Oyster Restoration in the Chesapeake Bay
A Cultural & Socioeconomic Assessment

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Executive Summary

In this report, we present findings on the cultural value of oyster restoration and the socioeconomic importance of different approaches to oyster restoration for a diverse range of Chesapeake Bay stakeholder groups, including commercial watermen, aquaculture growers of oysters, shellfish processors and shippers, scientists investigating oysters and marine-estuary ecosystems, environmentalists who are active in Chesapeake restoration, recreational fishers, and owners of seafood restaurants in the region. Each of these groups has a vested interest in oyster restoration. For each of the seven groups, we pursued parallel lines of research in both Maryland and Virginia. Our ethnographic approach included literature reviews, informal and structured interviews, extensive participant observation, and two surveys.

We investigated how similar or different our study groups are in their cultural knowledge, beliefs and values about oyster restoration. Specifically, we apply a cultural model approach to identify cultural attitudes and values related to oysters and oyster restoration. In using a cultural model approach, we diverge somewhat from traditional social impact assessments, though we feel the extensive cultural meanings that oysters have for Chesapeake Bay stakeholder groups warrant an extended analysis of the cultural as partially independent from the social or socioeconomic. The cultural model analysis was done at two levels. First, at a very explicit and descriptive level, we collected information on what members of the study's seven oyster stakeholder groups knew, believed or valued about oysters and oyster restoration? We found that oyster restoration means many things to many people, depending on scale, time frame and existing knowledge and involvement with oysters. There is, however, a widely-shared understanding of oysters as an indispensable part of the Chesapeake Bay. Also, we found no "great oyster expectations" among stakeholders, but rather that stakeholders seek modest and incremental improvements, a sense that we are "headed in the right direction." Finally, more than any other species in the Chesapeake, and perhaps more than any other natural resource (e.g., clean water), oysters and their restoration have great potential to connect and create a citizenry engaged in efforts to restore healthy ecosystems and support sustainable harvesting of the Bay.

Second, we focused on identifying what stakeholders have to know or believe in order to tell or show us what they did about oysters and oyster restoration. This implicit, tacit, taken-for-granted knowledge can form cognitive templates or schemas, known as cultural models. We found that our study groups share a cultural model of oyster restoration, which we labeled "Oyster Restoration for Multiple Needs," as an integrated approach that provides ecological, economic and cultural benefits by employing a mix of science, policies and understanding of natural cycles. What we believe is significant about this cultural model is not that it includes well-known oyster restoration benefits of ecology, economy and community, or that it includes well-known factors or requirements such as policy, science and recognition of natural cycles, but that the model of successful oyster restoration shared across the study's stakeholder groups is one that must include and integrate these factors and benefits. This cultural understanding of oyster restoration integrating efforts to meet multiple needs produces shared meaning, value and understanding across oyster stakeholder groups. Thus, increasing oysters without meeting the multiple needs of culture, economy, and environment is not what oyster stakeholders implicitly understand and value when they think about oyster restoration for the Chesapeake Bay.

Summary Table Proposed Actions and Alternatives

Action	Socioeconomic Effects
Proposed Action: Introduce the Suminoe Oyster (*Crassostrea ariakensis)* and Continue Efforts to Restore the Native, Eastern Oyster (*Crassostrea virginica)*	No anticipated increase by watermen in harvests of oysters due to probable low amounts of harvestable oysters and high fuel and labor costs (the action targets reserves and sanctuaries). Most oyster growers do not anticipate any increase in business, though more oyster processors see positive business benefits. Most scientists oppose the introduction until more research can reduce uncertainty and better clarify ecological risks and benefits.
Alternative: Continue Existing Native Oyster Restoration	A continued, slow decline in accomplishing economic, social and cultural/community goals valued by all oyster stakeholder groups is expected.
Alternative: Enhance Native Oyster Restoration	No anticipated immediate or near-term economic benefit for watermen since enhancement would target reserves and sanctuaries. A slight majority of growers believe their business would increase. Scientists view this alternative as presenting ecological risks and would be less costly than non-native oyster alternatives. Recreational fishers and restaurant owners support expanding native oyster restoration in general.
Alternative: Harvest Moratorium on Oysters	Approximately half of watermen report it would be very difficult to return to the fishery after only 2-3 years of a harvest moratorium; after seven years the percentage increases to 68%. Most of the growers in Maryland and about 1/3 of the growers in Virginia believe a harvest moratorium will negatively affect their businesses. About 80% of processors see their business being negatively affected by a harvest moratorium. Scientists and environmentalists, however, favor a harvest reduction if it is to accomplish necessary ecological goals. Recreational fishers and restaurant owners are also in favor of a harvest reduction, with the latter seeing consumers willing to pay more for seafood so as to compensate watermen for lost income.
Alternative: Cultivate Either Eastern or Other Non-native Oyster	For both native and non-native oysters, watermen were equally divided on whether the market for wild oysters would be positively or negatively affected. Growers and processors, not surprisingly, did see clear benefits from expanded state efforts to support oyster aquaculture. Both scientists and environmentalists believed that there probably was sufficient research to guide the expansion of oyster aquaculture, which they also felt could provide local environmental benefits.

In our socioeconomic analysis, we asked each study stakeholder group about the impacts of the proposed EIS action (introduce a non-native oysters, primarily in sanctuaries or reserves, with continuation of native oyster restoration) and alternatives to this action (e.g., maintain existing restoration practices, expand native oyster restoration, expand aquaculture of native and/or non-native oyster, impose a harvest moratorium). These alternatives and their socioeconomic effects are described in greater detail in the report, including the criteria we used to evaluate impacts varied by each stakeholder group. Here, we summarize in the above table the most salient socioeconomic effects of the EIS action and alternatives.

This report provides a baseline of cultural and socioeconomic data that can be used to refine and develop more specific analyses, particularly as the EIS action and alternatives are better defined by inclusion of the ecological risk and economic modeling information. As such, it emphasizes the presentation of variability and summary findings, rather than selected, focused analyses. Such analyses at the action and alternative level, with detailed ecological and economic data, represent the next stage in our analysis.

1. Introduction: Oyster Decline and EIS

The Chesapeake was once the largest producer of oysters in the world, supporting a harvest of millions of bushels per season. From the Colonial period through the late 19th century, demand for oysters and harvesting capacity continuously grew. In 1875, during the industry's peak productivity period, 14 million bushels of oysters were harvested from the Chesapeake Bay (MD DNR 2005). Soon after, oyster harvests began to decline sharply, falling by nearly 60% between 1880 and 1930 (NRC 2004). After a period of relative stability between 1930-1950 in Virginia and 1930-1970 in Maryland, oyster harvest levels have declined dramatically to where, for more than the past decade, combined harvests from both Maryland and Virginia are typically well below 500,000 bushels (ibid). The accepted causes of this precipitous decline are intensive harvesting in the past and, since the 1930s, changes in water quality and the increased presence of two devastating oyster diseases, MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus*). Disease impacts vary by salinity level, so the state of Maryland and the Commonwealth of Virginia experience mortality differentially as a result of disease.

Oyster mortality presents serious problems, not only because the bivalve supports a fishery, but also because oysters are a keystone species, providing critical ecological services. They are filter feeders who remove phytoplankton, suspended solids, and organic particles from the water, as well as reef-builders who provide habitat for a wide range of other marine species. The health of oyster populations is considered a major reflection of the health of the larger Chesapeake Bay environment. Accordingly, oyster restoration is a significant component of Chesapeake Bay restoration, and a number of policies and management actions focus on oysters. There is a species-specific management plan for oysters in the Chesapeake, developed in 1989, and updated in 2004 (Tarnowski 1999; NRC 2004). A number of symposia, workshops, and fora centered on oysters have encouraged multi-disciplinary collaboration in developing oyster science. Oysters were included in Chesapeake 2000: A

Watershed Partnership, a cooperative agreement between Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission and the U.S. Environmental Protection Agency that coordinates and directs Bay protection and restoration (CBP 2000). (For additional history of oyster management and policies, see Tarnowski 2002; Kennedy and Breisch 1981, 1983, 2001; Alford 1973).

In addition to state and federal restoration efforts, universities, private organizations, and community groups have also been involved in restoration. Scientific research on oyster biology, ecology, and disease is conducted at a number of regional institutions such as the Virginia Institute of Marine Science (VIMS) and the University of Maryland Center for Environmental Sciences (UMCES). Upon the request of the Virginia General Assembly (documented in House Joint Resolution # 450), VIMS began studying non-native shellfish in 1995 and began investigating the potential benefits of *Crassostrea ariakensis (C. ariakensis)* in 1998 (VIMS 2006). In 2002, the National Research Council (NRC) of the National Academy of Sciences (NAS) was commissioned to further investigate non-native oysters. NRC findings and recommendations were published in 2004.

That same year, the State of Maryland and the Commonwealth of Virginia agreed to cooperate in the preparation of an Environmental Impact Statement (EIS) to evaluate the potential introduction of a non-native oyster, as well as a series of alternative restoration actions. A Notice of Intent to prepare the EIS was published in the Federal Register in January of 2004, followed by a public scoping period, during which public comments were gathered on the scope, purpose, and schedule for the EIS (MD DNR 2006c). The United States Army Corps of Engineers is as a co-leader in the development of the EIS. The EIS is based upon Federal EIS guidelines, which exceed state standards, and provide a comprehensive evaluation of the issues surrounding oyster restoration (MD DNR 2006c). The EIS is designed to evaluate alternatives for restoring the Chesapeake Bay oyster population to a level that will provide self-sustaining harvests comparable to harvests in the 1920-1970 time period. Historical

figures indicate that the annual harvest of Chesapeake Bay oysters for the 1920-1970 period averaged 4.9 million bushels (Lipton, Kirkley and Murray 2005). This restoration is needed "…to restore the ecological role of oysters in the Bay and the economic benefits of a commercial fishery through native oyster restoration and/or an ecologically compatible non-native oyster species that would restore these lost functions" (MD DNR 2006c).

The State and the Commonwealth's Proposed Action is to introduce the oyster species, *C. ariakensis,* to be evaluated in a scientifically-based EIS and a Record of Decision. Reproductive *C. ariakensis* would be propagated from 3rd generation or later of the Oregon strain of the species, in accordance with International Council for the Exploration of the Sea's (ICES) protocols. Any approved introduction would occur first on designated sanctuaries and reserves, separate from native restoration sites. The State and Commonwealth further propose to continue native restoration with *Crassostrea virginica (C. virginica)* using the best available strategies. In addition to evaluating the proposed action of introducing *C. ariakensis,* the EIS is also considering eight different restoration alternatives:

1. No Action or continue current oyster restoration and repletion plans;
2. Expand and accelerate native oyster restoration plans;
3. Implement a temporary harvest moratorium and oyster industry compensation program;
4. Establish and/or expand State-assisted, managed and regulated aquaculture operations using the native oyster;
5. Establish State-assisted, managed, or regulated aquaculture operations using suitable triploid, non-native oyster species;
6. Introduce and propagate an alternative oyster species other than *C. ariakensis* or an alternative strain of *C. ariakensis*;
7. Introduce *C. ariakensis* and discontinue native oyster restoration efforts; and
8. Consider a combination of alternatives.

Based on identified research needs outlined by the 2004 NRC report and by the Chesapeake Bay Program's Scientific and Technical Advisory Committee (STAC), approximately 40 research projects are being conducted in support of the EIS, with expenditures exceeding $10 million (MD DNR 2006c).

Since Chesapeake Bay stakeholder groups will be variably affected by the oyster restoration action(s) taken, the EIS is charged with assessing the potential cultural and socioeconomic components of that action(s), as well as ecological and economic considerations. Potential cultural and socioeconomic impacts include, for example, changes in political support for oyster restoration plans, the consumption of oysters, participation in oyster recovery programs, commercial fishing, and the operation of oyster-dependent businesses. The purpose of this report is to provide an analysis of potential cultural and socioeconomic impacts. This analysis will be incorporated into a broader discussion of the ecological and economic risks and benefits of the proposed action and alternatives.

2. Cultural, Population, and Economic Context

The Chesapeake Bay region is rich in cultural and economic resources, as it has been a place of human and ecosystem interactions for centuries. Native American populations inhabited the region as early as 10,000 years ago (Curtin et al. 2001). In the 16th and 17th centuries, Spanish, Portuguese, Dutch, French, and English colonists settled the region, with the English a predominant group. Europeans immediately began using the area's vast natural resources to build expansive shipbuilding, timber, agricultural, and maritime enterprises. Africans were brought to the Chesapeake, first as indentured servants and then as slaves, to work in the budding economy. The number of colonists from both Europe and Africa grew with industry and by the Revolutionary War there were a quarter of a million newcomers in the region (CBP 2005). Population growth has continued unabated since. An estimated 18 million people will live in the Chesapeake Bay region by the year 2020 (US Census Bureau 2005).

An abundance of culturally and historically significant sites are located within the Chesapeake region, including sites critical to understanding the Colonial period, the Revolutionary War, the Civil War, Reconstruction, the Progressive Era, 20th century history, and contemporary life. Jamestown, the first permanent English settlement in what is now the United States, was established in 1607 on the banks of the James River in Virginia. Managed jointly by the National Park Service and the Association for the Preservation of Virginia Antiquities, Jamestown Island is now home to a publicly accessible historical and archaeological research center, Jamestown Rediscovery (an archaeological project), Historic Jamestowne, and an adjacent living history museum. Fort McHenry, a national monument and historic shrine in Baltimore, Maryland, was the site of the Battle of Baltimore in 1814. The battle inspired Francis Scott Key to write the "Star Spangled Banner." In Millsboro, Delaware, The Nanticoke Indian Association operates a museum celebrating Native American history with guided tours. The Association also hosts an annual powwow with Native American drumming,

dancing, and singing. These are only a few examples of the many museums, water trails, contemporary cultural institutions, historic districts, and heritage areas in the region.

The historic and cultural resources surrounding maritime activity in the Chesapeake are especially plentiful. The distinctive character of the Chesapeake as the nation's largest and once most productive estuary makes living and working on the water a challenge, requiring not only innovation but creativity. The interaction of human ingenuity with this complex ecosystem has generated a unique maritime culture, which is both highly valued by residents and serves as a foundation for the tourism industry. Citizens and visitors can witness shipwrights building the boats that were designed and built specifically for work in the Bay such as bugeyes, skipjacks, and buyboats. The Pride of Baltimore II, a reproduction of an 1812-era privateer, sails from the Baltimore Harbor. There are more than ten maritime museums and many other maritime celebrations in the region, including the Mariners' Museum in Newport News, Virginia, the Calvert Marine Museum in Solomons, Maryland, and activities at Dogwood Harbor in Tilghman Island, Maryland. The Bay hosts a variety of boating events, including the U.S. Sailboat Show, the Mid-Atlantic Small Crafts Festival, the Great Chesapeake Bay Schooner Race, and the Deal Island Skipjack Races. Fishing tournaments, crab and seafood festivals, lighthouse celebrations, and wildlife art festivals are all annual happenings in the region.

One particular element of Chesapeake maritime culture, oystering, has been a central component and driver of social and economic development in the region. From the colonial period to the 20th century, oyster harvests supported a vibrant regional industry that included primary harvesters (including growers), processors, and retailers in addition to secondary industries, fishing communities, and a culinary culture centered on the bivalve. The Bay itself is reputed to be named after the oyster. Several of the region's early Native American chiefdoms, together known as the Powhatan, called the

Bay "Chesepioc" (or Tschiswapeki), an Algonquin word that translates into English as "great shellfish bay."

Although the devastation of *C. virginica* populations has had a serious impact on the primacy of the oyster as a resource, the shellfish remains a culturally significant species. The native oyster, *C. virginica,* is highly valued as a source of food, a symbol of heritage, an economic resource, and an ecological service provider. Chesapeake oysters are renowned for their superb taste and texture. Several winter oyster festivals celebrate the culinary importance of this treasured food. At the J. Millard Tawes Oyster and Bull Roast in Crisfield, Maryland, oysters are prepared and served fried, steamed, smoked, raw, or in stew and shucking demonstrations are provided. At the Urbanna Oyster Festival in Urbanna, Virginia, some local young women are crowned the Oyster Festival Queen and Little Miss Spat. The St. Mary's County Oyster Festival in Maryland hosts the National Oyster Shucking Championship Contest and the winner goes on to compete at the international level. During oyster season, the shellfish is featured on countless restaurant menus in the area, although restaurant owners increasingly rely on oysters imported from other regions. Imported oysters are still prepared with classic Chesapeake recipes, like cornmeal fritters and oysters casino. Seafood houses throughout the region serve a variety of oyster dishes. An entire cookbook celebrating the oyster's place in Chesapeake culture has been published (2003).

