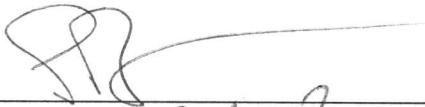
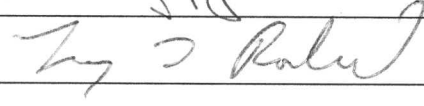
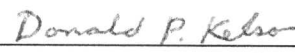
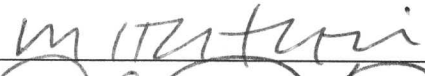



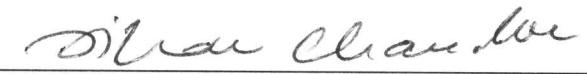


A COMPARATIVE ASSESSMENT OF AQUATIC INVASIVE SPECIES MANAGEMENT
IN MARYLAND AND VIRGINIA

by

John Franklin Christmas, Jr.
A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Environmental Science and Public Policy

Committee:

	Dr. Peter Balint, Dissertation Director
	Dr. Larry Rockwood, Committee Member
	Dr. Donald Kelso, Committee Member
	Dr. Daniel Terlizzi, Committee Member
	Dr. Albert Torzilli, Graduate Program Director
	Dr. Robert Jonas, Department Chairperson
	Dr. Richard Diecchio, Associate Dean for Academic and Student Affairs, College of Science
	Dr. Vikas Chandhoke, Dean, College of Science

Date: 5 / 6 / 11 Spring Semester 2011
George Mason University
Fairfax, VA

A Comparative Assessment of Aquatic Invasive Species Management in
Maryland and Virginia

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy at George Mason University

By

John Franklin Christmas, Jr.
Master of Science
Towson University, 1997

Master of Science
Towson University, 1991

Bachelor of Science
University of Maryland, 1979

Director: Peter Balint, Associate Professor
Department of Environmental Science and Public Policy

Spring Semester 2011
George Mason University
Fairfax, VA

Copyright: 2011 John Franklin Christmas, Jr.
All Rights Reserved

DEDICATION

This is dedicated to all of the individuals who have nurtured my growth and development in life—for all of the light—friends, family, teachers, and loved ones who have supported my spiritual, emotional, and intellectual growth and who have inspired me to seek truth and understanding. I hope that some truth is found herein, some contribution to the understanding of the dynamics of Aquatic Invasive Species, that rather nebulous arena of science and policy that I have come to know well and in which I have had the opportunity to have had varying roles—state biologist, author, editor, student, teacher, Chesapeake Bay Program Exotic Species Work Group Chair, and Aquatic Nuisance Species Task Force *ex officio* member

I would also like to dedicate this effort to those biologists who either collaterally or directly have been involved in the field of Aquatic Invasive Species—most often not by choice but serendipitously, and generally with all too little official time, support, and resources to do so—but considerable dedication. My hope is that this effort provides insight into the ambiguities and paradoxes that are so perplexing in the study of Aquatic Invasive Species—and that the concerns of professionals in this unique environmental policy arena, in some small way, can be better appreciated in this still-emerging discipline.

ACKNOWLEDGEMENTS

I would like to thank various individuals whose names I need not recount, as they well know the counsel and support and insights they have provided me throughout my career. In particular, I would like to thank the following individuals: Ron Lukens; Amy Benson; Chuck O'Neill; Art Bogan, Ph.D.; Stephen Jordan, Ph.D.; Ron Klauda, Ph.D.; Elizabeth Gunn, Ph.D., Linda Davis, Ph.D.; and Carolyn Watson. I would particularly like to thank Mary Vander Maten, Ph.D., for her unwavering support and for allowing me the time needed to attend necessary conferences. Also, I would like to thank those individuals I have had the opportunity to collaborate with over the years on various projects and publications relating to Aquatic Invasive Species, as well as those individuals who have participated in this project, for their candor and sincerity and professional insights which form the narrative of much of this study.

Especially, I would like to acknowledge my Doctoral Committee—Peter Balint, Ph.D.; Larry Rockwood, Ph.D.; Donald Kelso, Ph.D.; and Daniel Terlizzi, Ph.D.—for their encouragement, patience, guidance, and sustained support during all stages of this project. Also, I would like to acknowledge the various George Mason University staff with the Mason Media Lab, the Government Documents Unit, the University Library System, the STAR Lab, and the Collaborative Learning Hub, who were essential in the completion of this project. I would also like to acknowledge the partial funding provided by the Graduate Student Travel Fund for a conference I attended in the Netherlands.

TABLE OF CONTENTS

LIST OF TABLES	VIII
LIST OF FIGURES.....	IX
LIST OF ABBREVIATIONS	X
GLOSSARY	XI
ABSTRACT.....	XIV
CHAPTER 1. INTRODUCTION.....	1
OVERVIEW.....	1
THE AIS REGULATORY MILIEU: A PROLOGUE	3
DEFINITIONAL ISSUES RELATING TO AQUATIC INVASIVE SPECIES	6
STUDY AREA AND DELINEATION	10
PURPOSE OF STUDY.....	12
STUDY SIGNIFICANCE	15
STUDY LIMITATIONS	16
STUDY ORGANIZATION	19
CHAPTER 2. LITERATURE REVIEW	22
PART I. REVIEW OF REGULATORY AND THEORETICAL ASPECTS	22
<i>Historical Regulation of AIS.....</i>	22
<i>Recent National Guidance for AIS Planning and Management</i>	26
<i>Misconceptions about State-National AIS Legal Relationships</i>	34
<i>Comparative Evaluations of AIS Management in the United States.....</i>	35
<i>Environmental Typologies</i>	42
<i>Environmental Discourse Models</i>	44
<i>Comparative Rankings of Environmental Performance</i>	45
<i>Perceptions of AIS Risk.....</i>	47
<i>Framework for Analysis: the Policy Context</i>	48
<i>Contemporary Trends in Environmental Policy.....</i>	49
<i>Comparative Analyses of State Environmental Policy</i>	55
<i>The Nature of State Management Capacity.....</i>	61
PART II. REVIEW OF REGIONAL AIS MANAGEMENT AND THE ADOPTION AND DIFFUSION OF FEDERAL AIS COORDINATION MODELS THROUGHOUT THE CHESAPEAKE BAY WATERSHED	66
CHAPTER 3. METHODS	78
RESEARCH PURPOSE	78

RESEARCH QUESTIONS	79
RATIONALE FOR RESEARCH FRAMEWORK	81
FRAMEWORK FOR STATE AIS MANAGEMENT CAPACITY ASSESSMENT	83
PERCEPTUAL SURVEY OF COMPONENTS OF CAPACITY	85
SURVEY INSTRUMENT ORIGINS.....	86
THE SURVEY INSTRUMENT	88
HSRB REVIEW OF RESEARCH PROTOCOL	89
SAMPLE SIZE	90
RESPONDENT CHARACTERISTICS AND RECRUITMENT PROCESS	91
SURVEY ADMINISTRATION	93
PILOT STUDY AND PRETESTING.....	95
DATA COLLECTION	95
DATA CODING AND PRESENTATION.....	96
DATA ANALYSIS	98
<i>Grouping of Responses for Analysis</i>	<i>98</i>
<i>Qualitative Data Analysis.....</i>	<i>98</i>
<i>Statistical Analysis of Survey Data</i>	<i>99</i>
<i>Calculation of State AIS Management Capacity Index</i>	<i>101</i>
CHAPTER 4. RESULTS AND ANALYSIS.....	102
INTRODUCTION.....	102
SURVEY RESPONSE RATE AND RESPONDENT CHARACTERISTICS.....	103
RESPONDENT CHARACTERIZATION	104
SUMMARY OVERVIEW OF SURVEY RESULTS	105
STATE AIS MANAGEMENT CAPACITY INDEX	111
STATISTICAL ANALYSIS.....	113
ANALYSIS OF SURVEY QUESTIONS RELATING TO COMPONENTS OF CAPACITY.....	114
<i>Situational AIS Capacity</i>	<i>116</i>
<i>Political AIS Capacity</i>	<i>132</i>
<i>Institutional AIS Capacity.....</i>	<i>149</i>
<i>State AIS Capacity</i>	<i>162</i>
<i>Organizational AIS Capacity.....</i>	<i>173</i>
<i>Evaluation AIS Capacity</i>	<i>182</i>
ANALYSIS OF ANCILLARY SURVEY QUESTIONS-EXTRINSIC AND INTRINSIC	189
<i>National AIS Capacity.....</i>	<i>189</i>
<i>Greatest National Effect on State AIS Program.....</i>	<i>195</i>
<i>AIS Program Effectiveness and Achievements</i>	<i>201</i>
<i>Factors Relating to AIS Program Sustainability</i>	<i>207</i>
<i>Credibility and Legitimacy of State AIS Program</i>	<i>213</i>
<i>Adequacy of State AIS Rapid Response Plan.....</i>	<i>219</i>
<i>Recommendations for National AIS Legislation.....</i>	<i>224</i>
<i>Severity of State AIS Issues</i>	<i>226</i>
SUMMARY OF NARRATIVE COMMENTS BY RESPONDENTS	229

DETAILED SUMMARY OF RESPONDENTS COMMENTS RELATING TO COMPONENTS OF AIS CAPACITY	231
CHAPTER 5. DISCUSSION.....	237
COMPARISON WITH MALYSA’S ASSESSMENT	237
COMPARISONS OF I _{AIS} METRIC WITH ELI SELF-ASSESSMENT RANKINGS	239
ENVIRONMENTAL DISCOURSE MODELS	240
PROGRAM AND PROJECT DISTINCTIONS.....	242
CHAPTER 6. CONCLUSION AND RECOMMENDATIONS	244
APPENDIX A. SURVEY INSTRUMENT AND HSRB DOCUMENTATION	255
SURVEY INSTRUMENT: A COMPARATIVE ASSESSMENT OF AQUATIC INVASIVE SPECIES (AIS) MANAGEMENT IN MARYLAND AND VIRGINIA:	255
HSRB DOCUMENTATION	260
APPENDIX B. CHARACTERISTICS OF MARYLAND AND VIRGINIA RELEVANT TO AIS MANAGEMENT	266
<i>General Political Considerations.....</i>	<i>267</i>
<i>Constitutional References to Natural Resource Management.....</i>	<i>268</i>
<i>Maryland and Virginia’s Cabinet Level Natural Resources Secretariats.....</i>	<i>269</i>
<i>AIS-Related Issues of Concern in Maryland and Virginia</i>	<i>278</i>
<i>AIS Laws and Regulations in Maryland and Virginia</i>	<i>287</i>
<i>Centerpiece AIS Legislation in Maryland and Virginia</i>	<i>288</i>
<i>Current Definitions of AIS in Maryland and Virginia.....</i>	<i>295</i>
LITERATURE CITED	298

LIST OF TABLES

Table	Page
Table 1. Definitions of components of state AIS management capacity	13
Table 2. Ranking of government performance in Maryland and Virginia. (Data from Governing.com (2008))......	66
Table 3. A chronology of the development of models for the coordination of AIS management in the United States pursuant to federal legal mandates.	69
Table 4. General affiliations of survey respondents.	105
Table 5. Variability of I_{AIS} values among groups and subgroups of respondents surveyed.	112
Table 6. Results of permutation analysis of differences in group means relating to perceptions of six dimensions of AIS capacity in Maryland and Virginia (p-values <0.05 are asterisked).....	115
Table 7. Descriptive statistics relating to overall perceptions of the severity of threats posed by AIS to economic and ecological health in Maryland and Virginia with all groups combined.	227

LIST OF FIGURES

Figures	Page
Figure 1. The Chesapeake Bay Watershed.....	11
Figure 2. The nature of the interactive effects and feedback of intrinsic and extrinsic factors on state AIS management capacity (Adapted from Scheberle 2004).	18
Figure 3. A framework for evaluating state AIS management capacity.	84
Figure 4. Comparative perceptions of six components of state AIS capacity in Maryland and Virginia (means).....	107
Figure 5. Differences in means relating to perceptual assessments of six components of state AIS capacity in Maryland and Virginia.	109
Figure 6. Rank-order assessment of components of AIS capacity in Maryland.	110
Figure 7. Rank-order assessment of components of AIS capacity in Virginia ..	111
Figure 8. Perceptions of situational AIS capacity in Maryland and Virginia.	118
Figure 9. Perceptions of political AIS capacity in Maryland and Virginia.	134
Figure 10. Perceptions of institutional AIS capacity in Maryland and Virginia. .	151
Figure 11. Perceptions of state capacity in Maryland and Virginia.	165
Figure 12. Perceptions of organizational AIS capacity in Maryland and Virginia.	175
Figure 13. Perceptions of AIS evaluation capacity in Maryland and Virginia. ...	185
Figure 14. Perceptions of national AIS capacity in Maryland and Virginia.....	190
Figure 15. A depiction of the interaction of management factors and government performance factors on perceptions of state AIS management capacity. (Adapted from Ingraham and Donohue 2000).....	236

LIST OF ABBREVIATIONS

AIS	Aquatic invasive species
ANS	Aquatic Nuisance Species
ANSTF	Aquatic Nuisance Species Task Force
BDGIF	Board of Game and Inland Fisheries
CBC	Chesapeake Bay Commission
CBP	Chesapeake Bay Program
CZMA	Coastal Zone Management Act
ELI	Environmental Law Institute
E O	Executive Order
ICPRB	Interstate Commission on the Potomac River Basin
ISC	Invasive Species Council (whether used generically or specifically)
ISWG	Invasive Species Working Group (of the CBP)
ISMT	Invasive Species Matrix Team
LRSC	Living Resources Subcommittee (of the CBP)
MAPAIS	Mid-Atlantic Panel on Aquatic Invasive Species
MDNR	Maryland Department of Natural Resources
MISC	Maryland Invasive Species Council
NANPCA	Non-Indigenous ANS Prevention and Control Act
NANSA	Non-Indigenous Aquatic Nuisance Species A
NISA	National Invasive Species Act
NISC	National Invasive Species Council
MWHD	Maryland Wildlife and Heritage Division
MFS	Maryland Fisheries Service
APHIS	Animal and Plant Health Inspection Service
SNASAPA	155
TMDLs	Total Maximum Daily Loads
USDA	United States Department of Agriculture
USF&WS	United States Fish and Wildlife Service
VDAC	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VISWG	Virginia Invasive Species Working Group
VMRC	Virginia Marine Resources Commission
VNRS	Virginia Natural Resource Secretariat

GLOSSARY

AIS - A non-native species, introduced into the waters of the United States from another country, which has the potential to have adverse economic, ecological or public health consequences. In general invasive species are generally designated as either aquatic or terrestrial.

Adaptive Management - A management approach which is used with environmental problems for which there is considerable uncertainty, which integrates scientific approaches with adaptable policies, and can easily incorporate advances in the understanding of the particular issue.

Capacity-building - Increasing the ability of an organization to achieve its goals and objectives.

Case study - A detailed investigation of one or more organizations, or groups within a particular organization, providing for an examination of certain phenomenological processes in a manner not separated from the contextual setting in which they occur.

Comprehensive AIS Management Plan - A multi-species management plan for both aquatic and terrestrial invasive species, including definitions, strategies, goals, and actions, with a distinct policy statement, implementation plan and a detailing of specific agency/division/unit/ responsibilities.

Control - As appropriate, eradicating, suppressing, reducing, or managing invasive species populations, to prevent the spread of invasive species from areas where they are present, and taking steps to reduce the effects of invasive species and to prevent further invasions.

Ecosystem - The complex of a community of organisms and its environment.

Evaluation capacity - The ability of a state to evaluate whether existing policies/programs are sufficient to meet stated goals.

Introduction - The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.

Institutional capacity - The ability of a state to sustain an AIS organization within the fabric of the state bureaucracy which has a specific statutory authority.

Invasive species - An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Invasive Species Matrix Team - An established organization in MDNR that addresses invasive species issue, both aquatic and terrestrial.

Mixed methods - This refers to the use of both qualitative and quantitative methods to study a phenomenon. These methods can be either used at different stages or simultaneously in a particular study.

Multi-Species AIS Management Plan - comprehensive, multi-species management plan for Aquatic Invasive Species, including definitions, strategies, goals, and actions, with a distinct policy statement, implementation plan and a detailing of specific agency/division/unit/ responsibilities.

Native species - A species that is indigenous to a particular ecosystem.

Non-native species - A species that is not indigenous to a particular ecosystem.

Organization - A group of people organized for a particular purpose.

Organizational capacity - The ability of a state to apply its available skills and resources to accomplish stated AIS goals within state natural resource agencies.

Political capacity - The ability of individuals/groups to influence the allocation of public resources to AIS issues.

Policy outcomes - The effects that state pollution control regulations have on environmental quality, or less dramatically, on changes in citizen attitudes, legislative support, etc.

Policy outputs - What a state produces in response to a particular policy, such as laws, regulations, or publications.

Political capacity - The ability of a state to make and implement AIS policy decisions with appropriate public input.

Situational capacity - The ability of a state to identify and define AIS issues.

Stakeholder - State, tribal, and local government agencies, academic institutions, the scientific community, nongovernmental entities (including environmental, agricultural, and conservation organizations), trade groups, commercial interests, and private landowners.

State capacity - The overall capability of a state to marshal resources to develop a particular program when it has a need to so, as a function of fiscal resources, human resources, information technology, and infrastructure.

State AIS Management Capacity - The ability of a state to effectively manage AIS. The overall potential capability of a state to marshal its resources to address AIS issues, based on various components of capacity including: situational, political, institutional, state, organizational, and evaluation capacity.

United States - The 50 States, the District of Columbia, Puerto Rico, Guam, and all territories, and the territorial sea of the United States.

ABSTRACT

A COMPARATIVE ASSESSMENT OF AQUATIC INVASIVE SPECIES MANAGEMENT CAPACITY IN MARYLAND AND VIRGINIA

John Franklin Christmas Jr., Ph.D.

George Mason University

Dissertation Director: Dr. Peter J. Balint

The objective of this exploratory case study was to comparatively assess State Aquatic Invasive Species (AIS) Management Capacity in Maryland and Virginia. That is, to measure the perceived ability of each of these states to effectively manage AIS. To collect data for the assessment I conducted semi-structured interviews as scripted telephone surveys, which included both open-ended and closed-ended questions. The interviews generated data in the form of categorical responses to a series of perceptual questions relating to the various components of State AIS Management Capacity, including: situational, political, institutional, state, organizational, and evaluation capacities. The respondents surveyed represented a wide spectrum of AIS experts in Maryland (n=20) and Virginia (n=10) ranging from field biologists to senior managers in both the governmental and nongovernmental sectors.

Overall, considering all responses to each of the questions relating to the various components of capacity, the majority of responses in both states were “moderately-developed,” (i.e., AIS program needs some improvement) with this response selected for 52.3% of the responses in Maryland and 58.2% of the responses in Virginia. However, there was a greater frequency of “well-developed” (i.e., sufficient AIS program) responses in Maryland (30.3%) than in Virginia (10.9%) and conversely a lower frequency of “poorly-developed” (i.e., AIS program needs considerable improvement) responses in Maryland (17.4%) than in Virginia (31.0%).

Categorical data relating to the perceptual responses of the various components of AIS capacity was coded based on a traditional Likert-like scale ranging from 1-5 (poorly-developed=1, moderately-developed=3, well-developed=5). Group means were calculated for each component of capacity assessed by respondents in each state. The group means for the various components of capacity assessed ranged from 2.4–4.2 in Maryland and from 2.0-3.3 in Virginia, on a scale of 1 (poorly-developed)–5 (well-developed). The greatest differences were apparent in the respondent’s perceptions of situational and state capacity, which were both higher in Maryland than in Virginia.

An integrative metric—the index of State AIS Management Capacity (I_{AIS})—was calculated for each state, as a composite measurement incorporating coded values for all responses for all components of capacity evaluated. The overall I_{AIS} for Maryland was 3.3 while the I_{AIS} for Virginia was 2.6. On a relative

scale of 1-5, a higher I_{AIS} value indicates an overall perception by respondents of a better-developed State AIS Management Capacity.

Permutation analysis was conducted to determine whether the perceptions of the individual components of State AIS Management Capacity differed significantly in Maryland and Virginia. These analyses confirmed the empirical findings, with statistically significant differences found between states in relation to perceptions of situational ($p < 0.05$) and state capacity ($p < 0.05$), with Maryland receiving higher scores. No statistically significant differences were observed between states as far as perceptions of political capacity, institutional capacity, organizational capacity, or evaluation capacity.

Seemingly, the AIS programs in Maryland and Virginia are both reasonably effective, with adequate regulations in place to address most AIS concerns. A basic framework for state AIS management has been developed in both Maryland and Virginia. However, the framework for addressing AIS concerns is not codified or formally established in Maryland, unlike Virginia where such an AIS framework is both codified and formally established. Considerable differences were observed in the governance of the executive branch natural resource agencies tasked with AIS program implementation in these states.

While both states have an AIS organization, neither has a discrete AIS program. Staff are generally assigned in a collateral fashion on an *ad hoc* basis to particular AIS issues, while having other primary responsibilities. Both states have a long-standing regional involvement in AIS issues, and both states have

had successes in AIS eradication, although AIS issues remain generally a low priority issue in these states.

CHAPTER 1. INTRODUCTION

How wonderful that we have met with a paradox.
Now we have some hope of making progress.
Neils Bohr

Overview

There is a general scientific, political, and public acknowledgement of the magnitude of the ecological and economic concerns posed by invasive species (AIS) in the Chesapeake Bay Watershed, and elsewhere (Chesapeake Bay Program [CBP] 1993, CBP 1996, Chornesky & Randall 2003, Moser 2004). Invasive species are now considered to be the second greatest cause of biodiversity decline worldwide, second only to habitat alteration (European Commission 2008). The estimated number of species introduced into the United States ranges from about 4,500-50,000 (Office of Technology Assessment 1993, Pimentel *et al.* 2005), with considerable variability in estimates (Everett & Sherfy 2002). Many other invasive species may well be established but not yet identified in the U.S. (National Invasive Species Council [NISC] 2008). Estimates of costs associated with invasive species introductions into the United States are estimated at about \$120 billion annually (NISC 2001, 2005; Pimentel *et al.* 2005).

Moreover, it is anticipated that present concerns relating to invasive species as well as changes in the distributions of native species—both aquatic and terrestrial—will be exacerbated by the effects of anticipated global climate

changes due to global warming (Hellmann *et al.* 2008, Bierwagen 2008). This study focuses on aquatic invasive species (AIS).

Much has been written about efforts to address the adverse effects of AIS and their consequences (Chornesky & Randall 2003, Wong 2007). The literature relating to AIS management basically elaborates on the fundamental principles developed by Charles Elton (1958) in his seminal treatise on the topic, *The Ecology of Invasions by Animals and Plants*. Today, there are several accepted components to the management of AIS: prevention, early detection, rapid response, control and management, and organizational collaboration (NISC 2008).

However, as an indicator of how relatively new the field of invasive species biology is, one need only examine college science textbooks. Invasive species in general have only been incorporated into such texts during the past six years (Jane Reece, personal communication, August 2009).¹

One of the more succinct summaries of the AIS issue, which provides a contextual setting for this research effort, is presented by Slimak (2008) in *Effects of Climate Change for Aquatic Invasive Species and Implications for Management and Research* (U.S. Environmental Protection Agency [USEPA] 2008). He notes:

¹ Jane Reece, (personal communication, August 22, 2008) co-author of *Biology*, a standard among undergraduate biology texts noted that the term “invasive species” first appeared in *Biology* in the 7th Edition published in 2004. The terms “non-native species,” “introduced species,” and “exotic species” are often used as synonyms.

Invasive species are a major issue ecologically and economically. The economic damages and losses attributed to invasive species in the United States are sizable. In response to these issues, the federal government coordinates research and other activities concerning invasive species through the National Invasive Species Council (NISC) and the Aquatic Nuisance Species Task Force (ANSTF). NISC has written and revised a national management plan that describes strategies for prevention, early detection/rapid response, control, management, coordination, education, and research for federal agencies. The ANSTF has developed [voluntary] guidance for regions and states to develop their own management plans and the ANS Task Force reviews and approves these to distribute additional funding (USEPA 2008, p. vii).

An overarching goal of this research was to develop and provide information relating to AIS management in Maryland and Virginia. This was accomplished primarily by assessing the perceptions of AIS experts in these states regarding various components of AIS capacity. Such assessments, in aggregate, served as indicators of State AIS Management Capacity (i.e., the ability of a state to effectively manage AIS). This information may be useful to agency decision-makers for self-assessments of state AIS programs and enable other governmental and nongovernmental decision-makers to more effectively evaluate State AIS Management Capacity in the 50 states². As AIS issues become increasingly complex, with many confounding aspects, mandatory management and planning requirements may become necessary, requiring a better understanding of comparative aspects of state AIS management.

The AIS Regulatory Milieu: a Prologue

² References to the 50 states are inclusive of all territories of the United States as well the states, although not explicitly stated. The term is used to indicate that issues are being referred to at the level of the state or some other jurisdiction and not at the national level.

The nature of specific AIS issues and the breadth of state AIS programs vary widely in the 50 states as does the severity of AIS issues from state to state. However, all 50 states have some sort of AIS program in place with some statutory basis (USEPA 2008).

There is a substantial body of recent national statutory directives that facilitate state-national AIS coordination. The Non-Indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) of 1990 and the National Invasive Species Act (NISA) of 1996 (which reauthorized and amended NANPCA) provide limited financial incentives for the development of state and interstate (i.e. multi-jurisdictional) ANS Management Plans.³ There are no mandatory state AIS planning and management efforts pursuant to these laws.

NANPCA and NISA do provide a voluntary mechanism for the coordination of state-national AIS issues through the ANS Task Force (created by NANPCA) and its various federal advisory subcommittees, referred to as ANS Regional ANS Panels. The Panels provide modest competitive grants to participating states. As far as state-national interactions, NANPCA and NISA are essentially procedural laws and not regulatory in nature, merely providing voluntary mechanisms for coordination of state and federal AIS efforts.

However, the most expansive and inclusive national planning and management effort to address AIS the United States, is Executive Order 13112

³The abbreviation AIS (aquatic invasive species) will be used interchangeably with the abbreviation ANS (aquatic nuisance species) in this paper.

(E O 13112) issued in 1999. While it is directed at the coordination of federal AIS efforts, and explicitly excludes any state requirements, it does encourage state and national coordination. It also provides comprehensive policy models and guidelines suitable for state AIS planning and management efforts. NANPCA, NISA, and E O 13112 are described in detail in Chapter 2.

As detailed in the next section, AIS constitute a very difficult environmental problem to address, one which requires adaptive management⁴ to effectively address the inherent uncertainties of the issue. Adaptive management has become the rule rather than the exception in contemporary approaches to address environmental policy issues. While there are many critics of the seeming lack of comprehensive federal regulatory involvement in state AIS issues. Ruhl (2007) describes the difficulty in regulating such complex issues in the context of the existing legal structure. He notes that:

The subject of environmental law consists of interlinked complex adaptive systems. The realization that environmental law is fundamentally an endeavor to regulate many complex adaptive systems leads to the an awareness that our present framework of environmental law is designed as if its subject matter is dictated by uniformitarianism, rather than a set of dynamic, adaptive systems. Complex adaptive systems, because of their highly collectivized, nonlinear, dynamic behavior, defy prediction through classical reductionist method, or any other known method for that matter. Yet we have not designed our environmental law system with this underlying property in mind....The lack of predictability is a nagging aspect of complex adaptive systems (Ruhl 1997, p. 947).

⁴ Adaptive management, which has become an integral part of natural resource management over the past 20 years, is generally deemed essential for those types of environmental problems [such as AIS] for which there are high levels of uncertainty. It is an approach which allows for much more flexibility than traditional environmental management, as it readily allows for the accommodation of new information, approaches, and perspectives (Gregory et al. 2006).

Definitional Issues Relating to Aquatic Invasive Species

This study focuses only on AIS, those invasive species which are found in marine, freshwater, estuarine or wetland habitats. The term AIS is very generic, and at the outset of this research effort it is essential to define not only what the term means, but what particular subset of AIS is being addressed. The generally accepted definition of invasive species is detailed in E O 13112, which defines an invasive species as, “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”

Moreover, in this study the term AIS is restricted to the narrowly circumscribed subcategory of AIS whose management is relegated to state natural resource agencies. This includes, generally, only those species regulated traditionally as “fish and wildlife” or “nongame fish and wildlife” by state fish and wildlife agencies (i.e., state natural resource and conservation agencies). Unregulated aquatic plants are also generally included in this category. However, plant and animal pathogens are not considered to be AIS for purposes of this study. In the federal system, the state has historically been considered to be the trustee of the fish and game belonging to the people, and fish and wildlife issues have been managed—much like planning and zoning issues—without national preemption of this role.⁵

⁵ Although various federal statutes relate to the protection of plants and animals within a state, the general protection of fish and wildlife (and regulation of AIS) is regulated by state laws that mainly govern fishing and hunting. Thus, fish and game belong to the state, in its sovereign capacity as the representative of the people and for the benefit of

In addition, pathogens and parasites that infect humans exclusively are not considered to be AIS under the purview of natural resource agencies. NISC does not focus on these species as AIS because they are addressed by various other federal agencies, in particular the Department of Health and Human Services (DHH). The *Center for Zoonotic, Vector-Borne, and Enteric Diseases*, an agency of the Centers for Disease Control and Prevention, is involved with zoonotic diseases—diseases transmitted from wildlife to humans—as well as emerging human diseases. DHH's National Institutes of Health provides support for zoonotic diseases and research related to bioterrorism (NISC 2010, para. 1).

The Environmental Law Institute (ELI 2008) notes that AIS are not regulated as pollutants, and therefore are not regulated by U.S. EPA, although the agency has considerable involvement in AIS research and management. However, AIS have been increasingly acknowledged as causes of impairments in segments of water bodies and placed on state 303(d) lists,⁶ generally as non-pollutant impairments, and only rarely as pollutants. AIS are still considered an “emerging issue,” and one addressed relatively infrequently by the Clean Water Act (ELI 2008).

the people, including the authority to regulate the right to fish or hunt (USLegal.com 2010, para 1)].

⁶ Pursuant to the Clean Water Act (CWA), the 303(d) list reports on the impaired waters of the state and requires the preparation of plans to improve water quality by limiting the loadings of listed pollutants. Such plans are referred to as Total Maximum Daily Load Plans. There has been considerable controversy and litigation over the implementation of such provisions of the CWA.

In attempting to categorize AIS in any definitive way, it is important to understand that the designation of a species as “invasive” is a normative categorization (Lackey *et al.* (2003).⁷ The definition of AIS, based on E O 13112 refers to an invasive species as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.” However, whether a particular non-native species fits into the category of being invasive is not always predictable. The *Invasive Species Definition Clarification and Guidance White Paper* elaborates on the definition of AIS stated in E O 13112 and provides an excellent philosophical treatise on the subject (Invasive Species Advisory Committee 2006). The *White Paper* addresses the normative aspects of AIS management in detail and also notes that biogeographic considerations (e.g., the ecosystem in which an invasive species evolved) must be taken into account in any determination of the potential invasiveness of a species. Despite the increasing use and accuracy of AIS risk assessments as an analytical tool to predict whether a particular species might be invasive if introduced (Jenkins *et al.* 2007), it is still often conceded that:

The effects of introduced species are so poorly understood and the record of predicting which ones will cause problems is so bad that one can question how much credence to place in a risk assessment (Schmitz and Simberloff 1997, p.39).

In AIS management it is often as difficult of a problem to assess a problem as it is to manage one. One need only look at the paucity of AIS listed as

⁷Normative science is that based on societal norms and prevailing opinions about a particular scientific issue, while descriptive science has no such associated value judgments.

injurious wildlife pursuant to the Lacey Act (U.S. Fish & Wildlife Service [USFWS] 2007) to understand the difficulties in arriving at a normative national consensus as to what constitutes an invasive species throughout the United States. In the Chesapeake Bay Watershed there are only a few species which are included on this list, such as the zebra mussel, *Dreissena polymorpha*, the northern snakehead, *Channa argus*, and the Chinese mitten crab, *Eriocheir sinensis*.

Those species which are listed by the U.S. Fish & Wildlife Service (USFWS) as injurious, pursuant to the Lacey Act, cannot be legally imported into the United States or transported across state boundaries.

Basically, there has been an evolution of the terminology used to refer to harmful non-native invasive species since the enactment of NANPCA in 1990, generally in response to the changes in terminology used in federal legislation. Non-native species deemed undesirable have been variously referred to as exotic species, non-native species, non-indigenous species, alien species, nuisance species, or invasive species. The latter term, first extensively used by Charles Elton in 1958, came into common usage when included as part of the title of the National Invasive Species Act of 1996, and was effectively institutionalized by the definition provided in E O 13112, issued by President Clinton in 1999, which focused exclusively on harmful non-native species.

While the term invasive species is value-laden, it is intended to allow for a distinction of good non-native species from the bad, as much as possible. The nature of the term is explained well by NISC, which asserts that:

The definition includes many types of invasive species such as animals, plants and microorganisms. It focuses upon invasive species which are harmful, rather than focusing on non-native species, most of which are not harmful....Most non-native species, including many of our sources of food and fiber, are not harmful; and many are highly beneficial. [Only] A small percentage of non-native species that cause harm are collectively known as invasive species. (NISC 2008, p. 7).

Study Area and Delineation

The unit of analysis in this study was the state, and Maryland and Virginia are the two states which were studied. They are well-suited for a comparative analysis of State AIS Management Capacity in the Chesapeake Bay Watershed as they are similar in many ways that facilitate comparison. Before selecting Maryland and Virginia as the states to include in this project, I first analyzed the diffusion of various federal AIS policies in the Chesapeake Bay Watershed, which revealed other similarities. This information is presented in Part II of Chapter 2.

Most importantly, almost all of the tidal portions of the Chesapeake Bay are located within the jurisdictions of Maryland and Virginia. The 64,000 square mile watershed is comprised in part of drainages from four additional states: Delaware, New York, Pennsylvania, West Virginia, (as well as the District of Columbia), which are considered to be headwater states (Figure 1).



Figure 1. The Chesapeake Bay Watershed

The surface area of the Chesapeake Bay and its tributaries is about 4,480 square miles (sq. mi.) with the surface area of the main basin about 2,500 sq. mi. In Maryland, the surface area of the Chesapeake Bay and its tributaries is about 1,726 sq. mi. and in Virginia about 1,511 sq. mi. The total 8,100 sq. mi. shoreline of the bay—including tributaries—is also almost equally divided between Maryland and Virginia.

The tidal portion of the Chesapeake Bay provides a common habitat for natural resources uniquely shared by Maryland and Virginia for which there are established commercial fisheries, in particular, striped bass, *Morone saxatilis*, Eastern oysters, *Crassostrea virginica*, and the blue crab, *Callinectes sapidus*.

From the preceding discussion it is apparent that both Maryland and Virginia have considerable water resources. The overall percentage of the surface area of water in relation to total surface area (i.e., land and water) is high in Maryland (21.2%) and Virginia (7.4%) in comparison with other states. In Maryland 94% of the land area drains into the Chesapeake Bay (Truitt 1984) while in Virginia 60% of the land area drains into the Chesapeake Bay. The 32 miles of Atlantic Ocean coastline in Maryland (Surfrider Foundation 2010a), is considerably less than the 115 miles of Atlantic Ocean coastline in Virginia (Surfrider Foundation 2010).^{8, 9}

Purpose of Study

The primary purpose of this study was to assess State AIS Management Capacity in Maryland and Virginia, that is, the ability of these states to effectively

⁸ There is considerable variability in the degree of federal ownership of land in these states. In Maryland, 3.2 % of the total land acreage is federally-owned while 9.0% of the total land acreage in Virginia is federally-owned (Rosenbaum 2002). Nationally, the federal government owns about 29% of all U.S. land area; with such holdings greatest in the western states, in which federal land ownership may exceed 60% of the total surface area. This is of potential significance as federal AIS programs are seemingly better-established than state AIS programs.

⁹ Maryland and Virginia are both coastal states in the Mid-Atlantic Region, with a considerable amount of coastline and surface water. As such they have an increased susceptibility to both intentional and unintentional-introductions from various pathways (i.e., vectors), including ballast water discharge, hull fouling, recreational boating, and live bait introductions.

address AIS issues. The framework for this assessment consisted of various components of State AIS Management Capacity. These included: situational capacity, political capacity, institutional capacity, state capacity, organizational capacity, and evaluation capacity. A telephone survey of elites¹⁰ was used to provide a perceptual assessment of these various components of capacity, which were then evaluated as surrogate indicators of capacity.

The terms relating to the various components of capacity used in this study have been defined variously in the literature (Malysa 1996). In the context of this study they are defined as described in Table 1 below.

Table 1. Definitions of components of state AIS management capacity

Situational Capacity - The ability of a state to identify and define AIS issues as they arise.

Political Capacity - The ability of a state to make and implement AIS policy decisions with appropriate public input.

Institutional Capacity - The ability of a state to sustain an AIS organization within the fabric of the state bureaucracy which has a specific statutory authority.

Organizational Capacity - The ability of a state to establish a group of individuals to apply its available skills and resources to accomplish stated AIS goals within state natural resource agencies.

State Capacity - The overall ability of a state to marshal resources to develop a program to address a public policy issue as needed, as a function of fiscal resources, human resources, information technology, and infrastructure.

¹⁰ The term “elite”, as used in qualitative research, refers to individuals who are involved in professional activities in a particular discipline and does not necessarily have the connotation of exclusivity generally associated with the term. The respondents ranged from field biologists to senior managers.

Evaluation Capacity - The ability of a state to evaluate whether existing policies/programs are sufficient to meet stated goals.

The project was an exploratory case study, primarily qualitative in nature (Yin 2003). This is the first study of this type undertaken in relation to AIS. As far as analysis, some descriptive statistics were used to describe the data, and permutation analysis was used to examine the significance of differences between states in relation to each dimension of capacity assessed. The basic framework for the assessment was adapted from a study of wetlands management and planning capacity in Maryland and Virginia (Malysa 1996).

There are two temporal components to this case study. An historical perspective is provided that establishes the contextual setting for the research. Regional AIS management began in the Chesapeake Bay Watershed, and elsewhere in the United States, as a definable programmatic concept with the enactment of NANPCA in 1990. As a result, the various dimensions of State AIS Management Capacity assessed are ones which have been developed, for the most part, since 1990. However, the perceptual survey itself—which comprised the most original part of this research—is cross-sectional in nature, extending from April 5-July 30, 2010. Some respondents have been involved with AIS management since its “origins” in 1990, while others are relative newcomers to the field.

Various ancillary research questions were also addressed in this study. The questions addressed some of the following topics. Are Maryland and Virginia

effectively managing AIS? How serious are the AIS problems in each state? Is there a defined AIS program that meets each state's needs to address AIS issues? How do other AIS experts perceive the management of AIS in their state? Do the states feel prepared to respond to an AIS crisis that might arise? What's unique about the structure of the natural resource agencies involved in each state that might affect AIS management? The primary mechanism used to explore such additional research questions was the same survey instrument designed primarily to assess the perceptions of respondents in Maryland and Virginia regarding the various components of AIS capacity in these states.

Study Significance

This study examines the capacity for the management of AIS in Maryland and Virginia, focusing on those executive branch natural resource agencies designated as responsible agencies. Such agencies have the responsibilities of implementing various state statutes relating to AIS in these states. This research is novel in that it provides a framework that can be adapted for a self-assessment of State AIS Management Capacity by these and other states. The framework can also be utilized by other governmental or nongovernmental AIS agencies, to better evaluate successes and shortcomings of state AIS management efforts.

This research will provide the following:

- A forthright assessment of AIS management capacity in Maryland and Virginia based on the perceptions of AIS experts in these states;
- An exploration of underlying characteristics that influence the various components of capacity assessed;

- A better understanding of the particular components of AIS management capacity that need to be better-developed in order to improve AIS management effectiveness in Maryland and Virginia;
- Insights that might be useful as ongoing AIS policy formulation and implementation continue in Maryland and Virginia;
- Recommendations that facilitate capacity-building in AIS programs in Maryland and Virginia.
- More questions about the nature of AIS management in Maryland and Virginia.

Study Limitations

This study has several limitations. One relates to the nature of the validation criteria for this study. The assessments made in this study are all based on perceptual responses by respondents in Maryland and Virginia to categorical questions relating to the various components of State AIS Management Capacity. As a result, the means and metrics used to describe this data similarly have their basis in such perceptual data. And, as with any process of data collection through interviews, there are questions of replicability. In particular, the information presented in this study is based on telephone surveys with individuals whose anonymity is protected, pursuant to federal law.

Another limitation of this study is that, although the framework for analysis established is intended to evaluate the major components of State AIS Management Capacity, it was not designed to systematically assess every subcomponent of every component of capacity that was assessed. The choice of a telephone survey methodology imposed certain restrictions on the nature of the questions posed, such that they were necessarily broad.

Broadly, the various factors affecting AIS policy can be categorized as intrinsic or extrinsic factors (Scheberle 1997, 2004). By necessity, the perceptual survey used in this research focused primarily on intrinsic factors—those which are inherent to the states. Such factors include agency capacity, state-level agency culture, and state-level political support, with each of these factors having still other subcomponents. Extrinsic factors, which are those external to the state and not under its control in general, were generally beyond the scope of this study. Such factors include federal political arrangements, the nature of the environmental problem itself, federal statutory language, and legislative and policy history of federal statutes.

Scheberle's (1997, 2004) categorization of the effects of both intrinsic and extrinsic factors on policy development and implementation has been adapted in Figure 3 below to graphically depict the interactive nature of intrinsic and extrinsic factors in the development of State AIS Management Capacity. As extrinsic factors are very important in the policy process and can have a considerable effect on state capacity, they were addressed somewhat in ancillary questions. While the evaluation of extrinsic factors warrants additional evaluation, it is not the focus of this assessment.

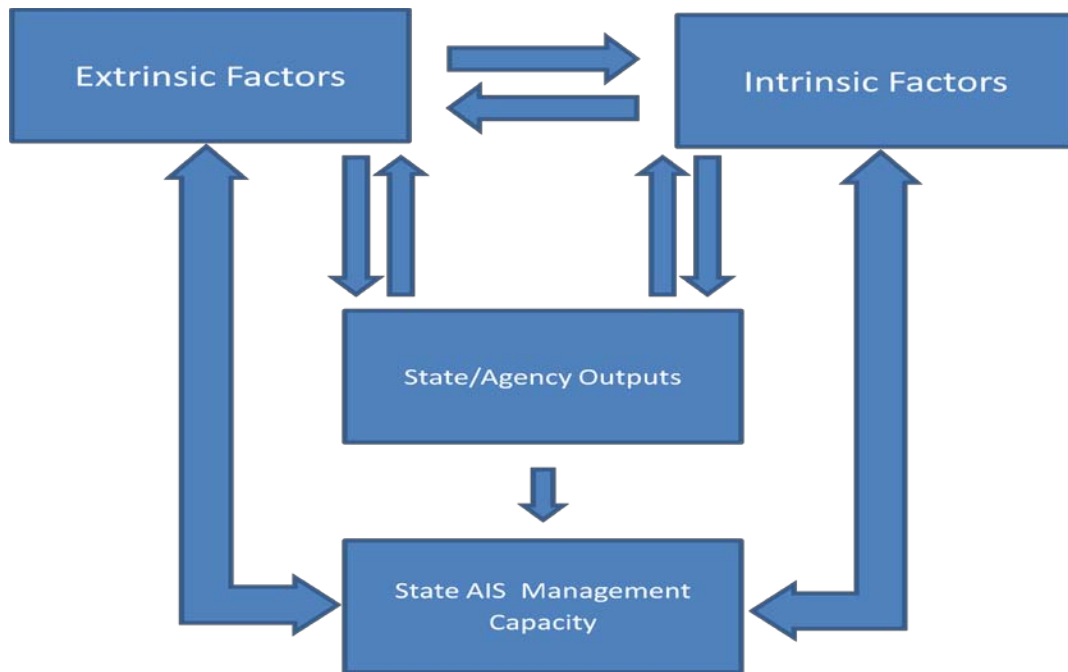


Figure 2. The nature of the interactive effects and feedback of intrinsic and extrinsic factors on state AIS management capacity (Adapted from Scheberle 2004).

Also, as noted by Malysa (1996), the forthrightness of the respondents considerably affects the utility of this research—not that there is any reason to question the authenticity of any of the responses. Factual statements have been researched as necessary, in order to clarify any discrepancies. However, the authenticity of perceptual comments cannot be as easily verified.

Lastly, while scientifically the watershed is the ideal unit of analysis for a study such as this, and ideally the level at which related regulation should occur, pragmatically, this is rarely possible (Ruhl 1999, Rosenbaum 2002, Christmas 2004). Such is the circumstance with this study.

Study Organization

This study is presented in six chapters. Chapter one presents an overview of this research project, first describing the nature of AIS concerns, and then provides a brief discussion of the AIS regulatory framework. This is followed by the development of a working definition of AIS and a detailed exposition of various aspects of this study, including a description of the study area, study purpose, study significance, and study limitations.

The second chapter presents a short, two-part review of the literature. Part I provides a brief history of AIS regulation in the United States and a description of recent national guidance in this area, followed by a review of the political framework within which AIS are managed, a description of the evolution of comparative environmental analyses, and a discussion of state management capacity. Part II provides a synoptic review of the management of AIS in the Chesapeake Bay Watershed from 1990 to the present, presenting both an historical overview as well as an examination of the adoption (i.e., innovation) and spread (i.e., diffusion) of national AIS policies throughout the Watershed.

The third chapter presents the research methodology for this study. It begins with a description of the rationale for the methodology and describes in detail the various methods employed in this study, including interviews, metric development, and permutation analysis. The framework for assessing State AIS Management Capacity is also detailed and the nature of the survey is described, including a discussion of the survey instrument, the HSRB approval process for

the research protocol, the recruitment process, and the manner in which the survey was administered.

The fourth chapter presents the results of this study. The results are first presented in a summary fashion, with both graphical and statistical analyses employed. Then, the results for each question in the survey are presented individually, in a sequential fashion, with the qualitative commentary provided by the respondents addressed in particular detail. Given the breadth of the results, some analysis is generally provided following the presentation of the results. This rather lengthy chapter concludes with a summary of the study results.

The final two chapters are much briefer than the preceding ones. The fifth chapter presents additional discussion of some key points relating to the theoretical underpinnings of the study, in relation to the results of the study. The sixth chapter presents the study conclusions and provides several recommendations for further research, as well as a detailed summary.

There are two appendices. Appendix A presents the survey instrument for this study and the elaborate documentation required by the Human Subject Review Board, including the informed consent letter, copies of approved correspondence and approved amendments. Appendix B addresses relevant state-specific characteristics of Maryland and Virginia. This includes a brief discussion of the state political systems and a description of the structure and history of the responsible natural resource agencies. This is followed by a discussion of one serious AIS infestation and eradication of consequence in each

state, and concludes with a description of the centerpiece AIS statute(s) in each state as well as related amendments, which in concert serve as the legal framework for AIS management in these states.

CHAPTER 2. LITERATURE REVIEW

Part I. Review of Regulatory and Theoretical Aspects

Historical Regulation of AIS

It is necessary to clarify the nature of the variable manner in which AIS are federally regulated in order to clarify state responsibilities. To do so one must understand the historical context of AIS management. Considerable insight into the nature of AIS in general is provided by the U.S. Geological Survey's Non-indigenous Aquatic Species Program. The North American invasion of the zebra mussel, *Dreissena polymorpha*, served as a triggering event for the ultimate emergence of this field of study, about which the USGS states:

In the 1980s Invasion Biology began to emerge as a true sub-discipline of ecology as evidenced by an exponential increase in scientific output on the subject. Most work on the subject was terrestrial. Invasions were not a large component of the popular environmental movement, and no serious legislation existed concerning invasions beyond agricultural pests. After the discovery of zebra mussels in 1988 the exponential rate of scientific output on invasions itself increased, the Non-indigenous Aquatic Nuisance Prevention and Control Act was written and passed, and Invasions became a topic discussed in the media. Aquatic invasions are [today] a topic of much research. For these reasons the zebra mussel is often described as the “poster child” of biological Invasions (Benson and Raikow 2011).

However, not all non-native species are so predictably problematic. One confounding aspect of the nature of AIS management is that many non-native

species that have been intentionally or unintentionally introduced into the U.S. are beneficial, some are benign, and relatively few have proven to be problematic. Many have consequences that are quite variable from one part of the U.S. to another (i.e., *Hydrilla verticillata*). The complexity of the management of AIS is explained well by Miller and Fabian (2004) who note that:

While it is clear that non-native species can be beneficial, and indeed are often the cornerstone of modern agriculture, blurring lines between important conceptual distinctions confuses both law and policy. It is often important for sound policy to distinguish between native organisms in their natural, evolved range, organisms native to a country (or other political unit) outside their natural range, organisms not native to the country but beneficial, non-native organisms that are harmful, and non-native organisms whose impact is unknown. Indeed, the definitional challenges include discussions of the nature of "harm" (economic, ecological, aesthetic), and the need for more precise geographic and measures of harm across different scales....The concept of what is native" becomes even more blurred in the context of substantial human transformation of the natural environment.... it has become more and more difficult to maintain any notion of what remains natural or wild (Miller and Fabian 2004).

However, Lodge and Shrader-Frechette (2003) insightfully delineate the narrow range of non-native species that are of pragmatic concern to U.S. state and federal AIS regulators. They note that:

Because regional biota are being homogenized by species invasions, it has become an appropriate and official public policy goal in the United States to reduce the harm¹¹ done by invasive species. The goal is not, however, a reduction of the numbers of non-indigenous species per se (Lodge and Shrader-Frechette (2003, p. 31).

¹¹ The philosophical debate relating to the concept of environmental harm, when defined simply by a change in native biodiversity, is one that has been the topic of considerable controversy (Lackey 2003) and (Sagoff 2009).

The introduction of problematic non-native aquatic species, although only recently referred to as AIS, has been regulated by the federal government—to some degree—for a very long time, beginning with the Lacey Act of 1900. This Act, administered by the U.S. Fish & Wildlife Service (USFWS) not only provides for a federal list of species designated as “injurious” and illegal to import into the U.S., but also forbids the interstate transport of such regulated species in violation of state laws. Aside from the Lacey Act, there are various other federal and listing processes to regulate the introduction of non-native species (ELI 2002, 2007). However, if all of these federally-listed species were compiled into a comprehensive list, it would still not be a very long list (Chris Dionigi, NISC, personal communication, November 2009).¹²

Enforcing the restrictions on introductions of non-native species into the country is fraught with difficulty. Presently, the Department of Homeland Security’s Custom and Border Patrol (CBP), U.S. Fish and Wildlife Service, and USDA’s Animal and Plant Health Inspection Service all inspect ports-of-entry for illegally introduced plants and animals, pursuant to the Lacey Act and other statutes restricting importations. However, such programs are generally considered to be understaffed (Jenkins 2007). While the Lacey Act is useful, once an AIS has entered a state, it is then the individual state’s responsibility to

¹² A comprehensive listing of Federal AIS laws can be found at the USDA’s Invasive Species Law’s and Regulation website (<http://www.invasivespeciesinfo.gov/laws/>) and in the appendices of the National Invasive Species Management Plan (NISC 2001).

regulate it. Some species-specific legislation has been enacted, on occasion, to assist states with the management of particularly invasive species.

The USDA's Animal and Plant Health and Inspection Service (APHIS) has the broadest federal regulatory authority in the United States relating to invasive species management, as far as pathogens and pests of agricultural crops and livestock are concerned (NISC 2008). Such regulatory authority has been consolidated in the Plant Protection Act (2000) and Animal Plant Protection Act (2002), and APHIS's role in relation to AIS is ever-increasing. This program is the most elaborate national program as far as aquatic and terrestrial AIS responses, and has far-reaching emergency quarantine authority to seize, hold, and destroy species which are prohibited from entry into the country or between states. In fact, APHIS is the only national program that has formal authority to undertake an emergency rapid response (NISC 2008).

The Lacey Act warrants some additional discussion, as it is limited to prohibiting the introduction of listed species into the United States and their interstate transport. But once a listed species makes its way into the U.S., and is found within the borders of a particular state, the intrastate movement, transport, and regulation of such a listed species is solely the responsibility of the affected state. For example, it is illegal pursuant to the Lacey Act to introduce zebra mussels (*Dreissena polymorpha*) into the United States or to transport them intentionally from one state to another, as they are listed as an injurious fish and wildlife species. Maryland and Virginia have state laws that regulate intrastate

introduction, possession, and transport of zebra mussels. However, because zebra mussels are not otherwise federally regulated, their regulation and management within state boundaries is strictly the responsibility of the individual states, in waterways under state jurisdiction.

As the species addressed in this research effort fall under the categories of traditional “fish and wildlife” (or otherwise unregulated species) regulatory responsibilities for their management are generally assigned to state conservation agencies. However the consequences of state management may affect an entire watershed and be interstate in nature. The range expansion of zebra mussels in the Susquehanna River from New York, into Pennsylvania and most recently into Maryland waters is an excellent example. As this species does not fall under the jurisdiction of APHIS, and is established in open waters, its regulation is left to the states.

Recent National Guidance for AIS Planning and Management

As previously noted, NANPCA, and NISA, and E O 13112 are legal mandates created during the period from 1990-1999, in the wake of the zebra mussel invasion of North America. These laws provide the framework for contemporary state and national coordination of AIS issues, as defined in this study. However, such a role was not the primary mandate of these laws. NANPCA and NISA established the framework for the regulation of ballast

water,¹³ first in the Great Lakes and subsequently in other U.S. coastal waters. The primary objective of E O 13112 was to coordinate and manage AIS at the federal level. Various other statutes regulating particular AIS issues (e.g., brown tree snakes and nutria) have been enacted since 1990, but the voluntary federal framework for state-national coordination established by NANPCA, NISA, and E O 13112 is of primary relevance for this research effort.

The regulation of AIS remains primarily the responsibility of the state. In relation to this study, what is most significant about NANPCA, NISA, and E O 13112 is that they provide federal policies that served as models for AIS management by the states. That is, rather flexible tools which can be adapted to the AIS issues of a particular state, providing mechanisms for coordination. NANPCA and NISA provide a mechanism for state participation in Regional ANS Panels as well as a process to facilitate the development of state and interstate (i.e., multi-jurisdictional) ANS Management Plans. E O 13112, most importantly, provides models for AIS invasive species advisory groups (i.e., Invasive Species Councils and Invasive Species Advisory Groups).

The voluntary mechanism for the coordination of state-national AIS issues pursuant to NANPCA and NISA is administered through the Aquatic Nuisance

¹³ Ballast water discharge is one of the few AIS issues to be regulated intensively. Ballast water discharge is believed to be the most significant potential vector of introduction of AIS into coastal waters; it is estimated that about two thirds of all such introductions have been via ship-borne vectors. The regulatory components of NANPCA and NISA, and EPA's more recent NPDES vessel discharge requirements, relate primarily to ballast water which is not addressed in this study (www.epa.gov/owow/invasivespecies).

Species Task Force (ANSTF), a legislatively mandated advisory committee and its various federal advisory subcommittees, referred to as ANS Regional Panels. Currently there are six Regional ANS Panels that encompass the entire United States and territories, which are designated as follows: Great Lakes, Western, Mississippi River Basin, Northeast, Gulf and South Atlantic, and the Mid-Atlantic (ANSTG, 2010). Only the Great Lakes and Western Panels were legislatively created, with the others formed pursuant to authority delegated to the ANSTF (Christmas 2004). Modest financial incentives are provided by the ANSTF for ANSTF-approved Aquatic Nuisance Species Management Plans and through small competitive grants which are administered through the Regional ANS Panels. It is important to emphasize that the grants to the states for participating in these coordination efforts are very modest.

Financial incentives are provided for the development of both state and interstate (i.e. multi-jurisdictional) Aquatic Nuisance Species (ANS) Management Plans, which are approved by the ANSTF. The approval of such ANS Management Plans by the ANSTF requires adherence to established AIS planning guidelines developed by the ANSTF. The guidelines for the preparation of the Plans require each state (or other participating jurisdiction) to address AIS issues in a comprehensive manner in the course of the preparation of the Plan (Aquatic Nuisance Species Task Force 2005). When the ANSTF approves a state or interstate Plan, funding is only provided for Plan implementation, and then subject to the submission of an approved five-year implementation plan,

which is reviewed at the end of that period. Since 2004, annual funding for all ANSTF-approved ANS Management Plans has been limited to \$1,075,000. This amounts to about \$35,000 annually for implementation funding for states with approved Plans. While the overall allocation for ANS Management Plans has not increased in recent years, the number of ANSTF-approved Plans has almost tripled (ANSTF 2009).

