

# **Public Preferences for Marine Protected Areas Off the U.S. West Coast: The Significance of Restrictions and Size on Economic Value**

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U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-F/SPO-144  
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NOAA Fisheries Office of Science and Technology  
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## Section I. Introduction

In 2000 when President Clinton signed *Executive Order 13158 Marine Protected Areas* to “help protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations” (EO 13158, 2000), less than 1% of U.S. territorial waters were part of a marine protected area, or MPA (National Marine Protected Areas Center 2014) (Kelleher 1999). Since that time, the area designated as an MPA has steadily increased, more than doubling in 2006 with the establishment of the Northwest Hawaiian Islands Marine National Monument and doubling again in 2009 with the addition of three marine monuments in remote Pacific waters (National Marine Protected Areas Center 2014). Excluding MPAs established for fisheries production<sup>1</sup> the majority of MPAs in the U.S. have been established to protect natural heritage, though most MPAs have multiple conservation objectives. Currently approximately 8% of all U.S. territorial waters are designated as a natural or cultural heritage MPA (National Marine Protected Areas Center 2014). Nearly all of this area is coastal, with only a fraction (~8%) sited one mile or more from shoreline.

In 2010 the Convention on Biological Diversity (CBD) (Convention on Biological Diversity 2010)<sup>2</sup> set an unambiguous goal for MPAs in developing Target 11, which states that by 2020 “10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape” (Convention on Biological Diversity 2010). The CBD was less direct in specifying use regimes for MPAs (e.g. resource extraction, no-take, no-access, etc.), though this matters in both an ecological and economic context. In the U.S. approximately 82% of the natural heritage and cultural heritage MPAs are multiple-use sites (allowing a variety of human activities, including resource extraction), while about 15% are no-take reserves (National Marine Protected Areas Center 2014).<sup>3</sup>

The ecological and economic benefits and impacts associated with MPAs will likely vary with use regime, the obvious case involving resource extraction. Wallmo and Edwards (2008) demonstrate that MPAs can also provide positive or negative economic value to the general public depending on the specific use regime, size of the MPA, and latent variables among respondents. Given the increasing interest in MPAs as a marine conservation tool, the increasing amount of U.S. waters designated as an MPA, and the international target outlined by the CBD (Target 11), it is legitimate to inquire about the public’s valuation of MPAs and the appropriate mix of protected areas and exploited areas. This research addresses this need by estimating how public economic values for MPAs in federal waters off the U.S. west coast change with different size and use configurations.

As a non-market good, the economic value of an MPA is not revealed in market data or by household production behavior (e.g., travel costs used as the price of a fishing trip); therefore,

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<sup>1</sup> The international definition of Marine Protected Area established by the International Union for the Conservation of Nature (IUCN) does not include areas regulated and/or established for fisheries management.

<sup>2</sup> The U.S. was not a party to the 2010 Convention on Biological Diversity.

<sup>3</sup> Almost all of the no-take reserve area lies in one marine monument in the western Pacific Ocean.

values are typically estimated from data collected from in-person, telephone, mail, or internet surveys. This research employs a stated preference choice experiment survey of households in California, Oregon, and Washington to quantify public preferences and simulate a suite of different MPA designs and their associated values. The research pertains specifically to MPAs designated in U.S. federal waters (waters 3 to 200 miles from shore) off the coasts of California, Washington, and Oregon West Coast, hereafter referred to as west coast federal waters. All permanently protected marine areas located in west coast federal waters prohibit industrial uses such as mining, oil and gas extraction, and windmill/turbine construction.

The results may be useful in helping managers understand public preferences for MPAs, particularly as they relate to key, and often contested, issues including:

- The effect of MPA size on public economic value
- The effect of MPA use regime on public economic value
- Size/use combinations for MPAs that maximize public values
- Preference heterogeneity for MPAs

The remainder of the report is organized as follows: Section II describes the methods used in the research, including survey development and implementation and choice model theory and estimation. Section III presents results of the general questionnaire and respondent demographics. Section IV presents econometric model results and value estimates associated with MPAs of different size and use configurations. Section V provides a brief discussion of the results and conclusions and recommendations stemming from the research.

## Section II. Methods

### Overview of Stated Preference Choice Experiments

Stated preference choice experiments (SPCE) are a specific type of non-market valuation technique. SPCE are grounded in Lancasterian consumer theory (Lancaster 1966), which specifies that utility for a good is a function of the good's attributes. For environmental applications, the good is typically a non-market good (i.e., one not bought or sold in explicit markets) that is characterized by a suite of policy-relevant attributes. A range of levels is specified for each attribute, and experimental design plans are used to generate different combinations of attribute levels to describe each alternative. Including price or cost as one of the attributes allows welfare estimates (WTP) to be calculated. As non-market goods are typically unfamiliar to consumers, a survey is used to provide basic information about the good in question. Survey respondents are then shown one or more choice tasks that contain alternatives (different bundles of attributes and levels), and are asked to express their preferences over the different alternatives, e.g. by asking for their most and least preferred. For a fully detailed explanation of the SPCE approach see Adamowicz et al. (1998).

### Survey Development

This study and questionnaire were based on previous work that estimated marine protected area values in the Northeast Region of the U.S. (Wallmo and Edwards 2008). The questionnaire for this study was developed between December 2010 and November 2012 when ten focus groups and two pilot tests were conducted. Three challenges were identified during this qualitative research period. First, the original versions of this survey were focused on different types of marine uses. These marine uses included open ocean aquaculture, wave energy development, marine ecological reserves, and marine fisheries reserves. However, it became clear after four focus groups that these different marine uses were perceived by focus group participants as either very positive or negative to the marine environment. Participants generally had strong feelings against open ocean aquaculture, and generally favorable feelings towards marine ecological and fisheries reserves. Perceptions relative to wave energy development were generally neutral. This positive or negative bias towards the different types of uses in a discrete choice experiment such as this one, is potentially problematic because rather than focusing on the attributes of each of these uses (i.e., size or cost), respondents may have strong preferences for or against a use regardless of its associated attributes. This makes it difficult to evaluate how sensitive respondents are to changes in attribute levels, a primary focus of discrete choice experiments.

After these first four focus groups, the survey questionnaire was revised to focus only on marine protected areas and the different types of MPAs that are currently in place on the U.S. west coast. Testing of this revised questionnaire in subsequent focus groups highlighted the differing views and understandings held by participants relative to MPAs, if they were familiar with them at all. Thus a second challenge in designing this survey was to clearly communicate the main objectives of MPAs in general. The following objectives of MPAs were highlighted: 1) setting aside ocean areas to conserve, restore, and understand the natural biodiversity and ecology of an area; 2) provide people the opportunity to experience these ocean areas now and into the future; 3) prevent industrial uses such as oil and gas exploration and drilling within MPA boundaries;

and 4) monitor and limit other uses such as commercial and recreational fishing, recreation and nature-based tourism, and scientific research.

A third challenge was to present balanced information on the current state of MPA science (based on NRC 2001), the costs and benefits of MPAs, and the current types and sizes of MPAs on the west coast. Marine protected areas and their development in California in particular has been controversial (e.g. Stokstad 2010, CDFG 2008) and invoked strong feelings from some focus group participants. Therefore it was particularly important to present this information in a neutral and objective manner. After repeatedly testing this information with different focus groups, we felt the information about the current scientific understanding regarding MPAs and their benefits (e.g., prevent habitat damage) were adequately balanced with information about the current size of MPAs on the west coast and the costs associated with them (e.g., displacement of fishing activities).

The qualitative research was also used to test the potential attributes for the choice experiment and to refine a range of attribute levels. The attributes of interest were the type of MPA and their corresponding size, the total size of MPAs in west coast federal waters (all MPA types combined), and a respondent's willingness to pay for changes to current MPA conditions. Size was defined as the proportion of water designated as each type of MPA within west coast federal waters off of California, Oregon, and Washington. Types of MPAs included No-access, No-take, and Multiple use. This range of MPA types was consistent with the status quo off of the U.S. west coast. It was also consistent with the objectives of conserving and restoring natural biodiversity and providing people with opportunities to experience these areas. Cost was the annual cost to a respondents' household, each year for three years, when choosing a particular scenario.

A pretest was conducted prior to implementing the final survey using a subset of a web-enabled panel (The GfK Group 2013). The pretest was administered to a random sample of 2,308 households and a total of 1,540 respondents completed the survey. The pretest assessed respondents' comprehension of the survey instrument, obtained an estimate of survey time (about 15 minutes), and examined the validity of the experimental design, discussed below. Based on the pretest results minor revisions were made to the survey instrument. The second pretest investigated the efficiency of a much smaller experimental design.

The final questionnaire, titled *Marine Protected Areas off the U.S. West Coast*, consisted of 6 sections and 55 questions. Sections 1 through 4 and 6 contained 4 to 30 attitudinal or informational questions that supported the section topic, including a total of 35 questions requiring responses on a Likert scale. Section 5 was the choice experiment. Each section is further described below.

- Section 1 introduced marine protected areas as the survey topic and the geographic region of focus, west coast federal waters, was shown on a map. Respondents were also asked general questions about whether they had ever participated in ocean-related leisure or business activities, or had visited an MPA in west coast federal waters.
- Section 2 provided background information about the primary objectives of MPAs . These objectives were to set aside areas of the ocean to conserve, restore, and understand

the natural diversity and ecology of an area, and to provide the public with opportunities to experience these ocean areas now and into the future. Types of activities that may be limited within these areas were also highlighted. These included industrial uses such as seabed mining, minerals extraction, and oil and gas exploration. Other uses that might be limited within MPAs included fishing activities (commercial or recreational) and nature-based tourism such as scuba diving. Respondents were asked to indicate the importance of each of these activities to them.

- Section 3 described the potential benefits and costs of MPAs and how MPAs may vary in size. Ecological and biological benefits due to protecting marine biodiversity and habitat for future generations were contrasted with social and economic costs related to monitoring and regulating these MPAs, and the displacement of scientific, recreational, and industrial activities. Respondents were asked to indicate their level of agreement with MPA-related assertions such as the role of society in protecting marine life and whether businesses should be compensated for lost income.
- Section 4 discussed the specific types and sizes of MPAs currently found in west coast federal waters. All permanently protected marine areas located in west coast federal waters prohibit industrial uses such as mining, oil and gas extraction, and windmill/turbine construction; however, other types of uses may be allowed depending on the designation. Currently in west coast federal waters:
  - 2.95% of west coast federal waters are designated as multiple use MPAs, where commercial and recreational fishing, tourism, and scientific research activities are permitted.
  - 0.05% of west coast federal waters are designated as no-take MPAs, where access is allowed but all extractive activities are prohibited.
  - None of west coast federal waters are designated as an ecological reserve or refuge that prohibits human access.
- Section 5 contained three choice task questions. Each choice task asked respondents to consider and choose from three options for permanent MPAs in west coast federal waters. Option 1 represented the current size of each of the three types of MPAs, described in the previous section. Options 2 and 3 increased the size of at least one type of MPA in west coast federal waters. However, a cost to their household would be incurred when choosing either Option 2 or 3; Option 1 would not result in a change in cost to their household.
- Section 6 consisted of questions related to a range of ocean and environmental behaviors and attitudes. Respondents were asked how often they engaged in different types of ocean-related activities, their level of trust in government and non-governmental institutions, their agreement with statements that encompassed various environmental attitudes, and their household's current and future employment and financial outlook.

If desired, respondents could revisit previous information or connect to additional information about a topic using hyperlinks embedded throughout the survey.

## Survey Implementation

The survey pretests and main survey periods were administered to a random sample of households in California, Oregon, and Washington that were part of a national web-enabled panel maintained by The GfK Group (formerly Knowledge Networks). Two pretests were conducted. The first was implemented from August 10 to 28, 2012 and used a preliminary experimental design. Of the 2,308 households that were randomly sampled, 1,540 surveys were completed, a 66.7% survey response rate. The experimental design was then modified for the second pretest, implemented from November 2 to 30, 2012. Of the 1,268 households sampled, 823 surveys were completed, a 64.9% survey response rate. The experimental design from this second pretest was used for the main survey periods.

The first survey period began on December 6, 2012. A random sample of 3,389 households on the panel who lived in California, Oregon, and Washington were invited to participate in this study. Up to two e-mail reminders were sent to non-responders, if necessary. The first reminder was sent on day three of the field period and the second on day 14. This first survey period ended on December 26, 2012 with 1,971 completed surveys and a survey completion rate of 58.1%. The second survey period began on January 23, 2013. A random sample of 1,960 households was selected from California, Oregon, and Washington. Similar to the first survey period, e-mail reminders were sent to non-responders if necessary. The first reminder was sent on day three of the field period, the second on day 14, and a third e-mail reminder on day 21. The second survey period ended on February 12, 2013 with 560 completed surveys and a survey completion rate of 28.5%. The final dataset used for this analysis included observations from the first and second main survey periods as well as the second pretest (n=3,354).

## Experimental Design Plan

An experimental design plan was used to create the alternative MPA scenarios that varied in the total size of the MPA, the use regime within the MPA, and a cost attribute. Cost was a 6-level attribute, and use regime attributes (i.e. the amount of MPA designated as multiple-use, no-take, and no-access) were all 5-level attributes. The cost attribute was specified as a payment added to the respondent's Federal tax return every year for the next three years. The payment would be used for research, monitoring, and enforcement within the MPA and to help offset costs to industries affected by any new restrictions until they can adjust to the changes. The payment would be made by all households in California, Oregon, and Washington. This cost attribute is similar to payment vehicles used in other stated preference research (Lew et al. 2010, Wallmo and Lew 2011). The total size of the MPA was simply the sum of all use regime attributes and was not an independent attribute (Table 1).

Table 1. Attributes and levels of experimental design

Attribute	Level
Amount of federal waters designated as no-access (no human access allowed, waters are ecological reserve or refuge)	0.05%
	1.0%
	2.0%
	3.0%
	5.0%
Amount of federal waters designated no-take (human access allowed but all extractive activities are prohibited)	0.05%
	2.0%
	5.0%
	8.0%
	10.0%
Amount of federal waters designated multiple use (commercial and recreational fishing, tourism, and scientific research activities permitted)	2.95%
	5.0%
	8.0%
	10.0%
	15.0%
Cost (household cost per year for three years)	\$10
	\$20
	\$50
	\$75
	\$100
	\$125

The design plan was computed using the SAS experimental design and choice modeling macros (Kuhfeld 2005). The final design plan attained a 93.24% D-efficiency and allowed restrictions that eliminated unrealistic designs. For example, a design that produced a scenario where one large MPA with a majority of the area designated as no-access cost less than a smaller, multiple use MPA would be considered unrealistic given that the cost attribute was partially used to offset losses to industry (see below). The design consisted of 150 alternative scenarios which were then paired and blocked into groups of three using the SAS choice efficiency macros. This design resulted in 50 different survey versions, with three choice task questions per version and two alternatives plus the status quo per question (Figure 1). The versions were randomly distributed during three phases (see Survey Implementation) among 6,617 randomly selected panel households in California, Oregon, and Washington.

Figure 1. Example of choice task question

MPAs West Coast Federal Waters	Option 1 (Current Status)	Option 2	Option 3
% of West Coast Federal Waters designated <b>No-Access MPAs</b>	0%	3%	1%
% of West Coast Federal Waters designated <b>No-Take MPAs</b>	0.05%	0.05%	1%
% of West Coast Federal Waters designated <b>Multiple Use MPAs</b>	2.95%	2.95%	4%
<b>Total amount of West Coast Federal Waters designated as a Marine Protected Area</b>	3%	6%	6%
<b>Cost to your Household</b> ...This cost will be added to your household's Federal Income Tax <u>every year for three years</u>	\$0	\$15	\$10
<b>Q6. Which option do you most prefer for West Coast Federal Waters? (check only one box)</b>	<b>Option 1</b> <input type="checkbox"/>	<b>Option 2</b> <input type="checkbox"/>	<b>Option 3</b> <input type="checkbox"/>

### Model Estimation

Random utility theory provides the modeling framework for this research. The theory specifies that utility ( $U$ ) for a good consists of a systematic, known component ( $V$ ) and a random component ( $\varepsilon$ ). In this case, the good in question is an MPA, and the utility that individual  $i$  receives from MPA alternative  $a$  can be expressed as

$$(1) \quad U_{ia} = V_{ia} + \varepsilon_{ia}$$

where  $U_{ia}$  is the unobservable utility that  $i$  associates with  $a$ ,  $V_{ia}$  is the quantifiable, known portion of utility, and  $\varepsilon_{ia}$  is the random, unobservable effects associated with  $a$  for individual  $i$ . Alternative  $a$  can be decomposed into its specific attributes of amount of MPA designated as multiple-use, no-take, and no-access, and the systematic component of utility  $V_{ia}$  is then

$$(2) \quad V_{ia} = \beta X_{ia}$$

where  $X_{ia}$  is a vector of attributes and the associated levels for MPA alternative  $a$  and  $\beta$  are the attribute coefficients. Substituting the expression for  $V_{ia}$ , the utility function can be expressed as

$$(3) \quad U_{ia} = \beta X_{ia} + \varepsilon_{ia}$$

Under the assumption that individuals are utility maximizers, the probability that an individual  $i$  will choose MPA alternative  $a$  from a set of  $C$  alternatives is equal to the probability that the utility derived from  $a$  is greater than the utility derived from any other alternative in the choice set  $C$ , expressed as

$$(4) \quad \begin{aligned} & \Pr(i \text{ chooses } a \text{ from } C) \\ &= \Pr(U_{ia} > U_{ij}) \forall j \in C \\ &= \Pr(V_{ia} + \varepsilon_{ia} > V_{ij} + \varepsilon_{ij}) \forall j \in C \\ &= \Pr(\beta X_{ia} + \varepsilon_{ia} > \beta X_{ij} + \varepsilon_{ij}) \forall j \in C. \end{aligned}$$

Assuming a type I extreme value distribution for the error component (a common assumption for discrete choice models; Louviere, Hensher, and Swait 2000), (4) is operationalized as

$$(5) \quad \Pr(i \text{ chooses } a) = \exp(\beta X_{ia}) / \sum_{j=1}^J \exp(\beta X_{ij})$$

If choice observations are ordered so that the first  $n_1$  individuals chose alternative  $a$ , the next  $n_2$  individuals chose alternative  $b$ , and so on for all  $j$  elements of the choice set  $C$ , the likelihood function for (5) can be written as

$$(6) \quad L = \prod_{i=1}^{n_1} P_{1i} \prod_{i=n_1+1}^{n_1+n_2} P_{2i} \dots \prod_{i=I-n_{j+1}}^I P_{ji}$$

which simplifies to

$$(7) \quad L = \prod_{i=1}^I \prod_{j=1}^J \ln P_{ij}^{f_{ij}}$$

Defining a dummy variable  $f_{ij}$ , where  $f_{ij} = 1$  when alternative  $j$  is chosen and  $f_{ij} = 0$  otherwise, the function can be written as

$$(8) \quad L^* = \sum_{i=1}^I \sum_{j=1}^J f_{ij} \ln P_{ij}$$

By replacing the term  $P_{ij}$  with (5), the only unknown parameters are the elements of  $\beta$ , which are estimated through maximum likelihood techniques.

The conditional logit model above is a popular choice for modeling discrete choice data, and when data are rich and disaggregate the model is often robust (in terms of prediction success) to the implicit behavioral assumptions arising from the chosen error distribution (Louviere, Hensher, and Swait 2000). The model is limited, however, in accommodating preference heterogeneity among individuals, leading to alternative specifications such as the random parameters logit and latent class logit (Greene and Hensher 2002) to address this need. This research adopts the random parameters logit model, as focus groups suggested that preferences for MPAs were not homogenous, and in fact could be utility-decreasing for some individuals.

As in the conditional logit model the unobserved component utility is assumed to be distributed as a type I extreme value distribution. However, the random parameters logit model assumes that one or more of the attribute parameters are distributed continuously over the population instead of being fixed (as in the conditional logit). Thus, the probabilities of selecting an option  $j$  in the RPL model ( $\pi_j$ ) are evaluated over the parameter distributions. They can be expressed as

$$(9) \quad \Pr(\text{choose } j) = \pi_j = \int \{\exp(V_j(\beta)) / \sum_k \exp(V_k(\beta))\} f(\beta) d\beta$$

for all  $j, k = \text{Options A, B, and C}$  and where  $V_j$  is the utility associated with the  $j$ th option and  $f(\beta)$  is the probability distribution of the utility parameters  $\beta$ . These probabilities are approximated through simulation as follows:  $R$  draws of  $\beta$  are taken from  $f(\beta)$ , and the conditional choice probabilities are evaluated at each draw. The simulated probability of choosing the  $j$ th alternative ( $\pi_j^s$ ) is the mean over the  $R$  draws

$$(10) \quad \pi_j^s = R^{-1} \sum_{r=1}^R \exp(V_j(\beta^r)) / \sum_k \exp(V_k(\beta^r))$$

where  $\beta^r$  is the  $r$ th coefficient vector draw from the mixing distribution,  $f(\beta)$ , assumed to be multivariate normal in this application.

Because each respondent was faced with three choice questions in the survey, the joint probability of observing the sequence of choices an individual makes is modeled as the product of individual choice probabilities, following Morey, Rowe, and Watson (1993)

$$(11) \quad \Pr[j, k, l] = \pi_j^s * \pi_k^s * \pi_l^s$$

where  $j$  is selected in the first question,  $k$  is selected in the second question, and  $l$  is selected in the third.

### **Section III. Survey Results: Respondent Attitudes and Demographics**

The questionnaire can be grouped into four general themes: uses of the marine environment on the west coast (Q1, Q2) and in general (Q7); respondent attitudes towards marine protected areas (Q3) and the general environment (Q9); managing the marine environment (Q4, Q5, Q8); familiarity with Citizens Advisory Panels (Q6); and respondent characteristics (GfK panel data and Q10, Q11, Q12). Responses to each question within these thematic areas are reported at the state and region levels in Appendix C. However, because our sampling design does not support state level comparisons (i.e. sample sizes in Oregon and Washington were too small), these state level responses are provided for informational purposes only.

The following sections will discuss region level responses. The number of observations per question is also reported in Appendix C. Though the total number of completed surveys was 3,354, the number of responses for any given question varied between 3,274 to 3,329<sup>4</sup>.

#### Uses of the marine environment on the west coast and in general

For these questions, respondents were asked whether they interacted with the marine environment through their job or recreation, and how important they felt certain marine-based activities were. For example, 13% of respondents across the region participated in saltwater recreational fishing activities in west coast Federal waters compared to 20% who participated in some form of ocean-based recreation (including fishing). A small proportion of respondents indicated that they or someone in their family fished commercially in west coast Federal waters (1.3%) and less than 1% stated that their own job was directly tied to west coast Federal waters.

Respondents were asked whether they had visited an MPA in west coast Federal waters. About 31% stated that they had<sup>5</sup> and 16% were unsure if they had. Respondents were then asked how important the following activities were to west coast Federal waters: commercial fishing, recreational fishing, oil and gas development, marine recreation and tourism, and alternative energy development. Eighty-three percent of respondents stated that commercial fishing was either “extremely” or “somewhat” important compared with 56% when asked about recreational fishing. Response levels related to the importance of oil and gas development (57% felt it was “extremely” or “somewhat” important) were comparable to those of recreational fishing. Response levels related to the importance (“extremely” or “somewhat”) of marine recreation and tourism (72%) and alternative energy development (72%) were similar.

Respondents were also asked how frequently they engaged in certain marine-based activities such as purchasing seafood or boating activities, in any region including west coast Federal waters. Frequency ranged from “at least once a week” to “I participate but not on a regular basis”, to “I do not participate in this activity.” For recreational fishing or shellfishing, boating and similar activities, water contact sports such as swimming, and viewing ocean features/wildlife, participation was 27%, 34%, 44% and 53%, respectively. For seafood

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<sup>4</sup> The number of respondents who did not answer a particular question, indicated as “Refused” in Appendix C, were not included in the summaries provided in this section.

<sup>5</sup> This proportion (30%) may seem inconsistent with the 20% of respondents who stated they participated in some form of ocean recreation. We suggest that some of the respondents who indicated that they visited a west coast MPA did not participate, or perceive that they participated, in an ocean recreation activity.

purchases and activities such as sunbathing or tidepooling, respondents participated with some frequency during the year. Seventy-three percent of respondents purchased or ate seafood “several times a month”, with 66% and 56% participating “several times a year” or “at least once a week”, respectively. As for activities such as sunbathing, tidepooling, and camping at the seashore, 36% indicated that they participated but “not on a regular basis”, 28% participated “several times a year”, and 29% do not participate at all.

### Respondent attitudes towards MPAs and the environment in general

Questions in this section were focused on gaining an understanding of respondents’ attitudes related to marine protected areas and general attitudes towards the environment. Regarding MPAs, respondents were generally supportive of establishing and maintaining MPAs but were mixed when it came to paying higher prices for seafood or compensating industry as a result of MPA development. For these questions, five response categories were presented ranging from “strongly agree” to “strongly disagree”. There was strong agreement among respondents that MPAs should exist even if they never see or use them (52% “strongly” agreed) and that society had a responsibility to protect ocean life and habitats (51% “strongly” agreed). There was disagreement or ambivalence with the statement that MPAs were not necessary because marine biodiversity and habitats were in good shape (33% “strongly” and 30% “somewhat” disagreed; 28% neither agreed nor disagreed). This indicates that respondents were not sure whether biodiversity and habitats were in good shape. Regarding whether industries should be compensated for losses related to MPA development, most respondents neither agreed nor disagreed (36%) but generally disagreed with this statement (43% “somewhat” and “strongly” disagreed). Respondents were more mixed when it came to their willingness to pay higher prices for seafood in order to establish MPAs. Most indicated their willingness to pay higher prices (44% “strongly” and “somewhat” agreed), but a fair proportion did not have an opinion (30% neither agreed nor disagreed).

