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Public perceptions of ocean health and marine protection: Drivers of support for Oregon's marine reserves

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ABSTRACT

Over the past several decades marine conservation policy has supported the implementation of protected areas in ocean and coastal environments to restrict some elements of human use for ecological benefits. The appropriate extent of protection and the allowable uses are often the subject of public debate about marine protected area policy. Local community dynamics around marine protected area designation and management have been the subject of much ocean and coastal management social science research. However, broader public opinions and attitudes about marine protected areas are not well understood and are critical for managers seeking to maintain their public trust obligations in environmental management. This paper provides a model for understanding the attitudes and beliefs that foster public support for or opposition to marine protections. We explored the relationships between awareness, attitudes and beliefs towards coastal and marine resource issues and uses, and demographics among a sample of Oregon, USA residents ($n = 459$), and tested their influence on support for expanding Oregon's recently established marine reserves. We found that Oregonians have relatively low familiarity with Oregon's marine reserve system, but that familiarity did not influence public support for Oregon's marine reserves. Instead public support was lower among coastal residents and those with positive attitudes towards commercial fisheries, and higher for those concerned with the ecological integrity of Oregon's ocean and supportive of some limits to human uses of the ocean. Our findings highlight the need for managers to engage both coastal communities and the general public to make a case for the value of marine protected areas in safeguarding the public trust.

1. Introduction

Concerns about the ongoing sustainability of ocean and coastal resources have led to a call for integrated resource management approaches to address increasing human uses of, and the impacts of climate change on the world's oceans (Levin and Lubchenco 2008). Among the suite of management tools for conserving ocean and coastal health are marine protected areas (MPAs). MPAs have been implemented around the world with a diverse set of management goals, governance structures, and varying community impacts and concerns (Halpern 2003; Lubchenco et al., 2003; Gaines et al., 2010; Edgar et al., 2014; Gopnik et al., 2012). Despite the science identifying optimal size and spacing of MPAs, the designation and level of protection of MPAs are ultimately management decisions influenced by political and social

concerns.

Establishment of MPAs introduces changes to human uses of marine and coastal areas and may impact local communities by limiting or affecting existing uses. The majority of social science research on marine protected area establishment has focused on local user community attitudes and political responses (Pollnac et al., 2001; Charles and Wilson 2009; Hoelting et al., 2013; Ordoñez-Gauger et al., 2018). In contrast, we examine the attitudes of a broader public to understand how MPAs may be perceived beyond the local domain, including whether concerns about local impacts or the perceived threats to coastal and marine systems are drivers of opposition to or support for this conservation tool.

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2. Marine protected areas, ocean health, and public attitudes

Public perceptions and attitudes about coastal and marine resources provide an opportunity to explore how the public may interpret different management choices for these resources (Suman et al., 1999; Johnston et al., 2020). We define perceptions as the ways in which people understand an object or phenomenon in their environment, in this case the ocean and coastal areas, through their knowledge, beliefs, and experiences with these spaces (Tuan 1977). In the context of natural and environmental resources, perceptions inform attitudes about how these resources *should be* managed, either for individual interests or some collective and shared set of interests. Research on public perception of marine systems reveals diverse sets of values and interests that inform the public and different stakeholders' perceptions of MPAs (Suman et al., 1999; Jefferson et al., 2015; Voyer et al., 2015). Public perceptions are tied to a variety of factors including environmental attitudes, personal experiences, and socioeconomic attributes as well as interest in marine and coastal environments (Steel et al., 2005; Perry et al., 2014). Understanding support for and opposition to marine conservation efforts is important for managers as public perceptions may inform whether marine protected areas are judged by policy-makers to serve the public interest (Gleason et al., 2010; Perez de Oliveira 2013, Cadman et al. 2020).

Previous research on perceptions of MPAs has focused on concerns of proximate communities and existing ocean users. Ocean users, for example, may support or oppose MPAs based on the impacts of an MPA designation to their ocean or coastal activities (Cocklin et al., 1998; Voyer et al., 2015). For example, tour guides may be supportive if they judge that MPA designation serves to increase coastal and marine tourism; on the other hand, MPA designation that limits access to historic or traditional fishing ground may marginalize fishers and promote opposition (Suman et al., 1999; Oracion et al., 2005). Sanchirico et al. (2006) note that no-take reserves are an optimal management strategy only when spillover effects outweigh fishing effort displacement, suggesting that fisher opposition to no-take reserves may occur due to displacement or uncertainty of MPA impacts. However, even though MPA designations may displace fishing effort, as Stevenson et al. (2013) observed following the implementation of a MPA network in Hawaii, fishers socioeconomic well-being may not be compromised due to fisher adaptation or market changes. Numerous studies have addressed fishing effort impacts from MPA implementation with mixed findings (e.g., Bucaram et al., 2018; Guenther et al., 2015; Stevenson et al., 2013). Factors affecting support or opposition may vary based on the location, extent, and level of protections for a given MPA. Charles and Wilson (2009) found that community priorities for two Canadian MPAs differed based on whether the protected area was a distant off-shore site or a near-shore site. The authors found that the off-shore marine protected area activated economically-based values and interests, whereas the near-shore site was important as a special place that provided non-utilitarian values to local communities, leading to different levels of opposition and support, respectively. Perceptions of the legitimacy of the processes that generate and manage MPAs are also important. If stakeholders view the decision making around MPAs as inclusive, fair in setting regulations, and using a well-informed process, support for MPAs increases (Hoelting et al., 2013). Gopnik et al. (2012) recommend that engaging stakeholders early and meaningfully in the process of designating new MPAs can acknowledge these differences and help identify strategies to develop more nuanced and responsive proposals.

