

# Preference Based Estimates of Wetland Mitigation Ratios and the Extent of the Market for Benefits Transfer of Wetland Values

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# Benefit Transfer

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- What's the relevant market area for ecosystem services?
- Do ecosystems have to be same? How do ecosystem values vary with ecosystem qualities?
  - Same ecosystems: marsh wetlands; forested wetlands
  - Qualities: habitat for birds; habitat for reptiles; access for nature viewing
- How do respondent demographics affect ecosystem prices/values?
- If ecosystem values can't be transferred, can a stated choice questionnaire be transferred from one ecosystem area to another?

# Project: Test the Transfer of an SC-Q and SC-Values across Ecosystem Regions

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- Stated Choice Questionnaire (SC-Q)
  - Developed for use in Michigan to elicit values for wetland services
- 1. Transfer of the MI SC-Q to 3 Different Ecosystem Regions
  - Test transfer using standard qualitative methods
- 2. Elicit values for wetland ecosystems and wetland qualities from subjects in a large scale internet panel
- 3. Evaluate the similarity and differences of interregional in-kind values

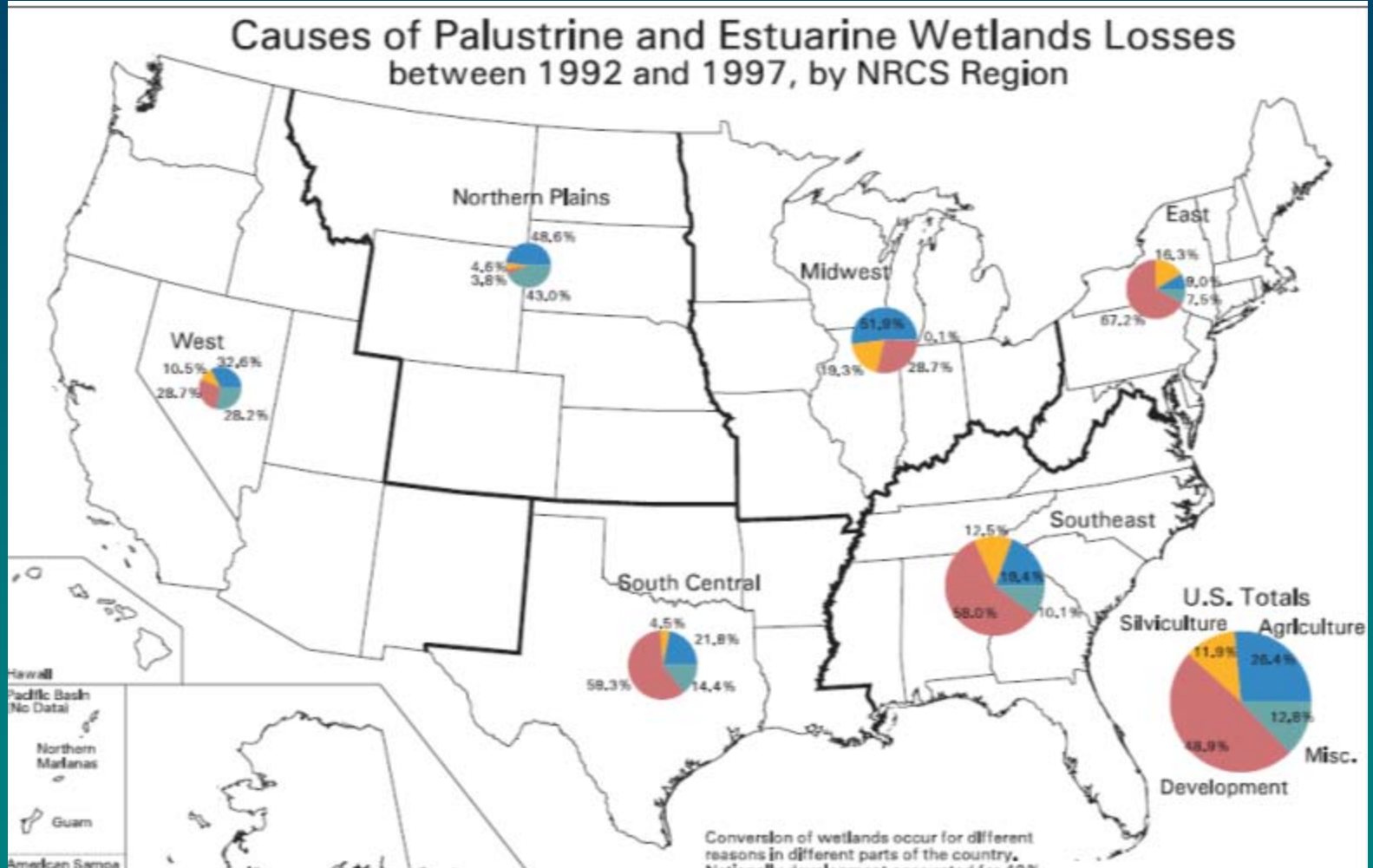
# Presentation Content

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- Choice of 3 transfer sites:
  - Regional wetland types within US ecosystems
- Qualitative research results for transfer of the SC-Q
- Estimate and Evaluate In-Kind Values for Wetlands and Services
