

Science, Politics and Policy: How Michiganders think about the Risks Facing the Great Lakes

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Published online: 28 October 2017
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Abstract The Great Lakes region is an important ecological asset for the United States, yet studies show that several environmental risks threaten its viability. As a result, it is important to respond to these risks with effective policies. When and how policy is implemented often depends on public opinion and perceptions; yet, we understand little about how individuals from the Great Lakes region construct opinions about the threats facing the lakes. We seek to understand how individuals from the state of Michigan form opinions on three risks to the lakes: invasive Asian carp, climate change, and offshore drilling. To do this, we evaluate the utility of two dominant models of environmental opinion formation: trust and deference to scientific authority, and partisan bias and motivated reasoning. We find that when issues have been politicized, opinion is greatly influenced by political factors like partisanship but that trust and deference as well as underlying environmental attitudes play a more important role for issues that have not been politicized. We discuss the implications of these findings in terms of policy and communication in Michigan, arguing that if we want Michiganders to support policy consistent with science, they must view risk in ways that are consistent with scientific consensus. For that to happen, advocates and policy makers must focus on reducing the political rhetoric around these threats,

developing communication that taps into underlying trust and deference to science, and using underlying attitudes about the role of government in environmental protection to promote environmental policy.

Keywords Great Lakes · Public opinion · Environmental policy · Asian carp · Climate change · Offshore drilling · Michigan

Introduction

Michigan has more freshwater coastline than any other US state, bordering four of the five Great Lakes. The Great Lakes contain nearly 20% of global fresh water, house distinct ecosystems, and support important biodiversity (About 2017). At the same time, they represent an essential economic resource for the state, providing nearly 823,000 jobs to Michigan residents, \$4 billion in commercial and sports fishing, and \$12.8 billion in travel and tourism (DeBeaussaert 2009). Further, they are considered an invaluable resource for the agriculture and food industry and for manufacturing, assisting in the production of 60% of the continent's steel and 60% of the automobiles made in the United States (DeBeaussaert 2009). Thus, the lakes sit at the intersection between economic and environmental interests and as a consequence face continual human-induced threats ranging from industrial and agricultural pollutants to invasive species (see e.g., Smith *et al.* 2015). Because of its coastline, tributaries and economic use, the state of Michigan and its residents significantly influence the health and use of these vital waters.

In recent years, there has been growing attention to stressors threatening the Great Lakes; however, the way that government and the public respond depends upon public perceptions of the threats (Stimson 2015). As a consequence, it is

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essential to understand how Michigan residents structure their opinions on key environmental issues impacting the Great Lakes. In addition, researchers have shown that support for environmentalism can moderate the impact of environmental stress at the state level (Dietz *et al.* 2015). Among other stressors, it is clear that the lakes face threats from the invasion of Asian carp, climate change, and offshore drilling. In this paper we examine the structure of public opinion on these three issues. Using data from the 2011 State of the State Survey conducted by the Institute for Public Policy and Social Research at Michigan State University, we ask whether individual opinions are consistent with scientific consensus and then test competing theories on what drives public sentiment. Ultimately, we evaluate public opinion to better assess how policy initiatives and public discourse can be structured to promote scientifically rigorous policy, and discuss the implications of these findings for Michigan's policy and practices.

Issue Selection

The following analysis evaluates opinion on Asian carp, climate change, and offshore drilling. The importance of public perceptions on these three issues is highlighted by a recent study that evaluated and ranked the top 50 Great Lakes stressors. Developing the ranking based on expert opinion, the study identified invasive species such as Asian carp as the leading environmental stressor followed by climate change. Drilling was also in the top 50 concerns (Smith *et al.* 2015). Climate change, for example, is expected to alter lake temperatures, change water quality and increase avenues for invasive species to take hold (Bosch *et al.* 2014). Over the next decade temperatures are expected to increase, which will increase evaporation and lead to more precipitation. In addition, lake levels are likely to decrease (Lofgren *et al.* 2002). Although there is strong scientific consensus that climate change is occurring (see e.g., Oreskes 2004), scientific information has had minimal effect on public opinion, which is often closely associated with cues from politically oriented elites (Brulle *et al.* 2012).

Offshore drilling involves constructing and drilling oil wells in the waters of the Great Lakes. Drilling's primary threat is the potential for spills, particularly uncontrolled spills, and well pollutants and wastewater contamination of the Great Lakes and associated watersheds (Gosman *et al.* 2012). Although environmental impacts like these have been documented in other offshore drilling operations, one past study showed that people living in the Great Lakes region generally have positive views of alternative drilling options like horizontal drilling and hydraulic fracturing because they value the economic impacts, are uncertain about the associated risks, and support regulation, taxation, and chemical use disclosure (Brown *et al.* 2013).