Despite the need to engage with proximate communities and ocean users, the establishment of MPAs for a variety of conservation interests requires broader public support for their long-term sustainability as a public policy tool. Changes in environmental public policy have historically responded to or waned in response to public concerns (Dunlap 1995). As the public develops awareness of environmental threats or benefits, public support can be mobilized for new policy options. The connections between public preferences and policy maker preferences

are complex, but for less polarized issues, there is evidence that the two can align (Hill and Hurley 1999). Public knowledge about MPAs varies greatly, and a lack of broader public knowledge can present a challenge for managers. The level of public knowledge is important to assess as it can provide the basis for mobilization of political engagement on marine management issues (Heinen et al., 2017). In Oregon, for example, Perry et al. (2014) found that even coastal residents were relatively uninformed about that state's recently designated marine reserves and protected areas; although others have shown that specific communities (e.g., fishers, tour guides, environmental non-governmental organizations) may be very knowledgeable and engaged (Suman et al., 1999; Cohen et al., 2012; Perez de Oliveira, 2013). In contrast to specific groups, the public may hold shallow or general knowledge, overestimating the number or size of MPAs or their efficacy in meeting various goals (Eddy 2014). Although the public may be informed about the existence of MPAs, specific details about their goals and management are commonly lacking (Snider et al., 2010; Stevenson et al., 2012; Perry et al., 2014). Greater self-assessed knowledge about ocean policy, such as MPAs, may be a product of coastal residency, coastal visitation, or other personal or economic connections to specific areas of the coast (Steel et al., 2005). Research on coastal visitors suggests that natural amenities and educational efforts are important influences on visitor knowledge and support for MPAs (Petrosillo et al., 2007); however, tourists or coastal visitors only capture one segment of the general public. Beyond connections to specific coastal communities, places, and management issues, political affiliations may also influence support for MPAs. In the United States (US), research since the 1970s has identified political ideology as an important predictor of environmental attitudes (Dunlap 1975; Jones and Dunlap 1992; Coan and Holman 2008), and we suggest that these associations are likely to carry over into marine conservation as well.

Public perceptions on ocean conservation, similar to other environmental attitudes, are also influenced by one's assessment of risk to the environmental resource in question. Since the birth of modern environmental policy in the 1960s and 1970s, concerns about the environment are broadly held in the US and elsewhere (Van Liere and Dunlap 1980; Jones and Dunlap 1992; Dunlap and Mertig 1997), and can roughly be divided into two main domains: concerns about environmental quality (e.g., pollution) and concerns about ecological integrity (e.g., habitat and species loss). In the coastal and marine context, interviews with community members have found that the perceptions of risks to ocean health are a strong predictor of priorities for ocean management, particularly in the climate change context (Thomas et al. 2015). Whether concern about environmental quality and ecological integrity are perceived similarly in the context of marine conservation policy is unknown. Risk, or a sense of crisis around marine resources, has been observed as a driver of community support for MPAs (Pollnac et al., 2001), and may influence individual support for environmental protections. At the same time, risk to supported uses of the ocean can foster opposition, as seen in a number of case studies on MPA planning (e.g., Suman et al., 1999; Voyer et al., 2015). Prospect theory suggests that in the context of uncertainty about future outcomes, individuals tend to underestimate risks in the context of potential gains and overestimate risks in the context of potential losses (Kahneman and Tversky 1979; Quattrone and Tversky 1988). For those who see threats to the environmental health of coastal and marine resources, MPAs may be perceived as a remedy to threats including overfishing, climate change, or other pressures, even if designated MPAs do little to alleviate those pressures. In contrast, those who support traditional uses may view MPAs with uncertainty leading to an evaluation of MPAs as a risk to the fishing sector, despite the body of data indicating the success of MPAs in enhancing fisheries when well planned (e.g., Roberts et al., 2001; Gell and Roberts 2003; Halpern et al., 2009). Prospect theory suggests that environmental attitudes, including the perceptions of risk and support for specific uses, may drive policy preferences among the general public. The sense of threat to a resource one cares about can also counteract influences from demographic or political considerations (Nielsen-Pincus

et al., 2017). Perceived threats to the ocean and its uses may therefore be important predictors of support for and opposition to marine protected areas. MPA support also has been connected to the engagement of local interests in marine spatial planning processes. Local groups may support or oppose MPAs based on perceived effects to traditional and emerging ocean uses adjacent to their communities (Lejano et al., 2007). In research on Pacific Island marine protection efforts, for example, Bartlett et al. (2009) found local interest in establishing protected areas stemmed from a desire to extend local control over ocean spaces. In particular, local communities based their support of MPAs on a desire to protect biodiversity or natural areas. Non-utilitarian values including conservation concerns motivated support for the creation of protected areas that controlled incursions on conservation efforts. In Spain, Perez de Oliveira (2013) found local fisher groups to be advocates as marine reserves were viewed as a means to reduce external impacts (e.g., illegal fishing and pollution) to local artisanal fisheries and tourism. Conversely, some local communities have opposed MPAs when they are seen as an external threat to local economic or cultural activities (Suman et al., 1999). This opposition occasionally mirrors terrestrial not in my backyard (NIMBY) reactions that often occur around industrial siting decisions (Dear 1992; Pocewicz and Nielsen-Pincus 2013). NIMBY attitudes and resultant opposition can arise once sites are selected, if they are perceived to impact the identity or economic base of nearby communities, even among communities considered generally friendly to MPAs. Whether the interests that steer local debate over MPA designations extend to broader public perceptions of MPAs is relatively unknown.

3. Oregon, USA marine reserves

In the US and elsewhere MPAs take several forms, ranging from multiple-use areas with conservation goals to no-take reserves (Gopnik et al., 2012). In the US, MPAs include a diverse set of habitats from open ocean to intertidal zones and estuaries. Over 1700 MPAs exist in the US with diverse designations including marine reserves (no take areas), marine protected areas, marine sanctuaries, marine national monuments, among others. Over the past two decades, MPAs have been implemented in various forms across the US West Coast, including in the states of California, Washington, and Oregon.

Oregon has jurisdiction to manage coastal and ocean resources located in its territorial sea, the ocean area within three nautical miles of shore. Oregon's state managed MPA system was designed and implemented based on an extensive public involvement process that began in earnest in 2008. Oregon's ocean resources, including its MPA system, are managed by several state agencies for the public trust, a concept that recognizes that resources must be managed for the benefit of the general public while balancing needs across many users (Sax 1970). In Oregon, and elsewhere, the public trust doctrine has evolved to expand from traditional uses, such as managing state waters for navigation, commerce, or fisheries, to include consideration of recreation, aesthetics, and ecological values (Blumm and Doot 2012). Historically, Oregon's political culture has embraced the coast, and extended the public trust doctrine over an array of coastal resources, including, most notably, the 1967 Beach Bill, which passed following a large public outcry and expanded and assured public access protections for all of Oregon's coastal beaches (Marsh 2012: 281–283).

