



Valuation of Marine Protected Areas: Comparison of MNL and Latent Class Models

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Types of MPAs

■ Natural Heritage

- to sustain the natural biological communities, habitats, ecosystems and processes, and the ecological services, uses and values they provide to this and future generations

■ Cultural Heritage

- to protect, understand and interpret submerged cultural resources that reflect the nation's maritime history and traditional cultural connections to the sea.

■ Sustainable Production

- to support the continued sustainable extraction of renewable living resources (e.g. fish, shellfish, plants, birds or mammals) within or outside the MPA



Research Question

- What are public preferences for MPAs in the northeast EEZ, given different combinations of protected area size and allowable uses?
- MPAs established to
 - Preserve variety of marine life and habitat on sea floor
 - Prevent future industrial uses
 - Incidental benefits to managed fisheries



Method

- **Stated Preference Choice Experiment**
 - Web-based survey using Knowledge Networks
- Sample drawn from Northeast Region
 - Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Washington D.C., Pennsylvania, Virginia, West Virginia, North Carolina
- Modified Dillman method

Please take the survey





Challenge: Information Provision

	Very Familiar	Somewhat Familiar	Not Very Familiar
How familiar are you with Marine Protected Areas?	1 %	18 %	81 %

■ General Information

- Benefits
- Costs

■ Attribute-specific information

- Information about Size
- Description of use levels
- Payment vehicle/cost



Example of Choice Set

<http://www.knowledgenetworks.com/clients/>

Wallmo
noaa345



Results

- 1,342 panelists sampled, 77% response rate
- Average age: 47
- Median income category: 40 – 49K
- Median education category: some college, no degree



Random Utility Model Multinomial Logit

Attribute	MNL
Size	0.0451 (5.5)
Size ²	-0.0014 (-9.3)
Use Level	-0.0978 (-4.2)
Use x Size	0.0094 (8.2)
Cost	-0.0085 (-9.0)
Income x Cost	0.0002 (3.1)
F1	-0.0322 (-21.5)
F2	0.0141 (10.4)
Pseudo r-squared	0.12
Log-likelihood	-5022.38



Extension of MNL

- MNL has shortcomings
- Alternative formulations
 - Nested logit
 - Random parameters/mixed logit
 - Latent Class – limited application to discrete choice data