Finally, researchers argue that the invasive species Asian carp could cause significant problems for the Great Lakes

ecosystems. To minimize ecosystem destruction, ecologists have recommended surveillance programs (Jerde *et al.* 2013; Lohmeyer and Garvey 2009; Murphy and Jackson 2013) and over \$70 million has already been spent on improving coordination, isolating immediate threats, establishing control mechanisms and assessing research needs (Stokstad 2010). We do not know of any studies assessing public opinion on this issue, so there is little understanding of how individuals form their opinions or the considerations driving them.

Theoretical Frameworks

The scholarly literature suggests that attitude formation arises from a combination of social, psychological, and demographic characteristics (see e.g., Boykoff 2009). Fiske and Taylor (1991) describe the general public as "cognitive misers" who will predominantly use informational shortcuts (or heuristics) provided by political elites and the mass media that they trust to form attitudes and make risk/benefit assessments (see e.g., Druckman and Bolsen 2011; Lupia *et al.* 2000; Lupia 2002; Nisbet 2005). To understand Michigan residents' opinion formation we examine the applicability of two prominent models of environmental opinion formation: trust and deference to scientific authority, and partisan bias and motivated reasoning. These models have distinct implications for policy and public rhetoric and so it is essential to differentiate the conditions under which each applies. Because the issues vary in key ways, such as the political rhetoric surrounding them, we expect the theories to play distinct roles in accounting for opinion on each of them.

Trust in Science and Deference to Scientific Authority

A common heuristic influencing attitude formation on complex environmental policy issues is the general trust of and deference to the scientific community (see e.g., Brossard and Nisbet 2007; Ho *et al.* 2008; Irwin 2001; Lee *et al.* 2005). The more individuals trust and are able to defer to scientific authority, the more likely they are to hold views consistent with scientific consensus on controversial scientific issues. Although deference is distinct from trust in that individuals can have varying levels of trust in science, but still believe that scientists are the best actors to make decisions on scientific issues, the concepts are intimately connected. Brossard and Nisbet (2007) argue that Americans are pre-disposed to having a strong deference to scientific authority based on the perception that science is both politically neutral and indisputable. This represents a "long-term socialized trait that guides citizens' responses to a range of technical controversies" (Brossard and Nisbet 2007: 30). Lee *et al.* (2005) assert that deference to scientific authority reflects a high level of institutional trust in science that crosses various science-related

topics. For example, Siegrist and Cvetkovich (2000) find that public acceptance of gene technology is influenced in part by trust in companies and the scientists who perform such research. Similarly, Priest (2001) notes that individuals' risk assessment of new technologies such as bioengineered foods are a product of the perceived trustworthiness of scientists and their employers. This body of literature suggests that people have been socialized to view the work of scientists as independent from the larger political debate, devoid of political controversy. As a result, when scientific debates over issues such as climate change or the risk of offshore drilling arise, individuals who defer to scientific authority should tend to hold views more consistent with scientific consensus than their counterparts who lack scientific trust and deference. Since elites and the media often address politicized issues, and at times present perspectives that are inconsistent with scientific consensus, but may also reference specific scientists, it is likely that deference to scientific authority is regularly in conflict with things like partisanship. Because of this, we expect scientific deference to have a greater impact on relatively a-political issues than on those that have been highly politicized (see e.g., Jerit and Barabas 2012). Thus, hypothesis one is as follows:

H1: Deference to scientific authority and scientific trust increases the likelihood that individuals hold opinions consistent with existing scientific consensus; however, this relationship will be weaker for highly politicized scientific issues.

Partisan Bias and Motivated Reasoning

Partisanship is a pervasive political predisposition that functions as an informational shortcut, helping individuals develop opinions on diverse issues (see e.g., Gaines *et al.* 2007; Hart and Nisbet 2011; Zaller 1992). Campbell and colleagues (Campbell *et al.* 1960: 1333) assert that partisan identification serves as a perceptual filter in which “[an] individual tends to see what is favorable to his partisan orientation.” More recently, Bartels (2002) asserts that “partisan bias is widespread and its effects are not significantly mitigated or enhanced by access to objective political information” (130). Blais and colleagues (2010) extend this understanding by demonstrating that partisanship's role varies by its strength, with “stronger” partisans more likely to be resistant to countervailing arguments (see also e.g., Kunda 1990, 1999; McCright and Dunlap 2011; McCright *et al.* 2013; Taber and Lodge 2006). Zaller (1992) notes: “polarization is more intense among the politically well-informed group because they are more attentive to partisan cues and more receptive to political messages that are congruent with their partisan predispositions” (2). Partisanship has been shown to be a key determinant in opinion formation on many environmental issues such as climate change (McCright and Dunlap 2011, 2013; McCright *et al.* 2014), support for energy development (Boudet *et al.* 2014;

Brown *et al.* 2013), and animal conservation (Manfredo 2008; Manfredo *et al.* 2008). As a result, we expect to find polarization in attitudes on issues for which political elites have provided partisan cues (climate change and offshore drilling) and a convergence of attitudes where elites have failed to do so (Asian carp). On issues where political polarization is present, we expect partisanship to play a larger role for those who have the strongest partisan identification. Thus, hypotheses two and three:

H2: Partisanship will influence an individual's adoption of policy opinions when the issue is politically salient.

