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Water Quality Improvements in Florida: A Benefits Transfer Valuation Approach

Sergio Alvarez, PhD
Chief Economist
Florida Department of Agriculture and Consumer Services
400 South Monroe Street Tallahassee, FL 32399-0800
(850) 410-2291
sergio.alvarez@freshfromflorida.com

Serhat Asci, PhD
Research Fellow
Institute for Food and Agriculture
California State University, Fresno
2910 E. Barstow Ave. M/S OF 115 Fresno, CA 93740
(559) 278-8590
sasci@csufresno.edu

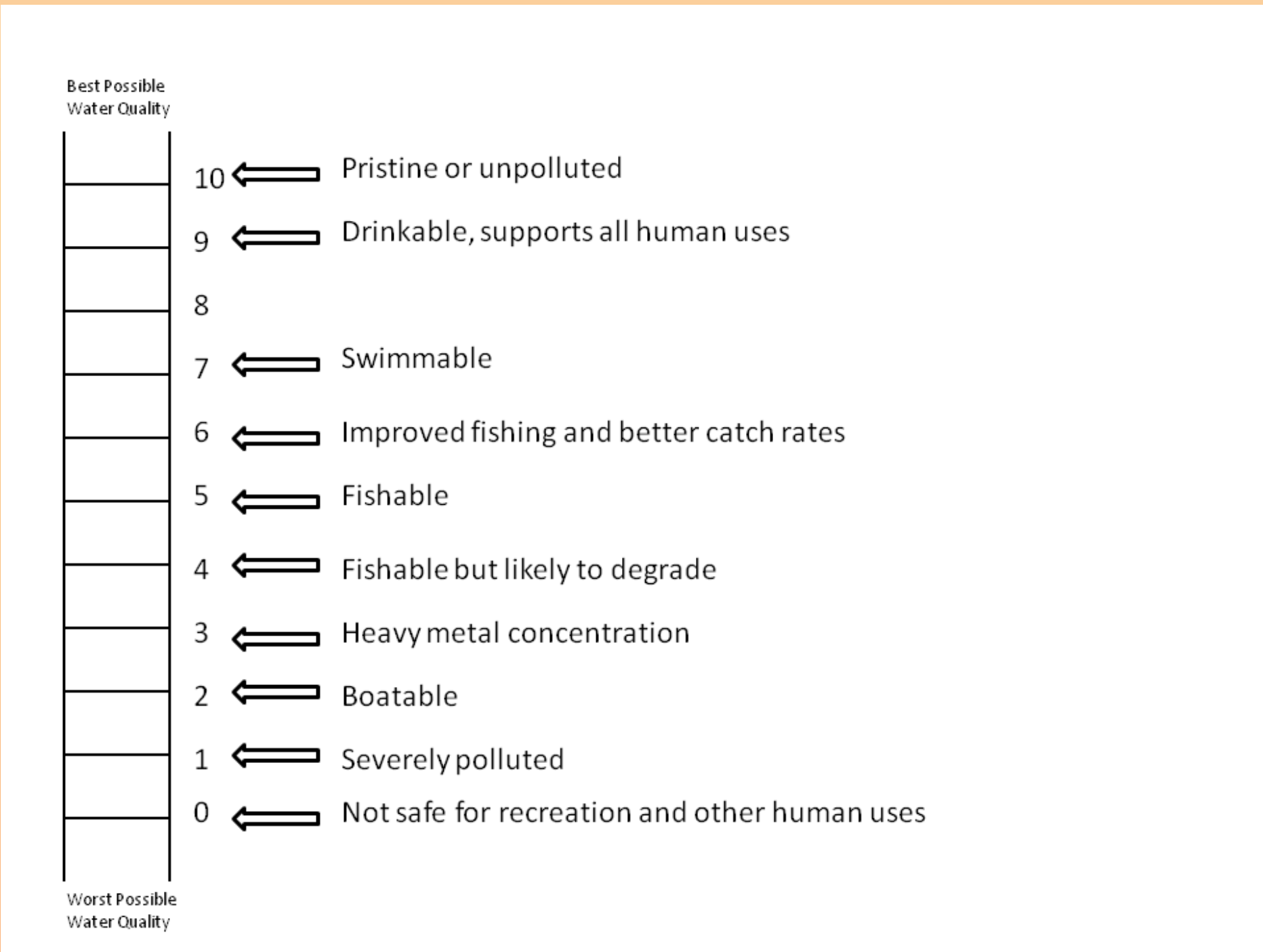
***Selected Poster prepared for presentation at the
2015 Agricultural & Applied Economics Association and Western Agricultural Economics
Association Joint Annual Meeting, San Francisco, CA, July 26-28***

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INTRODUCTION

We develop a database of existing peer-reviewed and high quality studies that value the non-market benefits of water quality improvements, including studies using the contingent valuation, travel cost, and hedonic pricing methods.