Presently in the United States, there are 36 ANSTF-approved State ANS Management Plans and 3 ANSTF-approved Interstate ANS Management Plans.¹⁴ Nine states have such ANS Plans under development, while another eight states still have no Plans underway (ANSTF 2011). With the exception of Florida, the only other coastal states without ANSTF-approved ANS Management Plans, and which currently do not have ANSTF-approved ANS Management Plans under development are localized in the Mid-Atlantic Region and are all part of the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS). These include: Delaware, New Jersey, and Maryland. New York, Pennsylvania, and Virginia all have ANSTF-approved ANS Management Plans, while North Carolina has one under development. Three interior (i.e., noncoastal) states, West Virginia, Nevada, and Arkansas, also do not have ANSTF-approved ANS Management Plans.

¹⁴ The three ANSTF-approved interstate ANS Management plans include the Lake Champlain Basin Interstate Management Plan, the St. Croix River Natural Scenic Waterway Interstate Management Plan, and the Lake Tahoe Interstate Management Plan (State ANS Management Plans, 2011).

It appears that the various interstate ANS Plans, including the three ANSTF-approved Plans and the two presently under development, are for relatively small watersheds—although involving multiple jurisdictions. The Great Lakes Region, despite seeming similarities in AIS issues, and despite strong state, federal, and regional leadership did not approach AIS management, as far as developing ANS management Plans, in a regional context. Yet all states in the Great Lakes Region now have ANSTF-approved ANS Management Plans. For some time such an interstate Plan was being informally considered for the Chesapeake Bay Watershed (Christmas 2001).

Additional funding is provided to states participating in the various Regional ANS Panels states via competitive grants; although states without Plans are not prohibited from participating in the grant programs. While the extent of geographic coverage is impressive—comprising the entire United States—there is presently a \$300,000 cap on the total annual appropriations for all six Regional ANS Panels, a limit which has been in place since 2004. Each Panel receives an equal portion of about \$50,000. This allocation funds the Panel coordinator's position in part (generally USFWS staff) with the remainder being distributed via small competitive grants among the state participants. It is conceded that the minimal nature of the funding for these incentives—which are far below the initial Congressional authorization—does not provide a considerable financial incentive for participation in these programs (ANSTF 2009).

While the most expansive and inclusive national planning and management effort to address AIS in a comprehensive way in the United States has been E O 13112, its primary role is to address AIS issues at the national level. The National Invasive Species Council (NISC) was established by E O 13112 to ensure the coordination, effectiveness, and efficiency of national programs and activities intended to prevent and control invasive species—both terrestrial and aquatic. NISC members include cabinet level representatives from 13 federal departments and the Council is co-chaired by the Secretaries of Commerce, Agriculture, and the Interior. NISC is formally housed within the Department of Interior.¹⁵ The National Invasive Species Council (2008) provides a succinct discussion of its role pursuant to E O 13112, noting that:

In 1999, E O 13112 charged all federal departments whose actions may affect the status of invasive species, to the extent practicable and permitted by law, to work together within their current authorities to prepare, prevent, and protect resources from harm caused by invasive species. E O 13112 also established the National Invasive Species Council (NISC), co-chaired by the Secretaries of the Interior, Agriculture, and Commerce. NISC was charged with providing coordination, planning and overall leadership for federal invasive species programs and outreach to state, tribal, local and private partners.

E O 13112 also created the Invasive Species Advisory Committee (ISAC), comprised of nonfederal experts and stakeholders, which advises NISC.

One of the primary duties of NISC has been to draft and periodically review and revise a National Invasive Species Management Plan. The first Plan

¹⁵ Although all cabinet-level departments have submitted Memoranda of Understanding (MOU) to the Executive Branch in relation to AIS issues, in response to E O 13112, and participate to varying degrees in federal activities, only DOA, DOI, and DOC have permanent liaison officers assigned to NISC.

was completed in 2001 and the second in 2008. The 2008 Plan has five strategic goals: prevention; early detection and rapid response; control and management; restoration; and organizational collaboration.¹⁶

The legal authority of NISC, and E O 13112 which it implements, is limited by design to the national government. However, it explicitly encourages cooperation between the federal and state governments, and other nonfederal entities. NISC provides models of comprehensive coordination tools adaptable to state AIS management, including the Invasive Species Councils (i.e., advisory groups) and comprehensive (i.e., aquatic and terrestrial) invasive species management plans.

As comprehensive as NANPCA and NISA are, they also only provide for coordination of state and interstate AIS efforts, with no state-national statutory requirements other than the creation of the previously described voluntary federal venues for coordination of AIS activities. There are no formal national requirements for states to develop AIS Management Plans or to participate in Regional AIS Panels. The aforementioned laws do, however, explicitly encourage state and federal coordination of AIS issues. The examination of contemporary environmental policy provided later in this chapter will provide some insight relating to the hesitancy of the federal government to enact more

¹⁶ It is NISC's fifth strategic goal, organizational collaboration, is that of relevance to this examination of state-national relationships as it addresses [the need to] "Maximize organizational effectiveness and collaboration on invasive species issues among international, federal, state, local and tribal governments, private organizations and individuals."

comprehensive federal AIS legislation, despite the reintroduction, year after year, of related bills to amend the 1990 legislation.

When considering the role of NISC and the ANSTF, it is important to understand that both entities have responsibilities that are national in scope and, the particular federal agency which houses both of these entities is the Department of the Interior. There is considerable logic to this as the federal government can more readily assert control over the management of federally-owned lands, unlike state lands and private property over which it has no direct control. Four federal agencies administer about 95% of these federal lands. Within the Department of the Interior, three federal agencies—the Bureau of Land Management, Fish and Wildlife Service, and National Park Service—together administer 65.3% of the approximately 650 million acres of land owned by the federal government. The U.S. Department of Agriculture's (USDA) Forest Service is responsible for an additional 29.5% of federal lands.

The existing state AIS statutory requirements for AIS efforts are quite variable from state to state (Environmental Law Institute [ELI] 2002, ELI 2010), with considerable variation in implementation requirements as a result. Such variability in AIS management will probably continue unless there is some legal requirement or major incentive for state consistency with federal guidelines and policies for AIS planning (ELI 2002, 2010). In their analysis of AIS management in 2007, the Environmental Law Institute emphatically stated that the role of AIS management is largely the role of the states, which might be able to improve their

effectiveness through regional cooperation. As things stand, it appears that the federal government does not have even adequate funding to ensure that federal importation and quarantine restrictions are complied with effectively (Jenkins 2007) much less, sufficient funding to assume more formal oversight of state AIS programs.

Misconceptions about State-National AIS Legal Relationships

It is often overlooked that the federal statutory provisions relating to the state-national relationships regarding AIS management that have been established by NANPCA, NISA, and E O 13112, relate simply to coordination of AIS efforts. Fundamentally the provisions are procedural in nature rather than regulatory. They provide metapolicy—policy about how policy should be made—without having any particular direct effects, in many ways like the National Environmental Protection Act. Bartlett (1994, p. 181) clarifies the benefit of such metapolicy in relation to the National Environmental Policy Act (NEPA), in a comment which is equally applicable to NANPCA and NISA:

NEPA embeds ecological rationality—a way of thinking about action, organizations, and ultimate ends and values—in political institutions, and its worth or merit must be evaluated with regard to that institutional transformation.

In the case of the NANPCA, NISA, and E O 13112, the metapolicy provided—ANS-Approved Management Plans, Regional ANS Panels, Invasive Species Councils, and Invasive Species Advisory Committees—have the same basic role. Such policies, which are meant to be formative in terms of AIS

management capacity-building, are presented as voluntary process models rather than obligatory ones.

There are many legal tools by which the federal government could require more consistent approaches to AIS management by the states if it desired. Various federal statutes require mandatory state capacity assessments and plan development in order for states to receive funding. And the use of cross-cut budgets in a coercive manner has been commonly employed at the federal level, requiring adherence to national goals in order to receive federal funding in a particular area (Scheberle 2004). However, what appears to be often misunderstood is that the seeming lack of federal regulation of state AIS issues reflects the traditional role of the states in this area, with the states being the “trustees” of the fish and wildlife for the people. The following two sections describe various typologies that have been used to categorize state environmental policies.

Comparative Evaluations of AIS Management in the United States

While there are no comparative rankings of all 50 states as far as state AIS program performance, criteria for state self-assessments of AIS programs have been developed for AIS management in the United States (ELI 2002) and various surveys have been conducted (ELI 2002, Responsive Management 2002, MAPAIS 2006). There are some states which are notable leaders and some which are laggards, with Maryland and Virginia generally somewhere in between these two extremes, based on these evaluations.

Since 2002, the Environmental Law Institute has evaluated various aspects of AIS management in the 50 states. In ELI's 2002 report titled *Halting the Invasion: State Tools for Invasive Species Management*, ELI concluded that if states are to improve upon their existing AIS programs—either through the adoption of new laws and policies or through amendments to existing laws and regulations—benchmarks are needed, specific targets for the states. ELI's study (2002) did not compare and contrast individual states. But it did comprehensively evaluate the utilization of particular tools by the states and provided a state AIS program self-assessment. ELI (2002) noted that their intention was merely to allow the states “to determine how strong their existing programs are, where they have significant gaps, and where improvements can be made.”

ELI (2002) developed a “state tools checklist” detailing established tools for the management of AIS. The checklist was designed as a self-assessment tool for individual states. Nineteen tools were aggregated into various broad categories, each with specific benchmarks: 1) definition of AIS, 2) coordination, 3) prevention, 4) regulation, 5) control and management, and 6) enforcement and implementation. The underlying premise of this exercise appears to be that the adoption of particular AIS management tools, whether formally or informally, is sufficient for the enhancement of a state's AIS program.

The self-assessment tool provides three categories: bronze, silver, and gold. The different categories represented increasingly comprehensive AIS programs. According to this scheme, states that meet the bronze standard

recognize the need to address the problem of AIS and have at least taken minimal action towards achieving this objective, adopting the minimum set of tools a state need to address AIS issues. States that meet the silver standard are those taking strong steps towards AIS, including not only the development of a comprehensive definition of AIS but the adoption of at least some AIS tools in each of the major categories described. Those states that meet the gold standard must have exemplary policies in relation to all sets of AIS tools relating to all categories of invasive species. Based on this scheme, Maryland would be classified as meeting the bronze standard while Virginia would be classified as meeting the gold standard

In recent years, there have been two additional survey assessments of AIS management that include states in the Chesapeake Bay Watershed. In 2002, Responsive Management conducted a survey titled the *National Aquatic Invasive Species Survey*. More recently, in 2006, MAPAIS conducted a survey titled *Mid-Atlantic Panel on Aquatic Invasive Species: State Activities and Priorities*. Although Virginia did not participate in either of these surveys, a brief summary of each provides a unique perspective on the status of state AIS management that is useful in elaborating the context for this research.

The *National Aquatic Invasive Species Survey* (Responsive Management 2002), a 49-question survey relating to various AIS issues, was conducted on behalf of the U.S. Fish and Wildlife Service and the International Association of Fish and Wildlife Agencies. The survey was conducted as a mailed questionnaire

to which forty-one states responded. Virginia did not participate in the survey.

The most relevant comments are summarized below:

- 57% of the respondents noted that issue of AIS was very important to their agency while 43% noted that the issue was somewhat important;
- 95% of the agencies noted that they have some statutes to grant agencies the ability to address AIS issues;
- 42% of the states noted that they have a comprehensive approach to address AIS issues while 58% noted that they have a limited approach;
- 66% of the states noted they the fisheries program is the lead program within the agency to direct efforts to address AIS issues while 7% had no lead program;
- 72% noted that their agency was not the only state agency with legal authority to address AIS issues while 28% noted that their agency was the only such agency;
- 21% of the states reported an excellent relationship with their state Sea Grant Program with respect to state AIS issues, while 29% reported a good relationship, and 7% a poor relationship;
- 70% of the states indicated they do not have staffing or financial resources to develop a State AIS Management Plan and Implementation Plan while 92% noted that if funding for planning and implementation were provided they would develop such a plan;
- Other state agencies that address the aquatic invasive species issue included: Agriculture, Universities, Environmental Protection, Marine Resource Management, Natural Resources, Health, and Transportation.

The *Mid-Atlantic Panel on Aquatic Invasive Species: Survey of Activities and Priorities*, (MAPAIS 2006) a 28-questionnaire survey relating to various AIS issues, was conducted on behalf of the ANSTF. The survey was conducted as an informal online survey, to which six states responded (Delaware, Maryland, North

Carolina, New Jersey, Pennsylvania, and New York). Virginia did not participate in the survey. The most relevant comments are summarized below:

- Most states noted there was not a designated lead for AIS issues, with multiple contacts and agencies for different species;
- Zebra mussels, snakehead, *Hydrilla*, *Phragmites*, and Eurasian watermilfoil were listed as the aquatic invasive species of greatest concern by the states, with different species of concern in different states;
- The primary negative impacts of AIS were noted as: 1) impacts on native species/biodiversity (worded in various ways), 2) impacts to recreational activities, and 3) economic impacts resulting from the control of species;
- Various obstacles to developing AIS Management Plans were noted including the following: critically low staffing levels, funding, cost, lack of staff time, lack of perceived need, no advantage over statewide invasive species plan, and available funding from other sources;
- Most states have some sort of unofficial or partial AIS list of species to target, with only New York having a formal list;
- There is considerable variability in the amount of state and federal funding from state to state and in the source of federal funds;
- All states reported having adequate AIS taxonomic expertise to identify aquatic invasive species;
- The respondents noted that the top needs in their states to improve AIS management were: more dedicated funding, more adequate statutes, regulations and policies, additional staff, increased priority of AIS within their state or state agency, more enforcement power, and improved control methods.

In ELI's (2007) report titled, *Halting the Invasion In the Chesapeake Bay Preventing Aquatic Invasive Species Introduction through Regional Cooperation*, they examine in detail the nature of AIS management in the Chesapeake Bay Watershed. This provides an elaborate discussion of AIS management in the three Chesapeake Bay Watershed states that are signatories to the Chesapeake

Bay Agreement, Maryland, Pennsylvania, and Virginia. This study, in which Virginia did participate, provides an excellent analysis of the regulatory framework for AIS management in these states. Aside from the exposition of the nature of AIS management in these states, ELI rather pointedly noted that, while in theory the federal government could enact comprehensive invasive species legislation, neither such comprehensive federal regulation nor increased federal funding will probably occur in the near future. They suggested that efforts to improve AIS prevention efforts in the Bay region should focus on state and regional efforts and elaborated on various possible mechanisms for increased regional coordination. Such mechanisms included recommendations for an increased role by interstate commissions, an increased responsiveness of the Chesapeake Bay Program to MAPAIS recommendations, and an increased involvement by the Chesapeake Bay Commission, in relation to regional AIS activities.

In a recent evaluation, Bierwagen (2008) addressed the topic of “capacity” in relation to the capacity of state ANSTF-approved AIS Management Plans to allow a state to address climate change issues. Essentially, climate change objectives of such ANSTF-approved state AIS Plans were used as a proxy for the ability of state to adapt its AIS program in relation to the effects of climate change. Noting the limitations of this approach, Bierwagen (2008) stated that:

These plans represent one articulation of state priorities, goals, and actions regarding AIS management...Nevertheless, these plans do not represent a complete portrayal of state AIS management activities (p. 569).

While Bierwagen's (2008) study provided a comprehensive analysis of the nature of ANS-approved AIS Management Plans as far as their potential to address climate change, no published report has yet addressed the capacity of AIS Management Plans to address AIS issues, or more importantly, the overall capacity of the states to address AIS issues otherwise, which is the topic of my research. Capacity, however, was not well-defined in Bierwagen's study (2008), in which State ANS Management Plans were used as proxies for state climate change capacity. As Maryland has no AIS-approved Management Plans, it was not included in Bierwagen's (2008) analysis. AIS Management Plans, *per se*, are neither an indication of a state's ability to address AIS issues nor a true measure of capacity; they are basically capacity-building tools.

Most recently, ELI (2010) reevaluated 11 states previously assessed (ELI 2002) in relation to AIS program components. In the most current study (ELI 2010) evaluated developments in AIS management since 2002 in selected states, as far as changes in both the use of policy tools and changes in the AIS legal framework of the various states. The only quantifiable portion of this study was an evaluation, in a simple tabular, check-list fashion, of the utilization of various available tools to address AIS management. Such tools were categorized based on their primary purpose: 1) prevention of introductions of potential AIS, 2) minimizing unintentional introductions of non-native species via known invasion pathways, and 3) addressing invasive species before they become established by early detection and rapid response.

Based on ELI's analysis (2010), it was apparent that there was considerable variability among the 11 states evaluated as far as the number of available AIS management tools which they utilized. California was rated as employing eight AIS management tools while Tennessee and Rhode Island both employed none. Both Florida and Oregon employed four AIS management tools, while Colorado and Maine employed three. While Maryland employed two AIS management tools, New Jersey, New Mexico, and Louisiana each employed only one. Virginia was not included in this evaluation.¹⁷

Environmental Typologies

Various evaluations of characteristics of state performance relating to a wide range of environmental issues have been made the 50 states, some as typological classifications and others as comparative rankings. While none of these address AIS issues as a component and many are somewhat dated, a brief review of such studies is warranted, in particular the comparative state ratings of Maryland and Virginia.

Lester's efforts (1986, 1990) provide not only comprehensive comparative assessments of state environmental policies in the 50 states, but also develop typologies that are useful in understanding state environmental policy. Lester (1986) developed a unique typological approach evaluating the 50 U.S. states

¹⁷ The original ELI report (2002) listed 19 policy tools in 6 categories. Each of the major categories of AIS tools (definition, coordination, prevention, regulation, control and management, and enforcement and implementation) detailed in ELI's 2002 report were also revisited in the ELI's 2010 report.

based on two factors, 1) state dependency on federal aid and 2) state commitment to environmental quality. The ratings were parsed into four categories (Lester 1986): interdependent, independence, dependent, and disengaged. Lester (1986) defined interdependence as circumstances where states form partnerships with the federal government to facilitate program implementation, independent as a circumstance where a state has well-developed environmental programs but is not heavily dependent on federal aid to implement programs, dependence as a circumstance where the dependence of a state on federal aid is considerable, and disengaged as a circumstance where a state does not have a strong dependence on federal aid and internally has little commitment to environmental issues. Lester (1986) rated Maryland as *interdependent*, with a high state dependency on federal aid and a high state commitment to environmental quality while Virginia was rated as *independent*, with a low dependency on federal aid¹⁸ yet a high commitment to environmental quality.

In a later analysis, Lester (1990) developed another typology which categorized each of the 50 states into one of the following four groups: progressive, strugglers, delayers, or regressors, in relation to the nature of their environmental policies. The progressive states represented those in which both environmental commitment and institutional capacity were high. Both Maryland

¹⁸ The low dependency on federal aid by Virginia is a continuing phenomenon as evident in Gray's examination of redistributive patterns of income among the states (2004) and patterns in federal aid distribution noted by the Commonwealth of Virginia (2010).

and Virginia included in the progressive group, along with nine other states. Most of the states rated as independent in Lester's 1986 analysis were rated as progressive in the 1990 analysis (Lester 1986, 1990).

Environmental Discourse Models

Dryzek (1997) has examined the various major categories of environmental policies worldwide and has classified various differing approaches into 10 different discourse models: "shared ways of apprehending the world," with each discourse model typified by particular assumptions and judgments. Three of these discourse models will be briefly addressed in this study, because of their relevance as explanatory typological models for particular state agency behavior. These include administrative rationalism, democratic pragmatism, and green rationalism.

As far as administrative rationalism, Dryzek (1997) noted that:

It's a problem-solving discourse; this discourse has a strong conception of the nature of government. Government is the administrative state, treated in monolithic terms. Governing is therefore not about democracy, but about rational management in the service of a clearly-defined public interest, informed by the best available expertise. Managers and experts have well-defined roles within the administrative monolith. Administrative rationalism assumes two complementary kinds of hierarchy. The first subordinates the people to the state. The second puts experts and managers in their properly dominant places in the state's own hierarchy, which is justified on the basis of expertise. Administrative rationalism can always sustain itself [as] long as it [delivers] the goods. (Dryzek 1997, pp.74,79).

Democratic pragmatism, another type of problem solving, is distinctively different from administrative rationalism. Dryzek (1997) notes that:

[Democratic pragmatism] is the exact opposite of administrative [rationalism], for it revels in unclear divisions of responsibility, political conflict, bending the formal rules so as to make things work, and substituting ordinary knowledge for analysis.... Problems are solved piecemeal, usually through series of rough compromises among the different actors concerned with an issue. ...Interaction substitutes for analysis and different actors bring different perspectives and concerns, which are somehow agglomerated into policy decisions (Dryzek 1997 p. 92).

And Dryzek (1997, p. 186) also describes the nature of the green rationalism discourse model, noting that:

Green rationalists can both explain hierarchy as well as condemn it; there is a strong conception of complex ecological connections. Humans are set apart from nature by virtue of their reasoning capacities, but this does not warrant hierarchy and domination of nature. A stewardship relationship is more likely to be posited. Political agency is granted to a variety of actors, both individual and collective, and so encompasses movements, parties, and states as well as persons. The possibility that there might be agency in nature is generally downplayed.

Comparative Rankings of Environmental Performance

Many other studies have provided comparative rankings of state environmental performance by developing metrics incorporating various subcomponents of environmental performance in the overall state rankings.

The 1987 *State of the States* report (Ridley 1987),¹⁹ rated the accomplishments of the 50 states in six environmental areas. The six categories included: surface water protection, land use planning, pesticide reduction, highway safety, energy pollution control, and eliminating indoor pollution. There was a maximum score of

¹⁹ This report, published by the Fund for Renewable Energy and the Environment, is often referred to as the FREE Report.

10 points for each category assessed, with each category having several subcomponents.

The ratings varied widely. The lowest rating of 15 for Wyoming indicated low accomplishment in the areas assessed while the highest rankings of 45 for Massachusetts and Wisconsin indicated high accomplishment in these areas. The ranking of Maryland was 17th and Virginia 18th, with scores, respectively, of 35 and 34. This indicated a high ranking of environmental performance for both Maryland and Virginia as measured by the criteria used.

The *State of the States Report* published by the Resource Renewal Institute (Siy 2001)—similar in name only to the preceding *State of the States* report—compared the performance of the 50 states in relation to the pursuit of sustainable development, by using 65 indicators to develop a Green Plan Capacity Index (GPC Index) for each state. The various indicators served to integrate information relating to four basic categories: 1) the environmental management framework, 2) environmental policy innovation, 3) fiscal and program commitment, and 4) quality of governance. Overall scores ranged from a low of 8 in Alabama to a high of 73 in Oregon. Overall, Maryland received a “high” rating and was ranked 11th, with a GPC Index of 43, while Virginia received an “above average” rating and was ranked 30th with a GPC Index of 29.

While the preceding comparative rankings assessed performance of the 50 states in several broad environmental categories, a more recent study by Hoornbeek (2005) evaluated the relative proactiveness of the response of states

to a single environmental issue—non-point source (NPS) water pollution control. Hoornbeek (2005) developed a quantitative measure (i.e., metric) of state activism in relation to this issue, evaluating three basic measures. These included the following: 1) a consideration of NPS water pollution concerns in state and local decision-making processes measured by statutory constraints, 2) the degree to which states develop enforceable statutes/regulation to compel particular groups and individuals to minimize the impact of NPS pollution, and 3) a determination of whether the states provide funding for NPS activities at a significant level beyond federal matching requirements.

The scores ranged from a low of 2.5 in Arkansas to a high of 25.5 in Maine. In this evaluation, Maryland was ranked 8th with an overall state policy AIS activism score of 21 while Virginia was ranked 19th with a score of 18. Both ratings were relatively high and indicate a proactive approach to addressing NPS water pollution issues.

Perceptions of AIS Risk

Slimak (2003) conducted the only nationwide ranking of perceptions of ecological risks, which compared perceptions of EPA's risk assessors and risk managers with those of the lay and experienced public with regard to 24 ecological risk items. Overall, in terms of the importance of the various ecological risk items, invasive species were ranked 9th by risk assessors, 12th by risk managers, 15th by the experienced public, and 19th by the lay public. For all groups, the perceptions of risks associated with invasive species were below the

rankings for the perceived risks relating to persistent organic pesticides, population growth, loss of wildlife habitat, wetland loss, surface run-off, global warming, and ozone depletion. Slimak (2003) observed that the perceptions of the lay public differed significantly from those of the other groups, concluding that the lay public is more concerned about risks of high consequence but low-probability, while the other groups are more concerned about risks that pose long-term, broader scale consequences.

Framework for Analysis: the Policy Context

A brief review of the traditional “policy cycle” is in order, as some of the perplexing aspects of AIS management can be understood within this construct. Although the “policy cycle” has been parsed in various ways by different authors, the basic components of the process are the same: 1) agenda setting, 2) policy formulation, 3) policy legitimation, 4) policy implementation, 5) policy and program evaluation, and generally, 6) policy change (Rosenbaum 2002).

Although the initial step in the emergence of an issue as a public policy is placing an issue on the governmental agenda, this is not sufficient to ensure that a public policy will result. The policy process and the subsequent emergence of a public policy is both a reiterative and transformative process. Rist (2000) reduces the policy cycle to a three-step process, once an issue has been placed on the agenda: 1) formulation (setting goals and making plans to implement such goals), 2) implementation ((translation into operational programs), and 3) evaluation (assessment and reformulation).

Policy-making is not a linear process, but rather a recursive one, often with some components of a policy being implemented as others are being formulated—while still others are being evaluated. As Rist (2002) notes:

Policy making is multidimensional and multifaceted. It is a process that evolves through cycles, with each cycle more or less bounded, more or less constrained by time, funds, political support, and other events. It is also a process that circles back on itself....and choosing not to decide is a frequent outcome (Rist 2000, p. 1002).

Contemporary Trends in Environmental Policy

The era of a dominant federal role in environmental regulations has waned since the passage of 22 major environmental laws between 1964 and 1980, during the so-called “golden era” of environmental lawmaking. During this period, preemptive national intervention resulted in the enactment of command and control legislation to regulate pollutants in various media—air, water, and land (Klyza and Sousa 2008). However the administrative, economic, and social ramifications of the implementation of these laws still resonates today. Many issues are still being sorted out as the implementation of these statutes continues (Percival 1996). A good example of this is the intense and often acrimonious litigation that has characterized efforts to implement the Total Maximum Daily Load provisions of the Clean Water Act.

Klyza and Sousa (2008) have observed that since the late 1980s most environmental policy has required the use of various “nontraditional paths” and many “points of access” to engage in the policy process at the federal level. It is posited that such approaches are necessary to compensate for legislative

inadequacies in dealing with such issues. The result is a more pragmatic approach to addressing environmental issues, but one that is much less transparent than the legislative processes historically employed by Congress.

Similarly, Mary Graham (pp. 90-91, 1999) elaborates on the current context of environmental regulation noting that:

The foundation [of environmental law] has shifted as times have changed and the building needs to be adapted to new underpinnings and new uses....as a practical matter, the remodeling of the nation's approach to pollution control and conservation is visible everywhere....Pragmatism is the unifying theme of this new environmental politics. The existing framework of environmental laws and regulations remains. But it is now accompanied by a latticework of informal accommodations to changing problems and changing times.

Klyza and Sousa (2008) noted the increasing use of five major alternative pathways. These pathways include the following: 1) appropriations politics, 2) executive-branch policymaking, 3) use of the courts, 4) collaboration-based politics, 5) and state-focused policymaking.

Bacot and Dawes (1996, p. 124) posited that, "Knowledge of a state's effort to manage environmental programs is paramount to understanding the potential effects of environmental federalism." The extent of national involvement varies considerably from one environmental area to another, and even markedly within specific areas. As noted by (Zimmerman 1992, p.54):

...there is considerable fluidity in the nature of the distribution of political powers....Central to a general theory of American federalism is the premise that there is no necessary optimal degree of centralization or decentralization of political power within the nation.

In general, along the continuum of state-national federal interactions, issues relating to “fish and wildlife,” have been left to the discretion of the states, much like planning and zoning issues (Klyza and Sousa 2008), with the result that AIS regulation is primarily the responsibility of the states.

The variability in the nature of the state’s role in relation to environmental regulation warrants additional discussion. Essentially the relationship between the national and state governments has always been cooperative to some degree; this cooperativeness increased during the New Deal era of the 1930s and more so during the Great Society era of the 1960s. In the environmental arena, first fiscal incentives, then technical aid, and finally preemptive national legislation were used to induce states to adopt national goals and minimum acceptable levels of pollutants. Such actions increased the national sphere of influence and encroached on policy areas traditionally regulated by the states (Zimmerman 1992).

Ruhl (1996) notes there are three approaches to cooperative federalism: coercion (i.e., preemptive command-and-control approaches), coordination, and cooperation. He suggests that the truly cooperative approach to environmental federalism has characteristics that are somewhere between the extremes of the non-regulatory state-national involvement afforded by the coordination model and the preemptive aspects of the coercion model. Essentially, such truly cooperative programs have well-defined federal standards and goals that are included as part

of a flexible regulatory framework that gives wide latitude to the state and local governments to adapt a particular program to local circumstances.

Ruhl (1999) concluded that the Coastal Zone Management Act (CZMA) of 1972 is a program that is a noteworthy example of such a truly cooperative approach, intertwining federal goals with state and local regulatory initiatives to protect and manage coastal zone resources. Ruhl (1999) notes that in such programs like those established by the CZMA:

The coercion element surfaces through well-defined federal standards and goals that are integrated into regulatory programs administered primarily through state and local initiative. The coordination element surfaces through the use of a regulatory framework that gives wide latitude to the state and local governments to shape the actual decision making procedure and structure in ways that fit state and local regulatory practices. The result is a national program that becomes distinctly local in its various local applications (Ruhl 1999, p. 525).

The CZMA encourages states and other designated groups to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, and estuaries, as well as the fish and wildlife utilizing such habitats. A unique feature of this law is that participation by the states is voluntary. The CZMA encourages states to participate, and makes federal financial assistance available to any legislatively-designated group that is willing to develop and implement a comprehensive coastal management program (i.e., states, Indian tribes, and territories). Both Maryland and Virginia have Coastal Zone Management (CZM) Programs. Amendments to the CZMA have allowed for a more effective mechanism for addressing Non-Point Source Water Pollution, as required by the Clean Water

Act. CZM Program requirements can effectively increase the degree of national influence (and funding) in relation to environmental issues of coastal concern.

While participation by the states is voluntary, actions agreed upon are stipulated in a management plan developed by the states and requires adherence to national goals. Such an approach might be useful with AIS issues in coastal states, given the variability in state and regional concerns, and provide for a more uniform adoption of federal goals for AIS management (e.g., Councils, Plans) in a more effective manner than that which has occurred as a result of the previously described voluntary components of NANPCA, NISA, and E O 13112.

Ruhl (1999) further elaborates on the benefits of the Coastal Zone Management Act as follows:

A legislative framework for distribution of decision making responsibility and authority must be devised that will avoid the pitfalls of coercive federal approaches taken under other laws, as well as transcend the limitations inherent in statutes under which the federal government has limited itself to a pure coordination function. The Coastal Zone Management Act, which is a model of the middle-ground cooperation approach, should serve as a template for national ecosystem management legislation that will avoid the pitfalls of coercive federal approaches taken under other laws, as well as transcend the limitations inherent in statutes under which the federal government has limited itself to a pure coordination function.

The federal Coastal Zone Program and many state CZM Programs has incorporated invasive issues into its evaluation components and AIS are widely considered to be a major coastal zone issue. There appears to be considerable

fluidity as far as the manner in which individual states²⁰ utilize their CZM Programs to address AIS issues. In Maryland, the involvement of the CZM Program with AIS concerns is minimal while in Virginia it is somewhat more involved, in particular with *Phragmites australis* (i.e., Phragmites) control efforts in the seaside areas. However, neither of these states have CZM programs that have a considerable role in AIS management.

This is in marked contrast to CZM involvement in AIS issues in a state such as Massachusetts where the state Aquatic Invasive Species Program is part of the Office of Coastal Zone Management. In Massachusetts, the State CZM program led the multi-stakeholder efforts of the AIS Working Group, which in 2002, developed a State AIS Management Plan, since approved by the ANSTF (Massachusetts AIS Working Group 2011).

In Pennsylvania, the CZM Program has provided the necessary funding for an AIS coordinator position, while the various Great Lakes States CZM Programs have been very involved in AIS issues since AIS first became an issue there. State CZM Programs appear to be a much more feasible way to facilitate further state AIS capacity-development than the enactment of more comprehensive federal AIS legislation, at least for coastal states.

Presently, AIS management in the fifty states is very reflective of the changes in the dynamics of environmental federalism in the United States over the past 30 years—with an emphasis on the use of alternative pathways to

²⁰ Not all states have Coastal Zone Management programs just as not all states have Sea Grant College Programs.

achieve policy objectives. There is a decentralization of national involvement in many environmental areas with a decrease in the enactment of coercive command and control legislation.

Comparative Analyses of State Environmental Policy

This section addresses research in the arena of comparative state environmental policy and will examine the primary approaches which have been used in such analyses. Bacot and Dawes (2000) note that the study of comparative state environmental policy had its origins in the devolution of responsibility for implementation of federal environmental programs to the states in the 1980s, and the requisite responses by the states. Various studies will be discussed which have evaluated state responses to environmental concerns. The later shift to integrate causal modeling to graphically depict factors affecting policy outputs and outcomes will also be discussed. Finally state capacity will be addressed, in the context of a qualitative framework, to allow for an assessment of the various components that account for the ability of a state to manage a particular environmental issue.

States differ markedly in their ability (i.e., capacity) to effectively address various environmental issues, including AIS. During the late 1950s and early 1960s Congress concluded that the states were poorly-suited to implement a much-needed expanded role in relation to pollution control. (Rosenbaum 2005). By 1965 it had become increasingly evident to the U.S. Congress that the national conditional grants-in-aid and technical aid programs to the states, which

were intended to provide solutions to several major significant national environmental problems, had failed to do so. Soon thereafter, a consensus was reached that preemptive environmental legislation—whether total or partial—was the only alternative approach to solve such emerging national, large-scale environmental problems (Zimmerman 1992). Such a consensus ushered in the “golden era” of preemptive environmental legislation that followed (Klyza and Sousa 2008).

As noted by Scheberle (2004), since the “golden era,” the devolution of federal responsibilities to state governments and has been underway in nearly every political venue, as the willingness and ability of the states to manage such efforts has increased. The general consensus is that in most environmental areas, state capacity—as far as competence and resources to address environmental issues—has increased dramatically since the 1980s. It is expected that the ongoing trend of increasing state self-reliance will continue (Rosenbaum 2005, Klyza and Sousa 2008).

However, along with delegated authority has come federal oversight and stipulations (Scheberle 2004) as well as elaborate implementation plans. Such plans have provided for national guidance and the adoption of national goals and policies by the states, with specific provisions and timelines. Thus, a new area of policy analysis unfolded as comparative evaluations of state responses to the

required federal implementation requirements for environmental regulations were undertaken by many investigators (Lester 1994).²¹

Many of the early comparative state environmental policy analyses in the 1980s and 1990s used the plethora of implementation data that became readily available such as enforcement activity, state expenditures, and federal grant monies, in order to evaluate which factors had the greatest explanatory value in determining a state's environmental effort (i.e., response) to a particular environmental concern. Such factors included those that had become increasingly common in comparative state policy analyses in other policy areas during this period (Dye and Robe 1980), including political, institutional, and economic differences.

Such comparative state analyses often employed multiple regression analysis as a statistical tool, using information relating to a fairly standard array of broad categories to evaluate particular independent variables in efforts to explain differences in state environmental responses (i.e., state environmental program effectiveness). State environmental response has been quantified in various ways as the dependent variable in such analyses (Bacot and Dawes 1996), most often based on some composite metric derived from one of the previously

²¹ This study differs markedly from those relating to almost all comparative analyses of state policies based on federal regulatory mandates. Such analyses have utilized federally mandated implementation records, which have included substantive required records and reports that are required. There are relatively few, if any, such required records at the state or federal level relating to many aspects of AIS management in Maryland and Virginia.

described comparative evaluations of environmental programs (e.g., Ripley 1987).

Despite considerable variability in the specific independent variables used, many of the same broad categories of independent variables appear in such studies, in one form or another (Bacot *et al.* 1996). Ringquist (1993) suggested that economic, political, and interest group factors are the primary categories of independent variables that effect environmental policy. Some of the more common components of these broad categories of independent variables include the following: 1) economic resources (e.g., gross domestic product, per capita income, state fiscal health, program funding, and full-time equivalent staff positions in programs), 2) political considerations (e.g., electorate ideology, political elite ideology, institutional characteristics, management capacity, and legislative professionalism), and 3) interest groups (e.g., environmental and industrial interest group membership per state, ratio of environmental and industrial interest group members/residents, landholdings of industrial and environmental interest groups, and the funding of state positions by industrial and environmental interest groups) (Lowry 1992, Ringquist 1993, Bacot and Dawes 1996, Scheberle 2004, Potowski and Woods 2002, Cogburn and Schneider 2003, Daley and Garand 2005). These independent variables have been generally quantified for analytical purposes, in a process referred to as "operationalization," in which generally one or more specific independent variables are used as an indicator for a broad category of independent variables.

A relatively small number of studies have been used to provide data for the dependent variables for such analyses. Most investigators during this phase of comparative analyses used data derived from a small number of comparative state environmental evaluations as the dependent variables, in marked contrast to the wider range of independent variables used. Such studies included the so-called FREE index (Ridley 1987) and the comparative state ratings found in the *State of the States* report (Siy 2001).²²

Causal path modeling has been used considerably to augment various other state comparative analyses, often to supplement more quantitative multiple regression analyses. Ringquist (1993) used this approach to graphically illustrate relationships between various independent variables and both state responses, (as far as strength of environmental program), and the effects of such responses on environmental conditions (i.e., outcomes). In fact, Ringquist (1993) was among the first environmental policy researchers to integrate causal path modeling with multiple regression analysis, and provide such an integrated methodology (Lester 1994). Causal path modeling has been used more widely since that time to provide a conceptual underpinning for studies. Scheberle used causal path modeling extensively (1997, 2004) to illustrate graphically the

²² Jennings and Woods (2007) provide an interesting discussion of the paucity of dependent variables used to quantify state environmental responses in most comparative policy analyses utilizing multiple regression analysis.

interplay of intrinsic factors which are under the control of the state government, and extrinsic factors, which are not.²³

Scheberle's (1997, 2004) analysis was markedly different in approach from those previously noted. Rather than evaluating individual states, she examined state-national relationships in relation to four federal environmental programs established by statute, with the objective of understanding two things: 1) those factors which facilitated or hindered progress in implementing environmental policy, and 2) the nature of federal-state working relationships. The principal sources of information were the perceptions of state and federal agency staff involved with the implementation of various environmental programs, obtained from responses to surveys and interviews of state program staff and federal regional staff. The perceptions of staff individuals involved in programmatic activities were considered to be instrumental in understanding the implementation processes she examined.

Scheberle's (2004) observed that the success of a program very much depends on political support for it, noting in relation to the voluntary radon law:

That radon is not a high-priority budget item for states or the national government seems clear. Radon fails to capture the attention of state legislatures or Congress, in large part because it fails to command much public attention (Scheberle, 2007 p.110).

²³ Factors categorized as intrinsic by Scheberle (2004) included: working relationships with federal counterparts, agency capacity, agency culture, relationship to the target group, state-level political support, and resistance to change. Factors categorized as extrinsic factors included: political arrangements, role orientations of the federal oversight agency personnel (if any), the nature of the problem, fiscal and human resource allocation, statutory language, judicial interpretations, and legislative and policy history.

Insufficient resources and a lack of interest by the public and state policy makers were among the major perceived hindrances of policy implementation in the several programs that Scheberle evaluated. Scheberle (2004) concluded that the larger and more diverse the target group, the greater the political support for a statute. Of considerable relevance to this study is a comment by Scheberle (2004) in her brief summary of environmental laws, in which she noted that:

One law may contain multiple approaches, and many environmental programs may provide some level of federal funding to facilitate state implementation.

The Nature of State Management Capacity

State capacity was previously discussed in relation to the increase in state environmental capacity that occurred in the 1980s and 1990s. As noted this was requisite for the subsequent devolution of preemptive national environmental program responsibilities to the states. The following section addresses the actual nature of state capacity in more detail.

Ringquist (1993) notes that the concept of “state capacity,” as it relates to the ability of the states to address environmental issues and other public policy issues, is multi-dimensional—involving fiscal, managerial, and political characteristics (i.e., capacities)—all of which are necessary if states are to adequately carry out policy responsibilities. It is a difficult term to define and Ringquist (1993) observes that when discussing the capacity of state

governments to accept significant policy responsibilities, one has to be specific about what particular type of “capacity” one is talking about.²⁴

The term state management capacity, when referring to a particular public policy, refers to the particular resources which a state can allocate to a particular policy issue. It is less often used in a more general way as a synonym for state capacity, without reference to a particular type of management capacity. It is essential to understand that only a certain portion of a state’s capacity can be directed to any public policy issue at any given time. Honadle (1981) notes that a consensus as to the definition of management capacity probably cannot be arrived at—although it generally is used to refer to the ability of institutions to do what is required of them. She suggests that at best, a reasonably integrated multi-component analytical framework can be developed to evaluate the characteristics that determine the capacity of state governments to address a particular policy issue. Honadle (1981) proposes that such an analysis requires an examination of a state’s ability to: 1) make informed intelligent decisions about policy; 2) develop programs to implement policy; 3) attract and absorb resources; 4) manage resources; and to 5) evaluate current activities to guide future action.

Malysa (1996) elaborated on Honadle’s capacity framework (1981) and developed a framework and methodology to comparatively assess the relative capacity of Maryland and Virginia in relation to wetland planning and

²⁴ For a comprehensive discussion of state capacity in relation to intrinsic state factors see Scheberle (2004, pp. 48-49) and for a comprehensive discussion of fiscal, managerial, and political aspects of state capacity see (Ringquist 1993, pp., 63-94).

management capacity. She developed a capacity assessment framework which examined the following components of capacity: situational, capacity, political capacity, institutional capacity, economic capacity, institutional capacity, organizational capacity, and evaluation capacity. Twenty-nine subcomponents of these six broad categories were evaluated, and referred to as elements.

Malysa's study (1996) consisted of a total of 35 semi-structured interviews of elites in both states. While no overall categorical rankings were assigned to each broad component of capacity, each element of the various components was ranked qualitatively as one of the following: not-developed, poorly-developed, moderately-developed, or well-developed. An integrative, qualitative discussion of each overall component of capacity was then provided.

While observing that different coastal states have differing "capacities" as far as their ability to respond effectively to environmental problems, Malysa (1996) observed that the majority of the elements of the wetland-related capacities in Maryland and Virginia were either moderately-developed or well-developed. The exceptions included subelements of economic capacity (i.e., state economic well-being and state budget commitments to resource protection) and certain aspects of organizational capacity (i.e., financial resources and staff resources), which were rated as poorly-developed. While Malysa (1996) concluded that all of the various capacities evaluated were essential, strong situational capacity and political capacity were noted as being essential as

prerequisites for the development of the other components of state management capacity.

Ingraham and Donohue (2000, p. 297-298) provide a more dynamic characterization of management capacity than that proffered in other studies of comparative environmental policy studies. They refer to the “potential” and “kinetic” capacity that a state has as far as the nature of its management capacity—that is what a state is capable of doing (potential capacity) in terms of its response to a particular public policy issue (e.g., AIS), as opposed to what it is actually doing (kinetic capacity). Ingraham and Donohue (2000) basically defined management capacity as the government’s ability to effectively direct its resources to attain a desired policy outcome.²⁵

Ingraham and Donohue (2004, p. 301) also provide a rather complex causal model of state management capacity. The model graphically illustrates the interplay between various established state government performance factors (financial management, human resources management, capital management, and information technology management) with particular management factors (exercise of leadership, use of information, and allocation of resources). Ingraham and Donohue (2000) suggest that the interaction between such factors

²⁵ Scheberle (2004) noted that sometimes the desired outcome of a state environmental effort is merely to give the appearance of the state having addressed an issue.

determines the nature of state management capacity in relation to a particular policy issue.²⁶

In their 2008 analysis, the Government Performance Project (GPP) of the Pew Center for the States (Governing.com 2008) used these same basic government performance factors (financial management, human resources management, capital management, and information technology management) in evaluating the governance of the 50 states.²⁷ Using various subcomponents to assess each factor, the various factor ratings were aggregated for each state, and each state was assigned a traditional letter grade on a scale of A (excellent) to F (very poor). Maryland received an overall grade of B while Virginia received a grade of A-, with a national average of B-. Table 2 shows the rankings for each of the various major factors in Maryland and Virginia, as well as national averages.

²⁶ Such factors are typically considered in the Managing for Results assessments that have been adopted nationwide for state management evaluation since the mid-1990s.

²⁷ Each component evaluated by the GPP (Governing.com 2008) is an aggregate measure. Infrastructure relates to roads, bridges, mass transit, wastewater treatment and other such factors. Information relates to the ability of state decision-makers to acquire and use sufficient information in making decisions relating to resource allocation and planning for the future. Money relates to the transparency of budget process, fiscal planning and budget balancing, internal controls and auditing. People relates to the ability of the state to acquire staff with needed skills, retention of skilled workers, workforce development, and performance evaluation.

Table 2 Ranking of government performance in Maryland and Virginia.
(Data from Governing.com (2008).

Group	Infrastructure	Information	Money	People	Overall
National Average	B-	B-	B-	C+	B-
Maryland	B+	B-	B+	C+	B
Virginia	B+	A	A-	A	A-

Part II. Review of Regional AIS Management and the Adoption and Diffusion of Federal AIS Coordination Models throughout the Chesapeake Bay Watershed

Maryland and Virginia have a long history of sustained dialogue relating to AIS issues,²⁸ facilitated by various regional organizations. However, the degree to which these states, as well as other states in the Chesapeake Bay Watershed, have used these national models for AIS coordination varies markedly, and is discussed at length in this section. This section provides the following description of AIS management in the Chesapeake Bay Watershed: 1) a brief review of the federally-coordinated regional organizations that have been instrumental in AIS efforts since 1990, 2) a review of the various state AIS coordination models provided by NANPCA, NISA, and E O 13112 since 1990, and 3) a summary of

²⁸ The Chesapeake Bay Commission, Chesapeake Bay Program, Interstate Commission on the Potomac River Basin, Potomac River Fisheries Commission, Nature Conservancy, and the Chesapeake Bay Foundation are all involved in various natural resource issues in both Maryland and Virginia—including relevant AIS concerns.

the pattern of the adoption of the various AIS coordination models (referred to as innovation) in the Watershed and the pattern of spread (referred to as diffusion) of such AIS coordination models throughout the Watershed.²⁹

It is useful to first preface this section with an overview of the history of regional AIS management within the Chesapeake Bay Watershed. Despite the vagaries and inconsistencies of the national milieu for the management of AIS and the variability in the nature of the state AIS programs within the Chesapeake Bay Watershed, since 1991 the Watershed has had an uninterrupted succession of federally-coordinated, regional AIS organizations. These organizations have had an essential advisory role in relation to the coordination of activities related to AIS management by the various states in the Watershed. In fact, for many years it was anticipated that the Chesapeake Bay Watershed would adopt a regional multi-state AIS Plan (Christmas *et al.* 2001).

Such regional organizations include the following, listed in chronological order: 1) Exotic Species Work Group [(ESWG) 1991-2000]; 2) Invasive Species Work Group of the Non-native Invasive Species *Ad hoc* Work Group [(NISAW) 2000-2003]; and the 3) Mid-Atlantic Regional AIS Panel/Mid-Atlantic Panel on

²⁹ As established, NISC has a companion Invasive Species Advisory Committee (ISAC) which consists of various nonfederal members and has the role of advising NISC—essentially an advisory group to the advisory group. Such ISACs are not addressed in this review as their inclusion tends to confuse the discussion rather than clarify it. Most states have a hybrid sort of AIS advisory group, consisting of a wide spectrum of stakeholders. The stakeholders include the following: various state agencies, watershed groups, environmental groups, nurseries, and agricultural and forestry organizations. Only New York and Virginia have a legislatively-established ISAC. This conforms more to the national model, but does not necessarily affect the efficiency of the Council, and can be rather confusing.

AIS [(MARP/MAPAIS) 2003-present]. The various roles of these groups are discussed in Part II of this chapter and are described in Christmas *et al.* (2001), and Everett & Sherfy (2002). The Chesapeake Bay Program facilitated the efforts of the Exotic Species Work Group and the Invasive Species Work Group, and the transition of such a regional forum from the U.S. EPA-coordinated Chesapeake Bay Program to the Department of Interior-coordinated Mid-Atlantic Regional Panel on Aquatic Invasive Species in 2004.

Detailed below is a brief review of both the creation of the various entities involved in state-national AIS coordination efforts and the various AIS coordination models which they have served to provide, which have been previously described. Selected models will be addressed in the discussion of the innovation and the diffusion of AIS management tools throughout the Chesapeake Bay Watershed.

Table 3. A chronology of the development of models for the coordination of AIS management in the United States pursuant to federal legal mandates.

**Non-indigenous Aquatic Nuisance Prevention and Control Act - NANPCA
(1990)**

- Established Aquatic Nuisance Species Task Force (ANSTF), with authority to approve ANS Management Plans;
- Created the Great Lakes Regional ANS Panel;
- Authorized funding for approved state ANS Management Plans.

National Invasive Species Act - NISA (1996)

- Created the Western Regional ANS Panel
- Authorized formation of additional regional panels as appropriate, with authority for approval delegated to ANSTF;
- Reauthorization of funding for approved state ANS Management Plans;
- Authorization of funding for approved Interstate ANS Management Plans.

Executive Order 13112 - E O 13112 (1999)

- Created the National Invasive Species Council (NISC) comprised of federal agencies;
- Created the Invasive Species Advisory Committee comprised of nonfederal members to advise NISC;
- Required the development and periodic update of a National Invasive Species Management Plan.

Only specific AIS management tools created pursuant to NANPCA, NISA, and E O 13112 will be evaluated in the following discussion of innovation and diffusion. These include the following: AIS advisory groups (most often referred to as Invasive Species Councils) and Multi-species AIS Management Plans.³⁰

³⁰While Invasive Species Advisory Committees (ISACs), modeled after the group that advises the National Invasive Council, are useful, they will not be discussed to minimize confusion. Only New York and Virginia have such legally-mandated group, yet all states have some degree of stakeholder participation aside from state officials.

It is not the intent of this brief overview to examine the effectiveness of the particular innovations adopted by the various states, merely to describe the nature and chronology of the adoption and spread of such tools throughout the Watershed. The time period reviewed was from the enactment of NANPCA in 1990 to December of 2010. This effort was initially undertaken as a preliminary assessment of state AIS management and coordination in the Watershed to help provide a context for this comparative research on State AIS Management capacity in Maryland and Virginia.

With this prologue, the remainder of Part II will present an evaluation of the adoption and spread of various coordination tools previously described. ELI (2002) describes the function of these coordination tools succinctly noting that:

The two most common mechanisms states have adopted to facilitate coordination are the establishment of a statewide council and the development of a state-wide management plan. The objective of developing either a statewide invasive species council or plan is to facilitate the coordination of statewide actions regarding prevention of and early detection and rapid response to new invaders; control and management of established invasive species; restoration of native species and invaded habitats; and monitoring, research, and public education and outreach efforts (ELI 2002, p. 84).

As far as invasive species advisory groups, all states in the Watershed presently have established some sort of AIS advisory group, whether formal or informal in nature. In the Chesapeake Bay Watershed these groups have been referred to variously as Invasive Species Councils, Invasive Species Working Groups, or Invasive Species Task Forces.

In a preliminary analysis of the adoption of Invasive Species Councils and related advisory groups in the 50 states, ELI (2002) found that, “Some were nonprofit organizations, others were governmental entities, and still others were less formally organized.” Similar variability is apparent in the development of such AIS advisory groups in the Chesapeake Bay Watershed. The model for such groups is the National Invasive Species Council.

The only states which have legal mandates for the formation of their AIS advisory groups are New York, Virginia, and Pennsylvania. The mode and year of formation of these various groups varies as follows: Delaware, 501 (c)(3), 1999 (federally tax-exempt, nonprofit corporation); Maryland, *ad hoc*, 2000; Virginia, General Assembly, 2003, Executive Directive 2, 2006, and NANSPA, 2009; New York, State Legislature 2003, 2007; Pennsylvania, Executive Order 2006; and West Virginia, *ad hoc*, 2004.³¹

Delaware established an Invasive Species Council in 1999, followed by Maryland in 2000. West Virginia established an Invasive Species Working Group in 2001 and both the Virginia Invasive Species Council and New York Invasive Species Task Force were formed in 2003, followed by the formation of the Pennsylvania Invasive Species Council in 2004.

Most advisory groups have changed very little since their inception, with the exception of those in Virginia and New York. In Virginia an Invasive Species

³¹. The frequency of state AIS advisory group meetings ranges from 1–12 times a year. At a minimum, meetings are scheduled twice a year.

Council was created by legislation in 2003, with a “sun-setting” provision, effectively dissolving it in 2006. Subsequently, Executive Directive 2 issued in 2006, sustained the Council, renaming it the Invasive Species Working Group (ISWG). The ISWG was subsequently codified by an amendment to the Virginia Non-indigenous Aquatic Nuisance Species Act of 2009. In New York a legislatively-created Invasive Species Task Force was formed in 2003. This group was superseded by a legislatively created Council formed in 2007 (New York Department of Environmental Conservation (NYDEC) 2011). All of the aforementioned advisory groups are comprehensive in nature, in that they address both aquatic and terrestrial invasive species. Generally, such groups are primarily concerned with invasive plant issues, with considerable input and management from state agricultural agencies, and with much less of a focus on AIS (ELI 2002).

Following the issuance of E O 13112 in 1999, and the subsequent creation of the National Invasive Species Council, the diffusion of such advisory groups was relatively rapid in the Chesapeake Bay Watershed. During the seven-year period following the issuance of E O 13112 all states within the Watershed adopted advisory groups with the basic function of an Invasive Species Council.

ELI (2002) addresses the significance of comprehensive AIS Management Plans, noting that: “These Plans are designed to provide a more concrete strategy for coordination and action (ELI, p. 89).” The time required for the

diffusion of a comprehensive, multi-species AIS planning approach to AIS management within the Watershed has taken considerably longer than that required for the diffusion of advisory groups. Only four of the six states within the Watershed have such comprehensive, multi-species AIS Plans—New York, Delaware, Virginia, and Pennsylvania. Only three of these Plans have been formally approved by the ANSTF as ANS Management Plans; Delaware's has not yet been submitted for approval.

New York's Non-indigenous Aquatic Species Management Plan was developed in 1993, not long after the enactment of NANPCA, and approved by the ANSTF in 1994. This was required by a New York legislative mandate, and was completed more than a decade before any other Plan in the Watershed (NYDEC 2011). The remaining states all have comprehensive multi-species plans, with both aquatic and terrestrial components. Delaware's Invasive Species Management Plan was developed in 2004, while Virginia developed a comprehensive Invasive Species Management Plan in 2005, of which the aquatic species component was approved as an ANS Management Plan that same year. The Pennsylvania Aquatic Invasive Species Plan was developed in 2006 and subsequently approved by the ANSTF. Neither Maryland nor West Virginia has a comprehensive, multi-species AIS management Plan, although several effective single species plans have been adopted in Maryland.³²

³² The information in the preceding discussion relating to State ANS Management Plans and Invasive Species Councils and other such AIS advisory groups was gathered

There has been considerable variability in not only the particular AIS tools adopted by the various states, but how long before a particular state adopted a particular tool after a model was first developed by the federal government, and the degree to which such tools have spread to the various states throughout the Chesapeake Bay Watershed.

In summary, the diffusion processes which have been addressed in this review are those of state responses to federal policy models, in particular, the development of state advisory groups and multi-species AIS Management Plans

The adoption and diffusion of advisory groups, has been quite rapid since the issuance of E O 13112 in 1999. Delaware's Council was established in the same year, and the diffusion of Councils throughout the Watershed occurred in the span of just six years, from 1999-2004.

The adoption and diffusion of multi-species AIS plans, however, has taken much longer. In the 20 years since the enactment of NANPCA, only four states (68%) in the Watershed have established Plans, and diffusion has been slow, with an 11 year interval between the development of New York's Plan in 1993 and Delaware's in 2004.