H3: When a science issue is politicized, partisanship will have a stronger influence on individuals who categorize themselves as strong partisans.

Although partisanship has been the focus of many studies, there is an additional political dimension of motivated reasoning that is likely to affect opinion formation: presidential and gubernatorial leadership. Often considered “the government's central actor,” (Hetherington 1998: 798), the president has a unique capacity to influence the formation of public attitudes on national issues such as climate change and offshore drilling (Druckman *et al.* 2013). It seems reasonable to expect that governors would have a similar impact on state and local issues. Past research suggests that presidents and their advisors often invest substantial time and energy to engage in permanent campaigns to shape public attitudes about issues on their agenda (see e.g., Burden and Hillygus 2009; Gronke and Newman 2003; Wood 2009). Numerous articles have found that presidents successfully shape public attitudes through mass media priming and framing (Druckman and Homles 2004; Krosnick and Brannon 1993). Presidential and gubernatorial rhetoric has the potential to act as a powerful cue that influences members of both parties because, as Wood (2009: 2) explains, it “can spark human emotions such as enthusiasm, anxiety, anger, fear, nationalism, patriotism, pride, etc. As a result, the usual cues of party identification and ideology become less important for some citizens, and emotional responses become more important.” President Obama has frequently used rhetoric to express his views on controversial issues such as climate change. For example in a 2014 interview, he argued “This is not some distant problem of the future...Whether it means increased flooding, greater vulnerability to drought, more severe wildfires — all these things are having an impact on Americans as we speak,” (Obama 2014). Similarly, Michigan's Governor Snyder has made a variety of public statements about environmental issues affecting the state, including offshore drilling and Asian carp. In his 2014 State of the State speech, for example, he said “Michigan has been a leader in terms of loving our environment, protecting our Great Lakes, and we need to continue that leadership. And we know it's important. This is both about aquatic and land-based threats. If you look to the Great Lakes, it's the threat of the Asian carp,” (Snyder 2014). Existing

studies suggest that a president's ability to bolster support for a given issue depends upon his ability to use rhetoric to boost levels of public approval and that his influence should vary depending on the political salience of the issue. Thus, we would expect an individual's assessment of the president's performance to influence their views on nationally salient issues such as climate change and offshore drilling, but because local or regional issues like Asian carp in the Great Lakes rarely gain presidential attention, we expect gubernatorial rhetoric to play a relatively greater role. Thus, we propose hypotheses four and five:

H4: Presidential approval will impact the likelihood that individuals adopt opinions consistent with scientific consensus when the issue is nationally politically salient.

H5: Gubernatorial approval will impact the likelihood that individuals adopt opinions consistent with scientific consensus when the issue is either nationally or locally politically salient.

In addition to these two models, the literature has shown demographics and underlying environmental attitudes and values to be important predictors of opinion formation (see for review e.g., Dietz 2015). We account for these in the statistical models that follow.

Data and Methodology

We use ordinal logistic regression to analyze survey data from the spring 2011 State of the State Survey conducted by the Institute for Public Policy and Social Research at Michigan State University. This quarterly survey uses a stratified random sample with both landline telephones and cell phones. A total of 947 Michigan residents were interviewed between May 13, 2011 and July 07, 2011. The survey has a margin of error of 3.2% (Institute for Public Policy and Social Research 2011).

Our dependent variables include responses to questions on three environmental issues: climate change, offshore drilling, and Asian carp in the Great Lakes. Table 1 lists each question's wording and possible responses. To the left of each response is the answer's coding, and to the right is the percent of respondents giving each answer.

These environmental issues have two characteristics that make them particularly useful for evaluating public opinion on threats to the Great Lakes. First, there exists a broad scientific consensus about two of the three issues. A majority of scientists believe there is strong scientific evidence of climate change (see e.g., Oreskes 2004) and there is widespread agreement that the introduction of Asian carp created a serious ecological threat for the Great Lakes (Jerde *et al.* 2013; Lohmeyer and Garvey 2009). Although offshore drilling does not have the same type of scientific consensus, the general sentiment is that there are some risks, neither as dire nor as

benign as individuals on both sides of the argument claim. In contrast to this scientific clarity, these issues often divide citizens and policy makers. Conservatives are most likely to be skeptical of the science that underlies claims about climate change (Lakoff 2010; McCright *et al.* 2014), while those on the left are thought to be more likely question the safety and desirability of drilling (Boudet *et al.* 2014; Brown *et al.* 2013); in contrast, Asian carp in the state of Michigan are relatively free of ideological connotations.