The fisheries of the Bay are a central part of regional heritage, as evidenced by the declaration of the skipjack as the Maryland State Boat in 1985 (State of MD). Skipjacks are shallow draft, single mast, large-sail workboats used to dredge oysters. Today, there are only between 20 and 30 skipjacks remaining from a fleet that once numbered almost 1,000 boats (National Trust for Historic Preservation 2003). The Chesapeake Bay Skipjack Fleet was the last commercial fishing fleet powered by sail in North America. Some of the skipjacks that remain are privately owned and continue to be used for dredging, while others are on display in museums or are used for educational programs and

heritage tourism. The *Rebecca T. Ruark*, a national historic landmark and the oldest vessel in the Chesapeake Bay Skipjack Fleet (117 years old), still sails commercially on historic charters (Murphy 2005). The Chesapeake Heritage Conservancy Program offers educational programs aboard the *Martha Lewis* (CHCP 2005), and the *Flora Price* serves as a floating classroom (Choptank River Heritage Center 2006). Every year on Labor Day weekend, many of the remaining skipjacks gather at Deal Island, Maryland, for the Annual Skipjack Races.

Submerged Cultural Resources

The State of Maryland and the Commonwealth of Virginia possess a number of submerged cultural resources ranging from prehistoric sites to historic sites. Cultural resources include structures such as bridge, building, and wharf remains, and a wide variety of vessels of historic importance such as Native American log canoes and colonial warships. Both Maryland and Virginia have legal mechanisms for protecting these valuable resources.

The Maryland Maritime Archaeology Program (MMAP) was established by Chapter 503 of the Acts of the General Assembly of 1988 known as the Submerged Archaeological Historic Property Act and codified within Article 83B, Title 5, Subtitle 6 of the Annotated Code of Maryland. This Act authorized the Maryland Historical Trust to establish a program for the issuance and administration of permits for certain activities relating to submerged archeological historic property (COMAR 05.08.03.01). The Trust is responsible for the protection and management of all cultural remains in State waters. The State Underwater Archaeologist or other MMAP staff members ensure regulatory conformance and conduct resource surveys, site assessments, and evaluations of National Register eligibility. Permits are not required to use and enjoy a submerged archaeological historic property if the use or activity does not involve excavation, destruction, or substantive injury of the historic property or its immediate environment (MHT 2005). Any other activities, including those associated

with oyster restoration, that may have an impact on submerged cultural resources are subject to intensive review by the MMAP and may require a valid permit.

The Commonwealth of Virginia is unique in that it places responsibility for the management and protection of submerged resources, both natural and cultural, with one agency, the Virginia Marine Resources Commission. The Habitat Management Division of the Commission was established in 1962, when responsibility for the oversight of activities on submerged lands was transferred from the Office of the Attorney General to the Commission of Fisheries (VMRC 2006). The Habitat Management Division is responsible for the protection and management of cultural resources in Commonwealth waters, and may work in cooperation with the Virginia Department of Historic Resources, Virginia Institute of Marine Science, or other agencies. Regulations within the Code of Virginia Title 28.2, Chapter 12 maintain that it is unlawful for any entity to conduct activities involving the removal, destruction, or disturbance of underwater historic property without a permit from the Virginia Marine Resources Commission (COV §28.2.1203). The Habitat Management Division reviews permit applications, solicits public comment, and develops recommendations to the Commissioner or Commission for a decision (VMRC 2006). The review of permit applications for activities that may impact submerged cultural resources in the Commonwealth take into account various local state and federal statutes governing the disturbance or alteration of resources. Applications receive independent, concurrent review by local wetland boards, the Marine Resources Commission, the Virginia Department of Environmental Quality, and the U.S. Army Corps of Engineers.

No comprehensive archaeological survey of historic oyster reefs in the Chesapeake Bay has been conducted to date. However, smaller scale surveys have been conducted. Some surveys have been completed in association with oyster restoration activities, and some have been in response to unrelated projects. Their results cannot be generalized but are informative. For example, in 1999, a

Phase I Remote Sensing Archaeological Survey for the Department of Natural Resources Shellfish Dredging Project was conducted in the Upper Chesapeake Bay (Pelletier, Trubey, and Williams 1999). The dredging project targeted buried oyster shell in the waters between Pooles Island, the mouth of Fairlee Creek, and Tolchester Beach, MD. Background investigations suggested a high potential for encountering submerged cultural resources. The archaeological survey covered 1,280 acres and utilized a differential Global Positioning System device, a digital side-scan sonar, a recording proton precession magnetometer, and hydrographic navigational computer software (Ibid). If any vessels were present, they should have been detectable with the instruments employed. The analysis of data recorded in this survey suggested the presence of 12 anomaly clusters and of those 12, two targets were recommended for diver verification or avoidance.

In 2002, the *Phase I Underwater Archaeological Survey of the Mill Hill and St. Mary's Power Dredge Oyster Sanctuaries in the Chesapeake Bay* was conducted (Meier, Pelletier, and Williams 2002). This survey covered two sites: the St. Mary's site east of Point Lookout where the Potomac River flows into the Chesapeake Bay and the Mill Hill site in the Eastern Bay near Piney Neck. Some portion of the Mill Hill survey was not completed due to extremely shallow waters near the shoreline (Ibid). This survey was conducted in a similar manner and with the same technology as the 1999 survey, and the analysis of collected data resulted in one target with the characteristics of a submerged resource site. Avoidance of the site or a Phase II evaluation was recommended (Ibid). Other investigations have been conducted in portions of the Lower Patuxent River, the Chester River, and the Magothy River (personal communication with Dr. Susan Langley on May 3rd, 2006).

Neither the proposed action nor any of the restoration alternative actions under consideration by this Programmatic Environmental Impact Statement are anticipated to affect on-shore cultural resource sites. Any activities associated with the proposed action or alternatives are anticipated to occur on existing or historic oyster bars, or in new areas to be seeded for on-bottom aquaculture.

Restoration activities involving bottomland disturbance such as dredging, reef construction, or seeding of open bottom with oysters have the potential to impact submerged cultural resources. Any activity undertaken in the future as a component of the proposed action or alternatives is subject to the permitting and review process of the location in which that activity will occur.

Population Characteristics

Several counties and independent cities in Maryland, Virginia, and Delaware border the Chesapeake Bay and the Coastal Bays. These counties and cities range in character from rural (defined by the U.S. Census Bureau in 1990 as places of less than 2,500 persons) to urban (defined as 2,500 persons or more). Maryland and Virginia counties located on the eastern shore of the Chesapeake Bay are generally more rural in nature. In addition to many rural areas, counties on the western shore also have urban metropolis areas such as Baltimore, Newport News, Norfolk, and Virginia Beach, with their respective surrounding suburbs.

Maryland's shoreline counties include Cecil, Kent, Queen Anne's, Talbot, Dorchester, Wicomico, and Somerset (on the eastern shore of the Bay) and Harford, Baltimore, Anne Arundel, Calvert, and St. Mary's (on the western shore of the Bay). Bordering the Coastal Bays is Worcester County in Maryland and Sussex County in Delaware. Virginia's shoreline counties and independent cities include Accomack and Northampton Counties on the eastern shore and on the western shore Gloucester, Lancaster, Mathews, Middlesex, Northumberland, Westmoreland, and York Counties and the cities of Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, and Virginia Beach. The U.S. Census Bureau database was accessed to provide demographic information for the Chesapeake Bay and Coastal Bay regions. This database is available on line at: http://quickfacts.census.gov/qfd/ (U.S. Census Bureau, 2004).

Populations as of the 2000 census were highest in Baltimore County (754,292), Virginia Beach (425,257), Norfolk (234,403), Newport News (180,150), and Hampton (146,437) (see Tables 2.1-2.2).

Minority populations were the highest in Baltimore City (69%) (not shown in Table 2.1), followed by Portsmouth (54.2%), Norfolk (53%), Newport News (48%), Northampton (47.5%), Suffolk, (46.2%), and Somerset County (44.2%).

Table 2.1 Population Profile of Maryland and Delaware Shoreline Counties*

Maryland & Delaware Counties	Total Population	Percent Minority	Percent Change 1990-2000	Projected Population 2010	Projected Population 2020
Anne Arundel	489,656	20.2	14.6	528,900	551,200
Baltimore	754,292	26.6	9.0	804,700	826,700
Calvert	74,563	17.0	45.1	93,750	100,450
Cecil	85,951	7.5	20.5	101,200	111,450
Dorchester	30,674	31.2	1.4	31,600	32,150
Harford	218,590	14.2	20.0	257,800	279,700
Kent	19,197	21.6	7.6	21,400	22,300
Queen Anne	40,563	11.6	19.5	49,600	56,950
St. Mary	86,211	19.6	13.5	102,700	116,700
Somerset	24,747	44.2	5.6	26,300	27,200
Talbot	33,812	10.7	18.8	37,000	38,750
Wicomico	84,644	28.5	13.9	94,500	103,300
Worcester	46,543	19.6	32.9	53,950	57,550
Sussex, DE	156,638	19.7	38.3	19,522	232,194

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Table 2.2 Population Profile of Virginia Shoreline Counties and Independent Cities*

Virginia Counties & Independent Cities	Total Population	Percent Minority	Percent Change 1990-2000	Projected Population 2010	Projected Population 2020
Accomack	38,305	38.1	28.0	20,414	20,468
Gloucester	34,780	14.3	15.4	46,048	53,055
Hampton	146,437	51.5	9.5	146,647	151,185
Lancaster	11,567	30.4	6.2	12,389	13,088
Mathews	9,207	13.2	10.3	9,098	9,419
Middlesex	9,932	21.5	14.8	10,100	10,796
Newport News	180,150	48.0	5.1	198,831	212,876
Norfolk	234,403	53.0	10.3	253,809	253,809
Northampton	13,093	47.5	0.2	9,396	9,396
Northumberland	12,259	27.8	16.5	12,095	12,830
Poquoson	11,566	3.7	5.1	13,833	14,786
Portsmouth	100,565	54.2	-3.2	101,963	101,963
Suffolk	63,677	46.2	22.1	53,544	53,624
Virginia Beach	425,257	30.5	8.2	418,953	488,369
Westmoreland	16,718	31.2	8.0	17,392	18,385
York	56,297	20.0	32.7	55,998	65,505

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Homeownership rates were highest in Calvert County, Maryland at 85.2% and Northumberland County in Virginia at 87.4% and the lowest in Somerset County, Maryland at 39.6% and in Norfolk, Virginia at 45.5% (Tables 2.3-2.4). The highest median household income levels were in Calvert County ($65,945), Anne Arundel County ($64,768), Poquoson ($60,920), York County ($57,956), Harford County ($57,234), and Queen Anne's County ($57,037). The lowest median household income levels were in Northampton County ($28,276), Somerset County ($29,903), Baltimore City ($30,078), Accomack County ($30,250), Norfolk ($31,815), Lancaster County, and Portsmouth ($33,742) (Tables 2.3-2.4).

Table 2.3 Housing and Income Rates in Maryland and Delaware Shoreline Counties*

Maryland & Delaware Counties	Per Capita Income (Dollars) 1999	Median Household Income 1999	Percent Persons Below Poverty	Number of Housing Units 2000	Percent Homeownership Rate 2000
Anne Arundel	$27,578	$64,768	5.1	192,435	75.5
Baltimore	$26,167	$50,667	6.5	318,844	67.6
Calvert	$25,410	$65,945	4.4	29,430	85.2
Cecil	$21,384	$50,510	7.2	36,074	75.0
Dorchester	$18,929	$34,077	13.8	14,740	70.1
Harford	$24,232	$57,234	4.9	86,697	78.0
Kent	$21,573	$39,869	13.0	10,014	70.4
Queen Anne	$26,364	$57,037	6.3	17,543	71.8
St. Mary	$22,662	$54,706	7.2	35,840	71.8
Somerset	$15,965	$29,903	20.1	10,055	39.6
Talbot	$28,164	$43,532	8.3	17,076	71.6
Wicomico	$19,171	$39,035	12.8	35,612	66.5
Worcester	$22,505	$40,650	9.6	48,147	75.0
Sussex, DE	$20,328	$39,208	10.5	96,242	80.7

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Table 2.4 Housing and Income Rates in Virginia Shoreline Counties and Independent Cities*

Virginia Counties & Independent Cities	Per Capita Income (Dollars) 1999	Median Household Income 1999	Percent Persons Below Poverty	Number of Housing Units 2000	Percent Homeownership Rate 2000
Accomack	$16,309	$30,250	18.0	19,550	81.0
Gloucester	$19,990	$45,421	7.7	14,494	81.4
Hampton	$19,774	$39,532	11.3	57,311	58.6
Lancaster	$24,663	$33,239	12.5	6,498	83.0
Mathews	$23,610	$43,222	6.0	5,333	84.7
Middlesex	$22,708	$36,875	13.0	6,479	83.1
Newport News	$17,843	$36,597	13.8	74,117	52.4
Norfolk	$17,372	$31,815	19.4	94,416	45.5
Northampton	$16,591	$28,276	20.5	6,547	68.6
Northumberland	$22,917	$38,129	12.3	8,251	87.4
Poquoson	$25,336	$60,920	4.5	4,362	84.1
Portsmouth	$16,507	$33,742	16.2	41,862	58.6
Suffolk	$18,836	$41,115	13.2	26,826	72.2
Virginia Beach	$22,365	$48,705	6.5	162,277	65.6
Westmoreland	$19,473	$35,797	14.7	9,389	79.2
York	$24,560	$57,956	3.5	22,143	75.8

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

The distribution of occupation types is similar across shoreline counties in Maryland, Virginia, and Delaware (Tables 2.5-2.6). The majority of workers provide management and professional services (23-40%) or are employed in sales and office occupations (23–29%). Service occupations, construction/maintenance occupations, and production/transportation occupations comprise approximately similar amounts of the remainder of the workforce in these counties and municipalities.

Table 2.5 Employment Profile of Maryland and Delaware Shoreline Counties*

Maryland & Delaware Counties	Management, Professional & Related	Service Occupations	Sales & Office	Fishing, Farming & Forestry	Construction, Extraction & Maintenance	Production, Transport & Material Movement
Anne Arundel	40.5	12.5	28.0	.01	9.9	9.1
Baltimore	39.5	13.2	29.0	.01	8.0	10.2
Calvert	36.8	14.7	24.4	0.2	15.0	8.8
Cecil	28.1	13.3	26.4	0.6	14.3	17.2
Dorchester	23.3	16.0	23.8	2.5	13.0	21.5
Harford	38.0	13.0	27.4	0.1	10.2	11.2
Kent	31.6	18.0	22.7	4.0	11.0	12.7
Queen Anne	36.3	13.8	25.8	1.5	12.0	10.6
St. Mary	39.1	13.1	23.5	0.7	14.3	9.3
Somerset	24.8	21.2	23.5	3.8	11.7	15.1
Talbot	34.9	16.6	24.9	1.7	10.3	11.5
Wicomico	30.8	17.2	26.7	0.9	10.0	14.3
Worcester	29.3	21.2	27.8	0.9	11.6	9.2
Sussex, DE	27.2	16.7	25.3	1.3	12.8	16.6

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Farming, fishing, and forestry occupations make up the smallest percentage of the workforce in all of the Maryland Chesapeake Bay counties and the Maryland and Delaware counties that border the Coastal Bays (Tables 2.5-2.6). A low percentage of the workforce (2% or less) was employed in these occupations in Anne Arundel County, Baltimore County, Baltimore City, Calvert County, Harford County, Talbot County, Queen Anne's County, Wicomico County, Worcester County in Maryland, and Sussex County in Delaware. Farming, fishing, and forestry comprised a higher percentage of the workforce on the Eastern Shore of Maryland in Dorchester County (2.5%), Somerset County (3.8%), and Kent County (4%) (Table 2.5).

Table 2.6 Employment Profile of Virginia Shoreline Counties and Independent Cities*

Virginia Counties & Independent Cities	Management, Professional & Related (Percentage)	Service Occupations (Percentage)	Sales & Office (Percentage)	Fishing, Farming & Forestry (Percentage)	Construction, Extraction & Maintenance (Percentage)	Production, Transport & Material Movement (Percentage)
Accomack	24.2	16.7	22.1	5.9	11.0	20.0
Gloucester	31.3	15.2	23.6	1.5	15.9	12.6
Hampton	32.1	15.1	27.8	.03	11.0	13.7
Lancaster	27.6	20.6	25.1	1.9	11.2	13.7
Mathews	27.3	17.1	22.9	1.6	15.4	15.7
Middlesex	30.1	14.0	23.3	2.1	15.4	14.9
Newport News	30.5	17.6	27.6	0.3	10.4	13.6
Norfolk	29.1	19.1	27.7	0.2	10.7	13.2
Northampton	27.1	20.0	19.9	6.6	10.0	16.4
Northumberland	30.0	16.4	23.3	3.8	12.4	14.0
Poquoson	44.1	13.5	20.8	1.5	10.3	9.9
Portsmouth	27.7	16.7	27.8	0.2	12.8	14.7
Suffolk	30.9	13.8	25.3	0.4	11.3	18.5
Virginia Beach	35.9	14.9	30.1	0.1	10.0	9.0
Westmoreland	26.5	16.3	25.8	1.9	13.4	16.1
York	45.9	13.1	24.3	0.3	7.3	9.1

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

The distribution of occupation types is similar for the 16 counties in Virginia that border the Chesapeake Bay and Coastal Bays. In the Virginia counties, the majorities of workers provide management and professional services (24-45%), or are employed in sales and office occupations (19–30%). Service occupations, construction/maintenance occupations, and production/transportation occupations are in approximately similar amounts by the remainder of the workforce in these counties. Farming, fishing, and forestry occupations employ the smallest percentage of the workforce. The percentage of workers in these occupations is less than 2% of total employment in most counties and independent cities. The exceptions are Northampton County (6.6%), Accomack County (5.9%), and Northumberland County (3.8%) (Table 2.6).