Other questions in this section focused on general attitudes towards the environment. The fifteen statements in this section were based on Dunlap et al.’s (2000) New Ecological Paradigm (NEP) scale, a method to measure general environmental views. Respondents were asked to indicate their agreement with each of the fifteen statements, from “strongly agree” to “strongly disagree”. Generally, these questions had the highest rates of nonresponse: between 1.5% and 2.4% of respondents did not answer these questions. Some of the responses are discussed here. The full suite of responses can be found in Appendix C.

Generally, respondents indicated that humans were negatively impacting the environment, were mixed as to whether earth’s resources were finite, and believed that an “ecological catastrophe” could occur if “things continue as-is”. That is, there was general agreement that humans were “severely abusing the environment” (69% “strongly” and “somewhat” agreeing) and 62% “strongly” or “somewhat” agreed that the earth had “limited room and resources”. Fifty-eight percent “strongly” and “somewhat” believed that an “ecological catastrophe” would occur “if things continue on their present course”. When it came to human ingenuity and whether this would “ensure that we do not make the earth unlivable”, 33% respondents neither agreed nor disagreed, while comparable numbers “somewhat” agreed or disagreed (25% and 25%, respectively). Fifty-eight percent of respondent “strongly” and “somewhat” disagreed with the statement that nature is “strong enough to cope with the impacts of modern industrial nations”.

Given the responses to these statements, our respondents generally appear to have a less-than-optimistic environmental outlook.

### Managing the marine environment

Questions in this section of the survey focused on human impacts on the marine environment and how much various governmental and non-governmental entities are trusted. Regarding the former, respondents were asked how much they agreed with statements related to human uses and impacts. Response categories ranged from “strongly agree” to “strongly disagree”. Sixty-seven percent of respondents disagreed “strongly” and “somewhat” with the statement that none of the marine environment should be restricted. This indicates some acceptance for placing some restrictions on how the marine environment can be used. A similar sentiment was indicated by 29% of respondents who “somewhat” agreed that some areas of west coast Federal waters “should prohibit all human activities (no-access)”. Other respondents “strongly” agreed with this statement (22%) or neither agreed nor disagreed (24%).

Regarding whether fishing gear should be allowed within marine protected area boundaries “as long as the fishing gear does not damage marine habitat”, 42% of respondents “somewhat” agreed with this statement. Respondents who “strongly” agreed (20%) or neither agreed nor disagreed (22%) were comparable in proportion. Seventeen percent of respondents disagreed either “strongly” or “somewhat” with this statement. When asked to indicate their agreement with the statement, “Temporary protected areas that are focused on rebuilding fish and shellfish populations provide enough protection for marine life,” most respondents either “somewhat” agreed (32%) or neither agreed nor disagreed (28%).

Respondents were also asked to indicate how much they trusted the following entities: federal, state, and local governments; academic scientists; scientists in private consulting firms; and citizen advisory panels. The response categories ranged from “trust completely” to “don’t trust at all” and “I am unsure”. Most respondents “somewhat” trusted each of the following entities: federal, state, and local governments (45%, 49%, and 41%, respectively); scientists in academia and in private consulting firms (54% and 39%, respectively); and citizen advisory panels (50%). A small proportion of respondents trusted any one of these entities “completely”, from 2.4% relative to state governments to 19% relative to academic scientists. “Somewhat” distrusting these entities also varied widely, from 13% relative to academic scientists to 33% relative to local governments or scientists in private consulting firms. The federal government had the highest proportion of respondents not trusting them at all with 15% of respondents indicating this. Local (14%) and state (12%) governments followed closely, as did scientists from private consulting firms (13%).

### Respondent characteristics

Respondent demographic characteristics were provided by the GfK Group and were as follows. The average age was 51 years old with 8 – 20% of respondents falling in each of the following age categories: 18-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years, 65-74 years, and 75 and over. Most respondents had completed a bachelor’s degree or higher (44%) or some college (40%), and their ethnicity/race was “White, non-Hispanic” (69%). Females comprised the majority of respondents (60%). The annual household income distribution of respondents

was as follows: \$24,999 or less was associated with 19% of respondents; \$25,000-\$49,999 was associated with 25%; \$50,000-\$99,999 was associated with 35%; and \$100,000 or more was associated with 21%.<sup>6</sup>

Finally, respondents were asked about their employment level and household finances. Twenty percent of respondents reported that they or someone in their household had been unemployed at some point within the last 12 months. Most respondents stated that their current financial situation was “just about the same” as it was a year ago (49%) and would be “just about the same” a year from now (43%). Thirty-five percent reported that their household’s finances were currently “worse off” compared to a year ago, but stated that their finances would be “better off” (25%) a year from now, though some stated their finances would be “worse off” (21%).

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<sup>6</sup> In comparison, the unweighted data for California, Oregon, and Washington from the December 2012 Current Population Survey (CPS; U.S. Census Bureau et al. 2012) showed the following demographic characteristics: average age was 46 years old and females comprised 51% of the region’s population. Educational attainment was as follows: 19% in the region completed less than a high school degree; 23% completed a high school degree; 28% completed an Associate’s degree or some college; and 30% population completed a Bachelor’s degree or higher. The race and ethnicity of the region was: 51% were “White, non-Hispanic”; 5% were “Black, non-Hispanic”; 11% were “Other, non-Hispanic”; 30% were “Hispanic”; and 3% were “2 or more races, non-Hispanic”. The annual household income distribution of the region was: 30% of households earned \$24,999 or less; 23% earned \$25,000-\$49,999; 26% earned \$50,000-\$99,999; and 21% earned \$100,000 or more. When comparing our unweighted respondent characteristics with the unweighted CPS data (one sample t-test and chi-square goodness of fit test), the null hypothesis that the datasets come from the same population is rejected at a statistically significant level for mean age and educational attainment ( $p < 0.0001$ ) and race/ethnicity ( $p < 0.05$ ). Gender and household income characteristics were not statistically significant ( $p = 0.06$ ).

#### Section IV. Survey Results: Choice Experiment and Econometric Model

The survey dataset contains 3354 observations. In the survey each respondent faced three separate choice tasks, resulting in 10062 choice task questions (3 x 3354). Less than 1% (52) of respondents left all three choice task questions blank; these respondents were removed from the dataset for the model estimation. The majority of respondents were able to make a choice among the three alternatives presented in each choice task, as item non-response to the first, second, and third choice tasks was 2.5%, 2.5%, and 3.3%, respectively. The status quo alternative was selected by 39.8%, 39.5%, and 41.0% of respondents in the first, second, and third choice task, respectively. The split between choosing alternative 2 or alternative 3 was 31.7/26, 28.3/29.5, and 29.6/26 for the first, second, and third choice tasks, respectively. Respondents also varied their choices in most cases, as only 9.6% of respondents chose the status quo in all three choice tasks, 2% always chose alternative 2, and 1.7% always chose alternative 3.

The econometric model allows for diminishing marginal utility for each size/use combination by specifying a quadratic functional form where  $X_1$  represents the percentage of federal waters designated as no-access,  $X_2$  is the percentage of federal waters designated as no-take,  $X_3$  is the percentage of federal waters designated as multiple use,  $X_4$  is the cost associated with the MPA, and  $\varepsilon$  is the error term.

$$(12) \quad V = \beta_1 X_1 + \beta_2 X_1^2 + \beta_3 X_2 + \beta_4 X_2^2 + \beta_5 X_3 + \beta_6 X_3^2 + \beta_7 X_4 + \varepsilon$$

As described in the Methods, a random parameters model is specified to allow for heterogeneity among respondents, and all parameters with the exception of cost were modeled as random. Model results are presented in Table 2.

Results show that all of the size/use attributes in the utility function are highly significant ( $p < 0.01$ ). The positive and significant attribute parameter signs on each linear attribute (except cost) imply that designating federal waters as no-access, no-take and multiple use MPAs is utility increasing, though diminishing marginal utility is shown via the negative and significant sign on each non-linear attribute parameter. The cost parameter is negative and significant ( $p < 0.01$ ), as expected. The standard deviations for each parameter, also presented in Table 2, suggest that for the linear attributes - % of no-access federal waters, % of no-take federal waters, and % of multiple use federal waters - there is significant heterogeneity among respondents ( $p < 0.01$ ). However, the insignificance of the standard deviation parameters for the non-linear size/use attributes suggests that preferences are homogenous for diminishing marginal utility. This result is intuitive and aligns with feedback received during qualitative research, where focus group participants appeared to be generally concerned with setting aside too much of west coast federal waters as an MPA but had varied preferences with respect to different MPA use regimes.

Table 2. Choice model results

Attribute	Parameter estimate	Z statistic
<b>Random parameters</b>		
No-access**	.57632	11.41
No-access <sup>2</sup> **	-.11720	-11.58
No-take**	.15999	6.26
No-take <sup>2</sup> **	-.01625	-6.29
Multiple use**	.17295	6.38
Multiple use <sup>2</sup> **	-.01051	-6.59
<b>Non-random parameters</b>		
Cost**	-.02295	-32.56
<b>Standard deviation parameters</b>		
No-access**	.66837	19.37
No-access <sup>2</sup>	.00164	0.16
No-take**	.32913	22.25
No-take <sup>2</sup>	.00222	1.05
Multiple use**	.25310	17.06
Multiple use <sup>2</sup>	.00029	0.27

\*\*parameters significant at  $p < 0.01$

### Optimal Size and Willingness-to-Pay

The magnitudes of the linear parameters suggest that preferences are strongest for designating federal waters as no-access; however, because the model specification suggests (significant) concavity for each size/use combination the optimal (maximum) size for federal waters designated for each use type is calculated by solving the first order conditions for a specific use type, holding the other two use types constant. This results in the following optimal designations:

- 2.5% of federal waters designated as no-access
- 4.9% of federal waters designated as no-take
- 8.2% of federal waters designated as multiple use

The economic value (willingness-to-pay, or WTP) of designating different MPA configurations (i.e. designating federal waters as MPAs with different use regimes) is calculated using the standard formula for estimating compensating variation (Hanemann 1984; Hanley, Mourato, and Wright 2001)

$$(13) \quad CV_i = WTP_i = \frac{1}{\beta_p} \ln \left\{ \frac{\sum_i \exp V_i^1}{\sum_i \exp V_i^0} \right\}$$

where  $V_i^0$  is the utility derived from the initial state, the status quo, and  $V_i^1$  is the utility associated with an alternative state. Using this formula the values for a variety of MPA designations can be calculated. Table 3 shows the value of the optimal designation of each use type (all else constant) and the standard Krinsky-Robb 95% confidence intervals. Values are expressed as household<sup>7</sup> WTP per year for three years.

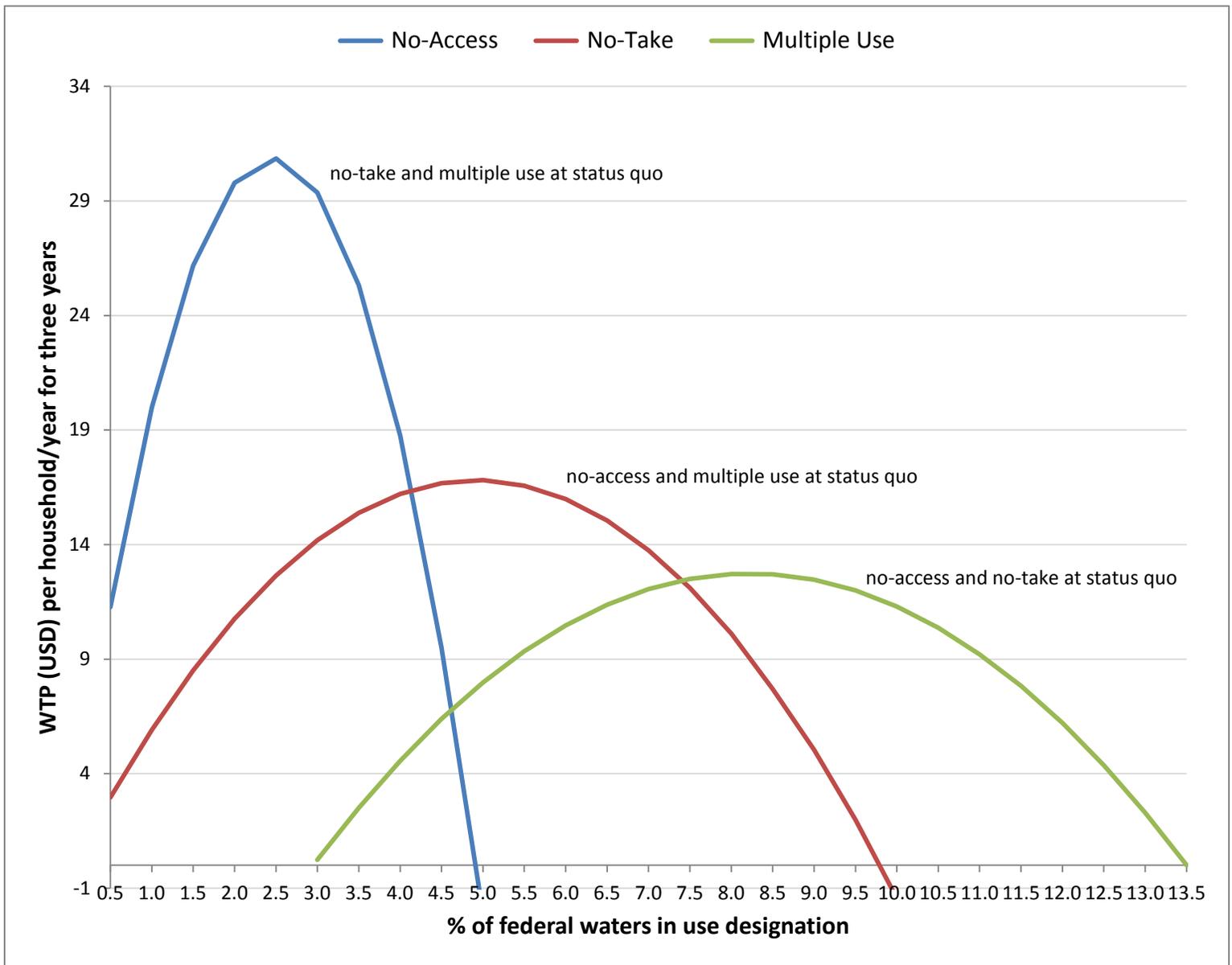
Table 3. WTP for Optimal Designation

	2.5% No-access (other use types at status quo level)	4.9% No-take (other use types at status quo level)	8.2% Multiple use (other use types at status quo level)
WTP	\$30.86	\$16.81	\$12.75
(95% Confidence Interval)	(24.73 – 37.00)	(10.90 – 22.73)	(7.63 – 17.86)

Though the optimal no-access designation yields the highest WTP, the value of this use type decreases sharply over a smaller range than no-take and multiple use designations, as shown below in Figure 2.

<sup>7</sup> Note that the sample for this study was drawn only from households in California, Washington, and Oregon.

Figure 2 . Changes in WTP with respect to size



Assuming that an MPA is designated as a single-use type, several key points emerge from Figure 2:

- Designating more than approximately 4.8% of federal waters as no-access yields disutility (negative economic value). The same is true for any amount of no-take over 9.75% and multiple use over 13.5%.
- MPAs whose size is less than about 4.2% of federal waters will yield the highest value designated as no-access.
- MPAs between about 4.2% and 7.5% of federal waters will yield the highest value if designated as no-take.
- MPAs larger than about 7.5% will yield the highest value if designated as multiple use.

When considering an MPA of mixed use-types, increasing the amount of federal waters in each use type to their maximum amounts shown in Table 3 – for a total of 15.6% of federal waters - provides the largest welfare gain, at approximately \$60.42 per household per year for three years. Other combinations will yield lower but still positive economic value to the public. For example, a large reserve whose total size is 20% of federal waters is valued at \$9.87 per household per year for three years when the use-type is split evenly between no-take and multiple use. However, moving just 1% of waters from a no-take to a no-access designation increases the value to \$36.36. Acknowledging that policy and politics will generally influence both the size and use-type of MPAs, the value (and 95% confidence interval) of mixed use-type MPAs of three different total sizes – 5%, 10%, and 15% of federal waters – are shown in Table 4 for illustrative purposes. Values are expressed in household WTP per year for three years.

Table 4. Value of multiple use-type designations

Total size (% of federal waters)	No-access (% of federal waters)	No-take (% of federal waters)	Multiple use (% of federal waters)	Value
	3	1	1	26.13 (16.00 – 32.25)
5%	2	2	1	29.40 (21.92 – 36.86)
	1	1	3	26.16 (22.80 – 29.52)
	3	4	3	45.82 (38.64 – 53.02)
10%	2	3	5	51.98 (46.59 – 57.37)
	1	5	4	41.39 (35.93 – 46.84)
	3	10	2	22.94 (13.49 – 32.39)
15%	2	3	10	55.29 (49.45 – 61.15)
	1	7	7	45.82 (39.83 – 51.81)

## Section V. Discussion

The model results suggest that the CBD target of setting aside 10% of coastal and marine waters as protected areas is palatable from the west coast public viewpoint, as the mixed-use designation that yields the highest value is 15.6% of west coast Federal waters. Results from the attitudinal questions also support the establishment of MPAs in west coast Federal waters. For example, over 70% of respondents agreed that ocean life and habitats should be protected in their natural state and 67% disagreed with the statement that none of the marine environment should be restricted. Further, nearly three-quarters of respondents felt that MPAs should exist even if the respondents would never see or use the area.

Results also demonstrate that the use-type within the protected area matters significantly, as disutility stems from setting aside ~ 5% of waters as a no-access reserve but not from no-take or multiple use designations. Again this is supported from the attitudinal questions, as nearly half of respondents agreed that some areas of west coast Federal waters should prohibit all human activities, though the amount was not specified in this question. While any specific protected area designation can be evaluated using the choice model results, a few broad-level key findings may help inform on CBD and other target-setting policies:

- The west coast public is generally supportive of the notion of marine protected areas.
- To generate high economic value designate small no-access protected areas, as costs are likely to be smaller for smaller areas.
  - In small sizes no-access is very valuable – designating 2.5% of federal waters as no-access yields more value than a 5% designation of no-take or multiple use.
- Moderately sized MPAs ranging from ~5% to 7.5% of federal waters should be in a no-take designation.
- To establish larger MPAs designate the areas as multiple use.
  - For any area larger than ~9.75% of federal waters only a multiple use designation will be utility enhancing.

It must be stressed that the values generated here are not net of the administrative and opportunity costs associated with designation, which would largely depend on the geographical location(s) of the protected area. When asked about some of the likely opportunity costs associated with establishing MPAs (e.g. restricted commercial fishing, energy development) over 70% of respondents felt that marine recreation and tourism and alternative energy development were important for west coast Federal waters, and over 80% of respondents felt that commercial fishing was important. Interestingly less than 30% of respondents felt that business and industry should be compensated for losses due to MPA restrictions.

It should also be stressed that the choice model results demonstrated heterogeneity among preferences for the linear attributes indicating use-type. This suggests that for some respondents certain MPA designations may be welfare-decreasing, which ultimately implies winners and losers from different policies. While distributional effects are an important political question, they are beyond the scope of this analysis. Future work could be undertaken to determine demographic and other characteristics of those who do and do not benefit from a specific MPA designation. In their analysis of MPAs in northeastern Federal waters, Wallmo and Edwards (2008) found similar preference heterogeneity using a latent class modeling approach – an

approach that could be undertaken with this data as well, the peculiarities noted by the above authors notwithstanding. In addition, state-level models could be estimated, as California has a fairly aggressive approach to establishing MPAs within state waters and this may differentiate public attitudes and support for MPAs in California as compared to the Oregon and Washington public.

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Appendices to:

Public preferences for marine protected areas off the U.S. west coast: the significance of restrictions and size on economic value.

**Appendix A:** The web-based questionnaire

**Appendix B:** Survey results by state and region

## Appendix A – Web-based questionnaire

### Marine Protected Areas off the U.S. West Coast

The National Marine Fisheries Service is sponsoring a survey to understand public opinion about marine protected areas in federal waters off the coasts of California, Oregon, and Washington.

- By *marine protected areas* we mean designated areas of the ocean where different types of activities such as fishing or boating, are monitored or prohibited. These marine protected areas are similar to designated areas on land such as national and state parks.
- By *federal waters* we mean non-coastal waters that typically extend 3 to 200 miles from the shoreline. For this survey we will refer to this ocean area as **West Coast Federal Waters**.

**Your opinions are important!** The best way for policymakers and ocean resource managers to understand the variety of viewpoints people have about ocean management is for you to complete this survey.



The survey is confidential and anonymous, and should take about 20 minutes to complete. Thank you very much for your participation.

## Section 1: Introduction

This survey is about marine protected areas in West Coast Federal Waters. Below is a map that shows West Coast Federal Waters (3-200 miles from the shoreline) in relation to state waters (shoreline to 3 miles).



In the following pages of the survey you will be provided with a description of marine protected areas and their main objectives, and some reasons why people may want larger or smaller marine protected areas. This information is intended to describe marine protected areas at a broad, general level, and is not intended to provide an in-depth analysis of the costs or benefits of marine protected areas.

Before we begin, we would like to ask you a few questions about your use of West Coast Federal Waters.

Q1. Please answer the following questions by checking the appropriate box.

	Yes	No	I am unsure
a. Do you go saltwater fishing for fun or food in West Coast Federal Waters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Do you or does anyone in your family fish commercially in West Coast Federal Waters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Is your job directly tied to West Coast Federal Waters (fishing, defense, shipping, marina, etc.)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Do you participate in recreational or leisure activities in West Coast Federal Waters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Are you currently a member of any type of organization involved with marine-based activities in West Coast Federal Waters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Have you ever visited a marine protected area in West Coast Federal Waters?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Section 2: What are Marine Protected Areas?

Marine Protected Areas, or MPAs, are similar to areas of land designated as state or national parks. The main objectives of MPAs are to:

- Set aside areas of the ocean to conserve, restore, and understand the natural biodiversity and ecology of the area. Natural biodiversity usually includes the fish and shellfish populations, the marine mammals that live or migrate through the MPA boundaries, and the seafloor habitat that these fish and marine mammals rely on for food, shelter, or reproduction.
- Provide people the opportunity to experience these areas of the ocean now and into the future.

For some MPAs, the boundaries are marked with buoys or shore-based signs. In other cases, MPA information and maps are available from government websites, and it is the responsibility of the individual to determine if they are in a MPA. Within the boundaries of a MPA, certain activities that may damage the marine environment are restricted or limited.

- Industrial uses (seabed mining, oil and gas exploration or drilling, windmill or turbine construction, minerals extraction) are prohibited within MPA boundaries.
- Other uses such as commercial and recreational fishing, recreation and nature-based tourism (such as scuba, snorkeling, whale watching), and scientific research may be allowed but are monitored and limited.

Generally when areas of West Coast Federal Waters are designated as MPAs they are permanent designations.

Q2. Please indicate how important you believe each of the following activities are for West Coast Federal Waters by checking the appropriate box.

	Extremely Important	Somewhat Important	Slightly Important	Not Important at all	I am unsure
a. Commercial fishing	<input type="checkbox"/>				
b. Recreational fishing	<input type="checkbox"/>				
c. Oil and gas development	<input type="checkbox"/>				
d. Marine-based recreation and tourism (whale watching, scuba, snorkeling)	<input type="checkbox"/>				
Alternative energy development (windmills, turbines)	<input type="checkbox"/>				

### Section 3: Marine Protected Area Size – Large or Small?

The appropriate size for a marine protected area is a difficult and controversial question for policymakers. Economic and social impacts are usually considered alongside the ecological and biological benefits of designating an area as an MPA.

- Some people may prefer large MPAs because they feel that designating larger areas will increase monitoring in these areas, prohibit industrial uses (seabed mining, oil and gas exploration or drilling, windmill or turbine construction, minerals extraction), and regulate other activities such as commercial and recreational fishing, nature-based recreation and tourism, and scientific research, if they damage the marine environment. In addition, some people may prefer large MPAs because they feel that larger MPAs will better protect marine biodiversity and habitat.
- In contrast, some people may prefer small MPAs, or no MPAs at all, because they feel the social and economic costs are too high. For example, MPAs can be expensive to designate, monitor and regulate. This cost may be passed on to the general public in the form of taxes, higher prices for fishing or boating licenses, or higher prices for seafood. In addition, the industrial uses that are prohibited within MPAs may lead to a loss of jobs related to these industries. Some people may also feel that the regulation of activities such as fishing, nature-based recreation and tourism, and scientific research is a cost that will limit their own or others enjoyment and use of the marine environment.

Q3. Please indicate how much you agree or disagree with the following statements by checking the appropriate box.

	Strongly Agree	Some what Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
a. I like knowing that a portion of West Coast Federal Waters is protected as an MPA even if I never see or use it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. MPAs are not needed in West Coast Federal Waters because marine biodiversity and habitats are in good shape.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. I would be willing to pay higher prices for products like seafood to establish MPAS in West Coast Federal Waters.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Our society has a duty to protect marine life and habitats in a natural state.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Industries and businesses should be compensated for lost income due to restrictions put in place for MPAs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### Marine Protected Area Size – What Scientists Believe

In 2001 a group of marine scientists from universities around the world assembled to summarize what was known about the design of marine protected areas in the U.S. and other countries. The group reported that no two places are alike, but in general:

- Between 10% and 40% of a marine ecosystem might be needed to preserve all of the species of marine life in their natural habitats.
- Even so, marine protected areas that cover relatively small areas still offer some protection for marine life and habitat.

Section 4: Current Status of Marine Protected Areas in West Coast Federal Waters

Within the boundaries of all permanent marine protected areas in West Coast Federal Waters industrial uses are prohibited. These industrial uses include seabed mining, oil and gas exploration or drilling, windmill or turbine construction, minerals extraction. However, other kinds of activities may be allowed, depending on the type of MPA. Below is a description of three main types of permanent MPAs and the percentage of West Coast Federal Waters designated to each type.

Multiple Use MPAs

- **Multiple Use MPAs** allow commercial and recreational fishing, nature-based recreation and tourism, and scientific research activities within their boundaries as long as they do not destroy marine biodiversity or habitat. All activities are monitored. About 2.95% of West Coast Federal Waters are permanently protected as a Multiple Use MPA.

