Valuation of ecological and social benefits provided by marshes and living shorelines for communities and fisheries

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Ecosystem Services

- Benefits to people provided by nature (provisioning, regulating, supporting, cultural)

- Measuring ecosystem services in monetary terms facilitates straightforward analysis of tradeoffs
  - E.g., National Strategy to Develop Statistics for Environmental-Economic Decisions (2023)

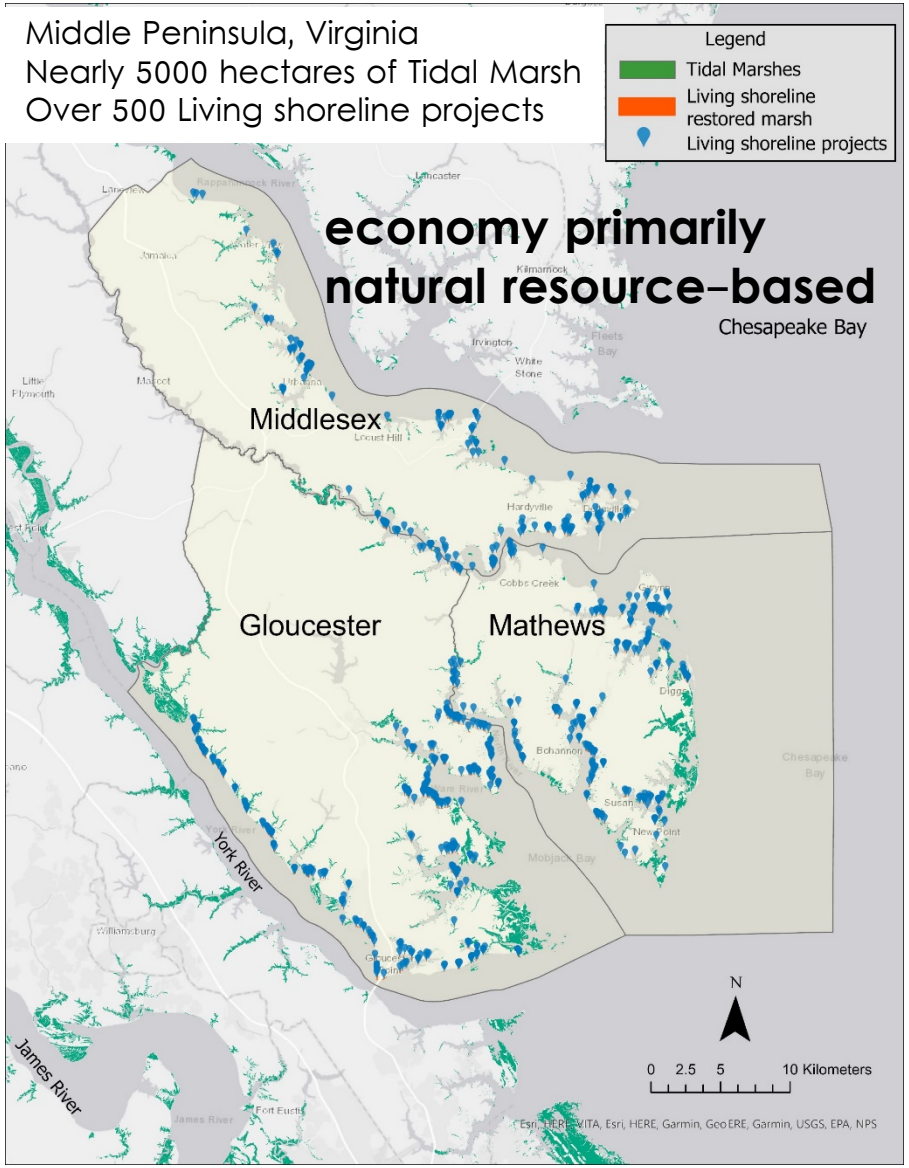
- Variability in ESV across ecosystems due to service provision and associated human values

Study Objectives

1. Estimate the ecological and social benefits provided by marshes and living shorelines for local communities within the Middle Peninsula Virginia region

2. Develop a *Shoreline Restoration Benefit Calculator* that allows users to input project specific information and output net societal benefits.