Levels of unemployment ranged in the Maryland counties from 1.9% in Queen Anne's County to 4.9% in Somerset County and 2.8% in Sussex. Levels of unemployment ranged in Virginia counties from 1.8% in York and Mathews Counties to 4.5% in Accomack County and 4.7% in Norfolk City.

Table 2.7 Employment Rates in Maryland and Delaware Shoreline Counties*

Maryland & Delaware Counties	Labor Force	Number Employed	Percent of Total Population Employed	Number Unemployed	Percent of Total Population Unemployed
Anne Arundel	269,772	250,254	66	8,077	2.1
Baltimore	396,897	379,705	63.7	16,521	2.8
Calvert	39,341	37,604	68.4	1,182	2.1
Cecil	44,866	42,953	66.4	1,834	2.8
Dorchester	15,144	14,255	58.4	882	3.6
Harford	116,981	111,792	68.1	3,522	2.1
Kent	9,733	9,294	59.4	427	2.7
Queen Anne	21,849	21,186	67.4	610	1.9
St. Mary	46,032	41,453	64.1	1,973	3.1
Somerset	10,389	9,368	45.4	1,004	4.9
Talbot	16,789	16,208	59.6	568	2.1
Wicomico	44,815	42,211	63.8	2,472	3.7
Worcester	23,122	21,510	56.5	1,568	4.1
Sussex, DE	73,325	69,596	55.5	3,565	2.8

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Unemployment rates are based on the reported values in the 2000 US census; current unemployment rates are likely higher (Tables 2.7-2.8).

Table 2.8 Employment Rates in Virginia Shoreline Counties and Independent Cities*

Virginia Counties & Independent Cities	Labor Force	Number Employed	Percent of Total Population Employed	Number Unemployed	Percent of Total Population Unemployed
Accomack	18,116	16,618	55.3	1,365	4.5
Gloucester	17,879	16,703	62.4	691	2.6
Hampton	71,790	60,810	52.8	4,277	3.7
Lancaster	4,682	4,381	45.6	301	3.1
Mathews	4,242	4,046	53.5	134	1.8
Middlesex	4,475	4,287	52.0	175	2.0
Newport News	92,586	78,194	57.7	4,604	3.4
Norfolk	123,360	87,490	47.6	8,632	4.7
Northampton	5,581	5,177	49.7	389	3.7
Northumberland	5,095	4,894	47.8	201	2.0
Poquoson	5,908	5,550	62.8	182	2.1
Portsmouth	48,163	40,353	52.1	3,352	4.3
Suffolk	30,345	27,519	57.7	1,414	3.0
Virginia Beach	234,257	194,923	60.7	8,247	2.6
Westmoreland	7,472	7,129	55.9	307	2.3
York	29,669	25,433	60.8	735	1.8

*Source: Year 2000 Census Data obtained from U.S. Census Bureau, 2000 Census

Tourism and Fisheries

The natural and cultural resources of the Chesapeake and Coastal Bays are essential components of the economic health of both Maryland and Virginia. A wide variety of resource-dependent commercial and recreational activities are significant to the economy of the region and to the well-being of its citizens. Through these activities, the cultural and natural resources of the Chesapeake and Coastal Bays create jobs, support communities, and generate revenue for the states.

Tourism, for example, has a significant impact on state and local economies in both Maryland and Virginia. Tourists engage in a wide variety of activities in the Chesapeake region including trips to beaches, historic sites, and urban centers. Popular outdoor activities include hiking, biking, sailing,

kayaking, wildlife recreation (i.e., hunting, fishing, wildlife watching), and farm tours. Visitors spent $9.3 billion in Maryland (MD Office of Tourism Development 2006) and $15 billion in Virginia in 2004 (Travel Industry Association of America 2005). Those expenditures represent an increase since 2003 of approximately 5% in Maryland and 8.3% in Virginia (Ibid).[1] Domestic tourism industries produced 108,200 jobs in Maryland in 2003 and 203,000 jobs in Virginia in 2004 (Ibid). The top three tourist destinations in Maryland are the Bay region cities of Baltimore, Ocean City, and Annapolis (MD Office of Tourism Development 2006). Virginia's Bay region cities of Virginia Beach and Norfolk are two of the state's top five most visited areas (Travel Industry Association of America 2005).

Recreational users, both tourists and residents, are also a major component of the economic picture in the Bay region. Approximately 1.9 million people engaged in wildlife recreation in Maryland in 2001, and they spent $1.7 billion on trips, equipment, licenses, etc. (U.S. Dept of Interior 2001). Wildlife recreation is even more profitable in Virginia where 3 million people spent $1.9 billion in 2001 (Ibid). The Bay's natural resources directly support these economic benefits to the states.

The Chesapeake Bay region is also home to many commercially productive fisheries, including several species of finfish and shellfish (e.g. blue crabs, striped bass, clams, and oysters). The seafood industry, which includes harvesters, growers, processors, packagers, shippers, and retailers, contributes approximately $400 million to Maryland's economy each year (State of MD 2006). Virginia's seafood industry is the third largest producer of marine products in the nation, contributing approximately $465 million annually to the Commonwealth's economy (VA Seafood 2004). In 2005, commercial fisheries landings alone earned $63,669,831 in Maryland and $155,262,654 in Virginia (NMFS 2006a). These data include ocean landings. More than 6,600 watermen work the Chesapeake Bay providing seafood to 74 seafood processing plants in Maryland that employ over 1300 people (MD Seafood 2005).

[1] These expenditures are state-wide and include but are not limited to the counties bordering the Chesapeake and Coastal Bays.

Virginia has over 194 processing plants and the seafood industry provides more than 11,000 part-time and full-time jobs (VA Seafood 2004). These jobs represent an assortment of positions including day laborers, sales representatives, managers, maintenance workers, delivery personnel, and others. There is reliance on H-2B workers[2] in this sector, particularly in oyster and crab processing facilities (Kirkley et al. 2005).

Oyster Fishery

The oyster fishery is an important part of the larger Chesapeake Bay seafood industry. Native Americans in the Chesapeake Bay watershed harvested large quantities of oysters to support their coastal villages. Early settlers to the shores of the tidal regions of the Chesapeake Bay quickly learned from Native Americans to harvest and rely upon oysters as part of their food production strategies. However, it was in the late 19th century that Chesapeake Bay oyster fishery became a major source of oysters in North America and a major economic engine for communities, businesses and local governments throughout the watershed. In the 1890s, there were some 4,500 boats of assorted size in the fishery (cited in Wennersten 2001:113). As is the case today, oysters were harvested from public areas by commercial fishermen known locally as watermen. In Virginia, however, some of the harvest is from private leased areas.

There is extensive literature on the oyster fishery, detailing the various harvesting practices used (e.g., diving, dredging under sail or power, tonging either by hand or with hydraulics), harvest levels, changes in regulations, and the special role of the Chesapeake's once-great fleet of skipjacks, the shallow draft, wide-beamed sail-powered dredging vessels made and used by watermen (cf. Blackistone 2001; Byron 1977; Peffer 1979; Vojtech 1993).

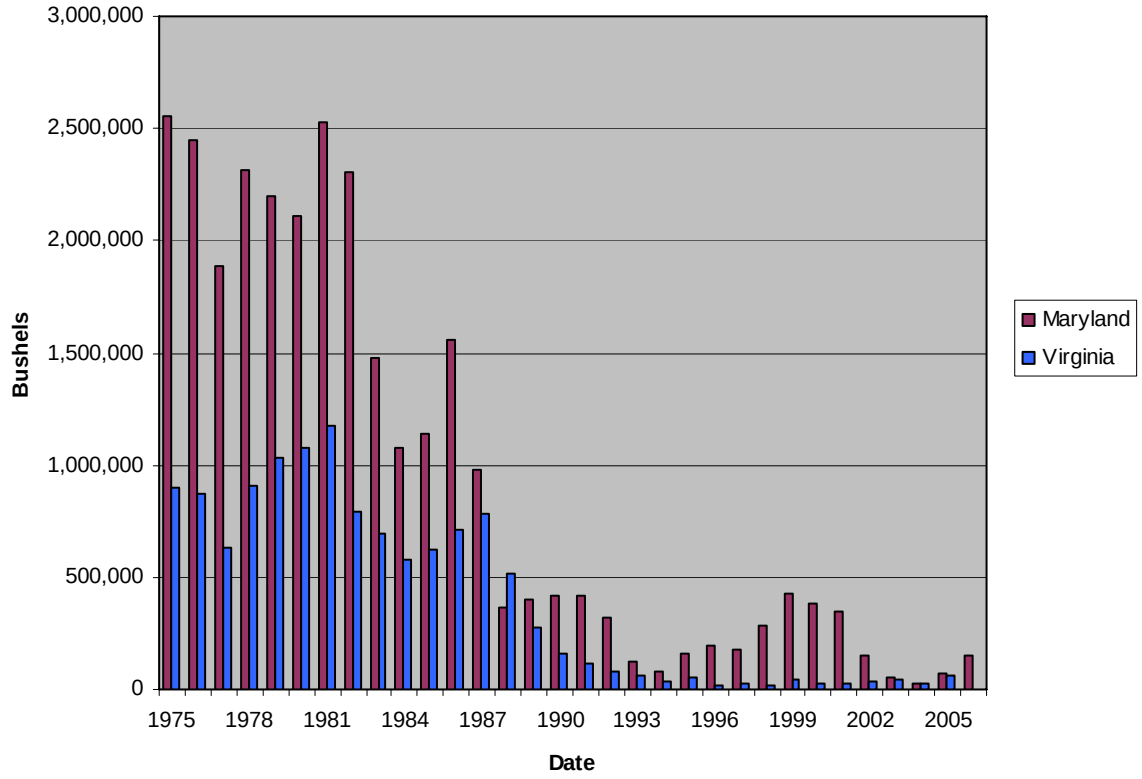
Oyster harvests from the Chesapeake Bay have declined significantly over the past two decades, due to disease, harvesting pressures and declining water quality and habitat (Figure 2.1).

[2] The H-2B worker program provides visas to support foreign workers for temporary or seasonal positions.

Estimates for the 2005 season calculate Virginia's public landings at 49,233 bushels and private landings at 16,297 bushels for a total of 65,530 bushels (See Figure 2.1). For Maryland, harvest from 2005 season yielded 72,218 bushels at a dockside value of $1,125,074; harvest from the 2006 season yielded 154,436 bushels for a dockside value of $4,734,818; and harvest from the 2007 season yielded 165,436 bushels with a dockside value of $5,017,498 (MD DNR 2008).[3] Maryland oyster harvest for the period of 2005-2007 totaled 391,713 bushels of which only 9,366 (or about 2% of the total) were harvested from oyster reserves (MD DNR 2008). Due to increases in rainfall, which lowers disease mortality, these recent harvests in Maryland are above the record lows of 26,495 bushels in the 2004 season (Ibid). However, they remain considerably lower than in the past and millions of bushels away from the state's targeted goal of 4.9 million bushels annually, the average harvest for the 1920-1970 time period (Lipton 2005).

[3] Estimates for the Virginia 2005-2006 season and more recent years have not yet been released.

Figure 2.1 Oyster Harvests*



*Source: Data from Maryland Department of Natural Resources (2008) and Virginia Marine Resource Commission (2005).

Although oystering today earns watermen much less than what they earn from crabbing during the spring and summer months, dredging or tonging for oysters in fall and winter still enables watermen to earn money and to get out and work on the water. This can provide small amounts of much needed income which act as a financial safety valve for watermen families (NRC 2004; Paolisso 2005a.

Watermen in both Maryland and Virginia must purchase a special license to harvest oysters. Virginia licenses are purchased by gear type. In Maryland, anyone seeking to harvest oysters must first be in possession of an Oyster Harvesting License (OYH) or a Tidal Fish License (TFL), which allows the holder to harvest a range of commercially valuable, marine species in the Bay. To be able to harvest oysters in any particular year, holders of OYH and TFL licenses must also pay an annual oyster

surcharge, which currently costs $300. In any given year, many TFL license holders elect not to oyster. Thus, for any year, the number of oyster surcharges purchased by OYH and TFL license holders is the best indicator of number of Maryland harvesters active for that year in the fishery.

In 2001, more than a thousand watermen in Maryland paid the oyster surcharge and 320 in Virginia held oyster gear licenses (Table 2.9). That same year, these harvesters earned an estimated $5,300 per license (either OYH or TFL) in Maryland and $1,800 per license in Virginia (NRC 2004). In 2004, only 284 watermen in Maryland purchased an oyster surcharge (MD DNR 2006b), while 420 watermen in Virginia held oyster licenses (Table 2.9). Overall, the decline in number of watermen paying the oyster surcharge in Maryland has been more pronounced between 1999 and 2006, relative to the changes in oyster licensing in Virginia, where the trend is one of shorter period declines and increases.

Table 2.9 Oyster Surcharges and Licenses per Year for Maryland and Virginia*

Year	1999	2000	2001	2002	2003	2004	2005	2006
Maryland Number of Oyster Surcharges	1135	1031	1004	725	461	284	420	577
Virginia Licenses Sold for All Kinds of Harvesting Gear	406	255	320	546	312	420	N/A	N/A

*Source: Data from Maryland Department of Natural Resources (2008) and Virginia Marine Resource Commission (2005).

Oystering in Maryland is done primarily on public grounds during the winter season (depending on the type of harvest equipment used, a designated time frame between October and March) (MD DNR 2006a). In Virginia, a significant portion of landings come from privately held leases, which are often harvested during the summer months, while public beds are used for oystering in the winter months (NRC 2004). During the 1990s, more than 96% of the oyster harvest in Maryland came from public beds, while over 60% of Virginia's harvest came from privately leased beds. In 2004, Virginia growers utilized 265 leases for oyster culture. In 2005, the number of leases used grew to 282 (Murray and Oesterling 2006).

Aquaculture operations are diverse and can include growers singly engaged in oyster aquaculture, wild harvesters who also grow, and processors engaged in aquaculture to serve their shucking needs. Intensive aquaculture of native oysters can be performed in several different ways to serve a variety of markets. Historically, oyster grow-out operations involved moving wild seed to privately leased ground (Murray and Oesterling 2006). Due to increased disease and mortality rates, this type of aquaculture is rarely practiced today. Intensive native aquaculture is primarily conducted in contained racks, floats, or bags either on bottom or off bottom.

From 2004-2005, there was a gradual increase in the amount of leased bottom used for oyster aquaculture in containers in Virginia, as well as an increase in the amount of oyster seed sold by hatcheries (Murray and Oesterling 2006). While oyster aquaculture currently exists at a relatively small scale as compared to clam aquaculture, this growth is expected to continue. With the exception of those involved in the Virginia Seafood Council trials with *C. ariakensis*, growers are using *C. virginica*, often disease-resistant strains purchased as seed from hatcheries. There is increasing interest in growing triploid *C. virginica*.[4] Growers in Virginia report primary sales outside of the Commonwealth, largely targeted to the half-shell market (as opposed to the shucked market) (Murray and Oesterling 2006). Reported prices in 2004-2005 were an average of $0.29 per oyster (Ibid). A significant number of growers are employed in oyster aquaculture part-time (a 2006 Virginia survey reported 30 out of 44 growers participating were employed part-time) (Murray and Oesterling 2006).

Due to variations in oyster population levels, regulatory frameworks, and structural disparities, the oyster industries in Maryland and Virginia are quite distinct, although they share a long history of supporting coastal communities. Processing, wholesale, and retail operations continue to operate in the region, but are increasingly dependent on oysters imported from elsewhere. The processing sector in Maryland, which consisted of 11 processing plants employing 249 people in 1997, is smaller than in Virginia, where 21 plants employed 389 employees that same year (NRC 2004: 107; Muth et al. 2000).[5]

The oyster fishery is an important part of the larger seafood industry in the Bay region. The native oyster, *C. virginica*, is one of the region's valuable natural resources. The oyster has a direct value as food source for consumers and as a product for the industry that catches, grows, processes,

[4] Triploidy refers to the manipulation of the chromosomes through chemical treatment or selective breeding, which results in three sets of chromosomes instead of the normal two, and renders the oyster sterile. Triploid oysters can grow faster, using energy for growth that would otherwise be devoted to reproduction. If growth can be accelerated, oysters can reach market size before they are likely to suffer mortality from disease (approximately 2-3 years).
[5] Updated counts of processing plants are pending.

and sells the shellfish (Lipton 2005). Oysters also have an indirect value derived from the ecological services they provide. Oyster reefs provide habitat for other commercially valuable species (e.g. blue crab). Oysters' contribution to water quality can lead to an increase in recreational activities such as boating or swimming, and a reduction in the costs of water quality improvement measures. Oystering also constitutes an important part of the cultural heritage of watermen communities in both Virginia and Maryland.