- Evaluate the prospects for transfer of the estimated in-kind values across ecosystems and demographic regions

# Wetland Conversions



# Cap and trade in wetland ecosystem credits

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Wetland Loss to Highway  
Construction

- **Cap:** No net loss of wetlands in US since 1989
- **Bank:** Wetlands are restored under Federal and state rules to create transferable credits to compensate for drained and converted wetlands
- **Trade:** Developers who drain existing wetlands purchase bank credits as compensation.
- **Problem:** What's the right compensation ratio?

# Problem: What's the right compensation ratio for acreage restored to acreage drained?

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- Wetlands are not equal in . . .
  - ecological function
  - ecosystem services
- Are the preferences of Joan or Joe Citizen relevant to compensation?
- Can compensation ratios be estimated using stated choice valuation?
  - Are they transferable?



# Simple Economics of Wetland Compensation Ratios

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Individuals get utility from wetland qualities,  $q$ , and wetland acreage,  $a$ :

$$U = u(\text{quality}, \text{acres})$$

Let  $r$  be restored acres with qualities,  $q_r$ ,  $d$  is lost wetland acres with qualities,  $q_d$ .

The **compensating mitigation ratio**,  $r/d$ , makes utility of the restored wetland equal to utility of the lost wetland,

$$u(\text{restored quality}, \text{restored acres}) = u(\text{drained quality}, \text{drained acres})$$

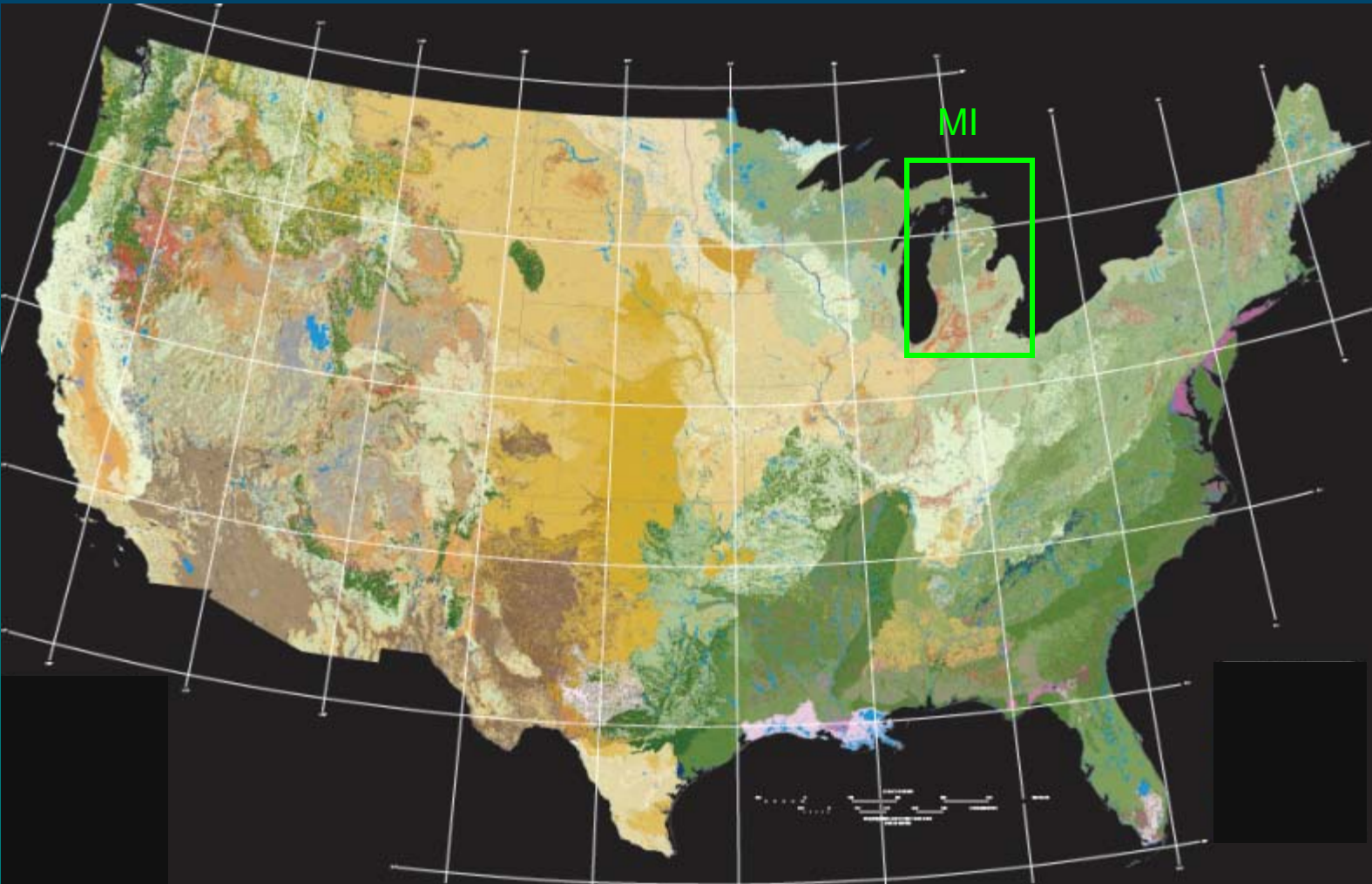
# MI Questionnaire to Estimate Wetland Preferences, $u(q,a)$