Study area & Shoreline Marsh Value



Switch Grass

Saltmeadow Hay

Saltmarsh Cord Grass

Ecosystem services:

Storm/flood risk reduction [1]

Carbon storage [2]

Nutrient storage [3]

Fish & crustacean habitat [4]

Recreation – **fishing**, birding[5]

[1]Shepard et al. 2011, Knutson et al. 1982; [2,3]Chambers et al. 2021, Beck et al. 2017; [4]Currin et al 2008, Minello et al. 1994, Peterson & Turner 1994, Bilkovic et al. 2021, Guthrie et al, 2021; [5]Bell 1997, Martín-López et al. 2011, Grilli et al. 2021

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Multiple ES valuation approaches

1. Hybrid Benefit transfer Approach – applied estimates of marsh ecosystem service values from existing studies to Middle Peninsula

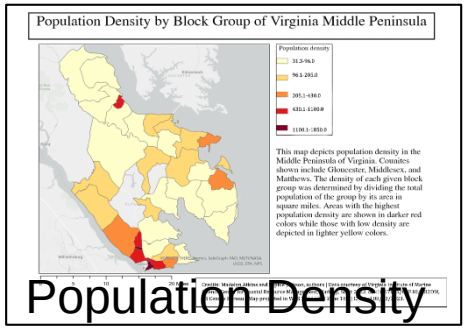
- Literature values refined with location specific information, such as pop density, marsh extent and mapped living shorelines extent
- Stated preference survey of recreational fishers used to value angler use

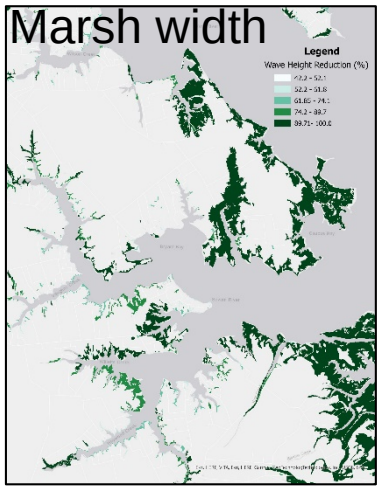
2. Multicriteria decision analysis (MCDA) – ES rankings from stakeholders (in progress)

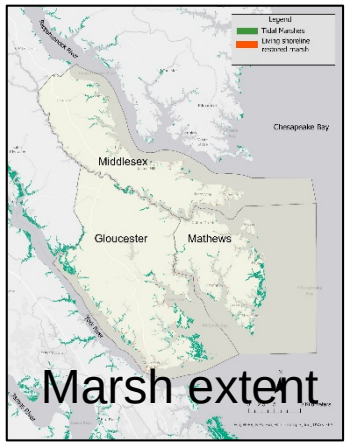
1. Shoreline management stakeholders surveyed for ES preferences (DCE)
2. Estimate WTP to derive rank and value of services

$/yr for MP for each service

Values scaled for local conditions







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1. PRELIMINARY BENEFIT TRANSFER ECOSYSTEM SERVICE VALUATION

Service	N	Mean ($/ha/yr)	Total Benefit Transfer ($/yr)	Total MP1 ($/yr)	Total MP2 ($/yr)
Carbon Removal/Storage	9	$1,908.50	$8.5M	$0.7M	$8.5M
Fish Habitat	8	$1,679.82	$7.4M	$7.4M	$7.0M
Recreation (e.g., Fishing)	9	$1,422.61	$6.3M	$6.4M	$6.3M
Storm/Flooding Risk Reduction	6	$11,244.74	$49.9M	$3.3M	$47.7M
Nutrient Removal/Storage	12	$4,065.33	$18.0M	$22.0M	$18.0M
Total	44		**$90.1M**	**$39.9M**	**$87.4M**

Spatial function

Location specific data function

Literature Review:

- 119 studies identified and reviewed for marsh ecosystem service value estimates
- 44 usable value estimates from 35 studies

Benefit Transfer:

- Values in the literature adjusted in benefit functions to approximate local ESVs
- Middle Penninsula total ESV ~$40M – $90M / yr
- Represents 1.5% to 3.4% of region GDP