No-Take MPAs

- **No-Take MPAs** allow human access and activities that do not extract or harvest any marine resources. All activities are monitored. About 0.05% of West Coast Federal Waters are permanently protected as No-Take MPAs.

No-Access MPAs

- **No-Access MPAs** are closed to all human access except for limited monitoring, and are used to prevent potential ecological disturbance and as a refuge for marine wildlife. 0% of West Coast Federal Waters are permanently protected as No-Access MPAs.

Q4. Please indicate how much you agree or disagree with the following statements by checking the appropriate box.

	Strongly Agree	Some what Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
a. Fishing should be allowed within MPAs as long as the fishing gear does not damage habitat.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Some parts of West Coast Federal Waters should prohibit all human activities within their boundaries (no-access).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Other Closed Areas in West Coast Federal Waters

In addition to the permanent marine protected areas in West Coast Federal Waters, there are other types of closed areas in West Coast Federal Waters that are temporarily closed to some or all types of fishing. These areas are focused on rebuilding fish or shellfish populations that have been overfished and are in need of protection.

Currently about 7% of West Coast Federal Waters are closed for rebuilding fish or shellfish populations. This amount can vary throughout the year, and the area boundaries can change depending on the status of fish and shellfish populations.

Unlike permanent MPAs, these temporary closed areas can be reopened when scientists and policymakers decide that these fish and shellfish populations are large enough to withstand fishing pressure.

Q5. Please indicate how much you agree or disagree with the following statements by checking the appropriate box.

	Strongly Agree	Some what Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
a. The marine environment is a public resource and none of it should be restricted.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Temporary protected areas that are focused on rebuilding fish and shellfish populations provide enough protection for marine life in West Coast Federal Waters.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Section 5: Your Preferences for Different Sized Marine Protected Areas

**In this section we ask you to assume that you are part of a Citizens Advisory Panel, or CAP. CAPs are often used when policymakers need public input on specific topics, and the input is intended to represent a variety of citizens’ attitudes and opinions. Most CAP members do not have in-depth scientific or technical knowledge of the specific topic they are being asked to provide input on.**

Q6. Please answer the following question by checking the appropriate box.

	Yes	No	I am unsure
a. Have you ever participated in a Citizens Advisory Panel?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**As a member of this CAP you will be shown a series of questions that ask you to compare three options for permanent MPAs in West Coast Federal Waters and choose the option you most prefer and the option you least prefer.**

- **Option 1 always represents the Current Status of No-Access MPAs, No-Take MPAs, and Multiple Use MPAs in West Coast Federal Waters.**
- **Option 2 and Option 3 increase the amount of at least one type of MPA in West Coast Federal Waters.**
  - By choosing Option 2 or Option 3 there is an added cost to your household. This cost would come through a payment added to your Federal tax return every year for the next three years. The payment would be used for research, monitoring, and enforcement within MPAs and to help offset costs to industries affected by any new restrictions until they can adjust to the changes.

Please note that larger MPAs may not always cost the most, and smaller MPAs may not always cost the least. Cost can depend on many factors, including the location of the MPA, the types of industries that may be affected, and regulations within the MPA.

For hypothetical questions like these, studies have shown that many people say they are willing to pay more for establishing MPAs than they actually would pay out of their pockets. We believe this happens because people do not really consider how big an impact an extra cost actually has to their family’s budget when answering these types of questions. It is easy to be generous when you do not really need to open your wallet.

To avoid this, as you consider each question, please imagine your household actually paying the cost of the option you select out of your household’s budget.

The following table shows three options for permanent MPAs in West Coast Federal Waters. Please look at the information contained in each option and answer the questions at the bottom of the table.

If you allow your cursor to hover over the blue texts, a box will appear that gives you more information about different types of MPAs.

MPAs West Coast Federal Waters	Option 1 (Current Status)	Option 2	Option 3
% of West Coast Federal Waters designated <b>No-Access MPAs</b>	0%	<b>Experimental Design Levels used to populate options</b>	
% of West Coast Federal Waters designated <b>No-Take MPAs</b>	0.05%		
% of West Coast Federal Waters designated <b>Multiple Use MPAs</b>	2.95%		
Total amount of West Coast Federal Waters designated as a Marine Protected Area	3%		
Cost to your Household This cost will be added to your household's Federal Income Tax <u>every</u> year for three years	\$0		
Q6b. Which option do you most prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>
Q6c. Which option do you least prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>

Q6d. Why did you choose Option 1 as the option that you most prefer? (check all that apply)

- The amount of permanent MPAs currently in West Coast Federal Waters is enough
- The annual costs of Options 2 and 3 are too expensive
- MPAs place too many restrictions on industries and recreational activities
- I do not feel it is my responsibility to pay for preserving the marine environment
- I don't trust the government to run the program
- I should not have to pay more taxes for any reason
- I need more information to make a choice
- There are other temporary closed areas that offer protection in West Coast Federal Waters
- I am too unsure about how I feel about MPAs
- I do not think MPAs will be effective or accomplish their goals
- More research needs to be done before I would pay for MPAs
- Other (please explain) \_\_\_\_\_

The next question is similar to the previous one. Please look at the information contained in each option and answer the question at the bottom of the table.

MPAs West Coast Federal Waters	Option 1 (Current Status)	Option 2	Option 3
% of West Coast Federal Waters designated <b>No-Access MPAs</b>	0%	Experimental Design Levels used to populate options	
% of West Coast Federal Waters designated <b>No-Take MPAs</b>	0.05%		
% of West Coast Federal Waters designated <b>Multiple Use MPAs</b>	2.95%		
Total amount of West Coast Federal Waters designated as a Marine Protected Area	3%		
Cost to your Household This cost will be added to your household's Federal Income Tax <u>every</u> year for three years	\$0		
Q6e. Which option do you most prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>
Q6f. Which option do you least prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>

The next question is similar to the previous one. Please look at the information contained in each option and answer the question at the bottom of the table.

MPAs West Coast Federal Waters	Option 1 (Current Status)	Option 2	Option 3
% of West Coast Federal Waters designated <b>No-Access MPAs</b>	0%	Experimental Design Levels used to populate options	
% of West Coast Federal Waters designated <b>No-Take MPAs</b>	0.05%		
% of West Coast Federal Waters designated <b>Multiple Use MPAs</b>	2.95%		
Total amount of West Coast Federal Waters designated as a Marine Protected Area	3%		
Cost to your Household This cost will be added to your household's Federal Income Tax <u>every</u> year for three years	\$0		
Q6e. Which option do you most prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>
Q6f. Which option do you least prefer for West Coast Federal Waters? (check only one box)	Option 1 <input type="checkbox"/>	Option 2 <input type="checkbox"/>	Option 3 <input type="checkbox"/>

Section 6: Attitudes Toward the Environment

In this section, we would like to ask a few questions about your attitudes toward the ocean and the environment in general.

Q7. In general, how frequently do you participate in the following activities?

	At least once a day	At least once a week	At least once a month	At least once a year	I do not participate in this activity
a. Purchase or eat seafood at restaurants, grocery stores, or at home	<input type="checkbox"/>				
b. View ocean features (such as waves) or wildlife (such as seabirds or dolphins)	<input type="checkbox"/>				
c. Recreational fishing or shellfishing in ocean or coastal waters	<input type="checkbox"/>				
d. Boating, kayaking, canoeing, or other boating activities in ocean or coastal waters	<input type="checkbox"/>				
e. Swimming, surfing, scuba diving, or other water contact activities in ocean or coastal waters	<input type="checkbox"/>				
f. Other activities such as sunbathing, tidepooling, camping, bonfires, horseback riding, etc., in view of the ocean or coast	<input type="checkbox"/>				

Q8. How much do you trust each of the following to effectively manage ocean uses and activities in West Coast Federal Waters?

	Trust completely	Trust somewhat	Distrust somewhat	Don't trust at all	I am unsure
a. Federal agencies, including scientists and policymakers	<input type="checkbox"/>				
b. State agencies, including scientists and policymakers	<input type="checkbox"/>				
c. Local governments	<input type="checkbox"/>				
d. Academic scientists such as those in universities or private consulting firms	<input type="checkbox"/>				
e. Citizen advisory panels made up of local interests such as business and environmental interests	<input type="checkbox"/>				

Q9. Below are statements about the relationship between humans and the environment. For each statement, please indicate how much you agree or disagree by checking the appropriate box.

	Strongly Agree	Some what Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
a. We are approaching the limit of the number of people the earth can support	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Humans have the right to modify the natural environment to suit their needs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. When humans interfere with nature it often produces disastrous consequences	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Human ingenuity will insure that we do not make the earth unlivable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Humans are severely abusing the environment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. The earth has plenty of natural resources if we just learn how to develop	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Plants and animals have as much right as humans to exist	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. The balance of nature is strong enough to cope with the impacts of modern industrial nations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Despite our special abilities humans are still subject to the laws of nature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. The so-called "ecological crisis" facing humankind has been greatly exaggerated	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
k. The earth is like a spaceship with limited room and resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
l. Humans were meant to rule over the rest of nature	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
m. The balance of nature is very delicate and easily upset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
n. Humans will eventually learn enough about how nature works to be able to control it	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
o. If things continue on their present course, we will soon experience a major ecological catastrophe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

In these last three questions, we would like to ask you how the current state of the U.S. economy may be affecting you and your household.

Q10. Have you or someone in your household been jobless at some point in the last 12 months?

- Yes
- No
- I don't know

Q11. Do you think that you and your household are better off, just about the same, or worse off financially than you were a year ago?

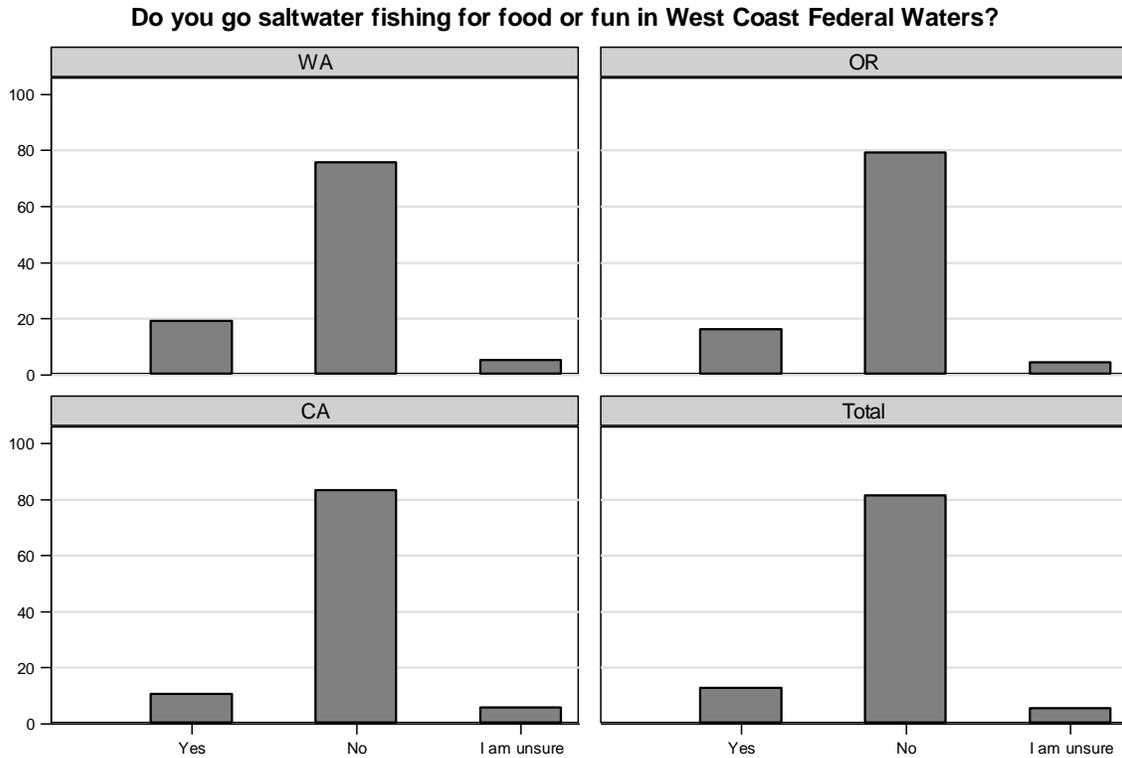
- We are better off
- We are just about the same
- We are worse off

Q12. Looking ahead to a year from now, do you think that you and your household will be financially better off, just about the same, or worse off financially?

- We will be better off
- We will be just about the same
- We will be worse off

## Appendix B – Survey results by state and region<sup>8,9</sup>

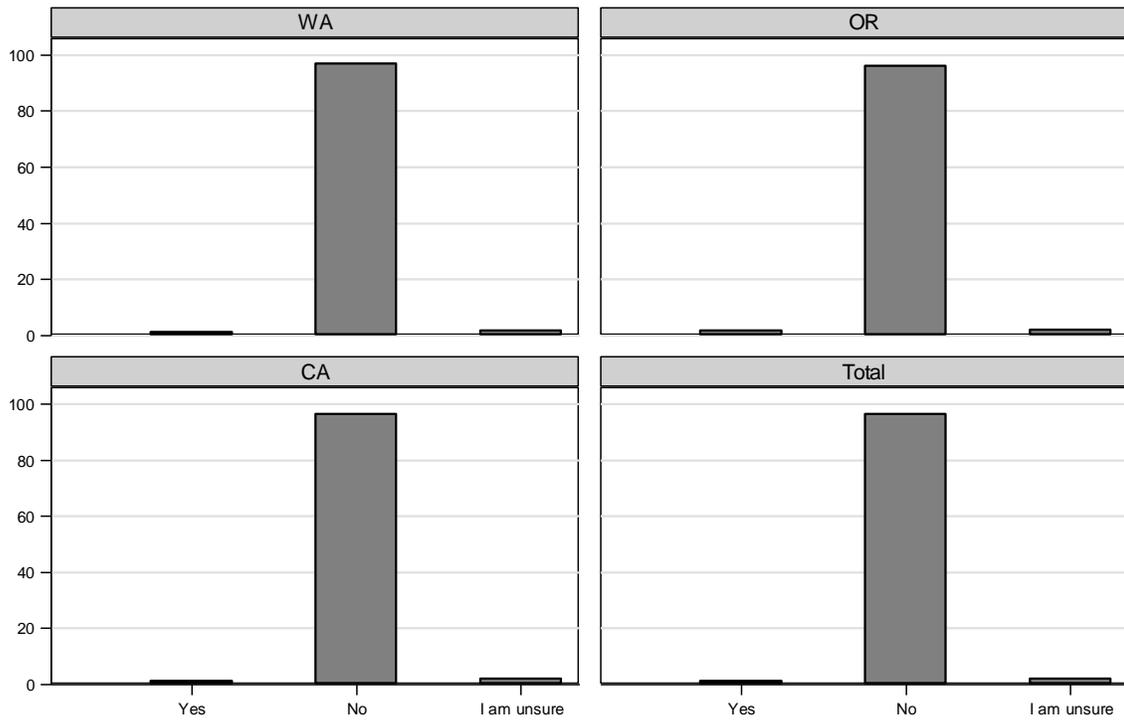
### 1A. Uses of the marine environment – West Coast (Q1, Q2)



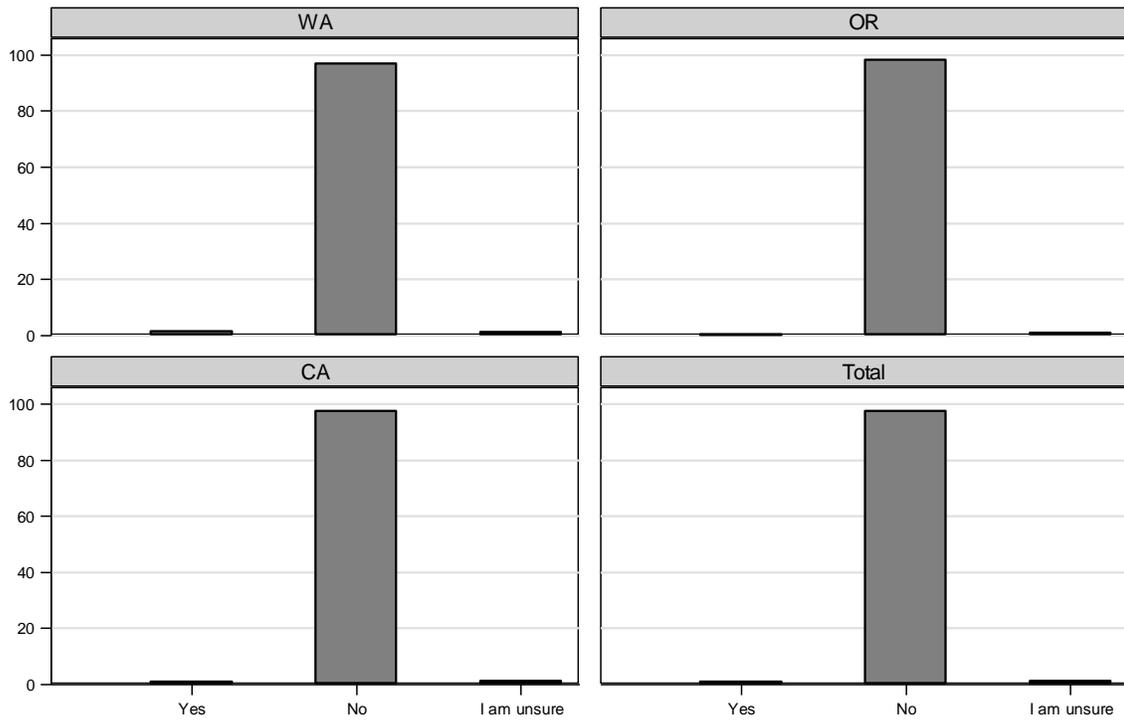
<sup>8</sup> The sampling design for this study does not support state level comparisons for Oregon and Washington because the sample sizes for these states were too small. The state level responses are provided here for illustrative purposes only.

<sup>9</sup> There were 3,354 possible respondents in this data collection. The number of respondents included in each graph is indicated (e.g., “n=3329”). This number excludes those who did not respond to a particular question.

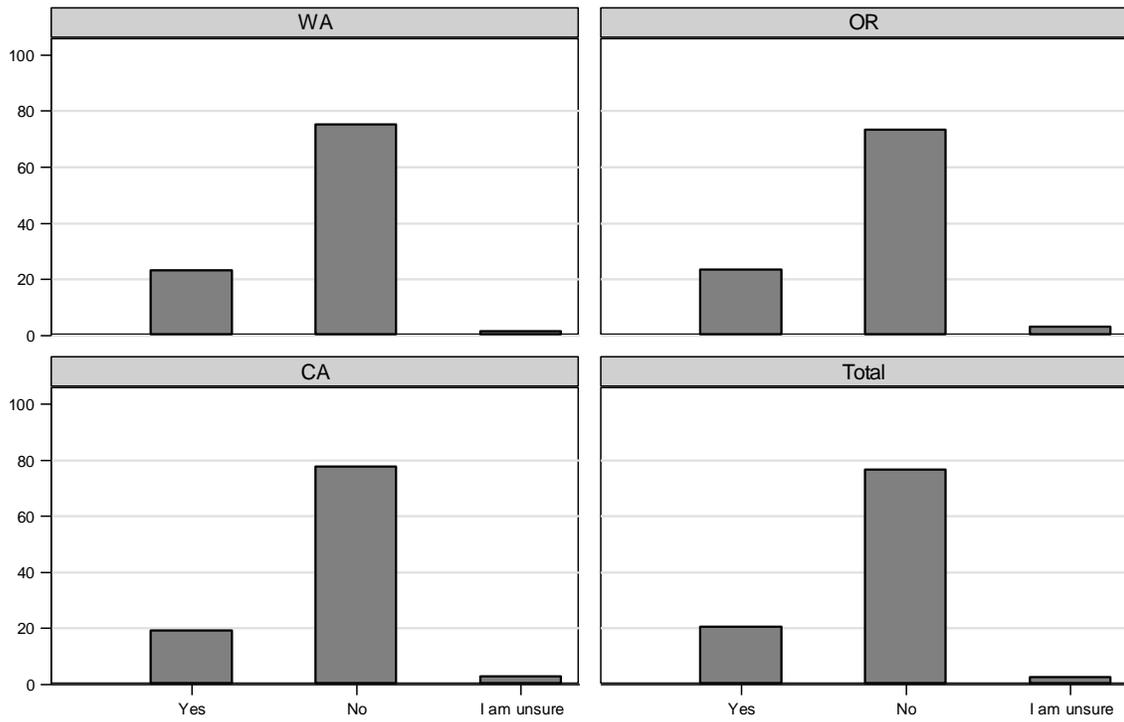
**Do you or does someone in your family fish commercially in West Coast Federal Waters?**



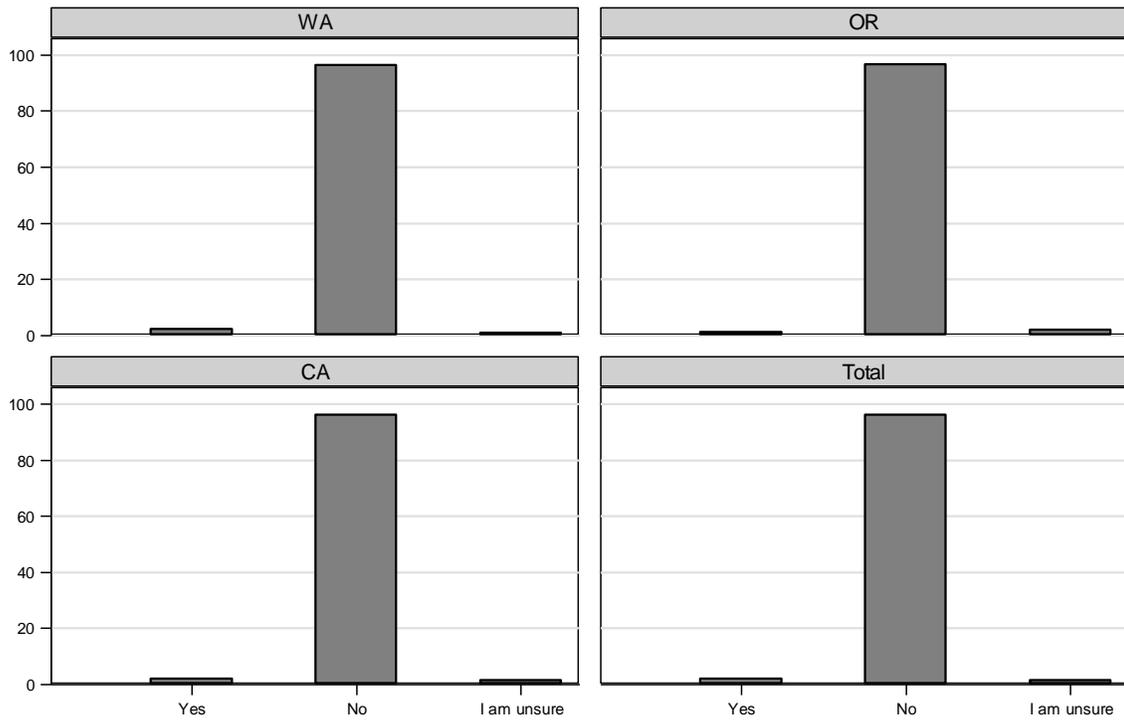
### Is your job directly tied to West Coast Federal Waters?



