environment issues (88% and 82%, respectively); while 82% agreed or strongly agreed that they would be more likely to purchase goods and services from tourism companies which were helping to tackle environmental issues (Fig. 3). Further, 92% of surveyed tourists ($N = 196$) stated they would be willing to pay towards community-based marine conservation in those areas in principle, with 77% stating they'd be willing to pay at least US$10, and a median bid category of US$15–20 (Table 1). However, there was a higher proportion of protest zeros in comparison to the online survey (7.6% compared to 3.8%) with scepticism regarding trust and transparency (e.g., *"Indonesia is too corrupted, and this money will never be used to help marine life", "management should guarantee that budget will use to support management"*). Relatedly, tourists also exhibited preferences for which institutions should be funded. We found strong support for

funding local environmental NGOs or direct payments to local communities: 86% and 80% of respondents (respectively) stated they were willing or very willing to donate towards these organisations (Fig. 3). In contrast, we found comparatively little support for funding national or local governments (19% and 34% willing or very willing, respectively) primarily due to a lack of transparency and mistrust regarding local investment of funds (e.g. *"Worry that funding to national govt could be diluted or shifted elsewhere", "Everything should be managed on the local level", "I'm happy to support local initiatives that support the local community, over larger companies or government," I believe that local NGOs… tend to know where the problems lie and typically have close ties already with the local community")* (Fig. 3).

3.2.1. Estimated revenues from tourism levies

3.2.1.1. Lombok, West Nusa Tenggara. In 2015 Lombok hosted 1.03 million international visitors, for an average of 2.3 nights each, 22% of whom were primarily motivated by water sports, especially diving (Horwath, 2017). This equates to a conservative estimate of 226,600 marine tourists per year, assuming no growth in tourism markets since 2015. Assuming each tourist is willing to pay US$ 10–14.99 per person per day and participates in just one day of marine tourism activities per trip, this could generate US$ 2.2–3.7 million in conservation finance for Critically Endangered marine species, or US$ 4.5–7.5 million if each visitor participates in 2 days of marine tourism activities (Table 3). Based on the Turnbull mean this could reach almost US$ 10 million. It is also estimated that by 2026 there could be up to 1.8 million foreign visitors to Lombok (Horwath, 2017), which could almost double these estimated revenues.

3.2.1.2. Pulau Weh, Aceh. In 2018, Pulau Weh hosted 29,827 international visitors, who were primarily motivated by snorkelling and scuba diving (Sabang Culture and Tourism Agency, 2019). If each participated in just one day of marine tourism activities per trip, this could generate US$ 300,000–660,000 in marine conservation finance per year, or up to US$ 1.3 million per year if each visitor participates in 2 days of marine tourism activities (Table 3).

3.2.2. Estimated costs of community-based conservation, and comparison with revenues

3.2.2.1. Tanjung Luar, West Nusa Tenggara. A stated preference study by Booth et al. (2021c) estimated that fishers in Tanjung Luar would be willing to accept performance-based compensatory payments of $142 - $357 and $107–571 per fishing trip to halt landings of hammerhead and wedgefish, respectively. Based on average total trips per year by all fishers operating out of the port, and their average catches of hammerheads and wedgefish per trip, it would cost $42,330–107,100 to incentivize fishers to stop landing hammerheads in Tanjung Luar (saving roughly 500 individuals per year), and $14,938–79,850 to stop landing wedgefish (saving roughly 140 individuals per year) (Booth et al., 2021c). This suggests that even the highest estimated cost for a PES scheme, which would produce major conservation benefits for Critically Endangered hammerhead sharks and wedgefish in Lombok (i.e., ~$US 186,950 per year), is an order of magnitude lower than the minimum estimated annual revenue from marine tourism levies on visitors to Lombok (US$ 2.27 million, Table 3).

3.2.2.2. Lhok Rigaih, Aceh. In Lhok Rigaih, it would cost an estimated $5382–32,292 per year to incentivize fishers to reduce their catches of juvenile hammerheads, and $8758–16,685 for wedgefish (Booth et al., 2021c). In this case, the minimum estimated annual revenue from marine tourism levies in Pulau Weh ($US 298,270, Table 3) is around six times greater than the highest estimated cost for a PES scheme in Lhok Rigaih (i.e., $US 48,977 per year), and could save over 18,000 juvenile hammerheads and 2000 sub-adult wedgefish. As the largest SSF landing site in the area, this scheme would produce meaningful conservation benefits for these taxa in Aceh, and with the potential revenues available, could be replicated in other similar smaller fisheries throughout the region.