Oregon's process for designating a system of MPAs relied on baseline monitoring, extensive public engagement with local stakeholder review teams, and establishment of long-term environmental, economic, and social monitoring programs designed to better understand the array of interests impacted by its system of MPAs. Following an initial study of various marine reserve site options, the Oregon Legislature passed a pair of bills creating the Oregon Marine Reserves System (OMRS). The entire OMRS currently includes five no take marine reserves and nine multiple-use marine protected areas adjacent to the reserves. The OMRS-established *marine reserves* prohibit take of ocean life, including fish,

invertebrates, and algae (e.g., seaweed), except for research and monitoring purposes. The reserve sites also include portions of the shoreline and prohibit activities such as beach-based fishing and, in some cases, clamming. Many OMRS marine reserves are bordered by larger *marine protected areas*, which allow differing levels of site-specific human uses across a series of spatially designated ocean and shoreline areas. The protected areas vary in size from three to 85 km² and span the Oregon coast from south to north. In total, the system covers approximately 9.5% of Oregon's territorial sea jurisdiction. Reserves, with the highest level of restrictions on use, make up 43% of the OMRS; the remaining 57% is designated as multi-use marine protected areas.

A two-year pre-closure environmental, economic, and social monitoring process began in 2009 after authorization (HB 3013) of the first two pilot marine reserves and three additional sites proposed for study. Following this baseline monitoring period, the pilot marine reserves were implemented and closed to extractive uses in 2012. Phased implementation of baseline monitoring began in 2012 after a second legislative act (SB 1510) authorized the designation and eventual closure of the three additional reserves in 2014 and 2016.

Following mandated policy guidelines (Oregon Ocean Policy Advisory Council OPAC, 2008) to avoid adverse socioeconomic impacts, the implementation of marine reserves in Oregon included an extensive public engagement process (Hayden-Lesmeister 2019; Bird and Conway 2012). In addition, research on the human dimensions of MPA establishment in Oregon started in 2010 with a focus on anticipated effort shift among fishers and perceptions from proximate affected fishing communities along the coast. Economic analyses of the potential displacement of fishers indicated that the limited spatial distribution of the reserves was unlikely to have significant aggregate economic impacts (The Research Group, LLC TRG and Golden Marine Consulting, 2012; TRG, 2018). Nevertheless, despite little evidence of broad displacement and effort shift (Marino 2015; Hudson 2018), some individual fishers were impacted (Marino 2020) and commercial fisher attitudes towards the marine reserves were often negative (Swearingen et al., 2017). Seeking to understand support and opposition for marine reserves among coastal residents, Needham et al. (2013) found that coastal Oregonians largely considered coastal resources healthy and improving in recent history, although some shared concerns about emerging global stressors such as marine debris, ocean acidification, and invasive species. The study also found that coastal residents had a relatively low self-assessment of their knowledge of marine reserves.

Oregon's primary population centers, however, are not along the coast. A follow-up study expanded human dimension research on Oregon's marine reserves to the populous Willamette Valley, home to the state's major urban areas. Needham et al. (2013, 2016) found strong support for Oregon's marine reserves, with 69% of coastal residents and 90% of non-coastal residents in western Oregon indicating they would vote to support establishing marine reserves in Oregon. Johnston et al. (2020) found that more urban populations were likely to view Oregon's marine reserves as the equivalent to terrestrial Wilderness designations, imbued with environmental protection values that may buffer against potential threats to those values. Despite important insights into the attitudes of regional populations of Oregon about coastal health and marine conservation, the public trust doctrine requires managers understand the needs and perspectives of the entire state.

During the development of the OMRS, proposals were made to expand the number and size of marine reserve sites. Most proposals made during the public engagement process were ultimately tabled on the premise that they could be considered after a review of the effectiveness of initial OMRS designations (Oregon Ocean Policy Advisory Council OPAC, 2008). The proposals for OMRS expansion presented an opportunity for us to test the likely support or opposition to increasing the scope of the OMRS through the designation of additional MPAs along the Oregon coast. Understanding public expectations and support for the ocean and coast is critical for managers seeking to steward the public trust.

Within this context, we conducted a statewide survey of Oregon residents designed to help understand the public's interest in and relationship with the state's coastal and marine resources. We examined the following questions: (1) How do coastal and non-coastal Oregonians differ in their awareness of coastal and ocean resource issues, and perspectives on Oregon coastal and marine management; (2) What underlying threats do Oregonians perceive to the state's coastal and marine resources; and (3) What predicts support or opposition for potential expansion of Oregon's marine reserve system? For the third question, we proposed three hypotheses:

H1. Familiarity with ocean resources increases the likelihood of support for MPAs. We hypothesized that visitation frequency and being informed about resource issues, and marine reserves specifically, would increase support for Oregon's MPAs.

H2. Coastal residency decreases support for expanding MPAs. The recent public engagement process to establish Oregon's marine reserves created controversy in some coastal communities as the issue was debated in public meetings and among community groups. In addition, recent research implies relatively lower support for Oregon's marine reserves among coastal residents (Perry et al., 2017) compared to residents of the state's most populous region (Johnston et al., 2020).

H3. Perceptions about threats to and acceptable uses of ocean resources influence support and opposition to expanding the extent of Oregon's MPAs. Perceived threats to integrity of the ecosystem or to the quality of the ocean environment may increase the likelihood of support for protected areas. Support for traditional uses of ocean resources, such as fishing, may decrease support for protected areas that limit ocean area for those uses.

4. Methods

4.1. Sampling and data collection

A telephone survey was conducted by callers at Portland State University in two waves of recruitment, with the first wave running between March and July 2016, and a follow-up wave in March 2017. We used a random digit dial sample of 3365 Oregon phone numbers chosen to capture a representative sample of Oregon residents. The sample included equal proportions land-line and mobile phone numbers, and the sample was screened by the provider to remove businesses and other potentially unsuccessful numbers. Callers introduced themselves as researchers at Portland State University and screened respondents to only include English-speaking adults who had resided in Oregon for at least twelve months. The final instrument was designed after a pre-test that selected a telephone administration mode and made some minor modifications to the draft instrument.