Our primary independent variables allow us to evaluate the applicability of models of scientific trust and deference and partisanship and motivated reasoning. We assess the role respondents' trust in scientists plays in opinion formation using a composite measure. The survey includes separate questions on respondents' trust in scientists from government, universities, and corporations. These questions are measured on four point scales with one representing the attitude that the scientist is not at all trustworthy and four representing the attitude that they are very trustworthy. We use a composite measure of these questions that averages a respondent's trust in all three types of scientists. A value of one indicates that the individual does not find any type of scientist trustworthy while a value of four indicates the individual finds all types of scientists very trustworthy. The average score for this composite measure is 2.9. The survey does not specifically ask about scientific deference, so we use a question of whether individuals believe we could do a better job protecting the environment if scientists had a greater role in the process as a proxy. This variable is measured on a five point scale from strongly agree (1) to strongly disagree (5).

We evaluate partisanship and ideology using individuals' party identification and ideology. Party identification is measured on a standard seven point scale, with one representing a strong Republican and seven representing a strong Democrat. We include a seven point ideological scale, with one representing extremely conservative and seven representing extremely liberal. Finally, we include respondents' assessments of how well President Obama and Governor Snyder are doing their jobs as measures of executive approval. These variables are measured on a four point scale, with one representing poor performance and four representing excellent performance.

In addition to these primary independent variables, we include a variety of demographic and attitude control measures. Since each of the issues have competing economic and environmental arguments, we control for individuals' economic outlook. We include respondents' personal employment situation, a dummy variable where one equals some type of employment and zero equals unemployment; how respondents' believe the nation's employment situation will fare in the coming year, where one equals better than present, two equals neither better nor worse, and three equals worse than present; and finally, their expectation about whether businesses in their

Table 1 Dependent variable question wording and responses

| | |
|----------------|--|
| Climate change | There has been much debate in recent years about global climate change and its causes and effects. Do you think there is: 1 Little or no scientific evidence that the earth's climate is changing (19%) 2 Some scientific evidence (45%) 3 Strong scientific evidence that the earth's climate is changing (36%) |
| Oil drilling | Geologists are confident that there are significant oil reserves under Lake Michigan. Which of the following best describes your position on drilling for oil under the Great Lakes? 1 Drilling for oil poses little or no risks to the Great Lakes (4%) 2 There are some risks associated with drilling for oil, but probably worth the risks (47%) 3 Drilling under the Great Lakes poses significant risks (49%) |
| Asian carp | There has also been debate about the possible effects Asian Carp may have on the Great Lakes eco-system. Do Asian Carp represent 1 Little or no threat to the Great Lakes and its eco-system? (8%) 2 Somewhat of a threat (34%) 3 A serious threat (58%) |

local community will face good or bad times over the next 12 months, with one equaling good times, two equaling neither good nor bad times, and three equaling bad times.

We also control for general environmental attitudes. We include questions that ask respondents the degree to which they agree with the following four statements: human behavior has only a small impact on the environment; natural resources exist to be used; protecting the natural environment should be a high government priority; and, efforts to protect the environment must be balanced with economic impacts. With the exception of government priority, which is measured on a four point scale, these questions are coded on a five point scale from strongly agree to strongly disagree.

Additionally, we include measures of scientific education. The knowledge deficit model (see e.g., Dickson 2005; Miller 2004), which argues that increased education diminishes skepticism and hostility around scientific views, has largely been discredited (see e.g., Bak 2001; Brossard and Nisbet 2007; Ho *et al.* 2008; Lee *et al.* 2005). Nonetheless, it is possible that for environmental issues with little political connotation, such as Asian carp, scientific knowledge and education may play a greater role. To evaluate whether individuals who have specialized scientific education are more likely to hold opinions consistent with scientific consensus we use two dummy variables: whether the individual has taken a college-level science class, and whether the individual has a college science degree, with zero indicating no course/degree.

Finally, we control for basic demographic characteristics including race (dummy variable where white equals one), age, gender (dummy variable where male equals one), college graduation (dummy variable where having a BA equals one), and an 11 point income scale measured from low (<\$10,000) to high income (>\$150,000).

Results

We construct a series of ordinal logistic regressions to assess how Michigan residents develop opinions on climate change, offshore drilling, and Asian carp, highlighting the distinct drivers of opinion across these issues as well as the importance of issue politicization (Table 2).

Consistent with past research, individuals appear to rely heavily on political factors - including party, ideology, and Presidential approval - to develop their opinions on climate change and to a lesser degree, drilling under the Great Lakes (where party matters); in contrast, they have no effect on the apolitical issue of Asian carp. Individuals appear to rely more heavily on existing environmental attitudes to develop their opinions on offshore drilling and on scientific trust/deference and demographic characteristics to develop their opinions on Asian carp. We discuss significant results in relation to our hypotheses using predicted probabilities presented in Table 3 for climate change, Table 4 for drilling, and Table 5 for Asian carp.