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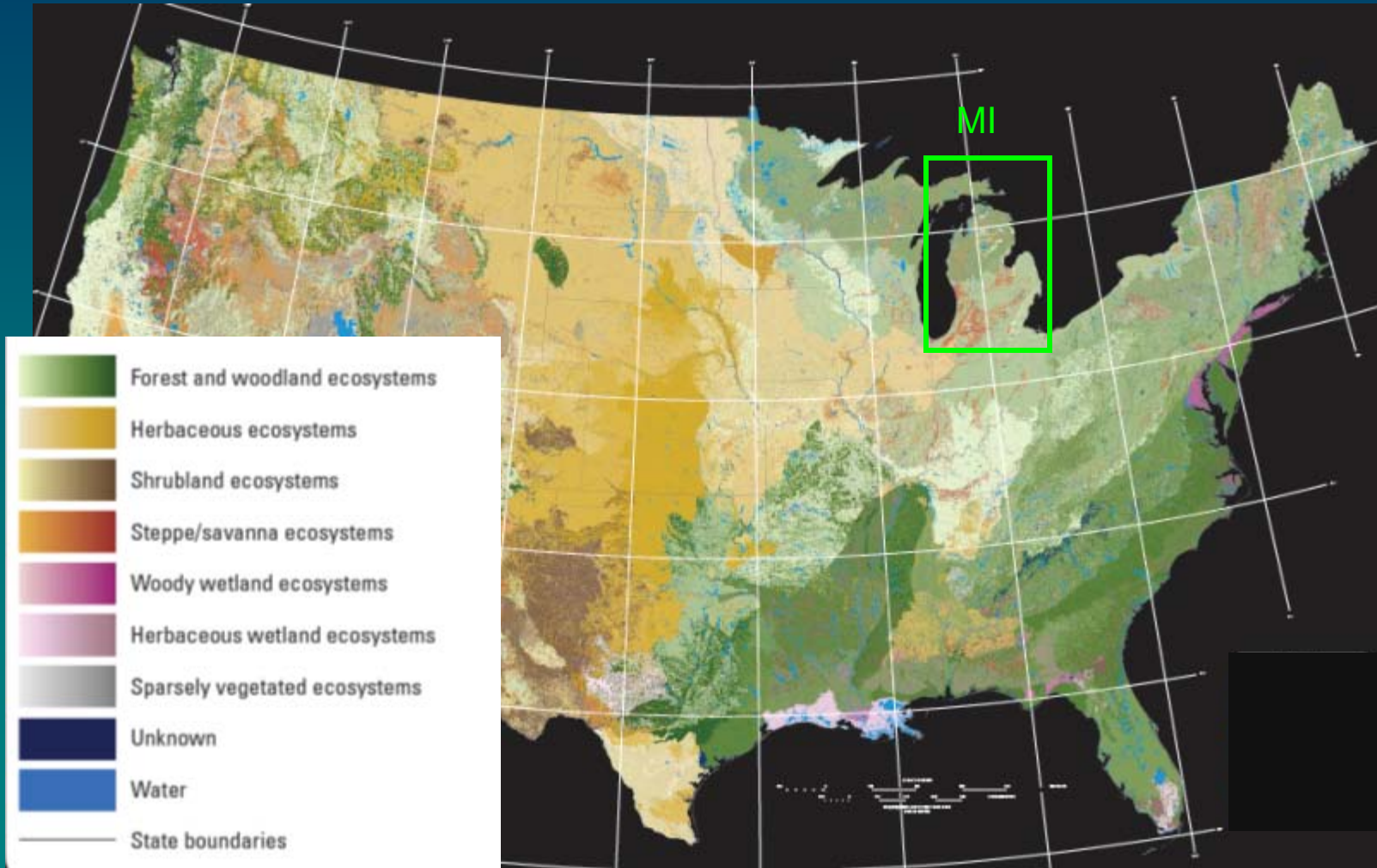
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- The MI questionnaire went through extensive qualitative pretesting, a mail survey, and on-line trials with Michigan subjects
- Provided basic information about wetlands, wetland habitats, and wetland compensation
- Elicited 5 Pairwise Choices: “Is the restored wetland sufficient to compensate you for lost of the drained wetland? Choice attributes:
  - ❖ Acreage
  - ❖ Access to public
  - ❖ Type of cover, wooded or marsh
  - ❖ Habitat for wildlife and plants: frogs and reptiles, birds, small animals, wading birds, wildflowers
- Can the MI questionnaire be transferred to other ecosystem regions? Are the in-kind values transferable?