Morgan's Branch, North River

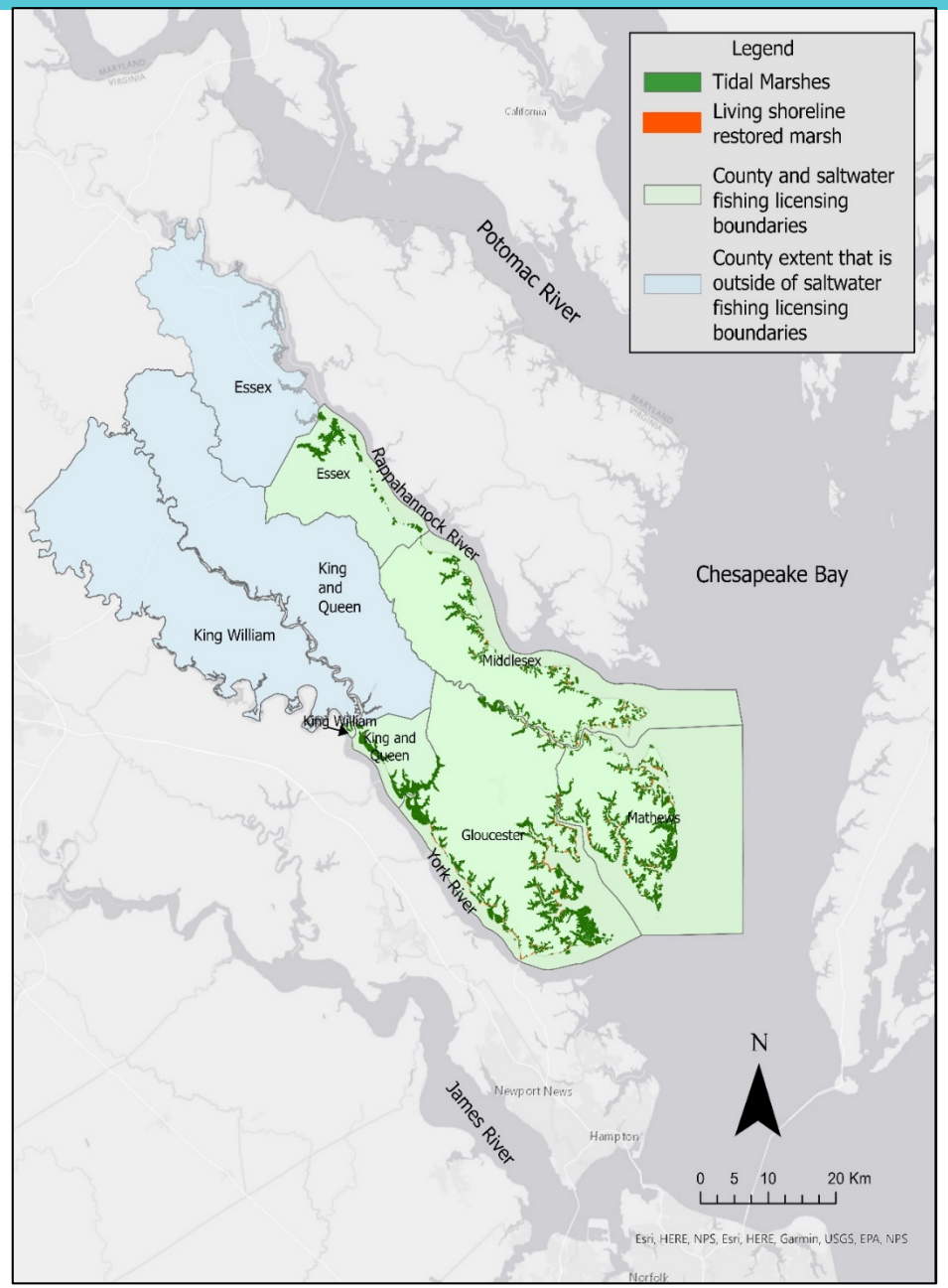
Recreational Benefits – fisheries

Wilson Creek, Gloucester, VA - Fishing

Louisiana Northshore

- Recreational fisheries provide significant economic benefits (~$343M estimated annual economic impacts in Virginia, NOAA 2022)
- 90% of saltwater recreational fishing trips in MD/VA occur in nearshore coastal and inland waters
- Marshes provide critical nursery and forage habitat for many fish species and are frequent destinations of recreational anglers
- **Surprisingly little information on habitat use → complicates ability to assess ESVs**