Hypothesis 1 predicts scientific trust and deference increase the likelihood of holding opinions consistent with scientific consensus, particularly for relatively apolitical issues that offer few political cues. The results provide support for this hypothesis. Scientific deference is important across all three areas; individuals who believe the environment would be better off if scientists were more involved are roughly 24% more likely to believe there is strong evidence of climate change (Table 3), 13% more likely to believe that offshore drilling poses some risks (Table 4), and 25% more likely to believe that Asian carp pose a serious threat to the Great Lakes (Table 5) than their counterparts who do not think scientists should be more involved in the environment. In contrast to this broad finding, trust in scientists is only important in predicting opinion on Asian carp, offering support for the hypothesis that these characteristics are more important for

Table 2 Ordinal logistic regression of public opinion on threats to great lakes

| | Scientific Evidence of Climate Change | | Offshore Drilling Under Great Lakes | | Risk Posed by Asian Carp | |
|----------------------------------|---------------------------------------|-------|-------------------------------------|-------|--------------------------|-------|
| | β | SE | β | SE | β | SE |
| Trust in scientists | 0.040 | 0.203 | 0.070 | 0.201 | -0.494* | 0.241 |
| Scientists role in environment | -0.354*** | 0.094 | -0.207* | 0.106 | 0.330*** | 0.106 |
| Political beliefs | | | | | | |
| Party | 0.156* | 0.065 | 0.157** | 0.068 | -0.031 | 0.078 |
| Ideology | 0.203*** | 0.064 | 0.120 | 0.066 | -0.076 | 0.074 |
| Presidential approval | 0.334*** | 0.131 | 0.155 | 0.134 | 0.064 | 0.161 |
| Gubernatorial approval | -0.001 | 0.112 | -0.094 | 0.117 | -0.010 | 0.130 |
| Baseline environmental attitudes | | | | | | |
| Human impact on Env. | 0.079 | 0.067 | 0.211*** | 0.070 | -0.853 | 0.080 |
| Use of natural resources | 0.349*** | 0.089 | 0.272*** | 0.092 | 0.124 | 0.096 |
| Government priority Env. | -0.372*** | 0.107 | -0.133 | 0.106 | 0.068 | 0.123 |
| Economy vs. Environment | -0.032 | 0.102 | 0.236* | 0.109 | 0.113 | 0.112 |
| Perceptions of economy | | | | | | |
| Local business conditions | -0.015 | 0.107 | -0.137 | 0.113 | 0.189 | 0.123 |
| Local unemployment | -0.209 | 0.154 | 0.172 | 0.155 | 0.497*** | 0.177 |
| Employed | 1.048 | 0.592 | -0.195 | 0.586 | -0.085 | 0.663 |
| Knowledge | | | | | | |
| College science class | -0.112 | 0.250 | 0.386 | 0.260 | 0.064 | 0.293 |
| College science degree | 0.194 | 0.274 | -0.868*** | 0.276 | 0.237 | 0.321 |
| Demographics | | | | | | |
| White | 0.038 | 0.339 | 0.774*** | 0.280 | -0.653* | 0.296 |
| Male | 0.102 | 0.182 | -0.052 | 0.192 | -0.142 | 0.218 |
| Age | 0.001 | 0.006 | -0.002 | 0.006 | -0.024*** | 0.007 |
| Income | 0.045 | 0.036 | -0.022 | 0.038 | -0.119*** | 0.044 |
| Bachelor's degree | 0.502* | 0.262 | 0.355 | 0.282 | 0.019 | 0.314 |
| Cut 1 | -0.808 | 1.055 | -0.157 | 1.136 | -0.777 | 1.220 |
| Cut 2 | 1.636 | 1.055 | 3.607 | 1.128 | 1.455 | 1.232 |
| N | 555 | | 560 | | 539 | |
| Likelihood ratio | 231.23*** | | 153.84*** | | 65.00*** | |
| Log likelihood = | -468.35 | | -393.38 | | -344.02 | |
| Pseudo R2 | 0.198 | | 0.164 | | 0.086 | |

***sig > =.001 **sig > =.01 *sig > =.05

apolitical issues. Individuals who find scientists to be very trustworthy are 23% more likely to believe that Asian carp pose a serious risk to the Great Lakes than their counterparts who believe scientists are not trustworthy at all.

Consistent with Hypothesis 2, partisanship and ideology play a significant role in determining opinion on the politicized issue of climate change, while partisanship influences the increasingly political issue of offshore drilling. In contrast, partisan/ideological factors appear to play no role in opinion formation on Asian carp. Importantly, whether Republicans/conservatives or Democrats/liberals are more likely to hold opinions consistent with scientific consensus depends upon

the issue. Democrats, liberals, and those who rank President Obama as excellent are significantly more likely to hold an opinion consistent with scientific consensus on climate change; strong Democrats are 17% more likely to believe there is strong scientific evidence of climate change than strong Republicans, and strong liberals are 23% more likely believe this than their strong conservative counterparts (Table 3). In contrast, in the case of offshore drilling, strong Republicans are 16% more likely to believe that offshore drilling poses some risks to the Great Lakes. These results also support Hypothesis 3, which suggests that partisan effects should be greater for strong partisans than weak ones. If the