Welch and Thompson (1980) observed that policies with federal incentives do in fact diffuse much faster than those without. However, given the present

primarily from conversations with various AIS experts in each of the states discussed and a review of public documents. The majority of the information was compiled for a presentation by the author titled *An Analysis of the Diffusion of Selected Federal Policies Relating to the Coordination of Aquatic Invasive Species Among States within the Chesapeake Bay Watershed*, presented at the 15th International Conference on Aquatic Invasive Species, Sep. (2007), held in Nijmegen, The Netherlands in 2007

milieu of federal agencies with AIS programs and available funding for invasive species management efforts, it is not readily apparent that adopting federal initiatives such as Invasive Species Councils and ANSTF-approved ANS Management Plans is a prerequisite for obtaining funding for state AIS management and coordination efforts. The AIS advisory group approach was readily adopted by the states. However, the financial incentives provided by the ANSTF, have been limited and the diffusion of ANSTF-approved ANS Plans in the Chesapeake Bay Watershed has been relatively slow.

New York appears to be at the vanguard of AIS Management in most ways, and is the only state in the Chesapeake Bay Watershed that has a truly institutionalized AIS program—with a legislatively designated organization with dedicated staff and funding. This is in marked contrast to the nature of AIS management in other states within the Watershed. The evolutionary nature of AIS capacity development is well-summarized in comments by Tim Sinnott, a former New York AIS Representative to MAPAIS. In a MAIP AIS report titled, *Synopsis of Survey Results of the Mid-Atlantic Panel on Aquatic Invasive Species* (MAPAIS 2006) he described the process of AIS program development in New York State.

For a long time, New York did not really have an ANS program. We had an approved Plan that brought in money from the Federal ANS Task Force, but there was no committed effort to implement the Plan in a meaningful way. ANS were not given a high priority, and staff allocation for ANS work was done so only on a part time basis. In 2003, the State Invasive Species Task Force (ISTF) was created by the State Legislature. They presented their report in December 2005, and the Legislature seems to have accepted their proposal. In 2006, \$3.25 million was provided to

implement the ISTF report, and there is reason to believe that funding will continue for invasive species programs at a level between \$3 -\$5 million per year for the foreseeable future. One Invasive Species Management Coordinator was hired, but the biggest obstacle to program success is still the need for staff. Many of the concepts in this questionnaire are likely to be initiated in the next few years, but the program is very much in its infancy at this time (MAPAIS 2006).

Since the preceding summary, many strides have been made in New York's AIS program. The Office of Invasive Species Coordination (OISC) was formed in 2008 and is comprised of a director and three permanent staff including an invasive species coordinator. Since its inception it has been responsible for implementing state-wide AIS programs for all state agencies, receiving appropriations of \$4 million in 2008 (Tim Sinnott, personal communication, March 2010). The New York AIS program is very unlike that of either Maryland or Virginia and it is discussed here in order to provide appropriate contrast as far as the degree of the institutionalization of AIS programs in the states comprising the Chesapeake Bay Watershed.

Various investigators have studied patterns related to the spread of policy and program initiatives (i.e., diffusion) among the 50 states, generally in relation to state legislative actions relating to a particular policy area. Walker (1969) concluded there is some predictability in terms of the propensity of states to initiate the adoption of policies and of other states to emulate them. Gray (1973) found conversely that the propensity of a state to adopt a policy was quite variable, dependent on both the issue and the timing. It is beyond the scope of this preliminary evaluation to attempt to explain the reasons for the noted

variability in diffusion and adoption of these coordination tools, although further research in this area would be useful.

The intent of this section has been merely to further elaborate the contextual setting for the current research effort relating to a comparison of State AIS Management Capacity in Maryland and Virginia.

This review has been regional in scope with the intent of providing a contextual overview. While not federally mandated, the adoption of Councils and multi-species AIS Management Plans as coordination tools are a reflection of state innovativeness and serve to legitimate a state's AIS program.

CHAPTER 3. METHODS

Research Purpose

The purpose of this research effort was to conduct an exploratory case study of two states within the Chesapeake Bay Watershed, with Maryland and Virginia as the units of analysis. The primary purpose was to qualitatively assess state aquatic invasive species (AIS) management capacity in each of these states. That is, to measure the perceived ability of states to effectively manage AIS. The framework for the assessment consisted of various individual components of capacity, including: situational capacity, political capacity, institutional capacity, state capacity, organizational capacity, and evaluation capacity.

To collect data for the assessment I conducted semi-structured interviews of elites as scripted telephone surveys, which included both open-ended and closed-ended questions. These perceptions were then evaluated as surrogate indicators of capacity. The assessment was based on perceptual responses to categorical questions relating to the various components of capacity.

Categorical data relating to the perceptual responses, regarding the various dimensions of AIS capacity, was coded to ordinal data based on a traditional Likert-like scale, ranging from 1-5 (poorly-developed capacity=1,

moderately-developed capacity=3, well-developed capacity=5). Group means were calculated for each component of capacity assessed. An integrative metric—the index of State AIS Management Capacity (I_{AIS})—was calculated for each state, as a composite measurement incorporating coded values for all perceptual responses for all components of capacity evaluated. This is the first study of this type undertaken in relation to AIS.

The respondents surveyed represented a wide spectrum of AIS experts in Maryland (n=20) and Virginia (n=10) ranging from field biologists to senior managers in both the governmental and nongovernmental sectors. Ancillary questions were also addressed in the survey to provide a broader context for the assessment.

As far as analysis, some descriptive statistics were used to describe the data and permutation analysis was used to examine the significance of differences between states in relation to each dimension of capacity assessed.

Research Questions

As noted previously, the research questions in this study relate primarily to the various components of State AIS Management Capacity, as reported by the respondents in Maryland and Virginia. However, as this case study is exploratory in nature, there are various other ancillary issues of concern. The overarching research question was the following:

Comparatively, what is the ability of Maryland and Virginia to effectively manage AIS, based on a categorical assessment of perceptions of AIS

professionals in Maryland and Virginia relating to the various components (i.e., dimensions) of capacity: situational, political, institutional, state, organizational, and evaluation?

However, various secondary questions were posed to respondents, as open-ended questions, for two purposes, 1) in order to clarify the categorical assessments of the various components of capacity, and 2) to better understand the nature of AIS programs in Maryland and Virginia. These questions were as follows:

- What best illustrates the situational capacity of your state (i.e., Maryland or Virginia)?
- What best illustrates political commitment to AIS efforts in your state?
- What is the nature of the legal framework of statutes and regulations addressing AIS in your state?
- Does this legal framework allow for sustainability of the state AIS program?
- How well has your state directed its available state management capacity towards addressing AIS issues?
- How established is your state AIS program?
- Is the organizational capacity of your state AIS program sufficient to accomplish its mission?
- Are evaluation tools sufficient to evaluate your state AIS program?
- How well-developed is national capacity to address AIS issues in your state—as far as prevention, early detection, rapid response, control, management, and coordination?
- What national factors have the greatest effect on your state AIS program?
- In what ways would you characterize your AIS Program as being effective?
- What characteristics of your state AIS program do you feel will allow for its sustainability?
- What aspects of your state AIS program do you feel confer credibility and legitimacy to it?
- Do you feel that your state has an effective rapid response plan in place?
- What changes to AIS national legislation would be most beneficial to your state AIS program?
- How severe are AIS problems perceived to be in your state?

Rationale for Research Framework

A comprehensive discussion of the research methodology is detailed in this section. The methodological approach was adapted from Malysa (1996). used in this study This is not a scientific survey, in the sense of the traditional quantitative positivist paradigm, rather the nature of inquiry used is primarily qualitative and constructivist in nature, although mixed methods are used. The value of a case study in such an exploratory effort is stated succinctly by Merriam (1998, p. 19):

A case study design is employed to gain an in-depth understanding of the situation and meaning for those involved. The interest is in process rather than outcomes, in context rather than a specific variable, in discovery rather than confirmation. Insights gleaned from case studies can directly influence policy, practice, and future research.

One of the key differences between a positivist paradigm and a constructivist paradigm is that the former posits that reality can be apprehended and that facts and laws can define that reality, whereas the latter posits that reality is relative and constructed by consensus—in fact constructivism asserts there are multiple realities, with trustworthiness, transferability, and confirmability being the relevant criteria to evaluate such relativistic constructs (Denzin and Lincoln 2000).

As noted by Jackson and Sorenson (2007, p. 253) constructivism is not in any way a denial of the importance of positivism and the scientific method, but an acknowledgement that:

Ideas and theories about the world always contain elements of both subjectivity and objectivity. The subjective element is tied to our adherence to different values and concepts and the inescapable fact that each and every one of us looks out upon the world from his or her personal standpoint. The objective element is tied to the fact that we can actually agree about very substantial insights about what the real world is like.

The relevance of constructivism to a discussion of AIS is significant in relation to both risk assessment and risk management. Jackson and Sorenson (2007, p. 253) state that, "...the core ideational element upon which constructivists focus is inter-subjective beliefs which are widely shared among people." The "inter-subjective beliefs" are those that relate to the very nature of the normative categorization of aquatic species as "invasive" (risk assessment), and the normative decision as to how to best respond to them (risk management).

Both risk assessment and risk management—however informally they are approached—are important determinants of what the states actually do about AIS in relation to problematic AIS as well as what they capable of doing, regardless of the underlying ecological concerns —essentially nuisance management generally has a greater priority than other concerns at the state level. However, different stakeholders may have different perspectives on what constitutes effective AIS management. The adage, "where you sit is where you stand," commonly referred to as Miles Law, summarizes this frequent multiplicity of perspectives observed in relation to a particular policy issue, each of which is valid (Miles 1978). A necessary generalization from this axiom is that where you

stand also determines what you see. Such multiplicity in perceptions is expected to be reflected in the subjectivity of the responses in this survey to the perceptual questions relating to State AIS Management Capacity.

Framework for State AIS Management Capacity Assessment

A discussion of the analytical framework first requires a clarification of the term “capacity” as there is considerable ambiguity as far as its use in the public policy literature. Honadle noted (1981, p. 575) that “it is unlikely that a consensus definition of ‘capacity’ will ever be reached.”

Pragmatically, Bowman and Kearney (1988, p. 343) noted that:

It seems appropriate, instead, to define the concept [capacity] in relation to its application. In other words, capacity can have different meanings depending on the institution, organization, or individual under consideration. Our task in this paper is to put forward a definition of capacity that is appropriate....

The basic framework for this assessment of State AIS Management Capacity in Maryland and Virginia was adapted from Malysa’s (1996) study of wetlands management and planning capacity in these states. The components of capacity that Malysa (1996) employed included the following: situational, political, economic, institutional, organizational, and evaluation capacity. However, I have made the following changes to Malysa’s framework (1996). State capacity was substituted for economic capacity and Malysa’s elaborate 23 element subdivision of the six components of capacity was dispensed with as a matter of necessity, given the relative brevity of a telephone survey. Instead, the focus in this study was on broad assessments of the components of capacity, and not on the

individual subcomponents. Rather than the in-person interviews and individual follow-ups which Malysa (1996) employed for the 35 interviews she conducted, this survey relied strictly on the data obtained from responses to the scripted telephone interviews, with follow-ups only at the request of the respondent. Also in this study categorical responses were coded such that means could be calculated and a State AIS Management Capacity index (I_{AIS}) could be calculated for both Maryland and Virginia, as conceptualized in the assessment framework detailed in Figure 3.

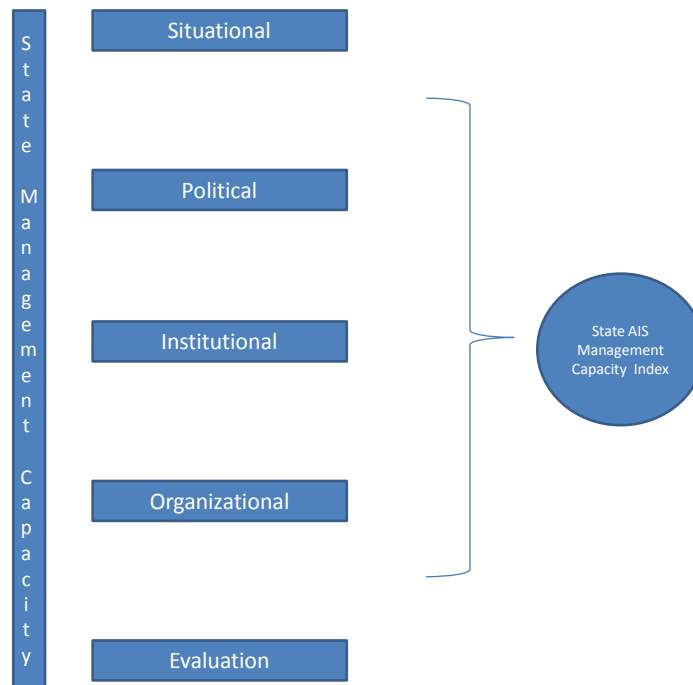


Figure 3. A framework for evaluating state AIS management capacity.

Following is a review of the definitions of the various components of state AIS capacity first presented in Chapter 1, which will be used in this study.

- **Situational Capacity** - The ability of a state to identify and define AIS issues as they arise.
- **Political Capacity** The ability of a state to make and implement AIS policy decisions with appropriate public input.
- **Institutional Capacity** - The ability of a state to sustain an AIS organization within the fabric of the state bureaucracy which has a specific statutory authority.
- **Organizational Capacity** - The ability of a state to establish a group of individuals to apply its available skills and resources to accomplish stated AIS goals within state natural resource agencies.
- **State Capacity** - The overall ability of a state to marshal resources to develop a program to address a public policy issue as needed, as a function of fiscal resources, human resources, information technology, and infrastructure.
- **Evaluation Capacity** - The ability of an organization/institution to assess whether existing policies/programs are sufficient to meet stated goals, requiring efficient reporting requirements.

Perceptual Survey of Components of Capacity

Semi-structured interviews were conducted as scripted telephone surveys to assess the perceptions of AIS professionals, ranging from field biologists to senior managers, in Maryland and Virginia. The perceptual questions related to the six previously described components of State AIS Management Capacity. The phrase “components of capacity” may on occasion be used interchangeably with the phrase “dimensions of capacity”.

The emphasis of the survey was particularly focused on characteristics of those responsible state executive agencies in Maryland and Virginia with the primary assigned roles in implementing AIS statutes.

These agencies are discussed in detail in Appendix B and by ELI (2007). Although the Maryland and Virginia Sea Grant College Programs, National Sea Grant, USEPA, USFWS, USDA, USGS, and various other stakeholders have very significant roles in AIS activities, these entities were not the focus of this study, although their considerable role is discussed tangentially.³³

An elaborate description of the survey is presented below. This includes a discussion of the origins and nature of the survey instrument, the HSRB review process, sample size considerations, the nature of the targeted respondent population, survey administration, pilot-testing of the survey, as well as a description of data collection and analysis.

Survey instrument Origins

The survey instrument included twenty-four questions, of various sorts and was uniquely developed for this research based on the various components of capacity specified in the analytical framework depicted in Figure 3. The questions were developed primarily to provide the following four categories of information:

- 1) perceptual responses needed to assess the various dimensions of state AIS

³³ Although Sea Grant agencies were not the emphasis of this study, in Maryland and Virginia they represent established state institutions which have a primary role in relation to AIS, much more so, probably, than the actual executive branch agencies in these states. However, Sea Grant's role is one that is essentially advisory and educational in nature—and nonregulatory.

management capacity (i.e., situational, political, institutional, state, organizational, and evaluation capacities), 2) qualitative commentary on each of the components of capacity assessed, 3) qualitative perceptual assessments of selected intrinsic and extrinsic factors, and 4) a perceptual assessment of the severity of AIS effects in each state.

The survey instrument included various elements adapted from previously described models. The basic format was adapted from the “framework for analysis” employed by Malysa (1996) in her assessment of Coastal Zone Management efforts in Maryland and Virginia. The adapted format provided for a qualitative categorical assessment for each dimension of state AIS capacity, using both closed-ended and open-ended questions.

The three possible responses used as rankings for each of closed-ended categorical questions were adapted from Malysa (1996) as follows: 1) a well-developed capacity ranking, indicating that the respondent’s perception was that the state’s capacity in the area assessed was very effective and there was no need for immediate changes; 2) a moderately developed capacity ranking, indicating that the respondent’s perception was that the state’s capacity in the area assessed was reasonably effective, and needed only minimal changes to be very effective; and 3) a poorly developed capacity ranking , indicating that the respondent’s perception was that the state’s capacity in the area assessed was ineffective and had weaknesses that needed to be addressed.

Certain elements of Scheberle's (1997, 2004) previously described concepts of intrinsic and extrinsic factors relating to policy development were addressed in the study, to provide a context for the analysis. And finally, based on my professional experience, a determination was made as to which questions could realistically be answered in the context of a telephone interview, in order to ensure that an inordinate amount of information was not requested of participants. As noted previously, this required the use of broader, less rigid, categories than those used by Malysa (1996) in her assessments, without elaborate subcategories (i.e., elements).

A major concern in the design of this survey was to ensure that the responses by the participants be based solely on their work experience and present understanding of AIS issues—and that their responses be spontaneous and unrehearsed. It was hoped that the responses would be reflective of individual perceptions and not reviewed and “work-shopped” to merely reflect agency positions. To encourage spontaneity in the responses—the survey was designed with the intention that the questions would not be distributed to the respondents prior to the survey. The questions were simply read in a scripted fashion to the respondents during a telephone interview, and repeated as necessary.

The Survey Instrument

Following is a summary of the various sections of the survey instrument, which can be found in its entirety in Appendix A. Parts I-VI relate to the

assessment of State AIS Management Capacity, with a closed-ended question followed by an open-ended question for each dimension of capacity assessed. The arrangement of this survey is as follows: Part I relates to situational capacity (questions 1-2); Part II relates to political commitment (questions 3-4); Part III relates to institutionalization (questions 5-6); Part IV relates to state capacity (questions 7-8); Part V relates to organizational capacity (questions 9-10); Part VI relates to evaluation capacity (questions 11-12); Part VII relates to characteristics of the respondents (questions 13-16); Part VIII (questions 17-18) relates to extrinsic factors that provide a contextual setting for the intrinsic factors evaluated in Parts I-VI (which comprise the primary survey sections). Part IX consists of supplemental questions: questions 19-23 are open-ended while question 24—the last question—is a continuum question on a scale of 1-10, relating to severity of AIS effects.

Although the questions are focused on particular designated state executive agency AIS organizations with designated AIS responsibilities, necessarily many of the questions relate to other AIS factors. Many of the respondents, in fact, were stakeholders who were not state officials, often with differing perspectives. Respondent affiliations were anonymously coded during the interviews along with other respondent information. Such information was used only in a way that ensured confidentiality and anonymity.

HSRB Review of Research Protocol

The survey was not implemented until the formal review and approval of all related documents by George Mason University's Human Subjects Review Board (HSRB). This review included the survey instrument, research protocols, informed consent forms and the cover letter and other forms. Any amendments to the protocols—such as extensions of the survey—were similarly reviewed before implementation. The review process was in accordance with Title 45 of the Code of Federal Regulations, Part 46.111, to ensure compliance with applicable federal and state regulations. Such compliance required that the following requirements were satisfied in the proposed research project: 1) risks to subjects were minimized, 2) risks to subjects were reasonable in relation to anticipated benefits; 3) informed consent was sought from each prospective subject and documented in writing, and 4) that there were adequate provisions to protect the privacy of subjects and to maintain the confidentiality of data. No survey materials were distributed and no respondents were contacted until formal notification of approval of the research protocol, informed consent letter and other documents was made by the GMU's HSRB. Prior to approval of the protocol, CITI training (Collaborative Institutional Training Initiative) was successfully completed by the author, relating to human subjects protection. Copies of the survey instrument and other documentation approved by the HSRB are found in Appendix A.

Sample Size

It was projected in the research protocol for this project that the sample population would consist of from 15-30 individuals. Sampling size in qualitative research is an area of considerable confusion for most positivist researchers experienced with scientific experimental models as the objectives are markedly different in quantitative and qualitative research (Marshall 1996 pp. 524-525) notes that:

This largely relates to misunderstanding about the aims of the qualitative approach, where improved understanding of complex human issues is more important than the generalizability of results. This basic issue explains why probabilistic sampling is neither productive nor efficient for qualitative studies and why alternative strategies are used.

In a review of the recommendations for adequate sample size in qualitative experiments, Onwuegbuzie and Leach (2005) noted that researchers have recommended from 20-30 participants for grounded theory analysis in particular and considerably fewer for many other qualitative paradigms. What is essential is that the sample size be adequate to allow for “data saturation and informational redundancy (Sandelowski 1995).” Basically, this means that it is essential to obtain a full spectrum of potential responses with a certain degree of repetition in commentary reinforcing major themes.

Respondent Characteristics and Recruitment Process

Recruitment was limited to individuals who have been directly involved (either in the recent past or presently) in a professional capacity in AIS management efforts in Maryland and/or Virginia, with comments provided only by respondents who had a familiarity with AIS activities and programs for the

particular state(s) which they assessed. The study population primarily consisted of individuals considered to be “elites” in this particular area (i.e., acknowledged experts in the field), and in the particular state which they addressed in the survey. The population sampled represents a substantial portion of the AIS professionals involved in such efforts in Maryland and Virginia.

The sample population ranged from field biologists to senior managers from both the governmental and nongovernmental sectors, and generally consisted of individuals who participate in various federal AIS advisory committees and other groups with public accessibility and accountability. Respondents were primarily recruited from groups such as the Mid-Atlantic Regional AIS Panel (MAPAIS), state invasive species councils or similar groups, advisory committees, and the Aquatic Nuisance Species Task Force (ANSTF), as well as state and federal agency staff. As possible, there was an effort to sample representative AIS professionals from a wide spectrum of groups: elected state officials, state and federal civil service biologists and managers, appointed state and federal officials, as well as representatives from non-governmental organizations and private environmental consultants. There was no “nomination” process by which participants could recommend other individuals to be interviewed and no resultant “snowball sampling” which is rather commonplace in such survey approaches (Noy 2008).

Survey Administration

The survey extended over a four month period from April 5, 2010 to July 30, 2010. There were generally three mailings including an initial cover letter followed by two follow-up cards (Appendix A). Although the survey itself was conducted via telephone, the recruitment process preceding the actual interviews was prescribed by HSRB requirements. There was no survey-related communication with potential respondents prior to the receipt by me of a written acknowledgement of their intention to participate in the survey. Likewise, surveys were not conducted until the return of signed informed consent letters to me, as stipulated in the *Response to Request to Participate in a Survey* (RRPS) form in conformance with the HSRB Research Protocol. This form also provided a check-box for the respondent to indicate whether they approved or disapproved of the interview being audio-taped. I will retain signed informed consent letters for three years following the completion of this research.

Recruitment efforts were initiated by distributing a packet of recruitment information by surface mail. This included a cover letter, the RRPS form, and a copy of the informed consent form. A self-addressed stamped envelope (SASE) was also enclosed. The potential respondent was requested to return the *Response to Request to Participate in a Survey* form, which was designed to establish the following: 1) whether the individual would participate in the survey, 2) what dates and times would be most convenient to interview the individual, and 3) whether the potential respondent preferred to be interviewed during

working or nonworking hours, and 4) whether the respondent would like to discuss overall survey results for their state prior to the publication of the project or alternatively receive a summary of the survey after its publication.

The potential respondent was also asked to review, sign, and return the informed consent letter along with the completed RRPS form in the SASE that was included. Generally, at the end of the first week or so following the distribution of the initial survey packet, a second notification, with a SASE enclosed, was sent as a confirmation for individuals who had indicated they would be participants and as a second request to participate for those individuals who had not yet responded to the initial letter. An additional *Response to Request to Participate in a Survey* form and an additional informed consent letter were also provided. As necessary, this process was repeated a third and final time. The second and third mailings were mailed in 4 x 6 inch bifold cards approved by the HSRB for this purpose.

There was no follow-up for non-responding individuals, beyond the procedures described, although this approach has been found to substantially increase response rates. By the end of the HSRB-approved sampling date, all survey-related written communication was discontinued. This meant that in several instances the third mailing was not made to individuals with whom initial written contact was initiated somewhat later during the survey period.

Organizations were not solicited to provide access to employees and no employee records were examined. Such public availability is generally

considered to be a discretionary and part of the respondent's professional responsibilities, and participation was voluntary.

Pilot Study and Pretesting

Although somewhat nontraditional in that it was not conducted prior to the actual survey itself, the survey was pilot-tested with the first three participants. Several minor changes were made based on responses. After several interviews, it became apparent that the survey duration would depend entirely on the length of the commentary of the respondents to the open-ended questions. While possible to complete within the 15-20 minute period noted in the recruitment materials, the telephone survey could and did often exceed that length of time. After the third interview, it was noted at the beginning of the interview that, depending on the length of the respondent's commentary, the interview might take considerably longer than 15-20 minutes.

Additionally, as initial inquiries regarding the job titles of the respondents were met with seeming discomfort and hesitation by the respondents, this question was discontinued after the third interview.

Data Collection

As far as the perceptual survey, once developed, the survey instrument was formatted as the telephone survey script. The telephone script was then used both to administer the survey and to record data while interviewing respondents during the telephone surveys. Each interview was assigned a unique code number at the time of the interview. A codebook was developed that

relates each respondent's unique identification code number to the transcribed notes and field interview sheets. Interviews were audio-taped only when written authorization to do so was given by the respondent on the informed consent form. Such recordings were later transcribed and reviewed to augment field notes taken, as needed, during the interview.

Multiple sources of information were used in this study, in addition to the survey, which is requisite for case studies in general. Yin (2002, p.98) notes that:

The use of multiple sources of evidence in case studies allows an investigator to address a broader range of historical, attitudinal, and behavioral issues. However, the most important advantage presented by using multiple sources of evidence is the development of converging lines of inquiry, a process of triangulation.

Such additional sources of complementary evidence used in this study primarily included direct observations, information obtained from e-mail list serves, participant observation in regional AIS organizations, and attendance of related AIS conferences.

Data Coding and Presentation

Data coding was limited to the categorical responses which were ordinal in nature (i.e., poorly-developed, moderately- developed, or well-developed). These were found in Parts I-VI of the survey instrument and related to the respondent's perceptual assessments of the various dimensions of State AIS Management Capacity: situational, political, institutional, state, organizational, and evaluation capacity and in question 17, a categorical question relating to national AIS capacity.

Two different methods were employed to facilitate both the presentation and analysis of the data. The first method was to calculate the frequency of the various categorical responses relating to the various components of capacity and national capacity, and then tabulate this information in contingency tables by group. Maryland and Virginia respondents constitute separate groups, statistically. The data was then presented graphically as bar charts.

The second method involved the coding of the categorical variables and subsequent analysis. The categorical responses, which themselves were ordinal in nature, were first coded to ordinal numeric values, using a Likert-like scale. The ordinal coding was made on a 1-5 scale as follows: poorly developed=1, moderately developed=3, and well-developed =5. The ordinal numeric values were then used to calculate group means to describe the perceptual responses of each group (i.e., Maryland and Virginia) to a particular question. The group means were then presented graphically in bar charts and rank order graphics and used in statistical analyses. The intervals between the various ordinal units (1-5) were not meant to represent an exact measure, as with descriptive quantitative statistics—merely an approximation, a relative value only (Warner 2008).

This approach was used with all categorical data relating to the various dimensions of State AIS Management Capacity, and again with question 17, relating to national AIS capacity.

Data Analysis

The data analysis for the survey, the major research component of this effort, was both quantitative and qualitative in nature—a mixed methods approach. The analysis involved a comparison of two independent groups, one representing Maryland (n=20) and the other Virginia (n=10); samples were independent but were not random.

Grouping of Responses for Analysis

Generally, data was aggregated into one of two distinctive groups representing either Maryland or Virginia respondents.³⁴ The explicit need and intention to ensure confidentiality in the data reported—both qualitative and quantitative, restricted the specificity of categories used. To ensure the confidentiality of all respondents, neither affiliations of respondents were revealed nor was attribution of comments made in such a way as to identify respondents.

Qualitative Data Analysis

The qualitative data relating to the perceptual survey was analyzed according to the tenets of grounded theory, with the first step being the process of coding the data in terms of broad categories, from which particular themes emerged. The coding process was cyclical in nature and considered to be a

³⁴ Only for the integrative determination of the State AIS Management Capacity metric (I_{AIS}) were the respondents in each group (Maryland and Virginia) parsed into three subgroups: responsible state AIS agencies, federal environmental agencies, and “other” including all respondents with other affiliations.

heuristic, a process in which patterns become apparent (Miles and Huberman 1994, Saldana 2009). After the coding of data, related elements were aggregated according to “similarity and regularity” and patterns and interconnections were noted (Saldana 2009, p. 4-9).

Various analytic memos were written as reflections on various aspects of the qualitative data that became apparent in the coding process and the inquiry process it involved. Such memos help to shape and frame the inquiry and facilitate the elucidation of “emergent patterns, categories and subcategories, themes, and concepts in [the] data. Saldana 2009, p. 33).” The majority of codes were either hand-written or word-processed in the margins of field notes transcribed from the interviews.³⁵

Statistical Analysis of Survey Data

While this study was non-experimental in nature and the data primarily qualitative in nature, the coding of the categorical responses into ordinal data as previously described, allowed for the use of nonparametric statistical methods. Permutation analysis was the nonparametric statistical method used in evaluating the significance of the differences observed in means between groups (i.e., Maryland and Virginia) for the six components of capacity evaluated. SAS (Statistical Analysis Systems Inc., Version 9.2, 2008) was used in these analyses. This is a distribution-free, nonparametric method and was used in the

³⁵ The author was trained in the use of Atlas.ti through two teleconference sessions of training with ResearchTalk in New York City.

analysis of the ordinal data rather than traditional formula-based statistical methods, as normality is not required for such analyses (McCabe et al. 2007).

The statistic used for the permutation analysis of each dimension was the P statistic (i.e., permutation statistic), which is the difference in observed means of the ordinal responses, between groups, for each dimension of capacity evaluated ($P = \bar{X}_{\text{Maryland}} - \bar{X}_{\text{Virginia}}$). The analysis evaluated whether there were significant differences in means between states ($p < 0.05$) for each separate dimension evaluated. The permutation distribution for each analysis was derived by resampling the same data set, without replacement.

The original coded data set was used to calculate both the initial observed P value—that is the difference in means between groups for each dimension—and to derive a unique empirically-constructed P distribution for each dimension evaluated. Basically the data from both groups was resampled a total of 1000 times, and mean values recalculated for each resampling event, with a new P value calculated based on the difference in means associated with each resampling event. A P distribution was then developed from these various P values. Then, the original P value, for each dimension evaluated, was compared with the derived P distribution for that dimension, with empirically derived probability values derived from each P distribution. The test allowed for a determination of whether the observed differences in responses between groups were significantly different from those that one would expect based on chance. Basically the hypotheses used in the permutation analyses were as follows:

Null Hypothesis - H_0 : The perceptions of the various individual dimensions of State AIS Management Capacity, as measured by the group mean for each dimension, are not significantly different in Maryland in comparison with Virginia .

Alternative Hypothesis - H_A : The perceptions of the various individual dimensions of State AIS Management Capacity, as measured by the group mean for each dimension, are significantly different in Maryland in comparison with Virginia.

For each of the six component of capacity evaluated, the statistical results were compared with the empirical results illustrated by the various comparative bar graphs and the rank-order graphics to determine whether the statistical results were corroborated by the empirical results.

Calculation of State AIS Management Capacity Index

An integrative metric, including all ordinal measurements of all dimensions capacities assessed, was calculated for both Maryland and Virginia. This metric, designated as the I_{AIS} , was based on an aggregation of all ordinal values for all responses to each dimension of capacity.

CHAPTER 4. RESULTS AND ANALYSIS

Introduction

This chapter presents the results of the semi-structured telephone survey conducted to assess the perceptions of respondents in Maryland and Virginia regarding the nature of State AIS Management Capacity in Maryland and Virginia. There are four basic parts to the chapter. First, I provide a comparative summary of the categorical responses to perceptual questions relating to the various dimensions of AIS capacity, including: situational, political, institutional, state, organizational, and evaluation capacities, which comprise the framework for the analysis. The second part presents an integrative metric, the State AIS Management Capacity Index (I_{AIS}), based on the various categorical assessments. In the third part, I present the results of a nonparametric statistical analysis used to examine the significance of differences in the perceptual responses in Maryland and Virginia relating to each component of capacity. Some descriptive statistics are used.

In the fourth part and final part, which is the longest, I present an analysis of the individual survey questions in a sequential fashion. In presenting the results for each question, graphical and statistical data are presented prior to the qualitative discussion of results. Following the initial discussion of the various components of capacity, I characterize the responses of participants to questions relating to the various intrinsic and extrinsic factors. In this final section, direct

quotations are used in many instances, without source attribution in order to ensure the anonymity of the respondents.

Survey Response Rate and Respondent Characteristics

The survey duration was from April 5, 2010 to July 30, 2010. The overall survey response rate was 43.1%, with 28 individuals participating in the interview of the 65 elites in Maryland and Virginia that were sent recruitment materials. The survey, however, consisted of 30 telephone interviews during which the survey instrument was administered. While there was a total of only 28 respondents, two individuals, because of the breadth of their AIS expertise, provided a perceptual assessment of both Maryland and Virginia. All other individuals chose to assess only one state—either Maryland or Virginia, but not both states. Fifteen respondents authorized the audio-taping of their interviews, which represents 50% of the total number of interviews. Transcripts were made from these audio-recordings, which included nine Maryland interviews and six Virginia interviews.

The interviews generally required considerably more time than the initial 15 to 20 minutes that was anticipated. In fact, the interviews ranged in duration from 25 to 60 minutes in Maryland with a mean length of 43.5 minutes and from 25 to 90 minutes in Virginia with a mean length of 41.5 minutes.³⁶

The sample size for this survey was somewhat larger in Maryland (n=20) than in Virginia (n=10). There was also some variability in the number of survey questions to which each respondent replied. Respondents were advised before

³⁶ Interview data was recorded only to the nearest 5 minute increment to account for various preparatory and concluding distractions.

the survey was administered that they could choose to pass (i.e., not respond) on any question for any reason and that they should feel free to do so. When there was any equivocation on their part during the survey, they were reminded of this provision.

Most participants responded to all categorical questions relating to the various components of capacity (i.e., situational, political, institutional, state organizational, and evaluation capacity). Overall there were only 18 questions for which there were no responses, which accounted for 10% of the 180 total possible responses to these categorical questions. The majority of declined responses were in relation to the question regarding evaluation capacity. Overall nine participants did not respond to this question, six from Maryland and three from Virginia. There were considerably fewer declined responses to other questions

Respondent Characterization

Generally, the groups studied were simply aggregated as Maryland respondents and Virginia respondents. Only for the analysis of the I_{AIS} were the respondents parsed into three subgroups within each group. The subgroups were as follows: 1) responsible AIS state agencies (i.e. regulatory agencies) 2) federal environmental agencies, and 3) other, a large group comprised of any respondents not in either of the preceding two groups. Table 4 below provides a summary of the affiliations of the various respondents.

Table 4. General affiliations of survey respondents.

Respondent Affiliation	No. of Respondents	No. of Interviews
Maryland Natural Resource Agencies	8	8
Virginia Natural Resource Agencies	4	4
Federal Environmental Agencies	5	5
Maryland/Virginia Sea Grant Agencies	3	3
Environmental Consultants	2	3
Non-Governmental Environmental Groups	3	3
Interstate Commissions	1	2
Academia	1	1
Municipal	1	1
Total	28	30

In Maryland, the mean percentage of work time reportedly spent by the 20 respondents on AIS issues ranged from 5-100%, with a mean of 24.8%. In Virginia, the mean percentage of work time reportedly spent by the 10 respondents on AIS issues ranged from 2-70 %, with a mean of 19.8%.

Summary Overview of Survey Results

Figure 4 below provides an overview of the responses by participants to the perceptual questions relating to the various components of capacity

previously described. Categorical values have been converted to ordinal values using a Likert-like scale and means³⁷ calculated for the components of capacity in each state. Graphics are presented in a comparative manner, with responses from both Maryland and Virginia shown. In the sequential treatment of each question which follows, separate graphics are also presented for each component of capacity, illustrating the frequency distributions of the categorical responses selected by the respondents.

What is most conspicuous in the comparison of all six components of capacity assessed in Maryland and Virginia is that—with the exception of evaluation capacity and organizational capacity—perceptions of capacity by respondents were higher in Maryland than in Virginia based on group means. Hereafter, the term group means will be used interchangeably with means, unless otherwise specified.

There were some obvious differences in the nature of the overall responses relating to assessments of the various components of capacity by respondents in Maryland and Virginia. In Maryland, the group means calculated indicated an overall moderate or greater than moderate ranking ($\bar{x} \geq 3.0$) for assessments of situational capacity, state capacity, and organizational capacity, while in Virginia the indices indicated an overall moderate or greater assessment ($\bar{x} \geq 3.0$) for only situational and organizational capacity assessments. Overall,

³⁷ While it is statistically justifiable to convert categorical values to ordinal values, and derived mean values which are then used as indices, the resulting values have meaning only in a comparative sense, the intervals between one unit and another are not exact (Warner 2008, Linda Davis, personal communication, GMU 2010).

evaluation capacity was assessed equally low in Maryland and Virginia ($\bar{x} = 2.4$). The only other assessment that was fairly similar in both Maryland and Virginia was that of organizational capacity, with a mean of 3.1 in Maryland and 3.2 in Virginia—the only component of capacity for which the Maryland ranking was lower than the Virginia ranking.

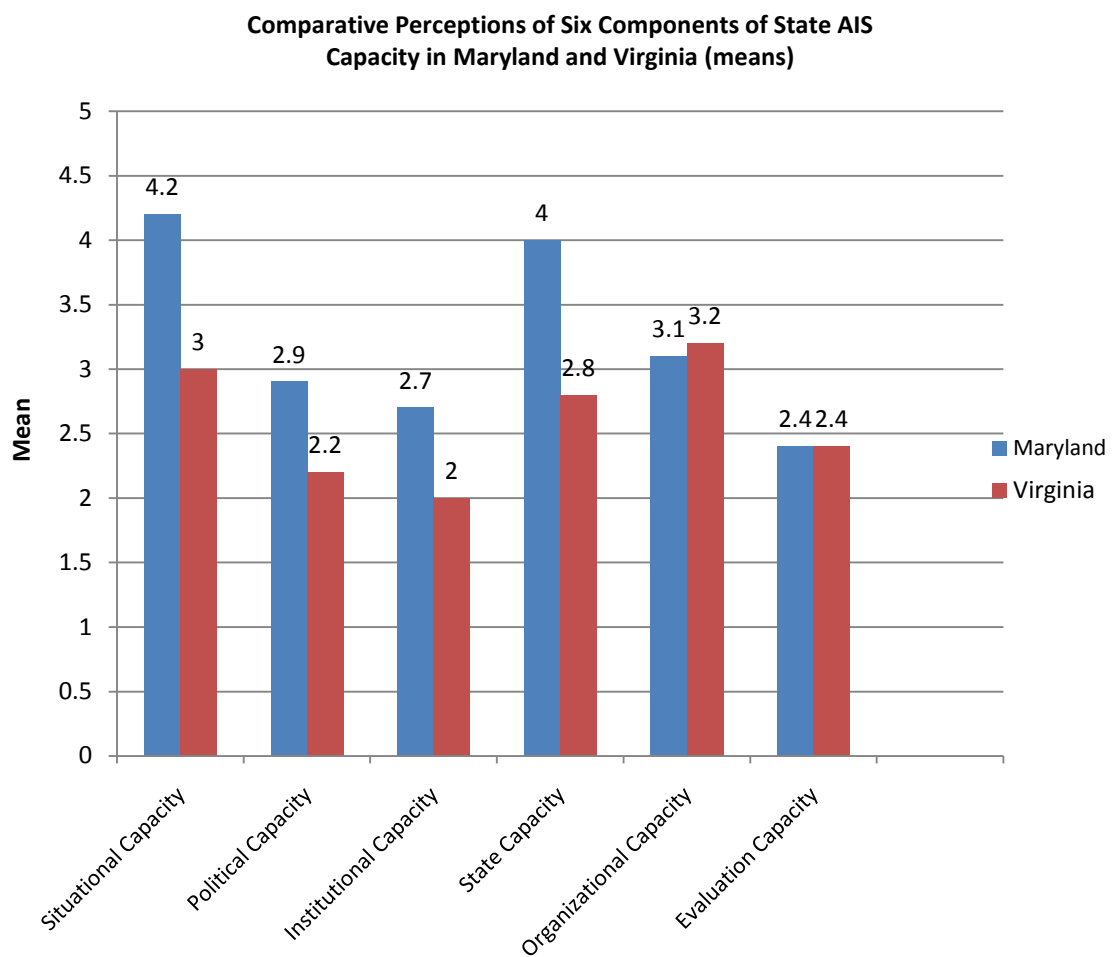


Figure 4. Comparative perceptions of six components of state AIS capacity in Maryland and Virginia (means).

In comparing group means for all components of capacity, the difference in means was calculated as $\bar{X}_{\text{Maryland}} - \bar{X}_{\text{Virginia}}$ for each dimension of capacity assessed in these states. The difference in means ranged from 0.0-1.2.³⁸ Figure 5 below shows the differences in means for all components of capacity evaluated in Maryland and Virginia. The greatest observed differences in means observed between these states was in relation to assessments of situational and state capacity, with a difference in means of 1.2 for each of these assessments.

³⁸The difference in means will always be defined in terms of the group mean of all the ordinal values relating to perceptions of a particular component of capacity by respondents in Maryland, minus the group mean for the perceptions of that same component in Virginia. The group means represent the average of the coded ordinal response scores for all respondents in a particular group.

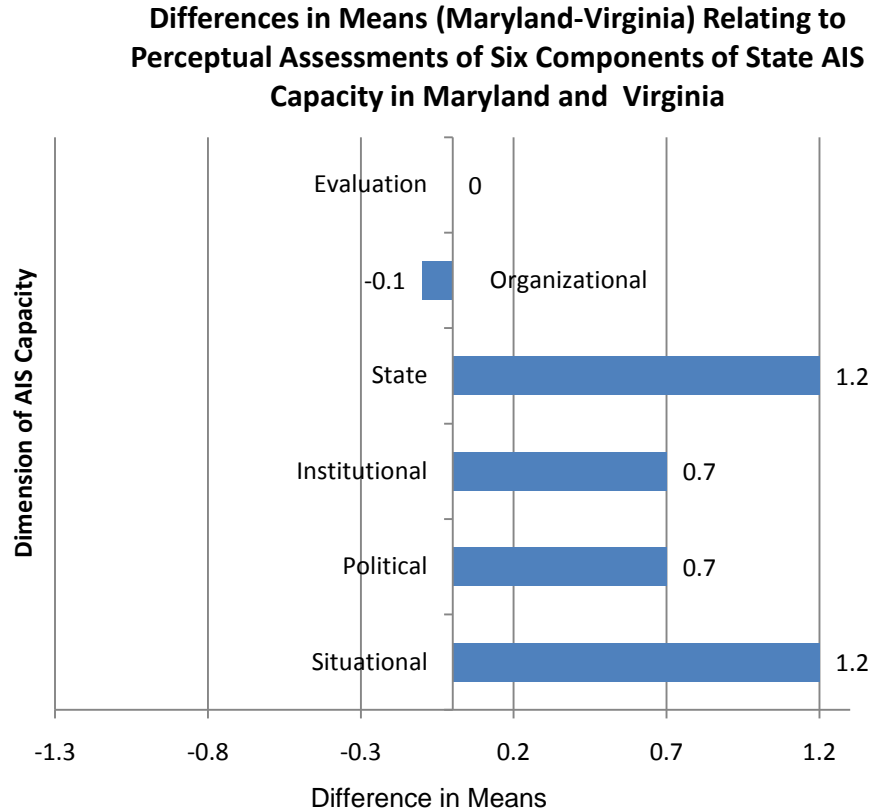
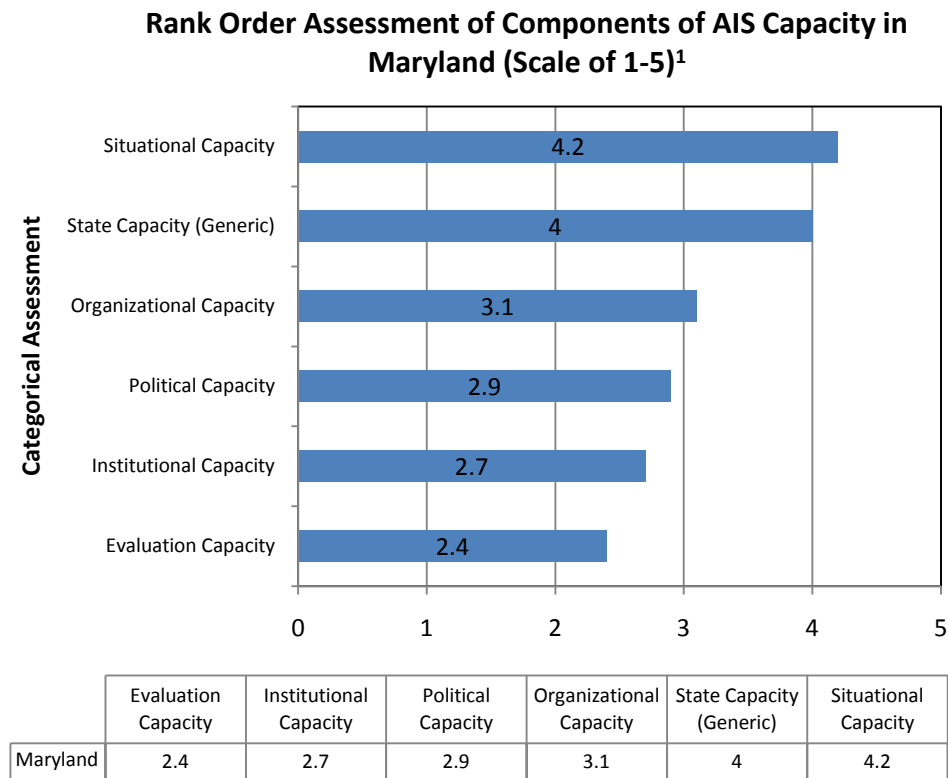


Figure 5. Differences in means relating to perceptual assessments of six components of state AIS capacity in Maryland and Virginia.

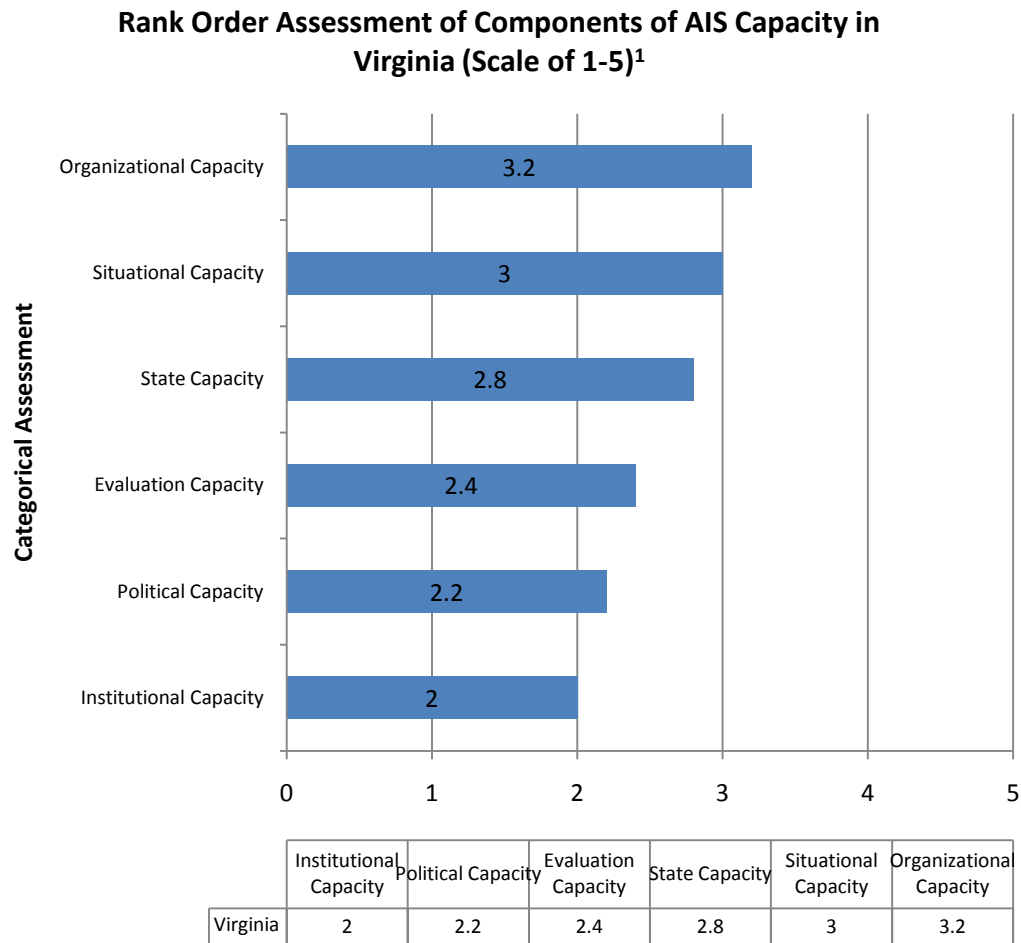
The rank-order assessment shown below in Figure 6 and 7 shows considerable similarities in the relative rankings of the various components of capacity assessed in these states, despite the variability in the differences in means observed in relation to responses in Maryland and Virginia as shown in Figure 5.



¹Categorical Assessments were coded as follows:
poorly-developed=1, moderately-developed=3, well-developed=5.

Figure 6. Rank-order assessment of components of AIS capacity in Maryland.

As shown in Figure 6 and 7, there were many similarities in Maryland and Virginia as far as the ranking of the various components of capacity. Situational capacity ranked highest in Maryland and second in Virginia, while organizational capacity ranked third in Maryland and first in Virginia. However, in both states political capacity, institutional capacity and evaluation capacity all ranked relatively low.



¹Categorical Assessments were coded as follows:
poorly-developed=1, moderately-developed=3, well-developed=5.

Figure 7. Rank-order assessment of components of AIS capacity in Virginia

State AIS Management Capacity Index

An integrative metric—the index of State AIS Management Capacity (I_{AIS})—was calculated for both Maryland and Virginia, incorporating all coded perceptual responses for all components of capacity evaluated, with no weighting off values. As previously noted, the categorical response data for all responses to the various questions relating to the six components of capacity assessed was

coded to ordinal data based on a Likert-like scale which was then used to calculate this index as depicted in Figure 3.

Essentially, the I_{AIS} represents the grand mean for each group or subgroup) assessed.³⁹ The I_{AIS} calculated for Maryland was 3.3 while the I_{AIS} calculated for Virginia was 2.6. What is apparent in Table 5 below is the considerable variability among subgroups in perception of the various components of capacity as reflected in the variability of the I_{AIS} values. The greatest similarities are between the I_{AIS} calculated for the responsible state AIS agencies in Maryland and Virginia, designated as state agencies in Table 5. The I_{AIS} calculated based on perceptions of federal agency respondents was considerably higher for Maryland than Virginia. The I_{AIS} ranking of the “other” subgroup was higher in both Maryland and Virginia than the I_{AIS} calculated for the responsible state AIS subgroups. This variability will not be addressed additionally as the subgroup sample sizes are relatively small.

Table 5. Variability of I_{AIS} values among groups and subgroups of respondents surveyed.

Group	State Agencies	Federal Agencies	Other	Combined
Maryland	2.9	3.7	3.5	3.3
Virginia	2.7	2.4	3.0	2.6

³⁹In this context, the grand mean refers simply to all of the data values divided by the sample size, whether referring to groups (i.e., Maryland and Virginia) or subgroups (i.e., responsible state AIS agencies, federal environmental agencies, or “other”).

The I_{AIS} values reflect rather well the overall nature of the aggregate categorical responses by each group (i.e., Maryland and Virginia) when the relative frequency of the various categorical responses selected are examined. The greatest frequency of responses in both states was the “moderately-developed,” category, with this response selected for 52.3% of the responses in Maryland and 58.2% of the responses in Virginia. However, there was a greater frequency of “well-developed” responses in Maryland (30.3%) than in Virginia (10.9%) and conversely a lower frequency of “poorly-developed” responses in Maryland (17.4%) than in Virginia (31.0%).

Statistical Analysis

Table 6 below shows the results of permutation analysis (Statistical Analysis Systems, SAS Inc., Version 9.2, 2008) of the data previously described relating to perceptions of the various components of State AIS Management Capacity. A separate analysis was conducted for each component of capacity assessed, to determine if there were any statistically significant “differences of means” between groups (i.e., Maryland and Virginia). The permutation analysis indicated there were significant differences in the perceptions of situational capacity ($p < 0.05$, $P=1.2$) and state capacity ($p < 0.05$, $P=1.2$), when comparing the categorical survey responses (coded as previously noted) from Maryland and Virginia respondents. However, based on this analysis, there were no significant differences in the perception of respondents in relation to political capacity, ($p > 0.05$, $P=0.7$); institutional capacity, ($p > 0.05$, $P=0.5$); or evaluation capacity, (p

>0.05, P=0). The statistical results were corroborated empirically by comparison with the relevant bar graphs and rank order graphics.

Analysis of Survey Questions Relating to Components of Capacity

While the preceding presentation of results has been summary in nature, the following is a sequential presentation of the results of the telephone survey, including a characterization of the perceptions of respondents to both closed-ended and open-ended questions relating to the various components of State AIS Management Capacity and other related questions. It is emphasized that the survey was focused on the “perceptions” of the respondents based on their work experience and understanding at the time of the interview. As necessary and as possible, factual information noted by respondents was corroborated.

In many respects, the respondents have provided their own narrative of AIS management in Maryland and Virginia. However, as this section is rather lengthy, I have provided considerable commentary and analysis as necessary, in an effort to weave the various threads of the narrative into a more easily understood exposition of State AIS Management Capacity in Maryland and

Table 6. Results of permutation analysis of differences in group means relating to perceptions of six dimensions of AIS capacity in Maryland and Virginia (p-values <0.05 are asterisked).

Dimension of Capacity	MD mean	VA mean	Difference in means ($\bar{X}_{\text{Maryland}} - \bar{X}_{\text{Virginia}}$)	p-value (two-sided)
Situational	4.2	3.0	1.2	0.0240*
Political	2.9	2.2	0.7	0.1963
Institutional	2.7	2.0	0.7	0.1388
State	4.0	2.8	1.2	0.0481*
Organizational	3.1	3.2	0.1	1.0000
Evaluation	2.4	2.4	0.0	1.0000

Virginia. The comments provided by respondents are often provided as direct quotes, and sometimes paraphrased or summarized, but in all instances without direct attribution for purposes of anonymity as required by the research protocol.

As a prologue, in reading the commentary of the respondents in this section, one should remember that the sample size for Maryland was twice that of Virginia. As a result, the commentary from Maryland respondents may at times seem to be more comprehensive. This is not necessarily indicative that Virginia respondents had less commentary to provide, merely that there were fewer respondents to provide commentary. In addition, to eliminate redundancy in the following section, it is to be understood that references to the various components of capacity (i.e., situational, political, institutional, state, evaluation capacity) as well as national capacity, are preceded by the designation “AIS” if not otherwise noted.

Situational AIS Capacity

The responses of survey participants to questions relating to situational AIS capacity are detailed below. The closed-ended question below is numbered and phrased as administered in the survey. The responses to the open-ended question relating to situational capacity are presented in the section immediately following (Question 2), with this question phrased somewhat differently.

Question 1. Overall, in your opinion, based on your experience and your present understanding, the overall situational capacity of your state in relation to AIS is: a) well-developed, b) moderately-developed, or c) poorly-developed?

As shown previously in Figure 4, the mean for the perception of situational capacity was significantly greater in magnitude in Maryland (4.2) in comparison with Virginia (3.0). In the previous rank-ordering of the various group means of the various components of capacity shown in Figures 6 and 7, situational capacity ranked first in Maryland and second in Virginia. Permutation analysis indicated that the most significant differences in perceptual responses in this survey were in relation to situational capacity ($p < 0.02$) in Maryland and Virginia.