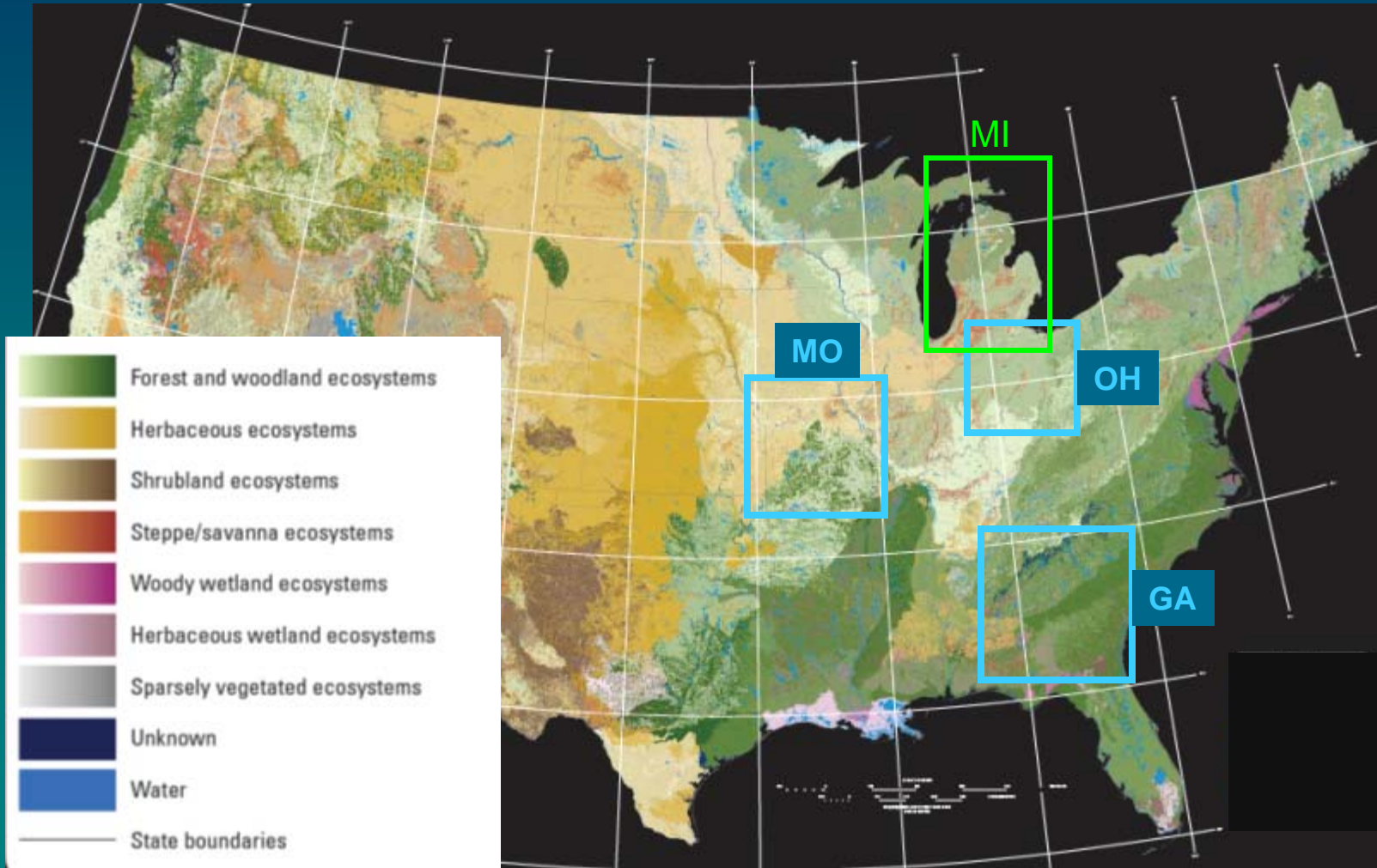
# U.S. Ecosystems: MI and Possible Transfers