Table 3 Predicted probabilities for the scientific evidence of climate change

| Environment would be better off if Scientists were more involved | | | |
|---|--------------------|------------------|--------------------|
| Agreement | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Strongly agree | 0.149 | 0.389 | 0.462 |
| Strongly disagree | 0.349 | 0.426 | 0.223 |
| Difference | 0.20 | 0.037 | 0.239 |
| Political party | | | |
| Party | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Strong republican | 0.259 | 0.436 | 0.304 |
| Weak republican | 0.236 | 0.432 | 0.331 |
| Weak democrat | 0.159 | 0.395 | 0.445 |
| Strong democrat | 0.143 | 0.381 | 0.475 |
| Difference | 0.116 | 0.055 | 0.171 |
| (Difference between strong republican and strong democrat) | | | |
| Political ideology | | | |
| Ideology | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Strong conservative | 0.254 | 0.442 | 0.303 |
| Weak conservative | 0.226 | 0.435 | 0.338 |
| Weak liberal | 0.133 | 0.374 | 0.492 |
| Strong liberal | 0.115 | 0.353 | 0.532 |
| Difference | 0.139 | 0.090 | 0.229 |
| (Difference between strong conservative and strong liberal) | | | |
| Presidential approval | | | |
| Approval | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Poor | 0.245 | 0.436 | 0.318 |
| Excellent | 0.127 | 0.368 | 0.503 |
| Difference | 0.118 | 0.068 | 0.185 |
| Natural resources are meant to be used | | | |
| Agreement | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Strongly agree | 0.237 | 0.421 | 0.341 |
| Strongly disagree | 0.095 | 0.307 | 0.597 |
| Difference | 0.142 | 0.114 | 0.256 |
| Protecting the natural environment should be a high government priority | | | |
| Agreement | Pr Little Evidence | Pr Some Evidence | Pr Strong Evidence |
| Strongly agree | 0.16517 | 0.399 | 0.436 |
| Strongly disagree | 0.323 | 0.428 | 0.248 |
| Difference | 0.158 | 0.029 | 0.188 |

strength of one's partisan identification had no effect, we would expect all Republicans or Democrats to have the same probability of holding a given opinion. Instead, we see that the probability of holding an opinion varies across the strength of respondents' partisanship, with the most partisan individuals being the least/most likely to hold opinions consistent with scientific consensus.

Hypotheses 4 and 5 predict that the President and Governor have an independent impact of Michiganders' perceptions of the risks facing the Great Lakes, with approval for President Obama being more important for the nationally salient issue of climate change and approval for Governor Snyder being more important for drilling and Asian carp. Although presidential approval was independently important for climate change

opinion, gubernatorial approval had no effect on any of the three risks posed to the Great Lakes. Those who rated President Obama as excellent were 18% more likely to believe there was strong evidence of climate change than those who rated him as poor. These results provide support for Hypothesis 4 but not for Hypothesis 5.

Beyond the hypothesized relationships, the most consistently important characteristics are individuals' general environmental attitudes. Existing attitudes about the environment are important for both the highly politicized and moderately politicized issues of climate change and offshore drilling, though they do not appear important in assessments of Asian carp. Strongly believing that natural resources are meant to be used decreases the likelihood that individuals agree with

Table 4 Predicted probabilities: Offshore drilling under great lakes

| Environment would be better off if Scientists were more Involved | | | |
|---|----------------------|--------------|---------------------|
| Agreement | Pr little or no risk | Pr some risk | Pr significant risk |
| Strongly agree | 0.032 | 0.559 | 0.535 |
| Strongly disagree | 0.067 | 0.432 | 0.373 |
| Difference | 0.035 | 0.127 | 0.162 |
| Political party | | | |
| Party | Pr little or no risk | Pr some risk | Pr significant risk |
| Strong republican | 0.059 | 0.553 | 0.387 |
| Weak republican | 0.052 | 0.530 | 0.420 |
| Weak democrat | 0.029 | 0.424 | 0.546 |
| Strong democrat | 0.025 | 0.396 | 0.577 |
| Difference | 0.034 | 0.157 | 0.190 |
| (Difference between Strong Democrat and Strong Republican) | | | |
| Natural resources are meant to be used | | | |
| Agreement | Pr little or no risk | Pr some risk | Pr significant risk |
| Strongly agree | 0.050 | 0.508 | 0.442 |
| Strongly disagree | 0.018 | 0.325 | 0.656 |
| Difference | 0.032 | 0.183 | 0.214 |
| Efforts to protect the environment must be balanced with economic impact. | | | |
| Agreement | Pr little or no risk | Pr some risk | Pr significant risk |
| Strongly agree | 0.049 | 0.487 | 0.463 |
| Strongly disagree | 0.021 | 0.333 | 0.645 |
| Difference | 0.028 | 0.154 | 0.182 |
| Human behavior has only a small impact on the environment. | | | |
| Agreement | Pr little or no risk | Pr some risk | Pr significant risk |
| Strongly agree | 0.067 | 0.562 | 0.371 |
| Strongly disagree | 0.031 | 0.466 | 0.538 |
| Difference | 0.035 | 0.096 | 0.167 |
| College science degree | | | |
| Has Science degree | Pr little or no risk | Pr some risk | Pr significant risk |
| Yes | 0.078 | 0.557 | 0.364 |
| No | 0.037 | 0.435 | 0.527 |
| Difference | 0.041 | 0.122 | 0.163 |