As shown in Figure 8 below, there were notable differences in the frequency distribution of categorical responses relating to perceptions of situational capacity by participants in Maryland and Virginia. In Maryland the majority of respondents (60%) felt that situational capacity was highly-developed while in Virginia only 20% of the participants responded similarly. In Maryland 40% of the respondents concluded that situational capacity was moderately-developed, while the majority of respondents in Virginia (60%) felt that situational capacity was moderately-developed. In Maryland, no respondents felt that situational capacity was poorly-developed while in Virginia 20% of the respondents believed that situational capacity was poorly developed

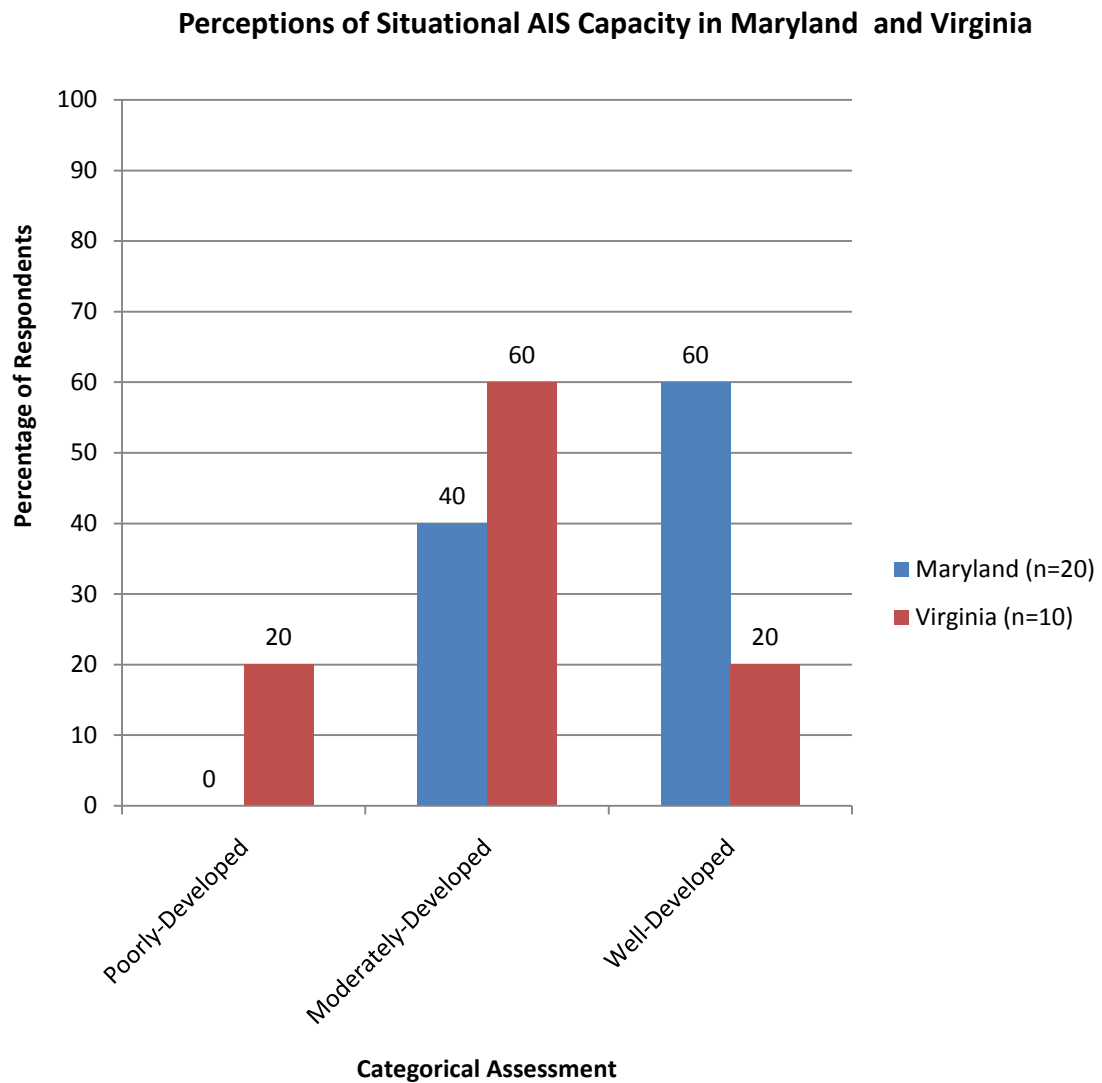


Figure 8. Perceptions of situational AIS capacity in Maryland and Virginia.

Question 2. Based on your work experience and your present understanding, what best illustrates the ability of your state or AIS program to identify, define, and respond to AIS issues, and what interest groups have helped in this process?

Maryland

In Maryland 20 respondents (100%) provided commentary on this open-ended question relating to situational capacity. Most responses were positive, and primarily related to: 1) professionalism and comprehensive coordination efforts, 2) the nature of the state monitoring programs, as well as 3) several species-specific comments. The few negative comments related to the lack of an AIS management Plan and a seeming lack of public input into agency AIS decisions.

Several comments were provided that were contextual in nature. One respondent noted that:

Maryland's situational capacity is moderate in relation to AIS. However, in Maryland and elsewhere in the U.S. situational capacity is much greater in relation to terrestrial plants than AIS.

And, it was noted by another respondent that as far as a basic philosophy relating to AIS:

Maryland is very precautionary and circumspect in relation to AIS. This is apparent with both the snakehead assessment, involving scientists outside the agency, and the assessment of non-native oyster issues.

It was also noted that while there has been considerable variability as far as AIS situational capacity in Maryland, it has improved markedly in the past five years. As far as the characterizing the well-developed nature of situational capacity in Maryland, one respondent noted that:

I guess our ability to get groups of workers from different units and agencies together to cohesively identify and resolve issues speaks to Maryland's situational capacity.

As far as the actual nexus within which coordination and situational responses occur, another respondent provided the following description:

In Maryland the ability to identify and define AIS issues is provided by several entities: 1) the Invasive Species Matrix Team (ISMT), 2) the Maryland Invasive Species Council (MISC), 3) and the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS). The ISMT developed from an informal informed group within MDNR, with common interests, which began with an exchange of e-mails and became formally recognized by MDNR and Governor O'Malley's Administration.

Several respondents elaborated on this theme, again emphasizing the role of the ISMT, and its effectiveness in identifying and defining AIS problems. One respondent noted:

The Invasive Species Matrix Team provides for group decisions on courses of action relating to AIS....[and] the ISMT is very much supported by Secretary Griffin; recommendations are sent along to the Governor, as necessary....Most solutions arise within the department.

And yet another respondent noted that,

When a new invader arrives MDNR is ready to respond. There are several groups within MDNR with the capacity to educate the public, coordinate monitoring, and write proposals for grants.

The collaborative nature of AIS efforts in Maryland was emphasized by several respondents who noted that:

...state officials also participate in MISC and the Mid-Atlantic Panel on Aquatic Invasive Species (MAIPAS) and interact with various federal AIS groups and other state agencies as well.

Although the Chesapeake Bay Program (CBP)⁴⁰ has a diminished role in relation to AIS activities in Maryland and Virginia in recent years, its role was formative in the Mid-Atlantic Region in relation to AIS management. The ANS Task Force has had an increasingly important role since the formation of the MAPAIS in 2003, as the role of the CBP has decreased. Although funding provided by the ANSTF to MAPAIS is generally rather small and divided among the member states, it is significant, particularly given the current budgetary constraints.

Various participants noted several species-specific responses to AIS as being representative of Maryland's situational capacity including responses to northern snakeheads, *C. argus*; rusty crayfish, *Orconectes rusticus*; zebra mussels, *D. polymorpha*; water chestnut, *Trapa natans*;⁴¹ *Didymo*, *Didymosphenia geminata*;⁴² the Chinese mitten crab, *Eriocheir sinensis*; and introduced oysters, *Crassostrea gigas* and *C. ariakensis*. Comments relating to

⁴⁰ The CBP's role was seminal in providing a regional forum for regional coordination of AIS activities and the diffusion of federal policies from the inception of the Exotic Species Work Group in 1991 until the CBP-mediated approval of the Mid-Atlantic Aquatic Invasive Species Panel by the ANSTF in 2003. The 2000 CBP Agreement established and completed three major regional AIS objectives.

⁴¹ The European water chestnut is a rooted, submersed, aquatic plant that anchors into the mud and extends upward to the surface of the water. The water chestnut was first introduced to North America in the 1870s. It can greatly impede recreational uses of the water. It was introduced into the Chesapeake Bay in the 1920s (Cao 2011). Most recently, when water chestnut populations increased in the Bird and Sassafras Rivers levels in the Upper Chesapeake Bay, considerable efforts were undertaken by MDNR to reduce populations to a manageable level from 1999-2004 (Naylor 2003) and thereafter.

⁴² *Didymosphenia geminata*, commonly referred to as "Didymo" is freshwater diatom, an algal species that is commonly called "rock snot" by anglers. While established in various areas in North America, only in the last several decades has this species expanded its range and become invasive.

Maryland's response and eradication efforts relating to the northern snakehead, (*C. argus*), mute swans (*Cygnus olor*) and water chestnut (*T. natans*) were cited most commonly. While not noted as frequently, nutria (*Myocastor coypus*), and introduced oyster management (as well as mute swans) were generally considered to be much more significant in terms of the comprehensiveness of the response—as each of these very complex issues took considerable time and effort to identify and define.⁴³

The significance of Maryland's water quality monitoring programs in identifying and defining AIS issues was noted by three respondents. It was noted that, in particular, the Maryland Biological Stream Survey has been important in the early detection and monitoring of zebra mussels and rusty crayfish. Other water quality monitoring programs—state, federal, and citizen—are equally significant, and have been important in monitoring distributional patterns of various other species of concern. This was summarized by one respondent who noted that:

Maryland has a good monitoring program. Although not directed at AIS, they are always in the back of everyone's mind. There are many information avenues and good communication between agencies, and considerable expertise across a broad taxonomic spectrum.

⁴³ Nutria, *M. coypus*, and the Asian oyster, *C. ariakensis*, are not generally discussed as frequently as other emerging AIS; as both have been addressed in a comprehensive fashion in various ways. This paper deals mainly with unintentional introductions although relevant references made by respondents relating to introduced species have been included.

Another participant noted that a particular difficulty in identifying and defining AIS concerns is that there is often considerable difficulty in telling what is native from what is not native, in relation to certain taxa.

Very few negative comments were made about Maryland's situational responses to AIS. However, several respondents noted that there appeared to be very little public input in decisions regarding AIS, aside from public comments on proposed regulations which often are minimal. This was particularly emphasized in relation to crayfish management.⁴⁴ Another respondent noted that, "There is a lack of congruence between what the public perceives as a problem and what MDNR perceives as a problem." Similarly, another respondent noted that:

No private groups or outside groups tend to be involved in AIS decisions made by MDNR. MDNR is able to identify threats with a good monitoring program that can assess them, yet there is much less public support than administrative support for managing them.

Several respondents noted that it is generally accepted that Maryland needs both a legislatively-mandated AIS Management Plan and a legislatively-mandated Invasive Species Council. However, one respondent noted that despite such "shortcomings" Maryland does "good stuff", with both the Chesapeake Bay Program and with Sea Grant".

Virginia

In Virginia 10 of the respondents (100%) provided commentary on the open-ended question relating to situational capacity. Most comments were

⁴⁴ For those species which are addressed by the legislature, (e.g., nutria mutes, swans, and snakeheads) the degree of public concern is generally much more pronounced, with considerably more public input than for other species of less concern.

positive and primarily related to: 1) the importance of the legislatively-mandated AIS framework in building situational capacity and facilitating the coordination of AIS issues, 2) the effectiveness of monitoring efforts, and 3) several species-specific comments.

One respondent noted that the Invasive Species Working Group and the Invasive Species Advisory Committee are “both-a product of the Virginia General Assembly” and comprise the most significant components of Virginia’s AIS situational capacity. However, as far as day-to-day coordination efforts, one respondent noted that many groups were essential and instrumental in identifying and defining AIS issues in Virginia. Groups identified, in particular, included the following: state agencies (e.g., VDCR and VDGIF), various local governments, and various environmental groups—most notably the Nature Conservancy.

Also, several respondents spoke to the strength of Virginia’s water quality monitoring program as an important component of situational capacity. It was noted that, “Virginia has one of the strongest aquatic monitoring programs among the states. It is probability-based and they’ve put effort into continuing to monitor for AIS.”

The extremely proactive response to zebra mussels in Milbrook Quarry in Northern Virginia and the successful eradication of zebra mussels at that site was the most frequently noted example of extremely good identification, definition, and response to an AIS issue. Various participants also noted particular species-specific responses to AIS as being representative of Virginia’s

situational capacity, including responses to the zebra mussels, northern snakehead, *Phragmites* (*Phragmites australis*), and the Rapa whelk, (*Rapana venosa*). However, in general, one respondent noted that,

There is a crisis mentality. Basically, it is catch as catch can, when a problem arises...no real discrete program is emphasized.

Analysis of Situational Capacity Responses

Differences in the governance of the Department of Natural Resources in Maryland and the agencies of the Natural Resources Secretariat Virginia, in particular VDGIF, seem to account for many of the observed differences in the perceptions of situational capacity. A history of these agencies and a detailed discussion of differences in agency governance are provided in Appendix B. In Maryland, those executive branch agencies tasked with implementing AIS statutes are centralized within MDNR and include the Wildlife and Heritage Service and the Fisheries Service, while in Virginia various agencies within the decentralized Natural Resources Secretariat have similar roles. The Department of Game and Inland Fisheries has the primary regulatory role, with the Virginia Department of Conservation and Recreation having more of a non-regulatory, support, and “natural heritage” stewardship role. While VMRC has considerable authority, its official regulatory role relates primarily to ballast water issues, which are essentially consistent with federal regulations.

Of considerable significance in Virginia, is that VDGIF has no direct role in the promulgation of AIS regulations—that is statutorily the responsibility of the Board of Game and Inland Fisheries (BDGIF) which basically directs VDGIF’s

activities. MDNR does not have a similar governing board. In fact, while there are numerous advisory groups which provide input in relation to various natural resource issues, none of these have a governing role and there are no such advisory boards that oversee AIS matters. Even within the Virginia Natural Resources Secretariat, such a governing board is unique in agency governance. As a result, careful deliberation is necessarily given to AIS issues in Virginia prior to a concerted agency response, with agency responses by MDNR less constrained than those of VDGIF.

Based on the commentary by Maryland respondents it is perceived by some respondents that MDNR's AIS program is not generally required to give considerable attention to public concerns or those of other agencies (aside from those required participants in BayStat) in making internal decisions relating to most AIS. While there is a Maryland Water Monitoring Council, there is no external deliberative body, aside from MAPAIS and MISC that provides a forum for the discussion of public concerns about AIS issues, which can then be brought to the forefront for consideration by the ISMT and the MDNR Secretariat. And, these groups (i.e., MAPAIS, MISC and the ISMT) can only provide recommendations. While the autonomy of MDNR's response to AIS issues has been strengthened in various ways in recent year, the perceived failure to consistently include constituent concerns in such AIS deliberations is potentially problematic, if it is a common occurrence.

In Maryland many factors serve to seemingly perpetuate a circumstance where the decisions made by MDNR are not subject to rigorous external review, as previously noted. Such an arrangement is characteristic of— at least in relation to the management of the AIS issue—a discourse model of administrative rationalism (Dryzek 1997). These factors include the following: 1) the lack of a formal requirement for MDNR to develop a State Multi-Species AIS Management Plan, with established objectives and implementation requirements, 2) the lack of a formal Invasive Species Council to coordinate AIS issues, 3) and the lack of a requirement to formally require coordination of the ISMT with MISC.

While MDNR has considerable authority to regulate AIS, and has done so most notably and successfully, with crayfish in the Potomac River, this effort details some of the inherent problems in MDNR's approach to AIS management. While regulatory promulgation in both Maryland and Virginia has a mandatory public comment period—it appears that there was little public concern about the crayfish issue in Maryland, based on reported public participation and commentary. This allowed for the policy process to proceed without the typical political controversy that often is inherent with such issues. While such agency autonomy allows for a rapid situational response by MDNR and facilitates the enactment of AIS regulations, it is apparent that more careful consideration needs to be given to such efforts.⁴⁵

⁴⁵ Such oversight prior to issuance of regulations might eliminate the possibility of enacting emergency regulations which are not enforceable or realistic, as with the emergency crayfish regulations enacted in the portions of the Potomac River Watershed

The Maryland General Assembly has enacted species-specific legislation to address particular AIS issues of major political concern (e.g., mute swans, introduced oysters, and northern snakeheads) but only in relation to specific species or specific issues, not in a comprehensive manner. The Maryland Invasive Species Resource Center website provides considerable AIS information online as well as an assortment of photographs, fact sheets, and posters relating to AIS, some of which are presently found in Maryland and others that are not (Maryland Invasive Species Resource Center 2011).

The situational capacity of the AIS agencies tasked with implementation of AIS policy in Virginia was perceived as being significantly less well-developed by respondents. However, there are various factors that may account for this, as previously noted. I suggest that it is not the ability to identify and define issues that is less-developed in Virginia, but the differences in the manner of agency governance within the Virginia Natural Resources Secretariat (particularly in relation to VDGIF) in comparison with MDNR.

As noted, the Virginia General Assembly has delegated to the Board of Game and Inland Fisheries (BGIF) the primary authority for not only promulgating additional AIS regulations, but also for directing the activities of the Department of Game and Inland Fisheries, which it oversees. VDGIF, in turn, is responsible for the primary implementation responses pursuant to such AIS regulations

in 2004. These were later dramatically changed before issuance in final form, as some provisions were not practical, as biologists themselves would generally not be able to make the necessary species identifications required by the emergency provisions.

issues in the Commonwealth, based on legislative mandate. The strategic plan for VDGIF, developed by BGIF, has several key components which are firmly based on constituent concerns, determined by periodic surveys. Also, the BGIF is comprised of appointed representatives from Virginia's 11 Congressional Districts, providing considerable external review that is quite democratic nature.

The Virginia Department of Conservation (VDCR) has primarily a support function in relation to AIS management, including the primary responsibilities for maintaining the AIS website, coordinating AIS meetings, and updating the Virginia Invasive Species Management Plan, as well as managing AIS on natural areas—primarily *Phragmites*. The Invasive Species Working Group and Invasive Species Advisory Committee primarily determine the prioritization of AIS concerns, which are displayed on the VDCR website titled *Twelve Highly Invasive Species Every Virginian Should Know* (VDCR 2011). This list includes six terrestrial invasive species as well as six aquatic invasive species: 1) zebra mussels, 2) rusty crayfish, 3) Chinese mitten crabs, 4) northern snakehead fish, 5) Rapa whelk, and 6) *Phragmites* (VDCR 2011).

There are additional governance issues that affect situational capacity in these states. The Natural Heritage Program in Maryland has a somewhat similar role in relation to AIS as its counterpart in Virginia, although it is not a formally designated one. However, in Maryland, the Natural Heritage Program is part of the Wildlife and Heritage Service within MDNR while in Virginia the Natural Heritage Program is a part of the Department of Conservation and Recreation.

In Maryland the Wildlife and Heritage Service is a separate entity from the Fisheries Service, with each under the direction of a different Assistant Secretary. In Virginia both freshwater fisheries and wildlife management responsibilities remain within one group, the Department of Game and Inland Fisheries. This results in overlapping authorities in the implementation of AIS policy in Maryland relative to Virginia.

Another factor that might affect situational response in these states is the vertical involvement of federal agencies with MDNR's AIS organizations relative to those of the Virginia Natural Resources Secretariat. The Maryland Invasive Species Council is formally facilitated by a USDA scientist, at present, and leadership in MAPAIS and its precursor groups in the Chesapeake Bay Program (CBP) has been dominated by Maryland representatives. The regional AIS groups previously coordinated by the CBP were chaired by four different Maryland members and one Pennsylvania member, but with no Virginia representative serving in such a capacity—whether by choice or otherwise. The regional successor to the CBP-mediated AIS groups, the ANSTF-mediated MAPAIS has had only three chairs—two of which were Maryland representatives and one a Pennsylvania representative. Whether Virginia's lack of leadership in these organizations is intentional or not is unknown. However, Virginia has actively participated in all major regional groups and policy initiatives undertaken by these regional entities. This lack of regional leadership in AIS groups (both CBP and ANSTF), coupled with the more “democratic” management structure of

VDGIF which has a governing board that oversees its activities, might contribute considerably to the perception of increased situational capacity in Maryland relative to Virginia.⁴⁶

Summary of Situational Capacity Responses

Definition - The ability of a state to identify and define AIS issues as they arise.

1. The rank order of situational capacity was relatively high in both Maryland and Virginia. In Maryland it was ranked first and in Virginia it was ranked second, as far as the six components of capacity assessed.
2. Permutation analysis indicated that there were significant differences in perceptual responses relating to situational capacity by Maryland respondents relative to perceptual responses made by Virginia respondents, with Maryland scoring higher ($p < 0.05$).
3. Both states have a long history of regional involvement in the process of identifying and defining AIS issues (since 1991) in the context of extralegal AIS groups. Such groups have been facilitated by both the Chesapeake Bay Program (ESWG and ISWG) and the ANS Task Force (MAPAIS).
4. Both Maryland and Virginia currently have Invasive Species advisory groups. Virginia's Invasive Species Working Group was created by legislative mandate while Maryland's Invasive Species Council is *ad hoc* in nature.
5. Virginia has developed a comprehensive invasive species management plan, which allows for a formal identification and definition of broad AIS issues and provides goal, objectives, and actions to address such issues. Maryland does not have such a comprehensive plan, but does have several single species plans such as the mute swan management plan, which was mandated by the state legislature.
6. MDNR has considerable autonomy in terms of formally identifying and defining AIS, for regulatory purposes. VDGIF, however, is overseen by a

⁴⁶ Another important difference in the governance of the Maryland and Virginia Secretariats is that the former is more centralized and tends to undergo frequent reorganization—as is currently being considered—unlike the latter, which is more decentralized, and particularly in relation to VDGIF, tends to undergo less dramatic reorganizations.

governing board, which has the responsibility of designating species as AIS and other regulatory aspects of AIS management in Virginia.

7. MDNR's Invasive Species Matrix Team (ISMT), a collaborative *ad hoc* organization, was noted as being very important in identifying and defining AIS issues, as were various groups outside of DNR—which collaborate with the ISMT.
8. MDNR's approach to AIS management was noted by respondents as being generally administrative in nature, with little public input.
9. The need for a comprehensive, legislatively-mandated AIS management plan and Invasive Species Council (ISC) was noted frequently by Maryland respondents as a necessary tool to build AIS capacity.
10. In Virginia, many respondents noted the importance of the legislatively mandated AIS framework in facilitating situational capacity (i.e., Invasive Species Working Group (ISWG), Invasive Species Advisory Committee (ISAC), and the Virginia Invasive Species Management Plan. The Nature Conservancy was noted as having had an important role in relation to situational AIS capacity in Virginia.
11. Both Maryland and Virginia respondents cited several species-specific examples which illustrated the responsiveness of these states to particular AIS issues and a high degree of situational capacity. In Maryland, responses to mute swans, nutria, northern snakeheads, rusty crayfish, zebra mussels, water chestnut, Didymo, and the Chinese mitten crab were noted most often. In Virginia, responses to zebra mussels, northern snakeheads and *Phragmites* were most often noted.

Political AIS Capacity

The responses of survey participants to questions relating to AIS political capacity are detailed below. The closed-ended question below is numbered and phrased as administered in the survey. The responses to the open-ended question relating to political capacity (Question 4) are presented in the section immediately following, with this question phrased somewhat differently.

Question 3. Overall, in your opinion, based on your work experience and your present understanding, the level of political action and commitment in your state

related to proactive AIS management is: a) well-developed, b) moderately-developed, or c) poorly-developed?

As shown previously in Figure 4, the mean for the perception of political capacity was markedly greater in magnitude in Maryland (2.9) in comparison with Virginia (2.2). In the previous rank-ordering of the various group means of the various components of capacity shown in Figures 6 and 7, political capacity ranked fourth in Maryland and fifth in Virginia. Permutation analysis indicated that there were no significant differences in the perceptual responses of respondents in relation to political capacity, ($p > 0.05$, $P = 0.7$) in Maryland and Virginia.

As shown in Figure 9 below, there were notable differences in the frequency distribution of categorical responses by participants relating to perceptions of political capacity in Maryland and Virginia. While 15.8% of the Maryland respondents believed that political capacity was well-developed, no Virginia respondents believed that political capacity was well-developed in Virginia. In both Maryland and Virginia, the majority of respondents (63.2% and 60.0% respectively) believed that political capacity in their states was moderately-developed. While 21% of the Maryland respondents believed that political capacity was poorly-developed in their state, 40% of the Virginia respondents similarly believed that political capacity was poorly-developed.

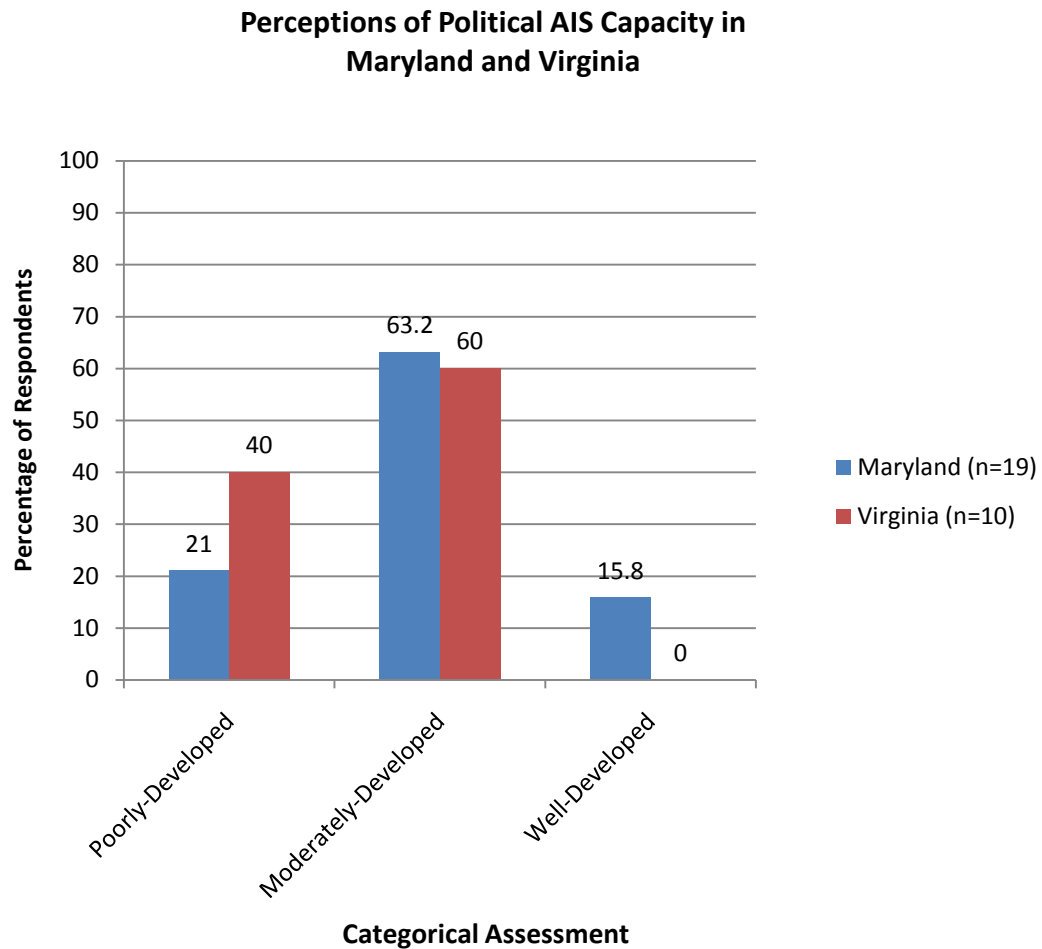


Figure 9. Perceptions of political AIS capacity in Maryland and Virginia.

Question 4. What best illustrates the political commitment and support of your state to your state AIS program and requires planning and coordination related to such issues?

Certain common themes were noted in relation to this open-ended question relating to political capacity in Maryland and Virginia. One respondent noted that:

Basically political will is based on the tension provided by public sentiment (from various factions) with commensurate capacity being developed and sustained as a result.

Another respondent commented that:

In relation to AIS, Maryland and Virginia are familiar in many ways as far as policies and laws. Both states have little proactive political support, unlike some other states, and both states have some evident failures in the leadership of agencies, legislatures, and executives. They might have to wait until the next CBP agreement for any concerted regional effort.

Maryland

In Maryland 18 respondents (90%) provided commentary relating to political capacity. The comments primarily related to 1) a broad and diverse network of support for AIS management group 2) increased legislative support in recent years, and 3) the overall low priority of AIS issues in general.

As far as legislative support, one respondent very circumspectly noted that:

Maryland does better than most states. There appears to be low commitment at the government level as the result of other priorities. However, there is considerable public and volunteer interest.

Similarly, another respondent noted that, "Political capacity is high in terms of NGOs and MD residents, but poor in terms of legislative response, with no real legislative champion.

However, this criticism was qualified by a respondent who noted that there has been strong legislative support for non-native AIS issues in terms of bills introduced in the Maryland General Assembly in recent years. However, it was noted that the nature of the political response varies from species to species, which is rather typical. While initial concerns about zebra mussels have been sustained in Maryland, as far as snakeheads, “aside from the initial hysteria” there hasn’t been the same sustained concern or response, despite their potential ecological effects.

Various statutes were cited as comprising the corpus of AIS statutes in Maryland, which reflects political support of state AIS efforts by the Maryland General Assembly. Of greatest significance have been the State of Nuisance - Abatement and Summary Abatement Procedures Act (SNASAPA) of 2003, and the 2008 amendments to the 2003 Act, as well as the regulations promulgated pursuant to these laws. Invasive crab legislation, a bait law and a ballast water law were also enacted, although the latter was later repealed. Various other zebra-mussel related regulations of lesser importance have been promulgated (e.g., zebra mussel-bait free certification).

In particular, since the 2008 SNASAPA amendments, MDNR has had greatly increased authority and autonomy as far as promulgating AIS regulations. And it has exercised this authority well. One respondent noted that as far as the responsibility for implementing AIS statutes, statutory authority has largely been delegated to the Fisheries Service. However, it was noted that the Invasive

Species Matrix Team (ISMT) is very important in providing information and staff expertise to aid in regulatory decisions made by the Fisheries Service, and serves to broaden the nature of the coverage provided.

One respondent noted that the framework for AIS regulation in Maryland seems a little “gray” in some areas, and at times the jurisdictional roles are not clear in the management of wildlife species considered as AIS (e.g., nutria and mute swans) and more traditional fish and aquatic invertebrate species considered as AIS. These taxa have traditionally been handled by different agencies in MDNR. An example noted was the management of mute swans and nutria. These are considered to be quasi-issues from the perspective of the Fisheries Service, but major issues from the Wildlife and Heritage Service perspective.

While most of the statutory authority for AIS management in Maryland is delegated to the Fisheries Service for species traditionally considered to be AIS (e.g., fish and aquatic invertebrates), the Wildlife and Heritage Service has considerable statutory and regulatory authority to address various other nuisance species, such as nutria, mute swans, and various other species. Moreover, despite the considerable legal authority delegated to the Fisheries Service in relation to AIS, this agency has shown relatively little leadership in regional AIS organizations or in state AIS representation, in comparison with MDNR units such as the Wildlife and Heritage Service.

There was a general consensus as to the well-developed nature of political capacity illustrated by mute swan and nutria management in Maryland. Several respondents cited Mute Swan Management as the best overall illustration of broad, “across-the-board” political support for the management of a particular AIS in Maryland. Such efforts have been lauded by conservation groups and other states and both initiated and supported by legislative mandates. One respondent noted that:

Legislatively, the Maryland General Assembly was supportive in passing enabling legislation, and the U.S. Congress was supportive in having mute swans removed from a federal list that protected them. The past two governors have been very supportive in the implementation and control required by the management plan that was developed. And conservation organizations have been supportive as well.

But there are several unique and perplexing aspects to the mute swan management program in Maryland. While its effectiveness is not denied by anyone; one respondent had an alternative perspective on the necessity of mute swan management, viewing it as merely a mechanism for the perpetuation of agency involvement.

The respondent noted that the mute swan issue could have been more simply addressed by the hunting constituency, with no real need for the considerable degree of administrative intervention used. While acknowledging the effectiveness of the administrative regulation of mute swan populations in Maryland, the respondent noted that it is questionable as to how the majority of either the general public or the general hunting constituency feel about the matter, and whether their concerns were included in the decision-making

processes. As far as a concerted political effort to eradicate a species deemed invasive by state and federal agencies conservation agencies as well as environmental groups—mute swans are a major AIS management success. But in terms of the necessity of the particular approach, one particular respondent felt that there might have been insufficient deference to public sentiment. While managed hunting is one means of population reduction noted by the USFWS, Maryland has chosen to address the matter with an eradication effort managed strictly by MDNR, ostensibly to preclude the inadvertent taking of migrating native species of swans. It was emphasized that MDNR manages mute swans in such a singular fashion that the public is still legally restricted⁴⁷ from hunting mute swans, despite the ongoing efforts by MDNR to eradicate the remnants of the original established population.

One respondent juxtaposed the issue of mute swan control in Maryland as an example of bad AIS management and nutria control as an example of good AIS management. The respondent noted that, in contrast to mute swan management efforts, the management of nutria has been addressed by an elaborate partnership of stakeholders, federal enabling legislation, and an eradication effort managed very effectively by USDA's APHIS, pursuant to

⁴⁷ There has never been a hunting season for mute swans in Maryland. Basically they were a protected species prior to the population reaching limits such that the Maryland General Assembly enacted legislation to reduce the population size.

federal requirements.⁴⁸ This level of political support is very atypical of state AIS management in Maryland and Virginia in general.

Aside from the noted controversy regarding the mute swan issue, and despite the perceived lack of a legislative champion for AIS management in Maryland presently,⁴⁹ one participant commented that there is still considerable administrative capacity in Maryland's AIS program noting that:

Political capacity is well-developed in Maryland at the organizational level with midlevel and lower levels of management and staff, particularly in relation to the Wildlife and Heritage Service and the Invasive Species Matrix Team.

It was noted that public support for AIS management has been variable from one AIS issue to another. Two particular examples cited as illustrations of considerable public interest in AIS issues were 1) the support given for the construction of wader wash stations, by angling groups, to prevent the spread of *Didymo*, and 2) the water chestnut eradication efforts in the Upper Chesapeake Bay. However, it was concluded that it would be beneficial to Maryland AIS efforts to have more public involvement—particularly at the legislative level—in order to increase related political pressure, relating to AIS issues.

⁴⁸ The management of nutria on Maryland's Eastern Shore (introduced in 1943, by the federal government to Backwater National Wildlife Refuge) was addressed by the 26-member Nutria Partnership, formed in 1997 and comprised of 26 federal, state, and private organizations. The Nutria Eradication and Control Act of 2003, introduced by Wayne Gilchrest (MD) in 2003 was instrumental in providing the appropriations and APHIS support that allowed for the eradication of nutria from Backwater National Wildlife Refuge in 2004, with eradication efforts ongoing elsewhere in Maryland.

⁴⁹ Wayne Gilchrest (R-MD), who was not re-elected to the House of Representatives in 2008, was a strong federal advocate of AIS management efforts, an "AIS champion," if you will, for Maryland.

Aside from the preceding clusters of comments, there were two singular comments of interest. While several participants noted the significance of the media in relation to AIS efforts, only one respondent noted the considerable political influence resulting from frequent positive coverage of Maryland's AIS efforts by the media: newspaper, radio, and television. In a related comment, another respondent noted that the increased availability of information via the internet, in recent years, has greatly facilitated participation in AIS issues, providing informational access to stakeholders

Several rather pragmatic comments were made. One respondent noted that the recent mandatory requirements imposed by U.S. EPA on Maryland and other Chesapeake Bay Watershed states as far as Total Maximum Daily Load requirements, pursuant to the Clean water Act, will require the dedication of considerable efforts by the affected states to address water quality impairments relating to nutrients (i.e., nitrogen and phosphorus) and sediments. It was projected by this respondent that "AIS will have to take a back seat."⁵⁰ These efforts will sap most of the energy and resources." Another respondent noted that:

⁵⁰ ELI (2008) noted in its seven-state case study relating to the use of TMDL's as a mechanism for AIS management that AIS have been increasingly acknowledged as causes of impairments in segments of waters listed as impaired and placed on state 303(d) lists. Generally, AIS have been listed as non-pollutant impairments, and only occasionally as pollutant impairments. ELI concluded that the Clean Water Act can be invoked as a regulatory mechanism to the degree that states chose to do so. They can list water segments on their 303(d) lists as impaired by invasive species without recognizing AIS as a cause of impairment on their 305(b) reports.

There appears to be a relatively slow response to potentially damaging issues and little understanding of the potential harm. There seems to be lip service when issues are in the news, with concerns soon diminishing.

Virginia

In Virginia 10 of the respondents (100%) provided commentary on the question of political capacity. The comments provided related generally to 1) the importance of various interest groups (primarily the Nature Conservancy), 2) the significance of legislative support, and 3) the perception of a lack of role definition.

Various interest groups were noted as being important in Virginia's AIS efforts. One respondent noted that, "The Nature Conservancy has been instrumental in AIS management in Virginia."⁵¹ This was echoed in the comments of various other respondents as well. Although it was noted that The Nature Conservancy is much more involved with terrestrial invasive species than aquatic invasive species, various efforts have established their role in addressing AIS as well. Their ownership of the Virginia Coast Reserve—which consists of 14 barrier islands that extend 60 miles from the Maryland border to the Chesapeake Bay—and related *Phragmites* eradication efforts, the organization of the "Salty

⁵¹ The significance of the Nature Conservancy's role in AIS issues in Virginia is highlighted by an uncorroborated anecdotal account of the impetus for the initial establishment of the Virginia ISC Council. It was recounted by one respondent that a Virginia environmental science class first came up with the idea, and drafted a mock bill of sorts as a class project, and then found an advocate with the Nature Conservancy who in turn found a legislative sponsor who reviewed the suggested bill. Purportedly, after due consideration and revision, it was later introduced as a bill and subsequently enacted by the General Assembly.

Water Species Conference” in 2009, and their role on the Virginia Invasive Species Advisory Committee firmly establishes the Nature Conservancy’s role in AIS management in Virginia. The Nature Conservancy’s involvement in AIS is national in scope, although their influence varies from one state to another.

Most respondents noted that the proactive legislative support from the Virginia General Assembly has been instrumental as far as political support for AIS efforts. This is best summarized by one respondent who noted:

Proactive political support for AIS efforts in Virginia is best illustrated by the mandates requiring the development of the Invasive Species Council, and its successor, the Invasive Species Working Group, the Invasive Species Advisory Committee and the Invasive Species Management Plan, although there is relatively no money to support these mandates.

The formal legal establishment of the Invasive Species Council (ISC), superseded by the Invasive Species Working Group (ISWG)—chaired by the Secretary of the Virginia Natural Resources Secretariat⁵²—and the mandated development of the Invasive Species Management Plan, were noted as being most illustrative of political capacity in Virginia. However, one respondent noted that, of the various legal mandates that form the framework of AIS management in Virginia and typify the nature of political capacity, the most significant indicator of political capacity is the Virginia Invasive Species Management Plan, and the ANSTF-approved ANS Management Plan that was subsequently developed.

⁵² The most recent 2009 amendments to the NANSPA mandated that the Secretary of the Natural Resources Secretariat continue to chair the Invasive Species Working Group and that the Secretary of the Department of Agriculture and Forestry serve as Vice-Chair.

Despite the overall satisfaction with the political support from the legislature for AIS management in Virginia and the framework for AIS that characterizes such support, there is some consternation by several respondents about what is perceived as conflicting interests and missions.

One respondent noted that:

There seems to be confusion and inconsistency as far as accountability and concern about impacts. There is no real sense of political action. Some state staff clearly are not supportive of AIS efforts.

More pointedly another respondent noted that:

As far as political commitment there is not a clear message and no clear concerns. While the ISWG and ISAC exist there is limited support for them.

While at first glance the aforementioned comments appear rather critical, they typify the discourse model of democratic pragmatism, as described by Dryzek (1997). While there are conflicts and multiple missions, these typify the sorts of conflicts between factions that we find in democratic settings and the agency responses typify the sorts of negotiations that are characteristic of democratic pragmatism, particularly in relation to the governance of VDGIF. A wide range of stakeholders having input in relation to AIS issues,

Analysis of Political Capacity

When evaluating political capacity in the Chesapeake Bay Watershed in relation to AIS, it is essential to note the contribution of the Chesapeake Bay Program (CBP), as described in Chapter 2, just as it is equally necessary to acknowledge its role in relation to situational capacity as well. The CBP was

essential in galvanizing initial support from key stakeholders in the wake of the “invasion” of zebra mussel and the subsequent enactment of NANPCA in 1990. From 1991-2003, the CBP provided the key forum for regional dialogue relating to AIS, as well as the fulcrum for the politicization of issues. The CBP oversaw the development of a regional policy for AIS and the development of an implementation plan for the policy. Efforts were made to develop a regional AIS Management Plan, but there was not sufficient political support for such an effort. The CBP also mediated various regional AIS issues.

The CBP 2000 Agreement provided the first formal “normative” regional prioritization of AIS issues in the Chesapeake Bay Watershed, with multiple commitments adopted, all of which have been fulfilled. The most relevant of these objectives included 1) the identification and ranking of non-native species as either problematic or potentially problematic invasive species (both aquatic and terrestrial), and 2) the development of management plans for those species considered to be most threatening to the integrity of the Chesapeake Bay (Chesapeake Bay Agreement 2000). In these early CBP-mediated efforts, many groups, including Maryland and Virginia, were very involved in AIS deliberations and regional AIS policy formulation.⁵³

⁵³ The Chesapeake Bay Commission had a lead role in the initial CBP efforts to address AIS and develop a regional AIS policy and later focused on efforts relating to ballast water primarily, producing a related publication. Both Maryland and Virginia subsequently developed ballast water legislation (although Maryland’s ballast water law was later repealed).

AIS issues are sufficiently problematic that both Maryland and Virginia have various AIS-related laws and regulations, as necessary to address various issues. Political initiatives by the Maryland General Assembly have focused on AIS only as necessary, in a species-specific and otherwise patchwork fashion, and in a general way to formally address aquatic nuisance abatement and access to private land.

However, Maryland has not legislatively mandated a framework for AIS coordination (i.e., Invasive Species Council) or required the development of an Invasive Species Management Plan that includes AIS.⁵⁴ As a result, the management of AIS in Maryland is more administrative in nature and managed directly by the Maryland Department of Natural Resources—with considerable administrative capacity but without considerable outside stakeholder participation.⁵⁵ The ISMT, as previously noted, generally has the responsibility of gauging both political interest and ecological risk in relation to particular AIS issues.

While there is still no comprehensive AIS legislation in Maryland, the legislative response to the various questions that arose as a result of the northern snakehead fish introduction in Crofton in 2002, was formative for AIS management. However, the enactment of SNASAPA in 2003; while notable in its

⁵⁴ Although the Maryland Emergency Response Plan for Forest Pests is exemplary, it does not address AIS.

⁵⁵ With issues such as introduced oysters and various AIS managed by the Wildlife and Heritage Service (e.g., nutria and mute swans), for which legislation detailed management strategies, there was considerable stakeholder interest. For other issues there has been considerably less.

approach to AIS management, and definitive in providing political support for MDNR AIS efforts, still does not provide for a legislative framework for a coordinated approach to AIS management in Maryland

As with SNASAPA described above, Maryland's management approach to mute swans, while lauded by many, typifies the discourse model of administrative rationalism described by Dryzek (1997). It was noted by one respondent that the State of Maryland could just as easily, and probably just as effectively, have managed the mute swan population in Maryland via the hunting constituency as is done in Virginia and Pennsylvania. In these states, they are hunted as nuisance species—with no limit; Virginia also has a specified season with a bag limit for Tundra Swans.

Generally, in Maryland, when a particular AIS issue is of major concern the General Assembly enacts regulations that stipulate the actions they desire; less significant matters are left to the MDNR's discretion. This has been the policy approach with invasive crab species, mute swans, and introduced oysters.

In recent years, the Nature Conservancy has been very involved with AIS issues in Virginia, but less involved in Maryland. However there are fewer venues for involvement in Maryland, aside from the Maryland Invasive Species Council in which the Nature Conservancy participates. The Chesapeake Bay Foundation has seemingly had very little involvement with AIS in Maryland or Virginia, aside from the issue of non-native oyster issues introductions, which are not formally

addressed in this study as they represent a proposed intentional introduction rather than an unintentional introduction.

In Virginia, however, the political support from the Virginia General Assembly has been sufficient to establish a legislatively-mandated framework for AIS management. As noted in Chapter 2 the legislatively-mandated Invasive Species Council created in 2003, which “sunset” in 2006, was sustained as the Invasive Species Working Group (ISWG) in 2006 by Executive Directive 2, and ultimately codified as such in 2009. This group receives input from an associated Invasive Species Advisory Committee (ISAC), based on the federal model. These groups provide for considerable coordination of AIS activities and are comprised of stakeholders from various interest groups. The legislatively mandated *Virginia Invasive Species Management Plan (2005)* also required the identification and participation of the various AIS stakeholders in the state and has facilitated coordination of AIS efforts with these groups. Also, the Non-indigenous Aquatic Nuisance Species Act of 2009, as well as the 2003 Act which it amended, specifies particular roles for particular agencies (VDGIF, BGIF, and VDCR). Although these groups have some overlapping responsibilities, the general duties are rather clear. However, although an excellent AIS framework is in place in Virginia, there is little funding for the AIS efforts in Virginia or in Maryland either.

Summary of Political Capacity Responses

Definition - The ability of a state to make and implement AIS policy decisions with appropriate public input.

1. The rank order of political capacity was relatively low in Maryland and Virginia. In Maryland it was ranked fourth and in Virginia it was ranked fifth, as far as the six components of capacity assessed.
2. Permutation analysis indicated that there were no significant differences in perceptual responses relating to political capacity by Maryland respondents relative to perceptual responses by Virginia respondents, with Maryland scoring higher ($p>0.05$).
3. In Maryland, AIS policy is not addressed in a comprehensive way as there is no statutory or executive directive to develop a Multi-Species AIS Invasive Management plan. Instead, there are various piecemeal efforts to address such concerns, which often are successful. Virginia, however, has a well-articulated, well-coordinated AIS program providing for a more cohesive AIS policy, with a statutory approach to developing and implementing AIS policy
4. Since 2003, both MDNR and BDGIF have been given considerable authority to draft and promulgate AIS regulations with appropriate legislative review. MDNR has considerable autonomy in this process. DGIF, however, must rely on oversight and approval from BGIF in drafting such regulations, which allows for more public input and a more circumspect and democratic approach to such deliberative AIS policy processes. Maryland has no governing board comparable to BGIF in relation to MDNR's involvement in AIS management.
5. Statutes relating to AIS in Maryland and Virginia generally delegate regulatory authority to state agencies with fish and wildlife responsibilities.

Institutional AIS Capacity

The responses of survey participants to questions relating to institutional AIS capacity are detailed below. The closed-ended question is numbered and phrased as administered in the survey. The responses to the open-ended question relating to institutional capacity (Question 6) are presented in the section immediately following, with the question phrased somewhat differently.

Question 5. Overall, in your opinion, based on your experience and your present understanding, the degree of institutionalization of your state AIS program is: a) well-developed, b) moderately-developed, or c) poorly-developed?

As shown previously in Figure 4 above, the mean for the perception of institutional capacity was markedly greater in magnitude in Maryland (2.9) in comparison with Virginia (2.2). In the previous rank-ordering of the various group means of the various components of capacity shown in Figures 6 and 7, institutional capacity was ranked fifth in Maryland and sixth in Virginia. Permutation analysis indicated that there were no significant differences in the perception of respondents in Maryland and Virginia in relation to institutional capacity ($p > 0.05$, $P = 0.7$).

As shown in figure 10 below, there were notable differences in the frequency distribution of categorical responses relating to perceptions of institutional capacity in Maryland and Virginia. In Maryland the majority of respondents (73.7%) felt that institutional capacity was moderately-developed while in Virginia 50.0% of the participants responded similarly. In Maryland 5.3% of the respondents felt that the institutional capacity was well-developed while in Virginia no respondents felt that institutional capacity was well- developed. In Maryland, only 21 % of the respondents concluded that institutional capacity was poorly-developed in their state while in Virginia, 50% of the respondents felt that institutional capacity was poorly-developed.

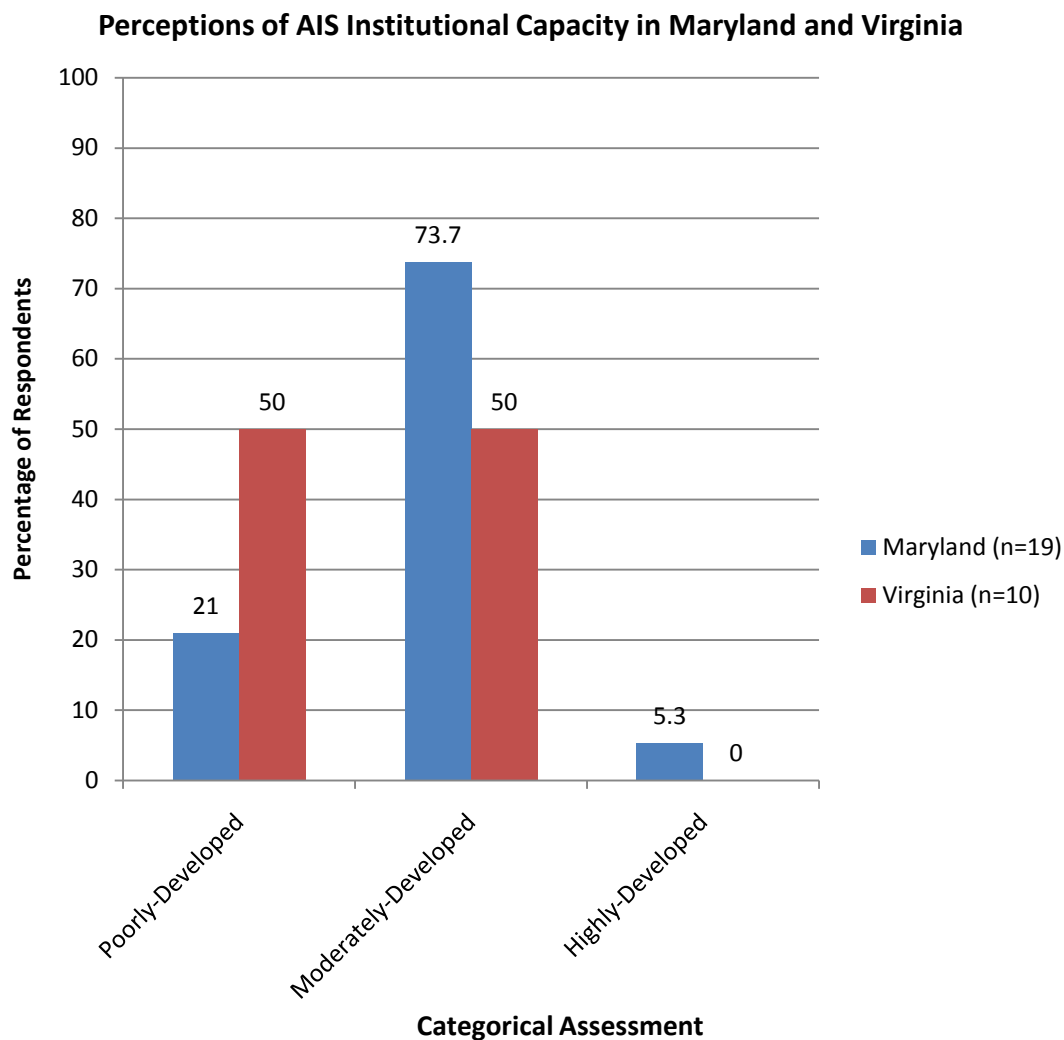


Figure 10. Perceptions of institutional AIS capacity in Maryland and Virginia.

Question 6. Based on your work experience, and your present understanding, what is the nature of the legal framework of statutes and regulations (or other mechanisms for governance) that have established your state AIS program and to what degree do they allow for its sustainability?

Certain common themes were noted in relation to this open-ended question regarding the “minimalist nature” of institutional capacity in Maryland and Virginia. One respondent noted that:

Both Maryland and Virginia lack adequate legal authority. The next real progress might have to wait until the next CBP agreement.

Maryland

In Maryland, 15 respondents (75%) provided commentary on this open-ended question relating to institutional capacity. The primary themes related to: 1) the importance of executive branch directives (i.e., BayStat and the ISMT),⁵⁶ 2) the existing legal nexus of laws, 3) the lack of a unified AIS program and management plan, and 4) the need for federal partnering (e.g., ANSTF).

Several respondents spoke positively of the nature of institutional AIS capacity in Maryland, although such comments represented the minority perspective on this issue. One respondent noted that:

I think from a legislative standpoint there is sustainability, in particular, because MDNR has started addressing things through the Invasive Species Matrix Team, a loosely-formed hub that can be worked with to facilitate the introduction of legislation.

⁵⁶ The description of the Invasive Species Matrix Team in the Maryland Manual is as follows: (<http://www.mdarchives.us/msa/mdmanual>): “In August 2007, the Invasive Species Matrix Team began meeting. The Team leads the Department's scientific and technical response to non-native species which pose potential threats to Maryland's natural ecosystems and the Chesapeake Bay. Besides advising the Secretary of Natural Resources on policy and regulations pertaining to invasive species, such as mute swans, nutria, and zebra mussels, the Team also shares information, works to prevent introduction, and coordinates early detection and rapid response to the threat of invasive species.” Although this group is sometimes referred to as the AIS Matrix team, it more properly is designated as the Invasive Species Matrix Team—with aquatic not being part of the official title.

Another respondent noted that:

The institutional response to AIS in Maryland basically exemplifies the strength of the executive branch. The BayStat Program⁵⁷ and the ISMT are the best examples.

It was also proffered that institutional capacity is evident in the related statutes in the Annotated Code of Maryland that specifically address AIS—and relevant chapters of COMAR.⁵⁸

One of the more circumspect comments, however, was made by a respondent who noted both the nature and limitations of institutional AIS capacity in Maryland stating that:

The ISMT is probably the most important aspect of institutional capacity in MDNR as much as there is any. As long as the current MDNR Secretary is around the matrix team will exist. However, there is little in the way of structural or legislative mandates to sustain it. Regardless though, the various AIS laws regulations and policies will require that some ongoing mechanism remain in place to implement and enforce them. However there is no line item budget allocation for AIS and no unit or division that is labeled as AIS; there is no funding to support the program, and no management plan to guide it.

⁵⁷ The 2007 BayStat Executive Order (E O 01.01.2007.02) issued by Governor O'Malley emphasizes the need to monitor and measure the progress of government efforts to protect and restore the Chesapeake Bay by providing accurate and timely data to policy makers. Representatives from the Departments of Agriculture, Natural Resources, Environment, and Planning as well as the University of Maryland (CEES) and various other groups. Quarterly meetings are required at a minimum. Although, AIS are not addressed specifically as an issue, such matters, "as deemed necessary," are addressed in this forum (Maryland BayStat, [http:// www.baystat. maryland.gov/](http://www.baystat.maryland.gov/), accessed Dec 10, 2010.). The governor and his cabinet also have much more frequent regular meetings at which such issues could be discussed if necessary.

⁵⁸ The various AIS laws and regulations in Maryland and Virginia have been discussed previously and are detailed on the previously noted websites.

Similarly another respondent stated that although the ISMT is very important, institutional capacity is not very well-developed in Maryland noting that:

The regional ANS panel (MAPAIS) provides some stable structure and there is considerable federal-partnering as far as *Phragmites* and nutria. A state Multi-Species AIS Management Plan and a mandated MISC are needed. Article 4, Section 205.1 of the Annotated Code of Maryland sets the general tone and authority for regulating the transport and importation of AIS, such as developing black lists, to restrict certain species. While legislation has been enacted to allowed access to private lands, in response to the Crofton Pond incident, the law is rather murky. However, within guidelines, MDNR can now draft AIS regulations within the Department, as needed.

The perceived need for a more sustainable AIS structure was noted by several respondents, most specifically as far as the need for a Multi-Species AIS Management Plan. One participant summarized these comments well, noting that:

As far as institutional capacity, Maryland needs an AIS Plan. Other states have plans and they serve to guide the development of AIS legislation. In Maryland responses to AIS are more of a knee-jerk nature—reactive versus proactive (e.g., the snakehead response). A good AIS plan is needed for a coordinated effort.