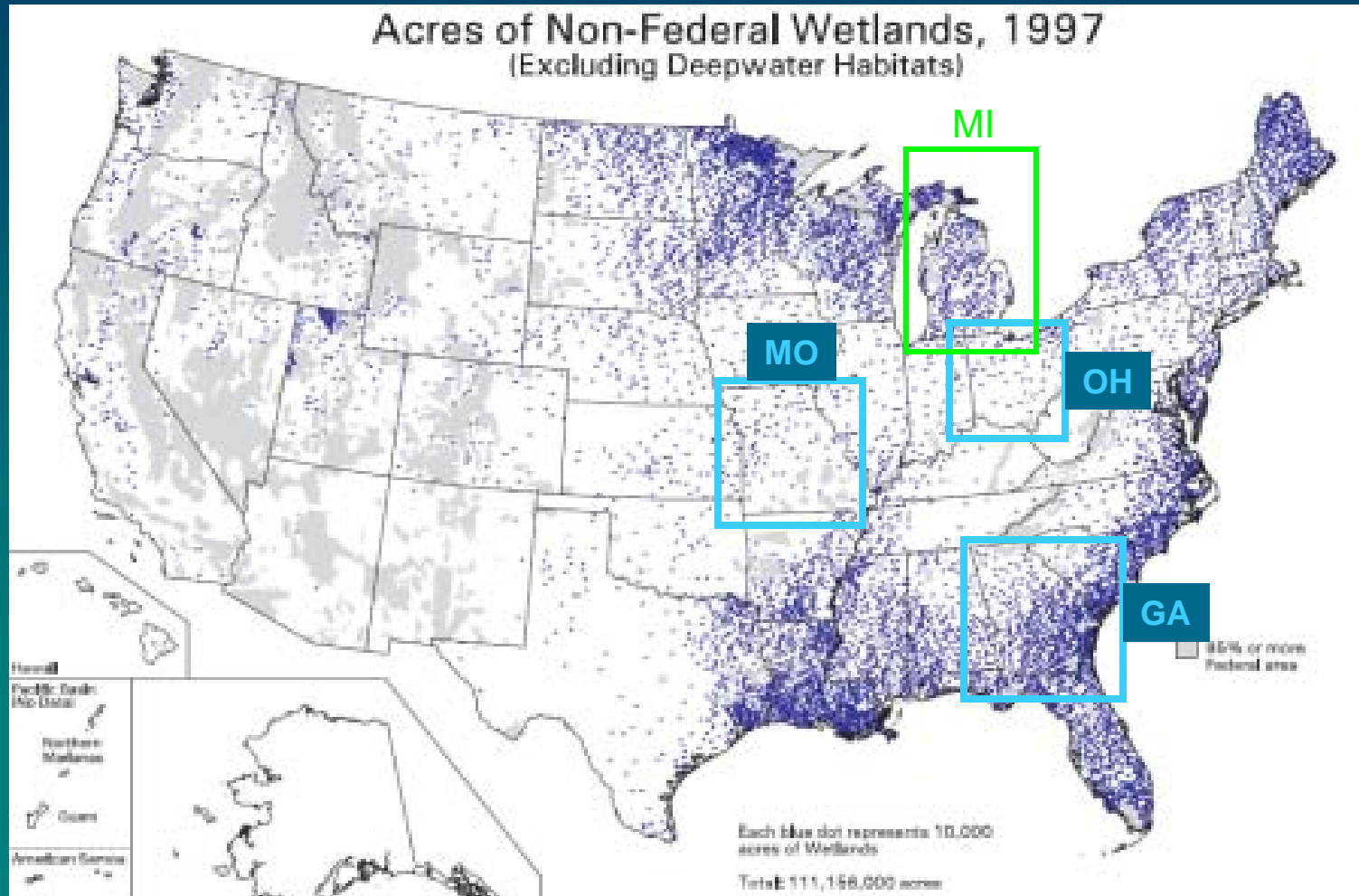
# U.S. Ecosystems: MI and Possible Transfers