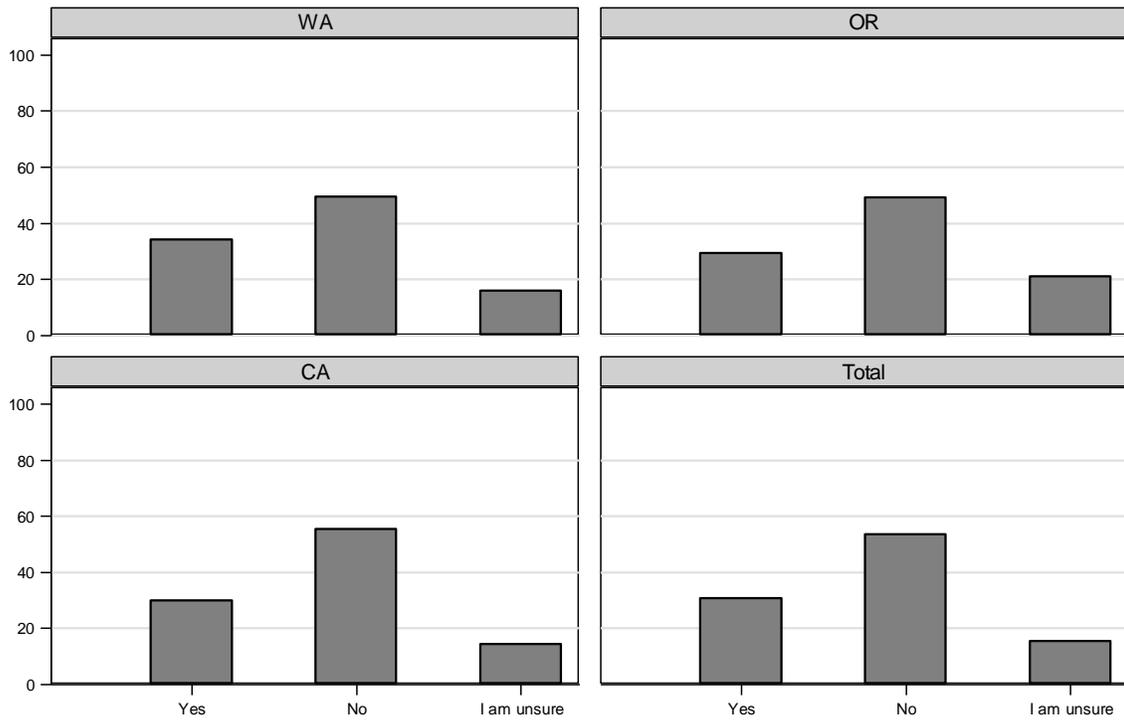
**Do you participate in recreational activities in West Coast Federal Waters?**



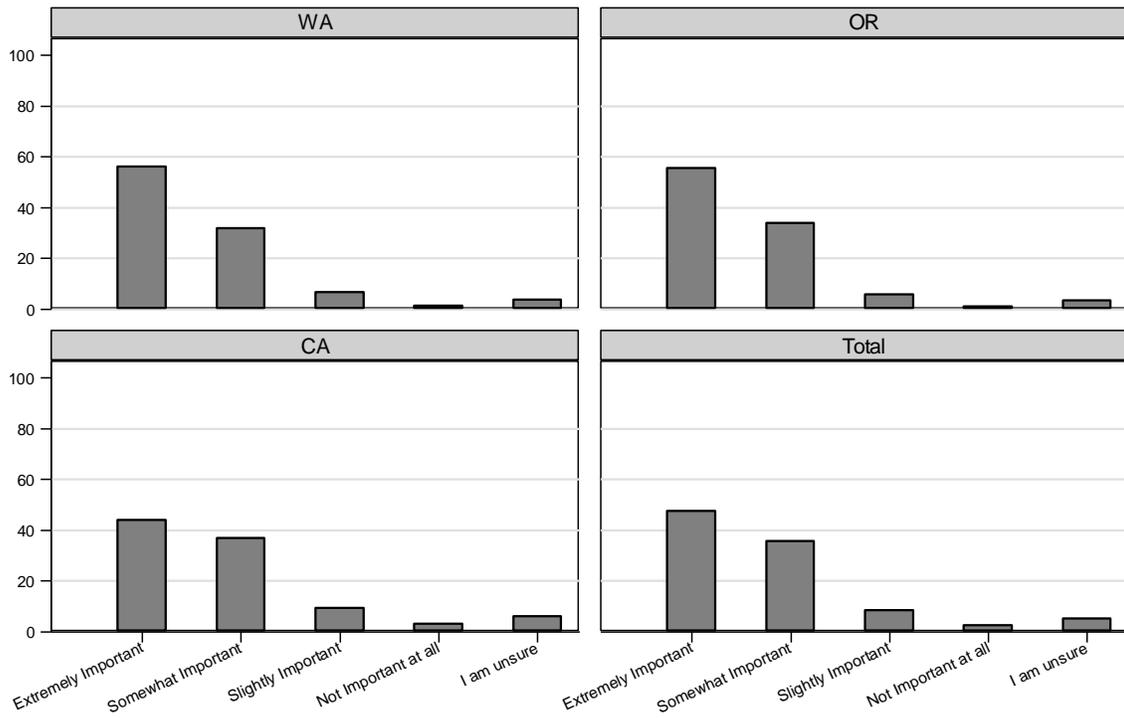
**Are you currently a member of a marine-based organization in West Coast Federal Waters?**



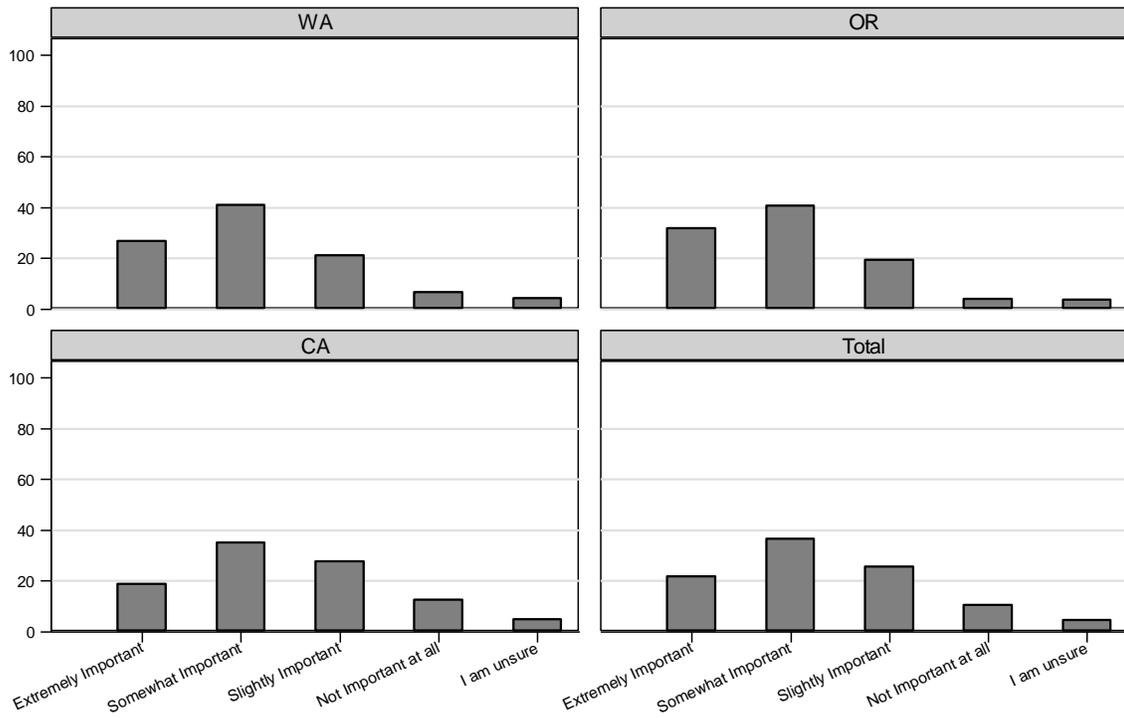
### Have you ever visited an MPA in West Coast Federal Waters?



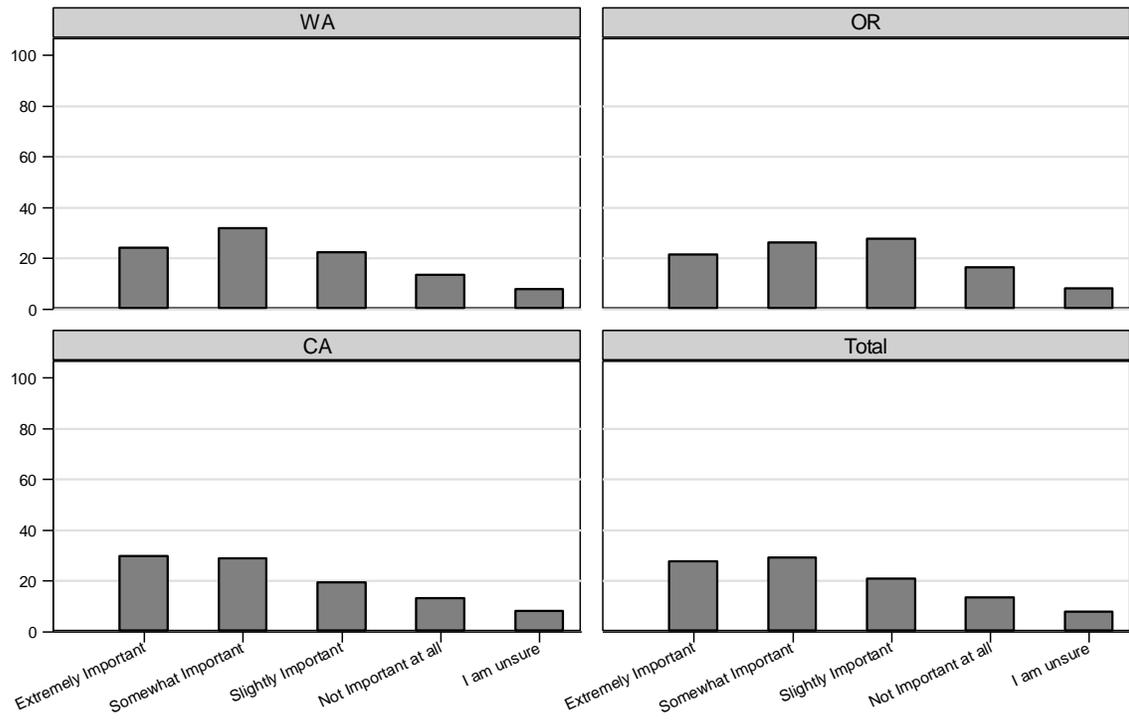
### Importance to West Coast Federal Waters: commercial fishing



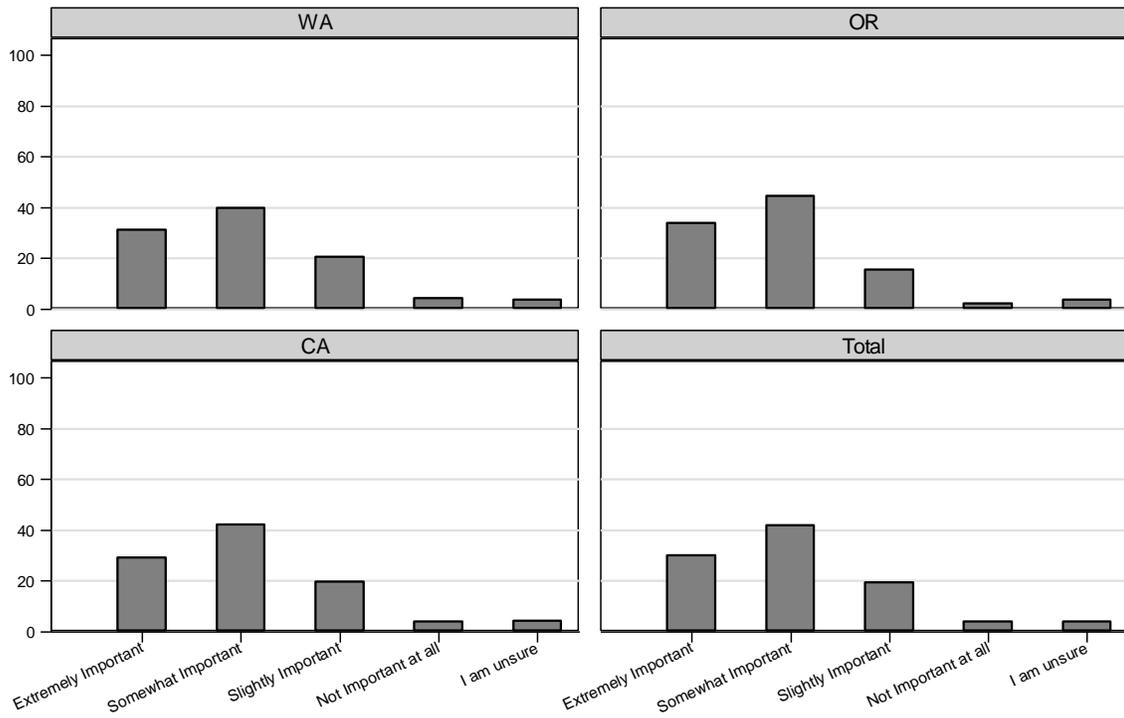
### Importance to West Coast Federal Waters: recreational fishing



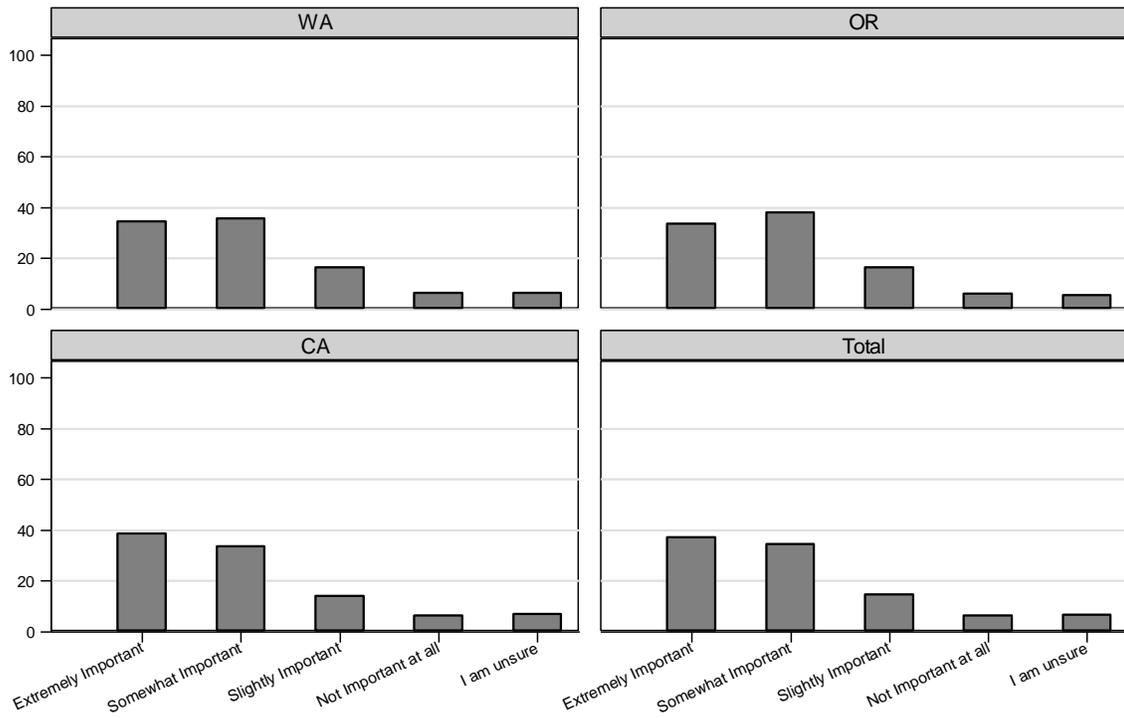
**Importance to West Coast Federal Waters: oil and gas development**



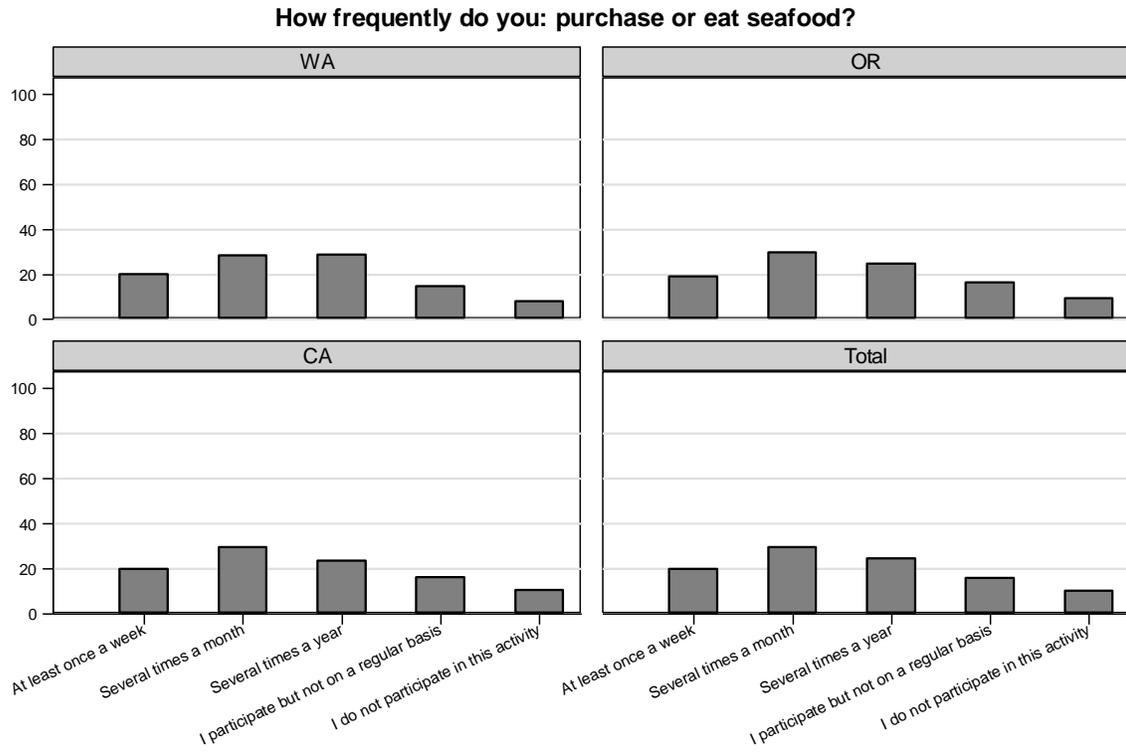
**Importance to West Coast Federal Waters: marine recreation and tourism**



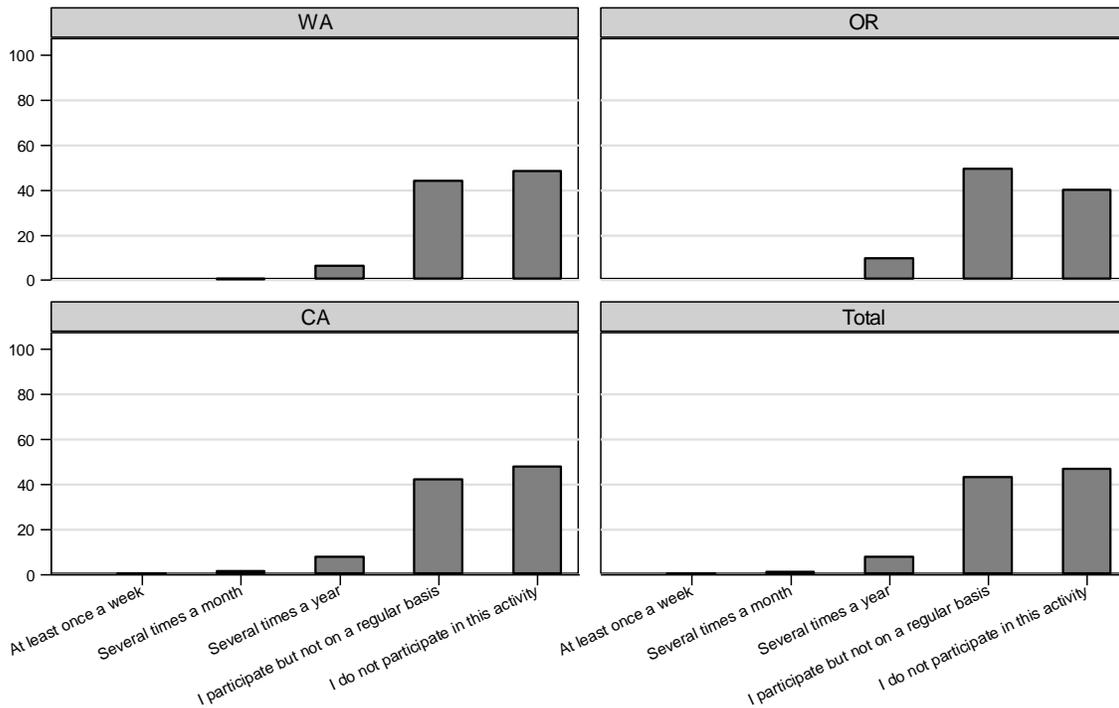
### Importance to West Coast Federal Waters: alternative energy development



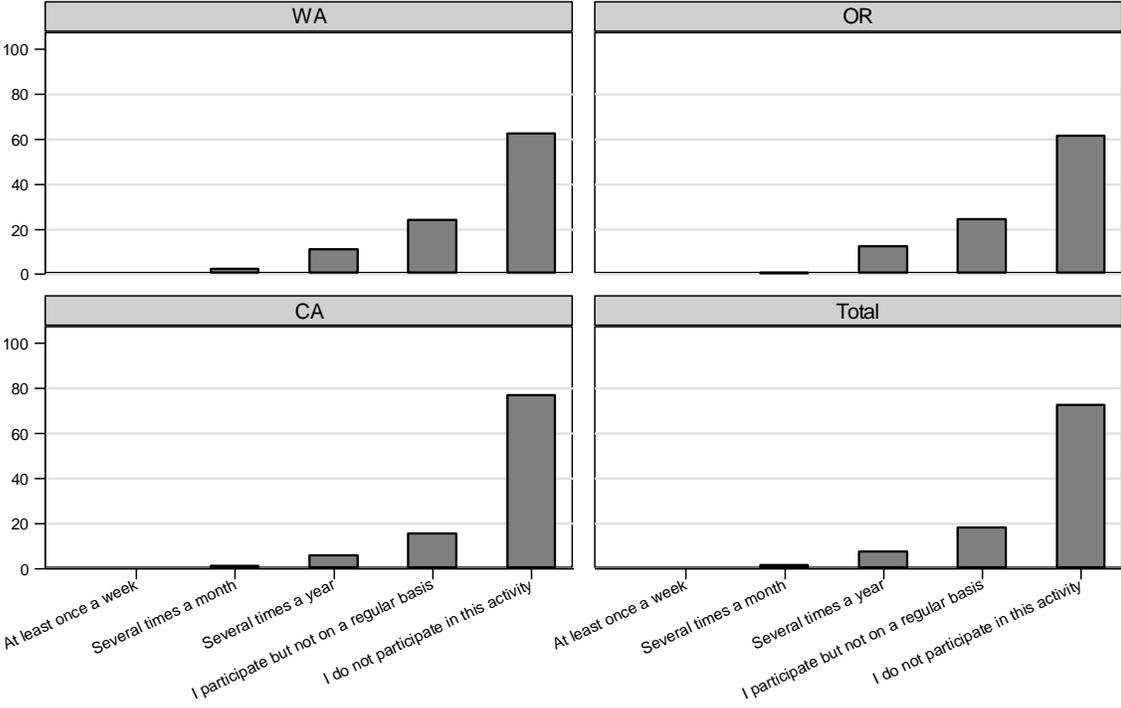
1B. Uses of the marine environment – General marine environment (Q7)



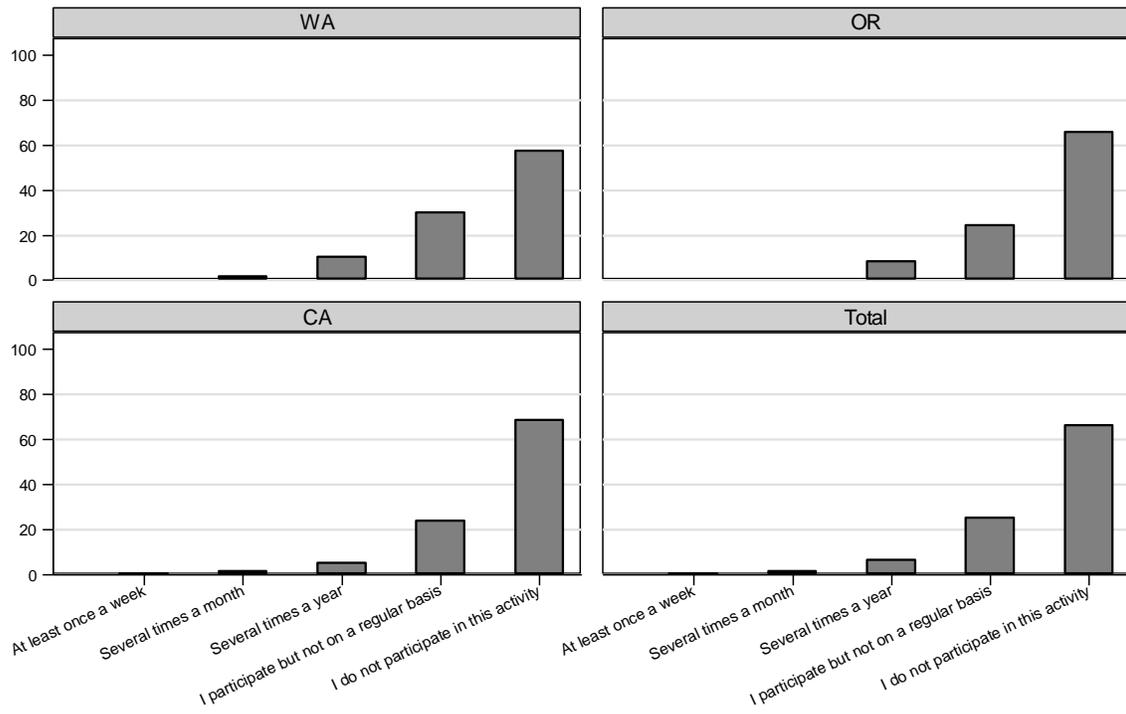
**How frequently do you: view ocean features or wildlife?**



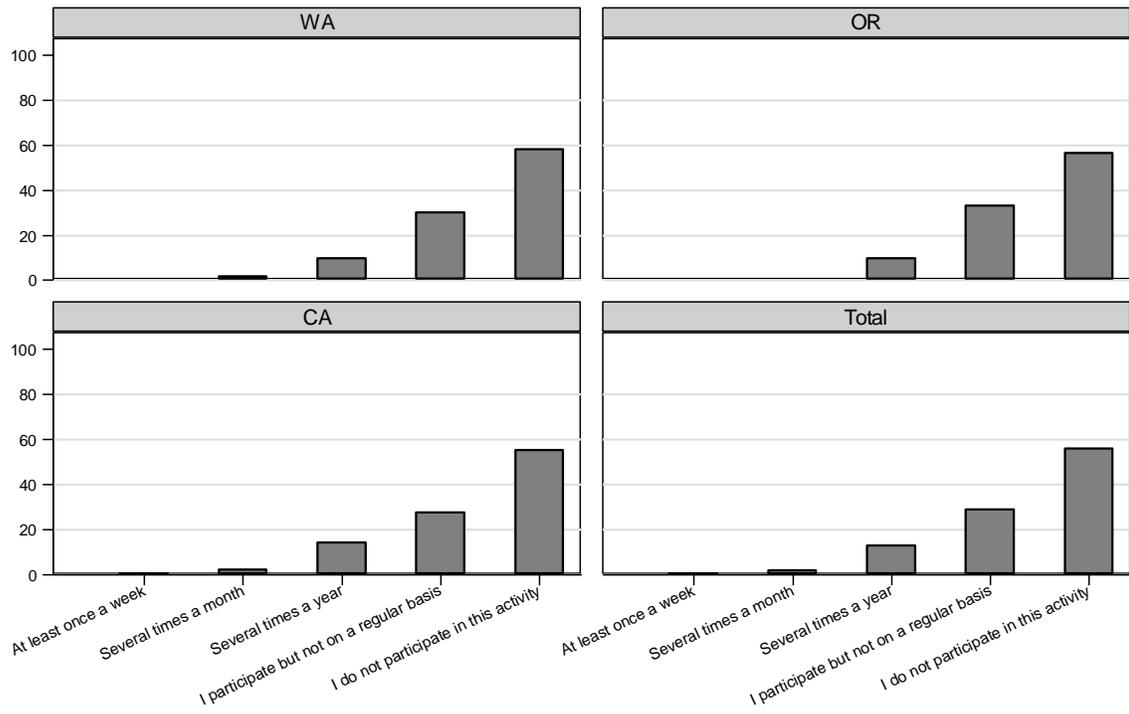
**How frequently do you: go recreational fishing or shellfishing in ocean/coastal waters?**