4.2. Survey design and measures

The survey included questions about respondents' experiences at the Oregon Coast, awareness of coastal and marine management issues, attitudes about various coastal and marine uses, and whether the respondent supports or opposes expansion of the OMRS. Respondents indicated whether they had visited the Oregon Coast before (yes = 1; no = 0), and, if so, selected the frequency of visitation over the past twelve months (coded as zero (0), once (1), twice (2), four times (4), monthly (12), twice a month (24), weekly (52), or daily (365)). Next, respondents were asked how informed they felt about general ocean and coastal resource issues, selecting from a four-point scale, from not informed (0) to very well informed (3). We then measured perceptions of ocean health by asking respondents to rate their level of agreement – strongly agree (+2) to strongly disagree (–2), with a midpoint of neither agree nor disagree (0) – that the following items were a threat to Oregon's ocean: pollution, marine debris, species loss, overfishing, introduced

and non-native species, habitat loss or degradation, and climate change. Following respondent perceptions of threat, surveyors asked respondents to indicate their level of support for or opposition to – definitely support (+2) to definitely oppose (–2), with a midpoint of unsure (0) – nine current and potential uses of Oregon's ocean resources: wave energy; wind turbines; commercial fish and shellfish fisheries; fish farming; shellfish farming; ocean agriculture (e.g., seaweed); offshore oil and gas development; drinking water desalination; and the creation of areas that prohibit fishing, harvesting, mining, or other human development. The survey then turned to the OMRS by asking respondents to rate how informed they were about the OMRS on a four-point scale ranging from not informed (0) to very well informed (3). Respondents were then read a prompt indicating that the original OMRS proposal called for more and larger reserves than were ultimately designated,² and asked whether they would vote yes (1) or no (0) on a hypothetical ballot measure to increase the number and size of marine reserves in Oregon (surveyors also recorded don't know responses rather than forcing a yes or no choice). Finally, the survey asked basic socio-demographic questions including age, race and ethnicity, political party affiliation, residential zip code, and employment status.

Residential ZIP Codes were then grouped into one of four regions for the state: Coastal Oregon, the Willamette Valley, Eastern Oregon, and Southern Oregon. The coastal region was generated approximately following the Coastal Zone Management Act (CZMA) regulatory boundary for coastal communities. ZIP Codes that were partially in the CZMA were assigned based on majority rule: if most of the area fell in the Willamette or Southern Oregon region, it was assigned to that area. The Willamette Valley region, containing the majority of Oregon's population, approximates the drainage for the Willamette River and extends south over 100 miles from the Columbia River at the Washington border and is bounded by Oregon's Coast and Cascades mountain ranges. Southern Oregon extends south from the Willamette Valley to the California Border. Eastern Oregon is the largest region of the state and includes many rural communities east of the Cascades mountains to the Idaho border.

4.3. Data analysis

To answer our research questions, we present a mix of descriptive, multivariate, and regression analyses. Given that nearly a year passed between the two survey waves, we tested for and found no differences in responses between the waves and thus pooled all responses. We compare coastal and non-coastal respondents' self-reported visitation, awareness, threat perceptions, and support for or opposition to various existing or emerging coastal and marine uses, testing for differences in relative frequencies of responses using chi-square statistics. We then used exploratory factor analysis (EFA) to identify underlying perceptions of the threats to coastal and marine resources. EFA was conducted using a principle iterated factor technique with a varimax rotation; factors that contributed more than 10% of variance were retained. Items that loaded heavily (>0.4) on latent factors were indexed using an arithmetic average; Chronbach's alpha was used to test the internal consistency of EFA suggested indices. Finally, we developed a binomial logistic regression model to predict willingness to vote for a ballot measure expanding the number and size of Oregon's marine reserves. The dependent variable was coded 1 for a Yes response and 0 for a No or Don't Know response, and the model was specified as:

$$P(Y = 1|X_i) = \text{logit}^{-1}(\alpha + \beta X_i),$$

² Prompt: "Oregon's original marine reserve proposal called for a greater number and increased size of marine reserves. Based on what you know, if you were asked to vote on a ballot measure to increase the number and size of marine reserves in Oregon, would you vote yes or no?"

where the probability of a yes response is the inverse logit of a vector of predictor variables, X_i , multiplied by a vector of regression coefficients, β_s , plus a constant, α .

To test our hypotheses, we selected salient survey measures, indices of perceived threats to coastal and marine resources that were suggested through the EFA, and demographic control variables as predictors. We assessed for potential multicollinearity among the covariates by examining variance inflation factors (VIF) and the correlation matrix of all model covariates, and removing variables with high VIF and correlations above 0.30 with other variables. After removing one variable, visitation frequency, variance inflation factors for all remaining variables included in the model were 2.0 or below, and 93% of correlations were below 0.30. Marginal effects were estimated using model predictions for willingness to vote for the ballot measure by varying each variable across its range while holding all other variables constant at their means.

5. Results

5.1. Response summary

The telephone-based survey resulted in contact with 2272 individuals; another 1093 phone numbers were called but failed to result in contact due to no one answering, disconnected numbers, or numbers reaching businesses or other establishments. Of those contacted, 459 participated in the survey, a 20% response rate after the two waves of recruitment. To assess whether our sample was representative of adult Oregonians, we compared sample demographics to those reported by the American Community Survey for Oregon and the distribution of our sample population in different regions of the state (Table 1). Although our sample was generally similar to the Oregonian adult population in terms of gender, race, and population distribution across the state, our sample tended to be older, more educated, and less likely to have Hispanic origins – plausibly due to the English language participation requirement. Our sample also had an overrepresentation of unaffiliated or minor political party affiliated residents and coastal residents, with roughly twice the number of coastal resident participants than expected based on Oregon’s population distribution – likely indicating the salience of the issue to coastal residents.

Table 1
Comparison of survey sample and Oregon adult population.

Variable	Sample	Oregon Adults	Difference
Demographic^a			
Gender (% female)	50%	51%	(1%)
Race (%white)	84%	87%	(3%)
Age (median years)	53	47	6
Hispanic origin (%)	4%	10%	(6%)
Education (% bachelor’s or graduate degree)	51%	31%	20%
Political party affiliation^b			
Republican (%)	25%	28%	(3%)
Democrat (%)	34%	38%	(4%)
Other party or unaffiliated voters (%)	41%	34%	7%
Region^a			
Coast (%)	13%	7%	6%
Eastern (%)	11%	12%	(1%)
Southern (%)	7%	9%	(2%)
Willamette Valley (%)	69%	72%	(3%)

^a Oregon adult demographic population distribution estimates from the 2016 5-year American Community Survey estimates.

^b Oregon political party affiliation estimates from Oregon Secretary of State, voter registration records, November 2016.