Recreational fisheries preference survey



- Collect information on saltwater angler effort, costs, and preferences across habitat types

- Estimate value of recreational fishing at different shoreline habitats (marsh, beach, hardened) with DCE

CHOICE SCENARIO

	Option A	Option B	Option C
			Do not go fishing
Shoreline Type	Marsh / Living shoreline	Bulkhead	
Total travel time	30 minutes	15 minutes	
Trip cost to you	$17	$24	

- Online survey (Qualtrics), ~25 questions; angler focus group to test/refine

- Invited all* licensed anglers in Middle Peninsula (n=5,420) and 2/3s of licensed anglers from counties that border Middle Peninsula (n=4,580)

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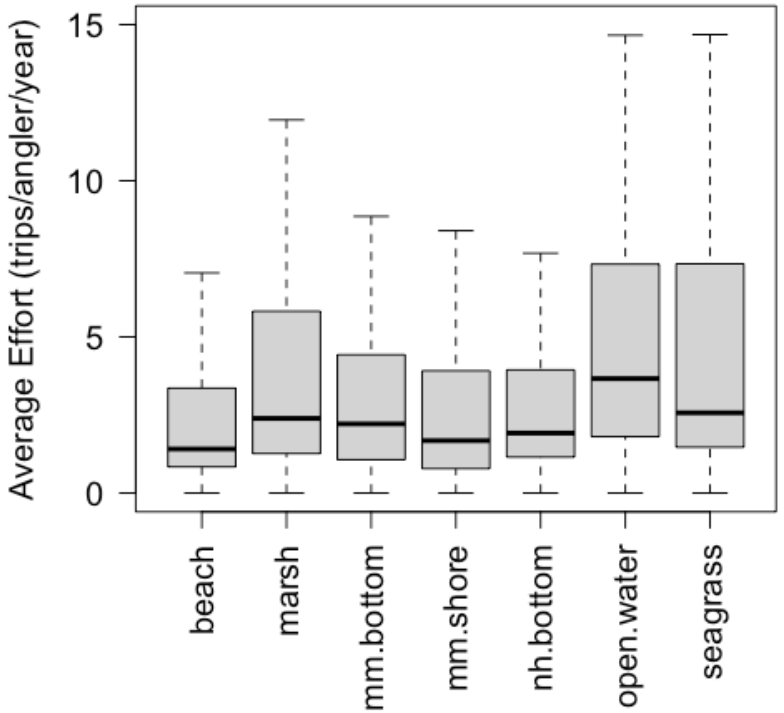
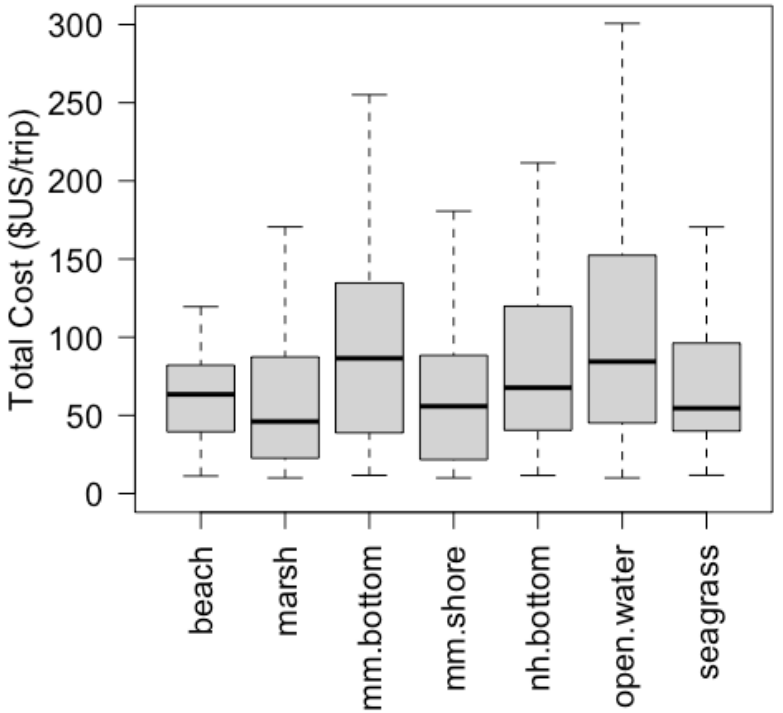
Recreational fisheries preference survey – results