Table 3
Estimated annual revenue ($US) from marine tourism conservation levies in Lombok and Pulau Weh. Estimated international marine tourists per annum based on Horwath (2017) for Lombok and Sabang Culture and Tourism Agency (2019) for Pulau Weh. Pppd = Per person per day.

Location	International marine tourists per annum	Days of marine activities per person	Median interval lower-bound (10 pppd)	Median interval upper-bound (14.99 pppd)	Turnbull mean (22.02 pppd)
Lombok	226,600	1	2,266,000	3,396,734	4,989,732
		2	4,532,000	6,793,468	9,979,464
Pulau Weh	29,827	1	298,270	447,107	656,790
		2	596,540	894,214	1,313,581

4. Discussion

4.1. Interpretation

Our study provides a first attempt to estimate a generic (i.e., non-site-specific) willingness-to-pay for conservation outcomes for Critically Endangered elasmobranchs in small-scale tropical fisheries amongst international tourists. The regression model, real donations, field data from tourists and tour operators, and comparison with other studies help to validate our findings.

WTP correlates with income and holiday budget, real donation behaviour, and other indicators of pro-environmental attitudes and behaviour, as expected. Each significant predictor – holiday budget (US$ 1000), existing pro-conservation behaviour, positive attitudes towards shark protection, and experience seeing sharks in the wild – contributed roughly one extra dollar per person per day towards WTP (Table 2). This result highlights how intrinsic values and meaningful nature experiences can translate into economic values. In contrast, the lack of significance of the information intervention, combined with the significance of other predictors of pro-environmental attitudes and behaviour, suggests that provision of information at 'point-of-sale' may do little to increase WTP, and rather that in this context WTP is dependent on pre-existing pro-environmental norms. We also note that the value of the intercept was relatively large compared to the value of the predictor coefficients, which may represent an underlying value for endangered sharks amongst the survey population, or some additional unexplained effects, such as national or regional differences in WTP.

The estimated WTP values also align with stated preferences of tourists who have visited Lombok and Pulau Weh, and with divers' estimated WTP for enforcement of a hypothetical marine protected for sharks in Malaysia (Vianna et al., 2018), which was the most closely comparable study on WTP for shark conservation that we could find.

The preliminary assessment of two potential beneficiary-pays mechanisms in Indonesia indicates that even relatively modest tourism levies could generate large and impactful sources of funding for community-based PES schemes, which, in turn, could have meaningful conservation benefits for Critically Endangered elasmobranchs. Moreover, well-designed, locally implemented, conservation programmes could have wide support from tour operators and tourists alike; and could boost tourist satisfaction and marine tourism revenues in the long run.

The data we have collected (which has been made available in an open access repository (Booth, 2021b)) and the model we have constructed could be applied to other studies or policy planning processes

which require estimates of the travelling public's economic values for the conservation of endangered sharks; and the methods we have used to link this estimate to local situations could be applied to other case study locations, conservation issues and types of nature-based tourism, where there is a need to more equitably redistribute the costs and benefits of conservation.