Conclusions

The Chesapeake Bay plays a prominent role in the lives of the people who reside in its watershed. This is true not only for watermen, but for all of the people who live and work in the region. People who eat Bay seafood, scientists who study the Bay, and people who use the Bay as a place of recreation are all connected to the Chesapeake and are all a part of the region's character. Human interaction with the Bay throughout history and today has contributed to a strong sense of local identity, rooted in shared experiences and traditions, yet encompassing the diversity of the Bay's people. This diversity is mirrored in the wealth and variety of cultural resources the region contains.

3. Approach, Research Design and Study Sample

Standard social impact assessment (SIA) studies include attention to potential impacts on population characteristics (present population makeup and expected changes, seasonal or migratory flows, and diversity), community and institutional structures (the character of local political systems, employment patterns, participation in voluntary associations, religious entities, or interest groups and linkages to larger political systems), political and social resources, individual and family changes (factors influencing daily life), and community resources (natural resource access and use, housing patterns, access to services such as health care) (Inter-organizational Committee 1994). SIA methods are used to evaluate changes in each of these elements of the human environment that may occur as a result of a proposed action. Proposed actions and alternatives must be articulated in detail, specifying the exact locations, land use requirements, facility needs, construction plans, work force requirements, institutional resource needs, etc. of the proposed action (Ibid).

This EIS is unique in that the proposed action and alternatives being evaluated may impact an entire region and in that the action and alternatives are less highly specified than EIS processes that focus on a localized project with defined labor needs (e.g. the construction of a bridge or dam). A wide variety of diverse stakeholder groups may be affected by the proposed action, including groups who lack homogeneity and groups who are geographically dispersed (See Appendix 1). While this assessment shares the objectives of a standard SIA, its character is a product of these circumstances. This impact assessment is also unique in that it adds an additional element of inquiry that is an extension of our larger interests and work in the Chesapeake Bay (cf. Paolisso 2005a; 2005b; 2002; see also Greer 2003 for an excellent overview of this anthropological work). This work includes an explicit interest in cultural (shared) knowledge about the environment and its influence on value and behavior.

The cultural and socioeconomic assessment began in May of 2004. The original scope of work was expanded in 2005 and further expanded in 2006. The assessment in its entirety encompasses the following tasks:

- Identifying cultural models for understanding the proposed action and alternatives;
- Identifying the cultural and socioeconomic implications of the proposed action and alternatives;
- Collaborating with others involved in developing the EIS;
- Identifying the range of cultural and socioeconomic constraints and opportunities to native and non-native aquaculture; and
- Exploring perceptions of adequacy of information and time frame for a decision.

As a result of the continued expansion and evolution of this research, we have built several layers of understanding and knowledge regarding these issues over approximately four years of engagement. Five reports/publications have been produced from our research to date. (Paolisso, Herman and Dery 2006; Paolisso, Dery and Herman 2006; Paolisso and Dery 2006; Dery and Paolisso 2006; Paolisso and Dery 2008). The results presented here are cumulative and reflect the aggregate nature of our work.

We define culture as "shared, learned knowledge and values" that different groups use to understand environmental issues for the Chesapeake. To use this cultural approach, we need to collect information on explicit cultural knowledge and values from placed-based communities and from dispersed groups (managers, scientists, seafood consumers, recreational users of the Bay, etc.), analyze these data using systematic qualitative and quantitative methods in anthropology (text to consensus analysis, all reinforced and framed by good ethnography) to identify cognitive models and potential impacts that are similar and different within and across groups. The result of this approach is an analysis of the impacts of restoration, informed by a comparative study of the underlying core of

knowledge and beliefs that groups are applying to various issues, in this case, the introduction of a non-native oyster.

We maintain a theoretical interest in cultural models, situated within a broader frame of cognitive and environmental anthropology. Cultural models are shared implicit and tacit understandings about how the world works. They are cognitive frameworks used by individuals to process and organize information, make decisions, and guide behavior. In an oft-quoted definition, Quinn and Holland describe cultural models as "presupposed, taken-for-granted models of the world that are widely shared by members of a society and that play an enormous role in their understanding of that world and their behavior in it" (Quinn and Holland 1987: 4). Cultural models are thus representations of "that knowledge individuals need to know to behave in appropriate ways," vis-à-vis the norms and practices of their group (Goodenough 1957).

Why use this cognitive approach of cultural models to conduct cultural analysis of the oyster fishery? First, a fundamental assumption of cultural modeling is that when individuals engage the world, they cannot possibly attend to it in all of its complexity. Consequently, individuals must use simplified, cognitive models to reason with or calculate by mentally manipulating the parts of the model to solve problems or interpret situations or events (D'Andrade 1995). Second, time is often of the essence, with an individual needing to make a decision, understand a situation, or provide verbal or behavioral responses with little or no delay. Thus, the cultural model used should contain essential or primary cultural knowledge that forms or reinforces core cultural beliefs and values among a group who shares that cultural model. Third, the cultural model identified helps explain behavior and cultural knowledge and values in related domains, both among group members and in the views and behaviors of group members toward other groups.

As a complement to the qualitative, cultural model approach, we also use a quantitative approach that looks for patterns of agreement and disagreement in knowledge and values about

Chesapeake fisheries. Patterns of agreement–disagreement are key data for studies of intra-cultural variation in knowledge of a particular area or domain. By investigating this variation, we can begin to understand how individuals learn and transmit information on fisheries. Specifically, we can investigate whether significant variation in knowledge is idiosyncratic or patterned within or between groups. This quantitative component involves analyzing survey data using cultural consensus models (Romney, Weller, and Batchelder 1986; Romney, Batchelder, and Weller 1987; Weller 2007) to determine to what degree people are drawing upon a shared knowledge. "The cultural consensus model formalizes the insight that agreement often reflects shared knowledge and allows the estimation of individual knowledge levels (cultural competence) from inter-respondent agreement. The central idea is that agreement among respondents is a function of the extent to which each knows the culturally defined "truth" (Kempton et al. 1996:235). The model provides an estimate of each individual informant's competency (the degree to which each informant represents a shared cultural knowledge about the given domain). These estimates are then used to determine the "correct" response and their associated level of confidence.

The consensus model is based on the assumption of a coherent cultural domain shared across informants, and it provides a criterion for assessing whether this assumption is met. This criterion is determined through factor analysis (minimum residual or maximum likelihood, depending on the data) of the inter-informant agreement matrix. If this procedure yields a single factor solution (the first factor's Eigen value is greater than or equal to three times the second factor's Eigen value), then the agreement data fit the consensus model. Informants' loadings on the first factor represent their cultural competencies, or amount of agreement with the pattern of responses that form the overall consensus. If the data fit the cultural consensus model, we conclude that individual competencies are based on one underlying cultural system that individuals share to varying degrees.

We employ this cognitive theoretical orientation here to help us describe what we suspect are long-term, wide reaching shifts in cultural knowledge surrounding oysters and the Bay. While these shifts may be less apparent and more difficult to measure than the socioeconomic impacts we investigate (e.g. expected changes in income), we believe these cultural changes are critical to understanding behavior and regional identity.

We feel that the oyster is at the center of complex intra- and inter-group cognition about the Chesapeake Bay. It is our hypothesis that the introduction of non-native oyster will affect existing cultural conceptions of the oyster and of the Bay in unstated but important ways. We are not assigning value to those changes, but arguing that they should be identified. In order to achieve this, all groups' cultural knowledge and beliefs must be "dredged up" and looked at for their impact on 1) how we understand, value, and use the Bay and its resources, and 2) how it affects our understanding of, support for, or resistance to policies and programs that manage and sustain Bay natural resources. Attention to cultural knowledge, then, is not only warranted but essential in our view. Our goal is to provide the necessary background information to the EIS that will allow policy makers to appreciate the cultural context for their decisions.

Research Design & Methods

We have utilized a variety of methods to conduct this assessment, including both qualitative and quantitative approaches. We use methods that compliment and inform one another, providing a more holistic and comprehensive analysis than the use of one method alone. These methods include literature reviews, key informant interviews (30 were conducted, primarily in 2004), participant observation, and the use of two survey instruments. (Please refer to Paolisso, Dery and Herman 2006 and Appendix 1 for an expanded explanation of the methods and protocols used.)

Our use of two separate survey instruments reflects the cumulative nature of the assessment. The first survey, distributed in 2004, was designed to systematically collect information on different

groups' views of oysters and oyster restoration. Some of the perceptions we captured were quite general in nature, and we discovered that stakeholders often lacked detailed knowledge of oyster management. The survey asked respondents for their level of agreement with statements according to a six-point scale, ranging from (1) (Strongly Disagree) to (6) (Strongly Agree). The statements used in the questionnaire were those we identified as representing important cultural beliefs and values, within and between groups. The survey also collected information on respondents' relevant personal histories. The stakeholder groups we targeted included watermen, scientists, environmentalists, recreational fishers, and the seafood eating public. Oyster retailers, processors, and distributors were included in a subsequent distribution.

The second survey, distributed in 2007, was designed specifically to serve three functions. First, we wanted to obtain additional descriptive information about our stakeholder groups to strengthen our understanding of who they are. Second, we wanted to refine and test the cultural models we constructed. Third, we wanted to test the existence and distribution of hypothesized impacts for each restoration alternative. Survey questions were written to achieve these three objectives and employed a variety of scales (binary or yes/no, and rating levels of importance, etc.). Since stakeholder groups will be differentially impacted by the proposed restoration action(s), we wrote distinct surveys for each group to extract information on the impacts specific to them. However, all surveys also included a set of common questions that we used to investigate the presence of cultural models. We targeted the same stakeholders as we had for the first survey, but added oyster growers as an additional group. We also redefined our sampling strategy for the second survey (see Appendix 1).

We consider each of these groups to have a vested interest in oyster restoration. Watermen, growers, processors/distributors, and restaurant owners all draw some amount of income or revenue from the sale of oysters. Recreational users access the Chesapeake for pleasure or enjoyment. Recreational use could be impacted by oyster restoration (i.e. if water quality improves, more

recreational users will visit the Bay) and recreational users increasingly have a strong voice in Bay politics. Scientists dedicate significant portions of their careers to studying oysters and/or Bay ecology, plus the information they produce is used to determine policy. Environmentalists are often directly involved in restoration projects, lobbying for restoration policies they support, or otherwise taking actions that affect oyster populations. Further, environmentalists also have a powerful political voice.

Table 3.1 Survey Sample I

	Population Targeted	Sampled	Resultant Sample	Response Rate
Watermen	MD = 284 VA = 180	MD = 284 VA = 180	MD = 55 VA = 36 Total = 91	MD = 19% VA = 20% Both = 19%
Recreational Fishers	46,693	MD = 300 VA = 300	MD = 68 VA = 73 Total = 141	MD = 23% VA = 24% Both = 24%
Environmentalists	CBF = 175 TOGA = 300	CBF = 175 TOGA = 300	CBF = 19 TOGA = 15	CBF = 11% TOGA = 5%
Scientists	124	124	33	26%
Seafood Consumers	Seafood Festival Attendees	Unknown	123	Unknown
Industry	MD = 25 VA = 156	MD = 25 VA = 156	MD = 11 VA = 53 Total = 64	MD = 44% VA = 34% Both = 35%
Total for All		1844	484	26%

CBF= Chesapeake Bay Foundation; TOGA= Tidewater Oyster Gardeners Association

Political figures, people working on regulatory issues related to oyster restoration, owners of Bayside property, tax payers, and employees of oyster processing facilities comprise additional stakeholder groups that we did not have the resources (time) to target. For each of the seven groups, we pursued parallel lines of inquiry in both Maryland and Virginia. We felt that separating the states conceptually

and methodologically allowed us to obtain a more holistic and accurate understanding of the variability within the Chesapeake region. In description and analysis, we explore the relevance of state residence, income differences, ethnicity, and gender for all study groups where relevant differences occur.

Table 3.2 Survey Sample II

	Sample Targeted	Distribution Failures*	Viable Sample	Resultant Sample	Response Rate
Watermen	MD = 1038 VA = 493	MD = 16 (M), 27 (N/A) VA = 6 (M), 1 (N/A)	MD = 995 VA = 486	MD = 266 VA = 111 Total = 377	MD = 27% VA = 23% Both = 25%
Recreational Fishers	MD = 250 VA = 250	MD = 32 (M) VA = 38 (M)	MD = 218 VA = 212	MD = 85 VA = 66 Total = 151	MD = 39% VA = 31% Both = 36%
Environmentalists	44 Organizations		44 Organizations	43	Unknown
Scientists	84	6 (M)	78	30	38%
Restaurant Owners	MD = 50 VA = 13	MD = 2 (M), 1 (N/A) VA = 2 (M)	MD = 47 VA = 11	MD = 10 VA = 6 Total = 16	MD = 21% VA = 55% Both = 28%
Oyster Growers	MD = 17 VA = 110	MD = 1 (M), 4 (N/A) VA = 2 (M), 13 (N/A)	MD = 12 VA = 95	MD = 7 VA = 22 Total = 29	MD = 58% VA = 23% Both = 27%
Oyster Processors & Shippers	MD = 120 VA = 41	MD = 2 (M), 24 (N/A) VA = 1 (M)	MD = 94 VA = 40	MD = 30 VA = 9 Total = 39	MD = 32% VA = 23% Both = 29%

* (M) Mailing Problems, (N/A) Not Oystering, Processing, Selling, Distributing, or Growing Oysters

Sample Characteristics Relevant to Oystering

We include here additional socio-demographic and economic background information for the study groups. This information complements the fishery-level information presented in section 2. It differs in that 1) it comes mainly from our 2007 survey and 2) the results are relevant for

understanding the following cultural model of oyster restoration and the responses by stakeholder groups about the impacts of the EIS action and alternatives.

Watermen:

The watermen who responded to our 2007 survey averaged about 51 years of age (Figure 3.1). On average, these watermen have "worked the water" commercially for about 30 years (Figure 3.2).