Figure 1. Water quality ladder



The database is used to estimate a benefits transfer valuation function for water quality improvements in the state of Florida as a result of adoption and implementation of agricultural Best Management Practices (BMPs).

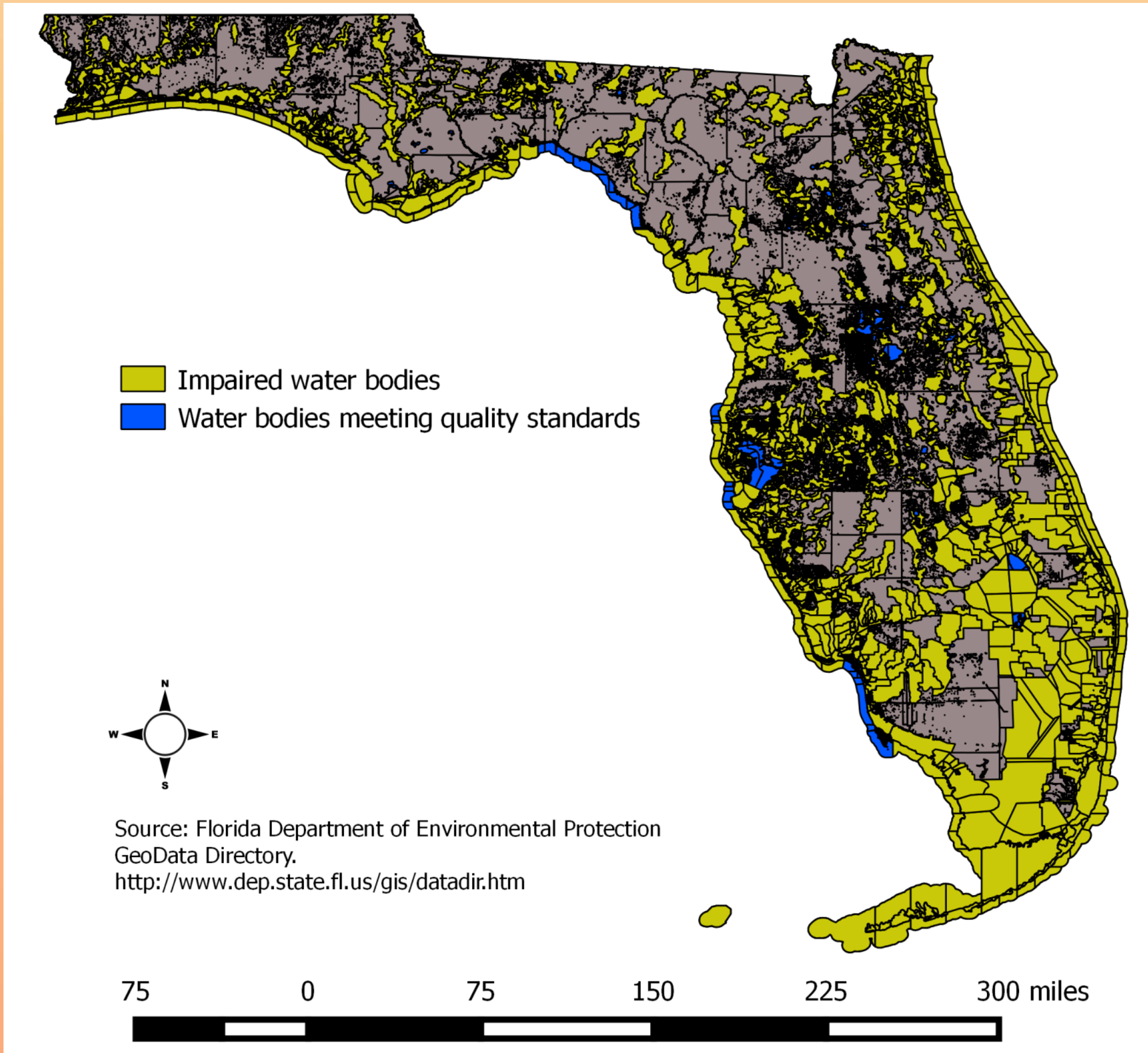
Table 1. Studies on water valuation used in meta-analysis