4.2. Biases and limitations

Our survey sample exhibits both coverage bias and selection bias (Bethlehem, 2010; Lehdonvirta et al., 2021). It is biased towards wealthier (i.e., OECD) countries, and to European and Northern American segments of the international marine tourism market in particular (Supplementary Materials, S4). This may be in part a feature of the target population (i.e., most international marine tourists are European and Northern American) and also due to biases introduced through survey design and distribution (i.e., the survey was only available in English, creating a barrier to participation in non-English-speaking countries; and distributed via Prolific, which is only available to people residing in OECD countries and South Africa (Prolific Team, 2022)). The results should therefore be used with caution when attempting to extrapolate more broadly – particularly in countries or sites which have a particularly large share of non-OECD visitors. Nationality was not identified as a significant variable in predicting WTP, which also corroborates with Vianna et al. (2018), who found that region of origin was not a significant predictors of divers' WTP for shark conservation in Malaysia. Nonetheless, we acknowledge that sample sizes were small for some nationalities that make up large and growing segments of the global marine tourism industry (notably China, Japan and South Korea, based on scuba-diving equipment sales (Kieran, 2019)). Other studies on environmental attitudes and WTP for sustainability amongst Chinese seafood consumers suggest environmental concern and WTP for conservation may be quite low (Fabinyi and Liu, 2014), such that our results may skew high relative to a more internationally-balanced sample. On the other hand, studies in Japan and South Korea indicate that there is WTP for environmental actions and outcomes – such as removal of microplastics from the ocean and environmentally-friendly food (Choi and Lee, 2018; Yang et al., 2022). Marine tourists or divers may also have more positive environmental attitudes and higher WTP for environmental outcomes than seafood consumers/the general population. More data would need to be collected from marine tourists in these countries to determine whether there is significant between-country variation in WTP for marine conservation outcomes.

For our case study sites, applying the median WTP from our online survey assumes our online panel is representative of the international tourists who will a) visit Lombok and Pulau Weh, and b) participate in a marine tourism activity as described in the survey. We designed our online survey to be realistic and consequential based on the context of the case study sites. Moreover, comparisons with field data and Vianna et al. (2018) suggest the estimated WTP is roughly in line with or potentially more conservative relative to what marine tourists in Indonesia and Malaysia may be willing to pay. In addition, based on available data on tourism demographics, European visitors represented 50% of all foreign arrivals in Lombok in 2015, with 18% from Australia and 10% from Americas (Horwath, 2017). Tour operators also indicated that most of their guests are European, which suggests our online panel was a reasonable fit for the Lombok tourism demographic. Our estimates of 1–2 days of marine tourism activities may be conservative, however, since Horwath (2017) noted that European visitors tended to stay considerably longer in Lombok than the average visitor, with typical trip lengths of 4–7 nights. We were not able to access data on the nationalities of international visitors to Pulau Weh, however tour operators indicated there is a mixture of Europeans, North Americans, Australians, and Malaysians. The number of Malaysians included in our online survey panel was low, creating an unknown bias in our revenue estimate. However, Vianna et al. (2018) found that WTP of European divers towards shark conservation in Malaysia was not significantly different from divers of Asian origin (Vianna et al., 2018), so this may not be an issue. We also did not find nationality or region to be a significant predictor of WTP in our full CV model (Supplementary Materials, S4, S6).

Our sample also does not capture people within very high-income brackets, who may be willing to pay much more towards marine conservation, since WTP is income dependent. This means our results may skew low relative to the international marine tourism market overall, particularly since some marine tourism destinations are very high-end. This may be less of an issue for our Lombok and Pulau Weh extrapolations, since most tourists visiting these areas are budget or mid-range, with a small proportion of high-end travellers, but means that our mean and median estimates may not be applicable to more expensive, luxury destinations, such as Raja Ampat, the Maldives, or French Polynesia. However, for these destinations, it may be possible to use our logistic regression model to predict WTP, though its predictive potential requires further validation with field data. On the other hand, our online WTP survey also did not capture Indonesian nationals, which means that WTP and total conservation revenues for domestic tourists to Lombok and Pulau Weh could not be estimated. While WTP per person may be lower for Indonesian nationals, given lower Purchasing Power Parity compared with Europe and North America, the domestic tourism market in Indonesia is significant. For example, domestic visitors to Lombok reached 952,648 in 2015, representing 48% of total visitors (Horwath, 2017). Based on this, even a small domestic tourist fee (e.g., US$ 1 per person per day) could considerably increase annual revenues from marine tourism conservation levies.

Self-selection bias is a common issue in online surveys, however since our targeted population was the broad spectrum of people who are interested in travel, this is not necessarily an issue for our study (Bethlehem, 2010; Lehdonvirta et al., 2021). We did not publicise the survey as a marine conservation study but simply as a marine tourism study, which should have guarded against people with an interest in conservation tending to take the study more that those with no interest in conservation. This is supported by the observed variability in existing pro-conservation behaviours and attitudes (Supplementary Materials, S4).