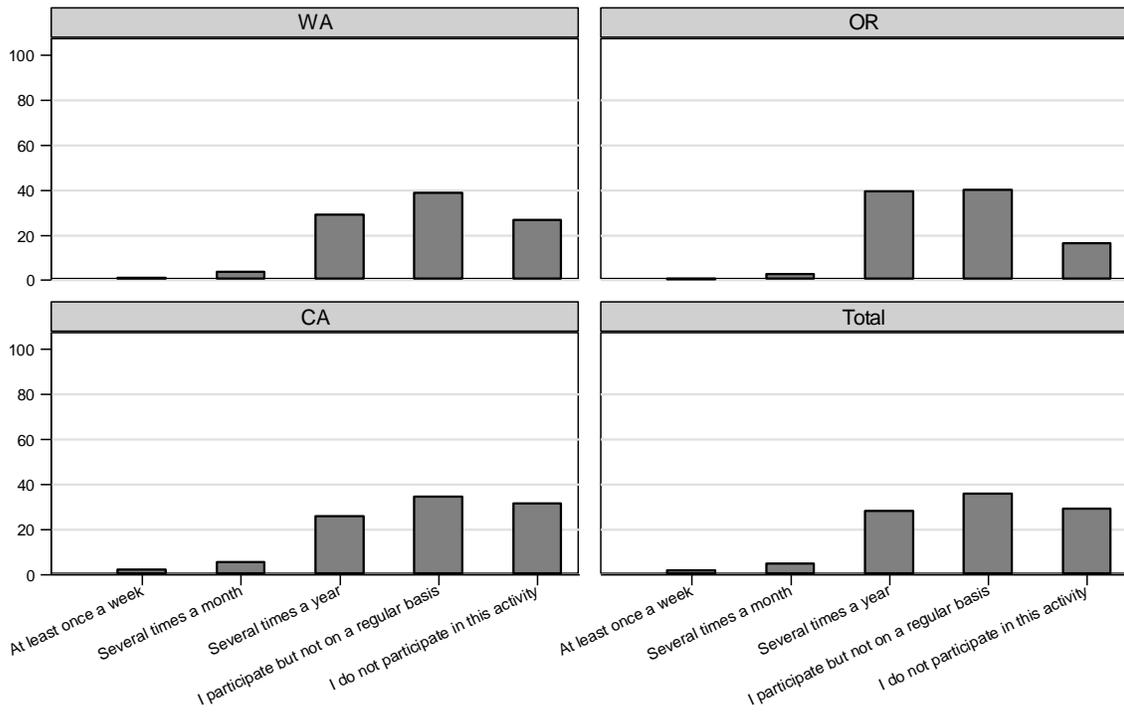
**How frequently do you: go boating/kayaking/canoeing/etc. in ocean/coastal waters?**



**How frequently do you: swim/surf/dive/other water contact in ocean/coastal waters?**

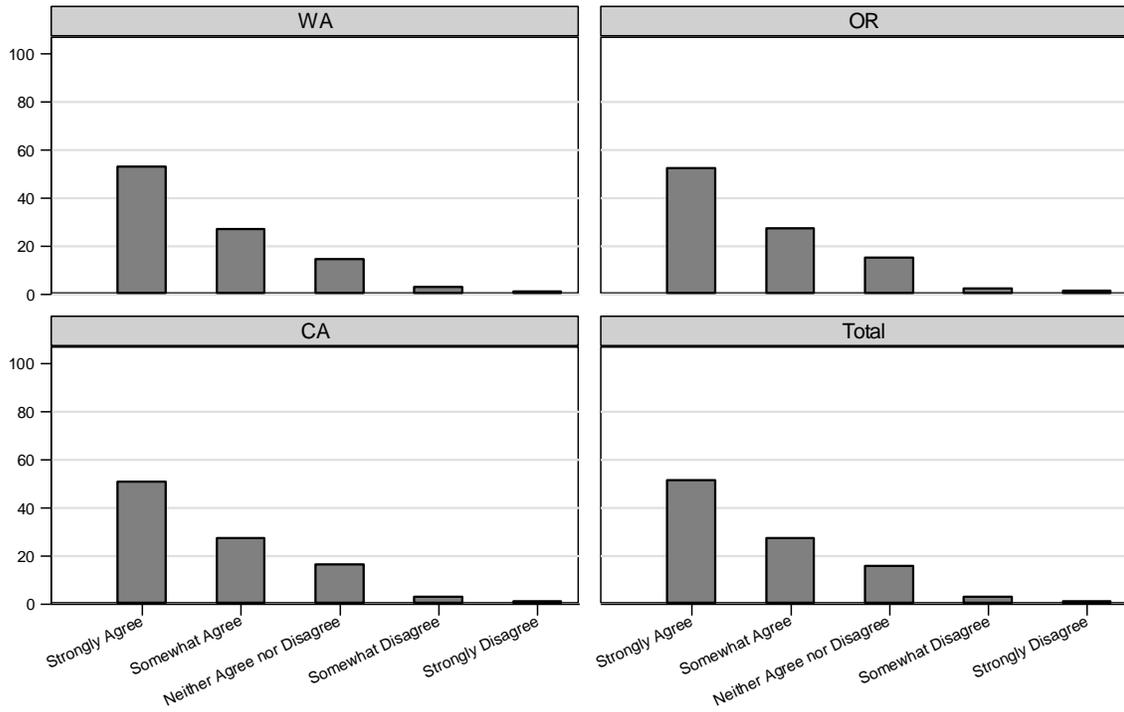


**How frequently do you: do other ocean/coastal activities like sunbathing/tidepooling/etc.?**

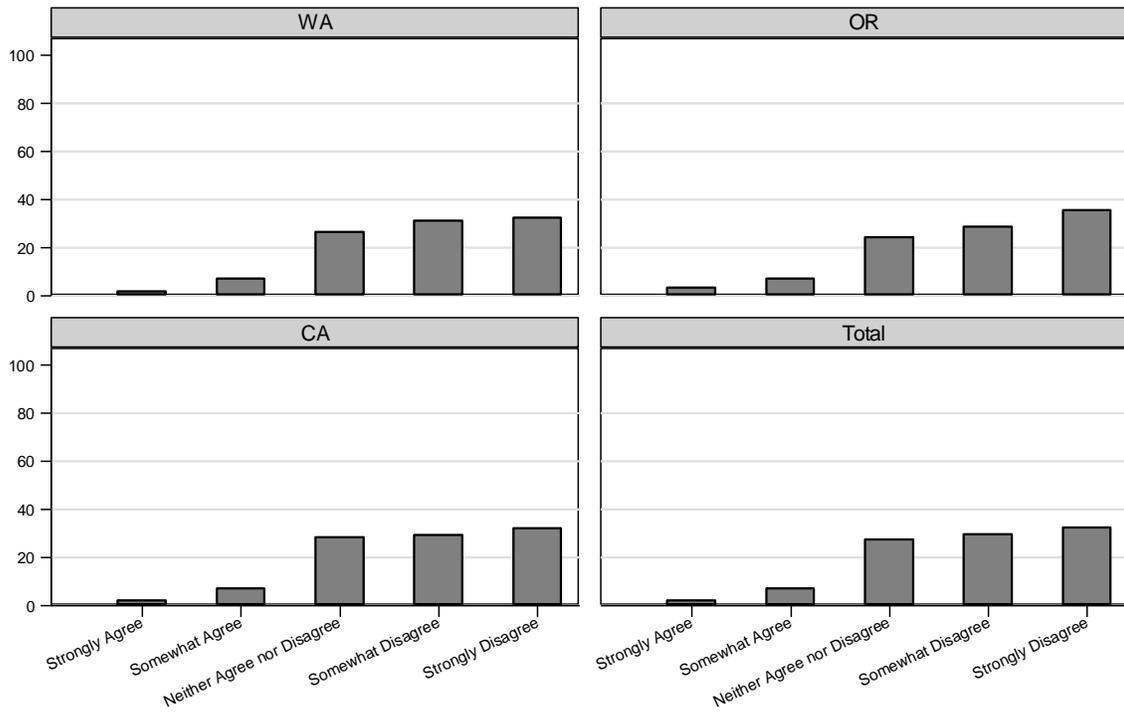


2A. Respondent attitudes – Marine protected areas (Q3)

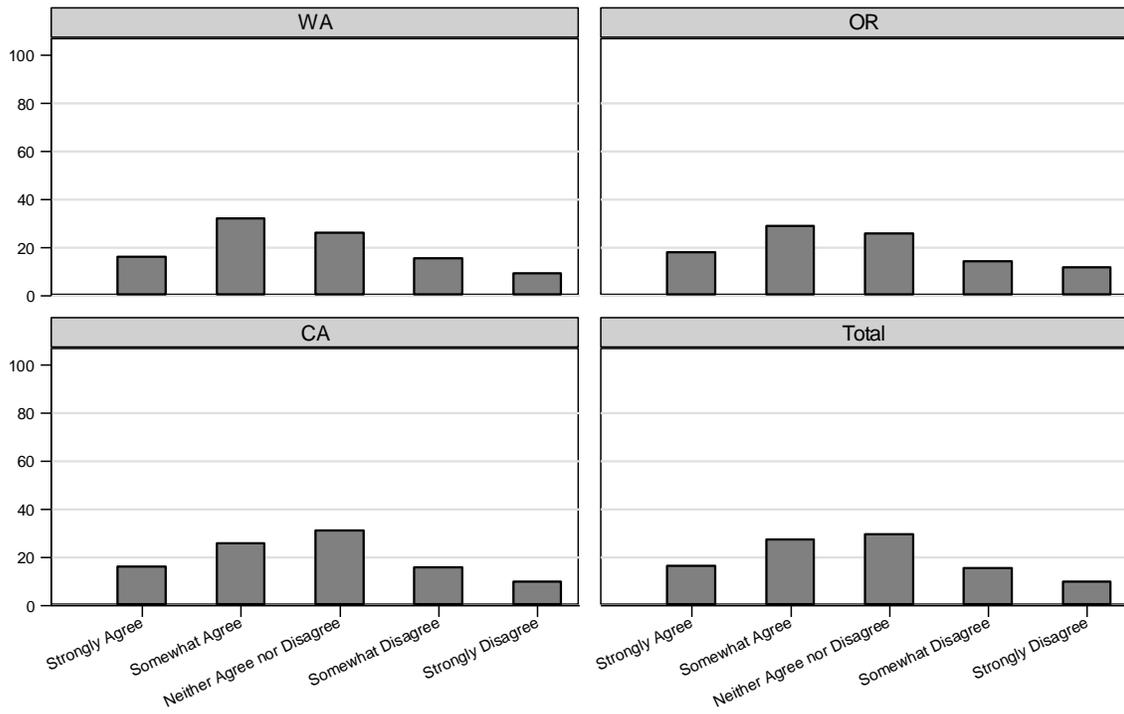
I like knowing that a portion of WC Federal Waters is protected even if I never see/use it.



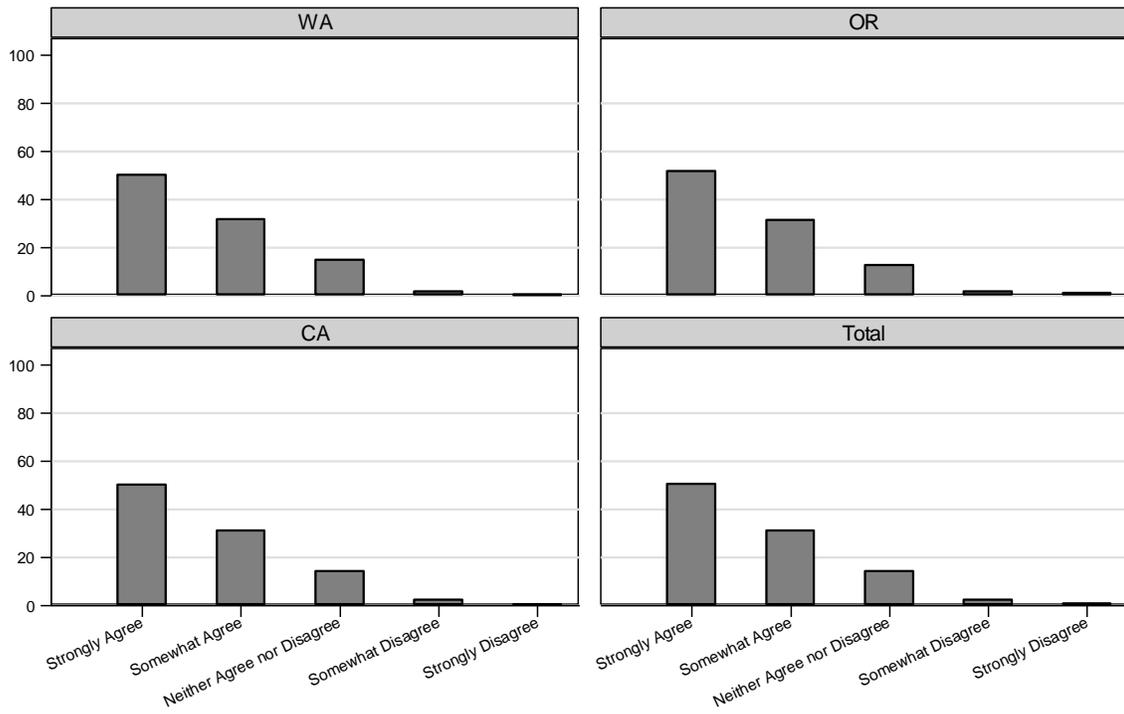
**MPAs are not needed in WC Fed Waters because biodiversity/habitats are in good shape.**



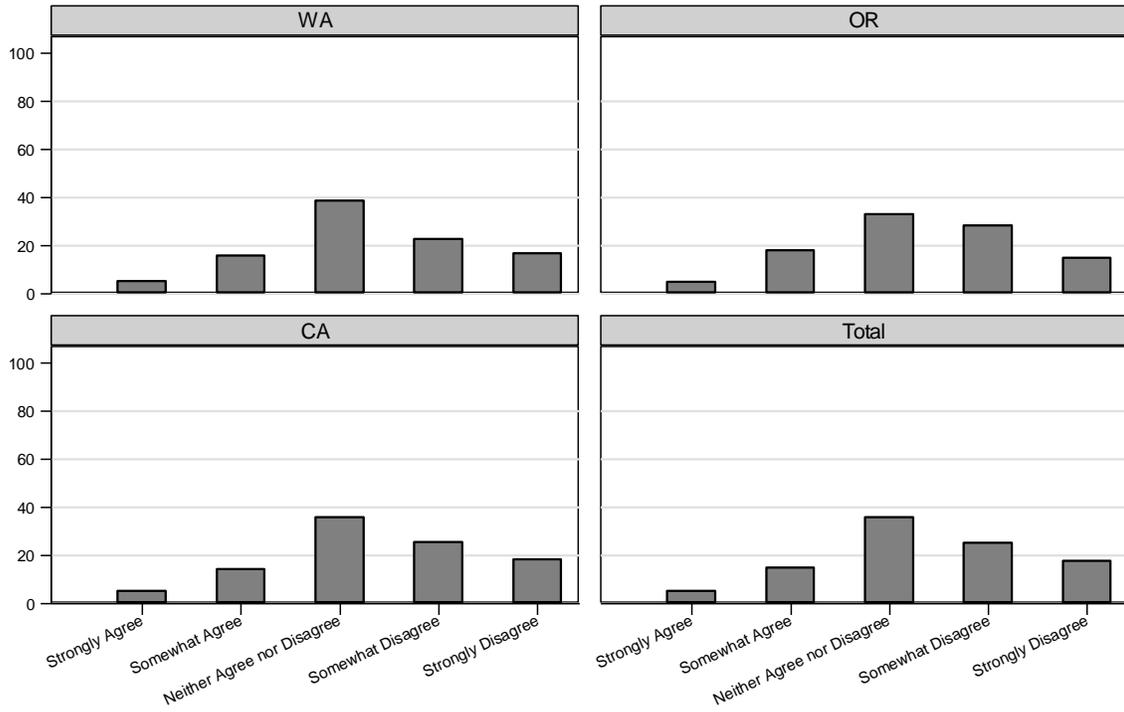
**I would pay higher prices for products like seafood to establish MPAs in WC Fed Waters.**



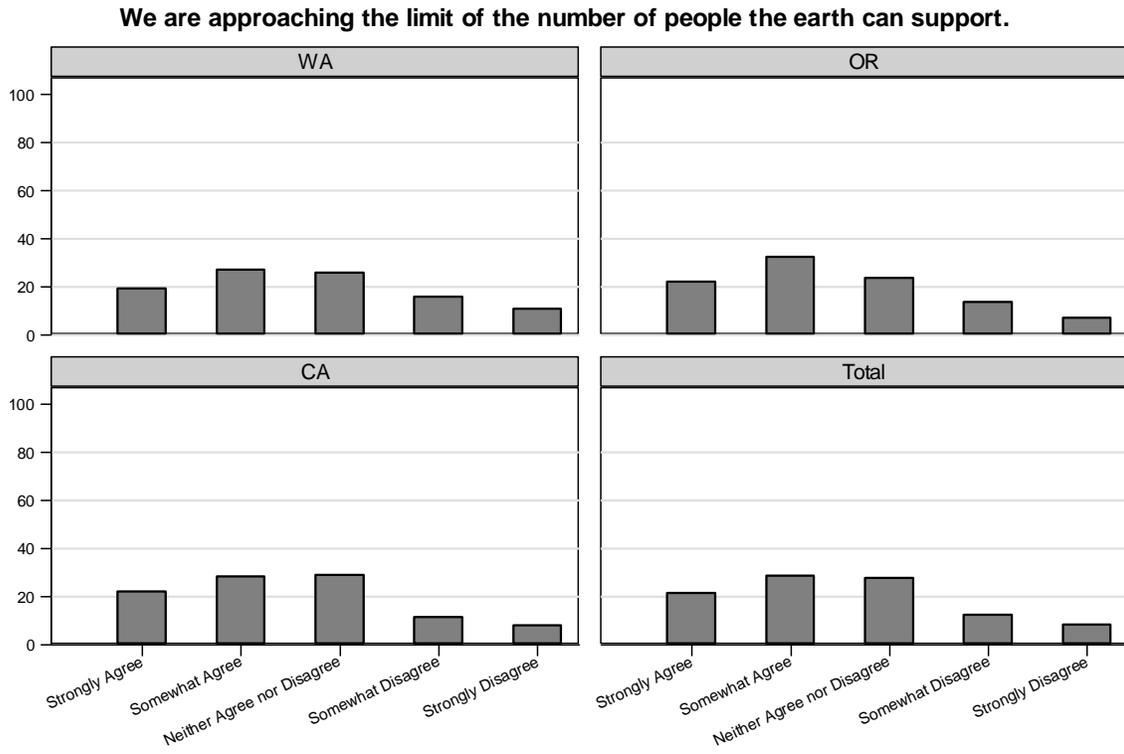
**Our society has a duty to protect marine life and habitats in a natural state.**



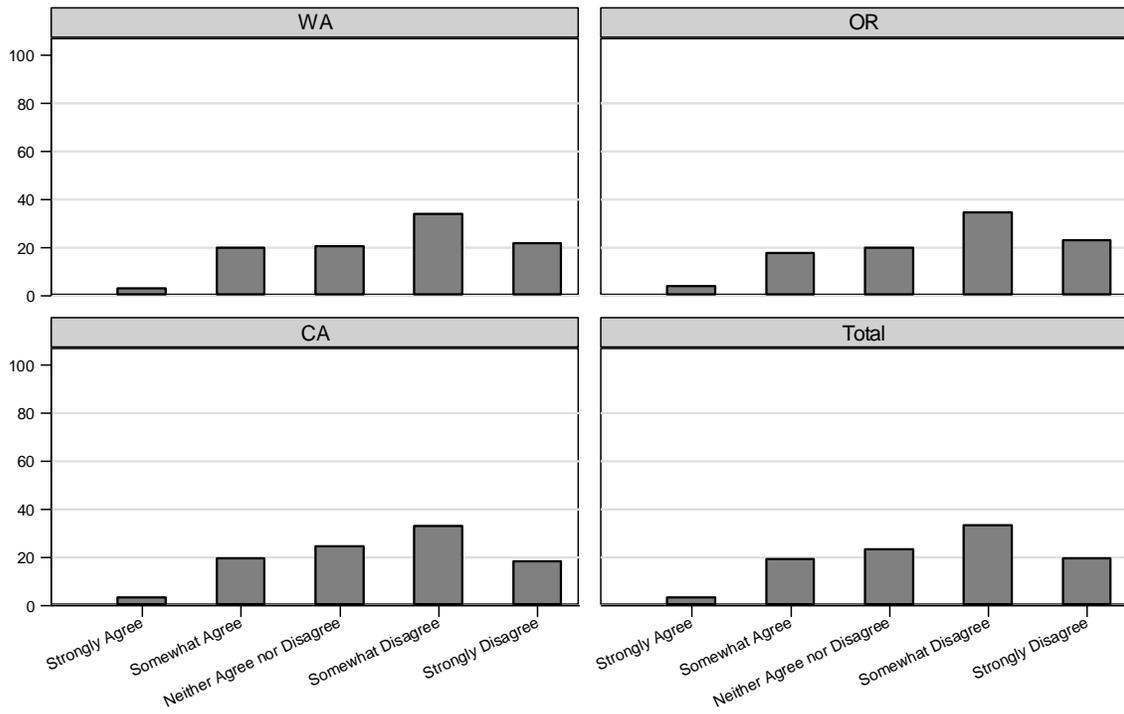
**Industries and businesses should be compensated for lost income due to MPA restrictions.**



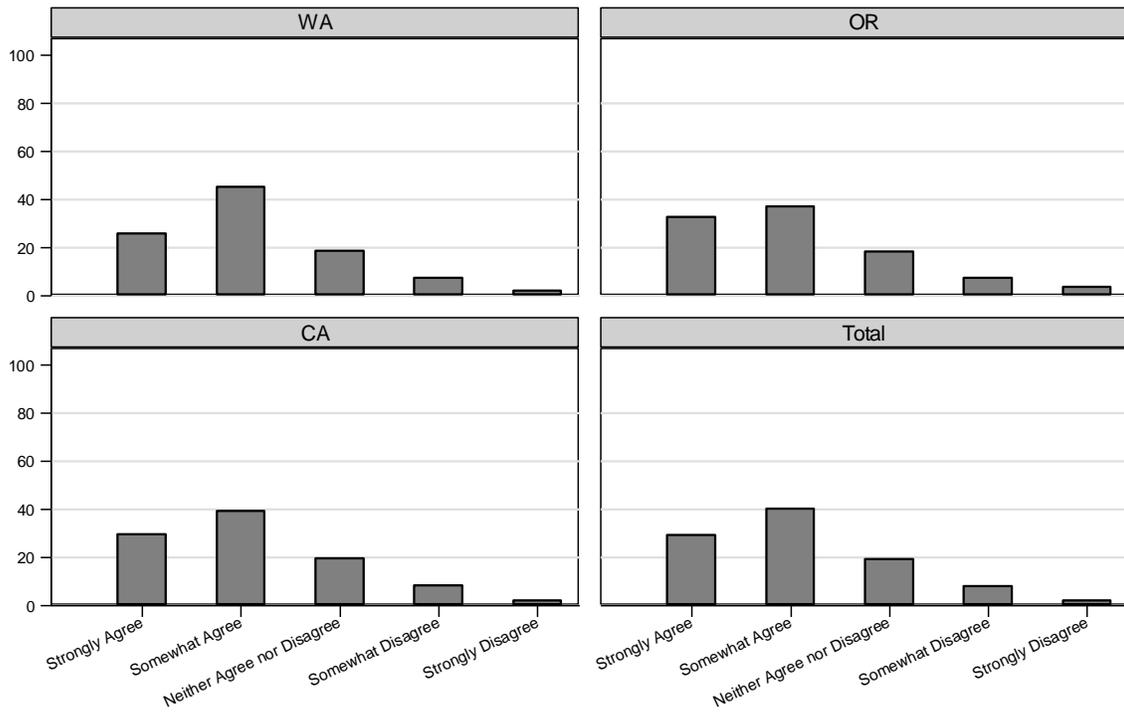
2B. Respondent attitudes – General environment, New Ecological Paradigm (NEP) (Q9)