scientific consensus on climate change by 19% (Table 3) but increases the likelihood they believe offshore drilling poses only some risks by roughly 18% (Table 4). Though certain groups of individuals are often portrayed as having anti-science attitudes, the difference in the direction for these policy areas highlights the fact that individuals often have attitude systems that bring them in line with scientific consensus at some times and away from it at others. In addition to attitudes about resource use, three other environmental attitudes are significant. Believing government should make protection of the natural environment a high priority increases the likelihood of believing there is strong evidence of climate change by nearly 19%, while believing that we must balance efforts to protect the environment with their economic impact increases the likelihood that individuals hold opinions on offshore

drilling that are consistent with scientific consensus by about 15%. Finally, believing that human behavior has only a small impact on the environment increases the likelihood of believing offshore drilling poses only some risks by almost 10%.

In addition to our primary independent variables, we include a variety of demographic controls that had varying affects across environmental issues. For brevity's sake we discuss these results in a limited way. We note an apparent contradiction with past work, which has shown education to be an important factor in environmental attitude formation. In this analysis, education is important only in the evaluation of the scientific evidence of climate change. Individuals who have a bachelor's degree are more likely to believe there is strong scientific evidence for climate change. The only other place education plays a role is in offshore drilling opinion, where having a college science degree increases the likelihood of believing there are only some risks by about 12%. In addition, personal unemployment was only important for climate change, a finding that is surprising since, of the three policy areas, climate science has the fewest direct connections to employment. Another surprising finding is that in contrast to past research on risk assessment (see e.g., Bieberstein 2014; Davidson and Freudenburg 1996), gender plays no role in opinion formation on these three risks to the Great Lakes.

Demographics appear to play a greater role in opinion formation for the apolitical issue of Asian carp. Whites are about 12% more likely to believe that Asian carp pose a serious threat to the lakes than non-whites. This may reflect the fact that in Michigan communities of color are far more likely to live in urban areas, and thus may have less knowledge of environmental issues affecting the Great Lakes and/or may be less likely to rely on the lakes for their economic wellbeing. In addition, older and wealthier individuals are significantly more likely to hold opinions consistent with scientific consensus on Asian carp. The oldest individuals are nearly 29% more likely to believe Asian carp pose a serious risk to the Great Lakes than the youngest individuals, and the wealthiest individuals are 20% more likely to hold this attitude than the poorest individuals. In addition to these demographic variables, those individuals who had a more positive outlook on the economy, believing unemployment would improve in the coming year, are 17% more likely to believe that Asian carp pose a serious threat than those who held a negative outlook.

Discussion and Conclusions

Because ecological, economic, agricultural, and social systems rely on the Great Lakes for vitality, environmental policy is needed to protect, restore, and sustain the lakes, guarding them from potential threats. However, implementing effective environmental policy requires a supportive population, which can be difficult to find when issues are controversial or highly

Table 5 Predicted probabilities: Threat asian carp pose to the great lakes

| Environment would be better off if Scientists were more involved | | | | |
|--|------------------------|-------------------------|-------------------|--|
| Agreement | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| Strongly Agree | 0.031 | 0.178 | 0.791 | |
| Strongly disagree | 0.101 | 0.360 | 0.537 | |
| Difference | 0.070 | 0.182 | 0.254 | |
| Trust in scientists | | | | |
| Trustworthiness | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| Not trustworthy at all | 0.0724955 | 0.295 | 0.632 | |
| Very trustworthy | 0.0185343 | 0.116 | 0.864 | |
| Difference | 0.054 | 0.179 | 0.232 | |
| Future national unemployment | | | | |
| Situation will be... | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| Better than | 0.0257 | 0.153 | 0.820 | |
| Worse than | 0.064 | 0.283 | 0.651 | |
| Difference | 0.039 | 0.130 | 0.170 | |
| Race | | | | |
| Race | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| White | 0.039 | 0.208 | 0.752 | |
| Not white | 0.072 | 0.299 | 0.628 | |
| Difference | 0.033 | 0.091 | 0.124 | |
| Age | | | | |
| Age | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| 20 | 0.096 | 0.346 | 0.557 | |
| 90 | 0.021 | 0.132 | 0.846 | |
| Difference | 0.075 | 0.214 | 0.289 | |
| Income | | | | |
| Income | Pr little or no threat | Pr somewhat of a threat | Pr serious threat | |
| <10 k | 0.072 | 0.303 | 0.624 | |
| 150 k+ | 0.024 | 0.147 | 0.828 | |
| Difference | 0.048 | 0.156 | 0.204 | |

politicized. As a result, it is important to understand how people think about environmental issues that impact the Great Lakes and to identify what makes them more likely to support scientifically sound policy. It is particularly important to dissect how the politics surrounding particular risks influence opinion formation, since they can cause individuals to form opinions on threats to the same environmental resource quite differently. Michigan provides an ideal case for studying these questions because the state and its citizens help dictate policy on the nation's largest fresh water supply.