~1,500 response (15%). angler response demographics (gender, age, income, education, avidity) similar to other recent studies





Effort (highest): open water, seagrass, marsh
Effort (lowest): beach, hardened shoreline
Trip cost (highest): open water, bottom structure
Trip cost (lowest): marsh, seagrass, hardened shoreline

Recreational fisheries preference survey – results

- Willingness–to–pay constructed for trips to shoreline habitats as function of travel time using mixed logit model

	WTP, high mobility ($US/trip)	WTP, low mobility ($US/trip)
Beach	$39.27 (17.18)	$90.89 (25.39)
Bulkhead	$60.02 (17.81)	$132.79 (29.92)
Revetment	$109.66 (19.69)	$140.76 (30.71)
Marsh	**$219.05 (33.61)**	**$224.74 (43.19)**

Average travel times per habitat and mode used

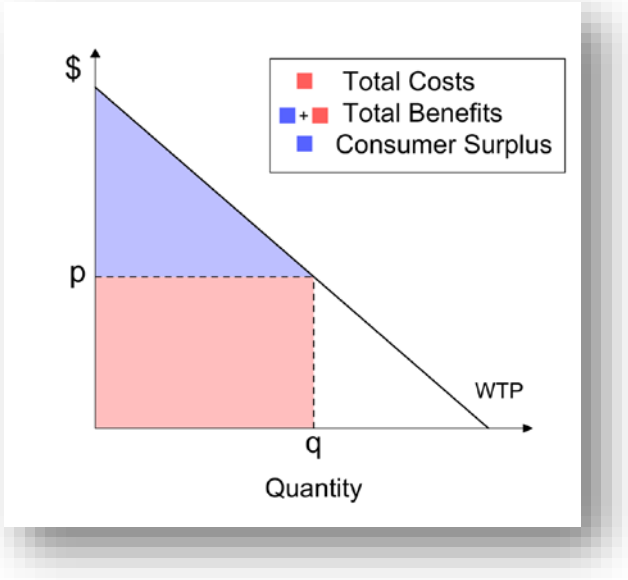
- Trips to marshes yield larger benefits in comparison to hardened shorelines, particularly for high mobility anglers

Recreational fisheries preference survey – results

	Total Benefits (sd)	Net Benefits (sd)
Beach	$0.78M (0.19M)	$0.31M (0.19M)
Hardened shoreline	$1.78M (0.31M)	$1.01M (0.31M)
Marsh / living shoreline	$6.42M (0.99M)	$5.23M (0.99M)

For Middle Peninsula anglers, considering habitat-specific effort, costs, and WTP

Suggests ESV of marsh habitat in Middle Peninsula of **$1085.73/ha**



–**$6.42M in annual benefits for recreational fishing** provided by Marshes and living shorelines in the Middle Peninsula

–a total value which is more than **3.5X greater** than that produced by hardened shorelines (& more than **5X greater** in net benefits)

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Summary & Next Steps

Hybrid Benefit Transfer ESV:

- Middle Peninsula total ESV ~$40M – $90M / yr
- Represents 1.5% to 3.4% of region GDP
- Marshes & living shorelines provide 3.6X the value of hardened shorelines for rec fishing (**$6.42M in annual benefits)**

Next steps

- Complete community survey analysis for Multicriteria decision analysis (MCDA) valuation
- Finalize ESVs
- Develop a *Shoreline Restoration Benefit Calculator* that allows users to input project specific information and output net societal benefits
- Manuscript on angler preferences and recreational fishing valuation submitted

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Questions?

Special thanks to the recreational anglers who participated in the focus group and/or took the survey!

Project Partners:

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THANK YOU!

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