5.2. Visitation, awareness, and perspectives on Oregon Coastal and marine management

Nearly all respondents had at some point visited the Oregon Coast (99%), 88% had visited the Oregon Coast at least once in the previous twelve months, and over two-thirds of the sample (70%) had visited two to more times over the previous twelve months showing the importance of the coast to our survey respondents (Table 2). Although a majority (52%) reported they were only somewhat informed about general coastal and ocean resource management issues, one in five (22%) reported being well or very well informed about general issues. Likewise, a majority (59%) reported that they were not informed about the OMRS, while only 8% reported being well or very well informed. In contrast to the general population, more than a quarter of coastal residents (29%) reported being well or very well informed about the OMRS. With the exception of overfishing (48%), a majority of all respondents also agreed that the following were threats to Oregon’s coastal and ocean health: marine debris (76%), pollution (73%), climate change (59%), habitat loss (56%), non-native species (55%), and species loss (53%). Non-coastal Oregon residents were significantly more likely to perceive threats to ocean and coastal resources than those on the coast for all but two items (non-native species and species loss).

Respondents varied in their level of support for and opposition to existing and proposed uses of coastal and ocean resources. The most commonly supported uses were creation of areas that prohibit human

Table 2

Summary of survey responses for visitation, awareness, perceived threats, and support for coastal and ocean uses, including expansion of the Oregon Marine Reserves Program. Superscript stars after sample sizes indicate the significance of a chi-square test of differences in relative frequencies between respondents from coastal communities and the rest of Oregon.

Respondent Characteristics	Overall	Coastal Respondents	Rest of the State
Frequency of OR Coastal Visitation (n = 385)***			
Never	11%	0%	11%
Once in past year	18%	<1%	18%
More than once in the past year	70%	98%	66%
% Very-well or Well Informed about ...			
General coastal & ocean resource issues (n = 385)***	22%	51%	18%
Oregon Marine Reserve Program (n = 362)***	8%	29%	5%
Coastal & Ocean Health Threats (% strongly agree/agree)			
Marine debris (n = 384) [†]	76%	65%	78%
Pollution (n = 383)**	73%	60%	75%
Climate change (n = 385)*	59%	51%	60%
Habitat loss or degradation (n = 383)*	56%	51%	58%
Introduced or non-native species (n = 379)	55%	52%	55%
Species loss (n = 381)	53%	51%	54%
Overfishing (n = 381)*	48%	44%	48%
Support for Uses of Coastal & Ocean Resources (% definitely or probably support)			
Creation of areas that prohibit fishing, harvesting, and other human development (n = 290)*	67%	50%	70%
Wind turbines (n = 289)	65%	61%	65%
Wave energy buoys (n = 290)	62%	56%	63%
Desalination for drinking water (n = 290)	55%	56%	55%
Ocean agriculture (e.g., seaweed farming) (n = 289)	53%	69%	51%
Commercial fish and shellfish fisheries (n = 290)	44%	56%	43%
Shellfish farming (n = 290)	41%	53%	40%
Fish farming (n = 290)	37%	42%	37%
Offshore oil and gas (n = 288)	16%	25%	14%
Vote for a ballot measure to expand Oregon Marine Reserves Program (n = 290)**			
Yes	59%	44%	61%
No	18%	39%	15%
Don’t know	22%	17%	23%

[†]p < 0.10; *p < 0.05; **p < 0.01; ***p < 0.001.

uses (67%) and emerging uses such as renewable energy development in the ocean using wind turbines (65%) or wave energy buoys (62%). A majority also supported the proposed uses of desalination for drinking water (55%) and ocean agriculture such as seaweed farming (53%). Although a minority supported uses such as commercial fish and shellfish fisheries (44%), shellfish farming (41%), and fish farming (37%), a substantial proportion (between 30% and 38%) indicated that they were unsure whether they supported or opposed these more traditional uses. Offshore oil and gas development were clearly opposed (68%). Few differences existed between coastal and other Oregon residents' support for existing and proposed coastal and ocean uses. The exception was a nearly 20% gap between coastal (50%) and other Oregonians (70%) support for the creation of areas in Oregon's ocean that limit human uses. Finally, support for expanding the OMRS was high. Fifty-nine percent of all survey participants reported they would vote in support of a ballot measure to expand the OMRS, and fewer than one in five (18%) indicated that they would vote no. Although coastal residents were significantly less likely to be supportive than respondents from other regions, more coastal residents indicated they would vote yes (44%) to expand the OMRS than no (39%).

5.3. Underlying perceptions of threat to Oregon's coastal and marine resources

To understand the underlying perceptions of threat to Oregon's ocean health we conducted an EFA on seven threat items (Table 3). The correlation structure of the perceived ocean health threats resulted in an EFA with two retained factors that explain 65% of the variance in the data. All seven items resulted in substantial rotated factors loadings on the two factors. We identified the two factors as *threats to ecological integrity* and *threats to environmental quality*, respectively, based on the rotated factor loading patterns. The *threats to ecological integrity* index included concerns about species loss, overfishing, habitat degradation, and climate change, which collectively represent potential threats to ecological structures and functions. The *threats to environmental quality* index was comprised of the pollution, marine debris, and non-native species threat items, which together represent perceived concerns about contamination of the ocean environment. Cronbach's alpha was 0.82 for the ecological integrity items and 0.70 for the environmental quality items, suggesting adequate internal validity and supporting the construction of indices for each factor based on the average rating for each set of items.

5.4. Predicting support for marine reserves

The inclusion of covariates in the binomial logistic regression of support for Oregon marine reserve expansion produced a model that was

Table 3
Exploratory factor analysis and indices of perceived threats to Oregon's ocean health.