Figure 3.1 Ages of Commercial Watermen

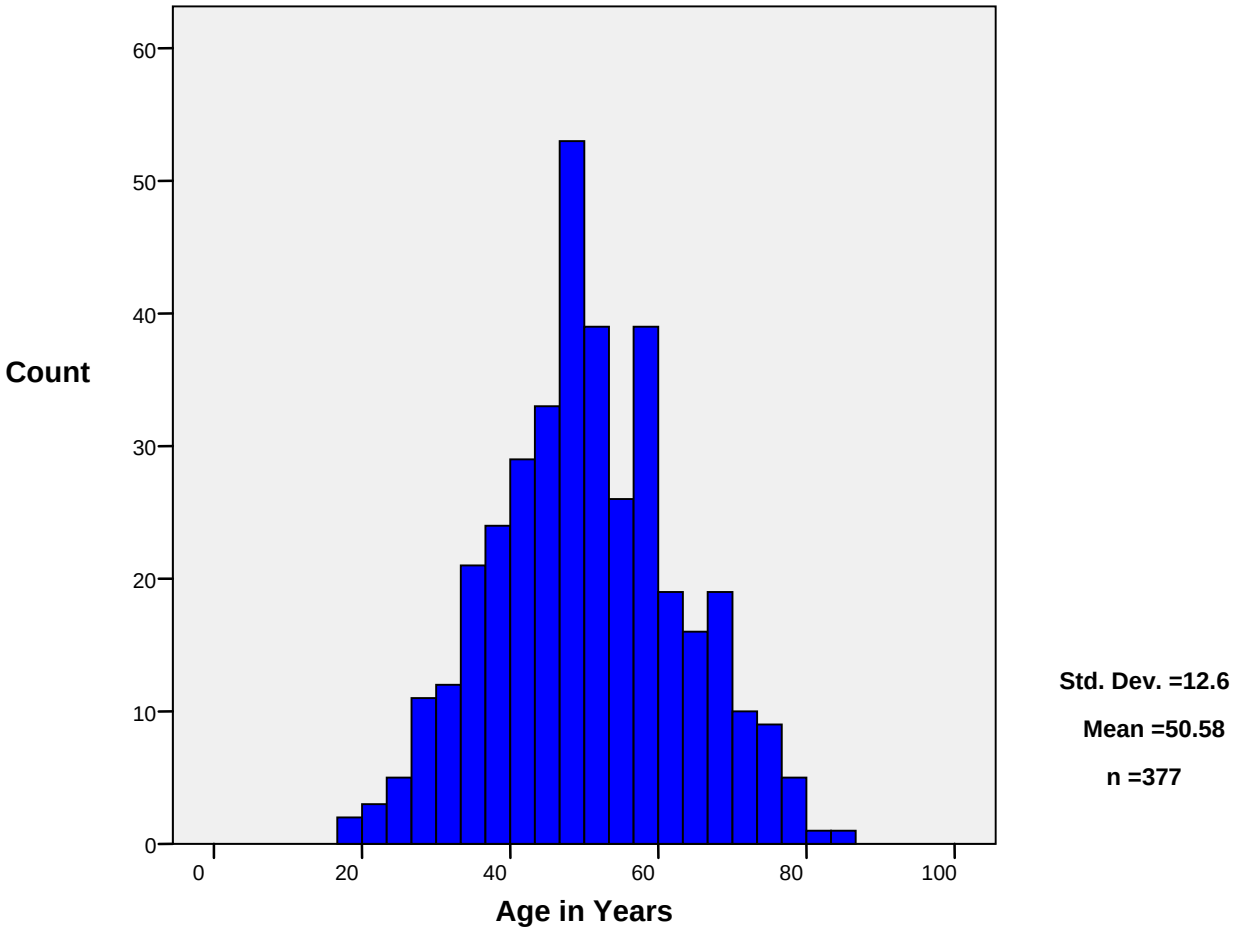
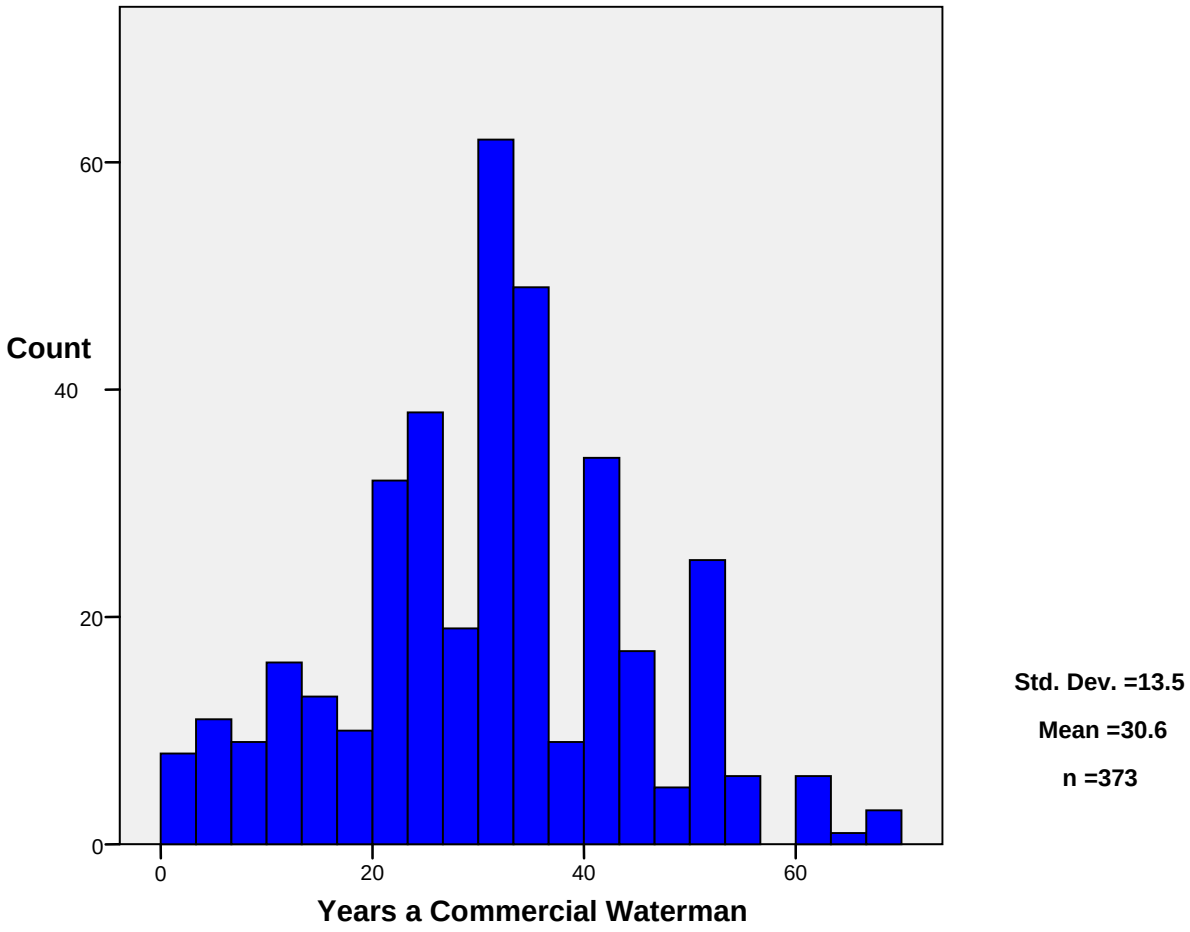


Figure 3.2 Number of Years a Commercial Waterman



There is no significant difference in age or years working as a commercial waterman depending on their state of residence. Close to 76% of these watermen reported that they harvested oysters during the 2006 season (Table 3.3).

Table 3.3 Watermen Harvesting Oysters Last Season

	Count	Percent
Yes	285	75.8
No	91	24.2
Total	376	100.0

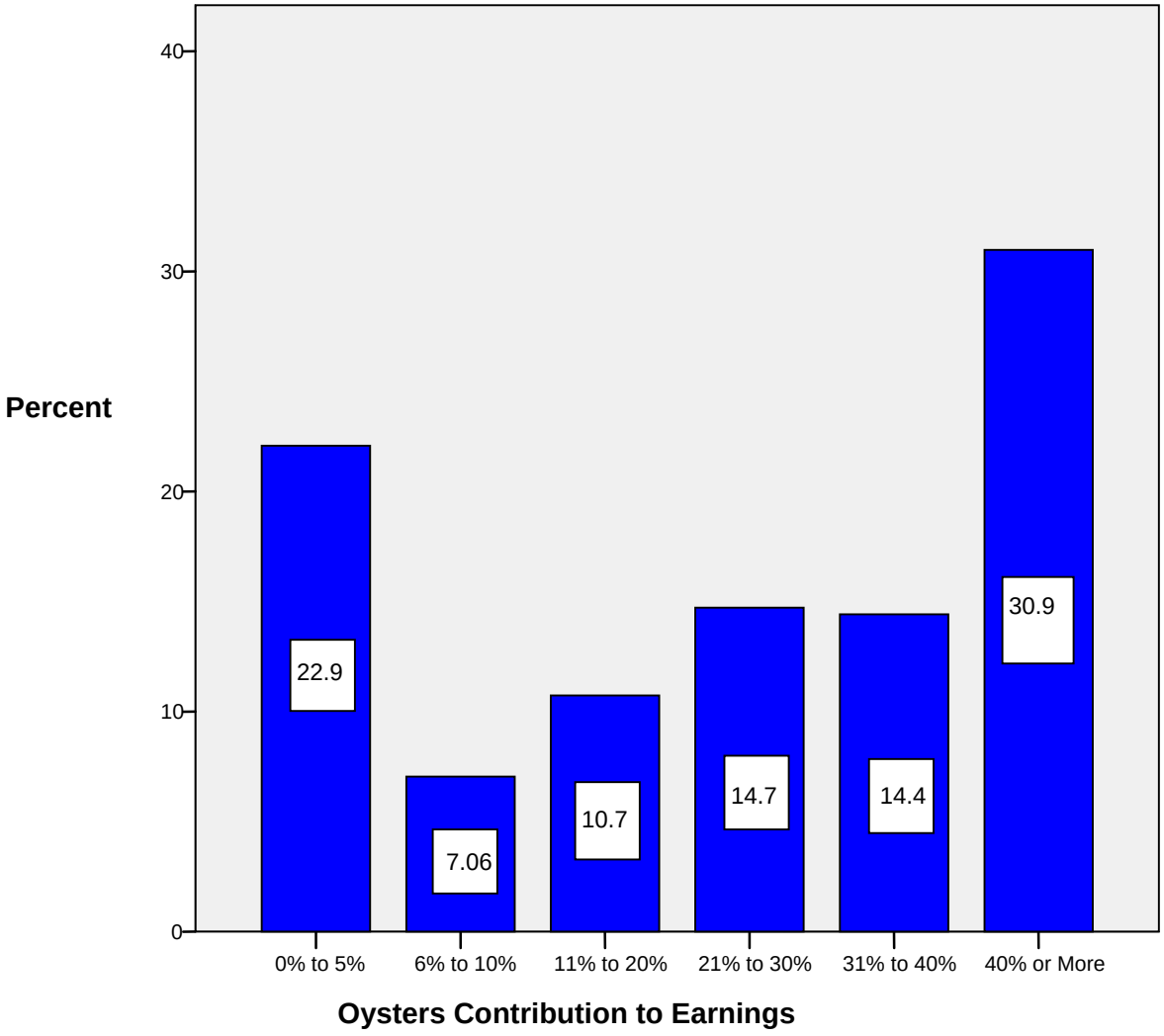
Approximately 66% of these watermen reported oystering between 4 and 5 days per week for the 2006 season, and another 23 percent oystered an average of 3 days per week last season (Table 3.4).

Table 3.4 Average Number of Days Watermen Oyster per Week

Days per Week	Count	%
1 Day a Week	9	3.2%
2 Days a Week	22	7.8%
3 Days a Week	65	23%
4 to 5 Days a Week	186	66%
Total	282	100%

For watermen who harvested oysters last season, their daily harvest was a median of 10 bushels. The contribution of this harvest to their commercial income varied. About 30% of the watermen who harvested oysters last season reported that oyster income represented less than 10% of their commercial fishing income. Approximately 25% of watermen who harvested oysters last year reported between 11% and 30% contribution to their commercial fishing income. Finally, about 45% of watermen reported a 31% or higher contribution from oysters to their commercial income (Figure 3.3).

Figure 3.3 Percent Contribution of Oyster Harvest (2005-2006) to Watermen's Commercial Fishing Earnings



In response to a survey question about what watermen would do if oyster harvests do not improve, almost 24% (n=76) responded that they would stop oystering next season (2007). Conversely, approximately 60% (n=192) of watermen responded they would continue harvesting indefinitely despite no improvement in the number of oysters available to harvest (Table 3.5). Of the watermen who would stop harvesting in the 2007 season, 55% (n=42) earn only between 0 and 10% of their fishing income from oystering. Of the watermen who would continue harvesting oysters indefinitely, almost 38% (n=72) reported earning 40% or more of their fishing income from oystering (Table 3.5). These findings suggest that those earning the least amount from oystering are those most likely to leave the fishery if harvests do not improve, and vice versa. There were no significant differences in age or years experience by whether a watermen would leave the fishery next season, within 5 years or would continue indefinitely.

Table 3.5 Watermen Harvest Responses if Harvests Do Not Improve by Oyster Harvest Contribution to Earnings

Harvest Response		Contribution of Oysters to Earnings				
		0 to 10%	11 to 30%	31 to 40%	40% or more	Total
Stop Harvesting Next Season	# Watermen	42	20	4	10	76
	% Watermen	55.3%	26.3%	5.3%	13.2%	100.0%
	% of Total	13.4%	6.4%	1.3%	3.2%	24.3%
Stop Harvesting In Next 5 Years	# Watermen	12	9	6	18	45
	% Watermen	26.7%	20.0%	13.3%	40.0%	100.0%
	% of Total	3.8%	2.9%	1.9%	5.8%	14.4%
Would Not Stop Harvesting	# Watermen	31	52	37	72	192
	% Watermen	16.1%	27.1%	19.3%	37.5%	100.0%
	% of Total	9.9%	16.6%	11.8%	23.0%	61.3%
Total	# Watermen	85	81	47	100	313
	% of Total	27.2%	25.9%	15.0%	31.9%	100.0%

Growers: All growers who responded to our 2007 survey have grown oysters in the past three years, at a variety of scales. The growers participating also reflect the state variations that exist within oyster aquaculture in the Chesapeake, with 76% of respondents growing in Virginia and 24% in Maryland. Like other direct users of oysters, the population of growers includes many individuals in the older age ranges (45% of 2007 respondents were 56 years old or older). Unlike watermen and industry members, most growers (unless they are also processors) likely did not inherit their businesses from previous generations of family.

Approximately 30% have owned or operated their businesses for five years or less, while another 38% have been in business for more than 16 years (Table 3.6). We believe the long-term business owners have diversified operations, either in processing (all but one of the long-term growers are serving the shucked market), in growing other types of shellfish (e.g. clams), or in selling seafood. Most respondents' (82%) growing operations support one full-time job or less and a majority (78%) are supporting three or fewer part-time positions. They are engaging in aquaculture part-time and relying primarily their own labor, which is consistent with the broader population of growers as mentioned above. Unlike industry members, many growers do not depend completely on income earned from oyster production.

Table 3.6 Length of Time Owned Aquaculture Business

	Frequency	Valid Percent	Cumulative Percent
0-5 Years	7	29.2	29.2
6-10 Years	5	20.8	50.0
11-15 Years	3	12.5	62.5
16 Years or More	9	37.5	100.0
Total	24	100.0	
Not Reported	5		
Total	29		

Our survey revealed interesting differences between the markets that growers in Maryland and Virginia are targeting (see Table 3.7). Approximately 50% of the growers in Virginia and 43% in Maryland are selling to the half-shell market, as we expected, but a majority of Marylanders (57%) and 28% of Virginians are serving other markets. Such markets include direct retail via the internet and on-site sales, as well as sales to restaurants.

Table 3.7 Markets in Which the Majority of Respondents' Oysters Were Sold In Over the Past Three Years

		Market Where Oysters Sold			
		Shucked Oyster Market	Half-shell Oyster Market	Other	Total
Maryland	Count	0	3	4	7
	% within State of Business	.0%	42.9%	57.1%	100.0%
Virginia	Count	4	9	5	18
	% within State of Business	22.2%	50.0%	27.8%	100.0%
Total	Count	4	12	9	25
	% within State of Business	16.0%	48.0%	36.0%	100.0%

There are some (22%) growers targeting the shucked market in Virginia (these are likely integrated operations), but none are doing so in Maryland. The half-shell market generally yields a higher per-unit price than the shucked market. However, certain oyster characteristics are favored by the different markets; the half-shell market prefers plump oysters that adhere to a particular aesthetic (e.g. shape and flavor), while the shucked market prefers oysters with shells that can be pried open easily and quickly. Growers targeting these different sales outlets obviously attempt to grow oysters with the characteristics that are demanded by the market(s) they serve. Growers' dependence on oysters varies depending on the size and nature of their operations, the degree to which they are diversified or vertically integrated, and the markets they target.

Processors and Shippers: There is a significant amount of diversity in the processing, shipping, and sales sector of the oyster industry. Businesses vary in their involvement in different economic activities, which can include wild harvesting, aquaculture, processing, and selling oysters in a number of settings (wholesale, retail, via the internet, etc.) to different markets (e.g. shucked, half-shell). There is not only diversity, but also vertical integration within the industry. Some processors also grow

oysters to supply their processing facilities (26% of 2007 sample reported engagement in aquaculture). Processing can include shucking, freezing, packing, adding value such as breading oyster products, etc. Processing houses report purchasing oysters from both wild harvesters and aquaculturalists, from both within and outside of the Chesapeake region (Dery and Paolisso 2006). Oyster processors and shippers also reported participating in activities as diverse as operating restaurants and running commercial shellfish seed nurseries (Dery and Paolisso 2006).

It is important to note that our sample (2007 survey) of oyster processors and shippers in Maryland is broader in coverage than in Virginia, since Virginia firms are licensed with a specific oyster processing designation (see Appendix 1). In Maryland, firms that do not process but repack, ship, or reship oysters are also included; thus, we received responses from 30 Maryland businesses and 9 Virginia businesses. Although our industry sample is purposive and relatively small, we feel the results are robust since the members included will be those impacted by restoration action.

Oyster processors and shippers, like watermen and growers, are a relatively older population; 41% of our respondents were in the 46-55 year old range and 39% were 56 years or older. Many of them have owned or operated their businesses for longer than 10 years (Table 3.8) and have an established presence in their respective communities. Oyster processors and shippers we spoke with talked about their personal connections to the native oyster and to the oyster industry, which often includes multi-generational family businesses. They are well aware of the potential that successful oyster restoration has for alleviating threats to their livelihoods.

Table 3.8 Length of Time Business Owned

	Frequency	Valid Percent	Cumulative Percent
0-5 Years	6	15.8	15.8
6-10 Years	5	13.2	28.9
11-15 Years	5	13.2	42.1
16-20 Years	5	13.2	55.3
25+ Years	17	44.7	100.0
Total	38	100.0	

The degree to which oyster processors and shippers will be impacted by restoration choices is tied to their dependence on oysters within their overall business strategies. Many processing houses deal in crabs, clams, or other species as well as oysters. Since Chesapeake oyster harvests have been low in recent decades, imported oysters are increasingly present in the region's seafood operations. The impacts of restoration, then, are also related to the degree of processor reliance on locally sourced oysters. Businesses with a heavy reliance on local oysters will be impacted more severely by restoration success or failure than businesses that are less dependent on Bay oysters.