Several other comments were made that expressed a perceived need for improvements to Maryland's AIS program. It was noted that while there are various groups in MDNR with collateral AIS responsibilities; there is no specific group with AIS as their sole responsibility. It was also noted by several respondents that the state mode of response to AIS concerns is generally "reactive rather than proactive," with no broad preemptive legislation or

regulations. Most critical, and quite singular, was the comment of one respondent who noted that:

As far as institutional AIS capacity, there are many programs in the state that probably aren't justified at all—many are self-perpetuating, bureaucratic endeavors. There is no particular program needed for AIS and there is a very marked difference between addressing pathogens and pests and agricultural pests that cause economic damage as opposed to species that are simply non-native.

Despite the criticism of the lack of formal institutionalization of Maryland's AIS program, one respondent noted the apparent capacity in Maryland's AIS program despite this seeming shortcoming, stating that:

There is considerable extralegal capacity in Maryland, despite the lack of institutional structures, with Maryland having a strong focus on the Chesapeake Bay and considerable input from nonprofits.

Rather pragmatically, another respondent noted that, "The situation is challenging and there are considerable limitations—but the situation is comparable to most states."

Virginia

In Virginia, 10 respondents (100%) provided commentary on the open-ended question of institutional capacity. The comments primarily related to the following: 1) the significance of the legislative AIS framework, and 2) frustration with the lack of implementation of AIS initiatives. The following comment by a respondent is parenthetical to the others:

A good framework is in place for injurious species in Virginia. Although Virginia is not as formalized as some states; it is "in the shadows" somewhat. The various tools that are employed are not fully incorporated into the official bureaucracy.

As noted previously and described in detail in Appendix B, the legal framework for AIS management in Virginia is much more formalized than in Maryland—with a mandated Invasive Species Working Group and Invasive Species Advisory Committee, and assigned roles for particular agencies (primarily VDGIF and VDCR) as well as a mandated Invasive Species Management Plan and an ANS Management Plan approved by the ANSTF.

Still, while the AIS framework was lauded by respondents, there was criticism by several respondents as far as limitations on the development of Virginia's AIS program, with funding constraints noted the primary inhibitory factor. Rather skeptically, one respondent noted that:

Basically the AIS organization consists of a group of natural resource agencies with different missions and no real focus on AIS issues. As far as institutional capacity, there are tools to address all pest-related problems as they arise but there is very little in the way of a legal framework and no funding commitment.

Another respondent observed that institutional AIS capacity is much greater in freshwater ecosystems than in estuarine and marine ecosystems.

Analysis of Institutional Capacity

It appears that in both Maryland and Virginia there is a framework for an institutional approach to address AIS issues within the state natural resource agencies, although it is considerably less formalized in Maryland than in Virginia. The framework is not codified in Maryland while it is in Virginia, although most respondents believe that Virginia's program has not yet been fully elaborated. In the case of Maryland, there is no formal AIS program to implement. In both

states there is, however, an organization of AIS professionals—whether formal or informal—that primarily address AIS issues in a collateral manner, with no committed funding for such efforts. However, it appears that neither state has yet determined that an elaborate AIS program is needed. Seemingly, issues of major concern only occasionally arise and tend to be addressed on an *ad hoc* basis. Presently, AIS responsibilities in Maryland and Virginia are generally imposed as collateral responsibilities on particular natural resource units wherein the expertise for AIS assessment and management is found.

Pragmatically, in both states, it was observed that there are certain existing laws relating to AIS that need to be addressed, based on statutory requirements, regardless of the nature of the state programs that address such AIS issues. It is essential that there be some state capacity to respond to emerging AIS issues, as they arise—and the current AIS organizations apparently provide a sufficient mechanism to do so; in both states they are able to assess and prioritize AIS issues and coordinate AIS activities with the Natural Resources Secretariats and with other stakeholders as needed. Realistically, in the realm of public policy, AIS rarely rise above the horizon of other politically important issues. And generally, in both states, decision-making authority regarding major AIS issues is the domain of the executive branch leadership or the General Assembly, although in Virginia, BGIF has considerable authority as well. Funds have been appropriated—either from federal or state sources—as

needed for specifically-authorized purposes (i.e., introduced oyster studies, zebra mussel eradication, nutria eradication, and *Phragmites* control).

It is quite apparent that the nature of institutionalized AIS planning and coordination in Virginia is markedly different from that in Maryland. Unlike Maryland, there has been sufficient political support in Virginia to provide for the development of a comprehensive mandated Invasive Species Management Plan, and a formalized Invasive Species Working Group, which coordinates activities with other stakeholders as necessary. In Maryland there are many individual species-specific plans that address invasive species—both aquatic and terrestrial—but no Multi-Species AIS Management Plan

Virginia's Invasive Species Management Plan (VISC 2005) is a flexible guidance and planning document. It details seven major goals: 1) Coordination, 2) Prevention. 3) Prevention, 4) Early Detection, 5 Rapid Response, 6) Control and Management, 7) Research and Risk Assessment and, 7) and Education and Outreach. Various strategies and actions are provided to achieve these goals and many objectives have been completed. While the Plan provides various recommendations for implementation it stops short of detailing strict deadlines; it is very adaptive in nature. In fact a discussion of the planning process notes that:

The Plan is meant to be an evolving document that will be revised and updated every three to five years, using an adaptive management process. Ongoing accomplishments and new information will guide the refinement and revision of goals and strategies in future versions of the Plan (VISC 2005 p. 5).

As noted, Maryland has no corresponding comprehensive invasive species plan delineating such state goals, strategies and proposed actions. As far as Maryland's AIS planning approach, it was characterized rather well in a MDNR presentation to a Joint Committee Meeting of the Maryland General Assembly, in which it was noted that:

Maryland MDNR is actively working to prevent the introduction of invasive species..... Most invasive species work is coordinated through the Invasive Species Matrix Team, but most of the actual effort is carried out by various units represented on the team....MDNR is implementing management plans for 10 invasive species. We are engaged in managing at least 50 others. Our efforts cover a large suite of pest species of many taxa. [However] The Department of Legislative Services analysis is correct in noting that the number of management plans being written or implemented is neither an outcome nor a particularly useful unit of measure of either effort or success (MDNR 2010 p. 15).⁵⁹

Despite the marked differences in the institutional requirements for AIS planning and coordination in these states, the overall nature of AIS program institutionalization and implementation is minimal in both states. However, despite the seeming shortcomings of the AIS executive programs in each state, based on the commentary of respondents in this survey and my professional experience, both Maryland and Virginia have very effective Sea Grant College Programs. Such programs have a long history of involvement in AIS issues—both freshwater and marine—which provide advisory support for state AIS management efforts as needed.

⁵⁹The commentary in the referenced presentation text (DNR 2010) goes on to provide a very elaborate detailing of possible outcomes that could be used to assess AIS performance.

Given the nature of pending federal legislation relating to AIS management, and the fact that federal AIS policy formulation is still ongoing. Various major issues are yet to be addressed at the federal level, such as funding for rapid response⁶⁰ to AIS issues and concerns relating to the effects of climate change on AIS. It might well be prudent for states to forego the establishment of elaborate AIS programs, given that their mission and priorities might soon change. The anticipation of such potential changes in federal legislation is, in fact, a part of situational capacity. As long as such a delay is not coupled in a cross-cutting manner with sanctions against federal funding of AIS efforts, one might even question whether it is detrimental at all—if the states are able to adequately address AIS problems otherwise.

King and Olson (1988) provide useful criteria for interpreting the degree of institutionalization of executive AIS programs by respondents in Maryland and

⁶⁰ Senator Carl Levin's (MI) office provided the following summary of the National Aquatic Invasive Species Act (NAISA) of 2007, several versions of which have been introduced in recent years (<http://levin.senate.gov/newsroom/release>). This act was proposed to reauthorize and amend the *Non-indigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANPCA)*, which itself was amended by the *National Invasive Species Act of 1996 (NISA)*. Section 302 of the proposed bill would establish a Rapid Response Fund to provide grants to states and regions to implement approved rapid response contingency strategies. The ANS Task Force [would] develop model state and regional rapid response contingency strategies to aid states and regions in the development of contingency strategies. The National Invasive Species Council, within 12 months of enactment, would establish a Federal Rapid Response Team to: (1) implement eradication and control responses on federal land; (2) assist, if requested, in implementing rapid response measures on non-federal land; and, (3) provide training to state, tribal, and regional rapid responders. Although not yet enacted, despite almost perennial reintroductions of some variant of the bill, "rapid response" is one of the basic provisions in all versions of such proposed amendments.

Virginia. Their comments are directed to state Sea Grant College Programs.

They note that:

...institutional capacity is the ability and commitment of a state to develop, staff, and sustain institutions capable of dealing with [programmatic] issues....Institutional capacity [refers to] the extent to which state elites have acknowledged the reality of [a policy issue] and have sought to establish institutions, enlist political support, garner legal and political resources, and assemble professional staff to grapple with them.

Describing the benefits and nature of public institutions, King and Olson

(1988) note that:

As agents of the executive branch, they [public institutions] have the authority and organizational resources to implement policy. Public institutions have permanence and stability that advisory committees, task forces, and other *ad hoc* arrangements do not....A state's ability to deal with [AIS] issues will be limited or enhanced in large measure by the kind of institutions it can bring to bear on them. (Olson and King 1988, p. 306)

In this survey, respondents in both states questioned the permanence and stability of the AIS programs in their states.

Summary of Institutional Capacity Responses

Definition - The ability of a state to sustain an AIS organization within the fabric of the state bureaucracy which has a specific AIS statutory authority.

1. The rank order of institutional capacity was relatively low in both Maryland and Virginia. It was ranked fifth in Maryland and sixth in Virginia, as far as the six components of capacity assessed.
2. Permutation analysis indicated that there were no significant differences in perceptual responses relating to institutional capacity by Maryland respondents relative to perceptual responses by Virginia respondents, with Maryland scoring higher ($p > 0.05$).
3. There were marked differences in Maryland and Virginia as far as what branch of government was perceived as being most important in

mediating the institutionalization of the AIS program. In Maryland it was perceived that the executive branch was most important while in Virginia it was perceived that the legislative branch was most important.

4. In Maryland it was perceived that the institutional capacity of the AIS program resulted from the creation of executive branch directives such as BayStat and DNR's Invasive Species Matrix Team.
5. In Virginia it was perceived that the institutional capacity of the AIS program resulted from the legislative mandates that created the Invasive Species Working Group (ISWG) (originally named the Invasive Species Council), the Invasive Species Advisory Group (ISAC), and required the development of a comprehensive Virginia Invasive Species Management Plan. Such statutes provide for both continuity and coordination in ongoing AIS activities and provide assigned roles for specific agencies.
6. Despite the deficiencies and the lack of such institutional structures for AIS management in Maryland, it is perceived that Maryland has considerable extralegal authority in this area.
7. It was noted that the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS) provides an institutional framework of sorts to address AIS issues. It is a voluntary state-national framework created pursuant to federal legislation. MAPAIS is administered by the ANSTF, with the group formed as a subcommittee to a Federal Advisory Committee, the ANS Task Force.
8. There are various laws and regulations relating to AIS management in both Maryland and Virginia, most often delegated to the state fish and wildlife agencies which need to be administered and enforced, whether or not a formal AIS program exists.
9. It was noted that AIS are generally perceived as a low priority issue in both Maryland and Virginia as a result, have received much less political commitment than other issues.

State AIS Capacity

The responses of survey participants to questions relating to state AIS capacity are detailed below. The closed-ended question below is numbered and phrased as administered in the survey. The responses to the open-ended

question relating to state capacity are presented in the section immediately following, with the question phrased somewhat differently. When administered, this question was prefaced by a brief discussion of the components of the Government Performance Project (GPP) index as one such measure of a state's overall capacity.⁶¹ The responses to the closed-ended question relating to state capacity are presented in the section immediately following, with this question being somewhat different in focus---addressing the degree to which state capacity is directed to AIS issues

Question 7. Overall, in your opinion, based on your experience and your present understanding, the overall generic management capacity of your state is: a) well-developed, b) moderately-developed, or c) poorly-developed.

As shown previously in Figure 4 above, the mean for the perception of state capacity was markedly greater in magnitude in Maryland (4.0) in comparison with Virginia (2.8). In the previous rank-ordering of the various group means of the various components of capacity assessed, shown in Figures 6 and 7, state capacity was ranked second in Maryland and third in Virginia.

Permutation analysis indicated significant differences in the perceptions of respondents in Maryland and Virginia in relation to state capacity ($p < 0.05$, $P=1.2$).

⁶¹ As previously noted the GPP is a metric, developed by the Pew Center for the States in collaboration with Governing Magazine (2008), used to evaluate the quality of management in state government, incorporating sub-indices relating to the state's capacity to marshal its resources, as far as fiscal management, human resources, infrastructure, and information technology.

As shown in Figure 11 below, there were considerable differences in the frequency distributions of categorical responses relating to the perception of state AIS capacity by participants in Maryland and Virginia. In Maryland, the majority of respondents (61.1%) felt that state capacity was well-developed, compared to a similar response by only 11.1 % of the respondents in Virginia. Conversely, only 27.8% of the respondents in Maryland felt the state capacity was moderately-developed, while in Virginia the majority of respondents (66.7%) believed that state capacity was moderately-developed. In Maryland, no respondents felt that the state capacity was poorly-developed while in Virginia 22.2% of the respondents felt that state capacity was poorly-developed.

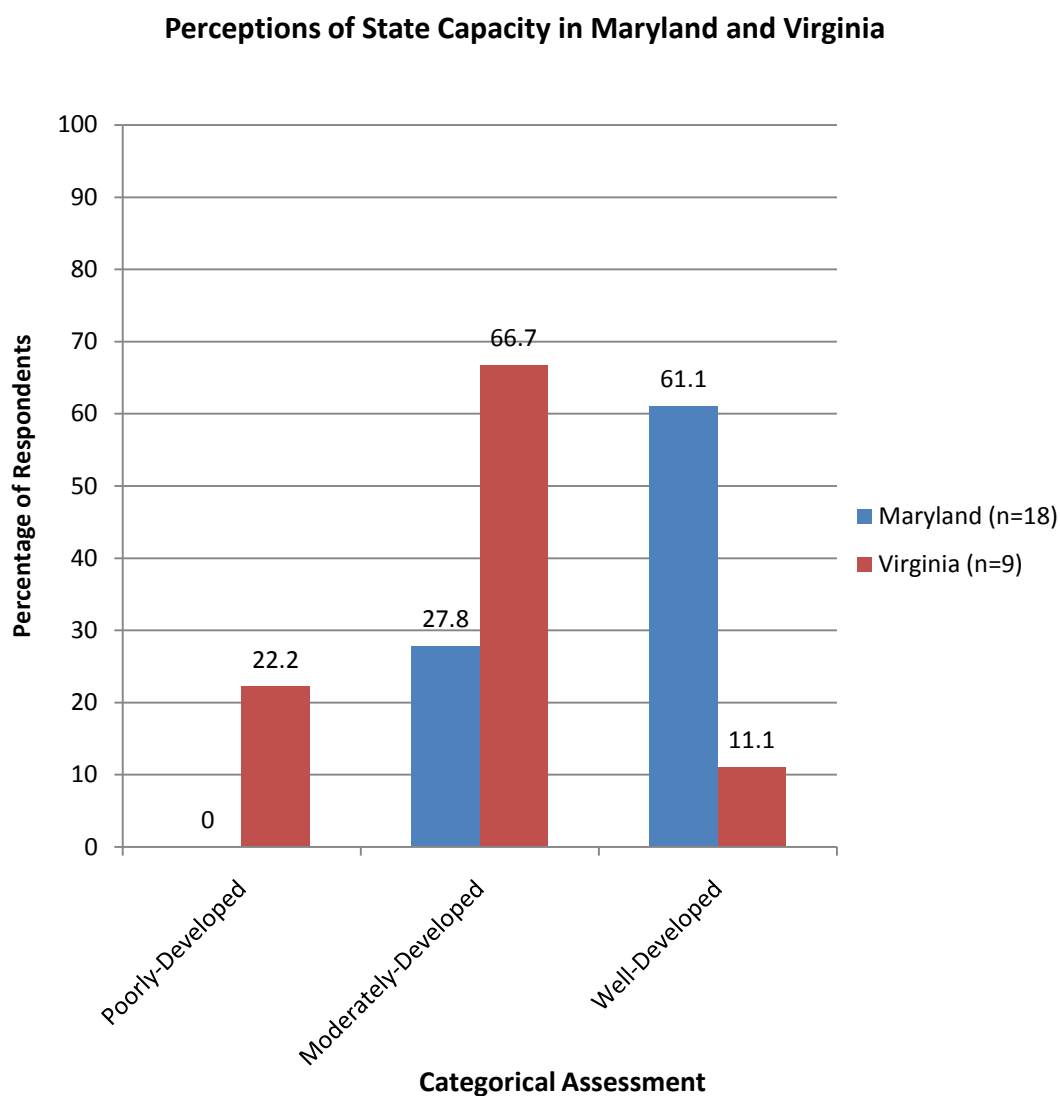


Figure 11. Perceptions of state capacity in Maryland and Virginia.

Question 8. How well has your state directed its available state management capacity towards addressing AIS issues?

It is essential to understand that the perceptions of respondents to the closed-ended question in this section relates to the overall capacity of each state

to address public policy issues; it is not an assessment of state capacity limited to AIS issues. Both Maryland and Virginia have high ratings nationally, as far as overall government performance. As previously noted, the Pew Center on the State's 2008 report (Governing.com 2008) provides a national assessment of the quality of governance in the 50 states.

In the Chesapeake Bay Watershed, Virginia was ranked the highest, with a grade of A-, while Maryland was ranked third highest with a grade of B. Other states in the Chesapeake Bay Watershed had grades which ranged from B- to C. Nationally Virginia was in the upper tier of states—with only Utah and Washington having an equally high score—while Maryland was in the third tier (GPP 2008). Not only are Maryland and Virginia affluent states, by all measures, and well-governed—they similarly have relatively high ratings in national environmental policy matters as described previously—although, as noted, neither generally seem to be leaders or laggards in such matters.

The open-ended question relating to state capacity directed to AIS issues is essentially asking for a synoptic appraisal of perceptions of State AIS Management Capacity, the primary topic of this research. A common theme in the commentary by respondents in both Maryland and Virginia was that the state response to AIS issues is reactive in nature, rather than proactive. Rather pragmatically, several respondents in both states observed that, "AIS have never risen to the level of a priority issue." One respondent provided a succinct perspective on the nature of state capacity in relation to AIS noting that:

It depends on the issues. With the Chesapeake Bay there are many invasions, many of which are very different from those in interior states. The state must focus on what is needed. The state can't do a bang-up job on everything".

Another respondent provided a more skeptical comment in relation to state capacity directed towards AIS efforts in Maryland, which is equally applicable to AIS Management in Virginia:

As far as AIS capacity, Maryland has little ability to regulate AIS on private lands. In other words it would be very difficult to require an eradication of Phragmites on private lands when it is so ubiquitous on public lands. Basically, non-native species can't be touched by Maryland officials unless a pathogen or agricultural pest is involved. If you have purple loosestrife growing in your front yard, little can be done....it would be better if they did nothing [about many AIS]. AIS management efforts are conducted generally on public lands only, apart from what the Nature Conservancy does.

Maryland

In Maryland 19 respondents (95%) provided commentary on the open-ended question relating to state capacity as directed to AIS issues. The comments primarily related to: 1) the general availability of resources as needed, 2) the lack of general funding for AIS issues overall, 3) the nature of the state response to the northern snakehead introduction in 2002 in the Crofton Ponds, and 4) the need for a state AIS management plan.

Several participants expressed similar sentiments to those of a respondent who noted that:

As far as AIS capacity, the state is as responsive as necessary, depending on the nature of the issue....Resources are generally forthcoming when needed. If an AIS issue is perceived as a significant threat, then necessary resources are made available.

It was noted that, while AIS have not yet been addressed comprehensively in Maryland from an institutional perspective, the state has shown considerable capacity in addressing terrestrial invasive species issues otherwise. One respondent noted that:

The Department of Agriculture and MDNR's forestry folks have considerable invasive species capacity and state capacity directed to their efforts, as evident in response to Forests Service's Emergency Pest Response Plan and species such as Emerald Ash Borers and Gypsy Moths.

However, it was noted that Maryland has been doing a fairly good job with AIS, and that it has been getting better at it over time, although the complexity of AIS issues which must be addressed are increasing. Maryland has several species-specific AIS plans and the state has begun to recently address more pathway and preventative approaches.⁶²

Several respondents lamented the chronic and problematic lack of dedicated funding and the vagaries of the allocation of existing funds. One respondent noted that, "A lot of money has been spent on different issues, but it's a matter of reallocation from different sources." Another respondent noted that, "The state capacity allocated to AIS is limited, considering the scope and extent of the problem." Yet, it was acknowledged that Maryland has done good things in

⁶² The increased regional emphasis on AIS pathways was illustrated by the recent (March 2010) joint Maryland Sea Grant-MAIP AIS Vector's Workshop in Baltimore, and a planned, NOAA-funded region wide cooperative "bait initiative", involving social marketing efforts among the various states in the Mid-Atlantic Region, for which a RFP was distributed in Fall 2010.

some areas with AIS, although very few resources have been devoted to such efforts.

Various species-specific circumstances were noted as being illustrative of state capacity devoted to AIS, with the northern snakehead fish introduction in the Crofton Ponds in 2002 representing the only situation where there has been a concerted, large-scale rapid response and eradication effort by the state. However, as the northern snakehead now ranges throughout the tidal Potomac River, the overall perception of the success of the eradication effort—although successful in the ponds themselves—has been somewhat muted.

Several respondents noted that the aforementioned AIS situation was formative in relation to overall AIS management in Maryland. This effort resulted in a legislative response to address the regulatory deficiencies that became apparent during the rapid response, which brought about changes as far as the available tools and legal recourse of MDNR in relation to the management of AIS species. One particular provision of the law addressed emergency powers to allow MDNR to gain access to private property.⁶³ See Appendix B for a more elaborate discussion of the northern snakehead incident. The Crofton Pond

⁶³ The *State of Nuisance-Abatement and Summary Abatement Procedure Act* of 2003 addressed concerns that arose during the northern snakehead incident at Crofton Pond, in a way that establishes a centerpiece sort of legislation that is a progressive approach although it will most likely need considerable clarification in the courts.

incident also was illustrative of the *ad hoc* manner in which Maryland approaches AIS issues.⁶⁴ It was noted that:

While Maryland has a robust group of scientists whose expertise can be marshaled, any such organization is *ad hoc*, and such groups must be reformed as needed.

Several respondents not only were disappointed that Maryland does not have an AIS management plan, but noted emphatically that it is something that Maryland needs.

Virginia

In Virginia, seven respondents (70%) provided commentary on the open-ended question of state capacity directed to AIS issues. The same general comments that characterized responses by Maryland respondents were noted by Virginia respondents. The comments provided primarily related to: 1) the general availability of resources as needed, 2) the lack of general funding for AIS issues overall, 3) particular examples where needed funding was provided for specific issues, and 4) the low priority of AIS issues overall.

One respondent juxtaposed the availability of state resources when needed for AIS efforts with the reluctance of the state to provide such resources through general funding. This was reiterated by another respondent who noted that, "The state has sufficient resources to address AIS issues, but only allocates

⁶⁴ In response to the 2002 northern snakehead incident in the Crofton ponds, A Snakehead Scientific Advisory Committee was convened to help address this problem; however the group solely provided scientific recommendations and not policy recommendations. Two reports were prepared by the group in relation to the incident. See Appendix B for a more elaborate discussion.

such resources as needed.” Yet another respondent noted that AIS decisions and allocation of funding for such purposes appear to be based on threats to the economy and well-being of the citizens. Despite such consternation about the continuing lack of dedicated AIS funding, one respondent noted that:

As problems arise there is adequate political capacity. With little exception, the agencies aren’t hamstrung by equipment or staff or materials. There is good will and support for AIS management.

This comment was reiterated by another respondent who noted that, “As far as state capacity, available resources are being well used, but virtually no resources are available.” The successful eradication of zebra mussels in Milbrook Quarry illustrates the capacity which Virginia can direct to AIS issues when necessary.⁶⁵

Analysis of State Capacity

It appears that both Virginia and Maryland have adequate state capacity and sufficient commitment to AIS management to effectively address AIS issues as they arise. When the matter is deemed serious enough, funding is forthcoming. It is agreed that both states are as responsive as necessary, depending on the nature of the particular issue. In Maryland, the response to northern snakeheads in 2002 in the Crofton ponds and in Virginia the response to zebra mussels in Milbrook Quarry in 2005 characterize the ability of these states to effectively respond to AIS issues when necessary. Yet it seems obvious that the upper echelon of state management—[e.g., Natural Resources

⁶⁵ As noted previously, the creative funding arrangement for the zebra mussel eradication at Milbrook quarry was very creative, and indicative of the historic self-sustaining nature of VDGIF.

Secretariat, Governor, or the General Assembly (or in Virginia, possibly the BG&IF)—will make major AIS decisions and not agency bureaucrats.

The lack of priority of AIS issues was a frequent complaint among the respondents in both states as was the reactive rather than proactive responses in both states to AIS issues. One respondent noted that, "AIS have never risen to the level of a priority issue." Another respondent noted that, "When it comes to AIS management capacity there are never any dedicated general funds....given current funding priorities it is a low priority issue—the first program to be cut." And yet another respondent commented that, "The AIS component of state capacity is more reactive than proactive; issues aren't planned in detail ahead of time."

Summary of State Capacity Responses

Definition - The overall ability of a state to marshal resources to develop a program to address a public policy issue as needed.

1. The rank order of state capacity was relatively high in both Maryland and Virginia. It was ranked second in Maryland and third in Virginia, as far as the six components of capacity assessed.
2. Permutation analysis indicated that there were significant differences in perceptual responses relating to state capacity by Maryland respondents relative to perceptual responses made by Virginia respondents, with Maryland scoring higher ($p < 0.05$).
3. Overall, the ranking of both Maryland and Virginia by the Pew Center on the States is rather high, with Maryland receiving a grade of B+ and Virginia a grade of A-, based on a 2008 evaluation.
4. Although there were significant differences in the perceptions of state capacity by respondents in Maryland and Virginia, in both states respondents generally felt that, as necessary, sufficient state capacity was

dedicated to AIS efforts. However, it was again noted that AIS concerns have never risen to a priority level.

5. In Maryland the northern snakehead eradication and in Virginia the zebra mussel eradication were cited as examples of state capacity directed kinetically to address an AIS issue.

Organizational AIS Capacity

The responses of survey participants to questions relating to perceptions of state AIS organizational capacity are detailed below. The closed-ended question below is numbered and phrased as administered in the survey. The responses to the open-ended question relating to AIS organizational capacity (Question 10) are presented in the section immediately following, with this question phrased somewhat differently.

Question 9. Overall, in your opinion, based on your experience and your present understanding, the organizational capacity of your state AIS program, is: a) well-developed, b) moderately-developed, or c) poorly-developed.

As shown previously in Figure 4 above, the group means for organizational capacity were similar in both Maryland (3.1) and Virginia (3.2)—with this being the only component of capacity for which there was a lower mean in Maryland than in Virginia. In the previous rank ordering of the components of capacity assessed shown in Figures 6 and 7, organizational capacity was ranked third in Maryland while ranked first in Virginia. Permutation analysis indicated that there were no significant differences in the perceptual responses of respondents in Maryland and Virginia relating to the organizational dimension of capacity ($P = -0.1$, $p > 0.05$).

As shown in Figure 12 below, there were no distinctive differences, overall, in the frequency distribution of categorical responses relating to perceptions of organizational capacity in Maryland and Virginia. The frequency distribution of particular categorical responses to perceptions of organizational capacity was quite similar in each state. The percentage of respondents in both Maryland and Virginia who felt that organizational capacity was well-developed was quite similar: 26.3% in Maryland and 22.2% in Virginia. In both Maryland and Virginia the majority of respondents (52.6% and 66.7% respectively) felt that organizational AIS capacity was moderately-developed. And the percentage frequency of respondents in Maryland and Virginia who felt that organizational capacity was poorly-developed was the lowest of the various categories selected in both states—21.1% in Maryland and 11.1% in Virginia.

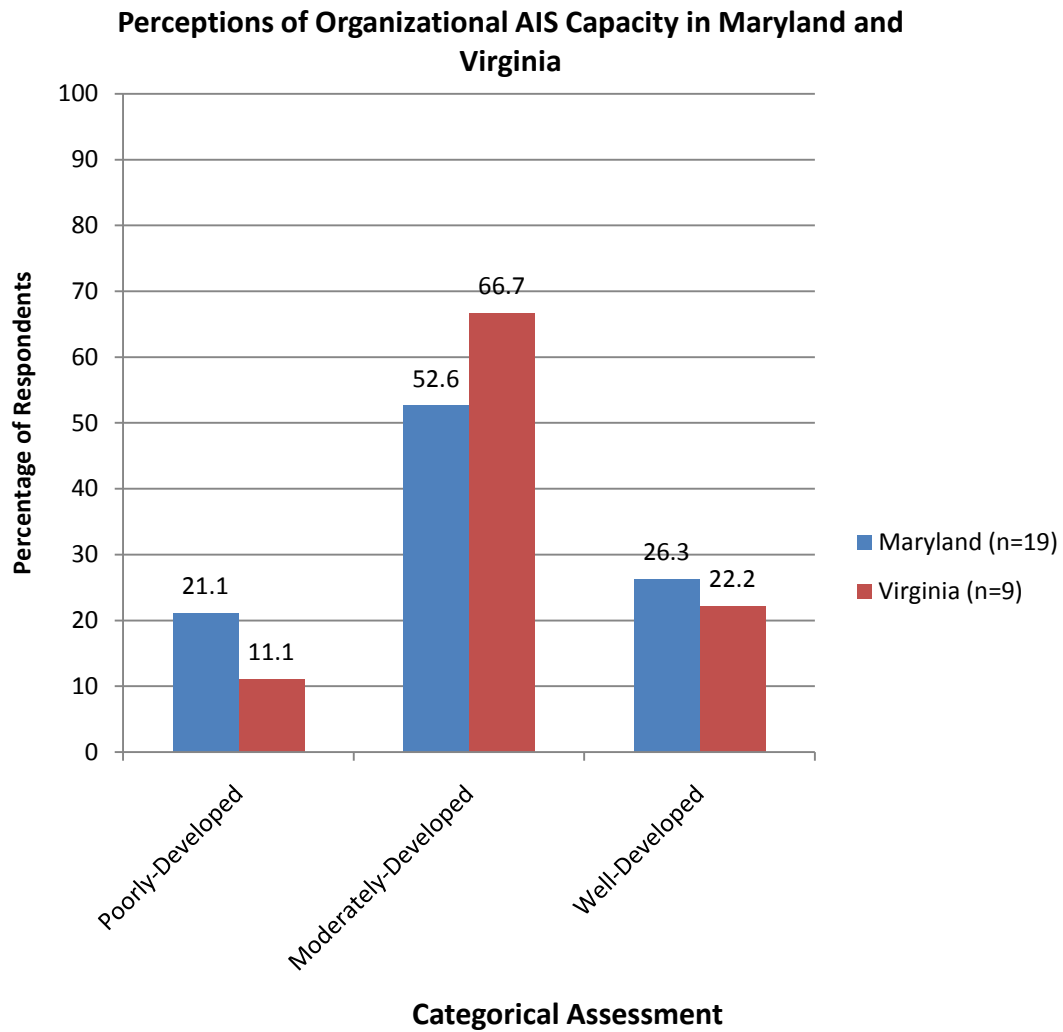


Figure 12. Perceptions of organizational AIS capacity in Maryland and Virginia.

Question 10. Based on your work experience and present understanding do you feel that the organizational capacity of your state AIS program—as far as it having the necessary organizational tools, experienced staff, and requisite resources—is sufficient for it to accomplish its mission?

As a prologue to a discussion of the commentary on organizational structure of AIS groups in Maryland and Virginia, the following response provides a useful context for interpreting the nature of organizational capacity in Maryland and Virginia:

Maryland and Virginia natural resource agencies probably have less funding than some other states, and neither state has spent a lot of money on aquatic pests. There are no full-time AIS positions. But that is the nature of the “AIS issue”—the rule not the exception. When there are not enough staff or resources available, there are limits to what an organization can do.

Maryland

In Maryland, 20 respondents (100%) provided commentary relating to AIS organizational capacity in the state. There were conflicting perspectives as to the sufficiency of Maryland's AIS organization—about an equal number of respondents felt that the organizational capacity was sufficient as did those who felt that it was not. The comments were generally positive and primarily related to: 1) the ad hoc nature of the organization, 2) the professionalism and dedication of staff, 2) the general sufficiency of the organization, and 3) the lack of organizational funding and state support. However, it was noted by several respondents that despite the lack of formality of Maryland's AIS program--there seems to be a fair bit of structure to it, although it is extralegal in nature.

One respondent's comment summarizes the general perception relating to Maryland's organizational structure, noting that:

Maryland's AIS organization is *ad hoc* in nature. There is considerable expertise and collaboration, though there is no mandate even for MISC.

Probably the true test of the organization's sufficiency will be its response to a big invasion.

Clarifying organizational structure somewhat, another respondent noted that:

The Natural Heritage program [i.e., Wildlife and Heritage Service] has considerable interest in AIS issues; everyone else seems to be involved in a collateral way. The invasive plant position (the only MDNR position with a designated invasive species role) is within this group.

Similarly another respondent noted that:

The Wildlife and Heritage Service is very active in the area of nuisance management with resources devoted to communication and action to minimize AIS impacts or remove them from the ecosystem.

More generally, one respondent succinctly noted that, "There is really nothing formal in place; the AIS program is more *ad hoc* in nature."

Several positive comments were made about Maryland's AIS program. It was noted that the AIS organization is well-suited to handle AIS problems, with the focus on public education being the most important component. Several respondents emphasized that there are a number of experienced, well-educated biologists on staff, with staff professionalism being all the more important considering the limited nature of institutional capacity, and that AIS efforts are mainly collateral in nature. One participant noted that, "The AIS organization is very diffuse and "hard to get a real handle on," noting at the same time that, "It does a very good job of informational networking and garnering funding from various sources." Only one respondent concluded—with certitude--that the state

AIS organization “absolutely” had the necessary organizational tools, to accomplish its mission. Other respondents were more ambivalent.

However, such positive perceptions were somewhat muted by the comments of other respondents. One respondent noted that although the organization has an outstanding capability, it has not yet been given sufficient support by the state, and not all of the elements are yet in place for it to fully accomplish its mission. Another individual noted that while the organization is sufficient, it could be better. And yet another respondent noted that while public outreach is effective, AIS activities are not generally very transparent. More pointedly, one respondent noted that, “As far as organizational capacity, it is agency-driven, with no apparent legislative backing or funding.”

One respondent noted, “AIS are being addressed, although the response depends on how significant the threat is, and with little emphasis placed on preventative strategies.” Funding was noted as a major problem, as was the need some legislative mandate needed.

An important singular, yet substantive point made by one respondent was that:

When it comes to talking about organizational mission and relative success one needs to distinguish between the mission on public land and the mission on private land.

Rather pragmatically, it was noted that, at present, all units addressing AIS in Maryland MDNR are providing funding from their own budgets, depending on the nature of the AIS issue. And it was noted that that the Invasive Species

Matrix Team needs to have its own source of funding to be more sufficient—as the indefinite, uncommitted nature of current funding is a major concern.

Virginia

In Virginia nine respondents (90%) provided commentary on the open-ended question of organizational capacity. The comments provided were paradoxical and related to: 1) the sufficiency and conversely the insufficiency of the AIS organization to fulfill its mission, 2) the advantages of legislative mandates yet the limitations imposed by lack of funding, and 3) the defined roles for some AIS responsibilities, yet the confusion about others.

A succinct overview of the general nature of AIS organizational capacity in Virginia was provided by one individual who noted that:

The organizational structure is well-developed for the most part, but there is no particular person to address things, such as a coordinator—and there is no assigned AIS staff.

This was elaborated on by another respondent who noted that while the AIS organization is sufficient to accomplish objectives—“Sufficiency is not the hallmark of a good organization. It certainly can be improved”. Several respondents noted that Virginia’s AIS organizational capacity was sufficient to accomplish its mission while several others felt that it was not—in terms of experienced staff, funding, and requisite resources. Rather, succinctly one respondent commented that:

If the definition of organizational capacity includes budget, personnel, and resources then the organizational capacity of the state AIS program is not sufficient for it to accomplish its mission.

Other comments focused on the statutory definitions of AIS roles for various state agencies provided by the Non-indigenous Aquatic Nuisance Species Act (NANSPA. 2003, 2009). There is an integrated and legally-mandated approach to AIS management in Virginia, which has been previously described. Only significant points will be noted again. Particular responsibilities are well defined for various agencies, with one respondent noting that the AIS capacity of VDGIF and VDCR is better developed than in most other Virginia agencies and that the core people in AIS efforts in Virginia are in these groups — although everyone “scrambling for funding.”

Although there are various legislatively-delineated responsibilities for some AIS issues, it was noted that there is often confusion as far as jurisdictional responsibilities for certain AIS-related matters, with some gray areas as far as agency responsibilities. It was suggested that part of the confusion has arisen because AIS issues have to be evaluated on a case-by-case basis. One respondent noted that:

Often, from an organizational perspective, it's a matter of sorting out “whose football it is” or whether it should be a shared issue. This involves sorting out the effective constituency in order to decide which agency should address the problem, as there are several agencies with different overarching missions.

Several respondents noted that the dynamic and often unanticipated nature of AIS issues is such that the professionalism of the staff is very important in addressing them in an adaptive manner. It was noted that the staff must improvise—problem by problem—with AIS groups “morphing” as issues change.

Analysis of Organizational Capacity

At its simplest, an organization is a group of people with a particular purpose, and in this discussion the purpose of the organization is AIS management. That both Maryland and Virginia have distinct organizations with an AIS function is indisputable. While the study of organizational structure is beyond the scope of this study, some commentary is warranted. The cross-functional teams which Maryland and Virginia have developed for addressing AIS issues in these states are composed of staff from various departments or programs who work together as needed, on an *ad hoc* basis, to solve problems and explore AIS management options. Such cross-functional teams are often referred to as matrix teams, in which staff belong to two formal groups at the same time—a major functional group (i.e., their funded position) and an AIS project position (i.e., their unfunded collateral AIS role) (PMBOK 2010). The objective is to break down functional barriers among disparate groups and allow for a more effective organization for solving particular problems requiring such diverse expertise. In Virginia the roles are better defined statutorily than in Maryland, minimizing the duplication of efforts, although this is still problematic on occasion. In Virginia, the defined missions for the various agencies are identified in the *Virginia Invasive Species Management Plan* and related legislation.

Ultimately, the AIS organization in each state has the common role of addressing AIS issues. However it is essential to remember that neither state has

a distinct AIS program. The AIS organizations in both states are composed of staff collaterally assigned from other programs. However, there is not the same degree of clarification of organizational responsibilities and mission in Maryland that is apparent in Virginia, nor is the nature of the organizational membership as clearly defined in Maryland as it is in Virginia.

Summary of Organizational Capacity Responses

Definition - The ability of a state to establish a group of individuals to apply its available skills and resources to accomplish stated AIS goals within state natural resource agencies

1. The rank order of organizational capacity was high in both Maryland and Virginia. In Maryland it was ranked third and in Virginia it was ranked first, of the six components of capacity assessed—the only component of capacity for which the perception of Virginia respondents was higher than that of Maryland respondents.
2. Permutation analysis indicated there were no significant differences in perceptual responses, relating to organizational capacity, made by Maryland respondents relative to perceptual responses made by Virginia respondents, with Virginia scoring higher ($p>0.05$).
3. While both states have an AIS organization, neither has a discrete AIS program. Staff are generally assigned in a collateral fashion on an *ad hoc* basis within state organizations with AIS responsibilities. The staff that comprise the AIS organization in each state are drawn, as needed, from agencies that have other primary missions, which can cause conflicts.
4. Virginia has a formal legally-mandated organizational structure while Maryland has one that is *ad hoc* in nature, without a legal mandate. However, neither organization has either a dedicated budget or full-time personnel.

Evaluation AIS Capacity

The responses of survey participants to questions relating to AIS evaluation and adaptive capacity are detailed below. The closed-ended question

below is numbered and phrased as administered in the survey. The responses to the open-ended question relating to evaluation and capacity (Question 12) are presented in the section immediately following, with the question phrased somewhat differently from the previous closed-ended question.

Question 11. Overall, in your opinion, based on your work experience and your present understanding, the provisions established to periodically evaluate and report on Virginia's AIS program, as far as attainment of goals and objectives, and to adapt the state AIS program based on such evaluations is: well developed, moderately developed or poorly developed?

As shown in Figure 4 above, the mean for evaluation capacity (2.4) was the same in Maryland and Virginia—the only dimension of AIS capacity for which the means for both states were identical. In the previous rank-ordering of the various components of capacity shown in Figures 6 and 7, evaluation capacity ranked sixth in Maryland and fourth in Virginia. Permutation analysis indicated that there were no significant differences in comparing the perceptual responses of respondents in Maryland and Virginia relating to the evaluation component of capacity ($p > 0.05$, $P = 0.0$).

As shown in Figure 13 below, the frequency distribution of categorical responses relating to evaluation capacity was notably skewed, in a similar manner in both states. In Maryland, only 7.1% of the respondents felt that evaluation capacity was well-developed while in Virginia 14.2% of the respondents selected this category. In Maryland the majority of respondents indicated that evaluation and adaptive capacity was moderately-developed (57.7%) while in Virginia only 42.9% % of the respondents indicated that such

capacity was moderately-developed. In Maryland 35.7% of the respondents felt that evaluation capacity was poorly-developed while in Virginia 42.9% of the participants felt that evaluation capacity was poorly-developed. In Virginia an equal number of respondents (42.9%) believed that evaluation capacity was moderately-developed as did those who felt that it was poorly-developed. Overall, there were considerable similarities in the frequency distributions of the various categorical responses in both Maryland and Virginia for evaluation capacity.

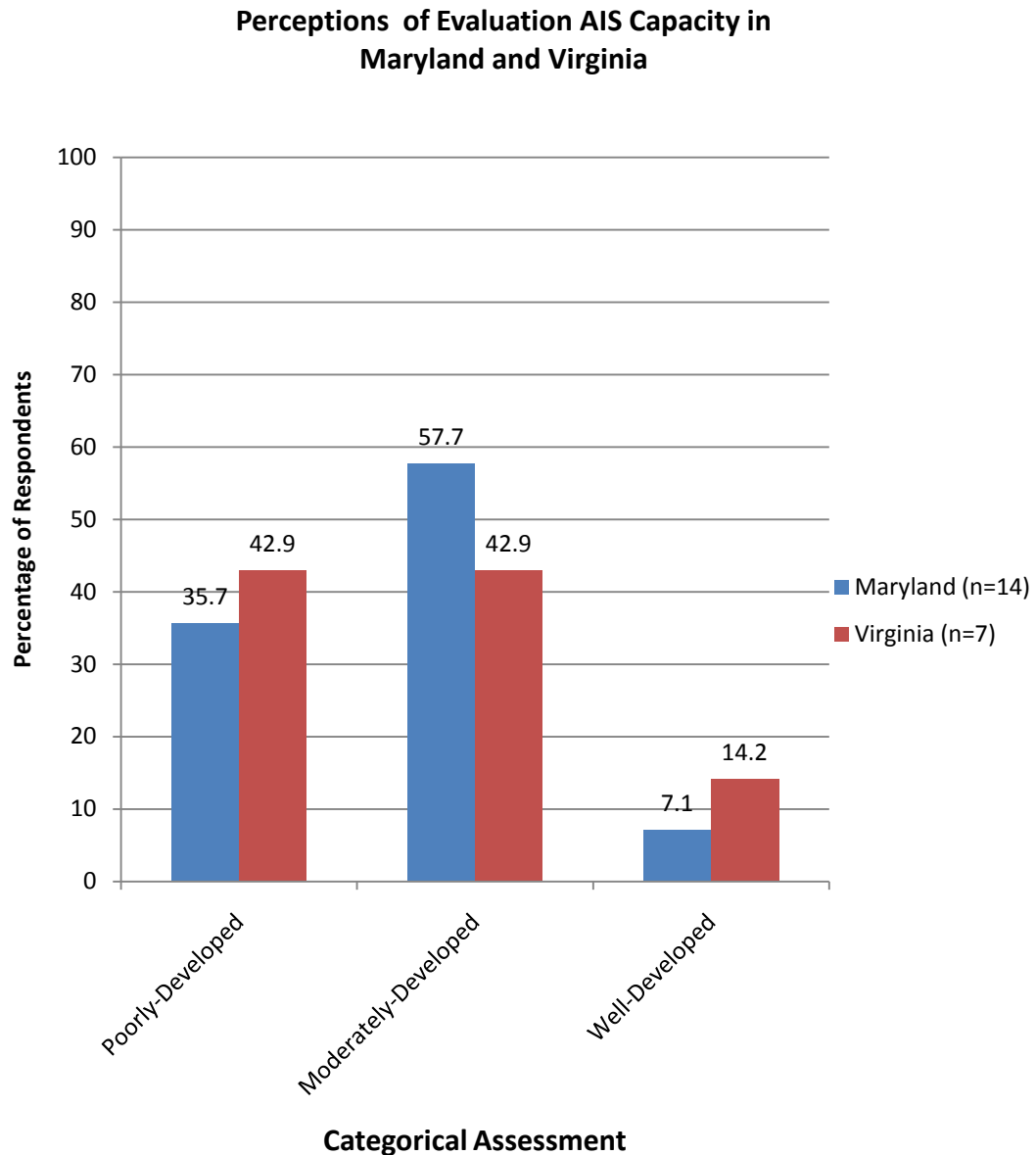


Figure 13. Perceptions of AIS evaluation capacity in Maryland and Virginia.

Question 12. Based on your experience and your present understanding do you feel that your state AIS program has sufficient evaluation tools to assess the performance of the state AIS program and adapt the program based on results?

Maryland

In Maryland, 13 respondents (65%) provided commentary on this open-ended question relating to evaluation capacity. Overall, it was noted that the previously described BayStat program, as well as periodic updates provided to the MDNR Secretariat by the ISMT, provide the primary mechanisms for evaluations of MDNR's AIS program. At the BayStat meetings significant AIS issues can be addressed with representatives of various agencies present, including Maryland Department of the Environment, MDNR, and Maryland Department of Agriculture. One respondent noted that the BayStat program is all the more essential as a mechanism for evaluation given the limited staff and the fact that the MDNR AIS organization really is not able to be self-evaluating at this point.

As far as the role of MDNR's ISMT Team in evaluation, it was noted by one respondent that:

Periodically, generally every six months, the ISMT reports to MDNR's leadership at meetings that include all unit leaders, Assistant Secretary's and the Secretary. Any relevant AIS issues for comment or action are reported at that time. The Secretary can then broach such issues at the BayStat⁶⁶ meetings, as deemed necessary.

The necessity of a Multi-Species AIS Management Plan to better manage AIS in Maryland was again noted by a respondent to this question, as in previous

⁶⁶ The BayStat program is organized in the fashion of the StateStat program, which Gov. O'Malley in turn modeled after the successful CityStat program he instituted as Mayor of the City of Baltimore.

ones. One respondent noted that, “Any state with a plan basically has some sort of adaptive mechanism. Maryland does not have such a plan.

Virginia

In Virginia only two respondents (20%) provided commentary relating to state AIS evaluation capacity. Essentially it was noted that the primary mechanisms currently in place is the reporting required pursuant to the requirements of the Memorandum of Understanding with the ANSTF in relation to funding of the Virginia ANS Management Plan. Additionally, periodic reports are submitted by the Invasive Species Advisory Committee to the Invasive Species Working Group and by the Invasive Species Working Group to the General Assembly

Analysis of Evaluation Capacity

Of foremost consideration here is the fact that in Maryland and Virginia, for the most part, there are few evaluation requirements. The information provided by respondents in both states related primarily to reporting requirements. In a 2010 Budget Presentation by MDNR in Maryland staff at a Joint Maryland General Assembly Budget Hearing, many points were made by MDNR staff relating to possible ways to better evaluate AIS-related performance. The comments were made in response to specific criticisms by the Maryland Department of Legislative Services (DLS).

Speaking of state planning in general, Reeves *et al.* (1985) cites the Council of State Governments (1966) noting that:

A serious deficiency of most states is the absence of overall state policy guidelines against which to evaluate state and federal activities. Because the effectiveness of coordination rests on the development and continuous evaluation and revision of a state policy framework, this mission becomes the central function of a state planning process. State policy should be articulated. Formal plans, published guidelines, policy statements, executive orders, and legislation establishing policy direction and provide the required basis for functional planning, budget preparation, and planning coordination (Reeves *et al.* 1985, p. 173).

Summary of Evaluation Capacity

Definition - The ability of an organization/institution to assess whether existing policies/programs are sufficient to meet stated goals.

1. The rank order of evaluation capacity was low in both Maryland and Virginia, with means in both states of 2.4. In Maryland it was ranked sixth and in Virginia it was ranked fourth, as far as the components of capacity assessed.
2. Permutation analysis indicated there were no significant differences in perceptual responses relating to evaluation capacity made by Maryland respondents relative to perceptual responses made by Virginia respondents with both states having equal scores ($p>0.05$).
3. The rankings reflect overall differences and responsibilities relating to reporting requirements for AIS programs in these states
4. In Maryland there are no formal reporting requirements for AIS efforts, in general. There are periodic updates which need to be submitted to the Secretariat by the Invasive Species Matrix Team. When warranted, such information is conveyed to the BayStat meetings convened regularly by the governor. However, AIS are neither a standing issue for BayStat consideration nor one for which performance metrics are regularly prepared.
5. In Virginia AIS reporting requirements are much more formalized. The ANS management plan, approved by the ANSTF, requires a five-year implementation plan which is evaluated by the ANSTF. There are also reporting requirements for both the ISWG and the ISAC. The Virginia

Invasive Species Management Plan is also updated periodically, requiring both reporting of AIS efforts and evaluation of goal attainment. All of these requirements provide for the reporting of AIS information requisite for any sort of evaluation.

The preceding questions have each assessed one of the six components of State AIS Management Capacity addressed in this study, characterizing them based on responses to both closed-ended and open-ended questions.

Analysis of Ancillary Survey Questions-Extrinsic and Intrinsic

National AIS Capacity

The responses of the survey participants relating to national AIS capacity are detailed below. The following closed-ended question is numbered and phrased as administered in the survey. Although this question did not have an open-ended component, considerable commentary was provided and is also presented.

Question 17. Overall, in your opinion, based on your work experience and present understanding, the national capacity to address AIS issues—as far as prevention, early detection, rapid response, control, management, and coordination—is well developed, moderately developed, or poorly developed?

The group mean for the perception of national capacity was somewhat higher in Maryland (2.5) than in Virginia (1.7), but was quite low in both states. As this was not considered to be a component of State AIS Management Capacity, but an extrinsic factor, neither was the mean presented in 4 nor was it rank-ordered in Figures 6 and 7.

As shown in Figure 14 below, overall, there were considerable similarities in the frequency distribution of categorical responses by both Maryland and

Virginia respondents relating to perceptions of national AIS capacity. The majority of respondents in both states felt that national AIS capacity was poorly-developed: (47.6% in Maryland and 66.7% in Virginia), an intermediate frequency of respondents in both states felt that national AIS capacity was moderately-developed (31.6% in Maryland and 33.3% in Virginia). However, while 21% of the respondents in Maryland felt the national AIS capacity was well-developed, no respondents in Virginia selected this response.

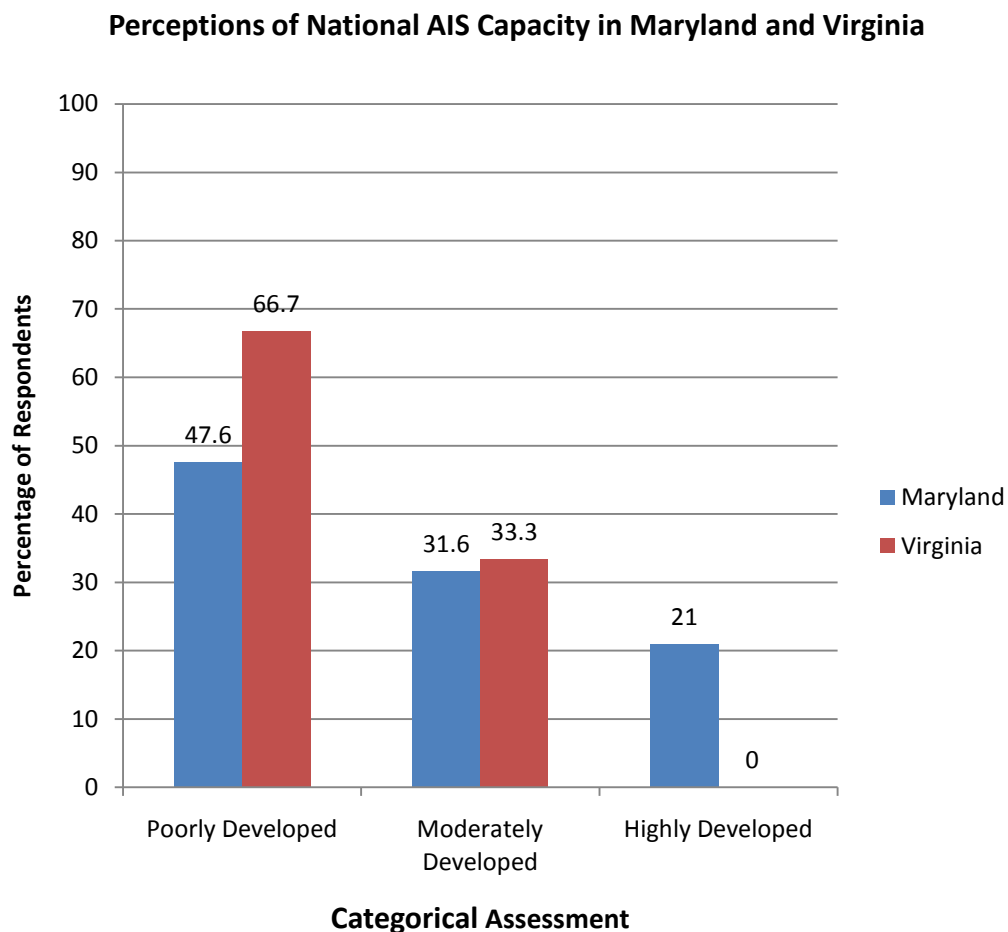


Figure 14. Perceptions of national AIS capacity in Maryland and Virginia.

Although there were no open-ended questions relating to the perception of national capacity, eight respondents (26.6%) offered additional commentary, five from Maryland (25%) and three from Virginia (30%). The comments are presented here but were not aggregated by state. Instead they were clustered based on major themes. This section is prefaced with a singular comment by one respondent who noted that:

The national capacity for AIS management is well-developed; in fact there may be too much capacity at the national level. APHIS, CDC, the National Invasive Species Council and the Nature Conservancy all have a considerable effect on AIS issues. When it comes to fish and wildlife there really isn't a lot of control or regulation that is possible at the state level.

Several comments were rather exceptional in nature. With circumspection, one respondent noted that as far as international comparisons of United States AIS policies with those of other countries:

Overall, national capacity is poorly developed in the United States in relation to countries such as New Zealand and Australia, which have much better programs that actually combine various issues and which in the U.S. are addressed by various agencies.

Only a relatively small number of respondents elaborated on the extensive and effective national program provided by APHIS, an agency of the U.S. Department of Agriculture. APHIS is responsible for various inspection quarantine, eradication, research, and collaborative efforts. One individual

suggested that the federal role should be more expansive, observing that, a “strong national program would be reflected in a strong state program.”⁶⁷

As far as federal organizations involved with AIS, one respondent noted that, “NISC has not been overly effective with the AIS problem; they tend to see it as the ANSTF problem.” Several respondents suggested that the ANSTF and the ANS Regional Panel Program that it administers are generally regarded as the most effective federal program providing for coordinated national support for state AIS programs. Regardless, it was noted that funding is woefully inadequate for the ANSTF, threatening its very usefulness.⁶⁸

Analysis of National AIS Capacity

As noted previously, the federal AIS program is expansive, with a wide-range of federal laws addressing such issues. There is also an elaborate network of national agencies involved with AIS management, coordinated via Memoranda of Understanding through NISC, pursuant to E O 13112. The federal agencies primarily involved with AIS activities are the APHIS, the U.S. Army Corps of Engineers, USGS’s Non-Indigenous Aquatic Species Program, the USFWS’s Invasive Species Branch, the National Oceanic and Atmospheric Administration’s National Sea Grant Program as well as U.S. EPA.