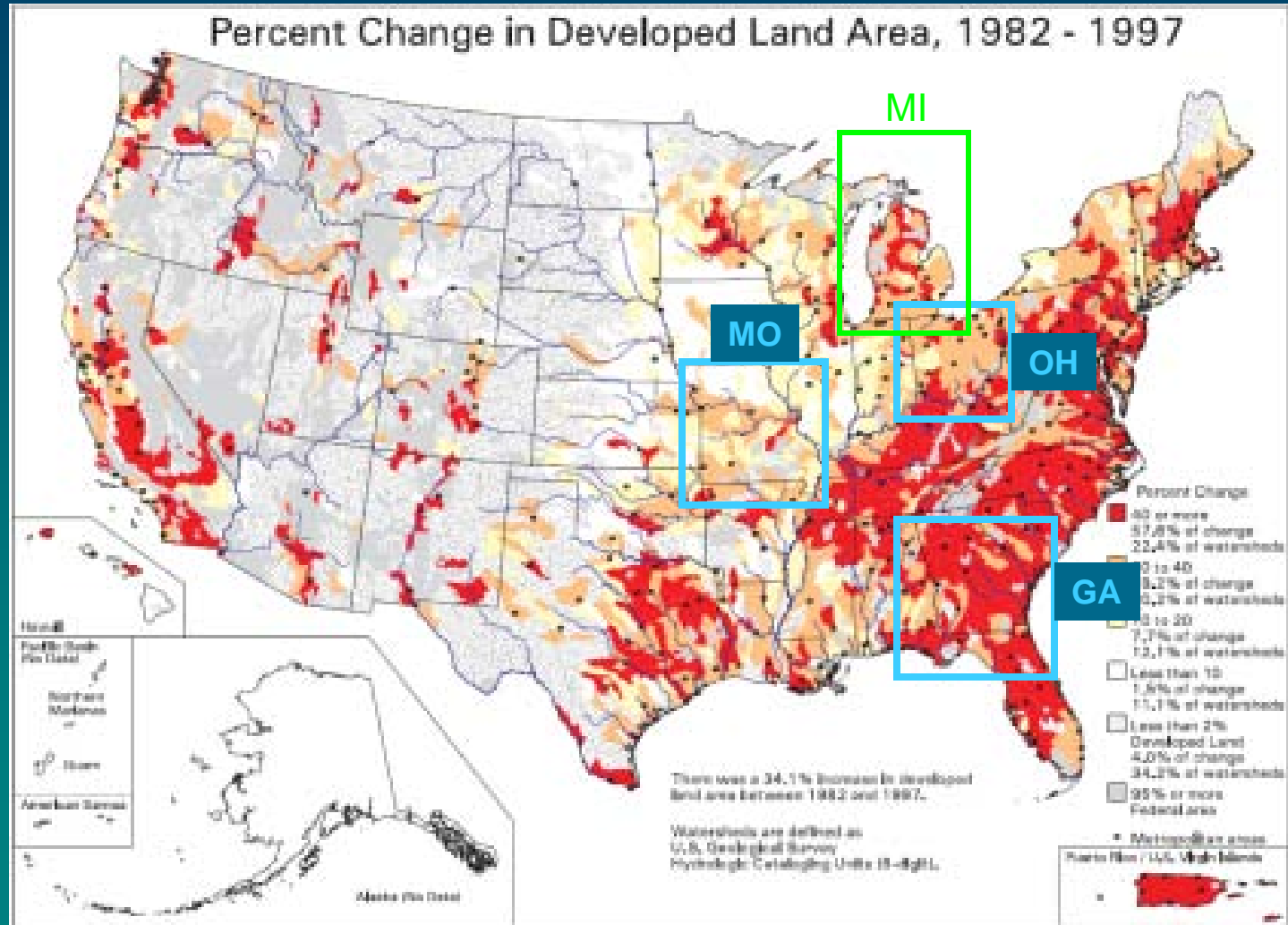
# Transfer Choices: Inland, Non-Coastal, Eastern Ecosystems