Table 3.9 Oysters - Percentage of Shellstock Handled

	Frequency	Valid Percent	Cumulative Percent
Approximately 25% of Shellstock Handled	13	33.3	33.3
Approximately 50% of Shellstock Handled	2	5.1	38.5
Approximately 75% of Shellstock Handled	9	23.1	61.5
All (100% of Shellstock Handled)	15	38.5	100.0
Total	39	100.0	

The majority of our respondents reported both a heavy reliance on oysters as a species (75% or more shellstock handled) (Table 3.9) and on Chesapeake sourced oysters (more than 50% of oysters

handled) (Table 3.10). This suggests the processing and shipping stakeholders will be significantly affected by restoration action(s).

Table 3.10 Percentage of Oysters Handled from the Chesapeake Bay

	Frequency	Valid Percent	Cumulative Percent
0%	2	5.0	5.0
1% to 10%	3	7.5	12.5
11% to 25%	3	7.5	20.0
26% to 50%	6	15.0	35.0
51% to 75%	9	22.5	57.5
76% or more	17	42.5	100.0
Total	40	100.0	

Scientists and Environmentalists: Scientists and environmentalists are distinctive stakeholders since they do not directly depend on the oyster resource for income or to support their livelihood (e.g. watermen, growers, and industry), but they do indirectly depend on oysters since they receive support for their work, which is focused on oysters. The number of scientists whose work is focused entirely on oysters is relatively small, and most environmental organizations focus on oysters only as a component of their more comprehensive efforts. These groups are also much more intimately involved with oysters than recreational users, seafood consumers, or other groups. In many ways, the scientists who work on oyster issues are key stakeholders; they produce the information that restoration and harvest policies are based upon, they spend an enormous amount of time (sometimes decades of their careers) studying oysters, and they have an important role in society as producers of policy-relevant knowledge.

Our investigations confirm that scientists posses a higher degree of knowledge about oysters, the environment in which they live, and the threats to their survival than most other groups. Non-scientists look to scientists and the science they produce to provide answers to questions about the

natural world and how it operates (in this case, understanding oyster population declines, disease, the potential for various restoration strategies to achieve population increases, etc.). Scientists are often more aware than non-scientists of the limitations in the scientific method for providing those answers and of the time required to build thorough scientific understanding of complex systems. Scientists also have a stake in the EIS process in that they are supported to conduct their research by that process. Over $10 million in public funds have been expended on 40 research projects of varying scales to increase our knowledge of both *C. virginica* and *C. ariakensis* and to aid decision making (DNR 2006c).

Environmentalists have a different kind of relationship to oyster restoration. They are not dependent on oysters for income, but they are involved in oyster restoration activities (this can include the provision of financial support for restoration programs or campaign efforts, volunteering to participate in restoration activities, and political activism on behalf of restoration). Environmentalists can have a powerful voice in the discussion about oyster restoration, especially if they spark the interest of populations that are not generally involved in oyster issues (e.g. urban citizens who are not recreational or commercial users of the Bay). One of the Bay region's most prominent environmental organizations, the Chesapeake Bay Foundation (CBF), has been instrumental in oyster restoration by raising awareness and operating a restoration program of its own. CBF supports citizen oyster growing programs, spat production at its Oyster Restoration Center in Discovery Village, and the operation of an oyster restoration vessel, the *Patricia Campbell*, used in plantings (CBF 2007).

The scientists that responded to our survey range in age from 33 years to 64 years of age, with a mean of 49 years. The vast majority (90%) holds PhDs and they've worked on Chesapeake Bay issues for a mean of 14 years. The environmentalists that responded to our survey ranged in age from 26 years to 84 years of age, with a mean of 53 years. They have been working for or volunteering for environmental groups for a mean of 5 years.

Recreational Fishers and Seafood Consumers: In an effort to capture potential impacts of restoration on the public in a manageable way, we targeted two specific groups, recreational fishers and seafood consumers. In the 2007 survey, we included restaurant owners (experts) who we felt could accurately characterize their customers' habits. We chose these sub-groups for two reasons: first, we feel they are some of the most knowledgeable members of the general public, and second, they definitely have some level of interaction with the Bay, either through fishing or seafood consumption. When appropriate, we have presented aggregate responses for these groups (both restaurant owners and recreational fishers) and labeled them recreational users (there are a total of 16 restaurant owners and 151 recreational fishers in our sample; see Table 3.2).

There are a large number of recreational fishers in both states. National Marine Fisheries Service estimates for 2005 suggest there were approximately 1,064,687 people fishing recreationally in Maryland and 1,054,889 in Virginia (excluding freshwater fishing in both states) (2006b). Since they are numerous, recreational fishers are a relatively powerful political group, and there is a history of conflicts occurring between the recreational and commercial fisheries (e.g. Jensen 1996). The recreational fishers in the 2007 survey range in age from 19 years to 90 years, with a mean of 55 years. The vast majority (98%) are male and more than half (55%) fish in the Chesapeake Bay more than 10 times a year. Recreational fishers are widely distributed across all areas of both states (56% of our respondents are from Maryland and 44% from Virginia), and some drive a couple of hours to reach the Bay. Others live near Chesapeake waters and can access them easily.

All owners in the survey serve oysters in their restaurants, and a majority (63%) is dependent on oysters for 1-10% of their seafood sales (Table 3.11). On average, these restaurants have been in business for an average of 10 years and 88% of them are sourcing oysters from the Chesapeake Bay. It makes sense that these restaurants are sourcing locally when they can, provided prices are acceptable.

Although the supply may be less reliable (i.e., wholesalers that import from a number of different regions can guarantee a constant supply), the quality and freshness of Chesapeake oysters are an asset.

Table 3.11 Percentage of Dishes with Oysters

	Frequency	Valid Percent	Cumulative Percent
1% to 5%	6	37.5	37.5
6% to 10%	4	25.0	62.5
26% to 40%	5	31.3	93.8
More than 40%	1	6.3	100.0
Total	16	100.0	

4. Cultural Model: Oyster Restoration to Accomplish Multiple Goals

A fundamental premise of our EIS research on Chesapeake Bay oyster restoration is that oysters provide significant cultural meaning and value to Chesapeake Bay stakeholder groups, and that oyster restoration will affect, and be affected by, this cultural meaning and value. We have argued that this is true for stakeholders who have a direct, working relationship with oysters, such as watermen, growers and processors, those who study and manage oysters, and those who fish recreationally or consume seafood (Paolisso, Herman and Dery 2005).

In this section, we draw on qualitative and quantitative information to suggest that the study's stakeholder groups share a generalized cultural model of oyster restoration. The specific components or schemas of this model and their connections were first identified from our interviews, the 2004 survey, review of published information on oysters and restoration, and from our participation and observation with the study's stakeholder groups, including our experiences as participants in the EIS process. Finally, in the 2007 survey we asked a number of questions about oysters as a resource and the factors and benefits of oyster restoration, and we tested the stakeholder agreement with these questions using cultural consensus analysis. The use of these different data sets and approaches to elicit a cultural model of oyster restoration is described in more detail below.

Oyster Restoration and Multiple Goals

Our first task in building the cultural model of "Oysters Restoration to Accomplish Multiple Goals," presented in Figure 4.1, was to identify specific components or schemas that would add specificity to the general proposition that oyster restoration must meet multiple benefits, including ecological, economic and cultural. It is this ethnographic specificity that adds analytical value, since the statement that oyster restoration must meet multiple needs or produce multiple benefits appears

rather obvious and perhaps even trivial. However, what we believe is significant, and to a degree implicit and tacit about this cultural model, is not that it includes well-known oyster restoration benefits of ecology, economy and culture, or that it includes well-known factors or requirements such as policy, science and recognition of natural cycles, but that these factors and benefits are understood by all stakeholders as an integrated whole, if oyster restoration is to be successful. Ethnographically, our understanding is that you can increase oysters, perhaps in aquaculture or on managed reserves and sanctuaries, but that is not the cultural conception that stakeholders across our study groups have of successful oyster restoration in the Chesapeake. Rather, oyster restoration should result in benefits in terms of ecology, economics and culture, and it will take science, policies and recognition that nature will have its management role, too. We present below our qualitative and survey data in support of this subtle yet powerful cultural understanding of oyster restoration as more than just an increase in oysters, but rather an increase that simultaneously accomplishes multiple goals.

Respondents across the study's stakeholder groups told us in many specific ways that oysters provide ecological, economic and cultural benefits (Paolisso, Herman and Dery 2006; Dery and Paolisso 2006). Consistently, respondents told us that oysters provide ecological benefits, which of course is a primary reason for the proposed action and alternatives being evaluated by this EIS. In the 2004 survey, we asked respondents to rate their agreement with the statement, "The primary goal of restoration should be to have a self-sustaining population of oysters that will improve the ecology of the Bay." There was very strong agreement with this statement by all stakeholders surveyed. Combining the response for all stakeholder groups (e.g., public, scientists, environmentalists, recreational fishers, and watermen), 93% of respondents agreed with this statement (Paolisso, Herman and Dery 2006).

In the 2007 survey we asked, "Is maintaining the oyster's role in a functioning ecosystem an important goal?" For all study groups combined, 97% of respondents felt that maintaining the oyster's

ecosystem role was an important restoration goal. We also asked in the 2007 survey, "Is maintaining the oyster's role in helping to clean up the marine environment an important goal?" Similarly, 96% of all respondents believed that maintaining the oyster's role in cleaning the marine environment was an important goal.

Qualitative data further support this view. In interviews, we were regularly told that "there will be ecological improvements to the bottom as oysters increase." Respondents across stakeholder groups recognized the value of oysters as reef builders and filters of water. As one respondent noted, "Look, the thinking is that clear water is good. Clear water is a minor benefit. Oysters are much more important as a reef builder. But I think if we got enough out there, both water clarity and reefs would be built." Respondents saw the local environmental or ecological benefits of oyster restoration: "In some cases seed plantings have created local positive ecological effects, which in turn has led to increased crabbing and localized spat set." Another respondent noted that oysters are "…crucial to the health of the Bay. We cannot define the Bay as healthy without an oyster population. It is the single most important factor."

In the 2004 survey, we also asked respondents to rate their agreement with the statement, "The primary goal of restoration should be to have a self-sustaining population of oysters large enough to support a commercial industry that includes watermen." As was the case with the statement about ecological and environmental benefits, respondents were overall in agreement with this statement as well (approximately 80% agreed) (Paolisso, Herman and Dery 2006). In the 2007 survey, we asked, "Is economic support to harvesters, coastal communities, and local economies an important goal of oyster restoration?" Across our study groups, 82% of respondents viewed economic support to harvesters, coastal communities and local economies as an important goal of successful oyster restoration. Our interview data also confirmed the survey findings on economic benefits. Respondents reported, "Restoration has kept hope alive in the fishery community," and "There would be an

economic benefit [of oyster restoration]. There used to be 80-100 oystermen around here. It would be great to put people back to work."

Finally, in the first-phase of the study, we also inquired about the cultural benefits of oysters. In the 2004 survey, we asked respondents to rate their agreement with the statement, "A key consideration for oyster restoration is the native oyster's place in the Bay's cultural history." About 64% of our respondents agreed with this statement. This percentage of agreement is lower than what was reported for ecological and economic benefits. We believe that part of this lower agreement may be due to some ambiguity among respondents as to what exactly "cultural history" means; we may have found stronger support for cultural benefits if we had asked questions focused on community and heritage.

We reworded our question in the 2007 survey asking, "Is maintaining the value of oysters as part of our history and heritage an important goal of oyster restoration?" Across study groups, 87% of respondents believed that maintaining oysters as part of our history and heritage is an important goal of restoration. We also found support for the history and heritage benefits in qualitative statements made during interviews, such as "The benefits of [oyster] restoration for communities are that they get activated." We also heard, "Restoration has kept alive a historically valued part of the culture in MD and to a lesser degree, in VA," and, "Restoration has created aesthetic value for the Bay."

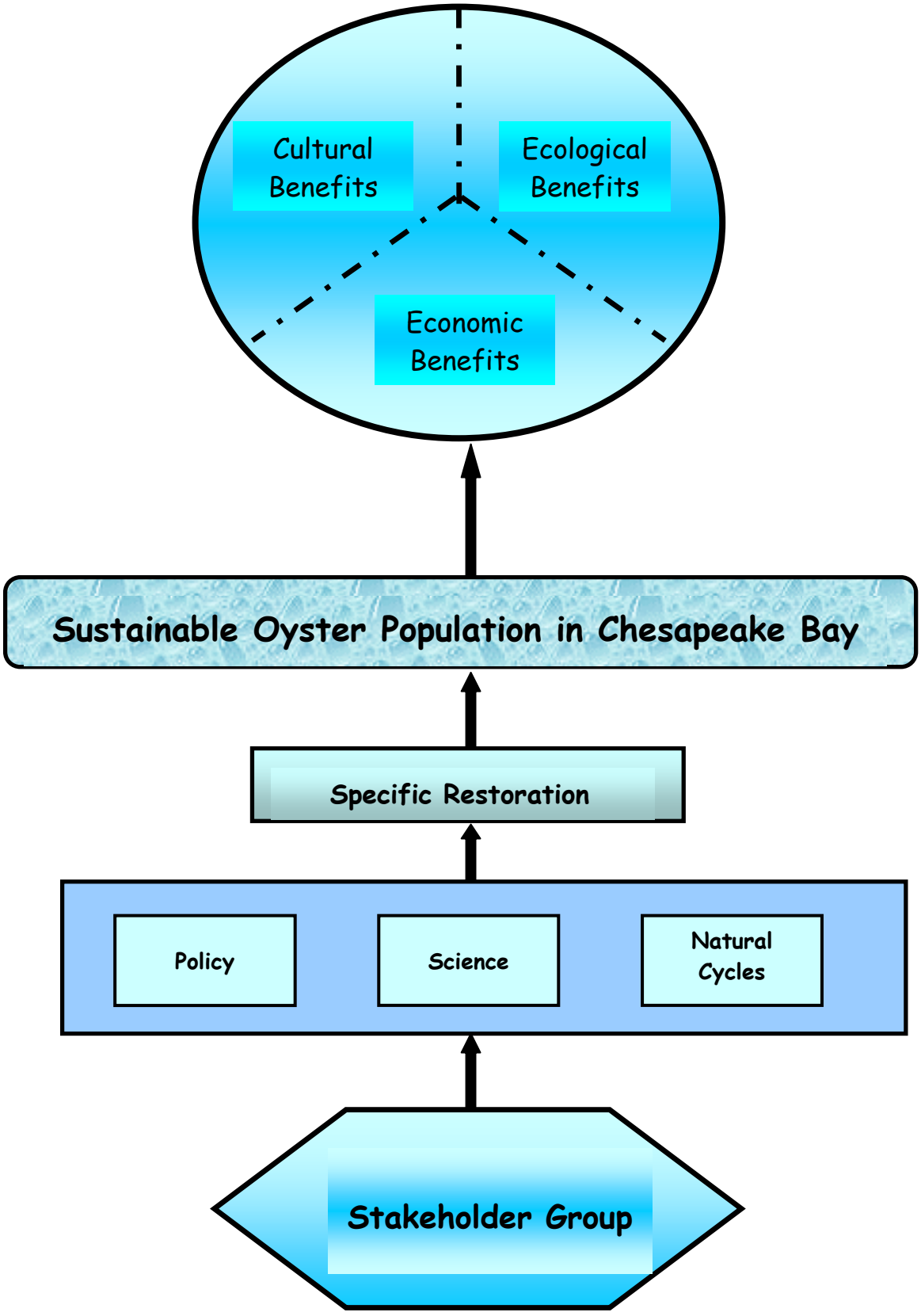
We represent respondents' views of the ecological, economic and cultural benefits of oyster restoration in the cultural model with a circle divided by dotted lines into three equal parts (Figure 5.1). We elected to leave the parts equal in size and the line dotted in order to convey that these benefits are inter-dependent. The cultural model in Figure 4.1 includes the schema "Sustainable Oyster Population in the Chesapeake Bay." A "sustainable oyster population" is one that can survive and reproduce under current and future conditions in the Chesapeake Bay. Included in our stakeholders'

understanding of sustainable oyster population is the tacit view of an oyster population that "naturally" reproduces and survives.

The cultural model links "sustainable oyster population" to specific restoration actions. Among our respondents, there is generalized agreement on the need for restoration action to accomplish a sustainable population of oysters. We did not encounter, with any stakeholder group, the belief that a sustainable oyster population is achievable without restoration assistance, at least for the foreseeable future. Thus, views of oysters as a resource are tied to ideas about restoration.

The EIS is evaluating a restoration action to introduce a non-native oyster and continue with restoration of the native oyster. Only a very few of the stakeholders interviewed or surveyed knew this specific information. Most respondents, especially among stakeholders who do not directly work with oysters, have little detailed information on oyster restoration actions. Instead, ethnographic insights from interviews suggest a schema for "specific restoration action" as any public-funded, science-based action that increases oyster populations. Surveys reveal that 85% of the study's stakeholders strongly support the use of public funding of oyster restoration.