Study	Year	State	Number of estimates	Water-body type	Methodology	WTP range (2014 dollars)
Azevedo et al 2001	2000	IA	2	Freshwater Lake	CVM	113.34-566.69
Berrens et al 1996	1995	NM	3	Stream	CVM	43.28-135.11
Bhat 2003	1996	FL	4	Florida Keys	Travel Cost	295.09-424.47
Boyle et al 1993	1990	AZ	12	River	CVM	195.05-1560.38
Carson and Mitchell 1993	1990	N/A	20	Freshwater	CVM	123.00-643.13
Carson et al 1994	1994	SC	1	Saltwater Coastal System	CVM	86.14
Cordell and Bergstrom 1993	1989	NC	4	Freshwater reservoirs	CVM	77.24-139.02
Duffield et al 1992	1988	MT	8	Freshwater river	CVM	93.18-1584.01
Farber and Griner 2000	1996	PA	9	Freshwater stream	Choice Experiments	5.5-161.51
Herriges and Shogren 1996	1993	IA	6	Lake	CVM	66.60-223.56
Huang, Haab and Whitehead 1997	1995	NC	8	Sounds	CVM	120.05-127.97
Lipton 2004	2001	MD	4	Bay	CVM	17.08-52.66
McKean, Johnson and Taylor 2003	1998	ID	2	Freshwater River	Travel Cost	18.53-21.44
Murray and Sohngen 2001	1998	OH	3	Freshwater Lake	Travel Cost	17.18-23.31
Park, Bowker and Leeworthy 2002	1996	FL	1	Keys	CVM	468.45
Stumborg et al 2001	2001	WI	1	Freshwater Lake	CVM	458.42
Whitehead, Haab and Huang 2000	1995	NC	2	Sounds	Travel Cost	79.09-101.40

DATA

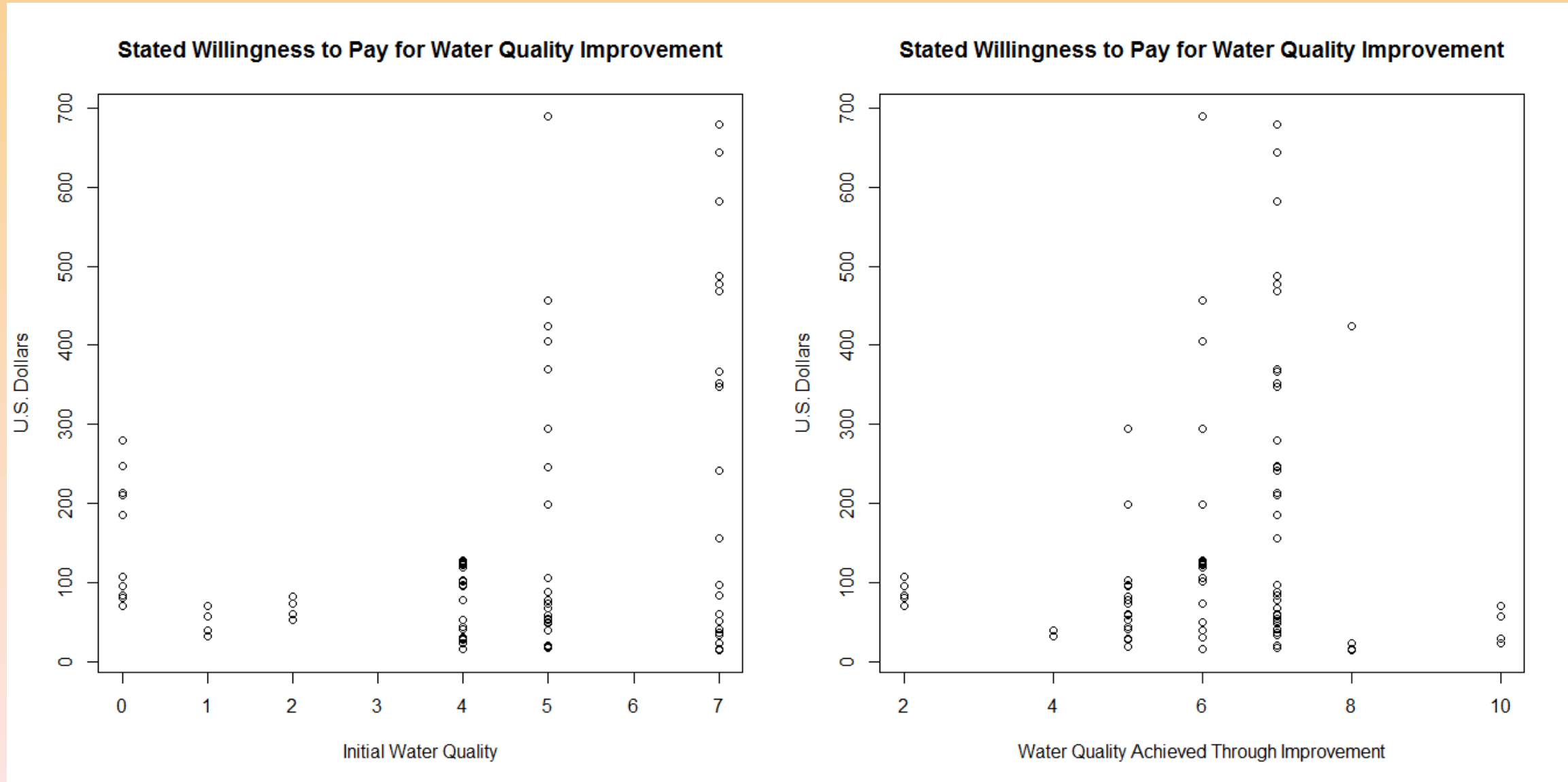
We conducted a literature search of peer-reviewed and other high quality published studies that estimate the non-market benefits of water quality improvements in the United States. Thus far we have identified 43 studies that use the contingent valuation method or choice experiments, and 13 that use the travel cost method.