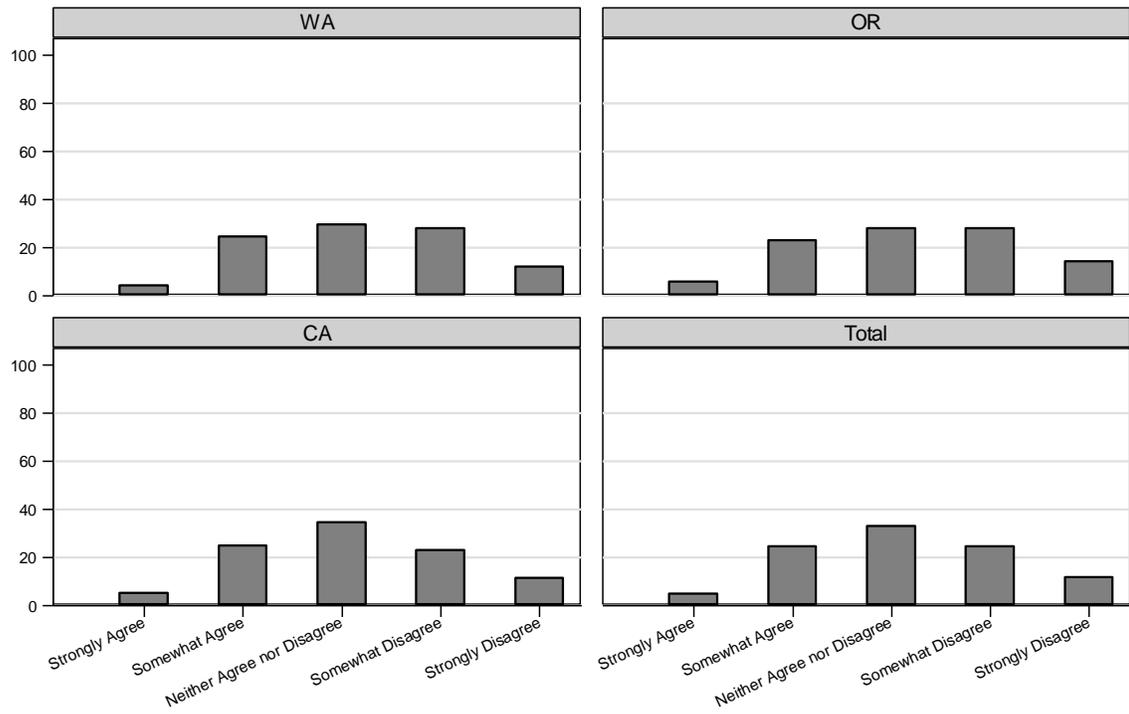
**Humans have the right to modify the natural environment to suit their needs.**



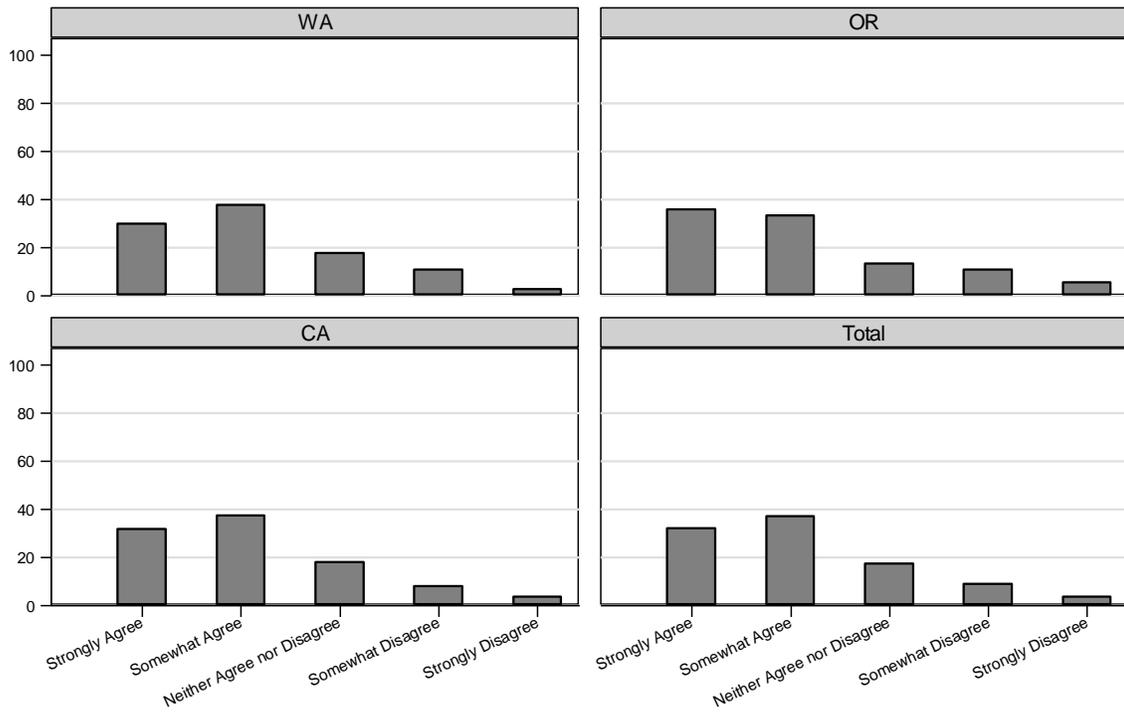
**When humans interfere with nature it often produces disastrous consequences.**



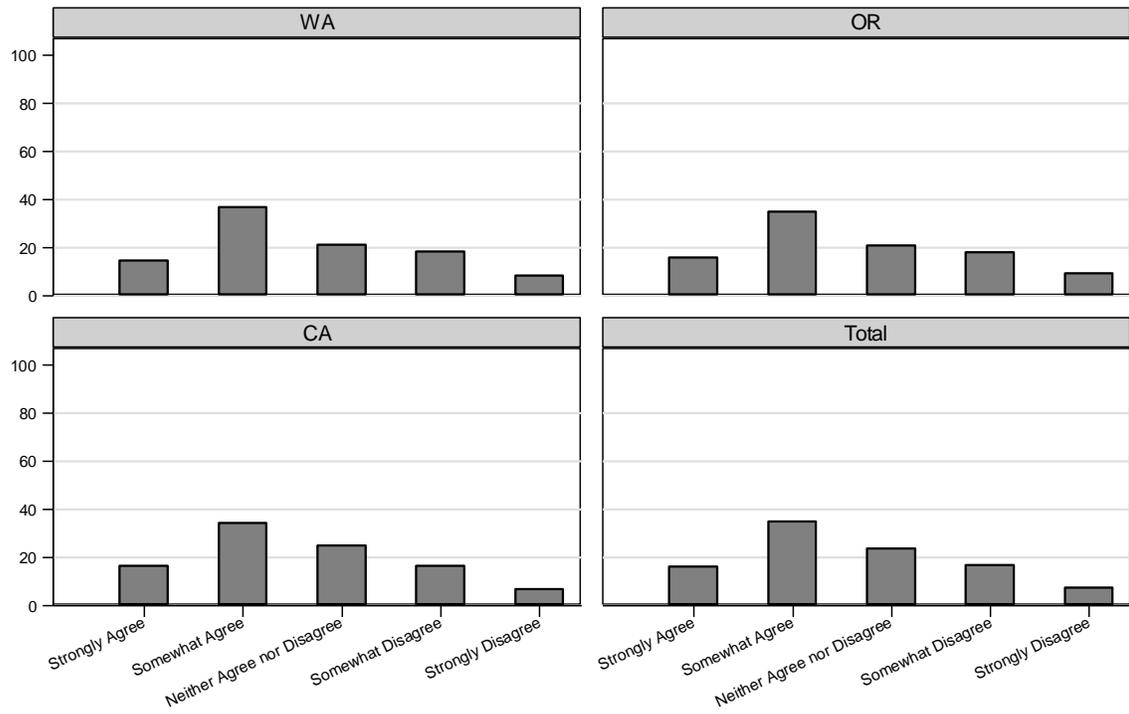
**Human ingenuity will insure that we do not make the earth unlivable.**



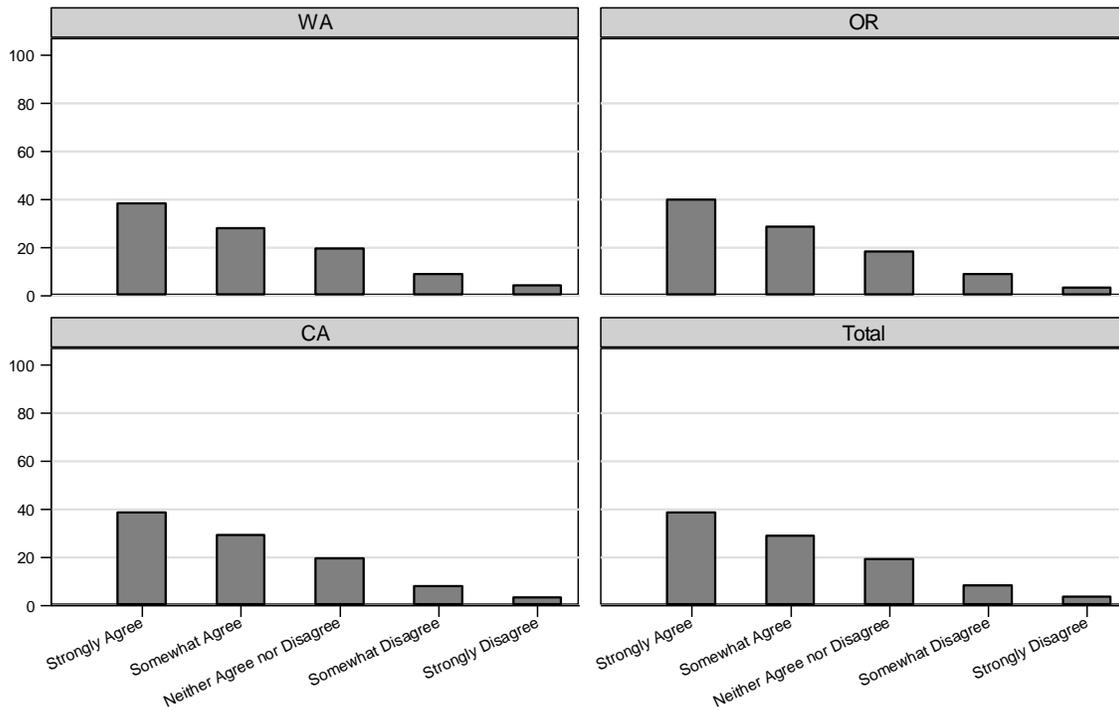
**Humans are severely abusing the environment.**



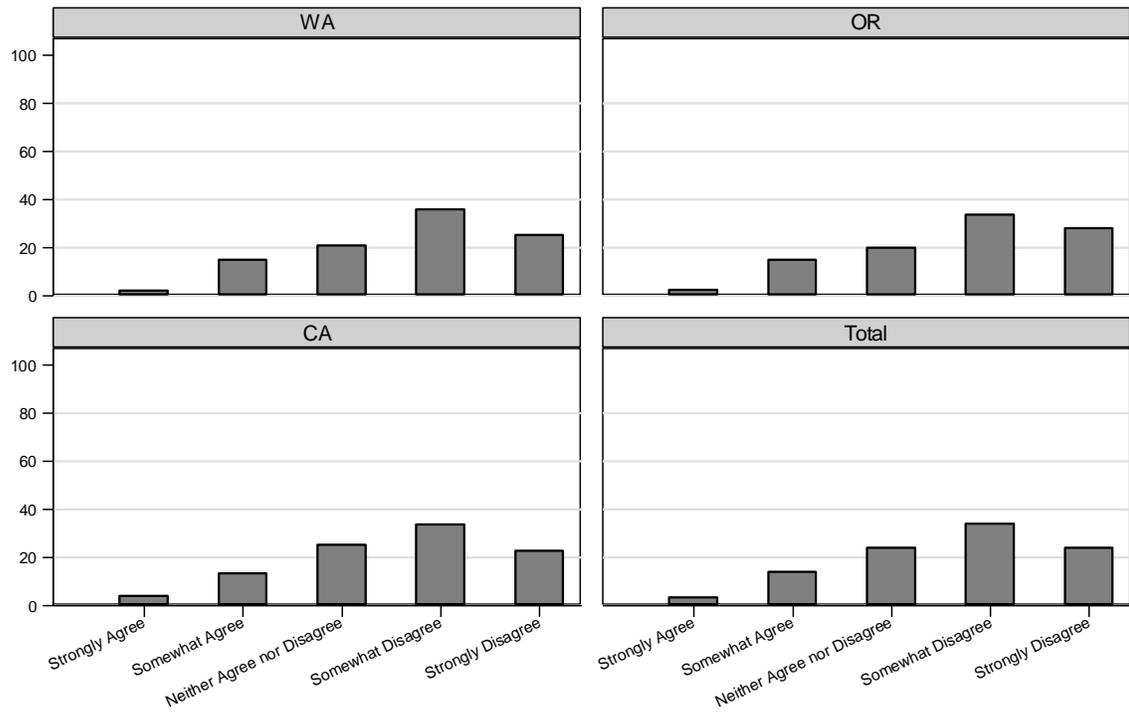
**The earth has plenty of natural resources if we just learn how to develop them.**



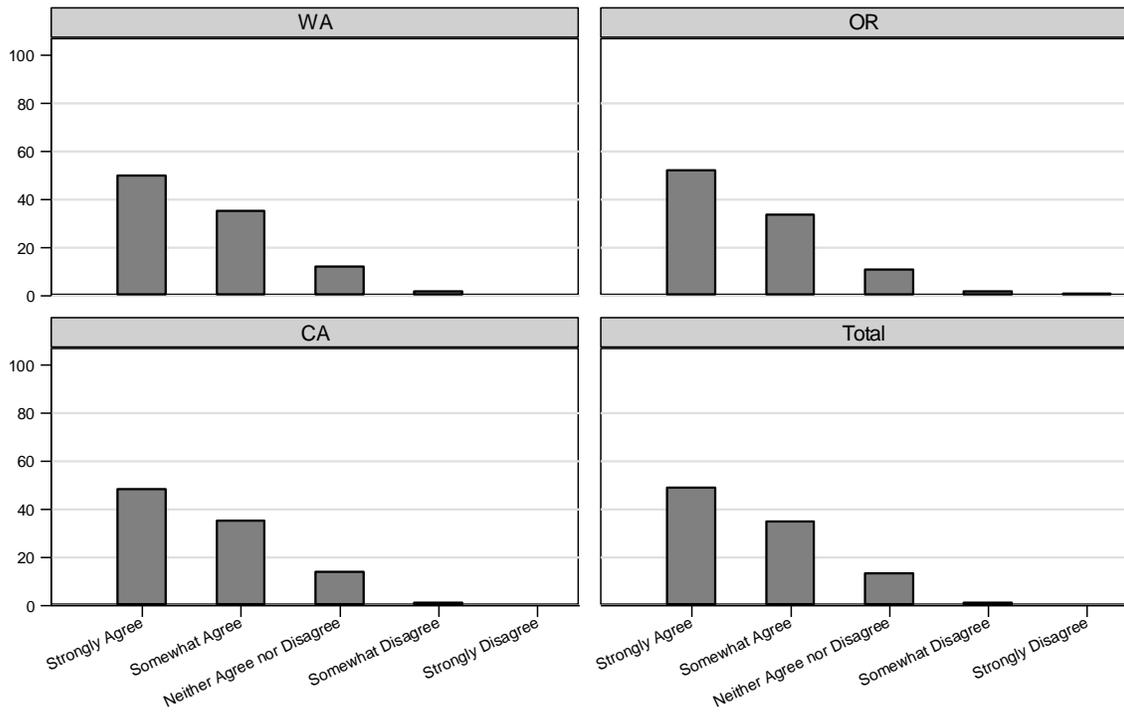
**Plants and animals have as much right as humans to exist.**



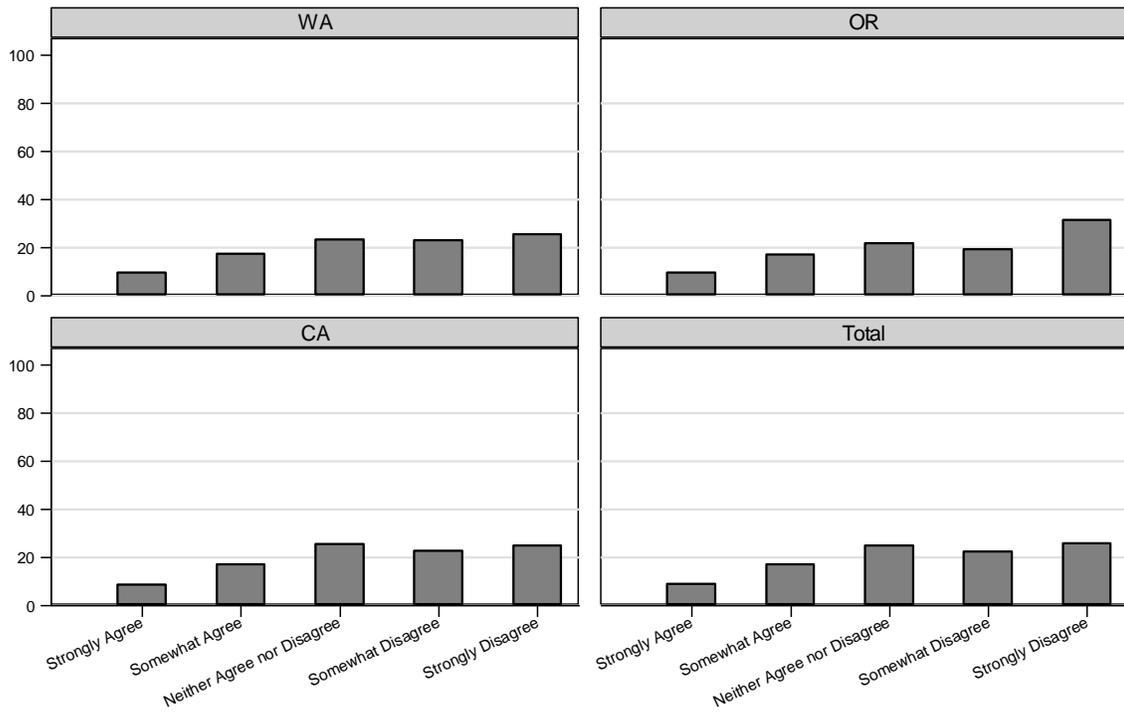
**Nature is strong enough to cope with the impacts of modern industrial nations.**



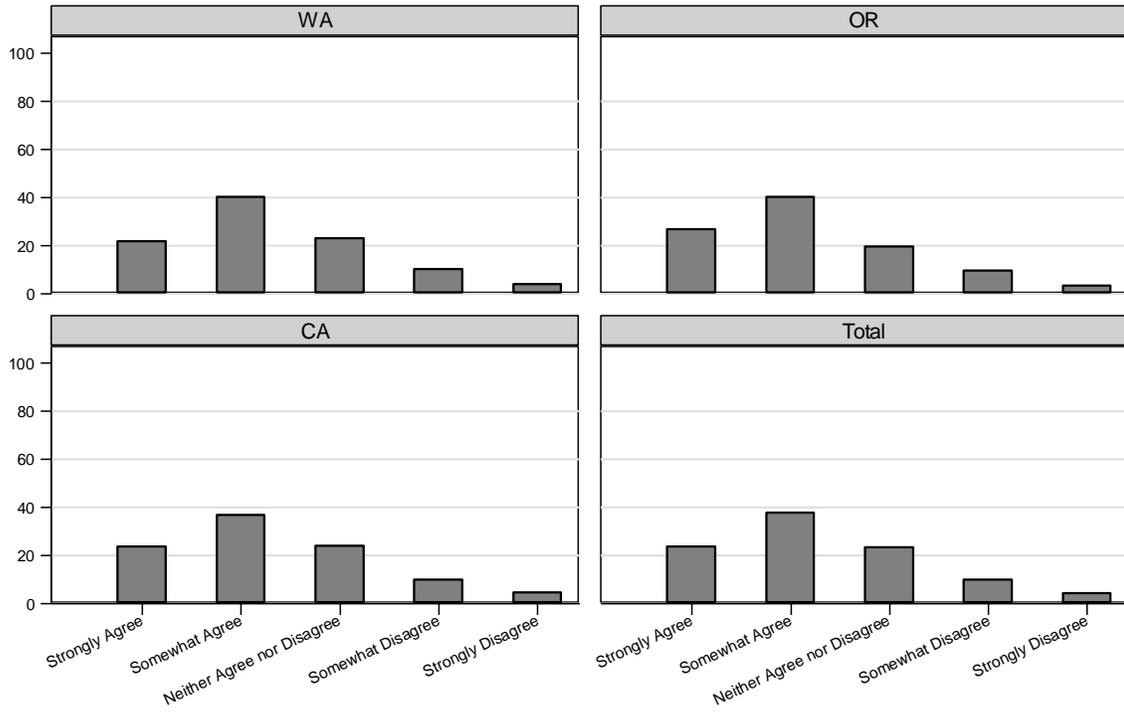
**Despite our special abilities humans are still subject to the laws of nature.**



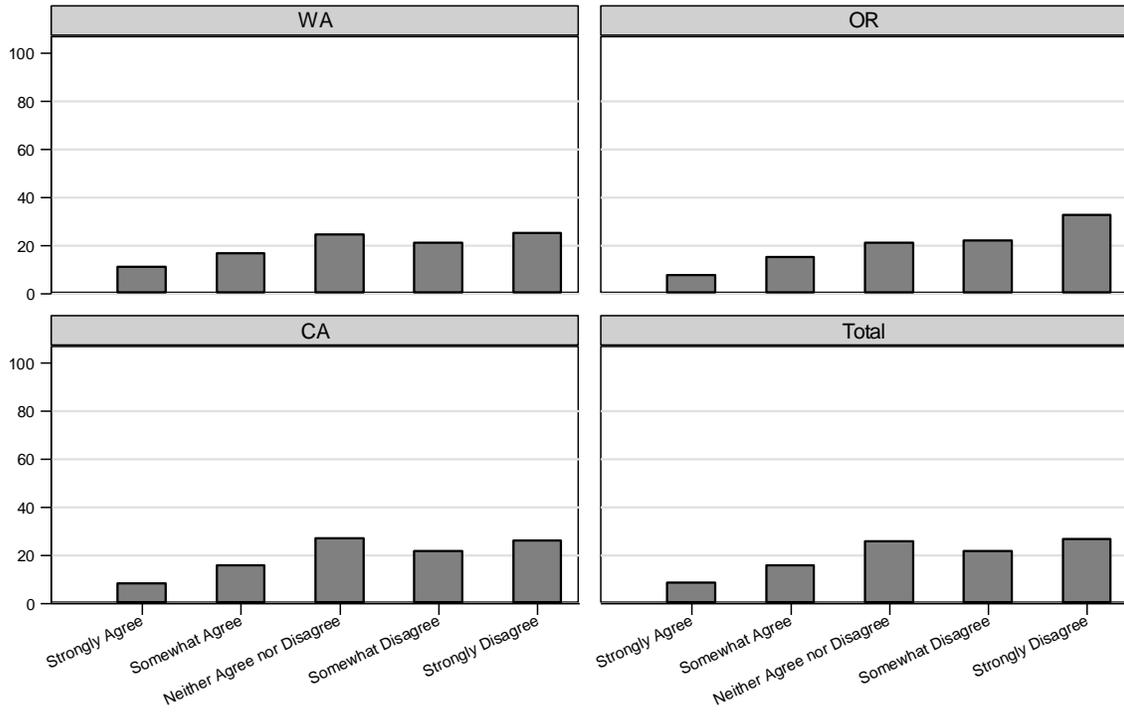
**The so-called 'ecological crisis' facing humankind has been greatly exaggerated.**



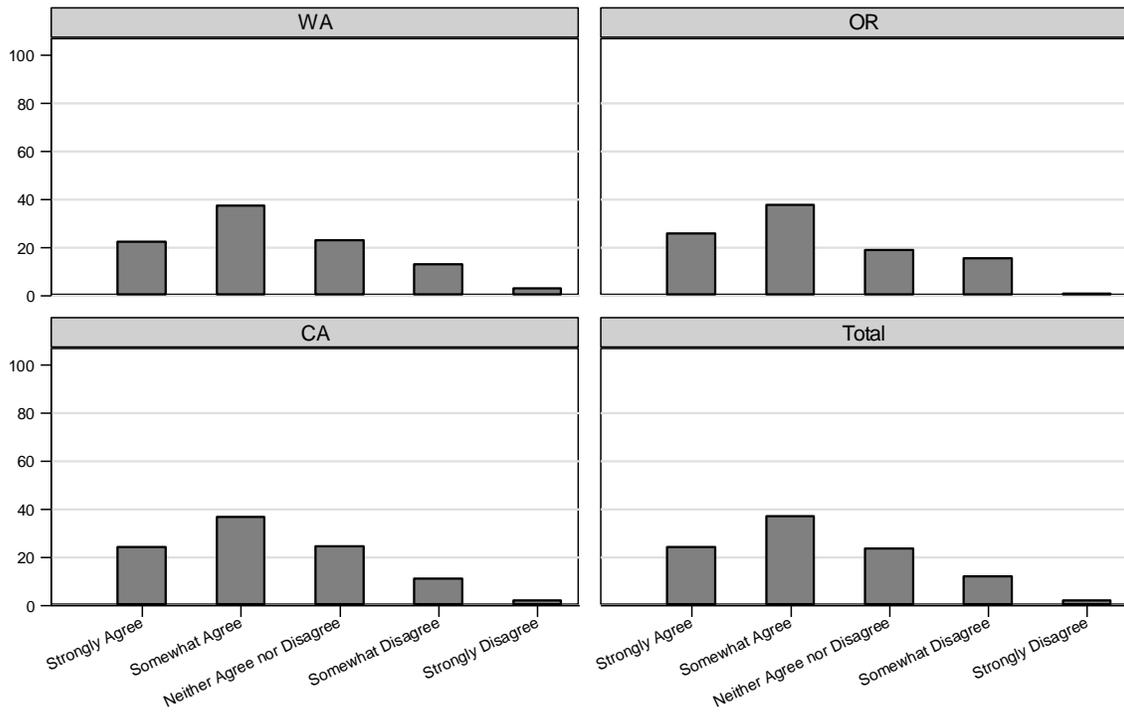
**The earth is like a spaceship with limited room and resources.**