⁶⁷ The nature of federalism varies markedly with each particular environmental issue, there is considerably less vertical (i.e., national) involvement with AIS issues than in the case of water pollution or hazardous waste issues.

⁶⁸ Current funding is such that any new ANS Management Plans that are approved will effectively shrink the funds available to be parceled out to states and territories which currently have approved ANS plans, as additional funds will not become available. Essentially it is a somewhat of a disincentive for “laggard” states to develop a plan at such a late date, and a disincentive for those states which already have approved ANS plans to cooperate with those who do not.

Only a small portion of the respondents seemed to have a circumspect understanding of the nature of federalism in relation to AIS. The suggestion that a strong federal program would be reflected in a strong state program—while probably relevant too much of the “golden-era” environmental legislation—is not reflective of the nature of contemporary state-national interactions relating to the management of fish and wildlife at the state level. The previously described national AIS legal guidelines (NANPCA, NISA, and E O 13112) by design, generally only serve to coordinate state efforts, not regulate it in a command and control fashion.

Despite frequent recommendations that a more centralized AIS program is needed—it appears that USDA’s APHIS has the dominant expertise—both actual and potential—in addressing AIS issues in the U.S., although its centralized leadership role is *de facto* in nature. Generally, this role is construed to relate mainly to pest management, quarantine, and border inspection,⁶⁹ in relation to agriculture crops and domestic livestock. However, the role of APHIS has been expanded considerably in recent years and APHIS’ Wildlife Services Division, which addresses both aquatic and terrestrial species, is probably one of the most significant national components of AIS Management.⁷⁰ The Invasive Species

⁶⁹ APHIS’s Plant Protection and Quarantine staff work with DHS Customs and Border Protection staff, as well as USFWS inspectors to limit the transport of AIS into the U.S. (APHIS Fact Sheet, Emergency Preparedness and Response, June 2009, <http://www.aphis.usda.gov/publications/aphis.emergence.preparedness.pdf>)

⁷⁰ The Wildlife Services program is an APHIS division that has the federal leadership role in resolving conflicts relating to wildlife (aquatic and terrestrial) which pose a threat to agriculture, natural resources and human health alike—a rather broad mandate. (USDA, Wildlife Services Factsheet, July 2010 <http://www.aphis.usda.gov/public>).

Research laboratory at the APHIS National Wildlife Research Center in Fort Collins, Colorado conducts state-of the-art AIS research and the APHIS Emergency Operations Center in Riverdale, Maryland, could serve to coordinate responses to any AIS issue of considerable magnitude that might pose a threat in U.S. waters. The emergency preparedness of APHIS is quite high, using the Incident Command System approach, guided by the U.S. Government's National Response Framework. This is the same approach used by National Sea Grant agencies in developing AIS Rapid Response Plans.

Summary of Perceptions of National Capacity to Address AIS Issues

1. The perception of national capacity to address AIS issues was rated relatively low in both Maryland and Virginia. The majority of respondents in both states felt that national AIS capacity was poorly-developed: (47.6% of the respondents in Maryland and 66.7% of the respondents in Virginia).
2. Those respondents which rated national capacity as well-developed noted the effectiveness and significant role of APHIS, CDC, the National Invasive Species Council and the Nature Conservancy.
3. The ANSTF and the Regional ANS Panel Program that it administers were generally regarded as the most effective federal program providing for coordinated national support for state AIS programs, despite low funding levels.

Presented below are the responses of survey participants to questions 18-24. Questions 18-23 are open-ended and have no closed-ended component. As a consequence, the results are limited to a discussion of commentary by respondents, with no graphical representations of data or statistical analysis. These questions are related to various supplemental perceptions of AIS management, some extrinsic and others intrinsic. Question 24, the final question,

relates to perceptions of severity of AIS problems in Maryland and Virginia. Descriptive statistics are provided for responses to this question as well as additional commentary.

Greatest National Effect on State AIS Program

Question 18. Based on your work experience and present understanding, what factors external to your state AIS program, at the national level, do you feel presently have the greatest effect on it?

As a prologue to this question it is important to note the question did not specify whether the national effects of concern were positive or negative in nature. The question simply asked which national factors the respondents perceived as having had the greatest effect on the AIS program in the state they were assessing. Most of the responses were positive in nature.

Maryland

In Maryland 15 respondents (75%) provided commentary regarding their perceptions of those particular national factors which have had the greatest effect on Maryland's AIS program. The responses related primarily to the following: 1) the benefits of federal coordination, collaboration and funding, 2) public outreach, and 3) federal statutes—particularly those relating to ballast water. Rather succinctly one respondent noted:

There are well-developed federal programs, with coordination and availability of expertise when needed, and funding from various grant sources.

Various federal agencies were cited as having had a considerable effect on Maryland's AIS program, in relation to coordination, collaboration, and funding. One respondent commented that:

The primary national influences on Maryland's AIS program are several, including the activities of NOAA, the U.S. Fish and Wildlife Service, the Chesapeake Bay Program, and Sea Grant agencies.

The U.S. Geological Survey's Non-indigenous Aquatic Species Program and its contribution to the state AIS efforts as far as public education, the Non-indigenous Aquatic Species Database, coordination, and technical expertise was also lauded, as was the role of the U.S. Army Corps of Engineers, particularly regarding their Congressionally-mandated role as the lead federal agency in the preparation of an Environmental Impact Statement prepared relating to the proposed introduction of non-native oysters into the Chesapeake Bay.

Several respondents noted that the ANSTF has had the greatest effect on the Maryland AIS program, providing some funding for various relatively small proposals, such as *Phragmites* mapping and rusty crayfish efforts, as well as a venue for regional AIS networking—but most importantly as a venue for state and federal AIS coordination. However, it was noted that overall, funding provided by both the NISC and the ANSTF were relatively tangential, in, comparison with other major funding sources.

One respondent, rather generally, noted that the national regulatory capacity has ultimately had the greatest effect on Maryland's AIS program, with

frequent reference made to the significance of the ballast water program, noting that respondent noted that:

The national ballast water management efforts have probably had the greatest effect on Maryland's AIS management; as this is the primary vector for introductions.

Several comments were made regarding the beneficial effects of education and outreach efforts at the national level. One respondent noted that these efforts have had the greatest effect on Maryland's state AIS program.⁷¹ Another respondent also elaborated on the significance of such national educational activities, noting that:

Both the degree of public buy-in and the nature of the public perception of AIS resultant from such educational activities have probably had the greatest effect at the state and local level.

Other comments were more critical in nature. More as an observation than a critique, it was noted that the greatest national effect on Maryland's AIS program was resource availability, with funding presently being limited as far as AIS issues. It was also noted that what limited federal financial support is available tends to be allocated in a reactive rather than a proactive fashion. However, the same respondent noted that this is more symptomatic of an overall

⁷¹ The Aquatic Nuisance Task Force has established two primary educational outreach programs, *Habitatitude*, which targets aquaria, backyard ponds, and water garden enthusiasts and *Stop Aquatic Hitchhikers* which targets recreational activities involving the water. The ANSTF also sponsors the *Hazard Analysis and Critical Control Point (HACCP)* which focuses on risks associated with natural resource management pathways.

deficit in federal funding of environmental issues in general, rather than a problem limited to AIS issues in particular.

It was also noted that while a broader concern about AIS issues is emerging nationally, various federally-funded fisheries programs still have specific requirements as far as permissible use of funds, such as required by the Federal Aid in Sport Fish Restoration Act (i.e., Dingell-Johnson Act), that are not always compatible with AIS efforts.

Yet another respondent noted that there is a seeming failure of the national government, on occasion, to act on various interstate problems. It was noted that:

There are a few cases where effective responses have been made by states; however, it is easy for one state to make a decision that affects an entire watershed, with there being little in the way of a federal response to mitigate a problem. Particular actions in one state can have considerable effects on many others.⁷²

Virginia

In Virginia, nine respondents (90%) provided commentary regarding their perceptions of those national factors which have had the greatest effect on Virginia's state AIS programs. The responses related primarily to the following: 1) the benefits of federal funding, 2) the formative benefits of NISC and the ANSTF

⁷²This appears to be the case with zebra mussels in particular in the Chesapeake Bay Watershed. Since first discovered in New York waters near Binghamton, NY, as there were found in open water, there were no attempts at eradication, as such are efforts are generally not a feasible alternative.

on AIS policy, and 3) the importance of various federal statutes, particularly those relating to ballast water.

Federal funding was cited as having had the most significant national effects on Virginia's AIS program. One respondent noted that funding from the ANSTF for the Virginia ANS Management Plan probably accounts for the most significant national effect on Virginia's AIS program, having provided partial funding for various statewide AIS projects. The ANSTF has also provided modest funding via MAPAIS grants for various projects, primarily relating to *Phragmites* efforts.⁷³ Other sources of federal funding were also noted as being important to Virginia's AIS program as well, with most of the VDCR funding for *Phragmites* removal coming from CZM-NOAA funding as part of the Coastal Zone Management Program.

It was noted that both the ANSTF and NISC worked very closely with Virginia in developing the state's framework for its AIS program, which has incorporated the major federal policies as innovations. Various federal statutes were noted as being important to state AIS activities, including National Ballast Water legislation and the Lacey Act.

⁷³There are both native and non-native subspecies of *Phragmites australis*, a perennial grass, with the native species being quite rare and the invasive species quite prolific and crowding out native plants. Both species are commonly referred to simply as *Phragmites*. The invasive subspecies of *Phragmites* is found throughout the United States. It is commonly referred to as *Phragmites*. While it is too pervasive to eradicate there are considerable ongoing efforts to map and reduce it to a low level of abundance Virginia. DCR has various ongoing *Phragmites* mapping and eradication program with various partners.(Virginia DCR 2009).

Only a few comments were critical in nature. One respondent noted that the most significant national effect on Virginia's AIS program has been the lack of national funding and the lack of concern by those who appropriate the funds. Another respondent was disappointed with the discontinuance of the Rapa whelk study in Virginia, as this was a very innovative, long-term longitudinal study.

Although seemingly unfounded, one respondent suggested that Virginia tends to often shrug off national opinions. The respondent suggested that because of Virginia's independence, the Commonwealth often tends to forge ahead on its own and at times is not as receptive to federal assistance as some other states.

Summary of Perceptions by Respondents of National Factors with Greatest Effects on States

1. NOAA, the U.S. Fish and Wildlife Service, and the Chesapeake Bay Program are considered to have the primary national influence on Maryland's AIS program.
2. Virginia respondents noted the importance of the legislatively-mandated framework for AIS management established in Virginia.
3. Most recently the activities of ANS Task Force were believed to have had the greatest effect on the Maryland AIS program, providing funding for various relatively small proposals, but most importantly as a venue for state and federal AIS coordination.
4. National educational programs, created by the Aquatic Nuisance Species Task Force, were noted as having had a considerable positive effect on state AIS management efforts. Such efforts include *Habitatitude*, which targets aquaria, backyard ponds, and water garden enthusiasts, and *Stop Aquatic Hitchhikers* which targets recreational activities involving the water.
5. Both NISC and the ANSTF have had considerable formative effects on AIS policy in Virginia.

6. ANSTF funding for the Virginia ANS Management Plan is believed to account for one of the most significant national effects on the state AIS program and has provided partial funding for various specific statewide AIS projects.

AIS Program Effectiveness and Achievements

Question 19. In what ways would you characterize your AIS Program as being effective? What are some of the most significant achievements of your AIS program that illustrate its effectiveness? Can it accomplish its mission?

Maryland

In Maryland, 14 respondents (70%) provided commentary to this open-ended questions relating to AIS program effectiveness and the achievements of Maryland's AIS program. The responses related primarily to: 1) the ability of the AIS program to accomplish things, 2) public education and outreach, 3) the AIS matrix team, and 4) several species-specific successes. Rather simply stated, one respondent circumspectly noted:

I believe we've been effective with education and outreach, with the control and eradication of some species, and in the prevention of introductions of some species.

Another respondent noted rather succinctly noted that, "Maryland does something when it needs to be done." Yet another respondent noted that,

As far as successes, outreach and education programs—including posters and watch cards—are probably more important than any control and management efforts. These are very important in regulating human pathways as far as vectors for introductions.

Programmatically, MDNR's formally acknowledged Invasive Species Matrix Team (ISMT) was often noted as a major success in relation to Maryland's AIS program. However, it basically serves as MDNR's AIS program rather than merely being representative of its success, as it is the principal venue for coordination of AIS issues within MDNR. One respondent noted that:

The ISMT is probably the most successful component of the AIS program—when a problem is identified, the Chair can approach the Department Secretary and Deputy Secretary, who are readily accessible. Updates are presented to the Secretary and Deputy Secretary and information can then be presented at the BayStat Meetings to the Governor and other cabinet level officials.

Other efforts noted as successes in Maryland's management of AIS included the following:

- Getting bills introduced and passed to ban fish importations;
- An innovative ballast water demonstration project;
- Good outreach and education programs;
- Funding of projects through MAPAIS;
- Effective outreach to anglers and landscapers;
- Inclusion of AIS information in fishing guides;
- Good media coverage of Maryland AIS issues;
- Engagement with other state and federal stakeholders.

As far as species-specific AIS successes, several efforts were commonly noted as successes—although various respondents had differing perspectives on which grouping of species constituted the major AIS management successes. Most frequently cited, in terms of successful AIS control and eradication programs, were mute swan and nutria efforts eradication efforts, which have both had considerable political support. One respondent noted:

Mute swan management has been very successful. There has been considerable legislative backing, and other support as previously noted. The ongoing eradication effort has been very successful with a 95% reduction in population since 2005. In contrast there has been no such management and control in relation to the northern snakehead fish. In terms of frequency of commentary by respondents as to which species

represents MDNR successes in AIS management, the following list is based on rank-order of frequency of commentary⁷⁴:

- Mute Swans and Nutria
- Northern snakehead fish
- Rusty crayfish -
- Water chestnut
- Didymo
- Chinese mitten crab monitoring program
- Asian oysters

Several respondents noted that in Maryland, the rapid response to the northern snakehead fish in the Crofton Ponds in 2002, and the subsequent legislative response and regulatory changes that occurred in its aftermath were quite laudable, formative even. However, according to several respondents, with the northern snakehead now established in the Potomac River--where there are shared boundaries with Virginia--the focus and interest by Maryland as far as this species appears to have decreased, although monitoring continues. While the eradication of the northern snakehead in the Crofton ponds was, in fact, a success, its discovery in the Potomac two years later, seems to have diminished the sense of success somewhat: one respondent noted that:

⁷⁴ These species are described briefly, as appropriate, throughout the text. However, they are detailed on the Maryland and Virginia websites previously noted.

Despite moderate successes, Maryland has no real halo of eradications as Virginia does with zebra mussels. Maryland's successes have been more modest than Virginia's.

The management of rusty crayfish in Maryland by MDNR was noted by many participants as a notable example of an AIS success, providing an example of a "process" that MDNR can use effectively in addressing AIS issues in a comprehensive fashion, with various tools employed. Related management efforts included: mapping of range and distribution in Maryland, promulgating regulations, public education (e.g., website postings, posters, and pamphlets), the presentation and publication of several related scientific papers, and securing MAPAIS grants for related projects. However, there apparently is little public concern about rusty crayfish, despite the adverse ecological harm that can result from this species.

Several respondents noted that Maryland's AIS organizational capacity was not sufficient to accomplish its mission, while almost an equal number felt that it was sufficient. Funding was noted as the major problem relating to AIS organizational effectiveness; it was also noted that some legislative mandate was needed to better develop organizational structure.

Virginia

In Virginia 10 respondents (100%) provided commentary relating to the effectiveness and achievements of Virginia's AIS program and its ability to accomplish its mission. The major successes noted in Virginia's AIS program

included: 1) the formation of a legislatively-mandated framework for AIS management in Virginia, and 2) several species-specific successes.

Rather modestly, one respondent noted, “Nothing really earth-shattering has been done. But a good framework is in place for injurious species.” This framework has been described previously and has the following components: 1) the Invasive Species Working Group (ISWG) (which superseded the Invasive Species Council), 2) the Invasive Species Advisory Committee which advises the ISWG, 3) the development of the Virginia Invasive Species Management Plan, the approval of Virginia’s AIS Management Plan, and the specific AIS roles assigned pursuant to the *Non-indigenous Aquatic Nuisance Species Act* (2003 amended 2009).

Various species-specific efforts have been noted as being illustrative of the effectiveness of Virginia’s AIS management efforts, in particular VDGIF’s role in the eradication of zebra mussels in Millbrook Quarry, Virginia, ongoing northern snakehead studies in the Potomac River, and ongoing *Phragmites* mapping and control efforts on state lands.

The previously described zebra mussel eradication effort in Millbrook Quarry is one of the most frequently cited eradications in the Chesapeake Bay Watershed. The zebra mussel eradication effort was a well-planned, multi-stakeholder collaborative effort that has been extremely effective, which involved an elaborate public education as well (including the use of posters, web-postings, and the media). There has also been a less publicized eradication of *Salvinia*

molesta in a spring in Northern Virginia, which was a joint activity of VDAC and APHIS.

VDCR has been very effectively involved with various AIS activities, of a non--regulatory nature VDCR had the primary role in developing the Virginia Invasive Species Management Plan, in developing and maintaining the AIS website, and has had considerable ongoing involvement with Phragmites mapping and control efforts, particularly on state-owned coastal lands, in collaboration with various other stakeholders (e.g., NOAA CZM, DEQ-CZM, and the Nature Conservancy). Also, VDCR has had considerable involvement with invasive plant rankings, including aquatic species.

Other successful components of Virginia's AIS program that were noted included the following:

- Outreach and education in relation to human pathways as vectors for introductions;
- Response to the Asian oyster issue and participation in the related ad hoc panel process.

Summary of Perceptions by Respondents of Most Significant Aspects and Achievements of State AIS Program

1. In Maryland, the most frequently noted species-specific successes related to Maryland's response to AIS included mute swans, nutria, and northern snakeheads.
2. The process employed in the management of rusty crayfish by in Maryland was cited as a successful example of administrative "process," utilizing multiple AIS management tools.
3. In Virginia, the most frequently noted species-specific successes related to the Natural Resources Secretariat's response to AIS included DGIF's eradication of zebra mussels in Millbrook Quarry, and ongoing northern

snakehead studies in the Potomac River, and Phragmites mapping and control efforts.

4. In Virginia the legislatively-mandated framework for AIS management is considered to be a major achievement.

Factors Relating to AIS Program Sustainability

Question 20. What characteristics of your state AIS program do you feel will allow for its sustainability.(e.g., laws that require consideration of AIS in decision-making, enforceable regulations relating to AIS, state program funding apart from matching funds, management plans, invasive species councils, etc.)?

Maryland

In Maryland 16 respondents (80%) provided commentary on this open-ended question relating to perceptions of state AIS program characteristics that would allow for sustainability. The comments related primarily to the following: 1) professionalism and dedication of staff, 2) public and political pressure, 3) the nature of the problem and necessary responses, 4) and the legal AIS infrastructure.

Staff professionalism and dedication were most frequently cited as characteristics of the state AIS program that will sustain it; seven respondents noted the importance of dedicated, committed, and professional staff in sustaining the AIS program. This was best articulated by one respondent who noted that: “Maryland’s AIS program will be sustained more by the commitment and involvement of its personnel” and “the core of individuals in the department, rather than anything else.” That is, the “bottom up” staff dedication and their

dedication and concern, will sustain it. More pointedly another respondent noted, “In fact there is no section or division that addresses AIS issues, it’s really the commitment of the staff.”

Such staff expertise is effectively marshaled by MDNR’s *ad hoc* ISMT which is generally believed to be the most sustainable aspect of the state AIS program. It allows for the review of various AIS activities by experts from various state agencies and a forum to provide recommendations for actions. One respondent noted that the ISMT’s ability to keep the lines of communication open will allow for the sustainability of the AIS program. While the efforts and effectiveness of MDNR’s ISMT team were lauded by many respondents, the official optimism was somewhat muted by the acknowledgement that in the event that the current Secretary of MDNR or key personnel in the core ISMT team should leave the Department—the ISMT Matrix team might well cease to exist, at least in the effective manner that it currently functions. Although this is speculation, the ISMT is not a formally established component of MDNR, in any tangible, programmatic way, although it has an important functional role.

Three respondents noted the importance of public opinion and political will as far as sustaining AIS efforts in Maryland. One respondent noted that, “Basically political will based on the tension provided by public sentiment will result in commensurate capacity being developed and sustained.” Another respondent noted that, “As far as sustainability, political awareness, understanding of the issues by politicians, and the “Save the Bay” philosophy in

the state will sustain AIS efforts. And yet another respondent added that the concerns of Watershed groups and waterfront property owners will help to sustain AIS efforts.

Several respondents noted that the nature of the AIS problem itself and certain statutory responsibilities will serve to sustain some sort of AIS program.

One respondent noted that as far as what will sustain the program,

It is in fact the issue itself and dedication of the staff—and the fact that there is a hodgepodge of laws that have to be addressed regardless of whether there is a formal program or not.

This opinion was echoed by another official who noted that the strong organizational structure and dedicated staff augment the legal framework in place. However several participants noted that, while significant, the AIS legal infrastructure could certainly be improved upon. Rather candidly, one respondent noted:

Although there is little in the way of structure or legislative mandates to sustain the AIS program, the various AIS laws regulations and policies will require that some ongoing mechanism remain in place to implement and enforce them.

Two respondents noted that the AIS program in Maryland was not yet sustainable. One respondent noted that, “Everything is not yet in place that is needed for sustainability, particularly in relation to financial resources and agency commitment.” More pointedly another respondent noted that they were unable to think of an example from the political or legal framework in Maryland that would ensure the AIS program's sustainability. While the significance of the Maryland

Invasive Species Council was noted, it was suggested that its utility was limited because of its *ad hoc* nature.

Two participants provided philosophical comments which provide a context for interpreting the nature of AIS program sustainability in Maryland as well as elsewhere. One respondent noted that:

As far as sustainability, public health and agricultural concerns will sustain the effort to address AIS. As far as other non-native invasions, they generally aren't relevant. One generally can't say that AIS are good or bad, as the study of AIS is not a normative science [in terms of ecological aspects]. One can only describe how an ecosystem changes.

Lastly, one respondent noted that the underlying dynamics of biological invasions are a natural biological phenomenon, and one that will continue regardless of any increased proficiency in AIS Management. And as a result of this inherent intermingling of species, AIS will continue to be problematic in the future and need to be addressed by some sort of AIS program—whether formal or informal.

Virginia

In Virginia seven respondents (70%) provided commentary on this open-ended question relating to perceptions of state AIS program sustainability. The comments provided related primarily to: 1) legal AIS infrastructure, 2) staff professionalism and stakeholder involvement (state, public, and other), 3) the nature of the problem itself, and 4) the reliability of Virginia's academic institutions.

Several respondents noted the significance of the legal infrastructure in Virginia, and the sustainability of the AIS program provided by the codification of various policies establishing defined goals, strategies, and actions. Rather succinctly one respondent noted that:

The Non-indigenous Aquatic Nuisance Species Act and the legislative mandate forming the Invasive Species Working Group, as well as the various tasks and duties imposed on certain agencies, will allow for the sustainability of the AIS program.

Despite the acknowledged significance of the legal AIS framework provided by the codification of the major components of AIS policies, some respondents qualified the present benefits of such legal sustainability, somewhat, noting that AIS program implementation had not yet truly occurred. One respondent noted that:

While there is an institutional framework, there is no money to support it and no positions to staff it. It is addressed in a collateral way.

Aside from the more frequently comments noted above, staff expertise and commitment, and the ability of staff to respond to issues as needed were noted as essential characteristics that will sustain Virginia's AIS program. Virginia's response to AIS issues such as zebra mussels and the northern snakehead fish were noted as being illustrative of such capability, with experienced and dedicated staff professionals allowing for such effective and sustained responses.

Rather pragmatically, regarding the sustainability of Virginia's AIS program, one respondent noted that:

Ultimately the most sustainable aspect is the fact that the AIS issue won't go away—and public awareness will increase as the number of AIS increase.

Another participant noted the significance of cooperative AIS efforts in Virginia regarding AIS, noting that:

Presently the most sustainable aspect of the AIS program is the commitment of the people involved, including: local state, federal, private, and nonprofit partners.

Another respondent noted the significant role that academia has had in sustaining Virginia's AIS program, stating that:

The history of Virginia in management of its natural resources is quite good. It has a strong academic support group....and the state relies heavily on its academic institutions for scientific support [for AIS efforts]. I would say that, historically, Virginia is in the top tier of states in terms of its sophistication in managing its natural resources.⁷⁵

Summary by Respondents of Perceptions of Sustainable Characteristics of State AIS Programs

1. Professional dedication was noted as a factor that will sustain the AIS programs in both states.
2. In both states it was noted that the nature of the AIS issue itself, and the fact that it will be a recurrent issue, will require that some sort of organization be sustained to address AIS. This will be necessary as there are various related statutes and regulations that have to be addressed administratively whether or not there is a formal AIS program.

⁷⁵ Virginia Commonwealth staff biologists, Old Dominion University biologists, and on occasion, biologists with the Philadelphia Academy of Sciences are involved in taxonomic identifications for benthic invertebrate samples collected as part of water quality monitoring programs in Virginia. In Maryland, state biologists and UMCEES biologists are involved in such efforts although Versar, Inc. has had a dominant role in Maryland DNR's Long Term Benthic Monitoring Program as well as in the development and support of the Maryland Biological Stream Survey—a freshwater monitoring program.

3. The Invasive Species Matrix Team was cited as the most sustainable aspect of MDNR's AIS program.
4. Both states have a long history of regional dialogue regarding AIS issues.
5. A legal framework has been established by the Virginia General Assembly for the major components of Virginia's AIS program and is considered the most sustainable aspect of MDNR's AIS Program. The codification of the AIS framework will require ongoing planning and coordination among stakeholders. This framework has addressed the development and periodic revision of the Virginia Invasive Species Management Plan, ongoing efforts of Virginia's Invasive Species Working Group and associated Advisory Committee, and has delegated specific tasks and duties to certain agencies.
6. Despite distinct differences in the legal framework for AIS management in Maryland and Virginia, the lack of organizational funding and staffing was perceived as restrictive in both states.

Credibility and Legitimacy of State AIS Program

Question 21. What aspects of your state AIS program do you feel confer credibility and legitimacy to it (e.g., planning, best management practices, coordination, innovations) in terms of how it is perceived or emulated by other states or the national government?

Maryland

In Maryland, 19 respondents (95%) provided commentary on the open-ended question relating to perceptions of credibility and legitimacy of the state AIS program. The comments, primarily related to the following: 1) the ability of Maryland to get things done in an extralegal fashion, 2) effective regional coordination, 3) staff dedication, and 4) the effectiveness with which Maryland has managed mute swans and nutria.

Despite the various successes previously noted in relation to AIS management in Maryland, one respondent noted, “There is nothing unique about Maryland’s AIS program.” Another respondent stated that, “There is nothing in particular about Maryland’s AIS program that confers credibility and legitimacy to it.” It was noted that Maryland uses some fairly common tools, including the Maryland Invasive Species Council, rapid response plans, and internal coordination via the Invasive Species Matrix Team.

Several respondents lauded the long-sustained efforts of Maryland’s AIS program. One respondent noted that Maryland does, “rise to the occasion” and, “goes the extra mile.” This theme was echoed by many respondents noting that the credibility of Maryland’s AIS program results from the fact that, “We get jobs done. We don’t just talk about it. Maryland jumps on things immediately.”

The often “extralegal” aspect of Maryland’s commitment to AIS issues was noted by several respondents. Maryland has been an active participant in various efforts to forge national AIS policy; despite the lack of a more formal institutional framework. Several respondents noted that there is a strong commitment in Maryland to AIS issues and there has been a sustained effort to manage AIS for many years. A lot of time has been spent with stakeholders and MDNR listens to its advisory committees, and the various coordinated efforts actually work.

Several individuals noted that the leadership of MDNR staff in MAPAIS and other organizational roles in the ANSTF has served to provide for good networking ability, and legitimate MDNR’s AIS program—enabling MDNR to get

its issues to the forefront for consideration. Maryland representatives chaired MAPAIS since its inception in 2003, until the recent selection of a Pennsylvania Sea Grant representative as chair.⁷⁶

The dedication of staff, and their collaboration with other state and federal agencies was also noted as an important aspect of Maryland's AIS program which conferred credibility to it. One respondent noted that MDNR staff thoroughly research the various AIS issues of concern, although their work efforts are largely "voluntary" (i.e., collateral) as is the nature of the staff who comprise the ISTM. It was noted that all of the individuals involved with AIS efforts have a genuine concern about AIS issues. One respondent candidly noted that Maryland is not the best state as far as AIS management, but qualified this by stating that,

....it is a credible one—primarily because of the professionalism of its staff—based on metrics such as the presentation of papers publication of articles, and networking ability.

The mute swan and nutria eradication efforts in Maryland cited as particular AIS management efforts that have conferred considerable credibility and legitimacy to Maryland's AIS program. These efforts represent legislative interventions at both the state and federal level, which have required

⁷⁶ In Maryland DNR there is only one specific position that is designated as relating to invasive species--that of an invasive plant biologist within the Natural Heritage Program of the Wildlife and Heritage Service. While funding for invasive plant efforts have been eliminated for FY 2010, the position was not eliminated. In fact, the individual in this position was recently elected by the Maryland Invasive Species Council (Fall 2010) to represent MISC on MAPAIS, essentially a *de facto* AIS coordinator role of sorts. This is the first time that DNR has had such a role, such a role was previously that assigned to an MDA official—although there has not been coordination between these two entities for several years.

considerable stakeholder involvement, planning and coordination, and political support.

In general, though, AIS legislation was not cited as a significant factor conferring credibility to the AIS program in Maryland. However, the relative autonomy of MDNR to address many AIS issues, through a facilitated authority to promulgate regulations, was noted as a characteristic that conferred credibility to the AIS program. The nature of the enabling statutes for this regulatory authority is detailed in Appendix B. One respondent commented that after AIS problems are identified and researched by MDNR, the agency is able to respond to them with less “hoops” to go through than agencies in many other states.

Various miscellaneous comments were noted, which are summarized below:

- Maryland is responsive to scientific input and research information.
- The AIS group is able to readily “pick up on” issues which have a big impact;
- The Wildlife and Heritage Service confers the most credibility and legitimacy to Maryland’s AIS program;
- Media coverage of AIS issues in Maryland is very important in engendering public credibility.

Several respondents noted that a generally acknowledged deficiency in AIS management in Maryland is the lack of a comprehensive multi-species state AIS management plan.

Virginia

In Virginia, nine respondents (90%) provided commentary on the open-ended question relating to the credibility and legitimacy of Virginia's AIS program. The comments almost exclusively related to the codification of the AIS framework as the most significant aspect of AIS program legitimation and credibility—as it has allowed for the establishment of an AIS legal infrastructure. Additional singular comments were also provided.

Commenting on the significance of the legislative AIS infrastructure, one respondent noted that:

The legislative mandate of the Non-indigenous Aquatic Nuisance Species Act (NANSA) forming the Invasive Species Work Group (ISWG), and the various tasks and duties imposed on certain agencies will allow for the sustainability of the AIS program.

Another respondent noted that:

Credibility and legitimacy has been conferred by the legislature speaking to the AIS issue, and the formal network of stakeholders established by the ISWG and ISAC—although the lack of funding is not to be emulated.

And insightfully, still another respondent noted that:

It's not only the development and approval of the Virginia AIS Management Plan, or the legislative mandate requiring an ISWG and ISAC, or NANSA, but the way in which these tools have helped to identify both the stakeholders and the species of concern.

In summary, several respondents observed that the codification of the framework for AIS management has provided various benefits as far as AIS program sustainability including: defined agency duties, a formally established stakeholder network, a venue for identifying species of concern, a mandate and

funding to develop an AIS Management Plan—as well as being indicative of the top-down political support necessary for the success of any public policy.

However, several respondents concurred that the lack of funding to more fully implement the AIS legislation has been problematic.

The significance of such top-down executive and legislative support in relation to the legitimization of Virginia's AIS program—and for any successful AIS program—was articulated eloquently by one respondent who noted the following:

I think clear messages from top political leadership contribute most to the legitimacy and credibility of a state AIS program. Anytime a governor gets up and talks about an Invasive Species Council (i.e., Invasive Species Working Group) and about the needs of coordination—not just about a particular invasive species—I think that really provides a signal. And when this sense of importance is communicated through the executive agencies, people begin to have performance evaluations and job descriptions that reflect such directives. What happens most often is that people begin to understand that coordination and collaboration are important. All too often it becomes an *ad hoc* issue that is collateral in nature--things additional that people do as time permits. And it's sometimes difficult for managers to release staff from what is perceived as their primary duties to work on AIS issues across departmental lines. Probably one of the best things that can be done is to instill a sense of the essential nature of such AIS activities.

Lastly, yet notably, and very relevant to the aforementioned comments one respondent commented that:

Credibility is mainly based on state behavior when problems arise—as with zebra mussels and snakeheads—and the state's ability to resolve problems. Also there is engagement with key groups; the exchange of information is essential as well.

Summary of Perceptions by Respondents of Factors Relating to Credibility and Legitimacy of State AIS Program

1. Both Maryland and Virginia have a long history of addressing AIS issues in the context of regional dialogue and ongoing participation in regional AIS organizations.
2. Nutria and mute swan eradication efforts confer legitimacy and credibility to Maryland's AIS efforts.
3. In Maryland, the leadership of MDNR staff in MAPAIS and other regional organizational roles in the ANSTF has legitimated DNR's AIS program.
4. The codification of the AIS framework in Virginia is the most significant aspect of AIS program legitimation and credibility.
5. In Virginia clear directives from political leadership in the state contribute most to the legitimacy and credibility of the state AIS program.
6. State credibility and legitimacy result from state behavior when AIS problems arise.

Adequacy of State AIS Rapid Response Plan

Question 22. Do you feel that your state has an adequate rapid response plan in place?

As a preface to responses to this question, a general commentary provided by a respondent about Virginia's AIS Response Plan is noted—which is applicable not only to such plans in both Maryland and Virginia, but elsewhere. This provides a context in which to interpret the commentary relating to this question:

I don't know that anybody's rapid response plan is completely adequate. I wouldn't give anybody that rating. I would say it is as adequate as it can be given the resources the state has to work with.

Maryland

In Maryland, 15 respondents (60%) responded to the open-ended question relating to the adequacy of Maryland's rapid response plan. Thirteen respondents believed that Maryland had an adequate rapid response plan in place while two believed that it did not, although only six respondents provided commentary on this question.

It was noted that the rapid response procedure has been invoked only occasionally, and then only in a relatively informal way—not as detailed as in the recently prepared Maryland Sea Grant Publication titled, *Rapid Response Planning for Aquatic Invasive Species: A Maryland Example* (2009). The most circumspect comment regarding rapid response in Maryland was made by one respondent who noted that:

The rapid response template developed by Maryland Sea Grant seems to work pretty well as an informal guide. It has helped to identify the channels to use in addressing issues, although the Governor has not yet approved the AIS rapid response plan. Basically though, it involves what you would logically do anyway—good common sense. Although the channels are laid out in it, you have to be adaptive at times.

As far as procedural aspects relating to AIS rapid response, several

Maryland respondents noted that once a species is initially identified as AIS, there is an internal assessment by the ISMT to determine the significance of the particular issue and a list of alternative responses is detailed. The Chair of the ISMT then decides whether a rapid response is needed, and whether to address such issues formally in a written document. If necessary, the matter is elevated to the level of the Secretariat for consideration. Apparently, AIS rapid response

plans have only been used on occasion, and then, as noted, only as guidance in an informal fashion.

One respondent noted the seeming arbitrariness of rapid response by MDNR, noting that:

There has and there hasn't been [rapid response]—depending on the species. Maryland has been very proactive in the Potomac in relation to crayfish but very reactive in relation to snakeheads, despite such an initial early proactive response to this species.

One respondent lamented the ambiguity of the rapid response provisions provided by the State of *Nuisance-Abatement* and *Summary Abatement Procedures Act* of 2003. It was noted that the requirements for MDNR intervention on private property to abate a designated “state of nuisance” are rather nebulous. Such a statutorily designated circumstance must be officially designated before rapid response can be initiated on private land. Enacted in the wake of the difficulties encountered during the northern snakehead infestation in Crofton, Maryland in 2002, this legislation facilitates MDNR’s access to private lands. It grants MDNR broad statutory to eradicate designated AIS if a “state of nuisance” is declared, with a danger to the ecosystem apparent.

Another respondent noted that while rapid response is well-developed for certain species (e.g. terrestrial species) it is not well-developed for AIS. And pragmatically, one respondent noted that, “As far as responses, it is enough to keep up with the AIS that are problematic right now.” It was generally agreed that MDNR has, “learned to act more quickly”, and is now able to “morph up” a rapid response plan as needed.

It was also noted by several respondents that there are many advisory groups, such as MISC, MAIPAS, as well as various other state and federal agencies that are able to facilitate early detection and rapid response to AIS. One respondent also noted the importance of the public and citizen groups contacting MDNR to report various sightings of AIS—such as zebra mussels and Chinese mitten crabs. Such public responses are essential in facilitating early detection to allow for necessary and timely rapid responses.

Virginia

In Virginia six respondents (60%) responded to the open-ended question relating to the adequacy of Virginia's rapid response plan, although little commentary was provided. The comments provided were fairly evenly mixed; three participants concluded that Virginia had an adequate rapid response plan in place for AIS, while three respondents concluded that Virginia did not.

It was noted that in relation to rapid response, "Virginia has utilized the whole palate of controls." However, one respondent noted that Virginia does not yet have an adequate and effective rapid response plan, while another respondent noted that while there was one, "It could be better. [But] It's better than no rapid response plan." Regardless, it was noted that there is no

formalized document yet that constitutes a discrete rapid response plan, although efforts are underway on one.⁷⁷

Summary of Perceptions by Respondents of Effectiveness of State AIS Rapid Response Plans.

1. Neither Maryland nor Virginia has a rapid response plan for AIS that has been formally adopted and approved by the governor.
2. Maryland Sea Grant has developed an elaborate rapid response plan, intended as a national model. However the plan tends to be used in an informal fashion as a common sense, adaptive guide and not in a formal way.
3. Virginia has no formalized AIS rapid response plan, but the Virginia Invasive Species Management Plan considers rapid response to be a priority and provides the basic information needed for rapid response to AIS issues in Virginia.
4. No response plan is completely adequate and Virginia's is considered to be as adequate as possible, given available resources.

⁷⁷ While Virginia does not yet have a formal Rapid Response Plan, the development of one is noted as one of the seven major goals specified in the Virginia Invasive Species Management Plan (2005, pp. vi, 11), which is intended to serve as the framework for Virginia's responses to AIS issues. There is a plethora of rapid response plan templates available (not limited to the one recently prepared by Maryland Sea Grant) that should be sufficient for the development of any rapid response protocol needed for any Virginia responses to AIS. In fact the Virginia Invasive Species Management Plan provides all of the relevant information needed for a rapid response effort—it details the responsibilities of the various agencies and provides contact information. In fact an elaborate rapid response plan would be probably be redundant.

Recommendations for National AIS Legislation

Question 23. What changes to national legislation would be most beneficial relating to your state AIS program?

Maryland

In Maryland 12 respondents (60%) provided commentary on the open-ended question relating to recommendations for beneficial changes to national laws relating to AIS management in Maryland. As the various recommendations are wide-ranging they are presented simply as a summary list.⁷⁸ For brevity, little elaboration has been provided with the comments:

- Legislation is needed to amend/reauthorize expired legislation, as well as provide additional legislation for AIS education and prevention activities.
- National level provisions for planning, rapid response, and emergency, funding would be beneficial, as proposed by current legislation.
- Funding, funding, funding.
- A better-defined framework for state participation in AIS efforts is needed.
- There should be a similar framework for AIS management from state to state.
- Some sort of parsing of coastal states from interior states is needed in addressing AIS issues, as each group has somewhat unique concerns.
- Invasive species should be under the umbrella of a single organization.
- A white list for introduced aquatic species, in general, would be useful.
- Provisions of the Clean Water Act applicable to AIS should be utilized

⁷⁸ It is important to note that while the recommendations from both Maryland and Virginia respondents are quite comprehensive, many of these represent bits and pieces of comments, proposals, and suggestions that have appeared in various AIS-related bills that have been unsuccessfully introduced in U.S. Congress over the past several years. However, many of the comments are rather novel—particularly those relating to the expansion of marine AIS efforts, expanding the framework for state involvement, and parsing states based on coastal or non-coastal characteristics.

Virginia

In Virginia, eight respondents (80%) provided commentary on the open-ended question relating to recommendations for beneficial changes to national laws relating to AIS management in Virginia. As the various recommendations are wide-ranging they are presented simply as a list. For brevity, little elaboration has been provided with the comments:

- Ballast water regulations could be improved and more restrictive AIS laws enacted.
- More funding from the federal government is needed and more competitive funding in particular, with mechanisms that allow for competitive grants at the state level.
- Programs like those established by the Dingell-Johnson and Pittman-Robertson Acts for fisheries funding are needed for AIS funding, in which the federal government allocates funds to the states according to a prescribed “formula.”
- A tax on anglers and hunters would probably be beneficial; most fishermen and hunters would probably be willing to pay a small additional tax on fishing tackle or ammunition if those funds were used by the state to keep AIS out of the state.
- A better definition of what the states should do in relation to AIS is needed and more explicit requirements and mandates, with enforcement of such requirements as well.
- There needs to be a better way to assess and rank AIS via risk assessments—both qualitatively and quantitatively in—order to prioritize AIS responses.
- Provisions of the Clean Water Act applicable to AIS should be utilized. The codification of NISC, which currently is mandated by E O 13112 would allow for more continuity in intergovernmental coordination from administration to administration, at the national level, benefitting not only Virginia but other states.

Summary of Perceptions by Respondents of Potentially Beneficial National AIS Legislation

1. There should be a similar framework for AIS management from state to state.

2. Some sort of parsing of coastal states from interior states is needed in addressing AIS issues, as each group has somewhat unique concerns.
3. A better-defined framework for state participation in AIS efforts is needed.
4. There needs to be a better definition of what the states should do in relation to AIS and more explicit requirements and mandates, with enforcement of such requirements as well.
5. There needs to be a better way to assess and rank AIS via risk assessments—both qualitatively and quantitatively, as AIS impacts are hard to predict.
6. There needs to be a better way to assess and rank AIS via risk assessments—both qualitatively and quantitatively in—order to prioritize AIS responses. Often however, AIS impacts can't be predicted.
7. A tax on anglers and hunters would probably be beneficial; most fishermen and hunters would probably be willing to pay a small additional tax on fishing tackle or ammunition if those funds were used by the state to keep AIS out of the state.
8. National level provisions for planning, rapid response, and emergency, funding would be beneficial, as proposed by current legislation.
9. Invasive species should be under the umbrella of a single organization
10. Provisions of the Clean Water Act applicable to AIS should be utilized.
11. The codification of NISC, which currently is mandated by E O 13112 would allow for more continuity in intergovernmental coordination from administration to administration, at the national level, benefitting not only Virginia but other states

Severity of State AIS Issues

Question 24. How would you rate the severity of the environmental problems (ecological and economic, and human health) posed by AIS in your state, in comparison with other states in the U.S.? Score your rating based on a continuum from 1 to 10, with 1 being least severe and 10 being most severe. [It was further clarified that this question relates to the perception of the severity of

AIS issues in the state the respondent is assessing in comparison with all other U.S. states.

All respondents (100%) in both Maryland (n=20) and Virginia (n=10) decided upon a severity rating for problems posed by AIS in the state which they assessed. As shown in Table 7, there was considerable variability in the perception of the severity of the problems posed by AIS among respondents, although the overall values were quite similar in Maryland and Virginia. In Maryland, the index of AIS severity (I_s) was 5.7, on a continuum scale from 1-10, and ranged from 2.0-9.0. In Virginia the index of severity (I_s) was 6.5, and ranged from 3.0-9.5

Table 7. Descriptive statistics relating to overall perceptions of the severity of threats posed by AIS to economic and ecological health in Maryland and Virginia with all groups combined.

State	Minimum	Maximum	n	Mean	sd.
Maryland	2.0	9.0	20	5.7	2.2
Virginia	3.0	9.5	10	6.5	1.9

Although there were no open-ended questions relating to perceptions of the severity of AIS issues in Maryland and Virginia, several respondents chose to provide commentary. It was generally acknowledged that AIS problems are less severe in both Maryland and Virginia than in many other areas in the United States, such as Florida, Hawaii, and the Great Lakes. These areas were all noted

as having had considerably greater loss of biodiversity relative to Maryland and Virginia.

Maryland

In Maryland, eight respondents (40 %) provided commentary regarding their assessment of the severity of adverse AIS effects in Maryland. The general consensus was that the nature of AIS concerns in the Chesapeake Bay—and in Maryland in particular—were much less severe than elsewhere. One respondent noted that:

There is the potential for broad scale infestations of AIS in Maryland, but presently, as far as zebra mussels and aquatic plants, things aren't as bad in Maryland as elsewhere.

Another respondent similarly noted that as far as the severity of AIS issues:

Maryland has been sort of lucky. Neither the poster children of AIS management are here, nor has there been the economic damage associated with the infestations of such species.

Virginia

In Virginia, six respondents (60 %) provided commentary regarding their assessment of severity of adverse AIS effects in Virginia. There appears to be a heightened concern in Virginia about AIS relative to Maryland. While the overall percentage of the surface area of water in Maryland is significantly greater than in Virginia, the overall area of the tidal Chesapeake Bay waters is about the same in each state. However, Virginia has a much greater portion of coastal shoreline along the Atlantic Ocean than does Maryland. And concerns about

marine issues are apparently much greater in Virginia than in Maryland. One respondent noted:

As far as severity, the vast amount of wetlands, estuarine habitat and major tidal rivers and associated aquatic resources suggests a high potential for aquatic invasions and a high vulnerability to them.

A sense of the uncertainty about what lies ahead in terms of AIS issues was voiced by a respondent who noted that:

There are some very serious challenges on our doorstep and it might take another catastrophe like zebra mussels to make people more aware of AIS problems.

Summary of Perceptions of Respondents Relating to Severity of State AIS Problems

1. The mean perception of the severity of adverse effects of AIS, designated as the index of severity (I_s) was lower in Maryland (5.7) than in Virginia (6.5).
2. The Chesapeake Bay Watershed has been fortunate as far as AIS and there has not been the same degree of adverse economic and ecological effects resultant from AIS infestations as observed in other areas of the country, such as Hawaii, Florida, and the Great Lakes.
3. The potential is quite high for serious AIS infestations in the Chesapeake Bay Watershed and it may require another problem like zebra mussels to increase public concern.

Summary of Narrative Comments by Respondents

The narrative responses by the respondents are succinctly summarized by the selection of comments provided below by the survey respondents. This is followed by a detailed summary of the major findings in this study.

“AIS have never risen to the level of a priority issue.”

“The issue itself and public concerns about AIS that will sustain AIS programs.”

"It is in fact the issue itself and dedication of the staff—and the fact that there is a hodgepodge of laws that have to be addressed regardless of whether there is a formal program or not."

"Although there is little in the way of structure or legislative mandates to sustain the AIS program, the various AIS laws regulations and policies will require that some ongoing mechanism remain in place to implement and enforce them."

"In relation to AIS, Maryland and Virginia are familiar in many ways as far as policies and laws."

"Basically the AIS organization consists of a group of natural resource agencies with different missions and no real focus on AIS issues."

"Basically political will based on the tension provided by public sentiment will result in commensurate capacity being developed and sustained."

"As problems arise there is adequate political capacity. With little exception, the agencies aren't hamstrung by equipment or staff or materials. There is good will and support for AIS management. "

"As far as AIS capacity, the state is as responsive as necessary, depending on the nature of the issue....[and that] Resources are generally forthcoming when needed. If an AIS issue is perceived as a significant threat, then necessary resources are made available."

"Credibility is mainly based on the state behavior when problems arise, and its ability to resolve problems....credibility arises from the nature of responses."

"As far as responses, it is enough to keep up with the AIS that are problematic right now."

"I don't know that anybody's rapid response plan is completely adequate. I wouldn't give anybody that rating. I would say it's as adequate as it can be given the resources the state has to work with."

With the Chesapeake Bay there are many invasions, many of which are very different from those in interior states. The state must focus on what is needed..."

"Staff is improvising, problem by problem, the groups have to "morph" as issues change.

"The response to AIS is more reactive than proactive.

“There needs to be a better definition of what the states should do in relation to AIS and some requirements and mandates-with enforcement of such requirements as well.”

“There should be a similar framework for AIS management from state to state. A better-defined framework for state participation AIS efforts is needed.....Some sort of parsing of coastal states form interior states is needed.”

“There needs to be more definition of what the state should do, some requirements and mandates....”

“There are some very serious challenges on our doorstep and it might take another catastrophe like zebra mussels to make people more aware of AIS problems.”

Detailed Summary of Respondents Comments Relating to Components of AIS Capacity

Situational Capacity

1. The rank order of situational capacity was relatively high in both Maryland and Virginia. In Maryland it was ranked first and in Virginia it was ranked second, as far as the six components of capacity assessed.
2. Both states have a long history of regional involvement in the process of identifying and defining AIS issues (since 1991) in the context of extralegal AIS groups. Such groups have been facilitated by both the Chesapeake Bay Program (ESWG and ISWG) and the ANS Task Force (MAPAIS).
3. Both Maryland and Virginia currently have Invasive Species advisory groups. Virginia's Invasive Species Working Group was created by legislative mandate while Maryland's Invasive Species Council is *ad hoc* in nature.
4. Virginia has developed a comprehensive invasive species management plan, which allows for a formal identification and definition of broad AIS issues and provides goal, objectives, and actions to address such issues. Maryland does not have such a comprehensive plan, but does have several single species plans such as the mute swan management plan, which was mandated by the state legislature.
5. MDNR has considerable autonomy in terms of formally identifying and defining AIS, for regulatory purposes. VDGIF however, is overseen by a

governing board, which has the responsibility of designating species as AIS and other regulatory aspects of AIS management in Virginia.

6. MDNR's Invasive Species Matrix Team (ISMT), a collaborative *ad hoc*, was noted as being very important in identifying and defining AIS issues, as were various groups outside of DNR—which collaborate with the ISMT. In Virginia, however, many respondents noted the importance of the legislatively mandated AIS framework in facilitating situational capacity (i.e., Invasive Species Working Group (ISWG), Invasive Species Advisory Committee (ISAC), and the Virginia Invasive Species Management Plan). The Nature Conservancy was noted as having had an important role in relation to situational AIS capacity in Virginia.
7. Both Maryland and Virginia respondents cited several species-specific examples which illustrated the responsiveness of these states to particular AIS issues and a high degree of situational capacity. In Maryland, responses to mute swans, nutria, northern snakeheads, rusty crayfish, zebra mussels, water chestnut, Didymo, and the Chinese mitten crab were noted most often. In Virginia, responses to zebra mussels, northern snakeheads and Phragmites were most often noted.

Political Capacity

1. The rank order of political capacity was relatively low in Maryland and Virginia. In Maryland it was ranked fourth, and in Virginia it was ranked fifth, as far as the six components of capacity assessed.
2. In Maryland, AIS policy is not addressed in a comprehensive way as there is no statutory or executive directive to develop a comprehensive invasive species management plan. Instead, there are various piecemeal efforts to address such concerns, which often are successful. Virginia, however, has a well-articulated, well-coordinated AIS program providing for a more cohesive AIS policy, with a statutory approach to developing and implementing AIS policy
3. Since 2003, both MDNR and BDGIF have been given considerable authority to draft and promulgate AIS regulations with appropriate legislative review. MDNR has considerable autonomy in this process. DGIF, however, must rely on oversight and approval from BGIF in drafting such regulations, which allows for more public input and a more circumspect and democratic approach to such deliberative AIS policy processes. Maryland has no governing board comparable to BGIF in relation to its agencies involved in AIS management.

4. Statutes relating to AIS in Maryland and Virginia generally delegate regulatory authority to state agencies with fish and wildlife responsibilities.

Institutional Capacity

1. The rank order of institutional capacity was relatively low in both Maryland and Virginia. It was ranked fifth in Maryland and sixth in Virginia, as far as the six components of capacity assessed.
2. There were marked differences in Maryland and Virginia as far as what branch of government was perceived as being most important in mediating the institutionalization of the AIS program. In Maryland it was perceived that the executive branch was most important while in Virginia it was perceived that the legislative branch was most important.
3. In Maryland it was perceived that the institutional capacity of the AIS program resulted from the creation of executive branch directives such as BayStat and DNR's Invasive Species Matrix Team. In Virginia it was perceived that the institutional capacity of the AIS program resulted from the legislative mandates that created the Invasive Species Working Group (ISWG) (originally named the Invasive Species Council), the Invasive Species Advisory Group (ISAC), and required the development of a comprehensive Virginia Invasive Species Management Plan.
4. It was noted that the Mid-Atlantic Panel on Aquatic Invasive Species (MAPAIS) provides an institutional framework of sorts to address AIS issues. It is a voluntary part of a state-federal framework created pursuant to federal legislation. MAPAIS is administered by the ANSTF, with the group formed as a subcommittee to a Federal Advisory Committee, the ANS Task Force.
5. There are various laws and regulations relating to AIS management, most often delegated to the state fish and wildlife agencies, which need to be administered and enforced, whether or not a formal AIS program exists.

State Capacity

- 1 The rank order of state capacity was relatively high in both Maryland and Virginia. It was ranked second in Maryland and third in Virginia, as far as the six components of capacity assessed.
- 2 Although there were significant differences in the perceptions of state capacity by respondents in Maryland and Virginia, in both states

respondents generally felt that, as necessary, sufficient state capacity was dedicated to AIS efforts. However, it was again noted that AIS concerns have never risen to a priority level.

3. In Maryland the northern snakehead eradication and in Virginia the zebra mussel eradication were cited as examples of state capacity directed kinetically to address an AIS issue.

Organizational Capacity

1. The rank order of organizational capacity was high in both Maryland and Virginia. In Maryland it was ranked third and in Virginia it was ranked first, as far as the six components of capacity assessed—the only dimension of capacity for which the perception of Virginia respondents were higher than those for Maryland respondents.
2. While both states have an AIS organization, neither has a discrete AIS program. Staff is generally assigned in a collateral fashion on an *ad hoc* basis within state organizations with AIS responsibilities. The staffs that comprise the AIS organization in each state are drawn, as needed, from agencies that have other primary missions, which can cause conflicts.
3. Virginia has a formal legally-mandated organizational structure while Maryland has one that is *ad hoc* in nature, without a legal mandate. However, neither organization has either a distinct budget or personnel.

Evaluation Capacity

1. The rank order of evaluation capacity was very low in both Maryland and Virginia. In Maryland it was ranked sixth and in Virginia it was ranked fourth, as far as the six components of capacity assessed.\
2. The rankings reflect overall differences and responsibilities relating to reporting requirements for AIS programs in these states
3. In Maryland there are no formal reporting requirements for AIS efforts, in general. There are periodic updates which need to be submitted to the Secretariat by the Invasive Species Matrix Team. When warranted, such information is conveyed to the BayStat meetings convened regularly by the governor. However, AIS are neither a standing issue for BayStat consideration nor one for which performance metrics are regularly prepared.

4. In Virginia AIS reporting requirements are much more formalized. The ANS Management Plan, approved by the ANSTF, requires a five-year implementation which is evaluated by the ANSTF. There are also reporting requirements for both the ISWG and the ISAC. The comprehensive invasive species management plan is also updated periodically, requiring both reporting of AIS efforts and evaluation of goal attainment. All of these requirements provide for the reporting of AIS information requisite for any sort of evaluation.

State AIS Management Capacity Indices (I_{AIS})

1. An index of State AIS Management Capacity (I_{AIS}) was calculated for each state, as an overall composite measurement of all perceptual responses, incorporating all components of capacity. The (I_{AIS}) was 3.3 for Maryland and 2.6 for Virginia. On a relative scale of 1-5, a higher I_{AIS} value indicates an overall perception of better-developed State AIS Management Capacity.
2. When the perceptual responses respondents in each state were evaluated as representative of separate subgroups, the I_{AIS} values for the responsible state subgroups were much more similar—2.9 in Maryland and 2.7 in Virginia.