Figure 2. Impaired water bodies in the state of Florida



The methodologies, respondent demographics, study area characteristics, type of water quality improvement, and welfare measures associated with the water quality improvements were recorded and a dataset of studies was created for 62 observations. We use a variation of the water quality ladder developed by Resources for the Future (Vaughan, 1989)—also known as the RFF water quality ladder—to include a common currency of water quality states and changes across studies.

Figure 3. Stated WTP according to base and improved water quality



METHOD

The functional form proposed by Johnston et al. (2005) is selected in this study due to its statistical performance and ability to capture curvature in the valuation function, as recommended by Johnston and Thomassin (2010). This form also allows independent variables to influence WTP in a multiplicative rather than additive manner. In addition, our models are estimated using random-effects models to address potential correlation among observations gathered from single studies, which gives more robust variance estimation by accounting for potential heteroskedasticity (Nelson and Kennedy, 2009).

$$WTP = f(q_0, q_{\Delta}, d, pl, m)$$

Where q_0 represents the baseline level of water quality, q_{Δ} represents the change in water quality, d represents demographic characteristics of the population including income, pl represents characteristics of the study site which can be interpreted as policy variables, and m represents methodological characteristics of the primary studies. This function provides the basic conceptual foundation for constructing a benefits transfer function to predict values for defined changes in water quality.