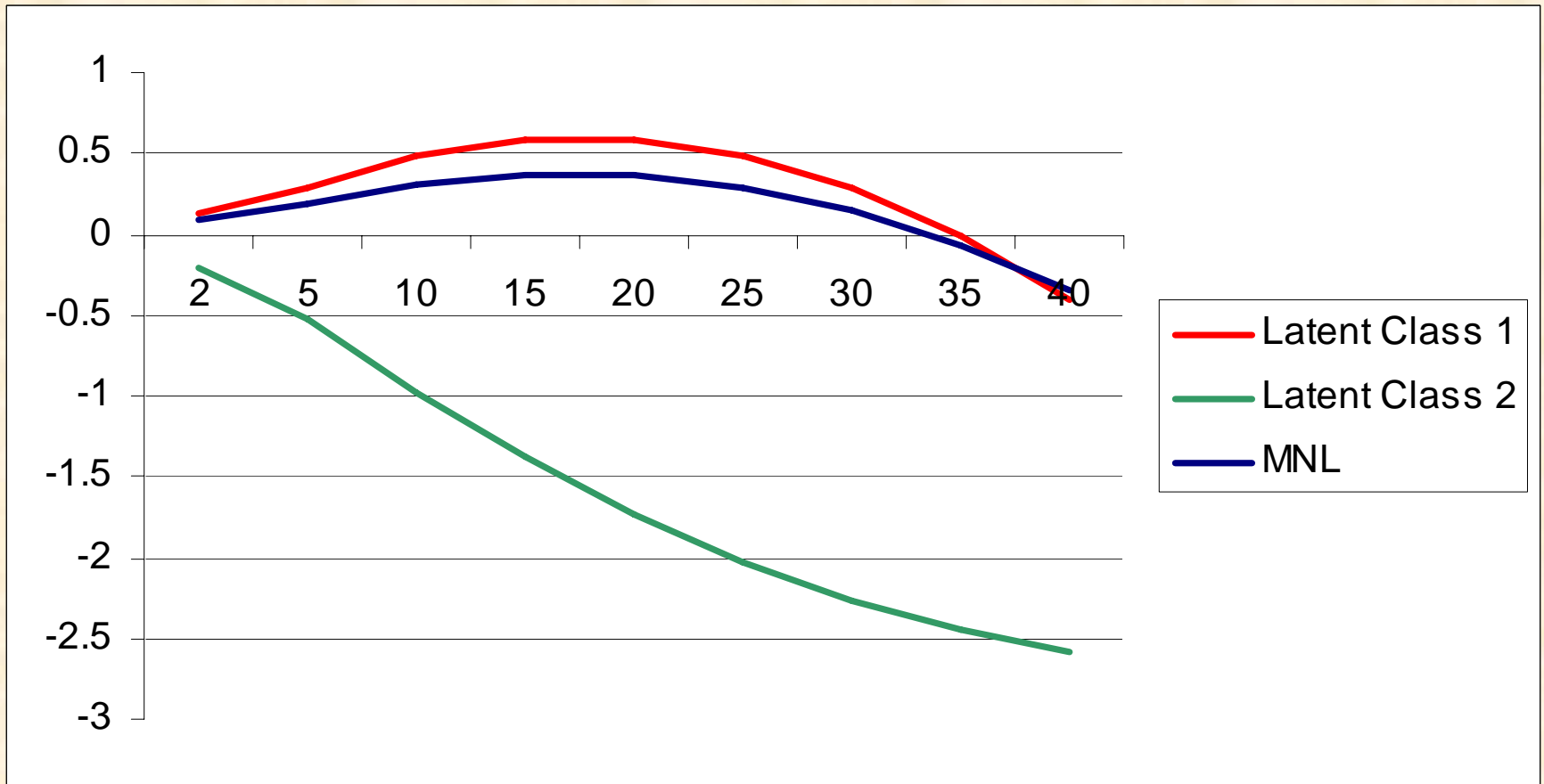
Latent Class Specification

- Individual behavior depends on observable attributes and on latent heterogeneity, unobservable
- LC allows for discrete parameter variation
 - No distributional assumptions about parameters
 - Individuals sorted into a set of Q classes
 - How many classes?

Random Utility Models

Attribute	MNL	Latent Class	
		LC 1	LC 2
Size	0.0451 (5.5)	0.0686 (8.4)	-0.1088 (-5.5)
Size^2	-0.0014 (-9.3)	-0.0020 (-13.7)	0.0011 (3.3)
Use Level	-0.0978 (-4.2)	-0.3113 (-12.3)	0.1431 (3.1)
Use x Size	0.0094 (8.2)	0.0166 (14.0)	0.0081 (2.7)
Cost	-0.0085 (-9.0)	-0.0062 (-14.6)	-0.0070 (-6.9)
Income x Cost	0.0002 (3.1)	-	-
F1	-0.0322 (-21.5)	-	-
F2	0.0141 (10.4)	-	-
Pseudo r-square	0.12	0.15	
Log-likelihood	-5022.38	-4820.90	
LC Probabilities		0.77	0.23

Preferences for network size





NEFMC RFP

- Call for candidate proposals to identify habitat areas of particular concern
- Criteria for eligibility
 - Importance of historic/current ecological function
 - Sensitivity to anthropogenic stresses
 - Extent of current or future development stresses
 - Rare habitat

EFH Omnibus 2 Proposals for Area Closures to Protect Habitat Diversity



Stellwagen Bank NMS
(0.6% of Federal waters)

Areas Proposed by Environmental Groups

-  Coral canyons
-  Stellwagen/Jeffrey's Ledge
-  Cashes Ledge
-  George's Bank Northern Edge
-  Seamounts

4.3% of Federal waters

0 25 50 100 Nautical Miles

Size (% of EEZ)

- Coral Canyons (1.4)
- Jeffrey's Ledge (.95)
- Cashes Ledge (.57)
- GB Northern Edge (.63)
- Seamounts (.71)



Welfare Effects

	MNL	Latent Class	
		LC 1	LC 2
4.3% of EEZ No-take	\$64 per household/year	\$ 237	\$ -136
4.3% of EEZ Limited Fishing	\$44	\$ 122	\$ -59

Kaldor-Hicks criteria not met when
--size is between 23 and 24 % for no-take



When is it too big to be no-take?

Size = 10

Use	MNL	LC 1
■ No-take	\$87	\$289
■ Limited fishing	\$86	\$219

Size = 11

Use	MNL	LC 1
■ No-take	\$91	\$296
■ Limited fishing	\$93	\$233

Size = 19



Preliminary Conclusions

- Latent class improves the MNL
 - Model fit
 - Distributional effects
- The public in the northeast region has value for an MPA network
 - They want more area in an MPA than is currently protected
 - They don't want too much
 - Use matters – no big, no-take areas



Next Steps

- Random Parameters model
- CI for welfare estimates



Experimental Design

- Size (percent of the northeast EEZ that is protected)
 - 5, 10, 20, 30, 40
- Use
 - no take
 - scientific research
 - tourism & recreation
 - limited commercial fishing
- Cost
 - 10, 25, 50, 100



Welfare Effects

	MNL	Latent Class	
		LC 1 (.77)	LC 2 (.23)
4.3% of EEZ No-take	\$64 per household/year \$ 2 billion	\$ 237 \$ 6 billion	\$ -136 \$ -1 billion
4.3% of EEZ Limited Fishing	\$44 \$ 1.4 billion	\$ 122 \$ 3 billion	\$ -59 \$ -433 million

In sample region, 31,936,499 households