Potential Threat Items	Factor 1 – Threats to Ecological Integrity	Factor 2 – Threats to Environmental Quality
Species loss	0.79	
Overfishing	0.59	
Habitat loss or degradation	0.72	
Climate change	0.66	
Pollution		0.68
Marine debris		0.66
Introduced or non-native species		0.84
Eigenvalues	3.74	0.83
% variance explained	53%	12%
Cronbach's alpha	0.82	0.70

Note: factor loadings less than 0.40 are suppressed for simplicity.

significantly improved relative to a null model (likelihood ratio chi-square test = 93.0 with 11 degrees of freedom; $p < 0.0001$), had reasonably good predictive capacity (Nagelkerke $R^2 = 0.44$; Table 4), and tested our three hypotheses about the influences of familiarity, coastal residency, and perceptions about Oregon's ocean while controlling for socio-demographic factors. Two of our three hypotheses were supported, as evidenced by significant coefficients for most of the variables of interest, while the hypothesis about familiarity leading to support for MPAs was rejected. Of the control variables (age, gender, employment, and political party affiliation), only political party affiliation was significant (standardized coefficient = -0.23 ; $p = 0.03$), and indicated that Democrats were more likely to support expansion than Republicans or those affiliated with other parties (Table 4). Average scores on variables designed to test each of the three hypotheses showed differences between respondents who reported that they would vote yes to expand Oregon's marine reserves and those who reported a no vote or didn't know (Table 5), and those differences manifest in varying marginal effects in the regression model (Fig. 1).

Although we dropped visitation frequency from the analysis due to multicollinearity, the remaining findings did not support hypothesis 1 that familiarity with ocean resources increases MPA support. Being informed about Oregon marine reserves did not have a significant influence on supporting the expansion of Oregon's marine reserves (standardized coefficient = 0.16 ; $p = 0.11$). Likewise, being generally informed about coastal and ocean resource issues also had no effect

Table 4
Results of binomial logistic regression predicting yes votes to support expanding Oregon's marine reserve system.

	Dependent Variable: Yes vote for Oregon marine reserve expansion			
	Coefficients ^a (Standard Error)	Standardized Coefficients	P-value ^b	Odds Ratio (95% CI)
Constant	0.09 (0.73)		0.901	
Informed on Ocean Issues	-0.002 (0.18)	-0.01	0.990	1.00 (0.71-1.40)
Informed on Reserves	0.27 (0.16)	0.16	0.095	1.31 (0.95-1.81)
Coastal Residence	-0.89 (0.54)	-0.17	0.097	0.41 (0.14-1.18)
Eastern Oregon Resident	-1.26 (0.62)	-0.21	0.042	0.28 (0.08-0.96)
Southern Oregon Resident	0.35 (0.86)	0.04	0.683	1.42 (0.26-7.74)
Threats to Ecological Integrity Index	0.60 (0.26)	0.29	0.021	2.08 (1.28-3.38)
Threats to Environmental Quality Index	-0.26 (0.25)	-0.04	0.318	0.77 (0.47-1.27)
Support for Limiting Human Uses	0.54 (0.16)	0.37	<0.001	1.71 (1.25-2.34)
Support for Commercial Fisheries	-0.64 (0.17)	-0.38	<0.001	0.53 (0.38-0.74)
Political Party Affiliation	-0.33 (0.16)	-0.23	0.044	0.72 (0.53-0.99)
Age	-0.0003 (0.003)	-0.01	0.932	1.00 (0.99-1.01)
Employed	-0.15 (0.34)	-0.04	0.203	0.86 (0.45-1.66)
Female	0.42 (0.35)	0.12	0.226	1.52 (0.77-3.00)
Observations	243			
Log Likelihood	-114.87			
AIC	257.74			
Nagelkerke R ²	0.44			

^a Coefficients are unstandardized.

^b P-values less than 0.10 are highlighted with bold font.

Table 5

Average responses to variables of interest by vote choice, and *t*-test for differences between respondents who reported they would vote yes and all others (*p*-values <0.10 are highlighted with bold font).

Variables	Vote Choice for Expanding Oregon Marine Reserves		t-value (p-value)
	Yes	No or Don't Know	
Threats to ecological integrity	0.9	<-0.0	-9.16 (<0.001)
Support limiting human uses	1.3	0.1	-8.39 (<0.001)
Support for commercial fisheries	0.2	0.7	4.93 (<0.001)
Informed on Oregon marine reserves	0.8	0.9	0.40 (0.692)
Political party affiliation	-0.5	0.3	5.88 (<0.001)
Coastal residents	9%	17%	1.95 (0.05)

Note: Threat and support item scales range from -2 (*strongly disagree* and *definitely oppose*) to +2 (*strongly agree* and *definitely support*); informed ranges from 0 (*not informed*) to 3 (*very well informed*); and political party affiliation ranges from -2 (*democrat*) to +2 (*republican*).

(standardized coefficient < -0.01; *p* = 0.98). In contrast, hypothesis 2 was supported as coastal residents were moderately less likely to support expanding Oregon's marine reserves than those from the populous Willamette Valley (standardized coefficient = -0.17; *p* = 0.08); participants from rural eastern Oregon were also less likely to support marine reserve expansion (standardized coefficient = -0.21; *p* = 0.03), demonstrating that geography can influence preferences. Hypothesis 3 was also supported as coefficients for perceptions of threats and supported uses were mostly significant. Respondents' concerns about the threats to the ecological integrity of Oregon's ocean positively influenced support for marine reserves expansion (standardized coefficient = 0.29; *p* = 0.02). Concerns about potential threats to environmental quality, however, did not influence support for marine reserve expansion (standardized coefficient = -0.04; *p* = 0.74). Respondents who supported designating areas to limit human uses of the ocean (standardized coefficient = 0.37; *p* < 0.001) and those opposed to commercial fishing (standardized coefficient = -0.38; *p* < 0.001) were more likely to support marine reserve expansion. The results indicate that stakeholder beliefs about the threats towards and uses of the ocean are significant predictors of support for expanding programs like the OMRS.

6. Discussion

Our research findings expand understanding of the drivers that underlie support for and opposition to MPAs across the general public. Previous research from around the world (Cocklin et al., 1998; Suman et al., 1999; Charles and Wilson 2009; Voyer et al., 2015) and in Oregon (Needham et al., 2013; Perry et al., 2014) has primarily centered on the affected communities or political geographies proximate to marine resources. We conducted a statewide survey of Oregon residents and found that Oregon's population generally supports the marine reserves despite demographic, geographic, and political value differences; however, coastal residents were less supportive than the general population. Further, we found that public opinion about perceived resource threats and traditional uses influences support and opposition for the OMRS despite specific awareness being low. For policy makers and resource managers, our findings suggest that, despite some geographic variation, public support for marine reserves in Oregon is relatively high, but that the effects of marine conservation area regulations on the fishing industry need to be better understood and communicated to minimize real and perceived losses.