Figure 4.1 Oyster Restoration to Accomplish Multiple Goals


Cultural Benefits
Ecological Benefits
Economic Benefits
Sustainable Oyster Population in Chesapeake Bay
Specific Restoration
Policy
Science
Natural Cycles
Stakeholder Group

As shown in Figure 4.1, the cultural model of oysters to accomplish multiple goals includes specific restoration actions that are needed for a sustainable oyster population. Informants told us that the key factors or inputs that would lead to successful oyster restoration fall into the general domains of policy, science, natural cycles, and market forces. We found little disagreement with the position that oyster restoration will require government action, given the low population levels, the difficulty of the problem, and the importance of the species to the Bay. In the 2007 survey, we asked, "Does successful oyster restoration need to include regulations and policies that protect the oyster as an ecological, economic and social resource?" Support for regulations and policies was found across all study groups, with 83% of informants responding "yes" to this question.

While respondents might disagree on exactly what policies should be implemented, they are in strong agreement on the need for policies that promote and protect the oyster. We heard informants tell us, for example, "I am not a pro-government guy, but yes, [oyster restoration] will improve water quality, enhance the Bay, and the well-being of people. It's an investment and it will be paid back." Another respondent said, "We need to manage without political power issues. All users need to resolve their issues. The states should be responsible for managing." In our 2004 survey, 82% all respondents agreed, for example, with the statement, "Managed oyster sanctuaries and reserves should be a larger part of the oyster fishery in the future" (Paolisso, Herman and Dery 2006).

Respondents were also clear about the important role of science in guiding restoration. We heard, "Science should be determining what the high priority research topics should be, what science should be conducted. Research may lead to the need for more research." In our 2004 survey, 73% of all respondents agreed with the statement, "Scientific findings will reduce concerns about the negative consequences of using the non-native oyster for restoration." In the 2007 survey, we asked, "Does successful oyster restoration need to include scientific information about oyster biology and ecology?"

Approximately 84% of all 2007 survey respondents believe that restoration needs to be guided by scientific information on oyster biology and ecology.

There was also widespread recognition among all stakeholder groups that there are certain unpredictable cycles, events and new inter-relationships in nature that affect the availability and distribution of natural resources. All groups accept that there is a great deal of uncertainty in the natural and ecosystem processes that affect oysters and attempts to restore oysters. In the 2007 survey, we asked, "Does successful oyster restoration need to include attention to changes in oyster populations caused by natural cycles?" Respondent support for this statement was 88% across the study groups.

We used these views and statements to build the component of the model that represents the mix of inputs needed for restoration.

Cultural Consensus Test of "Oyster Restoration to Accomplish Multiple Goals"

To explore the presence of shared, underlying cultural knowledge for the proposed model, we use cultural consensus. Cultural consensus theory formalizes the insight that agreement often reflects shared knowledge, and "that agreement among respondents is a function of the extent to which each knows the culturally defined "'truth'" (Kempton et al. 1995: 189). Practically speaking, the use of consensus analysis allows us to analyze survey responses as a group, rather than on a question by question basis. Second, the approach has established guidelines for deciding whether there is sufficient agreement to suggest the presence of a shared, underlying system of knowledge. Third, in cases where there is cultural consensus, qualitative data can be used to interpret what the underlying shared knowledge might be. (See section 3 for more background details on cultural consensus approach.)

To test for cultural consensus within and between stakeholder groups, we used responses to 20 questions in our 2007 survey about oyster restoration. Responses were binary, yes or no. They cover a

range of topics, including general questions about native oyster restoration and non-native oyster introduction, the factors and benefits of restoration, and some value questions related to the oyster fishery and oysters as food.

We found cultural consensus within each stakeholder group, and when across all groups combined. Results of the consensus analysis are presented in Table 4.1 for each of the seven groups individually and combined. The significant results in terms of testing the strength of the shared knowledge underlying responses to the questions based on the cultural model of "oysters as resource" are the 1st to 2nd Eigen value ratios.

Table 4.1 Cultural Consensus Results for Questions about Oyster as a Resource

		1st Factor Loading		Eigen value Ratio	
Stakeholder Group	**N**	**Mean**	**S.D**	**1st to 2nd**	**2nd to 3rd**
Combined	645	.70	.16	6.09	1.76
Watermen	377	.72	.16	10.11	1.18
Growers	29	.73	.10	3.85	3.16
Processors & Shippers	39	.76	.14	9.56	1.12
Scientists	30	.74	.16	4.64	2.68
Environmentalists	43	.77	.14	6.05	2.33
Recreational Users	151	.73	.09	5.49	1.78
Restaurant Owners	16	.75	.20	7.09	1.48

As noted in section 3, the Eigen values for these ratios over 3.0 are widely considered high enough to suggest that there is consensus among respondents on the correct responses to the questions, and

consensus theory suggests that consensus is based upon a system of shared, underlying knowledge and values.

Applied to our cultural model of "Oyster Restoration to Accomplish Multiple Goals," the cultural consensus findings suggest that underlying stakeholders' cultural understanding of *oyster restoration to accomplish multiple goals* is a shared system of cultural knowledge and values. Included in that system of cultural knowledge are shared beliefs and values about the benefits and actions required if oysters are to be an ecological, economic and cultural resource. Also, because the cultural consensus analysis evaluates agreement across all questions, the findings further support results from interviews and specific survey questions that showed high support for ecological, economic and cultural significance of the oyster. Respondents did not report one benefit (ecological, economic or cultural) as unimportant. Restated, respondents place high value on the oyster's multiple benefits, which explains why this natural resource is so important to Chesapeake Bay stakeholders. Correspondingly, there is strong agreement that today's oysters in the Chesapeake Bay are not self-sustaining, given the environmental and harvest pressures, past and present. Thus, there needs to be science-based, policies and consideration of market factors and natural cycles.

Conclusions

The qualitative and quantitative information presented above supports the argument that stakeholders across study groups all value the ecological, economic and cultural benefits of oyster restoration. From a cultural model perspective, the results suggest that in thinking about oyster restoration, what is taken-for-granted, or more implicit than explicit, is that efforts to increase the number of oysters in the Bay should include benefits of an ecological, economic and cultural nature. If efforts through policies, science, and attention to natural cycles do not result in some "triple" benefit, then culturally, according to the model presented here, it is not successful oyster restoration. That is not to say that there cannot be increases in oysters, with ecological or economic or cultural benefits.

However, such independent benefits do not fit respondents' shared cultural model of oyster restoration for multiple benefits. We return in the conclusions to this report to explore the policy and applied significance of this cultural model of oyster restoration after a discussion of the socioeconomic impacts of the EIS action and alternatives.

5. Socioeconomic Impacts of EIS Restoration Strategies

The proposed action of the EIS is the introduction of the oyster *C. ariakensis*, first on designated sanctuaries and reserves, and the continuation of native restoration with *C. virginica* using the best available strategies. The EIS is also evaluating eight alternatives to the proposed action, which are listed again below:

1. No Action or continue current oyster restoration and repletion plans;
2. Expand and accelerate native oyster restoration plans;
3. Implement a temporary harvest moratorium and oyster industry compensation program;
4. Establish and/or expand State-assisted, managed and regulated aquaculture operations using the native oyster;
5. Establish State-assisted, managed, or regulated aquaculture operations using suitable triploid, non-native oyster species;
6. Introduce and propagate an alternative oyster species other than *C. ariakensis* or an alternative strain of *C. ariakensis*;
7. Introduce *C. ariakensis* and discontinue native oyster restoration efforts; and
8. Consider a combination of alternatives.

In our research on the socioeconomic consequences of the EIS action and eight alternatives, we quickly discovered that many of the potential impacts cut across a number of alternatives. For example, watermen responses to questions about expansion of aquaculture did not vary significantly for either the native or non-native oyster. In part this response pattern is due an understandable lack of specific understanding among many of our respondents (in all groups) of the potential economic and ecological implications of the EIS action and alternatives. For example, recreational fishers and restaurant owners do not possess detailed knowledge of different approaches to oyster restoration and aquaculture, so it is difficult for them to asses what might be the possible impacts of using two different oyster species for expansion of reserves, sanctuaries or aquaculture. Another example: scientists are very knowledgeable about the ecological factors related to action and alternatives, but have less detailed understanding of the economic effects of the different alternatives on harvesters, growers and processors, or recreational fishers (a diverse group). That is not to say that these stakeholder groups do not have culturally reasoned and often unambiguous cultural beliefs and values

about the action and alternatives, but only that their knowledge and values are most appropriately applied at a level that aggregates the EIS oyster restoration strategies in a way that is consistent with the extent of their existing knowledge.

Given that the study groups see similar impacts across subsets of alternatives, and due to their understandable lack of the details or specific of each alternative, we aggregate the EIS action and alternatives into the following oyster strategies:

1. introduction of a non-native oyster (*Crassostrea ariakensis)*, with and without continued native oyster restoration;
2. expansion of native oyster restoration;
3. expansion of aquaculture using native and non-native oysters; and
4. an oyster harvest moratorium.

We discuss each of these four oyster restoration strategies separately. Within each of these four discussions, we discuss the socioeconomic impacts on the study groups. For some of the study groups that are only indirectly or not at all dependent on oysters for their livelihood (e.g., scientists, environmentalists, recreational fishers), we discuss only those strategies for which a reasonably direct socioeconomic impact can be identified.

Introduce a non-native oyster (*C. ariakensis)*

Watermen: In the 2004 survey, 64% of the watermen believed that a non-native oyster should be introduced. Among our study groups, this is the largest percentage believing a non-native oyster should be introduced. This is also the group for whom the economic dependence on wild oysters is the greatest (see section 3b). Therefore, it is noteworthy that despite their direct economic needs for oysters, 36% of the watermen did not support introducing a non-native oyster at the present. The reasons for this lack of support relate to how such an introduction would be undertaken and belief that native oyster restoration can be more successful (see below).

In terms of introducing a non-native oyster, we asked watermen how they would change their oyster harvesting if a non-native oyster was introduced into reserves and sanctuaries and native restoration was stopped. Approximately 63% of watermen in Virginia and Maryland reported that such a restoration strategy would not result in either an increase or decrease in their current harvesting effort of oysters. Equal percentages (18%) of watermen reported that either they would go harvesting more or they would go less (Table 5.1). Watermen recognize that any harvests from reserves would be very limited and costly in terms fuel and time.

Table 5.1 How Oystering would Change if a Non-native Oyster is Introduced, Primarily in Sanctuaries and Reserves, and Native Restoration is Stopped

		Would Go Harvesting More	Would Go Harvesting Less	Would Go Harvesting Same Amount	Total
Maryland	Count	37	47	164	248
	% within State of Residence	14.9%	19.0%	66.1%	100.0%
Virginia	Count	27	19	59	105
	% within State of Residence	25.7%	18.1%	56.2%	100.0%
Total	Count	64	66	223	353
	% within State of Residence	18.1%	18.7%	63.2%	100.0%

We also asked watermen whether they would change their harvesting practices if a non-native oyster is introduced and native oyster restoration continues at its current levels. The responses in Table 5.2 are similar to watermen's responses to the introduction of a non-native oyster with the cessation of existing native oyster restoration actions (Table 5.1). Overall, about 71% of watermen do not see any benefit from this oyster restoration strategy that would lead them to change their current levels of harvest. About 26% of watermen would go harvesting more. Also, proportionally, more Virginia watermen would increase their oyster harvesting under this restoration strategy (with or

without continuation of native oyster restoration). It is noteworthy that, compared to the results in Table 5.1, fewer watermen would reduce harvesting if a non-native introduction does not result in stopping native oyster restoration. Overall, only about 3% of the watermen said that they would reduce their harvesting under the non-native introduction strategy that includes continued native oyster restoration (Table 5.2). When native oyster restoration is ended, an overall 19% of watermen report they would harvest less (Table 5.1).

Comparing the data in Table 5.1 and 5.2 suggests that 1) the introduction of the non-native oyster, primarily in sanctuaries and reserves, is not seen by watermen as a restoration strategy that would lead them to increase their harvesting effort, and 2) to help minimize any resulting reduction in harvesting, native oyster restoration efforts should continue along side any introduction of non-native oysters into reserves and sanctuaries.

Table 5.2 How Oystering would Change if a Non-native Oyster is Introduced, Primarily in Sanctuaries and Reserves, and Native Restoration Continues

		Would Go Harvesting More	Would Go Harvesting Less	Would Go Harvesting Same Amount	Total
Maryland	Count	59	10	180	249
	% within State of Residence	23.7%	4.0%	72.3%	100.0%
Virginia	Count	33	2	70	105
	% within State of Residence	31.4%	1.9%	66.7%	100.0%
Total	Count	92	12	250	354
	% within State of Residence	26.0%	3.4%	70.6%	100.0%

Growers: When asked (in the 2004 survey) if *C. ariakensis* should be introduced now, growers were almost equally divided in their responses: 48% said we should introduce now, and 52% said we should

not. Some of those who feel *C. virginica* cannot be restored may favor approaches that focus on preserving the native's current levels of existence (which are relatively low) and trying new approaches, such as an introduction of *C. ariakensis*.

In the 2007 survey, we asked growers whether their business would increase, decrease or not change as a result of introducing a non-native oyster and continuing native oyster restoration. Approximately 43% of growers reported no anticipated change in their growing operation as a result of the proposed action (Table 5.3). Growers are knowledgeable about oyster restoration and the science that it utilizes. It is likely that many growers are aware of the potentially long period of time that will be required to establish a substantial population of *C. ariakensis*, which means they are also aware that an introduction will not necessarily increase the number of harvestable oysters in the Bay to any significant scale.

Table 5.3 Expected Business Impacts of a Non-native Introduction and Continuation of Native Restoration

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	9	32.1	32.1
Business Might Decrease	7	25.0	57.1
My Business Would Probably Not Change	12	42.9	100.0
Total	28	100.0	

Another set of growers (32%) anticipate the proposed action will benefit them (Table 5.3). A possible interpretation of these results is that some growers are interested in growing *C. ariakensis* and/or they feel continued native restoration efforts will lead to scientific knowledge that they can use (e.g. breakthroughs in breeding disease resistance). The remaining growers (25%) reported concerns that their businesses might be negatively impacted by the proposed action (Table 5.3). There is concern

about the unknown costs of an introduction. As one grower said, "We need to be careful with a voluntary exotic," suggesting a willingness to consider the use of the non-native, but wariness about the unanticipated consequences.

When asked how their businesses might be impacted if a non-native is introduced and native restoration is stopped, fewer growers (21%) anticipate increases in business and more growers anticipate decreases (39%) than for an introduction with continued native restoration (Table 5.4). Growers that have diversified operations may benefit from any wild harvests that are available and without native restoration efforts, that availability would in all probability be reduced. If native restoration is stopped, it also follows that support for scientific investment in native restoration could also wane, reducing the amount of usable information available to growers. Those who are interested in growing *C. ariakensis* could benefit, but those who are not will likely be unaffected or hurt by the cessation of native restoration.

Table 5.4 Expected Business Impacts of a Non-native Introduction and the Cessation of Native Restoration

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	6	21.4	21.4
Business Might Decrease	11	39.3	60.7
My Business Would Probably Not Change	11	39.3	100.0
Total	28	100.0	

Processors and Shippers: A minority (46%) of processors and shippers support the introduction of *C. ariakensis* (54% said no, we should not introduce now). Those processors and shippers who are supportive may be responding to the pressure of reduced harvests, and perceive that the risks

associated with a non-native introduction are outweighed by the potential economic benefits. Processors and shippers who do not believe we should introduce *C. ariakensis* most likely are not rejecting the use of a non-native oyster altogether. At the same time, processors and shippers (as is true for other study groups) do not want to give up on the native oyster (see below).

We asked processors and shippers whether introducing a non-native oyster and continuing native restoration would increase or decrease their business. The response is relatively positive, as 41% of firms report that their businesses might increase as a result of the proposed action, while another 46% of firms feel they would not be affected (Table 5.5).

Table 5.5 Expected Business Impacts of a Non-native Introduction, Primarily in Reserves and Sanctuaries with a Continuation of Native Restoration

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	16	41.0	41.0
Business Might Decrease	5	12.8	53.8
My Business Would Probably Not Change	18	46.2	100.0
Total	39	100.0	

Only a small percentage (10% in MD, 22% in VA) anticipates that their businesses would be hurt by this restoration strategy.

Processors and shippers revealed less optimism in response to the potential consequences of an introduction coupled with the cessation of native restoration. Fewer processors and shippers (27%) think their businesses would increase if an introduction of non-native oysters does not include continued efforts to restore the native oyster. Another 43% suspect they may be hurt by this action (Table 5.6). Those who responded that they expect to benefit may be thinking the non-native will multiply rapidly (and thus increase overall oyster populations throughout the Bay, despite its

placement in sanctuaries and reserves) or that prices will rise significantly if native restoration is stopped. Those who suspect their businesses will suffer may be concerned that native oysters will continue to decline without restoration, and so will their ability to supply demand.