Table 2. Coefficients estimates of random-effect GLS regression

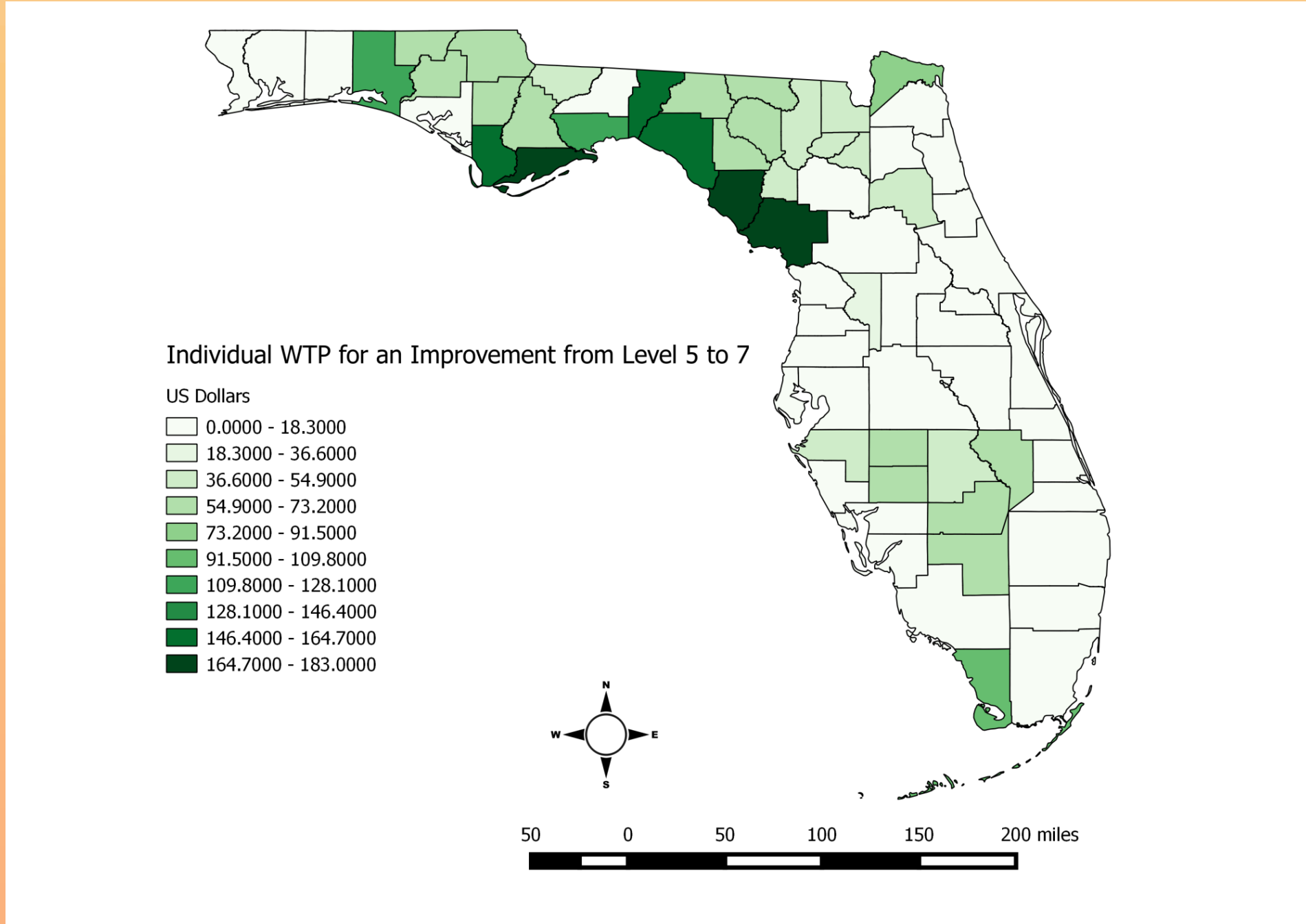
Variable	Semi-Log Estimation	Standard Errors
Intercept	4.615***	1.014
Water quality difference	0.201***	0.045
Water quality base	-0.249**	0.104
Income	0.000021*	0.000012
Population density	-0.003***	0.000
Urban areas	1.621***	0.362
Water body type (freshwater)	-0.984**	0.407
Pollution source (non-point)	-0.900*	0.475
Estimation method (CVM)	0.725**	0.286
Elicitation format (multi DC)	0.139	0.252
WTP dimension (individual one-time)	0.014	0.341
Payment vehicle (tax)	-1.582***	0.365
Users percentage in surveys	0.024***	0.003
R ²	0.71	
Log likelihood value	-60.68	

The coefficient for water quality difference shows that the larger the improvement, the more people are willing to pay for water quality. But the coefficient for base water quality shows that people are willing to pay less for quality improvements at the higher end of the ladder. That is, a change from level 1 to level 2 has a higher value than a change from level 6 to level 7, implying decreasing returns to water quality improvements.

RESULTS

We develop a map of estimated WTP for a specific water quality improvement from level 5 (fishable) to level 7 (swimmable) by county. It is surprising that the highest estimated WTP is for improvements in the Big Bend area, which is mostly a pristine part of the state.

Figure 4. WTP by counties for an improvement from level 5 to level 7 in the state of Florida



CONCLUSION

- There are two avenues for improving this study.
- The first and most important is to include more studies to get a more exhaustive database.
 - The second improvement is to try and classify the true current level of water quality in different regions of the state.

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