The preceding analysis supports the view that issue politicization profoundly influences Michigan residents' opinions on major problems facing the Great Lakes. For politicized issues, political characteristics including party, ideology and presidential approval play an important role. While pundits and commentators have argued that the Republican Party is anti-science, the results suggest that members of both parties develop opinions that are inconsistent with scientific consensus when their party has developed platforms inconsistent with science. Thus, Republicans are less likely to believe in

the scientific evidence of climate change while Democrats are more likely to overestimate the impacts of offshore drilling. In fact, when an issue has largely remained out of the political arena, as with Asian carp, ideology and party plays no role in individuals' opinion formation. Thus, it is not that members of one party have a predisposition against science but that the politicization of issues influences acceptance of scientific consensus.

Beyond political heuristics, we also find that scientific trust and deference and general environmental attitudes significantly influence the likelihood that individuals adopt opinions consistent with scientific consensus. Believing that the environment would be better off if scientists were more involved increases the likelihood that individuals hold opinions consistent with scientific consensus across all three environmental areas; however, scientific trust was important only for Asian carp. General environmental attitudes and demographic characteristics play varied roles across the three issues, but one commonality is that those who see more limited risks in drilling and less evidence of

climate change are more likely to hold underlying opinions that reflect an anthropocentric interpretation of the environment, such as the attitude that natural resources are meant for human use.

These findings have important implications for both ongoing discussions about the drivers of environmental opinion formation and for public policy. Consistent with past research, we find essentially no evidence to support the deficit model and instead find support for the trust and deference model and partisan bias and motivated reasoning model. From a policy perspective, the lack of evidence of the deficit model suggests that a number of relatively straightforward strategies that are popular with educators are unlikely to be effective. These include:

- **More Information:** It is clear that ideology and other cues tend to “screen out” or otherwise inhibit the impact of information.
- **More education:** A number of social and political critics argue that more education is a key to both public understanding and public acceptance of scientific information. Once again, it seems clear that ideology and other factors inhibit the impact of education.
- **Increased science education:** Like education in general, there is little evidence that college level science education directly increases the likelihood that citizen preferences will be more consistent with existing scientific consensus.

That is not to say that scientific information is unimportant however; instead we believe the impact of scientific information is best understood in terms of its delivery by political elites and the media. For example, in the public discourse surrounding environmental policy, citizens are often presented with a policy frame in which one must choose between conservation goals and economic benefits, between the political left and the political right. The results suggest that the interaction of this dichotomy with individuals’ ideological attitudes is often relatively straightforward: when environmental policy is presented in politicized terms, public divisions are largely driven by ideology rather than science. In Michigan, where the protection of the Great Lakes is essential for both environmental and economic prosperity, environmental advocates would do well to focus on depoliticized messages that tap into individuals’ deference to scientists. Finding unlikely bedfellows, for example Republicans who can speak to the scientific evidence of climate change or Democrats who can provide context for fears about drilling, is also likely to be beneficial in disrupting the political messages around these issues.

Further, it is important to recognize that the literature on issue framing suggests not all policy goals need to be promoted as representing mutually exclusive values. Circumstances do arise where policy goals can be seen as converging. Such “collaborative issue framing” may create extensive and

powerful coalitions for proactive environmental policy in Michigan. The clear implication of the analysis presented here is that for science to play a greater role in the creation and implementation of environmental policy, decision makers (and perhaps scientists themselves) will need to promote issue frames that emphasize complementary (or at least non-exclusionary) goals and outcomes. Future research is essential to understand the capacity of the general public in accepting these frames and incorporating them into their view of public policy (Scheberle 2007).

Finally, it should be noted that majority of respondents hold the attitudes that government should do more to protect the environment and that the environment would be better off if scientists were more involved. This should be heartening for those who believe scientifically driven policy is the answer to environmental threats. Future research should investigate how to better tap into these underlying attitudes and how to use these attitudes to help overcome political rhetoric.

Funding This research was supported by a grant from the Michigan Applied Public Policy Research (MAPPR) Grant Program of the Institute for Public Policy and Social Research at Michigan State University.

Compliance with Ethical Standards

Informed Consent No human subjects involved.

Conflict of Interest The authors declare that they have no conflict of interest.

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