Severity of AIS Effects (I_S)

1. The perceptions of respondents relating to the severity of adverse AIS effects in Maryland and Virginia were reported as the index of AIS severity (I_S) on a continuum scale from 1-10 (1=low severity, 10=high severity). The I_S in Maryland, was 5.7, while the I_S in Virginia was 6.5

Figure 15 below provides a graphical interpretation of the complex interaction of state government performance factors and government management factors on AIS perceptions. This is adapted from Ingraham and Donohue's (2000, p. 297-298) model described in Chapter 2.

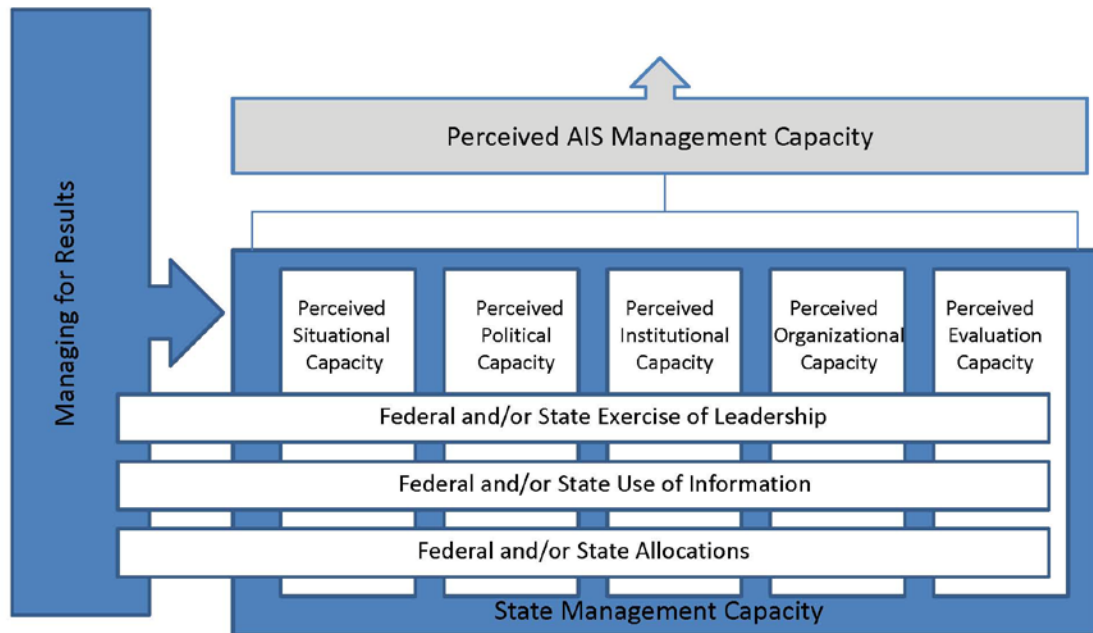


Figure 15. A depiction of the interaction of management factors and government performance factors on perceptions of state AIS management capacity. (Adapted from Ingraham and Donohue 2000).

CHAPTER 5. DISCUSSION

Comparison with Malysa's Assessment

The results from this assessment of various components of State AIS Management Capacity in Maryland and Virginia differed markedly from those reported by Malysa (1996) in a similar assessment of wetland management and planning capacity in these states. Differences were most pronounced in relation to perceptions of political, institutional, and evaluation capacity. While Malysa (1996) concluded that Maryland and Virginia had similarly well-developed ratings for these particular components of capacity, in this study these capacities were considered to be much less-developed, ranking among the lowest of the capacities assessed in each state. Malysa (1996) similarly ranked situational capacity and organizational capacity as well-developed in both Maryland and Virginia, and in this study they were also ranked among the highest of the capacities assessed in each state.

In making such comparisons with Malysa's study (1996) and this research it is important to keep in mind that rather than ranking each component of capacity in a singular way as in this study, Malysa (1996), evaluated several sub-elements of each component of capacity assessed, without using a summary

ranking for each. In part, these differences reflect the differences in the feasibility of the use of different types of questions in each methodological approach.

The only capacity which Malysa (1996) concluded was poorly developed was the targeting of “sufficient economic resources” to address wetland problems and other aspects of economic capacity. Interestingly, while state capacity was used in place of economic capacity in this analysis, the overall consensus was that sufficient resources were directed to AIS efforts, but only as needed. That is, overall, state capacity was believed to be adequate to address AIS issues. A comment by Malysa (1996) relating to economic capacity is as relevant today as it was then:

Poorly developed economic capacity rankings reflect the severe budget crises of both States. As a result... planning efforts are hampered because of inadequate budgetary commitments....(Malysa 1996, p. 211).

While noting the interdependence of all of the various components of capacity assessed, Malysa (1996) concluded strong situational and political capacity appeared to be “pre-conditions” for the effectiveness of all other capacities, with each of these capacities ranked as well-developed by Malysa (1996) with the exception of economic capacity. However, in this study, while the rank-order of situational capacity was first in Maryland, the rank-order of political capacity was fourth—with institutional capacity ranked fifth. Similarly in Virginia, while the rank-order of situational capacity was second, the rank-order of political capacity was fifth, with institutional capacity ranked sixth.

It appears that in Maryland and Virginia, situational and political capacity were sufficient for the enactment of centerpiece AIS legislation in each state in 2003—with the enactment of the *State of Nuisance -Abatement* and Summary Abatement Procedures Act in Maryland and the *Nonindigenous Aquatic Nuisance Species Act* (amended 2009) in Virginia. However, these laws did not require the establishment of discrete AIS programs, with designated funding and personnel to implement AIS policy in these states, in a manner comparable to the implementation requirements relating to the wetland legislation which Malysa evaluated (1996).

Although both states are very concerned about AIS issues, and have well-developed organizations which are able to identify and define AIS issues, it appears that the position of the states is that it is not yet necessary to develop discrete executive branch AIS programs in natural resource agencies to address this issue. Neither state has a discrete AIS program.

Comparisons of I_{AIS} metric with ELI Self-Assessment Rankings

The few comprehensive studies that have addressed AIS issues in the United States have done so primarily in the context of informational surveys (ELI 2002, Responsive Management 2002, MAPAIS 2006, and USEPA 2008).

However, aside from the framework for the analysis of AIS capacity provided in this research effort, the only other in-depth framework developed with any utility for a comparative analysis of any aspect of AIS capacity the ability of states to address AIS issues is that developed by ELI (2002). Based on this

scheme, as noted previously, Maryland would be classified as meeting the bronze standard (the lowest of the three) while Virginia would be classified as meeting the gold standard (the highest of the three), the converse of the results indicated by the I_{AIS} calculated based on data collected in this study.

However, when using a checklist approach to AIS assessment, it is necessary to evaluate not only the utilization of AIS management tools, but their effectiveness as well. ELI's self-assessment scheme was not meant to be used to assess the ability of a state to effectively manage AIS; it merely provided a list of effective tools that are generally accepted as means of increasing the ability of a state to manage AIS. Such an assessment of the utilization of particular AIS Management tools in Maryland and Virginia, as detailed, would be useful in providing information regarding particular sub-elements of certain components of capacity evaluated in this research effort. However, it would be insufficient in its own right to provide for an evaluation of the overall ability of a state to effectively manage AIS.

Environmental Discourse Models

It became apparent during this analysis that there is considerable variability in the general environmental discourse models (Dryzek 1997) employed by the responsible state executive agencies involved with AIS management in Maryland and Virginia.

In Maryland the general discourse model of MDNR in relation to AIS management appears to be one of "administrative rationalism" (Dryzek 1997),

with people's concerns subordinate to the technical expertise of the state.

However, no inference is intended as far as the management of other natural resource issues in Maryland. The origins of the AIS organization are within the executive branch. There is little public input relating to administrative decisions regarding AIS, aside from those stipulated by regulatory process and no AIS advisory groups. *Ad hoc* technical groups are often convened should specific AIS issues become problematic. The Invasive Species Matrix Team is comprised solely of MDNR staff. While some members participate in the Maryland Invasive Species Council, the latter group has no formal role in MDNR activities, as it is *ad hoc* in nature.

In Virginia, however, the general policy discourse model of the Virginia Department of Game & Inland Fisheries (VDGIF) appears to be one of "democratic pragmatism" (Dryzek 1997), which is very deliberative and inclusive in nature. The origins of the AIS organization are in the General Assembly. And there is considerable public input into administrative decisions relating to AIS as the Board of Game & Inland Fisheries (VBGIF), comprised of representatives from Virginia's 11 Congressional Districts, exercises considerable authority over the AIS activities and the regulatory authority of VDGIF.

These differences are important when evaluating the differences in the perception of situational capacity in these states. Administratively, in Maryland, MDNR is able to identify, define, and recommend responses to emerging AIS issues relatively quickly. In Virginia, these same processes must generally be

overseen by the Board of Game & Inland Fisheries, often requiring statewide input from various constituencies, and a more circumspect process in regard to identifying and defining emerging AIS issues.

In both states the Natural Heritage Programs (NHP) appear to exemplify the green rationalism discourse model and basically imbue the AIS organizations in each of these states with a heightened concern about biodiversity—even apart from AIS concerns. While the NHP programs have a considerable support role in both Maryland and Virginia in relation to AIS, they have no regulatory role, aside from recommendations for the lists of rare, threatened, and endangered plants and animals. Their support role is *ad hoc* in Maryland but codified in Virginia.

Program and Project Distinctions

The findings of this survey suggest that, overall, the respondents in both Maryland and Virginia perceive the capacity of the AIS organizations in these states as moderately-developed. The term organization, however, was defined broadly in this study as, “The ability of a state to establish a group of individuals to apply its available skills and resources to accomplish stated AIS goals within state natural resource agencies.” Although the respondents in both Maryland and Virginia rated the organizational capacity of each state similarly, in Maryland the AIS organization is very informal—an executive branch creation with little statutory authority, while in Virginia the AIS organization is very formal—a legislative creation, with considerable statutory authority.

However, other investigators have made more elaborate distinctions between different types of organizational approaches used to address environmental issues. Bartlett (1994) considers projects to be generally “time-bounded” efforts, which may or may not be part of larger programmatic effort, and suggests that programs usually have more formality, with official titles and readily identifiable boundaries. Bartlett (1994) elaborates on the characteristics of programs noting that:

Programs are formally created by executives or legislators, have defined goals, and are administered by a single agency or a relatively small, designated group of agencies (p. 173).

From this definitional perspective, it seems that Maryland is approaching AIS issues as a series of discrete, independent projects, without forming a comprehensive program to address the issues. Virginia, however, is approaching AIS issues from the perspective of a comprehensive AIS program, and is grappling with the particulars of such an effort and the legal framework which has been enacted.

CHAPTER 6. CONCLUSION AND RECOMMENDATIONS

The purpose and primary contribution of this study was to provide a comparative assessment of state aquatic invasive species (AIS) management capacity in Maryland and Virginia, essentially a perceptual analysis of the ability of the states to effectively manage AIS. The assessment was made using the responses of participants to questions relating to overall State AIS Management Capacity as surrogates, rather than measuring these components otherwise. The framework for this analysis included the following components: situational capacity, political capacity, institutional capacity, state capacity, organizational capacity, and evaluation capacity. The focus of the research was on the executive natural resource agencies responsible for the implementation of AIS regulations in each of these states. The survey was conducted from April 5, 2010-July 30, 2010 and the respondents surveyed represented a wide spectrum of AIS experts in Maryland (n=20) and Virginia (n=10), ranging from field biologists to senior managers, in both the governmental and nongovernmental sectors.

A secondary purpose of this research was to provide a contextual understanding of the nature of AIS management by natural resource agencies in Maryland and Virginia. An ancillary contribution, as a matter of necessity, was the

development of the novel methodology that was required for this assessment, which has not been used before.

Overall, considering all perceptual responses to each of the questions relating to the various components of capacity in each state assessed, the majority of responses in both states were “moderately-developed,” (i.e., AIS program needs some improvement) with this category selected for 52.3% of the responses in Maryland and 58.2% of the responses in Virginia. However, there was a greater frequency of “well-developed” (i.e., sufficient AIS program development) responses in Maryland (30.3%) than in Virginia (10.9%) and conversely a lower frequency of “poorly-developed” (i.e., AIS program needs considerable improvement) responses in Maryland (17.4%) than in Virginia (31.0%).

Categorical data relating to the perceptual responses regarding the various components of AIS capacity was coded as ordinal data based on a traditional Likert-like scale, ranging from 1-5 (poorly-developed capacity=1, moderately-developed capacity=3, well-developed capacity=5) with group means (i.e., Maryland and Virginia) calculated for each component of capacity assessed. The group means for the various components of capacity assessed ranged from 2.4–4.2 in Maryland and from 2.0-3.3 in Virginia, on a scale of 1 (low)–5 (high). The difference in means, measured as the group mean in Maryland minus the group mean in Virginia for each component of overall AIS capacity assessed, ranged from -0.1 to 1.2.

An integrative metric was calculated to provide an overall indicator of the perception of State AIS Management Capacity in each state. This metric represents the grand mean of all coded categorical responses for all components of capacity assessed. It is an unweighted metric, with each response simply assigned a numeric value depending on the nature of the response, as described previously. On a relative scale of 1-5, a higher I_{AIS} value indicates an overall perception of better-developed State AIS Management Capacity. While the intervals measured by the ordinal scale ranging from 1-5 are not exact, one can evaluate the I_{AIS} in relation to the initial ordinal rankings of the categorical values. Based on this approach, a reasonable scale for interpreting the score of this metric is the following: an I_{AIS} of 1-2.3 represents a classification of overall poorly-developed State AIS Management Capacity, an I_{AIS} of 2.3-3.7 represents a classification of overall moderately developed State AIS Management Capacity, while an I_{AIS} of 3.7-5 represents a classification of overall well-developed State AIS Management Capacity.

The overall I_{AIS} for Maryland was 3.3 while the overall I_{AIS} for Virginia was 2.6. These findings suggest that the perceptions of respondents in both Maryland and Virginia are such that each of these states has a moderately-developed capacity to effectively address AIS issues. However there was considerably variability in differences in comparative I_{AIS} scores in Maryland and Virginia when each separate group (i.e., Maryland and Virginia) was parsed into separate subgroups (e.g., responsible state AIS agencies, federal environmental agencies,

and other). This warrants additional study. Subgroup information is not reported in this study aside from this particular evaluation.

Permutation analysis was conducted to determine whether the perception of the individual dimensions of AIS management capacity differed significantly in Maryland and Virginia. These analyses confirmed the empirical findings, with statistically significant differences found between states in relation to perceptions of situational ($p < 0.05$) and state capacity ($p < 0.05$), with Maryland receiving higher scores. No statistically significant differences were observed between states as far as perceptions of political capacity, institutional capacity, organizational capacity, or evaluation capacity.

There was considerable variability in the perception of the severity of the problems posed by AIS among respondents in these states, although the overall values were relatively similar in Maryland and Virginia. In Maryland, the index of AIS severity (I_s) was 5.7, on a continuum scale from 1-10, with 1 designating the lowest severity and 10 the highest severity, as far as the perception of adverse effects from AIS by the respondents. In Virginia the index of severity (I_s) was 6.5. Generally, respondents believed that the adverse effects of AIS in the Chesapeake Bay are not as severe as in some other areas of the United States.

The findings of this study indicate that the AIS programs in Maryland and Virginia are believed to be reasonably effective and moderately-developed, with adequate regulations in place in both states to address most AIS concerns. A basic framework for AIS management has been developed in each state. The

framework for the AIS organization in Virginia is codified in Virginia while it is not in Maryland. Both states have an organization tasked with addressing AIS issues, although neither state has a discrete AIS program with dedicated funding and personnel. Instead, each state has a group of professionals that is comprised of staff, assigned to various programs with other primary responsibilities, who are assigned AIS duties collaterally. Both states have a long-standing regional involvement in AIS issues and both states have had successes in AIS eradication. However, it was noted that AIS are generally perceived as a low priority issue in these states and, as a result, have received much less political commitment than other issues.

Distinct differences were observed in Maryland and Virginia as far as which branch of government was believed to be most important in facilitating the development of the AIS programs within the state natural resource agencies. In Maryland it was believed that the executive branch was most important while in Virginia it was believed that the legislative branch was most important.

Considerable differences were observed in the governance of the executive branch natural resource agencies tasked with AIS program implementation in each state, which may considerably effect perceptions of situational capacity by respondents. In Maryland, the AIS program has little oversight with no governing board while in Virginia VDGIF is overseen by the Board of Game and Inland Fisheries, which is a governing board. Distinct typological characteristics were apparent in the approach to AIS management by

MDNR (administrative rationalism), VDGIF (democratic pragmatism) and the Maryland and Virginia Natural Heritage Programs (green rationalism).

A significant finding that emerges from this study is that the role of the state executive branch AIS organizations in Maryland and Virginia is basically to advise senior state officials regarding AIS issues, aside from other duties. In general, the responsible state agencies in Maryland and Virginia lack the resources themselves to address a major invasion of AIS, aside from identifying and defining the issue, and offering recommendations for action. Considerable reliance of such AIS organizations on external sources for funding and technical expertise would be necessary in the event of a significant AIS infestation. And given the relatively high state capacity in Maryland and Virginia, based on objective assessments and the responses of participants in this survey, it seems probable that Maryland and Virginia will continue to intervene in order to alter the course and potential effects of a particular AIS invasion, when deemed necessary.

The technical expertise and resources of the Maryland and Virginia Sea Grant and Land Grant College Programs, including the Sea Grant Extension Service and the Cooperative Extension Service, will continue to be of importance. And the technical expertise and resources of APHIS could also be readily made available via federal legislation should an AIS problem in these states become intractable, as evidenced by federal interventions in relation to nutria, brown tree snakes, and Asian carp.

It apparently has not yet been considered necessary in these states to establish discrete programs to address AIS issues, given the general low priority of AIS issues and the infrequency with which issues of major concern arise. While considerable political capacity and institutional capacity may not be readily apparent as far as the degree of development of the AIS organizations in these states, should the severity of AIS issues increase, then possibly more elaborate, better-staffed, and better-funded AIS organizations will be established.

The perceptual assessments provided by this research, as well as the various descriptive statistics, metrics, and statistical analyses provided in this research are all meant to be relative indicators of State AIS Management Capacity in Maryland and Virginia. It is hoped that this research has contributed to a better understanding of the various components of state AIS management capacity that affect the ability of states to effectively manage AIS. And that such a contextual understanding will better enable the states to engage in capacity-building efforts to enable them to more readily achieve their often unique AIS objectives.

Summary Conclusions

1. The survey was conducted from April 5, 2010-July 30, 2010, with an overall survey response rate of 43.1%.
2. The comparative assessment of State AIS Management Capacity in Maryland and Virginia was based on categorical responses to perceptual questions relating to various components of AIS capacity, including: situational, political, institutional, state, organizational, and evaluation capacities.

3. Semi-structured interviews were conducted as scripted telephone surveys, to collect data for this research, with the survey instrument comprised of both open-ended and closed-ended questions.
4. Thirty telephone interviews were conducted (Maryland n=20; Virginia n=10), with the respondents representing a wide range of AIS professionals in both the governmental and nongovernmental sector;
5. The interviews ranged in duration from 25 to 90 minutes with a mean length of 43.5 minutes in Maryland and a mean length of 41.5 minutes in Virginia.
6. Comparative percentage frequencies of the various categorical responses selected (i.e., poorly developed, moderately developed, and well-developed). The majority of responses chosen in both states were “moderately-developed,” (i.e., AIS program needs some improvement) with this selected for 52.3% of the responses in Maryland and 58.2% of the responses in Virginia. However, there was a greater frequency of “well-developed” (i.e., sufficient AIS program) responses in Maryland (30.3%) than in Virginia (10.9%) and conversely a lower frequency of “poorly-developed” (i.e., AIS program needs considerable improvement) responses in Maryland (17.4%) than in Virginia (31.0%).
7. Categorical data obtained from the survey, relating to the various components of overall AIS capacity, was coded based on a traditional Likert-like scale, ranging from 1-5 (poorly-developed capacity=1, moderately-developed capacity=3, and well-developed capacity=5).
8. Group means (i.e., Maryland and Virginia) were calculated for each component of capacity assessed. The group means for the various components of capacity assessed ranged from 2.4–4.2 in Maryland and from 2.0-3.3 in Virginia, on a scale of 1 (low)–5 (high).
9. The difference in means, measured as the group mean in Maryland minus the group mean in Virginia, for each component of capacity assessed, ranged from -0.1 to 1.2.
10. In Maryland the ranking of the group means of the various components of capacity in decreasing rank-order, was 1) situational capacity, 2) state capacity, and 3) organizational capacity.
11. In Virginia, the ranking of the group means of the various components of capacity, in decreasing rank-order, was 1) organizational capacity, 2) situational capacity, and 3) state capacity.

12. The greatest observed differences in means were apparent in relation to perceptions of situational and state capacity, with both values higher in Maryland than in Virginia. The group means of the various components of capacity were generally higher in Maryland than in Virginia, with the exception of organizational capacity and evaluation capacity.
13. Permutation analysis indicated that there were significant differences in perceptual responses relating to both situational and state capacity by Maryland respondents relative to Virginia respondents ($p < 0.05$). No statistically significant differences were observed between states as far as perceptions of political capacity, institutional capacity, organizational capacity, or evaluation capacity.
14. The overall I_{AIS} calculated for Maryland was 3.3 while the I_{AIS} calculated for Virginia was 2.6. A higher I_{AIS} indicates an overall perception of better-developed State AIS Management Capacity.
15. The various agencies involved with AIS management in these states exhibit characteristics typically associated with particular types of environmental discourse models. MDNR exhibits characteristics of *administrative rationalism*, VDGIF exhibits characteristics of *democratic pragmatism*, while the Natural Heritage programs in both states exhibit characteristics of *green rationalism*.
16. There were marked differences in Maryland and Virginia as far as what branch of government was believed to be most important in facilitating the development of the AIS program. In Maryland it was believed that the executive branch was most important while in Virginia it was believed that the legislative branch was most important.
17. Considerable differences were observed in the governance of the executive branch natural resource agencies tasked with AIS program implementation in each state, which may considerably effect perceptions of situational capacity. In Maryland, the AIS program has little oversight with no governing board while in Virginia VDGIF is overseen by the Board of Game and Inland Fisheries, which is a governing board.
18. The framework for addressing AIS concerns is not codified or formally established in Maryland, unlike Virginia where such an AIS framework is both codified and formally established.

19. While both Maryland and Virginia have an AIS organization, neither has a discrete AIS program. Staff is generally assigned in a collateral fashion on an *ad hoc* basis within responsible state AIS organizations.
20. Both states have a long-standing regional involvement in AIS issues and both states have had successes in AIS eradication.
21. It was noted that AIS are generally perceived as a low priority issue in these states and, as a result, have received much less political commitment than other issues.
22. The perceptions of respondents relating to the severity of adverse AIS effects in Maryland and Virginia were reported as the index of AIS severity (I_s) on a continuum scale from 1-10 (1=low severity, 10=high severity). The I_s in Maryland, was 5.7, while the I_s in Virginia was 6.5

There are various implications that arise from this study, as far as recommendations for additional research and for AIS policy in general. While respondents in both states characterized the executive branch AIS programs in their states as moderately-developed overall, there was considerable frustration noted in relation to the lack of dedicated funding and they lack of a distinct AIS program, and the fact assignments to AIS projects are generally *ad hoc* in nature. Following are some recommendations that might be useful in facilitating the management of AIS in Maryland and Virginia:

- An AIS coordinator position—whether funded by the state, the Chesapeake Bay Program, the USFWS or NOAA--might alleviate some of the burden and conflict that arises as a result of the collateral responsibilities of staff given *ad hoc* AIS responsibilities.
- The Coastal Zone Management Act could be revised to include AIS issues in a more inclusive fashion, much in the same fashion that NPS water pollution issues have been addressed.
- Based on the framework for analysis used in this study, self-assessment matrices should be developed for the use of AIS

programs in Maryland and Virginia (and elsewhere) to periodically assess their AIS capacity in the context of focus groups.

- The framework for analysis used in this study, could be developed more fully, with various subcomponents used to describe the various components of capacity in a more definitive manner.

In closing, while much of this research has focused on differences in the management of AIS in Maryland and Virginia, the following paragraph provides a synthesis of various comments by several participants in this study from both Maryland and Virginia. Despite the differences in State AIS Management Capacity observed in this study, these comments reflect the fundamental commonality of AIS issues and concerns in these states:

In relation to AIS, Maryland and Virginia are familiar in many ways as far as policies and laws....AIS have never risen to the level of a priority issue.... Basically the AIS organization consists of a group of natural resource agencies with different missions and no real focus on AIS issues.... the various AIS laws regulations and policies will require that some ongoing mechanism remain in place to implement and enforce them....If an AIS issue is perceived as a significant threat, then necessary resources are made available. The issue itself and public concerns about AIS that will sustain AIS programs.

APPENDIX A. SURVEY INSTRUMENT AND HSRB DOCUMENTATION

Survey Instrument: A Comparative Assessment of Aquatic Invasive Species (AIS) Management in Maryland and Virginia:

Part I. Dimensions of Situational Capacity

This part asks you to rate your perceptions relating to the *situational capacity* of your state as reflected in its ability to identify, define, and effectively respond to AIS issues. The first question in this part is closed-ended while the second question is open-ended. After I read the first question to you, and the answer choices, please respond with the answer that is closest to your view about the statement.

1. Overall, in your opinion, based on your work experience and your present understanding, the level of situational capacity in your state is:

- a. ,Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

2. Open-ended Question: Based on your work experience and your present understanding, what best illustrates the ability of your state or AIS program to identify, define, and respond to AIS issues, and what interest groups have helped in this process?

Part II. Dimensions of Political Action and Commitment

This part asks you to rate your perceptions relating to political action and commitment that have facilitated proactive AIS management in your state—factors external to the structure of the AIS program itself. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer that is closest to your view about that statement

3. Overall, in your opinion, based on your work experience and your present understanding, the level of political action and commitment in your state related to proactive AIS management is:

- a. Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

4. Open-ended Question: Based on your work experience and present understanding, what best illustrates the political commitment and support of your state to your state AIS program and requires planning and coordination related to such issues.

III. Dimensions of Institutional Capacity

This part asks you to rate your perceptions relating to the *institutional capacity* of your state AIS program, that is, the legal and regulatory framework that establishes it in a sustainable fashion within a state agency. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer that is closest to your view about that statement.

5. Overall, in your opinion, based on your experience and your present understanding, the degree of institutionalization of your state AIS program is:

- a. Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

6. Open-ended Question. Based on your work experience, and your present understanding, what is the nature of the legal framework of statutes and regulations (or other mechanisms for governance) that have established your state AIS program and to what degree do they allow for its sustainability?

Part IV. Dimensions of State Capacity

This part asks you to rate your perceptions relating to state capacity, the overall generic ability of your state to marshal resources to develop a program. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer that is closest to your view about that statement.

7. Overall, in your opinion, based on your experience and your present understanding, the management capacity of your state is:

- a. Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

8. Open-ended Question: Based on your work experience and your present understanding, how well has your state directed its available state management capacity towards addressing AIS issues?

Part V. Dimensions of Organizational Capacity

This part asks you to rate to your perceptions of the organizational capacity of your state AIS program, as far as it having the necessary organizational tools, experienced staff and required resources to accomplish its mission. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer that is closest to your view about that statement.

9. Overall, in your opinion, based on your experience and your present understanding, the organizational capacity of your state AIS program, is:

- Well developed _____
- Moderately developed _____
- Poorly developed _____

10. Open-ended Question: Based on your work experience and present understanding do you feel that the organizational capacity of your state AIS program, as far as it having the necessary organizational tools, experienced staff, and requisite resources, is sufficient for it to accomplish its mission?

Part VI. Dimensions of Evaluation and Adaptive Capacity

This part asks you to rate your perceptions of the effectiveness with which your state AIS program is periodically monitored and evaluated as far as attainment of goals and objectives, and the ability of the program to adapt based on such evaluations. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer that is closest to your view about that statement.

11. Overall, in your opinion, based on your experience and your present understanding, the established provisions to periodically evaluate your state AIS

program and to have its performance monitored and evaluated and make adaptive changes are:

- a. Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

12. Open-ended Question: Based on your experience and your present understanding do you feel that your state AIS program has sufficient evaluation tools to assess the performance of the state AIS program and adapt the program based on results?

Part VII. Respondent Information

State Coding ID [VA/MD] _____

Respondent Coding ID from Response to Request to Participate in Survey Form _____

13. What state are you evaluating?

Maryland _____

Commonwealth of Virginia _____

14. What is your job title?

15. What type of agency do you work for?

16. What percentage of your time would you estimate that you spend on AIS matters, ranging from 0 to 100%?

Part VIII. Extrinsic Factors.

The preceding portion of the survey primarily addresses intrinsic factors—those under the control of the state or characteristic of the state itself. The following questions examine the national context of AIS management, as you presently understand it. The first question in this part is closed-ended while the second question is open-ended. After I read the question to you, and the answer choices, please respond with the answer choice that is closest to your view about that statement.

17. Overall, in your opinion, based on your work experience and present understanding, the national capacity to address AIS issues—as far as prevention, early detection, rapid response, control, management, and coordination—is:

- a. Well developed _____
- b. Moderately developed _____
- c. Poorly developed _____

18. Open-ended Question: Based on your work experience and present understanding, what factors external to your state AIS program, at the national level, do you feel presently have the greatest effect on it.

Part IX. Supplemental Questions

Questions 19-23 below are open-ended while question 24, the final question is closed-ended. Please respond to these based on your work experience and your present understanding of AIS issues.

19. In what ways would you characterize your AIS Program as being effective? What are some of the most significant achievements of your AIS program that illustrate its effectiveness?

20. As political support, at best, waxes and wanes, what characteristics of your state AIS program do you feel will allow for its sustainability (e.g., laws that require consideration of AIS in decision-making, enforceable regulations relating to AIS, state program funding apart from matching funds, management plans, invasive species councils, etc.)?

21. What aspects of your state AIS program do you feel confer credibility and legitimacy to it (e.g., planning, best management practices, coordination, innovations) in terms of how it is perceived or emulated by other states or the national government?

22. Much emphasis is given to the critical nature of early detection, rapid response, and eradication in AIS management. Do you feel that your state has an adequate and effective rapid response plan in place?

23. What changes to AIS national legislation would be most beneficial to your state AIS program?

24. How would you rate the severity of the environmental problems (ecological, economic, and health) posed by AIS in your state? Score your rating based on a continuum from 1 to 10, with 1 being least severe and 10 being most severe? Response _____.

HSRB Documentation

A Comparative Assessment of State Aquatic Invasive Species (AIS) Management in Maryland and Virginia: AIS Management Capacity and State Activism

INFORMED CONSENT FORM

RESEARCH PROCEDURES

This research is intended as a pilot assessment to allow for a comparative evaluation of Aquatic Invasive Species (AIS) programs in Maryland and Virginia, two states that have both been successful in management of AIS issues although somewhat different management approaches have been employed. The survey data will be used to evaluate, in a semi-qualitative manner, the capacity of the AIS programs in both of these states and to facilitate the development of a metric of "state activism" to evaluate particular aspects of state AIS programs that are perceived as representing an active AIS program and which allow for sustainability of such programs.

The specific purposes of this research are 1) to assess the capacity of AIS programs in these states by both evaluating both qualitatively and quantitatively various traditional determinants of capacity (e.g., dimensions such as political capacity and organizational capacity) and to 2) develop a metric to assess the activism of the Aquatic Invasive Species (AIS) Programs in Maryland and Virginia. This research relates to the management of non-native aquatic fish & wildlife species (i.e., AIS considered to have harmful ecological or economic effects) and is being conducted to aid in the completion of a study assessing such characteristics of AIS management.

If you agree to be interviewed, you will be asked to participate in a telephone survey relating to various dimensions of AIS program capacity (e.g., situational, political, institutional, organizational) in Maryland and Virginia. The survey should take no longer than 15-20 minutes to complete.

RISKS

There are no foreseeable risks for participating in this research.

BENEFITS

There are no direct benefits to you as a participant other than to further research in AIS management in Maryland and Virginia. In the future, there may be benefits to others who are affected by changes in national AIS actions or improvements in AIS management in Maryland and Virginia in that in the planning process for AIS management may be improved, maximizing benefits and providing greater program adaptability.

CONFIDENTIALITY

All information obtained in this survey will be confidential in nature. The survey sheet used will be coded and confidentiality protected in the following ways: (1) your name will not be included on the survey forms and other collected data; (2) a code will be placed on the survey and other collected data; (3) through the use of an identification key, the researcher (John Christmas Jr.) will be able to link your survey to your identity; and (4) only the researcher will have access to the identification key.) The codes and any other identifiable data or other materials will be maintained in a secure safe throughout the study and will be destroyed at its conclusion.

PARTICIPATION

Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty. There are no costs to you or any other party.

Approval for the use
of this document
EXPIRES

MAR 31 2011

Protocol # 6886
George Mason University

CONTACT

This research is being conducted by John Christmas, a Ph.D. candidate in the Environmental Science and Policy Department at George Mason University. He may be reached by phone at (410) 757-6146 or (703) 323-2000 x 27470, or by e-mail at ichristm@gmu.edu for questions or to report a research-related problem. Peter Balint, Committee Chair for this project, may be reached at 703-993-1404. Also, you may contact the George Mason University Office of Research Subject Protections at 703-993-4015 if you have questions or comments regarding your rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your participation in this research.

If you prefer, the telephone survey can be conducted as an audio-taped interview. If you choose this option, the tapes will be handled with the same confidentiality previously noted for all survey data and destroyed at the conclusion of the study. Please check the appropriate box below to indicate your preference.

I do not agree to audio-taping. _____

I do agree to audio-taping _____

Approval for the use
of this document
EXPIRES

MAR 31 2011

I have read this form and agree to participate in this study.

Protocol # 6886
George Mason University

Name

Date of Signature

Version date: March 6, 2010

MAR 31 2011

1

Dear Colleague,

Protocol #: 6556
George Mason University

The Environmental Science and Policy Department at George Mason University (GMU) will be conducting a brief telephone survey relating to aquatic invasive species (AIS) management efforts in Maryland and Virginia. As an "elite" individual in this particular discipline—an expert in a particular aspect of AIS biology and management—we are requesting your participation in this survey. It is brief and should take only about 15-20 minutes, should you decide to participate.

This research is intended as a pilot assessment to allow for an evaluation of AIS programs in two states which have both been successful in the management of AIS—using somewhat different approaches to AIS management. This survey is a part of a dissertation research project that I am conducting as a Ph.D., candidate at GMU. The project is titled *A Comparative Assessment of Aquatic Invasive Species (AIS) Management in Maryland and Virginia: State AIS Activism and Management Capacity*.

The primary focus of this survey is on characteristics of those state executive agencies in Maryland and Virginia with primary AIS regulatory roles as detailed by the Environmental Law Institute in *Halting the Invasion in the Chesapeake Bay: Preventing Aquatic Invasive Species Introduction through Regional Cooperation*, published in 2007. In Maryland the Department of Natural Resources (MDNR) is the primary agency responsible for AIS regulation. In Virginia this responsibility is shared by the Departments of Game and Inland Fisheries (VDGIF) and Agriculture and Consumer Services (VDACS) along with the Virginia Marine Resources Commission (VMRC). The Virginia Department of Conservation and Recreation (VDCR) has an advisory role. Although Maryland Sea Grant, Virginia Sea Grant, USEPA, USFWS, and USDA have very significant roles in AIS activities, these agencies are not the focus of this study.

The survey will be administered by telephone over a four-week period from April 5-April 22, or thereabout. It will include 15 open-ended questions (ones that you can discuss) and 11 closed-ended questions (ones for which you have to select a choice from several possible responses). The questions are meant to be interpreted only in terms of your work experience and perceptions about AIS issues, as you understand them in your state. Please remember that there are no right or wrong answers; the survey is only concerned with your view on particular issues.

All information obtained in this survey will remain strictly confidential and all potentially identifiable data obtained from the survey will be coded so that you cannot be identified. If you choose to participate in this study, it is your prerogative not to answer any question that you would rather not. The survey is completely voluntary.

If you have any questions about this study, you can contact John Christmas at (410) 349-1941 or (703) 323-2000 x27470, or my advisor, Dr. Peter Balint, at (703) 993-1404. You may also contact the George Mason University Office of Research Subject Protection Sponsored Programs at (703) 993-4015 for additional information regarding human research subject protection in relation to this project and your rights as a participant in this research. This project has been reviewed pursuant to George Mason

Survey-Instrument-Final-Dissertation Summary Points

University protocols governing participation of individuals as respondents in this research.

If you choose to participate in the survey there are a few attached forms that you will need to review and return to me; please return both of these forms in the self-addressed stamped envelope. The attached *Response to a Request to Participate in a Survey* should be used to choose a date and time to participate in the survey. Also, it is important that you review, sign, and return the attached informed consent relating to your participation in this survey. This form has been approved by George Mason University's Human Subject Review Board. It is important that both of these forms are completed and returned to me prior to the administration of the survey.

If you would like me to provide you with a synopsis of the results of the survey; please indicate this on the *Response to a Request to Participate in a Survey* form. However this information will not be available until sometime after the completion of the dissertation. But if you would like to discuss the overall ratings prior to publication, I would be happy to discuss them with you.

Regards,
John Christmas

Approval for the use
of this document
EXPIRES

MAR 31 2011

Protocol #: 6886
George Mason University

Second Contact - Mailed Reminder of Survey

This document will be printed as a 4"x6" (approximate size) bifold card with a photograph of a mute swan on the front. The photograph was taken by me.

The inside left of the card will have the following text:

Colleagues,

This is just a reminder about the recent note that I sent you regarding the survey that I will be conducting as a Ph.D. candidate at George Mason University. The title of my dissertation research proposal is:

A Comparative Assessment of Aquatic Invasive Species (AIS) Management in Maryland and Virginia: State AIS Activism and Management Capacity

If you could please review the enclosed form and return it to me whether you are able to participate or not—I would very much appreciate it. A self-addressed-stamped envelope is enclosed as well. If you have already responded to my previous request, I would like to confirm the interview that we have arranged for _____ 2010 at _____ AM/PM.

Regards,
John Christmas

The inside right of the card will have the following text:

"...a hundred years of faster and bigger transport has been kept up and [has] intensified this bombardment of every country by foreign species, brought accidentally or on purpose, by vessel and by air, and also overland from places that used to be isolated. Of course, not at all the plants and animals carried around the world manage to establish themselves in the places they get to, and not all that do are harmful to man, though they must change the balance among native species in some way. But this worldwide process, gathering momentum every year, is gradually breaking down the sort of distribution that species had even a hundred years ago."

Charles Elton, 1958

Approval for the use
of this document
EXPIRES

MAR 31 2011

Protocol # 6886
George Mason University

Notice of Extension of Time Period to Respond to a Request to Participate in Survey

A Comparative Assessment of Aquatic Invasive Species (AIS) Management in Maryland and Virginia:
State AIS Activism and Management Capacity

Please check the appropriate box below:

I will not be able to participate in this Aquatic Invasive Species Survey. ☐

I will be able to participate in this Aquatic Invasive Species Survey. ☐

At the request of potential respondents--given field projects, meetings, and vacations scheduled for this time of year--the end date for this survey, initially scheduled as June 3, 2010, will be extended until July 30, 2010. Brief interviews (15-20 minutes) will be conducted during the afternoons on weekdays (Monday-Friday) from 1:00-4:30 PM. Please select the best time for your participation from the choices below. If possible, list alternate choices as well, to preclude scheduling conflicts. In scheduling the interview, please try to ensure that you will be able to complete the survey in privacy without disruption. If nonworking hours are more convenient for you and will allow more privacy, please select a time from 6-9 PM for any of the dates listed below:

May 24-May 28, 2010	_____	June 1-June 4, 2010	_____
June 7-June 11, 2010	_____	June 14-June 18, 2010	_____
June 21-June 25, 2010	_____	June 28-July 2, 2010	_____
July 6-July 9, 2010	_____	July 12-July 16, 2010	_____
July 19-July 23, 2010	_____	July 26-July 30, 2010	_____

Day: of Week (Please Circle) M T W Th F Time: _____

Name: _____

Phone number to contact you at: (Day) _____ (Evening) _____

State you wish to address: Maryland ☐
Virginia ☐

Code Number Assigned by Researcher: _____

If you have any questions concerning this survey, please contact John Christmas at (410) 349-1941 or (703) 323-2000 x 27470, Dr. Peter Balint at (703) 993-1404, or the Office of Research Subject Protection at George Mason University (703) 993-4015.

Please return this note in the enclosed self-addressed stamped envelope whether or not you are able to participate in the survey. If you will be participating in the survey please be sure to review, sign and return the informed consent letter that is attached.

If you wish to receive information about this study at its conclusion please indicate this below.

I would like a synoptic survey of the results of this research after completion of the study, when available.
Yes ___ No ___

I would like to discuss the overall ratings for the state I addressed prior to the conclusion of the study.
Yes ___ No ___

Thank you for taking the time to review this information.

Approval for the use
of this document
EXPIRES

MAR 31 2011

Protocol # 6886
George Mason University

APPENDIX B. CHARACTERISTICS OF MARYLAND AND VIRGINIA RELEVANT TO AIS MANAGEMENT

This appendix describes some relevant aspects of the political histories of Maryland and Virginia, and then provides a brief description and history of the particular responsible natural resource agencies tasked with the implementation of AIS regulations in Maryland and Virginia. This is followed by a brief overview of a major AIS crisis in both Maryland and Virginia—respectively, the discovery of a reproducing population of northern snakehead fish in ponds in Crofton, Maryland (Anne Arundel Co.) in 2002 and the discovery of a reproducing population of zebra mussels in Milbrook Quarry, Virginia (Prince William County), also in 2002. Both of these infestations resulted in subsequent interventions by the states to eradicate such invasive species. This appendix concludes with a discussion of the centerpiece AIS legislation in each of these states, which has been critical in the development of the framework for AIS management policies in these states. In both Maryland and Virginia, such centerpiece legislation appears to have been precipitated as a result of the previously noted infestations. These infestations and difficulties that arose during the subsequent interventions by the states served as refocusing events (Scheberle 2004) for AIS management in these states. Deficiencies in the state AIS management policies were highlighted, with sufficient political pressure generated to statutorily remedy them.

General Political Considerations

A brief summary of general aspects of state government in Maryland and Virginia will allow for a better understanding of the nature of AIS management in these states. The General Assemblies of Maryland and Virginia are the most similar of the various states in the Chesapeake Bay Watershed. The state legislatures are both intermediate in professionalism, in terms of the overall diversity of such organizations in the 50 states, as measured by legislative session length, salaries, and number of staff (Harrigan 1988). Both Maryland and Virginia are considered to have considerable power vested in the executive branch (Gray and Hanson 2004), although the executive powers of Maryland's governor are generally rated, overall, as somewhat higher than Virginia's governor. In Maryland the governor has a four-year term and is restricted to two terms, while in Virginia the governor has a four-year term with consecutive reelection prohibited.

Maryland is essentially a one-party "Democratic" state, currently and typically total under Democratic Party control. Since 1935 there have been only three Republican governors in Maryland. In Virginia, there is considerable variability in party control, with current control presently split, with a Republican governor. The House of Delegates is controlled by Republicans while the Senate is controlled by the Democrats. There have been six Republican governors in Virginia since 1934. While there is infrequent change in party control in Maryland there is frequent change in party control in Virginia.

Constitutional References to Natural Resource Management

The state constitution provides the basic blueprint for the requisite political structure for each state; providing the primary legal directive for prioritizing particular issues. Reeves' (1985) notes that:

The political life of each state takes place within the boundaries established by the federal and state constitutions...the state constitutions impose the major legal restraints on state action. A constitution determines the structure of government in a state to a substantial degree. Because constitutions are less easy to change than ordinary legislation in most instances, they settle some controversies on a more or less permanent basis, (Reeves 1985, pp. 27-30).

Maryland's constitution is relatively old and outdated in many ways; it has not been updated since 1867, which was its fourth and most recent revision, having been initially adopted in 1776 (Swanson *et al.* 1970). It is one of just a few state constitutions that has no provisions for natural resource conservation and protection of any sort, with no such amendments currently under consideration. (Grad and Williams 2006, Tarr and Williams 2006). In contrast, the Commonwealth of Virginia's constitution—the first state to adopt a state constitution in the United States—has been revised on five occasions, most recently in 1971. It has several provisions that directly relate to natural resource conservation.

Article XI (Conservation, Sections 1 and 2) of the Constitution of Virginia provides explicitly for effective natural resource and environmental conservation (Banks 2007), stating that:

To the end that the people have clean air, pure water, and the use and enjoyment for recreation of adequate public lands, waters, and other

natural resources, it shall be the policy of the Commonwealth to conserve, develop, and utilize its natural resources, its public lands, and its historical sites and buildings. Further, it shall be the Commonwealth's policy to protect its atmosphere, lands, and waters from pollution, impairment, or destruction, for the benefit, enjoyment, and general welfare of the people of the Commonwealth. (Constitution of Virginia Article XI)

The Constitution of Virginia Article XI (Conservation, Section 4) further details the rights of the citizen's to the common natural resources of the state stipulating that:

The people have a right to hunt, fish, and harvest game, subject to such regulations and restrictions as the General Assembly may prescribe by general law.

Maryland and Virginia's Cabinet Level Natural Resources Secretariats

The management of natural resources is of considerable importance in both Maryland and Virginia, and a cabinet level department has been established in both states for the administration of such resources. A cabinet level form of government is relatively new in Maryland and Virginia, as well as many other states. Prior to the cabinet formation in these states during the late 1960s and early 1970s, both Maryland and Virginia had a wide-assortment of literally hundreds of governmental boards and departments with a wide-range of functions and reporting responsibilities. These diverse groups were consolidated into a much smaller number of Departments with Cabinet-level Secretaries appointed by and reporting directly to the governor. Of concern here are only those Departments created for the management of natural resources in these states.

MDNR was created in 1969, pursuant to legislation introduced at the urging of Governor Marvin Mandel. The architecture of the cabinet structure was largely developed during the 1967-1968 Maryland Constitutional Convention. Although the proposed revisions to the constitution were not adopted, the governor was successful in supporting the introduction and subsequent enactment of legislation which codified various proposed executive changes that had been proposed in the course of the constitutional convention. This legislation increased the governor's power substantially (Swanson *et al.* 1970).

A cabinet level form of government was adopted in Virginia in 1972, with the General Assembly subsequently establishing the Virginia Natural Resources Secretariat in 1986 (University of Virginia 1990). The constitutional revision of 1971 firmly established a legal mandate for resource conservation and environmental protection efforts already provided by various established Departments such as the State Water Control Board, the Department of Air Quality, the Department of Game and Inland Fisheries, and the Marine Resource Commission. In 1986 the position of Secretary of Natural resources was formed in the governor's cabinet to oversee various environmental agencies, including some that were previously under the authority of the Commerce and Resources Secretariat. Since its inception, the tenure of the various Virginia Secretaries of Natural Resources Secretariat has been no longer than four years (VDEQ 2010, para. 17), quite unlike MDNR in which there is infrequent change in political party leadership and generally longer periods of stasis in the MDNR Secretariat.

While ELI (2007) described the nature of the agencies involved in implementing AIS regulations in Maryland and Virginia, one must look at the historical origins of these agencies to better understand the nature of their roles in relation to AIS management. At first glance, what is strikingly different between the two states is the centralized structure of natural resource agencies in Maryland in contrast with the decentralized structure of Virginia natural resource agencies.

In Maryland such natural resource responsibilities have been consolidated into one agency, the Maryland Department of Natural Resources, while in Virginia the various agencies with similar responsibilities remain loosely organized, in many cases still designated as “Departments,” although they are under the umbrella of the Natural Resources Secretariat. Such agencies in Virginia include the following: Department of Conservation and Recreation (VDCR), Department of Environmental Quality (VDEQ), Department of Game and Inland Fisheries (VDGIF), Department of Historic Resources (VDHR), Virginia Recreational Facilities Authority (VRFA), Virginia Museum of Natural History (VMNH), and the Marine Resources Commission (VMRC).

Despite the noted structural differences in the natural resource agencies in Maryland and Virginia, functionally there are many similarities. In MDNR the responsibilities of the various Assistant Secretariats and the Services and Divisions which they oversee are comparable in function to the responsibilities distributed among the various Departments within the Virginia Natural Resources

Secretariat. However, the nature of governance in MDNR is basically similar from Service to Service, with various advisory boards but no governing boards. In Virginia, however, there are often marked differences in governance between Departments and Commissions, with there being both governing boards and advisory boards, which have markedly different roles.

In Maryland, the various “Services” (roughly equivalent to Virginia’s Departments) with the primary legislatively-delegated AIS regulatory responsibilities include the Fisheries Service and the Wildlife and Heritage Service, with the Resource Assessment Service involved with supporting monitoring and assessment activities. In Virginia, the Departments with the primary legislatively-delegated AIS regulatory responsibilities are the Department of Game and Inland Fisheries (VDGIF) and the associated Board of Game and Inland Fisheries. The Department of Conservation and Recreation was tasked by the legislature with the development of the Invasive Species Management Plan and has a support role. While the Virginia Marine Resources Commissions (VMRC) has considerable regulatory and enforcement authority, its AIS role is limited presently to ballast water regulations. The Virginia Department of Agriculture and Consumer Services (VDACS) has quarantine authority for certain AIS, such as Beach Vitex. Both VMRC and VDACS currently have more peripheral roles in AIS management, as far as day-to-day activities. A more comprehensive discussion of the role of Virginia’s natural resource agencies in

relation to AIS is provided in the Virginia Invasive Species Management Plan (Commonwealth of Virginia 2005).

The following section provides a brief history of the relevant natural resource agencies in Maryland and Virginia. This is essential in understanding the nature of implementation of AIS responsibilities in Maryland and Virginia and may provide information useful in understanding whether such characteristics, in aggregate, are representative of distinct environmental discourse models in these agencies.

History of Maryland's Natural Resource Agency

Maryland's history of natural resource management is rather convoluted. A Commission of Fisheries was created in 1874, to study and report on the status of fish resources. This group was succeeded by the Conservation Commission, created in 1916 with the primary role of establishing and enforcing hunting and fishing regulations (MDNR 2005). Subsequently, in 1922 the State Conservation Department was created, a one man commission reorganized into the Conservation Commission in 1935. This group was further divided in 1939 into the Game & Inland Commission and the Tidewater Fisheries Commission. In 1941, the Board of Natural Resources was formed to integrate the statewide activities of the various conservation agencies. This group served as an umbrella organization, coordinating the activities of the various state conservation agencies for the next 28 years until the formation of the Department of Natural Resources in 1969, a cabinet level Department (MDNR 2005).

While there is considerable legislative influence as far as the role of MDNR, the overall structure of the agency is determined by the governor with comprehensive reorganizations occurring periodically. Presently the three major Assistant Secretariats within MDNR are Aquatic Resources, Land Resources, and Mission Support.

MDNR has various statutorily-created advisory boards and commissions authorized by the Governor or General Assembly that function in advising the Governor and the MDNR Secretary on various matters concerning natural resources. However, these groups, comprised of private citizens and state employees, are advisory in nature and have no governing authority. Other *ad hoc* advisory groups may be appointed by the Secretary as needed.

Virginia Natural Resource Agency History

There appears to be more continuity in the history of several of the natural resource agencies in Virginia than in Maryland. The Virginia General Assembly provides an elaborate history and analysis of the Natural Resource Agencies in Virginia.⁷⁹ There is no comparable legislative analysis of Maryland Natural Resource agencies. Both VMRC and VDGIF are agencies with long histories of

⁷⁹ In Virginia, the Joint Legislative Audit and Review Commission (JLARC) of the Virginia General Assembly (VGA), has a function somewhat similar to the Maryland General Assembly's Office of Legislative Audits. JLARC has completed a series of comprehensive studies of all aspects of natural resource management in Virginia. Such analyses provide a comparative analysis and summary of natural resource management in Virginia in relation to other coastal states as well as an exhaustive examination of the various agencies in the Natural Resources Secretariat. Such analyses have examined the feasibility of agency consolidation, concluding that at this time the present decentralized structure is sufficient.

natural resource management in Virginia and current AIS responsibilities. The Virginia Department of Conservation and Recreation⁸⁰ (VDCR) and the Virginia Department of Agricultural and Consumer Services⁸¹ (VDACS) are more recently established organizations. As noted previously, the VDCR is involved with biodiversity and natural heritage issues as well as updating of the Invasive Species Management Plan, while VDACS is involved with the quarantine of certain AIS.

VMRC had its origins in the Virginia Fish Commission in 1875. Not until 1968 was the name of the agency changed to the Virginia Marine Resources Commission. VMRC has a regulatory role in relation to marine issues, with a statutory mission to represent all parties interested in Virginia's marine resources, including commercial interests, recreational users, and environmentalists. Essentially VMRC has authority over territorial seas, tidal rivers, and marine organisms (JLARC 1997). VMRC has numerous advisory committees. While VMRC has been involved significantly with issues relating to proposed non-native oyster introductions of *Crassostrea ariakensis* and ballast water. Its role in other AIS issues has been limited—although its regulatory

⁸⁰ In 2003, the Natural Heritage Program within VDCR was given the legislative mandate of coordinating the drafting of the Virginia Invasive Species Management Plan, which was completed in 2005. The agency is also involved with various AIS mapping and control projects, most notably with Phragmites. The agency maintains an invasive species website which addresses AIS issues and has various other AIS roles.

⁸¹ VDACS is involved primarily with terrestrial species but has been involved with quarantine efforts relating to Beach Vitex, an AIS.

authority certainly is not.⁸² VMRC works closely with the Virginia Institute of Marine Science, where the Molluscan Ecology Program is located, as well as Virginia Sea Grant on marine issues.

The Virginia Department of Game and Inland Fisheries (VDGIF) was created by the General Assembly in 1916, overseen initially by the Virginia Fish Commissioner. Its primary role was established at that time as the management of inland fish and wildlife. When reorganized in 1926, the Commission of Game and Inland Fisheries—an independent commission comprised of five-members appointed by the governor—was given the responsibility of overseeing VDGIF's activities. Currently, the expanded 11-member Board of Game and Inland Fisheries (BGIF), with members appointed by the Governor and confirmed by the General Assembly, has that same role. The Board is comprised of one member representing each of the 11 Congressional Districts in Virginia. A chairperson is elected by the Board and reports regularly to the Secretary of MDNR (Board of Game & Inland Fisheries 2009).

The BGIF is created by statute pursuant to § 29.1-102, and is subject to the provisions of the Code of Virginia. The powers of the board are quite broad; it

⁸² The focus of this research is on unintentional introductions and not intentional introductions. Intentional introductions, in particular the proposed introduction of *Crassostrea ariakensis*, while involving state agency input (MDNR and VMRC) involved the General Assemblies of Maryland and Virginia, various *ad hoc* Panels, Oyster Roundtables and ultimately an elaborate Environmental Impact Statement pursuant to NEPA, which the Army Corps of Engineers oversaw based on a Congressional mandate.

is a supervisory board responsible for VDGIF operations. The VDGIF Director is not only appointed by the Board, but the Director is subordinate to the Board, and the appointment is subject to confirmation and reconfirmation every four years by the General Assembly. The Board also approves requests for appropriations, and promulgates regulations for VDGIF, developing the agency's strategic plan as well. While members can be removed by the governor, their appointment must be confirmed by the General Assembly.

The distinction between the Board of Game and Inland Fish and the Department of Game and Inland Fish is noted in the Governance Manual of the Board, which states that:

The Board of Game and Inland Fisheries....fully recognizes that the General Assembly has given stewardship responsibilities for the Commonwealth's wildlife and boating resources to the Department (VDGIF) on behalf of Virginia's citizens and has entrusted the Board with the moral ownership of the Department on behalf of the public. Therefore; the Board will strive to understand the public's values regarding wildlife and boating resources and shall govern its actions based on those values. (BGIF 2009 p. 1)

As far as VDGIF, the governing Board which directs the agency is unique, even among the other agencies within the Natural Resources Secretariat. Many other Virginia natural resource agencies have advisory boards of various sorts, with varying degrees of responsibility, but none has the far reaching authority of the Board of DGIF. As far as AIS, the Board of GIF, and not VDGIF, has the statutory authority to designate species as non-indigenous aquatic nuisance species, and regulate their importation and possession, apart from specific legislative designations.

In the next section I will first provide a brief discussion of general AIS issues relevant to Maryland and Virginia. This is followed by a discussion of specific AIS infestations in Maryland and Virginia that were critical in refocusing AIS policy in these states. The section concludes with a discussion of the centerpiece AIS legislation and amendments that were enacted in the wake of these infestations in both Maryland and Virginia. These statutes serve as the framework for AIS management in these states.