# Transfer Choices: Inland, Non-Coastal, Eastern Ecosystems



# Transfer Choices: Inland, Non-Coastal, Eastern Ecosystems



# Qualitative Tests of Transferring MI SC-Questionnaire

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- Dayton, OH
  - Familiar with same wetlands: marsh, forested, and mixed
  - Development issues and mitigation somewhat familiar
  - Feedback very similar to MI qualitative subjects
- Atlanta, GA
  - Some experience wetlands of MI type; more familiar with southern marsh and cypress forest wetlands
  - Not many subjects familiar with mitigation
  - Very willing to follow guidance the questionnaire
- St. Louis, MO
  - Almost no direct experience with wetlands
  - Very willing to follow guidance in the questionnaire
- Overall: Somewhat surprised by the *lack* of contrary indicators to transfer

# 4 State Internet Panel Experiment to Test the Transfer of Compensation Ratios and Quality Effects

## Michigan SC-Questionnaire, 5 Pairwise Wetland Choices

Subject Attributes	Panel Means				
	Full Panel	Michigan	Ohio	Georgia	Missouri
Number of subjects	5,225	1,797	1,288	1,097	1,043
Income, \$1,000s	52.6	53.9	50.8	57.2	47.8
High school or more school (%)	97.9	98.1	97.8	98.2	97.5
Age, under 25 years (%)	9.1	8.3	9.5	9.5	9.3
Age, 65 and over (%)	11.8	3.3	16.0	16.3	17.0
Male (%)	46.7	41.8	49.1	48.9	50.0
Never visited a wetland (%)	20.7	14.2	25.5	20.6	26.4
Never see wetlands (%)	38.8	20.7	44.6	49.0	57.5

# In-Kind Compensation Function Estimated Using a Panel Probit Model

$$m_s = m(\hat{n}, \hat{q}_m, \hat{q}_n)$$

$$m_s = \beta_{s0} + \beta_{sd}n + \sum_{k=1}^K \beta_{sk}\Delta q_k + \sum_{r=1}^R \gamma_{sr}c_r + \varepsilon_s$$

$$Prob[\text{accept } m^0 | n, q_m, q_n] = \Phi[(m^0 - \beta_{s0} - \beta_{sn}n - \sum_{k=1}^K \beta_{sk}\Delta q_k - \sum_{r=1}^R \gamma_{sr}c_r) / \sigma_{\varepsilon_s}]$$

# Estimated Demographic Coefficients

Table 1. Choice Equation Estimates

	Choice Equation Estimates by State			
	Michigan	Missouri	Ohio	Georgia
Income	-.05** (.02)	-.09** (.02)	-.03* (.02)	-.03* (.02)
High school or more schooling	-9.14** (3.11)	-12.38** (4.80)	-17.74** (5.19)	-17.74** (5.19)
Age, under 25 years	3.60* (1.56)	3.93 (2.58)	6.34* (2.49)	6.34* (2.49)
Age, 65 and older	-4.16 (2.41)	-7.37** (2.05)	1.27 (1.90)	-4.65* (2.34)
Male	-2.94** (.89)	-1.89 (1.49)	-2.47 (1.44)	-1.49 (1.73)
Never visited wetland	2.16 (1.29)	2.17 (1.72)	5.18** (1.76)	14.60** (2.69)
Never see wetlands	.89 (1.11)	3.35 (1.56)	6.22** (1.59)	3.41 (1.80)
Error Variance	30.66** (1.97)	39.62** (3.78)	42.47** (2.83)	47.31** (5.12)
N	8971	6440	5225	5485
Log-Likelihood	-5718	-3315	-4421	-3789
Degrees of freedom	27	27	27	27

a. A “\*\*\*” (“\*\*”) indicates that a coefficient is statistically different from zero at the 1 (5) percent.

