



**NOAA
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Using Choice Models to Inform Large Marine Protected Area Design

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Marine Protected Areas as a Conservation Strategy

- Last 15 - 20 years have seen increasing number of MPA designations
 - Australia has designated > 200 MPAs covering ~ 10% of EEZ
 - Namibia designated ~ 1 million hectares as Namibian Islands MPA
 - US established four MPAs in northwestern Pacific
- Many of these examples of Large Marine Protected Area (LMPA) (>30,000 km²)

LMPA Designation

- Great Barrier Reef (1971) thought of as first LMPA
- Since then ~ 24 LMPAs established, most within last 10 years
- May be politically easier to establish, some evidence of decreasing cost per unit area
- Not without controversy
 - Often in open ocean and thus are just lines on a map; limited enforcement of boundaries
 - MPAs should be scaled up to attain the intended ecological benefits

LMPA Economic Benefits

- Benefits of LMPAs may not result from direct use
- Few studies have examined these types of passive or non-use benefits
 - Ireland – preferences for expanding the current protected area for deep sea corals to include all deep sea corals (Wattage et al. 2010)
 - South Africa – loss of \$4.4 million by allowing some fishing in three protected areas; loss of \$27.6 million from eliminating all three protected areas (Turpie et al. 2006)
 - Australia – households willing to pay \$100 to protect 30% of southwestern waters (Gillespie and Bennett 2011)
 - US – households willing to pay between \$23 and \$106 to increase amount of protected areas in northeast by 4.2% (Wallmo and Edwards 2007)

Research Agenda for LMPAs

- Existing studies show preferences vary for both size and restrictions within protected area boundaries
- Understanding the relationship between LMPA configurations and economic value can inform LMPA policy
- Social science research agenda (Gruby et al. 2013) calls for “examination of the full range of economic benefits associated with LMPAs”

Public Value of LMPAs off the U.S. West Coast

Objective: estimate the value of different LMPA size/use designations for households on the U.S. west coast



For west coast households, what are preferred sizes for an LMPA and what are the associated values?



When (if ever) do LMPAs generate negative values?



How do restrictions within the LMPA (i.e. use type) including no human access, no harvesting, and limited take, affect preferences for LMPA size and associated value?



U.S. West Coast



Study Methods: Stated Preference Choice Experiment Survey

Survey describes a good – in this case marine protected areas sited in west coast Federal waters – in terms of attributes.

Background Information on West Coast Protected Areas




- About 2.95% of west coast Federal waters are permanently protected as Multiple Use MPAs
 - commercial and recreational fishing, nature-based recreation and tourism, and scientific research activities allowed as long as they do not destroy marine biodiversity or habitat.
- About 0.05% of west coast Federal waters are permanently protected as No-Take MPAs
 - human access and activities that do not extract or harvest any marine resource allowed.
- 0% of West Coast Federal Waters are permanently protected as No-Access MPAs
 - closed to all human access except limited monitoring; used to prevent potential ecological disturbance and as a refuge for marine wildlife.

Within the boundaries of all permanent marine protected areas in west coast Federal waters industrial uses including mining, oil and gas exploration or drilling, and windmill or turbine construction are prohibited.

Study Methods: Stated Preference Choice Experiment Survey

Survey describes a good – in this case protected marine areas sited in west coast Federal waters – in terms of attributes.



Respondents choose their most and/or least preferred option from different bundles of the good in a choice set.


| MPAs West Coast Federal Waters | Option 1 (Current Status) | Option 2 | Option 3 |
|---|--------------------------------------|--------------------------------------|--------------------------------------|
| % of West Coast Federal Waters designated No-Access MPAs | 0% | 0.5% | 0% |
| % of West Coast Federal Waters designated No-Take MPAs | 0.05% | 0.5% | 1% |
| % of West Coast Federal Waters designated Multiple Use MPAs | 2.95% | 3% | 4% |
| Total amount of West Coast Federal Waters designated as a Marine Protected Area | 3% | 4% | 5% |
| Cost to your Household This cost will be added to your household's Federal Income Tax <u>every year for three years</u> | \$0 | \$25 | \$15 |
| 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"/> |

Study Methods: Stated Preference Choice Experiment Survey

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Respondents choose their most and/or least preferred option from different bundles of the good.