AIS-Related Issues of Concern in Maryland and Virginia

From the inception of the Chesapeake Bay's Program's (CBP) Exotic Species Work Group in 1991, at the urging of Chesapeake Bay Commission—until the formation of the Invasive Species Working Group in 2001—CBP efforts were focused primarily on proposed intentional introductions, as formally detailed in the CBP's publications titled *Chesapeake Bay Policy for the Introduction of Non-Indigenous Aquatic Species* (USEPA 1993). The Policy was adopted by Maryland and Virginia, as well as other CBP signatories in 2003. As noted by Christmas et al. (2001) the *Policy* represented a non-regulatory, consensus-based approach to addressing inter-jurisdictional differences, relating to AIS. The critical issues forum and the *Ad hoc* Panel review process were established as the principal mechanisms to address regional concerns about proposed intentional introductions. A commitment to a proactive approach in addressing

unintentional introductions was also a stipulation of the *Policy* (Everett and Sherfy 2002).

While the Policy provided broad objectives for addressing ANS in the Chesapeake Bay Watershed (Everett and Sherfy 2002) the subsequent development of the related *Introduction of Non-indigenous Aquatic Species Implementation Plan* (USEPA 1996) detailed various mechanisms by which the Policy's goals might be formalized. Although issued by the CBP, the Implementation Plan was a voluntary undertaking, with no mechanism to require implementation.

However, aside from the regional dialogue established by earlier CBP efforts, the first formal regional CBP directives for AIS management were formally articulated in the 2000 Chesapeake Bay Program Agreement (CBP 2000). The CBP reestablished the Non-native Invasive Species *Ad Hoc* Working Group (later referred to as simply the Invasive Species Working Group) which focused more on unintentional AIS introductions and completing the task required by the 2000 Chesapeake Agreement. These tasks included 1) the identification and ranking of potential ANS and 2) the development of management plans for the species of greatest concern (Christmas *et al.* 2002). In 2002, the Chesapeake Bay Program's Invasive Species Working Group organized *A Workshop to Develop Regional Invasive Species Management Strategies* (Moser 2004). The species addressed in this regional workshop—for which regional management plans were subsequently developed—were selected

based on an elaborate survey conducted in 2002 by the CBP. Final selections of priority species were based on responses solicited from all states in the Chesapeake Bay Watershed, various federal agencies, and the Chesapeake Bay Commission.⁸³

Of particular interest are the species ranked as the top five AIS of concern by Maryland and Virginia in the 2002 survey. In Maryland the priority aquatic invasive species of concern were the following: 1) green crab, *Carcinus maenas*; 2), mute swan, *Cygnus olor*; 3) nutria, *Myocastor coypus*; 4) Phragmites, *Phragmites australis*; and 5) water chestnut, *Trapa natans*. In Virginia, the priority aquatic invasive species of concern were the following: 1) Asiatic clam, *Corbicula fluminea*; 2) blue catfish, *Ictalurus furcatus*; 3) Hydrilla, *Hydrilla verticillata*; 4) purple loosestrife, *Lythrum salicaria*; and 5) zebra mussels, *Dreissena polymorpha*. The species for which management plans were ultimately developed were the following: mute swans, nutria, Phragmites, purple loosestrife, water chestnut, and zebra mussels (Moser 2004).

However, the extent of non-indigenous aquatic species in the Chesapeake Bay Watershed is more considerable. Dr. Paul Fofonoff, with the Smithsonian Environmental Research Center in Edgewater, Maryland noted that:

Our current estimate for [invasive] species with established populations in tidal waters and wetlands of the Chesapeake Bay is 172 species. This includes 123 species regularly residing in the Bay, and 49 “boundary

⁸³ The CBP’s Invasive Species Working Group “sunset”, that is was dissolved, after the completion of the Regional Management Plans. The CBP sponsored the formation of the Mid-Atlantic Aquatic Panel on Invasive Species which is the current venue for a regional AIS forum in the Chesapeake Bay Basin.

residents', primarily freshwater and terrestrial species, which occasionally cross the line (e.g. stream fishes such as trout, and weedy plants which occasionally occur in tidal marshes and marsh-utilizing terrestrial mammals such as Sika deer). In addition, in an unpublished report, I've found 67 additional aquatic species established in the Watershed but not reported from the Chesapeake Bay yet. These include 18 plants, 26 freshwater invertebrates, and 23 fishes. (Paul Fofonoff, personal communication, June 29, 2007).

It wasn't until 2002 that both states had an actual "novel"⁸⁴ infestation of a potentially highly invasive non-indigenous species, with considerable potential for adverse economic and ecological effects—northern snakeheads, *Channa argus*, in Maryland and zebra mussels, *Dreissena polymorpha*, in Virginia. As a result, each of these states undertook their first major eradication efforts—interventions of sorts⁸⁵—and subsequently enacted AIS legislation which has served as a framework for future AIS management efforts in these states. The nature of the infestations and subsequent eradication of these species are detailed below, followed by a discussion of the legislation enacted in their wake.

Maryland's Northern Snakehead Infestation

The northern snakehead, *Channa argus*, is native to freshwater regions in China and Korea and typically may range in size from 85 cm-1.5 m in total

⁸⁴In this context, "novel" refers to an unintentional introduction in the "post-enlightenment" period of AIS management—arbitrarily designated as following the issuance of E O 13112 in 1999, after the development of sufficient tools and protocols to address such AIS issues.

⁸⁵ Although the term intervention is rarely used in relation to AIS efforts, rapid response and eradication efforts are essentially interventions to maintain a certain environmental state and to minimize what is perceived as environmental harm. However the term intervention is used widely in the public health field.

length. It has been noted that it is difficult to predict both the ecological and economic effects of northern snakehead infestations, although they prey extensively on juvenile and adult game fish (ENSR International 2005, Courtenay and Williams 2004).

In May of 2002, an angler caught a rather unusual fish in a pond in Crofton, Maryland (Anne Arundel County), in the Patuxent River Watershed, and returned it to the water, after taking several photographs. MDNR staff later identified the fish from photographs as a northern snakehead, *C. argus*. A month later another specimen was caught by an angler, who also dip-netted several juveniles (Courtenay and Williams 2004).

In response, the Secretary of MDNR assembled a Snakehead Advisory Panel to address the issue which provided the Secretary with two subsequent advisory reports. The primary concern for MDNR was to prevent the escape of northern snakeheads from the pond into the Patuxent River drainage, and from there possibly into the Chesapeake Bay. At the time of the Crofton Pond incident in Maryland, 14 states had already banned the possession of *C. argus*, primarily because of ecological concerns. This species, and various other species of *Channa*, was introduced into the United States primarily via the pet trade and the live-food fish trade (Courtenay and Williams 2004).

The Crofton, Maryland pond where northern snakeheads were discovered was located on private property and permission was eventually obtained from the landowner for the eradication of both vegetation and fish. Rotenone (a piscicide)

was applied in August of 2002 and was successful in eradicating the snakehead population, with six adult northern snakehead and about 1000 juveniles killed and removed, along with sundry other fish. The estimated cost of the entire Crofton Pond eradication effort was about \$110,000 (Courtenay and Williams 2004), the majority of which was accounted for by staff time required for meetings, the eradication effort, and subsequent fish removal.

Despite the success of the Crofton Pond eradications, In April of 2004 a northern snakehead was also caught in Pine Lake in Wheaton Regional Park, which was subsequently drained. Pine Lake is in close proximity to Sligo Creek, a tributary to the Northwest Branch of the Anacostia River, a tributary to the Potomac River. In cooperation, the Maryland-National Capital Park and Planning Commission and MDNR drained Pine Lake, but no additional northern snakeheads were found (Klein 2004, May 14).

However, in May 14, 2004, 26 northern snakeheads were subsequently captured within a 23-km reach of the main-stem tidal freshwater Potomac River in Virginia and Maryland with the abundance and range expanding annually. Presently *C. argus* has been found at the mouth of the Potomac River, in Maryland, and beyond. However, DNA tests have indicated that the Potomac River population is not from the same stock, genetically, as the Crofton Pond population (Associated Press April 27, 2005).

Subsequent to the Crofton, Maryland infestation all 28 known species of snakeheads, including *C. argus*, were listed under the “injurious fish and wildlife”

provisions of the Lacey Act in October of 2002. Most, but not all states, have since made it illegal to possess live snakeheads (Courtenay and Williams 2004). A Northern Snakehead Working Group (NSWG 2006) was established by congressional mandate in 2006 to provide input on the development of a Northern Snakehead Control and Management Plan (NSCMP). Of critical importance, and a pragmatic consideration in the management of *C. argus* presently [as well as with other AIS], is that as they are now established in open waters it is impractical to eradicate them. Courtenay and Williams (2004) noted that:

Control methods in a non-isolated pond or lake, or in flowing water (streams, rivers) situations would be ineffective in eliminating snakeheads whether or not they were established.

Virginia's Zebra Mussel Infestation

Zebra mussels were first discovered in the United States in 1998 in Lake St. Clair, which straddles the U.S.-Canadian border, and by 1990 they were found in all of the Great Lakes. In 1991 zebra mussels began expanding their range into nearby river systems and presently are found in all major river systems in the eastern U.S. river systems, as well. Smaller populations have been found elsewhere in the United States. Aside from adverse ecological effects, the biofouling capabilities of zebra mussels are such that considerable expense has been incurred in their removal, particularly from water supply facilities and hydroelectric plants (USGS 2011). Zebra mussels are often considered to be the “poster child” of AIS, a particular species whose effects

have served as a triggering event (Scheberle 2004) in eliciting political support to address a particular issue.

Zebra mussels were first observed in Virginia in 1993, when they were found and then removed from a boat at Smith Mountain Lake. About a decade later, in 2002, a widespread infestation of zebra mussels was discovered in Millbrook Quarry, located in Prince William County, Virginia. The 12-acre, 93-foot-deep quarry—abandoned since 1963—was established in 1947 to produce road stone for highway construction of Virginia Highway 55. “The Dive Shop” in Fairfax first began using the quarry for scuba diving in the early 1970s, and has leased it since 1978 (VDGIF 2005).⁸⁶

In late August 2002, the Virginia Department of Game and Inland Fisheries (VDGIF 2005) collected specimens of mussels from Milbrook quarry after being notified that what appeared to be zebra mussels were observed in the quarry. These were subsequently identified as zebra mussels and Milbrook quarry was identified as the first site of a zebra mussel infestation in Virginia. Consequently, VDGIF was designated as the lead agency to work with various stakeholders, including representatives from federal, state, and local agencies in order to pursue the eradication of the population (VDGIF, para 1-12, 2011). Concerns were heightened by the possibility of the escape of zebra mussels into

⁸⁶For a more detailed discussion see VDGIF’s *Milbrook Quarry Zebra Mussel Eradication* webpage at www.VDGIF.Virginia.gov/zebramussels, and the related Environmental Assessment prepared by VDGIF(2005).

Broad Run, which is a tributary of the Occoquan River, in close proximity to public water reservoirs at the Occoquan Reservoir and Lake Manassas.

VDGIF organized the *ad hoc* Millbrook Quarry Zebra Mussel Workgroup which began meeting in October 2002. A preliminary analysis was completed in August, 2003. In response, VDGIF began more formal efforts to obtain funding for eradication of the zebra mussels. Initial funding was sought through the Emergency Procurement Solicitation process, but this effort was canceled when funding was not forthcoming. Furthermore, VDGIF was instructed not to pursue such an eradication effort or even evaluate related proposals unless adequate funding had been previously arranged. By September 2004, a commitment to VDGIF's predetermined goal of \$800,000 in funding for this effort was met and competitive negotiations were begun via the Virginia Procurement process (VDGIF 2005).

The contract for eradication was awarded to Aquatic Sciences in August of 2005. From January 31 to February 17, 2006, 174,000 gallons of potassium chloride (KCl) solution was injected into Millbrook Quarry as detailed in the Ecological Assessment prepared by VDGIF (2005). The target potassium concentration throughout the quarry was 100 ppm.⁸⁷ Post-treatment sampling has indicated potassium concentrations ranging from 98-115 ppm. It is estimated that the treatment will provide protection of Millbrook quarry from another zebra

⁸⁷ While toxic to zebra mussels at 100 ppm, VDGIF calculates that you would need to drink about 19 gallons of Millbrook Quarry water to consume your daily recommended dose of potassium.

mussel infestation for about 33 years. The cost for eradication and bioassays totaled approximately \$365,000, and another \$54,000 was awarded for post-project monitoring.⁸⁸

AIS Laws and Regulations in Maryland and Virginia

The preceding events—the northern snakehead infestation in Maryland and the zebra mussel infestation in Virginia—effectively served as refocusing events as described by Scheberle (2004), particular situations that resulted in a reappraisal of the implementation of AIS policies in these states. The following section details the basic legal framework for AIS regulation in Maryland and Virginia, and discusses what appear to be revisions of the AIS programs in these states most probably resulting from such reappraisals. ELI (2010) notes that most of the legislative changes that have occurred in states in recent years have, in fact, occurred in response to the discovery of a well-publicized AIS in a state.

ELI (2007) provides an exhaustive examination of AIS laws and regulation in Maryland and Virginia (as well as Pennsylvania, which is not addressed in this study). It is not my intention to replicate such an authoritative and comprehensive effort, but to merely provide a brief summary of AIS laws in these states. It is sufficient to note that ELI (2007) concluded that in both Maryland and Virginia,

⁸⁸The funding which provided for the zebra mussel eradication was made possible by arrangements made by VDGIF through the Wildlife Habitat Incentive Program (WHIP), a grant from the Virginia Office of the Natural Resources Conservation Service (USDA) and a State Wildlife Grant (USFWS). Matching funds were provided by the local water authority (Fairfax Water), Prince William County, the City of Manassas, and Dominion Virginia Power (VDGIF 2005).

state laws have been enacted to prevent introductions of AIS, with each state law implemented by a particular responsible agency. These agencies have been previously described. Such relevant legislation basically addresses the following:

....the importation of potential AIS; intentional release of potential AIS imported into or otherwise within a state, and the escape of potential AIS from captivity (ELI 2007 p.8).

Centerpiece AIS Legislation in Maryland and Virginia⁸⁹

My focus in this section is on what is generally considered to be the centerpiece AIS legislation, that which has been most formative and enabling in terms of establishing the statutory framework for AIS management in Maryland and Virginia. In both states, such centerpiece laws were enacted in each state within very similar time periods following the previously noted AIS infestations. These incidents apparently resulted in enough concern and sufficient political support for the AIS legal framework to be reevaluated and strengthened in these states. Although somewhat different in nature, the centerpiece AIS laws enacted in Maryland and Virginia were both enacted in 2003 and later amended within the same basic timeframe as well, in 2008 in Maryland and in 2009 in Virginia.

In each state, there have been specific implementation requirements, particularly for the agencies responsible for freshwater fisheries management

⁸⁹In addition to the “centerpiece laws discussed in this section, Maryland enacted invasive crab legislation in 2001 codified as § 4-816 which allowed MDNR to regulate Chinese mitten crabs, Japanese shore crabs, and the green crab. Also HB 226, enacted in 2008, commonly referred to as the Bait Law” required MDNR to adopt regulations as to what species may be harvested, used, sold or imported as bait. Maryland enacted a ballast water law in 2000 which was repealed in 2005.

(Fisheries Service in Maryland and VDGIF and BDGIF in Virginia). This examination does not address state regulations that have been promulgated pursuant to such statutory authorities, but they are rather similar in overall scope and quite expansive. ELI (2007, 2010) provides a more detailed regulatory analysis.

The statutory role of the Natural Heritage Programs (NHP) in each state varies—In Maryland there is no apparent clearly defined role relating to AIS for the NHP, while in Virginia this group has been given a key, legislatively-mandated role in developing and updating the Invasive Species Management Plan and in providing support activities. However, Maryland's Wildlife and Heritage Service, does administer several wildlife management programs which have statutory authority relating to the management of nutria and mute swans, which are considered to be AIS. The role of the Maryland Natural Heritage is Program more peripheral in relation to AIS management, although it has a staff invasive species plant biologist, whose primary role relates to terrestrial issues. In both Maryland and Virginia the related centerpiece AIS laws relate primarily to freshwater and estuarine ecosystems, primarily species such as fish, aquatic invertebrates, and aquatic plants.

Maryland Centerpiece Law 2003

In Maryland, the enactment of the *State of Nuisance-Abatement and Summary-Abatement Procedures Act* (SNASAPA) followed soon after the previously described discovery and eradication of a reproducing population of

northern snakeheads, *C. argus* in a pond in Crofton, Maryland in 2002. In testimony during the Senate Hearing on SB 287 in the Maryland General Assembly, State Senator Brian Frosch, who introduced the bill in 2003 following the successful eradication of northern snakeheads from the Crofton pond, noted that:

Snakeheads are a remarkable animal. They can breathe air, walk on land, and live for days outside of water. It's almost like something out of a horror movie. They can eat almost anything and they can decimate an entire ecosystem. [If they were to have reached the Chesapeake Bay...the damage would have been incalculable. But MDNR rose to the occasion. They removed the threat. While it had a happy ending, the Crofton experience revealed some loopholes in MDNR's authority to deal with non-native aquatic species (Sen. Brian Frosch, Maryland General Assembly, 2003).

SB 287 was subsequently enacted and codified as §4-205.1 of the Natural Resources Article of the Annotated Code of Maryland. The State of *Nuisance - Abatement* and Summary *Abatement* Procedures Act (SNASAPA) has three major provisions: 1) to authorize the Secretary of MDNR to adopt regulations relating to the importation, possession or introduction into state waters of a designated non-native aquatic nuisance species; 2) to allow MDNR to list additional non-native aquatic nuisance organisms; and 3) to allow MDNR to respond rapidly in the event that a designated aquatic nuisance species is found on private property and constitutes a "state of nuisance."⁹⁰ Such a circumstance

⁹⁰ Interestingly, the law does not address the nature of the state's responsibility to remove a nuisance species that is found in state waters and constitutes a threat to private landowners; it addresses the state's recourse but not that of the private landowner.

refers to one in which an organism “will foreseeably alter and harm the ecosystem.” The Act stipulates the following:

If the Secretary finds that a state of nuisance exists that presents an imminent danger to the healthy balance of an ecosystem, the Secretary may summarily abate the nuisance as provided by the bill. When making a determination regarding a state of nuisance, the Secretary must consult appropriate experts and any other available scientific resources. MDNR may seize a nuisance organism that has created or will foreseeably create a state of nuisance and may dispose of a seized nuisance organism. (Maryland General Assembly 2003)

The bill prohibits a person from interfering with the abatement or refusing to allow entry on any property for the purpose of abating or summarily abating a state of nuisance. (Maryland General Assembly 2003), and allows for both civil and criminal penalties for related violations.

Maryland Centerpiece Law 2008 Amendment

The Non-native Nuisance Organisms – Regulatory Management Authority Act, enacted in 2008 both repealed and reenacted, with amendments, the 2003 SNASAPA (Natural Resources Article, §4-205.1(a) and (b) Annotated Code of Maryland). The 2008 Act defined and clarified several terms used in designating AIS in Maryland, but most notably granted considerably more authority, with only certain exceptions, to MDNR to promulgate AIS related regulations—authority which has been well-exercised since that time.

Maryland Legislative Services (2008) notes that “This departmental bill authorizes the Secretary of Natural Resources to manage the sale, transport,

purchase, importation, possession, harvest, season, size limits, open area, catch limits, and the introduction of nuisance organisms.”

Virginia Centerpiece Laws

In Virginia, two centerpiece AIS laws were enacted in 2003—the Non-indigenous Aquatic Nuisance Species Act (NANSA) and the Invasive Species Council Act (ISCA). Each Act addressed a unique aspect of the statutory framework for AIS management in the Commonwealth, a framework that is much more robust and comprehensive than that delineated by Maryland statutes. NANSA addressed necessary AIS regulatory activities while ISCA addressed AIS planning and coordination efforts. Maryland has no AIS statute that has the latter function.

NANSA delegated activities relating to the regulation and control of AIS, to VDGIF and the Board of GIF. §29.1-572 of NANSA (2003) specifies that: NANSA specifically designates both zebra mussels and northern snakeheads as “non-indigenous aquatic nuisance species.” However, it authorizes the Board of Game and Inland Fisheries to designate other species as non-indigenous aquatic nuisance species, if the Board concludes that their presence “poses or is likely to pose a significant threat of harm.” The bill also authorizes VDGIF:

....to take measures to suppress, control, eradicate, prevent or retard the spread of any non-indigenous aquatic species. It also provides for a civil penalty of up to \$25,000 for any person that violates the provisions of the Act.

Additionally, pursuant to §19.2-52, NANSA (2003) provides authority for the Director of VDGIF, either with the consent of the owner or by obtaining a warrant if necessary:

....to conduct reasonable inspections of any property in the Commonwealth to determine if a non-indigenous aquatic nuisance species is present and to seize or eradicate any non-indigenous aquatic nuisance species found on such property.

Furthermore, NANSA (2003) makes it illegal to

....import, possess, transport, sell, purchase, give, receive, or introduce into state waters, any Non-indigenous aquatic nuisance species without a permit from the Director.

The General Assembly was very circumspect in acknowledging the potential fiscal impacts of AIS management pursuant to the statute, noting that:

While a one-time situation that involves the eradication of a species in a small lake may have only minor costs, a major outbreak of infestation of a nuisance species throughout the waters of the Commonwealth would have a significant fiscal impact on the agency, which cannot be absorbed. Considering that such events are impossible to, predict and there is no funding source designated for this bill, the fiscal impact cannot be determined. (Virginia Department of Planning and Budget, 2003a).

NANSA was enacted, in part, as an emergency response to the infestation of zebra mussels in Milbrook Quarry in Prince William County, after their first detection in 2002, but well before their eradication in 2005. The matter was handled as expeditiously as possible, considering that state general funds were not available for this AIS eradication, and NANSA specifically provided that in such a circumstance, VDGIF must secure funding elsewhere before proceeding

with any related AIS activities. The four-year lag between first detection of zebra mussels and their eradication is not atypical for responses to AIS in general.

The Invasive Species Council Act (ISCA 2003) had the principal role in mandating statewide AIS planning and coordination in Virginia. The statutory objective of § 2.2-220.2.2 was the “Development of strategies to prevent the introduction of, to control, and to eradicate invasive species.” The Act established a nine-member Invasive Species Council, advisory in nature, comprised of executive branch agency heads, and chaired by the Secretary of Natural Resources. It also established an Invasive Species Advisory Council to broaden input to the Council, including stakeholders from the agricultural and forestry sectors as well. ISCA was intended to provide state leadership relating to the prevention and control of not only aquatic invasive species in Virginia, but terrestrial species as well.

VDCR, and in particular the Natural Heritage Program, was tasked with the preparation of a legislatively-mandated Invasive Species Management Plan,⁹¹ which was completed in 2005, as well as an organizational and support role for the Council and Invasive Species Advisory Committee. The Invasive Species Council and ISAC were legislatively “sunset” in 2005 (i.e. dissolved), although sustained as an institutional entity by Executive Directive 2 issued by Governor Thomas Kaine in 2006.

⁹¹ It was estimated in the policy analysis for this bill that the support expenses for the required meetings for this effort would total \$10,000 annually while the preparation of the Invasive Species Management Plan was estimated as requiring a one-time cost of \$25,000 (VA Department of Planning and Budget, 2003a).

Virginia Centerpiece Law Amendment – 2009

In 2009, NANSA was amended to codify and integrate the basic provisions of the Invasive Species Council Act of 2003 which first codified the ISC and ISAC. It essentially codified the *Invasive Species Working Group*, the name which had been given to the ISC after it was dissolved and re-established by Executive Directive 2 in 2006. The 2009 amendment also provided for the continuance of the Invasive Species Advisory Committee as a group to advise the ISWG, and required a four-year update of the *Virginia Invasive Species Management Plan*. The amendment also affirmed the role of the Secretary of Natural Resources as Chair of the ISWG and designated the Secretary of Agriculture and Forestry as Vice-Chair. A continuing support role for VDCR was also established.

VDGIF and BDGIF were not formally addressed in this amendment aside from designated membership on the ISWG. Essentially, the amendment served to integrate the regulatory aspects of AIS management in NANSA (2003) with the AIS coordination and planning requirements of the ISCA (2003), in a single statute.

Current Definitions of AIS in Maryland and Virginia

It is useful to compare the nature of the legal definitions of AIS in Maryland and Virginia. However, this discussion requires a preface. ELI (2002) notes that:

To manage invasive species effectively, states should first address the fundamental issue of defining what will be legally considered an invasive

species. The large majority of non-native species do not pose a threat to the natural or human systems in which they are introduced....Therefore, states should develop a definition for determining which non-native species will be considered invasive for the purposes of regulation (ELI p. 83).

However, in its evaluation of the 50 states, ELI (2002) found that almost 90% of the states did not have a legal definition for the term aquatic invasive species. In a more recent survey by the Mid-Atlantic Panel on Aquatic Invasive Species (2006), of those states that participated in the survey (which included Delaware, Maryland, New York, and Pennsylvania) only Maryland indicated that it did not have a legal definition of AIS. In a more recent updating of previous AIS evaluations of 11 selected states, which included Maryland, it was noted that Maryland still had no comprehensive definition of AIS. However, neither did most of the other states studied. Oregon was the only one the 11 states reevaluated which did have a comprehensive statutory definition of AIS. Virginia has had a comprehensive statutory definition of AIS since 2003.

Various terms relating to invasive species are defined in the Annotated Code of Maryland, although the term invasive species is not defined. The definition in the Maryland statute for a “nuisance organism” refers to a non-native aquatic organism that will, “foreseeably alter and threaten to harm the ecosystem.” A “state of nuisance” refers to a condition in which a nuisance organism will foreseeably alter and threaten to harm the ecosystem or the abundance and diversity of native or naturalized fish and other organisms.

While Maryland's legal definition of an aquatic nuisance organism is rather vague, it is clear that the nature of the more accepted definition of AIS is quite well-understood in Maryland. In the Maryland Mute Swan Management Plan it is stated that:

An invasive species is defined as a species that is (1) non-native (or alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (MDNR 2003, p. 13).

The legal definition of aquatic invasive species is quite explicit in Virginia, basically adopting the generally accepted federal definition, as many states have. AIS are defined in § 29.1-571-577 of the Virginia Non-indigenous Aquatic Nuisance Species Act of 2003 as follows:

Non-indigenous aquatic nuisance species means a non-indigenous aquatic freshwater animal species whose presence in state waters poses or is likely to pose a significant threat of harm to (i) the diversity or abundance of any species indigenous to state waters; (ii) the ecological stability of state waters; or (iii) the commercial, industrial, agricultural, municipal, recreational, aquacultural, or other beneficial uses of state waters. Non-indigenous aquatic nuisance species shall include the zebra mussel, quagga mussel, and all species of snakehead fishes of the family Channidae.⁹²

The 2009 amendment to NANSPA expanded the definition of invasive species, including both aquatic and terrestrial species, and noting that:

Invasive species mean a species, including its seeds, eggs, spores or other biological material capable of propagating that species, that is not

⁹² It is significant that the statutory definition of non-indigenous aquatic nuisance species pursuant to NANSA (2003) is limited to freshwater aquatic species.

native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.⁹³

A significant characteristic of AIS legislation in both Maryland and Virginia is that with the exception of the funding provided by the Virginia General Assembly for the development of the Virginia Invasive Species Management Plan, there has been essentially no funding allocated specifically for AIS efforts as a result of the centerpiece laws or their amendments. Related bill analyses in Maryland have generally noted a projected decrease in AIS funding. Virginia bill analyses, while providing no direct funding aside from that noted, have acknowledged that implementing such legislation might at times require funding beyond that which the agency is able to manage on its own.

Additionally, an interesting observation is that in Maryland while some AIS regulatory authority was granted to MNDR pursuant to SNASAPA (2003), such authority was broadened considerably by the 2008 amendment. However, in Virginia, the delegation of regulatory authority to BDGIF with NANSA (2003) appears to have been adequate for necessary AIS regulatory authority by BGIF.

LITERATURE CITED

⁹³The definition continues to exclude both agricultural species and various aquaculture species.

LITERATURE CITED

- Aquatic Nuisance Species Task Force. (2005). Developing and revising state and interstate aquatic nuisance species (ANS) management plans. U.S. Fish and Wildlife Service. Arlington, VA.
- Aquatic Nuisance Species Task Force. 2009. Minutes of the aquatic nuisance species task force meeting. Bozeman, Montana.<http://www.anstaskforce.gov>.
- Aquatic Nuisance Species Task Force. (2005). Developing and revising state and interstate aquatic nuisance species (ANS) management plans. U.S. Fish and Wildlife Service. Arlington, VA.
- Bacot, H. & Dawes, R. (1996). Responses to federal devolution: Measuring state environmental efforts. *State and Local Government Review*, 28: 124-135.
- Bartlett R. (1994). Evaluating environmental policy success and failure. 167-188. In N. Vig and M. Kraft (Eds.) (2nd ed.). Environmental policy in the 1990s: toward a new agenda. Congressional Quarterly Inc.: Washington, D.C.:
- Bacot, H & Dawes, R. (1997). State Expenditures and Policy Outcomes in Environmental Program Management." *Policy Studies Journal*, 25: 355-370.
- Bacot, H. & Dawes, R. (1999). Chapter 22. Administration of State Environmental Policies. In J. Gargan (Ed.). Handbook of state government administration.(1st Ed.). New York, NY: Marcel-Dekker.
- Banks, C. (2007). The Commonwealth: a History of the Government and Politics of Virginia. Boston, MA: Pearson Custom Publishing.
- Benson, A. and D. Raikow. (2011). *Dreissena polymorpha*. USGS Nonindigenous Aquatic Species Database, Gainesville, Florida. Retrieved at <http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/>.
<http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=5> RevisionDate: 7/8/2010
- Bierwagen, B. (2008a). Capacity of management plans for aquatic invasive species to integrate climate change. *Conservation Biology*, 22 (3): 568-74.

- Bierwagen, B. (2008b). A synthesis of climate-change effects on aquatic invasive species. *Conservation Biology*, 22 (3): 518-20.
- Chesapeake Bay Program. (1993). Chesapeake Bay policy for the introduction of non-indigenous aquatic species. CBP/TRS 112/94. Annapolis, MD.
- Chesapeake Bay Program. (1996). Introduction of non-indigenous aquatic species: Implementation plan. Annapolis, MD. EPA-903-R-96-004.
- Chesapeake Bay Program. (2000). Chesapeake Bay Agreement 2000. Annapolis, MD.
- Chornesky, E., & Randall, J. (2003). The threat of invasive alien species to biological diversity: setting a future course. *Annals of the Missouri Botanical Garden*, 90 (1): 67-76.
- Christmas, J. (2001). Management of aquatic nuisance species in the Chesapeake Bay basin: Past and present. *Aquatic Nuisance Species Digest* 4 (2): 18-20.
- Christmas, J. (2004). The status of regional aquatic nuisance species panels in the United States. *Aquatic Invaders*, 15 (1): 15-20.
- Christmas, J. (2007). An analysis of the diffusion of selected federal policies relating to the coordination of aquatic invasive species among states within the Chesapeake Bay watershed. 15th International Conference on Aquatic Invasive Species. Nijmegen, 75
- Clark, J. (1985). Policy diffusion and program scope: research directions. *Publius*, 15 (4): 61-70.
- Commonwealth of Virginia. (1971). Constitution of Virginia. Richmond, Virginia. Retrieved at <http://legis.state.va.us/laws/search/constofva.pdf>.
- Courtenay, W.R., Jr. & Williams, J.D. (2004). Snakeheads (Pisces, Channidae): A biological synopsis and risk assessment. U.S. Geological Survey Circular 1251.
- Daley, D. & Garand, J.C. (2005). Horizontal diffusion, vertical diffusion, and internal pressure in state environmental policymaking 1989-1998. *American Politics Research*, 37: 615-644.
- Davis, C. & Flick, R. (1992). Testing theories of state hazardous waste regulation: a reassessment of the Williams and Matheny study. *American Politics Quarterly*, 20: 501-511.

- Denzin, N. & Lincoln, Y. (2000). Introduction: The discipline and practice of qualitative Research. In N. Denzin, N. & Y. Lincoln. (Eds.) (2nd ed.) The handbook of qualitative research. Thousand Oaks, CA: Sage Publications, Inc.
- Durant, R., D. Fiorino & O'Leary, R. (Eds.). (2004). Environmental governance reconsidered: challenges, choices, and opportunities. Boston, MA: MIT Press.
- Dye, T. & Robey, J. (1980). Chapter 1. Politics versus economics. In T. Dye T. and J. Robey (Eds.). The determinants of public policy. Lexington, MA: Lexington Books.
- Eisner, M., Worsham, J. & Ringquist, E. (2007). Contemporary regulatory policy. Boulder. Colorado: Lynne Rienner Publishers, Inc.
- Environmental Law Institute. (2002). Halting the invasion: State tools for invasive species management. Washington, DC. Retrieved at www.eli.org.
- Environmental Law Institute. (2007). Halting the invasion in Chesapeake Bay: Preventing aquatic invasive species introductions through regional cooperation. Washington, DC. Retrieved at www.eli.org.
- Environmental Law Institute. (2008). The role of aquatic invasive species in state listing of impaired waters and the TMDL program: Seven case studies. Washington, D C. Retrieved at www.eli.org.
- Environmental Law Institute. (2010). Status and trends in state invasive species policies: 2002-2009. Washington, DC. Retrieved at www.eli.org.
- European Commission. (2008). The European Union's biodiversity action plan: halting the loss of biodiversity by 2010—and beyond. Luxembourg, Belgium:
- Everrett, R.A. & Sherfy, M.H. (2002). The Chesapeake Bay: A model for regional approaches to the prevention and control of aquatic non-indigenous species. Transactions of the North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, D.C. Volume 66: 611-624.
- Gargan, J.J. (2000). Handbook of state government administration (2nd ed.). New York, NY: Marcel-Dekker. 167-188.

- Gargan, J. Chapter 1. Introduction and overview of state government administration. In John Gargan (Ed.) *Handbook of state government administration* (pp.1-11). Marcel Dekker. Inc. NY:New York.
- Governing.com. 2008. Measuring performance: the state management report card for 2008. Pew Center on the States. Government Performance Project in collaboration with Governing Magazine. Retrieved at Governing.com.
- Grad, F. (2005). Chapter 9. Abatement of nuisances and dangerous conditions. In F. Grad, *Public health law manual*. Washington, DC: The American Public Health Association.
- Graham, Mary. (1999). *The morning after earth day: practical environmental politics*. Washington, DC: Brookings Institution Press.
- Gray V. (1973). Innovation in the states: a diffusion study. *The American Political Science Review*, 7 (4): 1174-1185.
- Gray, V. & Hanson, R. L. (2004). *Politics in the American states: A comparative analysis*. Washington, DC: CQ Press.
- Gray, V. & Lowery. D. (1993). The diversity of state interest group systems. *Political Research Quarterly*, 46: 81-98.
- Gunderson, L. (1999). Resilience, flexibility, and adaptive management—antidotes for spurious certitude? *Conservation Ecology*, 3 (1), Article 7. Retrieved at URL: <http://www.consecol.org/vol3/iss1/art7/>.
- Harrigan, J. J. (1988). *Politics and Policy in States and Communities* (3rd Ed.). Glenview, IL: Scott, Foresman and Company.
- Hays, S.P., Esler, M. & Hays, C. E. (1996). Environmental commitment among the states: Integrating alternative approaches to state environmental policy. *Publius*, 26: 41-58.
- Hayes, K. (2004). Chapter 15. Biosecurity and the role of risk assessment. In G. M. Ruiz, & J. T. Carlton (Eds.) *Invasive species: vector and management strategies*, (pp. 382 -414). Washington, DC: Island Press.
- Hefferenen, K.E., Coulling, P.P., Townsend, J.F. & Hutto, C.J. (2001). *Ranking invasive exotic plant species in Virginia*. Natural Heritage Technical Report 01-13. Virginia Department of Conservation and Recreation. Division of Natural Heritage, Richmond, Virginia.

- Heinrich, C. (2002). Outcomes-based performance management in the public sector: Implications for government accountability and effectiveness. *Public Administration Review*, 62: 712-725.
- Hoornebeek, J. 2005. The promises and pitfalls of devolution: water pollution policies in the American States. *Publius*, 35: 87-114.
- Hellmann, J., Byers, J., Bierwagen, B. & Dukes, J. (2008). Five potential consequences of climate change for invasive species. *Conservation Biology*, 22, (3): 534-543.
- Hird, John. (2008). Democratic laboratories: policy diffusion among the American states. *Publius*. Summer. 38 (3): 605-608.
- Huff, D, J. Lutz, and R. Srivastava. (1988). A geographical analysis of the innovativeness of states. *Economic Geography* 64(2): 137-146.
- Holling, C.S. (1978). Adaptive environmental assessment and management. London, England: John Wiley.
- Honadle, B.W. (1981). A capacity-building framework: A search for concept and purpose. *Public Administration Review*, 41 (5) (September-October): 575-580
- Hornbeek, J. (2005). The promises and pitfalls of devolution: Water pollution policies in the American states. *Publius*. Winter, 35 (1): 87-127.
- Ingraham, P.W. & Donahue, A.K. (2000). Dissecting the black box revisited: characterizing government management capacity. In C. Heinrich & L. Lynn (Eds.) *Governance and performance: New Perspectives* (pp. 292-318). Washington, DC: Georgetown University Press.
- Jackson, R. & Sorensen, G. (2007). Chapter 9. Methodological debates: Post-positivist approaches. In R. Jackson, & G. Sorensen, *Introduction to international relations: Theories and Approaches* (3rd ed.) (pp. 247-266). Oxford, England: Oxford University Press.
- Jackson, R. & Sorensen, G. (2007). Chapter 8. Methodological Debates: Classical versus Positivist Approaches. In R. Jackson & G. Sorensen, *Introduction to international relations: Theories and approaches* (3rd ed.) (pp. 227-246). Oxford, England: Oxford University Press.

- Jennings, E. & Woods, N. (2007). Does management really matter? Management quality and state environmental performance. Martin School of Public Policy and Administration, University of Kentucky. 9th National Public Management Research Conference, October 25-27.
- Joint Legislative Audit and Review Commission. (1997). Interim report: Feasibility of consolidating Virginia's wildlife and marine resource agencies. House Document No. 17 (1996 Session). Virginia General Assembly, Commonwealth of Virginia.
- Joint Legislative Audit and Review Commission. (1997). Feasibility of consolidating Virginia's wildlife resource functions. House Document No. 44 (1997) Session. Virginia General Assembly, Commonwealth of Virginia.
- Joint Legislative Audit and Review Commission. (1998). Structure of Virginia's natural resources secretariat. House Document No. 74. Virginia General Assembly, Commonwealth of Virginia.
- King, L. & Olson, S. (1988). Coastal state capacity for marine resources management. *Coastal Management*, 16: 305-318.
- Klein, A. (2004 May 4). Warnings to be posted about snakehead fish. Baltimore Sun. Retrieved at <http://www.baltimoresun.com>
- Klyza, C. & Sousa, D. (2008). Environmental policy 1990-2006: Beyond gridlock. Cambridge, Massachusetts: The MIT Press.
- Lackey, R.. (2003). Appropriate use of ecosystem health and normative science in ecological policy. In *Managing for Healthy Ecosystems*. D. J. Rapport, W. L. Lasley, D. E. Rolston, N. O. Nielsen, C. O. Qualset & A. B. Damania (Eds.). Boca Raton, FL.: Lewis Publishers.
- Larson, B. (2005). The war of the roses: Demilitarizing invasion biology. *Frontiers in Ecology and the Environment*, 3 (9): 495-500.
- Lester, J.P., & Bowman A. O'M. (1989). Implementing environmental policy in a federal system: A test of the Sabatier-Mazmainian Model. *Polity*, 21: 731-53.
- Lester, J.P. (1986). New federalism and environmental policy. *Publius*, 16 (1): 149-165.
- Lester, J.P. (1995). Federalism and state environmental policy. In J. P. Lester, (Ed.) *Environmental politics and policy: Theories and evidence*, (2nd ed.) Durham, NC: Duke University Press.

- Lester, J.P. (1994). Comparative state environmental politics and policy: The evolution of a literature. *Policy Studies Journal*. 22, (4): 696-700.
- Lincoln, Y.S. & Guba, E.G. (2000) Paradigmatic controversies, contradictions, and emerging confluences. In N. Denzin and Y. Lincoln. The handbook of qualitative research (2nd ed.), (pp. 163-188).
- Lindblom, C. (1959). The science of muddling through. *Public Administration Review*, XIX (2): 79-88
- Lindblom, C. & Woodhouse, E. (1993). The policy making process (3rd ed.). Englewood Cliffs, NJ: Prentice Hall.
- Lodge, D. & Shrader-Frechette, K. (2003). Non-indigenous species: ecological explanation, environmental ethics, and public policy. *Conservation Biology*, 17(1): 31-7.
- Lowry, W. (1992). The dimensions of federalism: state governments and pollution control policies. Durham, NC: Duke University Press.
- Malysa, L.L. (1996). A comparative assessment of state planning and management capacity: Tidal wetlands protection in Virginia and Maryland. *State and Local Government Review*, 28 (3) Fall: 205-218.
- Marshall, M.N. (1996). Sampling for *qualitative research*. Family Practice, 13: 522-525.
- Maryland Department of Natural Resources. (2003). Mute swans in Maryland: A statewide management plan. Wildlife and Heritage Service. Retrieved at <http://www.MDNR.maryland.gov/wildlife/msfinalleg.html>
- Maryland Department of Legislative Services (2010) Fiscal and Policy Note. H.B. 1360. Maryland General Assembly.
- Maryland Department of Legislative Services. 2003. Fiscal and Policy Note. Senate Bill 287. Maryland General Assembly.
- Maryland Department of Legislative Services (2003). Testimony of Sen. Brian Frosch, S.B. 287. Maryland General Assembly. Audio-recording.
- Maryland Department of Natural Resources. FY 2011. (2010). Operating budget presentation. Senate Budget and Taxation Committee Subcommittee on Public Safety, Transportation and the Environment March 1.

- McClure, P. & Campbell, R. (2004). Clearer focus and greater commitment needed by federal agencies to effectively manage invasive species. *Aquatic Invaders*, 15 (4): 10-15.
- Merriam, S.B. (1998) Qualitative research and case study applications in education. (Rev. ed.) San Francisco, California: Jossey-Bass, Inc.
- Merriam, S.B. (2009). Qualitative research: guide to design and implementation. San Francisco, California: Jossey-Bass, Inc.
- Mid-Atlantic Panel on Aquatic Invasive Species. 2006. Survey Results of State Activities and Priorities. Unpublished report.
- Miller, M. & Gunderson, L. (2004). Introduction: biological and cultural camouflage: The challenges of seeing the species problem and doing something about it. In M. Miller and R. Fabian (Eds.). Harmful invasive species: Legal responses. Environmental Law Institute. Washington D.C.
- Mooney, H.A. & Hobbs, R.J. 2000. Invasive species in a changing world. Washington, DC: Island Press.
- Moore, D., G. McCabe, and B. Craig. 2007. Introduction to the Practice of Statistics (6th ed.). New York, NY: WH Freeman and Co.
- Moser, F. (Ed.). 2004. Invasive species in the Chesapeake Bay Watershed. A workshop to develop regional invasive species management strategies. Final Draft Report to the Chesapeake Bay Program, Invasive Species Working Group. Maryland Sea Grant College.
- National Governors' Conference. 1967. Subcommittee on State Planning. State Planning. A Policy Statement. Subcommittee on State Planning Chicago, IL.
- National Invasive Species Council. (2001). National invasive species management plan. 74 pp.]]
- National Invasive Species Council. (2005). Five-Year review of Executive Order 13112 on Invasive Species. 44 pp.
- National Invasive Species Council. (2008). 2008-2012 National invasive species management plan. 35 pp.
- National Invasive Species Council (2010). Department of Health and Human Services. Retrieved at http://www.doi.gov/NISC/main_nav/hhs.html.

- Naylor, M. (2003) Water Chestnut (*Trapa natans*) in the Chesapeake Bay Watershed: A Regional Management Plan. Maryland Department of Natural Resources.
- Odendahl, T., & Shaw, A. (2002). Chapter 15. Interviewing elites. In J. Gubrium and J. Holstein (Eds.) *The handbook of interview research: context and method* (pp. 299-315). Thousand Oaks, CA: Sage Publications Inc.
- Onwuegbuzie, A. & Leech, N. (2007). A Call for Qualitative Power Analyses, *Quality & Quantity* 41: 105-121.
- Peterson, J., Moore, C., Wenger, S., Kennedy, K., Irwin, E. & Freeman, M. (2007). Proceedings of the 2007 Georgia Water Resources Conference, March 27-29, 2007, University of Georgia.
- Percival, R. H., Miller, A.S., Schroeder C.H., & Leaped, J.P (1996). *Environmental Regulation: Law, Science, and Policy*. Little Brown, Boston, MA.
- Pew Center. 2009. Trade-off time: How four States continue to deliver. <http://www.pewcenteronthestates.org/report>.
- PMBOK. (2000). A guide to the project management body of knowledge (PMBOK guide). Project Management Institute, Newtown Square, PA: Project Management Institute
- Pimentel, D., Zuniga, R. & Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics*, 52: 273-288.
- Potowski, M. & Woods, N. (2002). Dimensions of state environmental polices: air pollution regulation in the United States. *Policy Studies Journal*, 30 (2): 208-226.
- Rabe, B. 2007. Power to the states: the promise and pitfalls of decentralization. In N. Vig and M. Kraft (Eds.) *Environmental policy: new directions for the twenty-first century*, (pp. 34-56.) Washington, DC: CQ Press.
- Rabe, B. (2007). States on steroids: the intergovernmental odyssey of American climate policy. *Review of Policy Research*, 25: 105-128.
- Rabe, B. 2007. Environmental policy in the Bush era: the collision between the administrative presidency and state experimentation. *Publius*, 37: 413-431.

- Raik, D.B., Decker, and Siemer, W.P. (2003). Dimensions of capacity in community-based suburban deer management: the managers' perspective. *Wildlife Society Bulletin*, 31(3): 854-864.
- Reeves, M. (1985). The question of state government capability. U.S. Advisory Commission on Intergovernmental Relations (microfilm). Washington DC.
- Responsive Management. (2002). National aquatic invasive species survey. 2002: Final Report. Conducted on behalf of the U.S. Fish and Wildlife Service and the International Association of Fish and Wildlife Agencies. Harrisonburg, Virginia.
- Ridley, S. (1987). State of the States. Fund for Renewable Energy and the Environment (FREE): Washington, DC.
- Ruhl, J.B. (1997). Thinking of environmental law as a complex adaptive system: how to clean up the environment by making a mess of environmental laws. *Houston Law Review*, 34 (4): 101-164.
- Ruhl, J.B. (1999). The (political) science of Watershed management in the ecosystem age. *Journal of the American Water Resources Association*, 35 (3): 519-526.
- Ruhl, J.B. (2005). Regulation by Adaptive Management—Is It Possible? *Minnesota Journal of Law, Science, and Technology*, 7 (1): 21-57.
- Ringquist, E. (1993). Environmental protection at the state level: Politics and progress in controlling pollution. Armonk, NY: M. E. Sharpe.
- Ringquist, E. (1993). Environmental protection at the state level: Politics and progress in controlling pollution. Armonk, NY: M. E. Sharpe.
- Ringquist, E. (1993). Does regulation matter?: Evaluating the effects of state air pollution control programs. *The Journal of Politics*, 55 (4) November: 1022-1045.
- Rist, R. (2000) Chapter 39. Influencing the policy process with qualitative research. In N. Denzin & Y. Lincoln (Eds.) (2nd ed.). The handbook of qualitative research (pp. 1001-1017). Thousand Oaks, CA: Sage Publications Inc.
- Ruhl, J.B. (1997). Thinking of environmental law as a complex adaptive system: how to clean up the environment by making a mess of environmental laws. *Houston Law Review* 34: 933-999.

- Ruhl J. B. (2008) Adaptive management for natural resources –inevitable, impossible, or both? Rocky Mountain Mineral Law Institute Proceedings, 54 (p.11-1), (Florida State University College of Law: Public Law Research Paper No. 343.)
- Ruhl, J.B. (1996). Biodiversity conservation and the ever-expanding web of federal laws regulating nonfederal lands: Time for something completely different? 66 *U. Colorado Law Review*, 555: 578-79.
- Ruhl, J. B. (1999). The (political) science of Watershed management in the ecosystem age. *Journal of the American Water Resources Association*. Vol. 35, No. 3 June 1999: 519-526.
- Ruhl, J. B. (1999). The (political) science of Watershed management in the ecosystem age. *Journal of the American Water Resources Association*. Vol. 35, No. 3 June 1999: 519-526
- Sagoff, M. (1999). "What's wrong with exotic species?" Report from the Institute for Philosophy and Public Policy, School of Public Affairs, University of Maryland, 19 (4): 16-23.
- Sagoff, M. (2005). Do non-native species threaten the natural environment? *Journal of Agricultural and Environmental Ethics*, 18: 215–236.
- Sagoff, M. (2009). Environmental Harm: Political not biological. *Journal of Agricultural and Environmental Ethics*, 22 (1): 81-88.
- Saldana, Johnny. (2009). The coding manual for qualitative researchers. Thousand Oaks, CA: Sage Publishers.
- Scheberle, D. (1997). Federalism and environmental policy: Trust and the politics of implementation. (1st ed.) Washington, D.C: Georgetown University Press.
- Scheberle, Denise. (2004). Federalism and environmental policy: Trust and the politics of Implementation (2nd ed.) Washington, DC: Georgetown University Press.
- Simberloff, D. and Schmitz, D. (1997). Biological invasions: A growing threat. *Issues in Science and Technology*, 13: 33-40.
- Siy, E., Koziol, L., & Rollins, D. (2001). State of the states report: Assessing the capacity of states to achieve sustainable development through green planning. San Francisco, CA: Resource Renewal Institute.

- Slimak, M. (2003). Personal values, beliefs, and ecological risk perception. Doctoral Dissertation. George Mason University.
- Stankey, G., Clark, H., Roger N., & Bormann, B. T. (2005). Adaptive management of natural resources: theory, concepts, and management institutions. Gen. Tech. Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 pp.
- State of Maryland. (1867). The Constitution of Maryland. Annapolis, Maryland. Retrieved at: <http://www.msa.md.gov/msa/mdmanual/43const/html/const.ht>
- Swanson, W. R., Comwell, E.E, & Goodman, J.S. (1970). Politics and constitutional reform: the Maryland experience, 1967-1968. Washington Center for Metropolitan Studies. Washington, D.C.
- Stanton, Timothy. (1994). Special interests and comparative state policy: An analysis. *Eastern Economic Journal*, 20 (4): 441-452.
- State of Hawai'i. (2004). ANS Management Plan. State of Hawai'i.
- Surfrider Foundation. (2011). State of the beach report: Maryland beach description. Retrieved at <http://www.surfrider.org/stateofthebeach>.
- Surfrider Foundation. (2011). State of the beach report: Virginia beach description. Retrieved at <http://www.surfrider.org/stateofthebeach>.
- Tatu, Ketan. (2006). An assessment of impacts of mute swans (*Cygnus olor*) on submerged aquatic vegetation (SAV) in Chesapeake Bay. West Virginia University, Davis College of Agriculture. Doctoral Dissertation.
- Teske, P. (2004). Regulation in the states. Brookings Institution Press: Washington, D.C.
- Theodoropolous, D.I. (2003) Invasive biology: critique of a pseudoscience. Blythe CA: Avvar Books.
- Thompson, K., Hodgson, J., & Rich, T. (1995) Native and alien invasive plants: more of the same? *Ecography*, 18: 390-401.
- Truitt, P. G. (1984) Maryland air and water quality atlas: Maryland Department of Health and Mental Hygiene, Office of Environmental Programs.

- University of Connecticut. (2010). Trustworthiness: credibility, credibility, and dependability. Retrieved at www.gifted.uconn.edu/siegle/research/Qualitative/trust.html.
- University of Virginia & Virginia Chamber of Commerce. (1990). Virginia government and politics: readings and commentary. Third revised Ed. Rectors and Visitors of the University of Virginia & the Virginia Chamber of Commerce.
- U.S. Congress. (1993). Harmful non-indigenous species in the United States. Office of Technology and Assessment. OTA-F-565. Washington, DC: U.S. Government Printing Office.
- U.S. Department of Agriculture. (2009). Emergency preparedness and response. APHIS Fact Sheet. Retrieved at http://www.aphis.usda.gov/publications/aphis_general/content/printable_version/fs_emerpre.pdf.
- U.S. Environmental Protection Agency. (1993). Chesapeake Bay policy for the introduction of non-Indigenous aquatic species. CBP/TRS112/94. Chesapeake Bay Program, Annapolis. Maryland.
- U.S. Environmental Protection Agency. (1996). Introduction of non-indigenous aquatic species: implementation plan. EPA-903-R-96-004. CBP/TRS 146/96. Chesapeake Bay Program. Annapolis, Maryland.
- U.S. Environmental Protection Agency. (2008). Effects of climate change on aquatic invasive species for management and research. National Center for Environmental Assessment, Office of Research and Development. EPA/600/R-(EPA/600/R-08/014. Washington, D.C. Retrieved online at <http://www.eoa.aov/ncea>.
- U.S. Fish and Wildlife Service. (2007). Injurious wildlife. A summary of the injurious provisions of the Lacey Act (18 U.S.C. 42; 50 CFR 16).
- U.S. General Accounting Office. 2003. Invasive Species: Federal Efforts and State Perspectives on Challenges and National Leadership. GAO-030916T. Washington, DC.
- U.S. General Accounting Office. 2002. Invasive Species: Greater Focus and Greater Commitment Needed to Effectively Manage the Problem, GAO-03-1 (Washington, D.C.: October 22, 2002).
- Virginia Department of Game and Inland Fisheries. 2005. U.S. Fish and Wildlife Service. Final Environmental Assessment Millbrook Quarry Zebra Mussel Eradication. Wildlife Diversity Division. Richmond, Virginia.

Virginia DGIF. 2011. Millbrook Quarry Zebra Mussel Eradication. Retrieved at http://www.dgif.virginia.gov/zebra_mussels.

Virginia Board of Game & Inland Fisheries. (2009). Fisheries Governance Manual. Commonwealth of Virginia. Virginia Department of Game and Inland Fisheries. Website retrieved at <http://www.VDGIF.virginia.gov/about/>.

Virginia Department of Planning and Budget. (2003). Fiscal Impact Statement Bill Number: HB 2436. Commonwealth of Virginia

Virginia Invasive Species Council. (2005). Virginia invasive species management plan. Commonwealth of Virginia.

Walker J. (1969). The diffusion of innovations among the American states. *American Political Science Review*, 63: 880-899.

Warner. 2008. Applied statistics: from bivariate through multivariate techniques. R Los Angeles, CA: SAGE Publications.

Welch S. and K. Thompson. (1980). The impact of federal incentives on state policy innovation. *American Journal of Political Science*, 24(4): 715-729.

Williams B. & Albert, M. (1984). Testing theories of social regulation: Hazardous Waste regulation in the American states. *Journal of Politics*. Vol. 46 (2): 428-458.

Wong, Wei Ying. (2007). Invasive species: Rethinking science and economics. Brown University. Doctoral Dissertation.

Yin, R. (2003) Case study research design and methods 3rd ed. Applied Social Research Methods Series. Volume 5. Thousand Oaks, California: Sage Publications Inc.

Zimmerman, Joseph. 2005. Congressional preemption: regulatory federalism. State Albany, New York: University of New York Press.

CURRICULUM VITAE

John Franklin Christmas, Jr. was born in San Diego, California. He received a Bachelor of Science in Conservation and Resource Management from the University of Maryland, College Park in 1979, a Master of Science in Biology from Towson University in 1991, and a Master of Science in Professional Writing from Towson University in 1997. His work with aquatic invasive species began while employed as a Natural Resources Manager with the Maryland Department of Natural Resources (MDNR) when he was assigned to the Chesapeake Bay Program's (CBP) Exotic Species Work Group in 1991. He represented MDNR in various capacities as a regional representative of the CBP initially in relation to zebra mussel monitoring efforts. For several years, he served as Chair of the Chesapeake Bay Program's Exotic Species Work Group and as the first *ex-officio* representative to the Aquatic Nuisance Species Task Force. He has given numerous presentations and has authored several publications relating aquatic invasive species. Presently he is a college biology educator