# Estimated Compensation Ratios and Wetland Quality Effects

Table 1. Choice Equation Estimates

	Choice Equation Estimates by State			
	Michigan	Missouri	Ohio	Georgia
Acres restored for each 1 acre drained (compensation ratio)	1.51** (.16)	1.44** (.30)	.96** (.29)	1.46** (.35)
Gain of access by public	-5.72** (.90)	-7.16** (1.28)	-7.93** (1.25)	-10.34** (1.68)
Restored wetland type differs from drained type (marsh, forest, mixed)	6.21** (1.03)	5.23** (1.58)	4.32** (1.51)	3.93* (1.80)

# Estimated Compensation Ratios and Wetland Quality Effects

Not significantly different from 1.5 at 5% level

Table 1. Choice Equation Estimates

	Choice Equation Estimates by State			
	Michigan	Missouri	Ohio	Georgia
Acres restored for each 1 acre drained (compensation ratio)	<u>1.51**</u> (.16)	<u>1.44**</u> (.30)	<u>.96**</u> (.29)	<u>1.46**</u> (.35)
Gain of access by public	-5.72** (.90)	-7.16** (1.28)	-7.93** (1.25)	-10.34** (1.68)
Restored wetland type differs from drained type (marsh, forest, mixed)	6.21** (1.03)	5.23** (1.58)	4.32** (1.51)	3.93* (1.80)

# In-Kind Values for Habitat Quality Changes

Table 1. Choice Equation Estimates

	Choice Equation Estimates by State			
	Michigan	Missouri	Ohio	Georgia
Drained habitat, poor				
Reptile	-4.64** (1.29)	-4.00* (1.75)	-3.46* (1.68)	-4.46* (2.06)
Wading bird	-3.34** (1.26)	-4.46* (1.79)	-7.65** (1.81)	-3.53 (2.06)
Song bird	-5.10** (1.29)	-2.61 (1.73)	-3.51* (1.68)	-1.51 (2.02)
Wild flowers	-2.24 (1.22)	-5.12 (1.81)	-5.42** (1.74)	-2.72 (2.04)
Drained habitat, excellent				
Reptile	9.16** (1.34)	4.05* (1.80)	4.50** (1.74)	6.79** (2.20)
Wading bird	10.25** (1.40)	5.10** (1.79)	2.88 (2.69)	3.98 (2.05)
Song bird	7.70** (1.31)	3.94* (1.82)	4.72** (1.74)	5.06* (2.14)
Wild flowers	3.54** (1.45)	7.01** (1.91)	5.26** (1.79)	7.42** (2.23)
Restored habitat, poor				
Reptile	3.76* (.98)	14.27** (2.10)	13.00** (1.93)	18.27** (2.72)
Wading bird	4.47** (1.00)	13.07** (2.14)	13.76** (2.08)	17.24** (2.75)
Song bird	3.10** (1.00)	11.06** (2.03)	13.40** (2.05)	12.62** (2.46)
Wild flowers	5.06** (1.26)	4.53* (1.96)	10.06** (2.08)	8.12** (2.41)
Restored habitat, excellent				
Reptile	-7.18** (1.06)	-2.70 (1.78)	-5.25** (1.78)	-3.80 (2.08)
Wading bird	-4.54** (1.02)	-4.16* (1.77)	-3.23 (1.69)	-4.92* (2.08)
Song bird	-6.00** (1.03)	-5.84** (1.80)	-2.00 (1.67)	-3.62 (2.05)
Wild flowers	-3.72** (1.00)	-2.59 (1.71)	.24 (1.62)	-1.62 (1.97)

# Are the Estimated Compensation Ratios and Quality Effects Transferable?

Statistical Tests	Result at 5% Level
Basic compensation ratio is 1.5 when type & quality is held constant	Don't reject
Pool all coefficients: MI, OH, GA, MO	Reject
Pool compensation and quality coefficients for MI, OH, GA, and MO; allow demographic coefficients to vary by state	Reject
Pool all quality and demographic coefficients: OH, GA, MO	Reject
Pool compensation and quality coefficients for OH, GA, and MO; allow demographic coefficients to vary by state	Don't reject
Pool all coefficients for pairs: OH and GA or GA and MO	Don't reject

## Work-in-Progress: Conclusions?

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- The MI questionnaire transfers without difficulty
- What about the transferability of estimated values?
  - The basic compensation ratio for *ecological similar wetlands* was transferable across 4 eco-regions/states, *1.5*--a little less than the actual national average of 2.0 for all wetland mitigation (ELI, 2006)
  - Wetland quality adjustments are statistically & quantitatively significant
    - ❖ Ordinary people do care about habitat qualities and the basic compensation ratio *does* need adjustment for quality
  - Quality adjustments are not as transferable as the basic ratio
    - ❖ Quality adjustment are transferable across MO, GA, and OH, but separable demographic are not transferable
    - ❖ MI quality adjustment are not transferable in general