Model estimated from data on respondent choices.

- Model specification to incorporate respondent heterogeneity

Implementation and Sample Demographics

Survey Implementation

- Implemented using Knowledge Networks randomly recruited panel.
- Implemented from Dec. 2012 to Jan. 2013.
- 6,617 panel households from CA, WA, and OR contacted with invitation to participate in survey
- 3,354 completes

Sample Demographics

- Mean age 51
- 60% female
- 69% white, non-Hispanic
- 45% had college degree or higher
- 35% had household income > 100K

Respondent Attitudes



- Over 75% of respondents agree that it's important to protect areas of the ocean even if they never get to see or use them
- About 50% of respondents agree that some parts of west coast Federal waters should be restricted to all human access



- About 50% of respondents think that commercial fishing in west coast Federal waters is extremely important for the region
- About 20% of respondents think that recreational fishing in west coast Federal waters is extremely important for the region
- About 60% of respondents think that fishing should be allowed in protected areas as long as gear does not damage habitat



- About 50% of respondents are willing to pay higher prices for seafood to establish protected areas
- About 30% of respondents think that businesses and industries should be compensated for their costs due to protected area restrictions

Choice Model Results

% of west coast
Federal waters

| Attribute | Parameter estimate | Z statistic |
|--|--------------------|-------------|
| Random parameters | | |
| No-access** | .57632 | 11.41 |
| No-access ² ** | -.11720 | -11.58 |
| No-take** | .15999 | 6.26 |
| No-take ² ** | -.01625 | -6.29 |
| Multiple use** | .17295 | 6.38 |
| Multiple use ² ** | -.01051 | -6.59 |
| Non-random parameters | | |
| Cost** | -.02295 | -32.56 |
| Standard deviation parameters | | |
| No-access** | .66837 | 19.37 |
| No-access ² | .00164 | 0.16 |
| No-take** | .32913 | 22.25 |
| No-take ² | .00222 | 1.05 |
| Multiple use** | .25310 | 17.06 |
| Multiple use ² | .00029 | 0.27 |
| **parameters significant at $p < 0.01$ | | |