Finally, our study has not considered potential wider impacts on demand for tourism and markets for other species because of this hypothetical market-based intervention. Since a marine conservation levy would effectively increase the price of marine tourism activities, this may result in reduced demand for tourism activities. However, our study shows that tourists and tour operators exhibit preferences for making payments to NGOs or local communities over government bodies. This suggests that real-world implementation of a marine tourism levy may be more widely accepted if it is implemented via a system of suggested voluntary donations (administered and coordinated through a local NGO), while issues of low trust may hamper a system of compulsory levies (administered and coordinated via the government). As such, demand for marine activities may not decline since those who strongly disagree with or feel they cannot afford the levy could refuse. This finding also corroborates with previous studies showing that trust in fee collecting institutions and transparency regarding how money is spent can significantly influence tourists' WTP towards marine conservation (Peters and Hawkins, 2009; Wang and Jia, 2012). Regarding demand for other species, discussions with fishers and empirical analyses of supply-demand dynamics from the case study fisheries indicate that shark prices may be supply-driven (catch Granger-causes price (Booth et al., 2021d)) with fishers typically catching and selling whatever they can get. Moreover, hammerhead sharks and wedgefish are a small component of the overall catches in both case study fisheries, with fishers making most of their income from other sharks and teleost (Booth et al., 2021d; Simeon et al., 2020). As such, we expect changes in demand for species to be small enough to ignore.

4.3. Implications and next steps

Coastal communities and small-scale fishers (SSF) often face an inequitable burden of the costs of marine conservation (Booth et al., 2021d; Jaiteh et al., 2016; Stevenson et al., 2013). This must be addressed on order to achieve 'a sustainable and equitable blue economy' and move towards socially-just marine conservation (Bennett et al., 2019, 2021). However, there is a lack of operational mechanisms for incentivising pro-conservation behaviour and redistributing the costs and benefits of marine conservation. Nature-based marine tourism is often promoted as a win-win solution to trade-offs between marine conservation and coastal livelihoods, yet is often difficult to implement in practice, since those who benefit from consumptive use of marine resources are not necessarily well-placed to work in and benefit from the tourism sector (Balmford and Whitten, 2003; Mustika et al., 2020).

Our study has shown how the beneficiary-pays principle could be applied to the marine tourism industry to generate a feasible, socially just, and scalable ocean financing mechanism, which can support small-scale fishers to reduce their impacts on marine life. In our case study sites, this could operate through performance-based PES schemes to mitigate fishing mortality of specific Critically Endangered species (Booth et al., 2021c). If implemented elsewhere such mechanisms could also fund marine protected areas (MPAs), the provision of bycatch reduction technologies or more sustainable fishing gears for communities who otherwise could not afford it, and/or a range of other activities such as beach cleans and habitat restoration (Bladon et al., 2016; Gjertsen et al., 2014; Pakiding et al., 2020; Sykes et al., 2018; Vianna et al., 2018). Since Indonesia hosts an estimated 18 million reef-associated tourists per year, with around 70 million globally (Spalding et al., 2017), at least US$ 180 million (based on a WTP of US$ 10 per person, as the lower-bound of the WTP estimate) could be generated for marine conservation in Indonesia, and over US$ 700 million globally, which could contribute considerably towards financing MPAs and closing marine biodiversity financing gaps (Balmford et al., 2004; Johansen and Vestvik, 2020). Moreover, such investments could not only deliver biodiversity and well-being improvements in SSFs but would help to maintain valuable natural assets upon which marine tourism companies and the blue economy depend.

We acknowledge, however, that this study represents a preliminary economic feasibility assessment. Putting such mechanisms into practice would require strong institutions, long-term engagement by facilitating organisations, together with monitoring and enforcement, to ensure that funding is appropriately collected, re-distributed and used to create measurable conservation outcomes (Engel et al., 2008). However, such operating costs could also potentially be covered by marine tourist levies, given the potential surplus of income relative to the cost of community-based PES schemes.

Researchers, NGOs, tourism operators and policy makers could explore the feasibility of applying beneficiary-pays approaches to other locations where mismatches between the costs and benefits of marine conservation need to be reconciled, as a central mechanism for delivering a sustainable and equitable ocean economy.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data has been made available open access via the Harvard Dataverse

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Appendix A. Supplementary data

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