Social science research in a variety of contexts finds that those most proximate to a resource in question tend to have different views of that resource than the general public (Danielsen et al., 2007; Weible 2008; Voyer et al., 2015). Local perspectives and experiences in contexts from forestry to fisheries may be driven by ties to a resource dependent economic base, a traditional identity that is perceived to be under threat, or any number of other local concerns (e.g., NIMBY; Dear, 1992; Force et al., 1993; Peluso et al., 1994). While the view from the coast on marine protected area policy is likely to be unique to specific communities, there are many examples globally of coastal communities supporting marine conservation efforts (e.g., Gleason et al., 2010; Cohen et al., 2012; Perez de Oliveira, 2013, Cadman et al. 2020). Our findings suggest that while geography may occasionally serve as a convenient proxy, coastal support and opposition to marine protected area policy may be more related to policy processes and inclusion of coastal residents therein (Gopnik et al., 2012; Fox et al., 2013), the specific substance of marine conservation policy proposals (Perez de Oliveira 2013; Voyer et al., 2015), and the methods of evaluating MPA impacts after their designation (Gallacher et al., 2016). Although our study focused on perceptions following the establishment of MPAs, involving stakeholders early to better understand the potential impacts and designing MPAs to avoid and balance those impacts can improve support, as shown

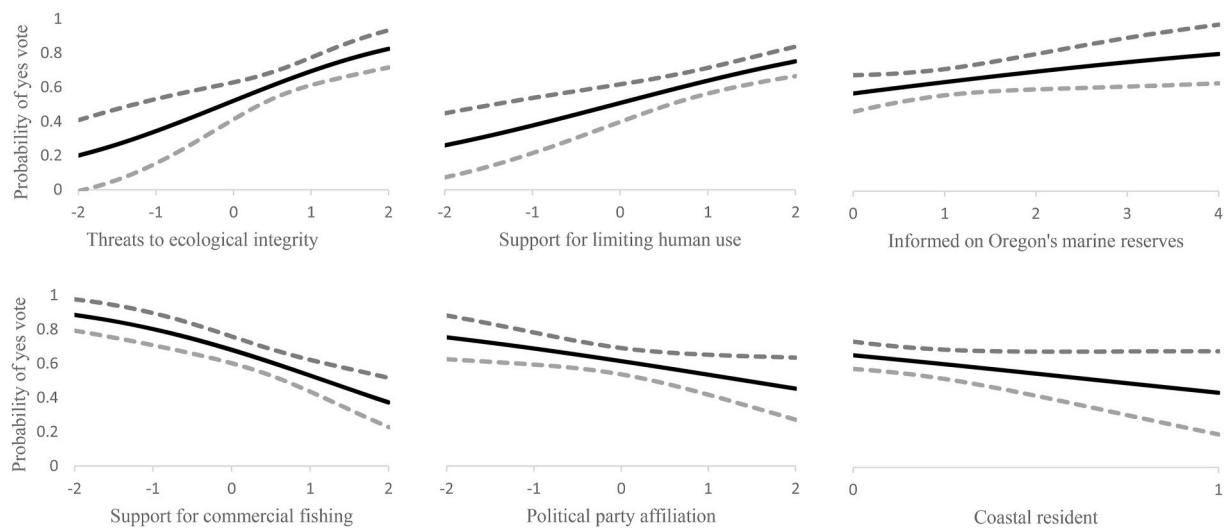


Fig. 1. Predicted probabilities, with 95% confidence intervals, of willingness to vote to expand Oregon's marine reserves by significant covariate. Note: Threat and support item scales range from -2 (*strongly disagree* and *definitely oppose*) to +2 (*strongly agree* and *definitely support*); informed ranges from 0 (*not informed*) to 3 (*very well informed*); and political party affiliation ranges from -2 (*democrat*) to +2 (*republican*).

by Sayce et al. (2013) in California, Guénette and Alder (2007) in Canada, and Perez de Oliveira (2013) in Spain. Oregon's legislation (HB 3013) for establishing marine reserves relied on a process that engaged Community Teams comprised of diverse coastal stakeholder groups in the planning process. Although there was some contention about the process and its outcomes (Wondolleck and Yaffe, 2017; Marino 2020), many coastal residents engaged in the process (Hayden-Lesmeister 2019; Bird and Conway 2012), and the state continues to study the effects of Oregon's marine reserves on coastal communities and user groups (Oregon Department of Fish and Wildlife, 2017). Despite significantly more coastal residents being opposed to the expansion of Oregon's marine reserves, a plurality of coast residents reported they would be willing to vote in support of an expansion, and coastal residency was only marginally significant in our logistic regression. Our finding concerning coastal residents aligns with national level research findings that predictors of environmental concerns tend to be similar for coastal and non-coastal residents, with unique exceptions dependent on local economic or resource issues (Hamilton and Safford, 2015).

Attitudes about threats to environmental resources also influence support for environmental policy (Dietz et al., 2005). US environmental policy has made environmental quality a priority with laws to control pollution and other inputs into water, air, and land. In addition, concern over habitat loss and the functioning of ecosystems has led to a number of federal, state, and local laws and programs intended to maintain, restore, and conserve the integrity of ecosystems. While environmental quality and ecological integrity concerns have been distinguished and elevated over the past several decades, with respect to marine conservation, it is unclear whether the same distinctions hold as the public generally lacks knowledge and is relatively uninformed about ocean environments (Steel et al., 2005; Perry et al., 2017). Despite our confirmation of the relatively low levels of knowledge and a high degree of being uninformed, we do find that the public distinguishes ocean threats in ways that we interpret as focused on environmental quality (e.g., pollution, marine debris, and invasive species) and ecological integrity (impacts of overfishing and species loss, habitat degradation, and climate change). Although the designation of MPAs will not directly mitigate for climate change, MPAs may plausibly be linked to species persistence, improvements in ocean habitat and connectivity, and a reduction of fishing pressure, and may act as refugia for species impacted by climate change (Roberts et al., 2017), which likely translated into support for marine reserves among those who perceived threats to the ecological integrity of the ocean. On the other hand, MPA designations are less likely to alleviate environmental quality concerns as pollution, garbage, and invasive species are generally exogenous to marine spatial conservation designations, explaining why concerns about environmental quality did not influence support for expanding Oregon's marine reserve system.