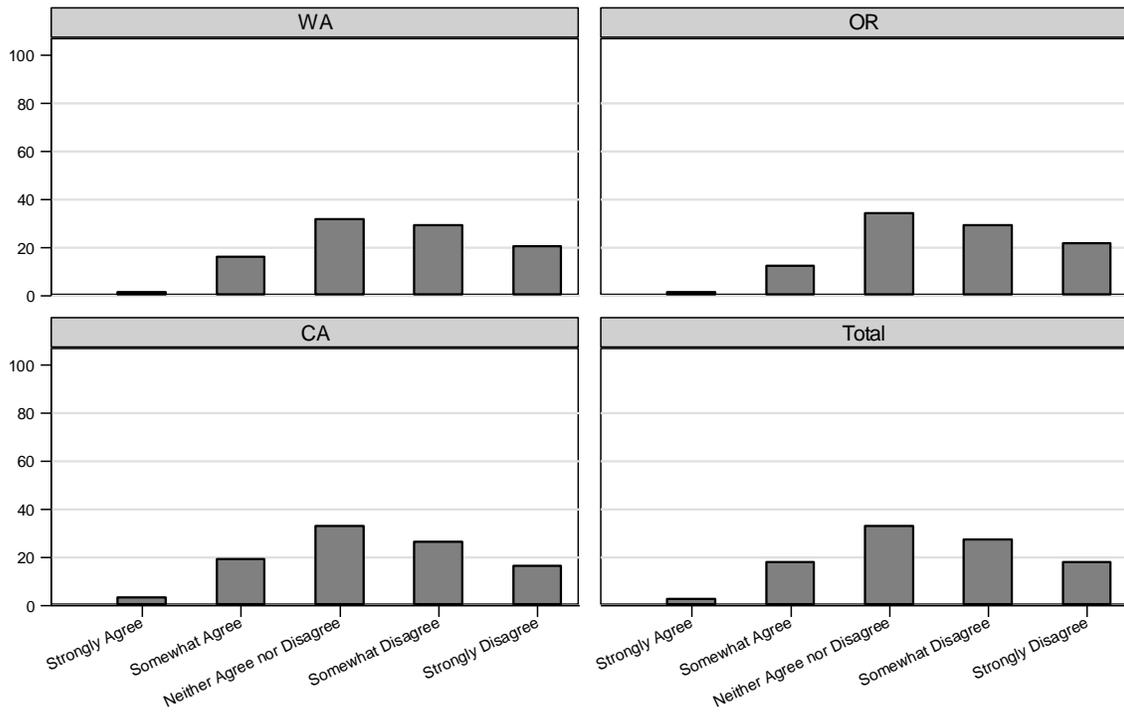
**Humans were meant to rule over the rest of nature.**



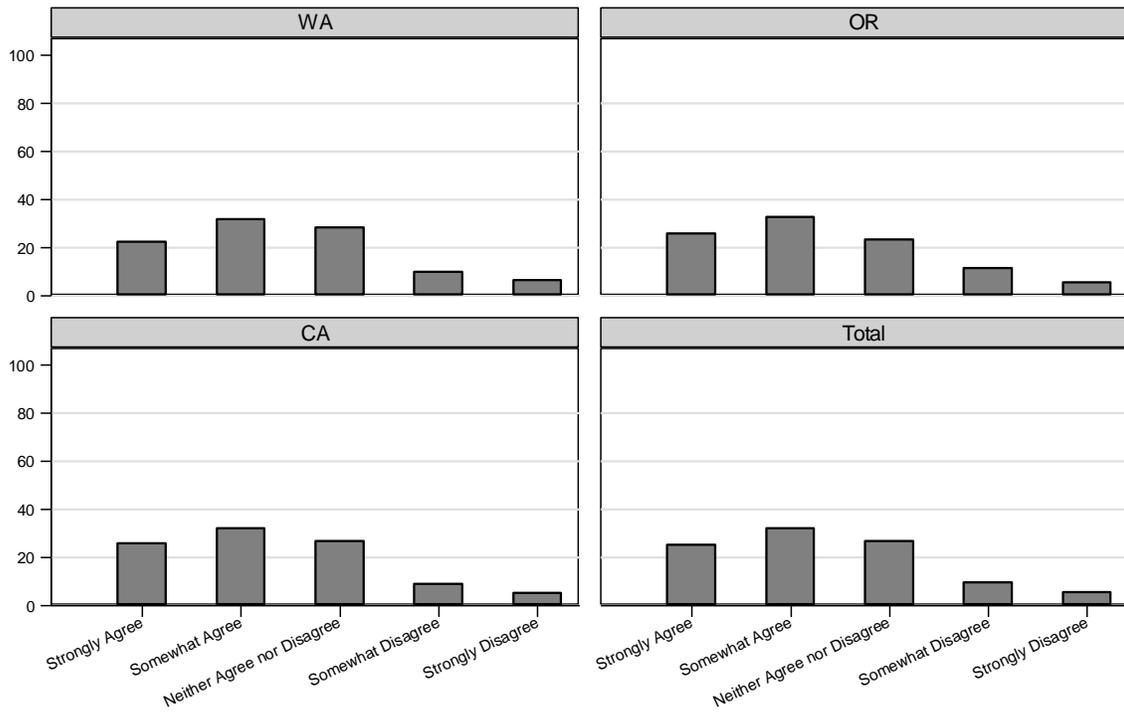
**The balance of nature is very delicate and easily upset.**



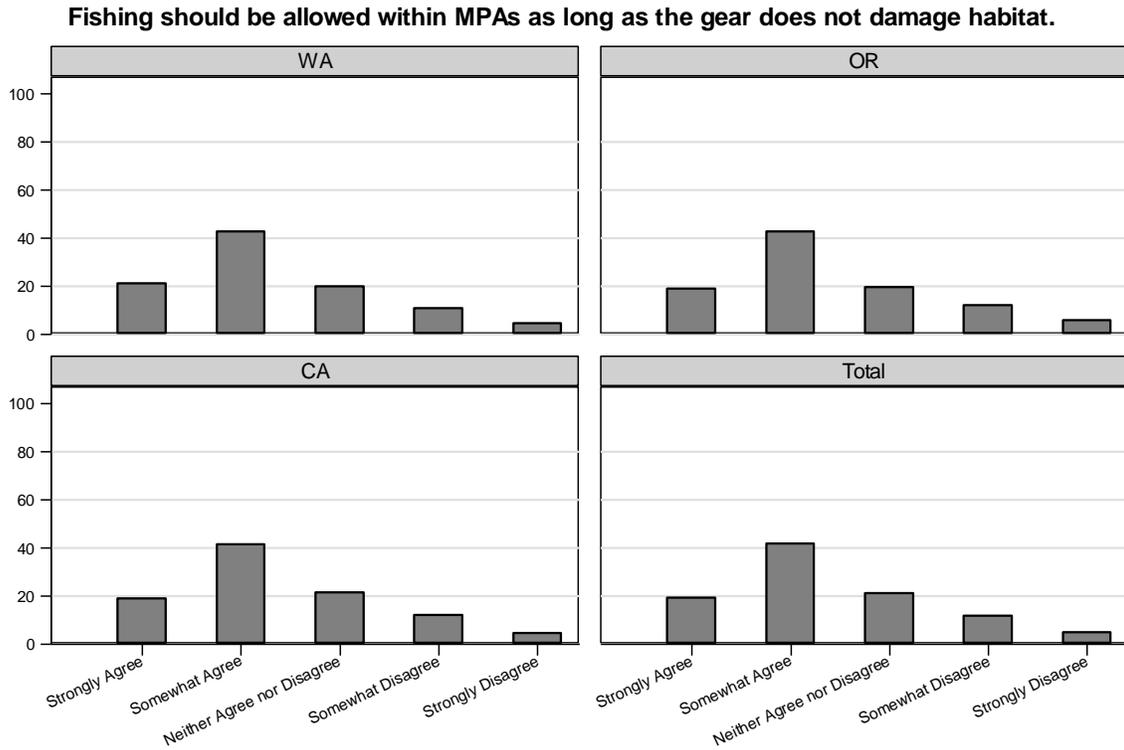
**Humans will eventually learn enough about how nature works to be able to control it.**



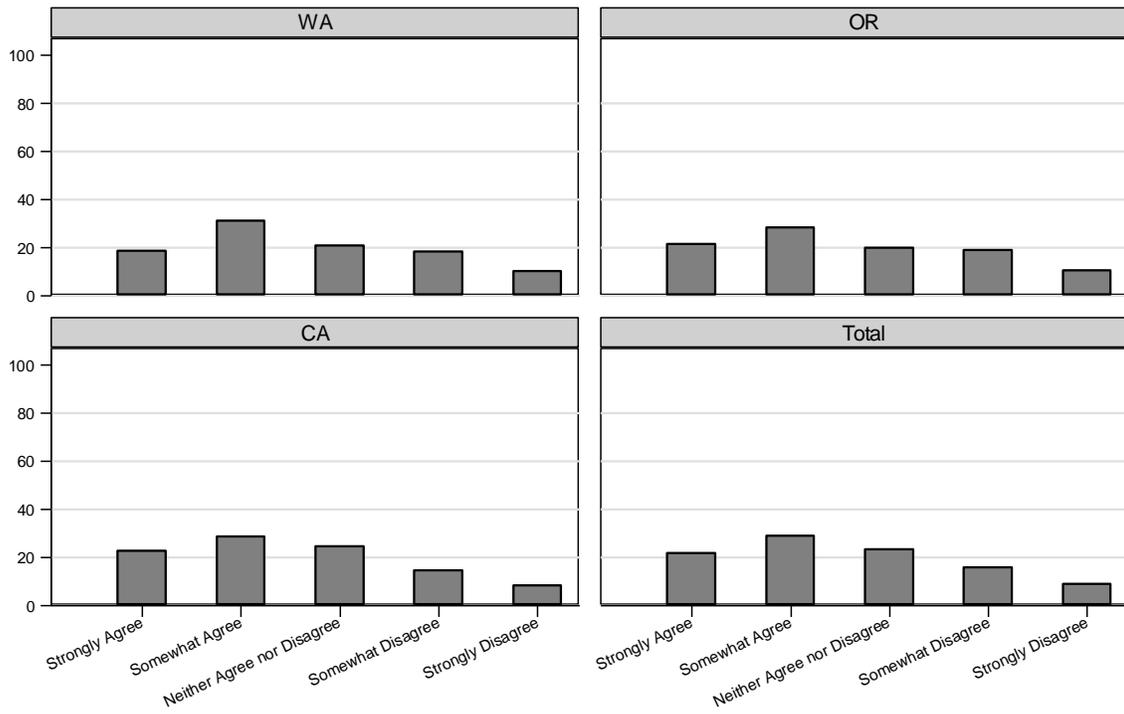
**If things continue as-is we will soon experience a major ecological catastrophe.**



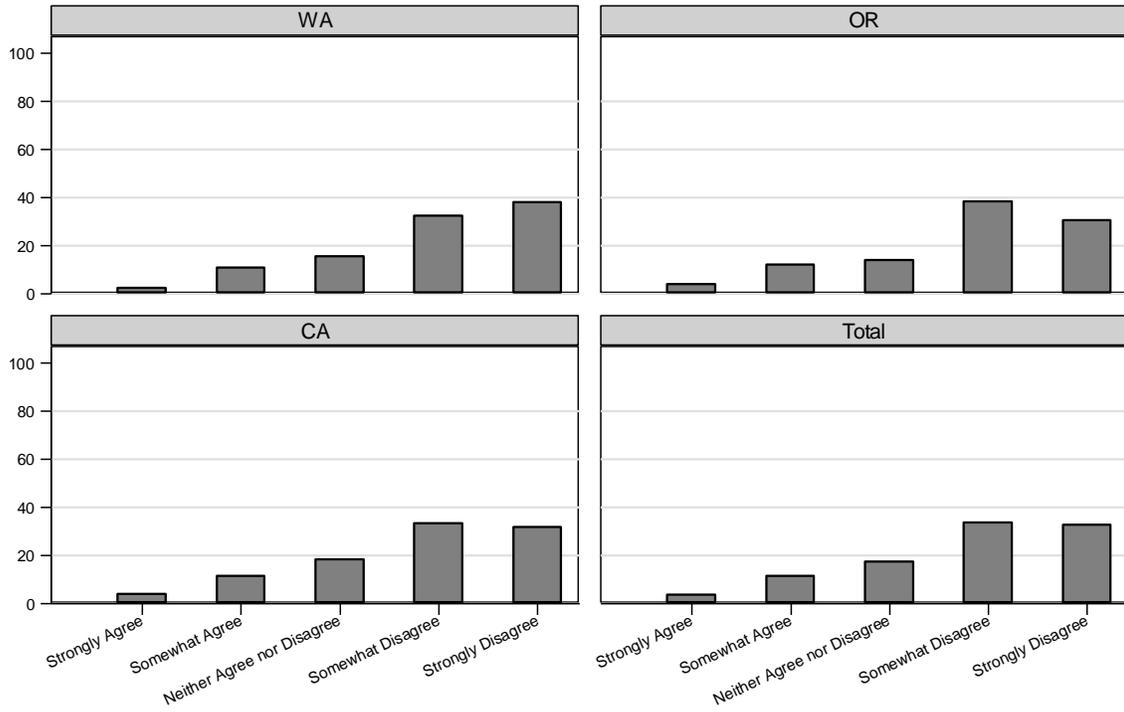
3. Managing the marine environment (Q4, Q5, Q8)



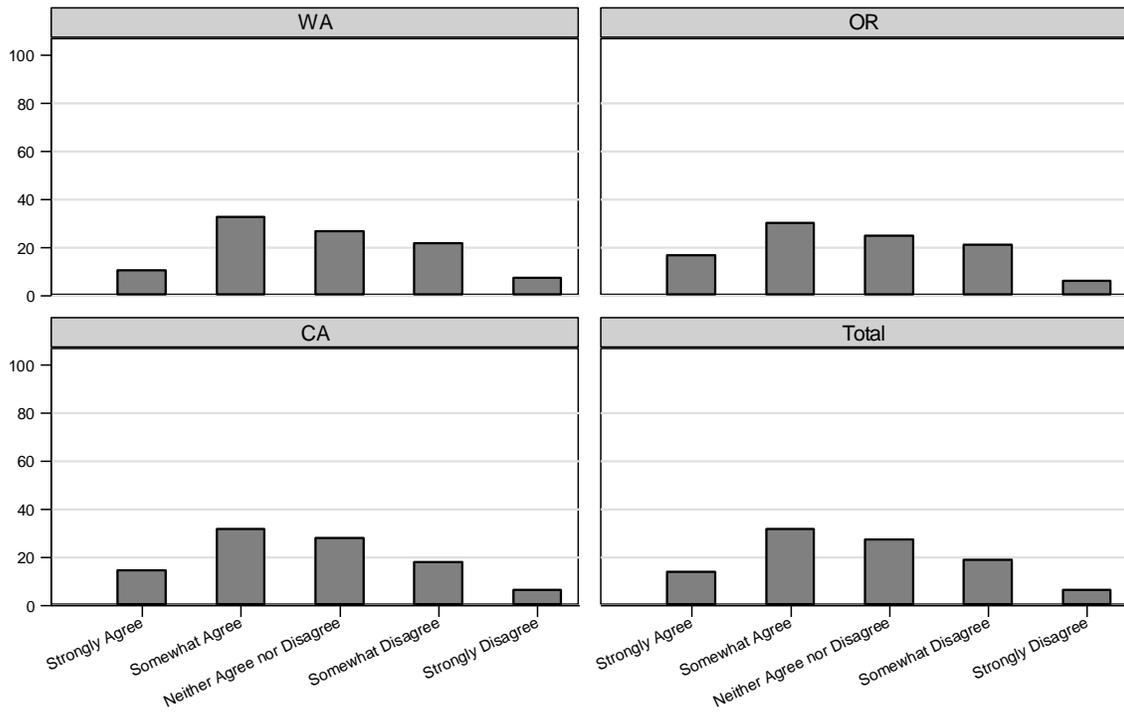
**Some parts of WC Federal Waters should prohibit all human activities (no-access).**



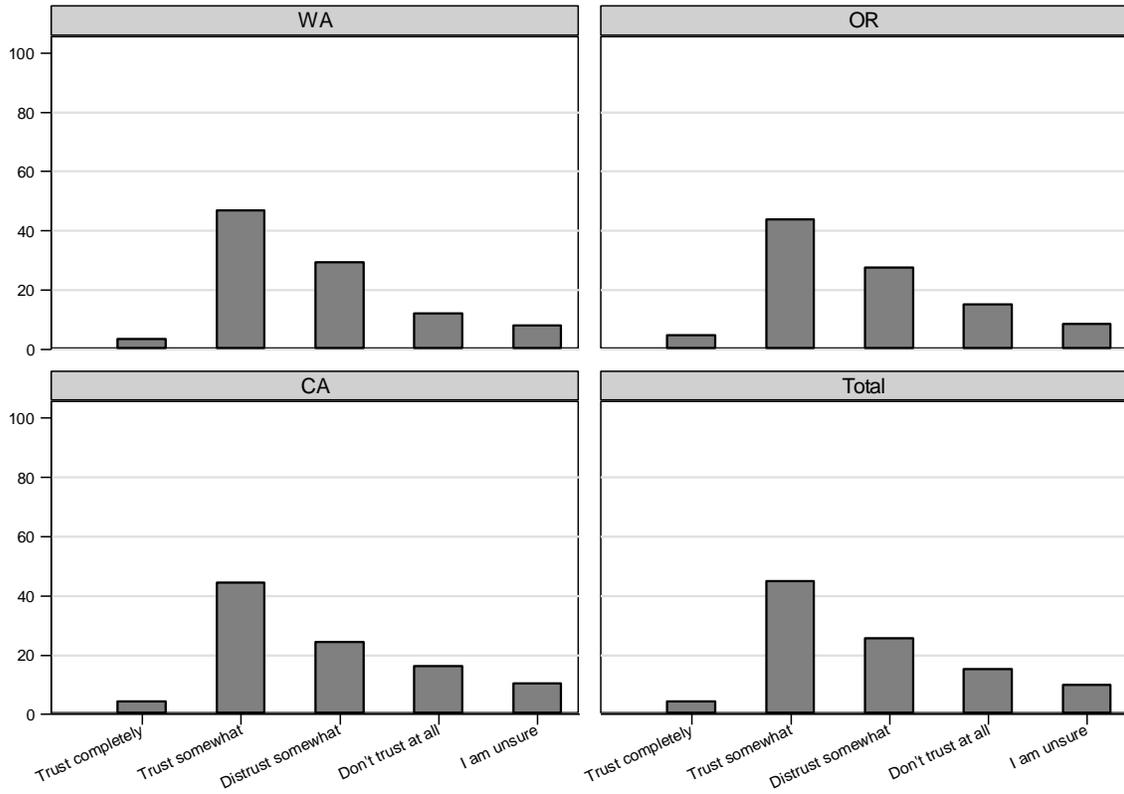
**The marine environment is a public resource and none of it should be restricted.**



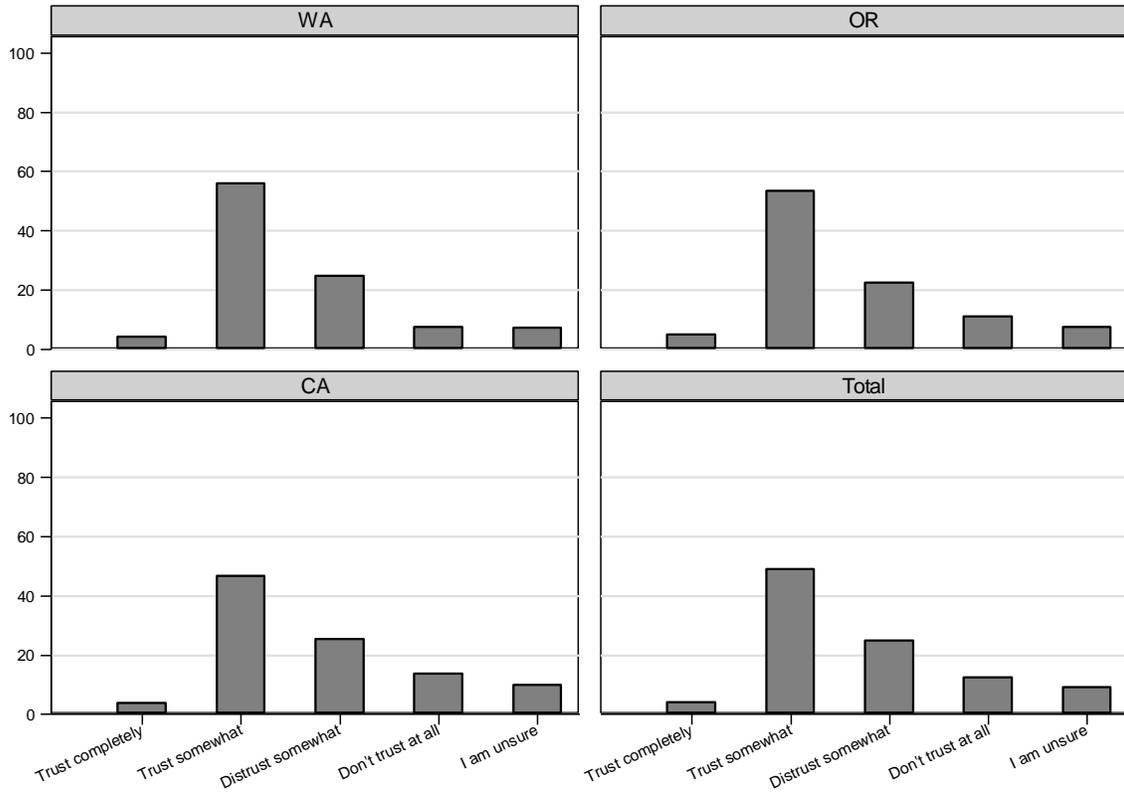
**Temporary protected areas for rebuilding fish/shellfish provide enough protection.**



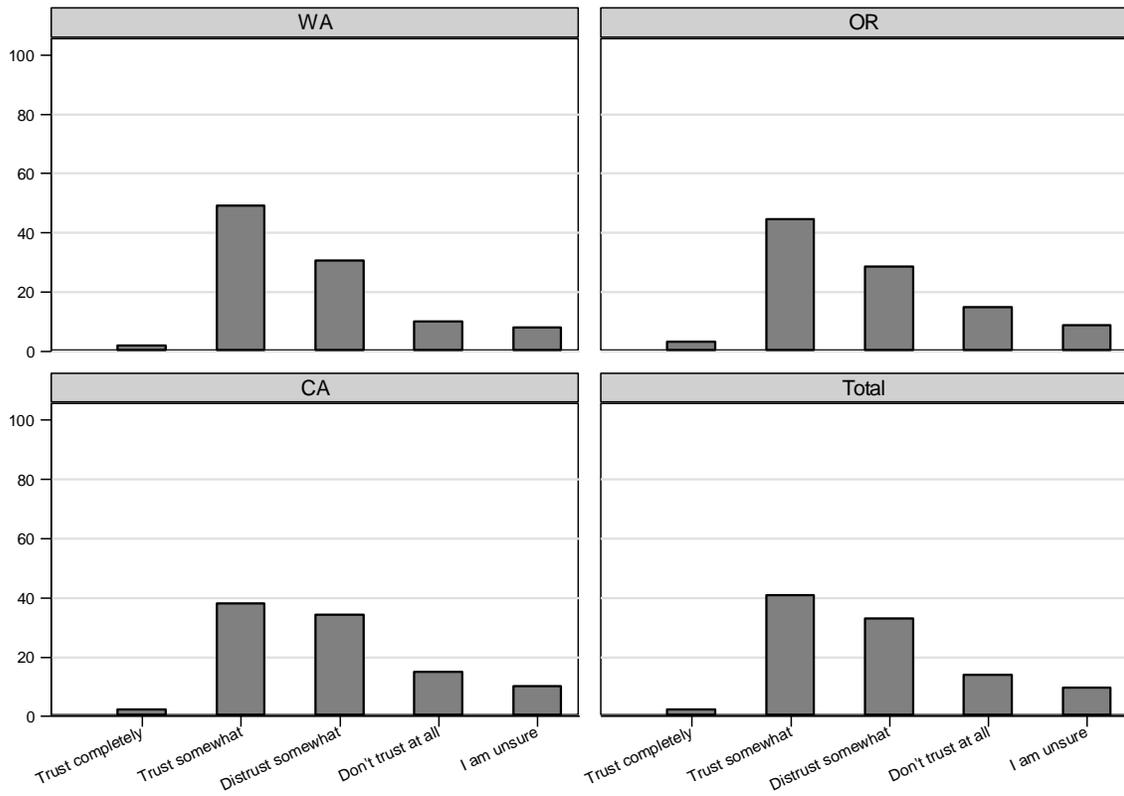
**How much do you trust: Federal agencies including scientists and policymakers.**



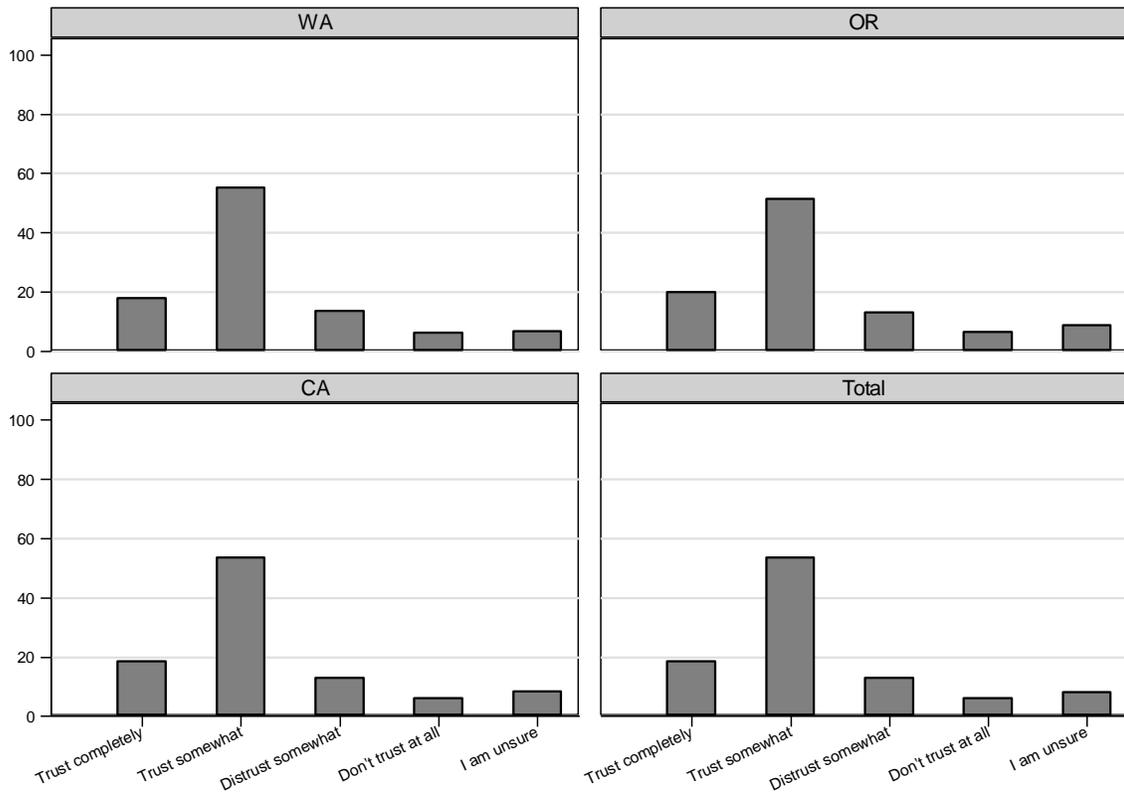
**How much to you trust: State agencies including scientists and policymakers.**



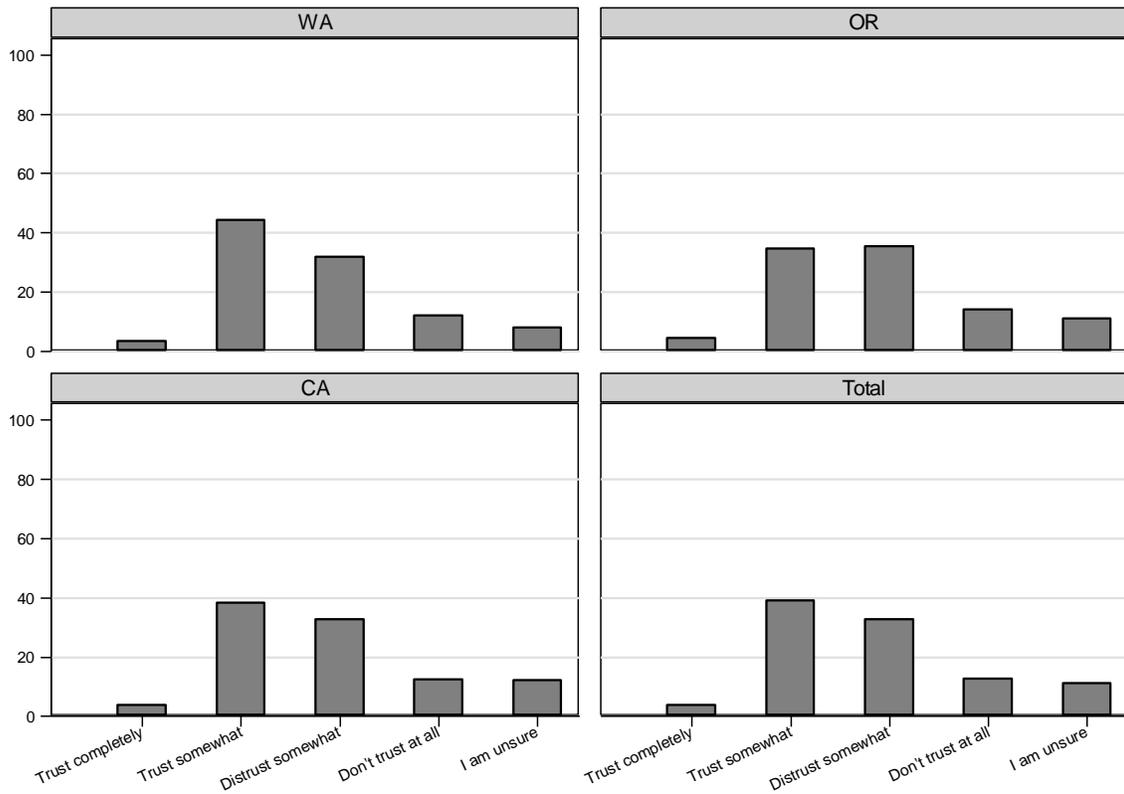
### How much do you trust: Local governments.