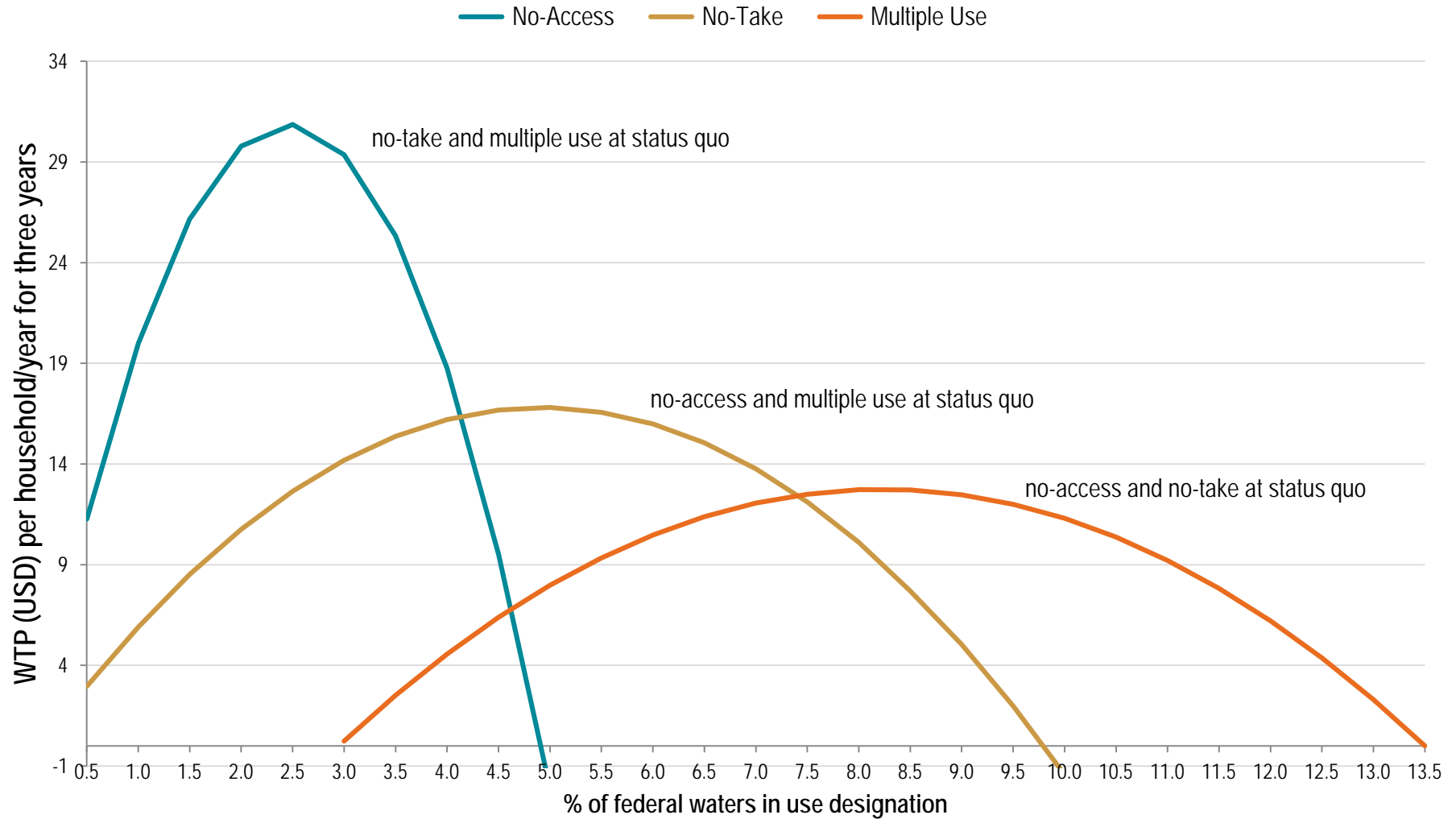


Value-maximizing size for single use-type

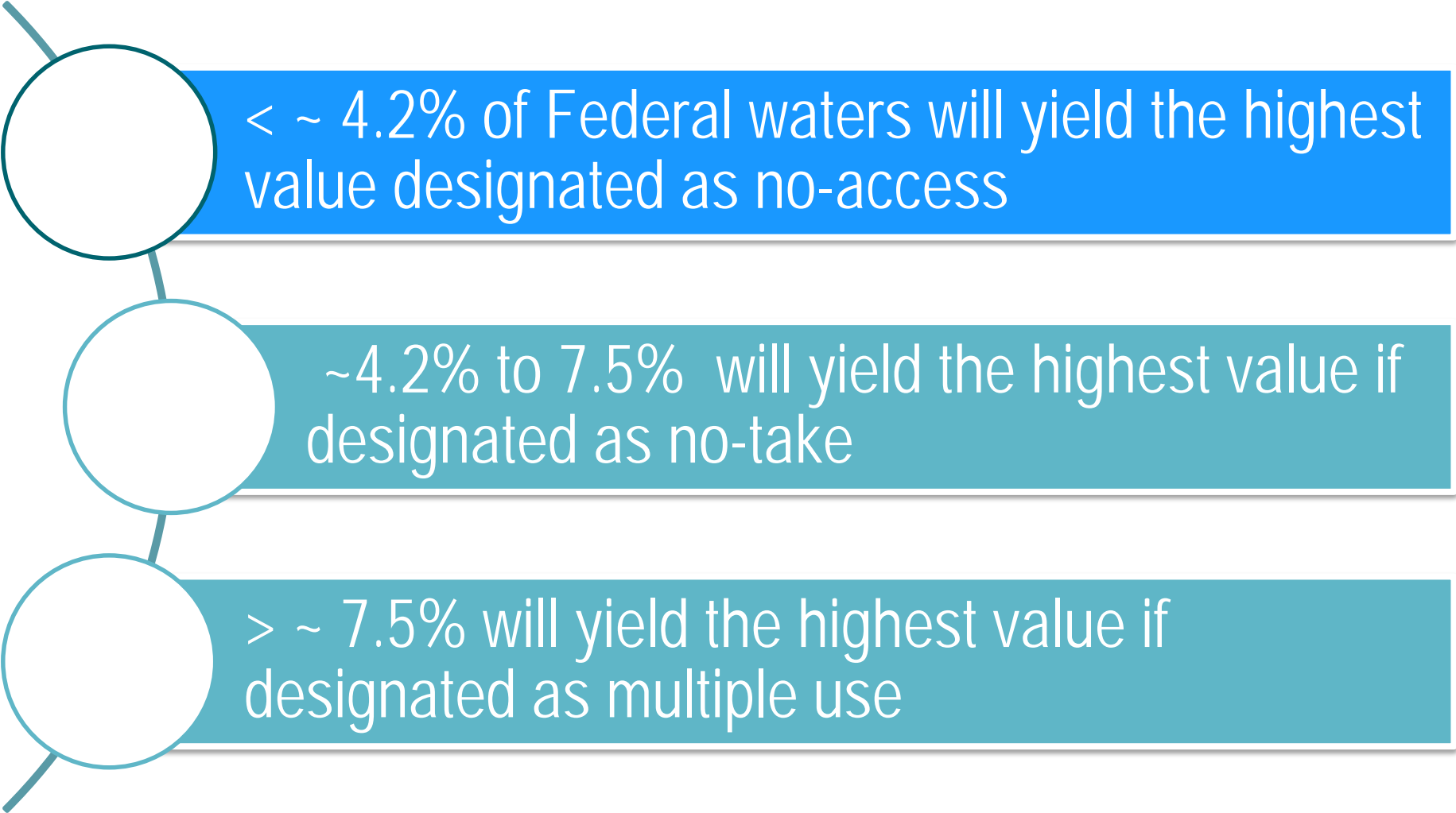
- 2.5% of west coast Federal waters in No-access LMPAs
- 4.9% of west coast Federal waters in No-take LMPAs
- 8.2% of west coast Federal waters in Multiple use LMPAs

| | 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) |

WTP Values and Size



Assuming an LMPA is a single use type...



< ~ 4.2% of Federal waters will yield the highest value designated as no-access

~4.2% to 7.5% will yield the highest value if designated as no-take

> ~ 7.5% will yield the highest value if designated as multiple use

When do LMPAs yield negative economic value*?



Designating > ~ 4.8% of Federal waters as no-access

Designating > ~ 9.8% of Federal waters as no-take

Designating > ~ 13.5% of Federal waters as multiple use

*assumes MPA is designated in a single use type

Assuming LMPA is a mix of use types...

| Total Size (% of Federal waters) | % No-access | % No-take | % Multiple use | Value (\$ per household every year for 3 years) |
|----------------------------------|-------------|-----------|----------------|---|
| 15 | 2.5* | 4.9* | 8.2* | 60.42 |
| | 3 | 10 | 2 | 22.94 |
| | 2 | 3 | 10 | 55.29 |
| | 1 | 7 | 7 | 45.82 |
| 10 | 3 | 4 | 3 | 45.82 |
| | 2 | 3 | 5 | 51.98 |
| | 1 | 5 | 4 | 41.39 |
| 5 | 3 | 1 | 1 | 26.13 |
| | 2 | 2 | 1 | 29.40 |
| | 1 | 1 | 3 | 26.16 |

Conclusions

- The west coast public is generally supportive of the notion of large marine protected areas.
- Optimal size from a west coast public perspective = 15.6% of Federal waters (2.5% no-access, 4.9% no-take, 8.2% multiple use)
 - *Other designs also utility-enhancing*
- Small size, high economic value = no-access protected area.
 - *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.*
- Marginal increases to LMPAs larger than ~ 9.75% of Federal waters should be in multiple use designation.

Next steps

- Parameter heterogeneity
 - certain LMPA designations will likely have negative value for some respondents
 - Latent class model may be able to identify winners and losers from specific designations
- Can benefits be transferred among different LMPA sites
- Can net benefits be estimated?
 - Opportunity costs, other costs