Attitudes about ocean uses also influenced support for expanding Oregon's marine reserves. Despite majority support for a variety of ocean uses among both coastal and non-coastal Oregonians, support for activities most likely impacted by MPA designations, such as commercial fisheries and shellfish farming, was more polarized. Attitudes about fishing, particularly among those supportive of fishing, may invoke a loss framing of MPAs, which favors risk aversion to avoid the uncertainty of a change from a valued or reference condition (Kahneman and Tversky 1983; Kahneman 2003). This finding implies that an adaptive management approach that continues to engage fishers over the life of a MPA is likely an important strategy for managers to reduce uncertainty about outcomes of MPA design. Depending on the outcomes, continued engagement may validate concerns represented by loss attitudes, or contribute to changing attitudes if MPA benefits and fisher adaptation are evident. Our results on the influence of perceived threats to and uses of the ocean on MPA policy were clear, yet exploratory; future research should seek to confirm or identify more nuanced interpretations in other broad public contexts, including new "mutual understandings" that may result from stakeholder engagement (Potts et al., 2016).

Marine conservation policy has increasingly extended the public trust doctrine to MPAs, sometimes elevating questions about whose interests MPAs serve. As the public trust doctrine is extended by governments beyond the traditional triad of public trust ocean uses (i.e., fishing, navigation, and commerce), the doctrine has evolved to reflect contemporary concerns including, recreation, preservation of natural environments, open space and scenery, and maintaining natural resources for future generations, among others (Christie 2004). In Oregon, nearly a century and a half of legal opinions provide precedent for a flexible interpretation of the public trust that evolves with contemporary concerns to extend the doctrine beyond the traditional public uses (Blumm and Doot 2012). For several decades Oregon wildlife and fisheries managers and state governments have interpreted this flexibility to include habitat integrity and environmental quality as public trust doctrine resources based on the notion that the state's stewardship of water resources includes a responsibility for "conservation, maintenance, and enhancement of aquatic life, fish, wildlife, habitat, and 'any other ecological values'"³ for present and future generations (Blumm and Doot 2012). As Oregon and other states establish and investigate the impacts of new MPA designations on fisheries, coastal communities, and related sectors, managers need to understand what influences the general public's support for and opposition to these management tools.

Although our research found a broad base of support for future OMRS expansion, we also found relatively low awareness of Oregon's marine reserves, suggesting that with limited outreach, marine reserves may have low salience with the general public. This support is consistent with similar survey research efforts conducted globally examining public concerns and assessments of marine environments and protections (Lotze et al., 2018). Sax (1970) writes that public trust resources often face the challenge of a "disorganized and diffuse majority" of public support (p. 560). This dynamic is especially common when managing environmental resources wherein the general health or conservation of a resource is a broadly distributed public good that may stand in contrast to the economic benefits from extractive uses of the environment for a group of users (Dietz et al., 2003). While we find Sax (1970) principle to hold value with regard to the OMRS, we note that there is room for further public engagement concerning marine reserves as more than one in five respondents reportedly didn't know whether they supported or opposed future OMRS expansion. Maintaining and activating broad public awareness of MPA designations can elevate marine policy as a public trust issue for which existing legislative and administrative policies are appropriate tools.

Although broad public activation is important (e.g., Gopnik et al., 2012; Voyer et al., 2015), managers also need continued engagement with coastal residents, commercial fishers, and other groups found in this study to be less supportive of Oregon's marine reserves. Finally, our finding that respondents affiliated with the Republican party are less likely to support OMRS expansion, may indicate political polarization around MPAs more generally, at least in the USA. The political nature of the issue conforms with findings in the USA dating back several decades (Dunlap 1975; Jones and Dunlap 1992), while reinforcing the importance of impact and effectiveness monitoring that may enhance trust in MPAs as a flexible and adaptive tool that use on-going management processes to identify ways to minimize unnecessary impacts to local communities.

While our findings are clear, we recognize several limitations. The wording of our main dependent variable focused on whether respondents would support expansion in the size and number of reserves. Others, including Needham et al. (2013), Perry et al. (2017), and Johnston et al. (2020), asked questions about values supporting marine reserves "establishing marine reserves" and found dramatic support – in some cases over 90%. Our framing, that a set of reserves already exists,

³ Oregon Revised Statute 537.332(5). Available on-line [URL]: <https://www.oregonlaws.org/ors/537.332> (accessed June 22, 2020).

may have tempered support as some individuals may want to learn more about the outcomes of existing reserves before supporting more. We also recognize that survey mode and response rates may have influenced our findings. Testing phone and mail surveys, Loomis and King (1994) found that for contingent valuation methods, respondents provided higher estimates of willingness to pay via postal mail surveys due to differing response rates among certain socioeconomic backgrounds. Maguire (2009) found similar results – that contingent valuation estimates were highest among mail and in-person surveys, and suggested that in-person administration may lead to a social desirability bias. On the other hand, Nielsen-Pincus et al. (2017) found higher willingness to pay for ecosystem services among web respondents relative to mail respondents, all of which suggests that responses to telephone surveys may be the most conservative relative to telephone, mail, and in-person modes. Finally, although our sample is similar to the Oregon population on most demographic characteristics (Table 1), we found that our respondents tended to be older and better educated than Oregon adults generally. While not uncommon biases in survey research, future studies should identify ways to engage less well-represented segments of the population.

7. Conclusion

Over the past several decades, using a series of policy tools, marine conservation policy has supported establishment of protected areas in ocean and coastal environments to restrict elements of human use for ecological benefits. Public support for these tools maintains their validity as a public trust resource. Perceptions of MPAs by the general public are not well understood as most research has focused on coastal and proximate communities. We explored the relationships between awareness, attitudes towards coastal and marine resources, and uses and demographics among a sample of Oregon, USA residents, and tested their influence on support for expanding Oregon's recently established marine reserves and protected areas. The significant support (and room for further engagement) was linked to concerns for the ecological integrity of Oregon's ocean jurisdiction and positive attitudes towards areas of limited human use in the ocean. We also found that support for commercial fisheries and right-leaning political affiliations lessened the likelihood that respondents would vote to expand Oregon's marine reserves. Although borderline in their statistical significance, being informed about the marine reserves and being a coastal resident had opposite influences. Our findings highlight the need for MPA managers to continue to engage those communities potentially affected by MPA designations with data about MPA effectiveness and impacts as part of an adaptive management strategy that seeks to safeguard the public trust for coastal and marine resources against a multitude of potential risks.

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.

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