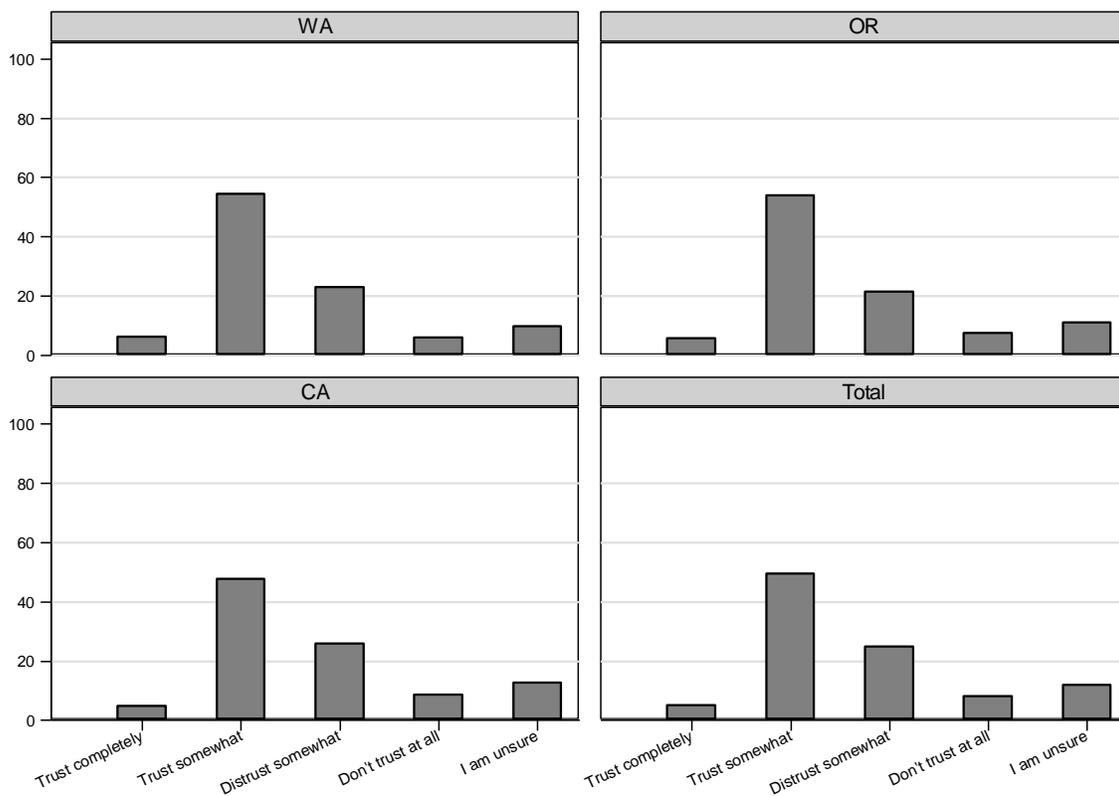
**How much do you trust: academic scientists such as those in universities.**



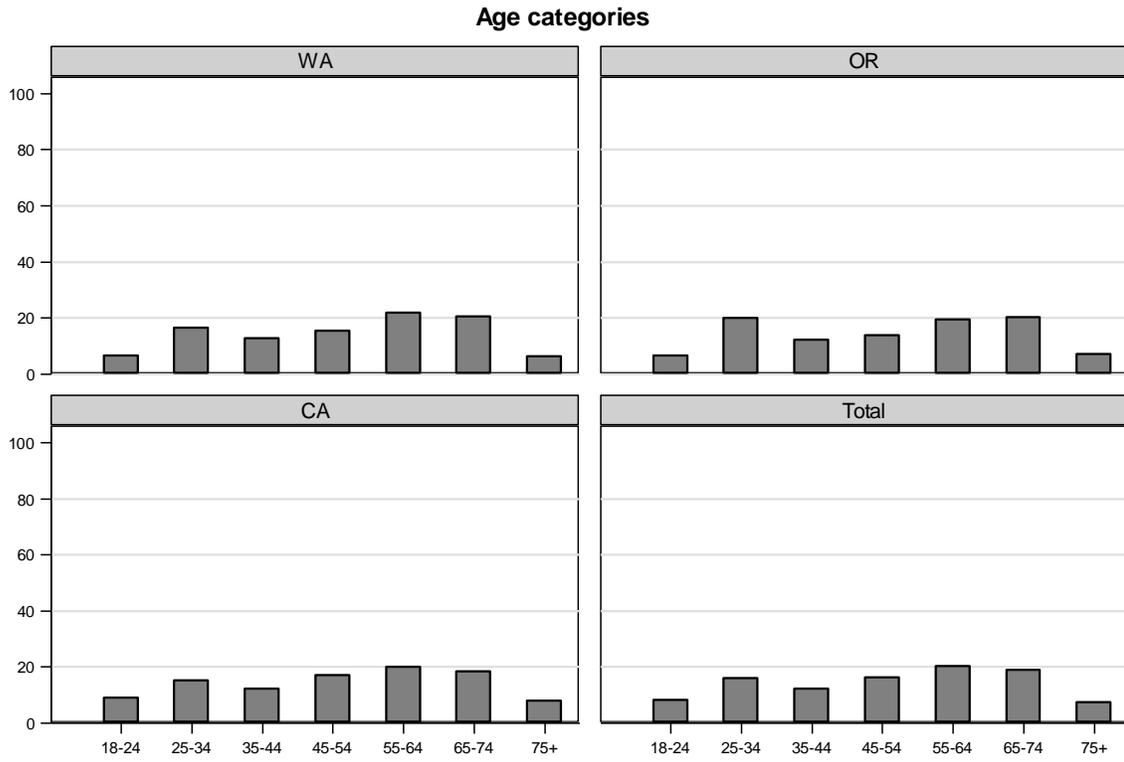
**How much do you trust: scientists in private consulting firms.**



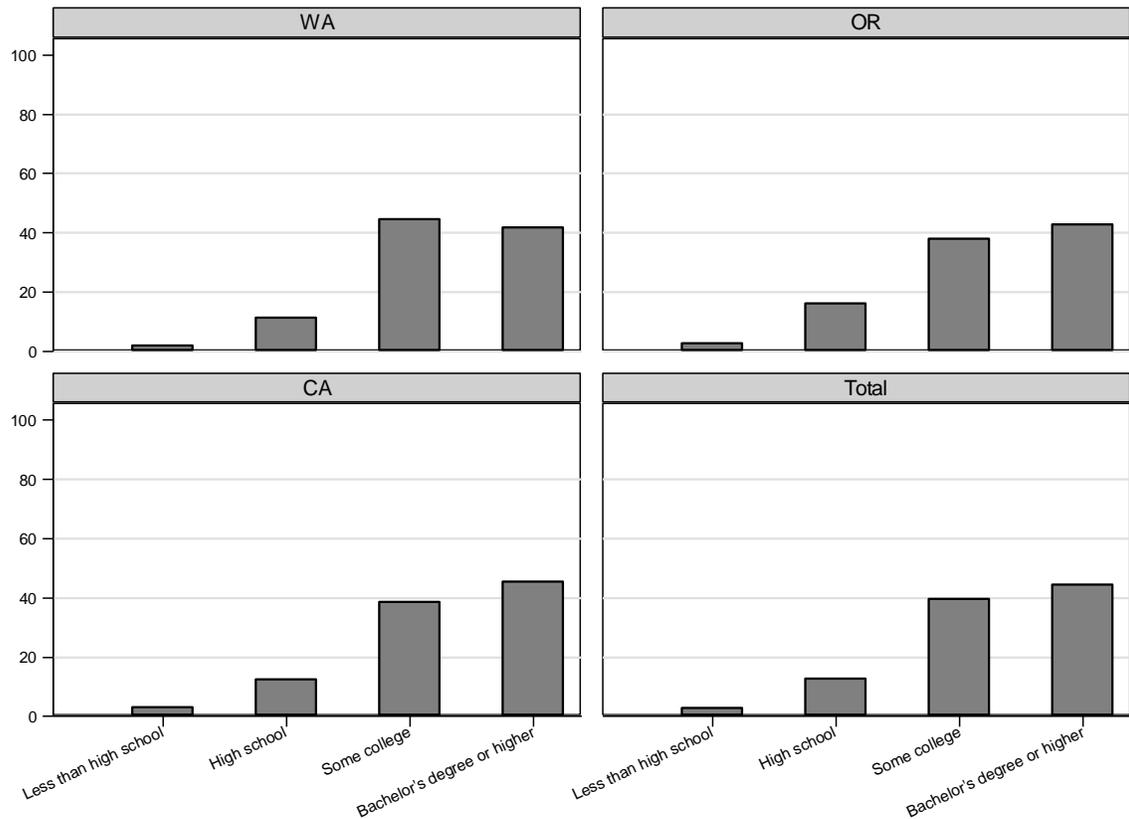
How much do you trust: citizen advisory panels.



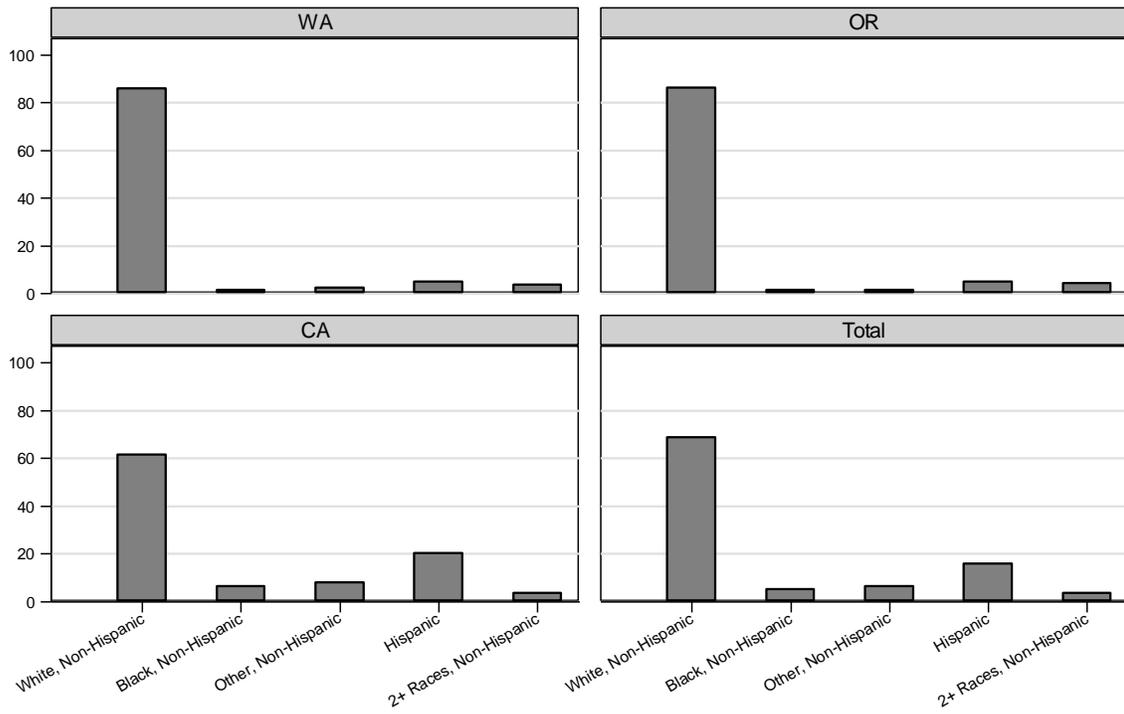
4. Respondent characteristics (GfK panel data and Q10, Q11, Q12)



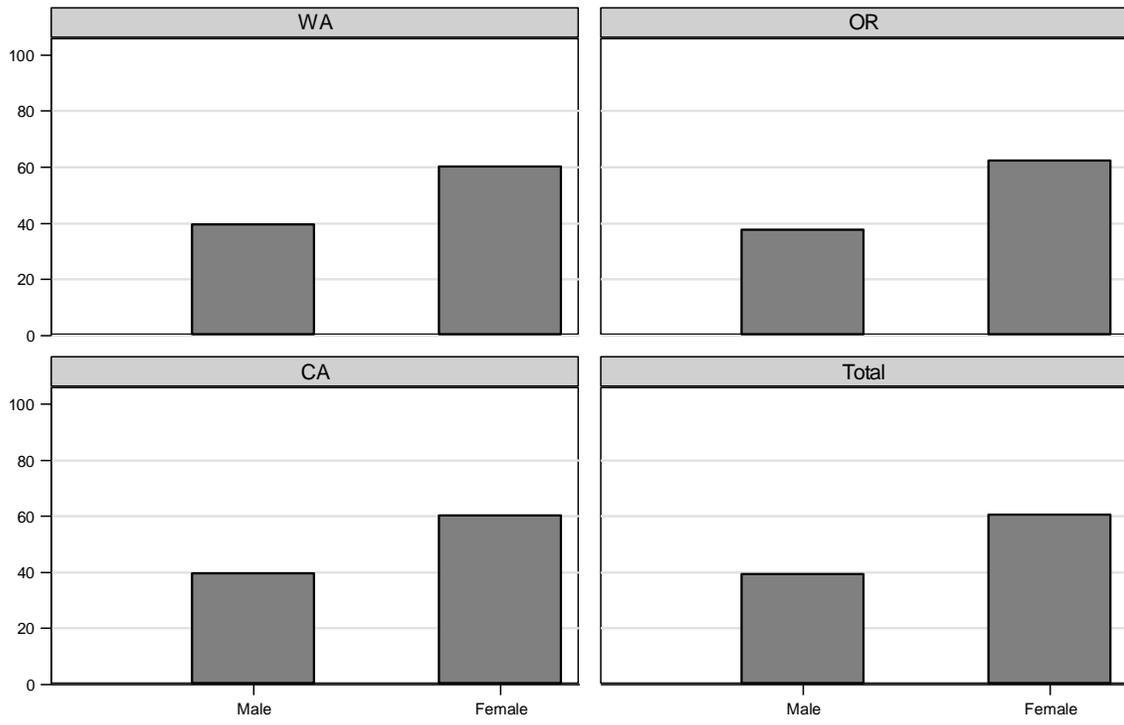
### Education categories



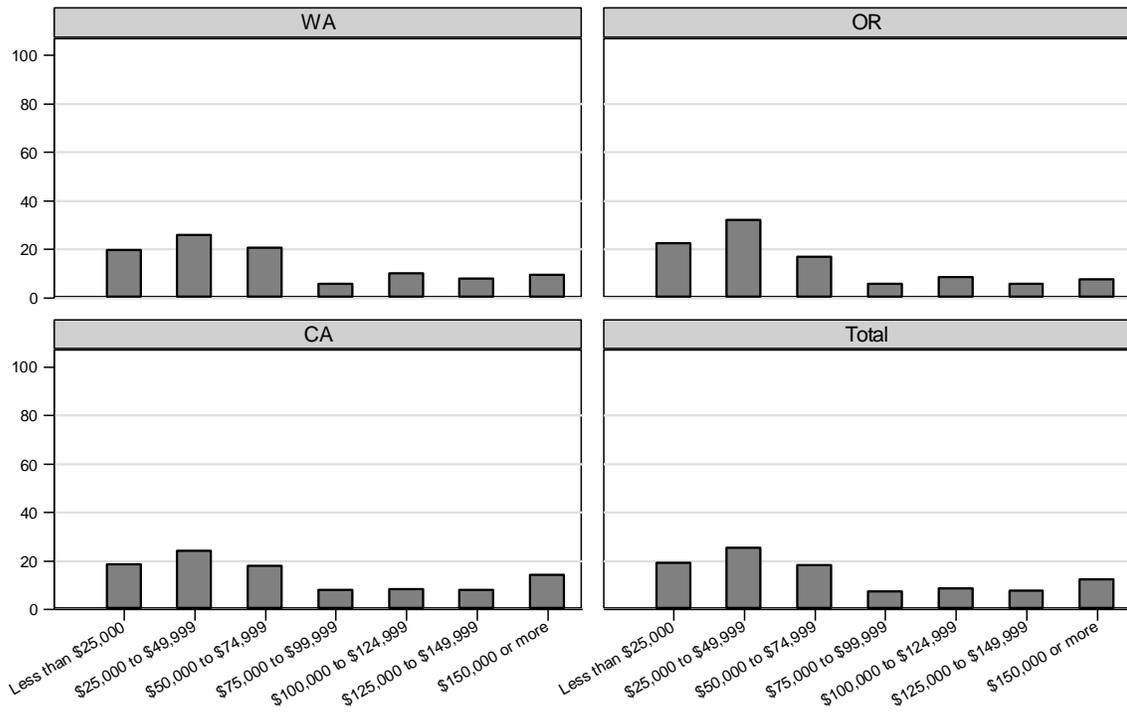
### Race and ethnicity



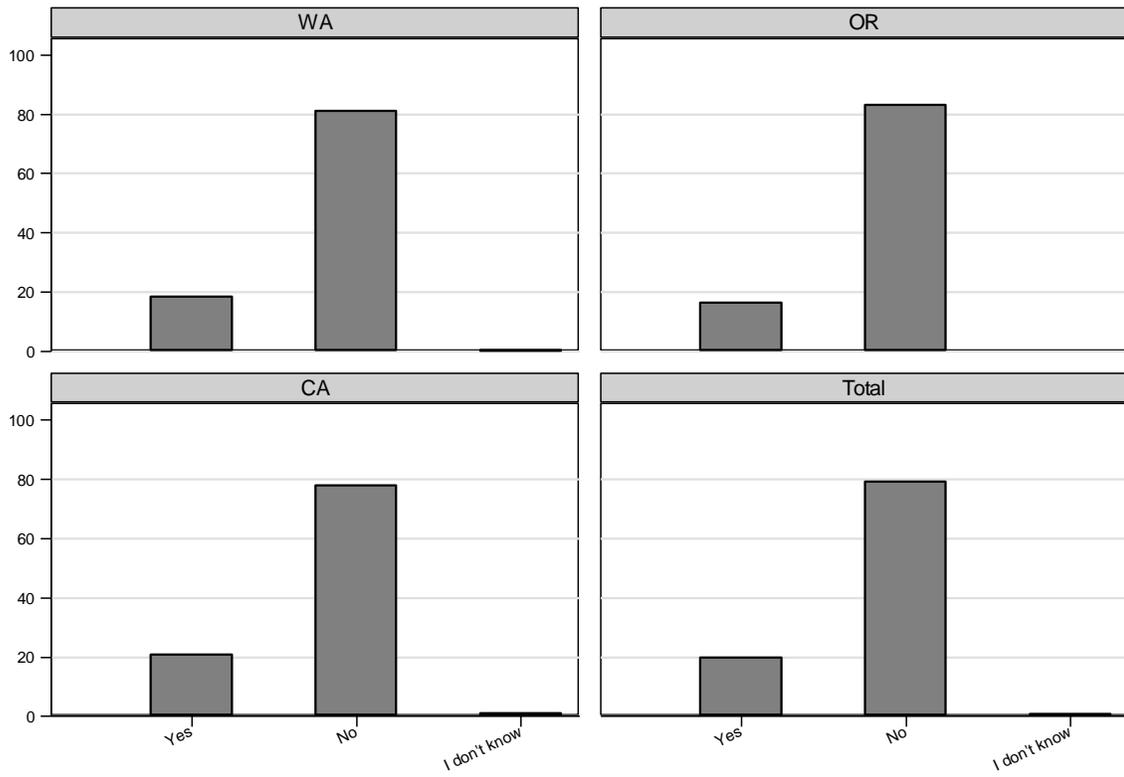
### Gender



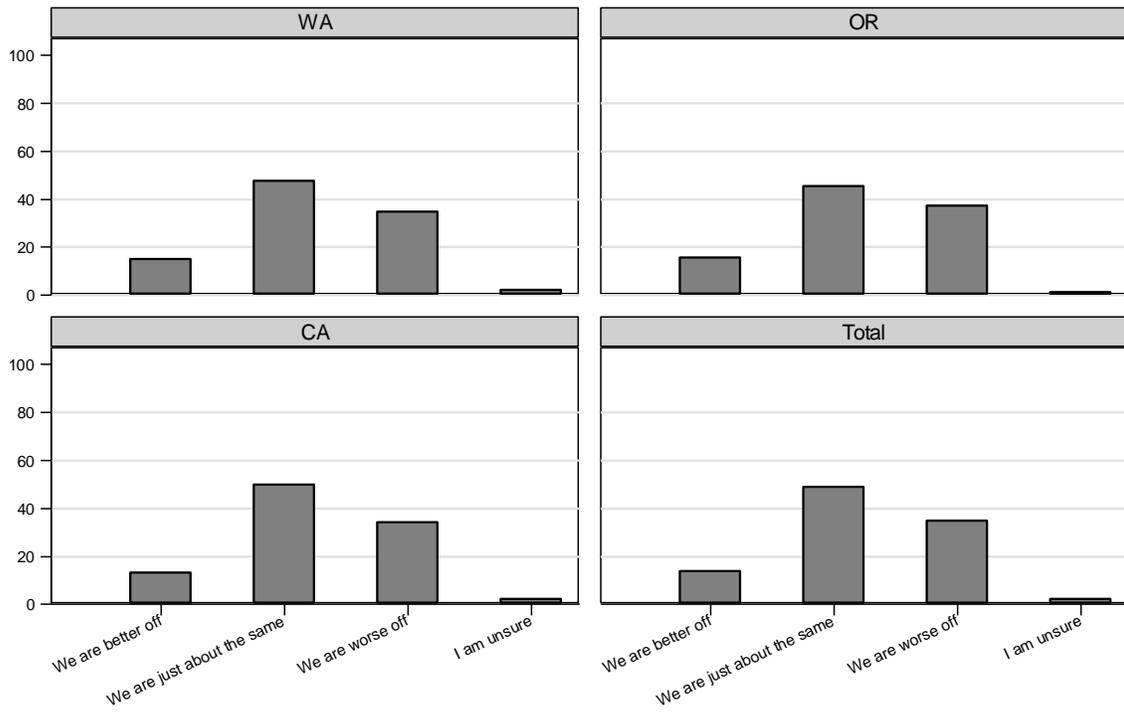
### Income categories



**Have you or someone in your household been jobless at some point in the last 12 months?**



**You and your household's finances compared to a year ago.**



### You and your household's finances a year from now.