Table 5.6 Expected Business Impacts of a Non-native Oyster Introduction, Primarily in Reserves and Sanctuaries and the Cessation of Native Restoration

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	10	27.0	27.0
Business Might Decrease	16	43.2	70.3
My Business Would Probably Not Change	11	29.7	100.0
Total	37	100.0	

Processors' and shippers' responses in Tables 5.4 and 5.5 are most likely also influenced by the physical qualities of *C. ariakensis.* Some of the non-native's physical characteristics are viewed as assets. "This oyster does well in a turbid environment." Favorable comments were made regarding its taste. "It [*C. ariakensis*] looks like our oysters. It tastes like our oysters. The only difference is it is a little chewier." "It tastes good to me. Fried, they were just as good as the native." Processors and shippers note that the physical differences matter, and some feel *C. ariakensis* is undesirable, at least for certain purposes.

> *C. ariakensis* is a shucking oyster. It's too large to be served on the shell. Its shelf life is atrocious. It does not lend itself to traditional harvesting techniques. You cannot let this oyster sit out on your boat deck. It's just not suitable for the half-shell market unless it's very young in cold water.

Other processors and shippers accept the physical attributes of *C. ariakensis* as limitations for the half-shell market, but still see the non-native as a viable product. As one processor explained,

> Well, it gapes more than *C. virginica* and the shell is thinner. If it can be grown on bottom, that might help but we don't know. We don't see it as a half-shell market – we see it as a shucked product. You have to handle it quickly but it's not so thin that it

> cracks when you shuck it. It's easier to detach from the shell than the native. The other side of that is there is more meat in the shell. The economics then begin to look very attractive.

It is important to note here that the processors and shippers we interviewed know a great deal about oysters, including the scientific and political dimensions of restoration, in addition to the economic repercussions of any action. Many industry members spoke about the inherent variability of ecological conditions within the Bay and its tributaries, and the consequences of that variability for restoring oyster populations. Several were aware of concerns about genetic homogeneity in hatchery reared *C. virginica* stocks. Some talked about the history of oyster science in the Chesapeake, and outlined summaries of the early trials with *C. gigas* (Dery and Paolisso 2006). They feel that their knowledge should be utilized in decisions about oyster restoration.

Scientists and Environmentalists: When asked if *C. ariakensis* should be introduced now, only a small minority (13% - the same percentage who don't feel the native can be restored [see below]) of scientists responded yes. This is what we would expect, as most scientists expressed in interviews the impossibility of modeling all the variables involved in a non-native introduction in a laboratory setting, noting that it is also impossible to completely anticipate the costs and benefits of an introduction (Paolisso, Herman, and Dery 2006).

A slightly larger minority (20%) of environmentalists think we should introduce *C. ariakensis* now. Our interpretation of this response is that some environmentalists are increasingly fearful that there is not enough being done to mitigate the deleterious human impacts to the Bay's water quality and ecosystem, and while a non-native species introduction is perhaps anathema to many environmentalists, there are some who believe the potential for the non-native oyster to provide water quality and other environmental benefits is very appealing. In other words, if the non-native can do enough to clean up the environment, that potential may outweigh the fact that it's not native.

In order to assess socioeconomic impacts to scientists, we asked about the amount of research and funding that would be required to achieve successful restoration under various scenarios. This line of inquiry provides us with information about scientists' assessment of needs as well as likely impacts to them, since increases or decreases in research support are relevant socioeconomic effects to this group. Seventy percent of the scientists surveyed reported that the proposed action (introduction and continued native restoration) will require a large amount of additional research to support a science-based strategy (Table 5.7). This view is logical since it is the alternative with the highest degree of uncertainty. As one scientist exclaimed, "the potential positives are clear. It's the unknowns that are the problem." Only 17% felt that a small amount of additional research would be needed to help ensure a science-base to this strategy (Table 5.7).

Table 5.7 Amount of Additional Research Needed to Support Science-based Restoration through a Non-native Introduction

	Frequency	Valid Percent	Cumulative Percent
A Large Amount of Additional Research Needed	21	70.0	70.0
A Medium Amount of Additional Research Needed	4	13.3	83.3
A Small Amount of Additional Research Needed	5	16.7	100.0
Total	30	100.0	

A majority (63%) of scientists also feel that the proposed action will require more funding than currently exists. However, 37% said that an introduction could be successful with the same amount or less funding than is currently available (Table 5.8). This could be because they see the amount of funding currently allocated to oysters as relatively high. There is also the possibility that long-term investments will be less costly than native restoration; if *C. ariakensis* can survive and multiply, less

hatchery production, fewer seed plantings, potentially less habitat rehabilitation, etc. may be required to achieve target population levels.

Table 5.8 Amount of Additional Funding Needed to Support Science-based Restoration through a Non-native Introduction

	Frequency	Valid Percent	Cumulative Percent
The Same Amount that Currently Exists	8	26.7	26.7
More than Currently Exists	19	63.3	90.0
Less than Currently Exists	3	10.0	100.0
Total	30	100.0	

In the 2004 survey, we asked environmentalists if they think support for their organizations' programs and activities will be affected by oyster restoration activities and 68% responded that they would. We felt the best way to determine impacts to environmentalists was to ask how important they thought various oyster restoration actions would be in reducing pollution and revitalizing the natural systems of the Chesapeake Bay (Table 5.9).

Table 5.9 Importance of a Non-native Introduction, Conducted Primarily in Reserves and Sanctuaries, to Reducing Pollution and the Revitalizing Natural Systems of the Chesapeake

	Frequency	Valid Percent	Cumulative Percent
Very Important	6	15.4	15.4
Somewhat Important	12	30.8	46.2
Not Important	21	53.8	100.0
Total	39	100.0	

Over half of environmentalists do not think the proposed action will be important to reducing pollution and revitalizing the natural systems of the Chesapeake Bay (Table 5.9). Our interpretation of

this response is that respondents feel uncomfortable with the use of a non-native in restoration, even if that use is confined initially to sanctuaries and reserves and subject to ICES protocols. However, some environmentalists report that a non-native introduction would be somewhat (31%) or very important (15%) to reducing pollution, perhaps suggesting again that some are open to the possibility of reaping what could be substantial environmental benefits from the non-native.

The majority of scientists and environmentalists do not think we should introduce *C. ariakensis* now, which is in keeping with concerns expressed in interviews. Scientists and environmentalists almost without exception can discuss the ecological threats associated with non-native introductions (introduced oysters can serve as disease vectors, reproductive and resource competitors with native species, and introductions can inspire social consequences such as the possibility of a lawsuit against a state introduction by another state) at length. One informant described these dangers as the "Russian Roulette" of species introduction. However, these lists of threats are almost always followed with a call for additional research, suggesting a conviction that research is not only needed, but can reduce the costs of an introduction (Paolisso, Herman, and Dery). Many scientists added the caveat that additional research would not eliminate risk, and that ultimately the decision to introduce would have to be a "political" one. The fact that many in the scientific community see the ultimate decision as being in the "political sphere" and yet the stakeholder groups outside of the research establishment see the decision as being one dependent on "good science" is something of a conundrum (Paolisso, Herman, and Dery 2006).

Overall, both scientists and environmentalists think restoration is important, even if cannot be achieved at a Bay-wide scale. It is in this conceptual environment that the impacts to these stakeholder groups are situated. Socioeconomic impacts to these groups would be indirect if at all significant, and, therefore, minor. However, impacts on shared knowledge and values would prompt action, in both research and advocacy, which has programmatic and financial implications.

Recreational Fishers and Restaurant Owners: The recreational fishers were split 50%-50% on the question of whether we should introduce a non-native oyster now. This is not surprising, considering the diversity of recreational users, their varying degrees of knowledge about oysters, and the uncertainty surrounding an introduction. Put simply, some feel the risk is worth taking, while others do not. In order to assess the potential impacts of oyster restoration, we asked fishers about their fishing habits and their views on the relationship between oyster restoration and Chesapeake Bay health. All fishers (n=151) feel that oysters are important to the health of the Bay (95% - very important, 5% - somewhat important). Approximately 90% believe the number of oysters in the Bay affects the abundance and diversity of sport fish, but the majority does not feel their fishing will be impacted by any of the proposed action or alternatives.

The impacts on recreational fishing behavior will be minimal and the same level of fishing effort will be maintained (assuming access does not change as a result of restoration action(s)) at current levels. We can also conclude that their understanding of the Bay's health is connected to oysters, thus while their fishing behavior may not change as a result of restoration action(s), their conception of the Bay might.

We also examined how restaurant owners felt their customers' behavior might change as a result of restoration action(s). Approximately 80% of respondents thought their customers were interested in knowing where and how the oysters they consume were harvested (Table 5.10).

Table 5.10 Customers' Interest in Knowing Where the Oysters They Eat Were Harvested

	Frequency	Valid Percent	Cumulative Percent
Yes	12	80.0	80.0
No	3	20.0	100.0
Total	15	100.0	

When asked how concerned they think their customers are about what species of oyster is in the Chesapeake Bay (the native or an introduced non-native), the majority (67%) responded that their customers are concerned, but approximately 20% are not concerned at all (Table 5.11).

Table 5.11 Estimated Level of Customer Concern About Whether Oysters in the Chesapeake Bay Are a Native Species or an Introduced Non-native Species

	Frequency	Valid Percent	Cumulative Percent
Not Concerned at All	3	20.0	20.0
Concerned	10	66.7	86.7
Very Concerned	2	13.3	100.0
Total	15	100.0	

Restaurant customers' interest and concerns about oysters in the Bay do translate into actual purchasing or consumption behavior. When asked if customers feel it is important that the oyster they are ordering is native to the Chesapeake Bay and its tributaries, about 2/3 of restaurant owners report that it is important or very important to their customers (Table 5.12).

Table 5.12 Estimated Importance Level to Customers of Knowing that Oysters They Are Served Are a Species Native to the Chesapeake Bay

	Frequency	Valid Percent	Cumulative Percent
Very Important	2	12.5	12.5
Important	9	56.3	68.8
Not Very Important	5	31.3	100.0
Total	16	100.0	

To further explore into the effects of restoration strategies on consumer behavior, we investigate whether or not owners' customers would be willing to purchase more oysters or pay higher prices for oysters in support of various restoration strategies. Roughly 40% of restaurant owners feel they can sell more non-native oysters after a state managed introduction, while 60% do not. (Their responses are more positive for expanded native restoration, as 75% feel they can sell more oysters if customers know they are part of an effort to restore native oyster populations and support watermen communities.)

Expanded Restoration of Native Oyster

Watermen: In our 2004 survey, 72% of watermen said they believe that the native oyster can be restored to the Chesapeake Bay. However, it appears as though the harvesting benefits of continued native oyster restoration do not apply when that restoration is targeted for reserves and sanctuaries. As show in Table 5.13, when asked if harvesting practices would change if native oyster restoration is expanded, primarily in sanctuaries and reserves, more than 66% of watermen report they would not change. Moreover, if the reserves and sanctuaries are located in places far from a watermen's home

port, then the costs in fuel and time to reach these reserves, to harvest on the specified days, are probably prohibitive.

Table 5.13 Expected Harvest Change if Native Oyster Restoration Is Expanded, Primarily in Sanctuaries and Reserves

		Would Go Harvesting More	Would Go Harvesting Less	Would Go Harvesting Same Amount	Total
Maryland	Count	40	36	175	251
	% within State of Residence	15.9%	14.3%	69.7%	100.0%
Virginia	Count	28	15	63	106
	% within State of Residence	26.4%	14.2%	59.4%	100.0%
Total	Count	68	51	238	357
	% within State of Residence	19.0%	14.3%	66.7%	100.0%

Growers: Somewhat surprisingly, a sizeable minority of growers (39%) do not feel the native oyster can be restored. Still, a majority (61%) do feel the native can be restored (2004 survey), although growers share others' frustration with the lack of success achieved to date. As one grower suggested, "Maryland and Virginia's public success rates have been impacted by their approaches. The public effort has been disappointing, but that doesn't mean *C. virginica* can't thrive in the estuary."

When asked about the potential impacts of expanded native restoration, primarily in sanctuaries and reserves, growers largely felt they would either be unaffected (43%) or they would benefit (46%) (Table 5.14). Clearly, many growers feel that native restoration is a good thing, even if markets and consumer demand are unaffected. Knowledge is produced that can improve survival rates and can potentially be used in growing operations. Only a small number of growers (11%) anticipate their businesses could be hurt by native restoration expansion (Table 5.14).

Table 5.14 Expected Impact on Business of Native Expanded Native Oyster Restoration, Primarily In Sanctuaries and Reserves

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	13	46.4	46.4
Business Might Decrease	3	10.7	57.1
My Business Would Probably Not Change	12	42.9	100.0
Total	28	100.0	

Processors and Shippers: A majority (82%) of processors and shippers do have confidence that the native oyster can be restored. Despite this positive outlook, there is a sense of frustration with restoration's lack of large-scale success to date. We heard statements such as, "We've been doing things for years. I can't believe people who say enough work hasn't been done. Every time a new group gets involved, it's as if we have to start all over again," and, "I've done restoration for years and it hasn't made a difference." One processor insisted, "Look, we produce oysters. We plant beds. We are currently working with a triploid native in a native nursery system. We grow out small oysters. We've planted James River seed oysters in several places. But, it has cost a lot of money and it hasn't gotten us anywhere."

When asked how they expect to be affected by expanded native oyster restoration, the majority of firms (60%) responded positively (Table 5.15). Those who feel they will benefit are likely confident that more concentrated efforts and better restoration strategies will promote population growth beyond restoration sites. Those processors and shippers who are not heavily dependent on wild harvested oysters and who do not expect to benefit directly from selling those oysters may still see a benefit from enhanced wild stocks, as the health of oysters generally influences consumer attitudes and markets. A smaller number of processors and shippers anticipate a decrease in business (13% in MD and 22% in

VA) and the remainder expects no change. The few who feel their businesses may decrease as a result of this action could be reacting to the focus on sanctuaries and reserves as primary restoration sites.

Table 5.15 Expected Impacts on Business of Expanded Native Oyster Restoration

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	24	60.0	60.0
Business Might Decrease	6	15.0	75.0
My Business Would Probably Not Change	10	25.0	100.0
Total	40	100.0	

These sites will not offer continuous product for industry, as harvest in these areas is restricted or prohibited and if recent trends continue, the harvests are likely to decline gradually. Additionally, many of them consider past efforts a failure and thus do not have much faith in restoration success resulting from expansion alone.

Scientists and Environmentalists: In our 2004 survey, we found that a small minority (13%) of scientists does not feel the native oyster can be restored. Some scientists we spoke with told us that restoration can work locally in specific cases to achieve benefits in a particular tributary, for example, but that restoration for the Bay as a whole is unrealistic (Paolisso, Herman, and Dery 2006). For these scientists, the success of oyster restoration efforts is very dependent on time and scale. As one scientist reported, "I don't want to give up on *C. virginica*. [However,] there are parts of the Bay where we should give up on it – where disease pressure and salinity are not right. The places where *C. virginica* can thrive are too limited, and there are not enough good areas to use it." Still, the vast majority (87%) of scientists and almost all the participating environmentalists (98%) do feel restoration of the native is possible. Even those who don't feel the native can be restored see value in very localized restoration and more than 95% of both groups think restoration should be supported by public funds.

According to scientists, expanded native restoration will require additional research, although less than an introduction of a non-native (Table 5.16).

Table 5.16 Estimated Amount of Additional Research Needed to Support Science-Based Restoration through Expanded Native Restoration

	Frequency	Valid Percent	Cumulative Percent
A Large Amount of Additional Research Needed	11	36.7	36.7
A Medium Amount of Additional Research Needed	11	36.7	73.3
A Small Amount of Additional Research Needed	8	26.7	100.0
Total	30	100.0	

This suggests scientists think the strategies currently available for native restoration are inadequate for achieving population goals. Further supporting this interpretation is the result that almost ¾ of scientists think more funding than is currently available would be required to achieve restoration goals with expanded native restoration (Table 5.17).

Table 5.17 Amount of Additional Funding Needed to Support Science-based Oyster Restoration through Expanded Native Restoration

	Frequency	Valid Percent	Cumulative Percent
The Same Amount that Currently Exists	8	26.7	26.7
More than Currently Exists	22	73.3	100.0
Total	30	100.0	

Considering the long history associated with native restoration and the challenges facing native recovery (disease virulence, lack of viable habitat, etc.), it is reasonable to assume that major changes in either method or scale would have to occur for native restoration to succeed. As one scientist said, "It's not working the way they are doing it."

Most environmentalists (81%) report that expanded native restoration is very important to reducing pollution, suggesting that they have faith in the potential of native restoration (Table 5.18).

Table 5.18 Estimated Importance of Expanding Native Oyster Restoration, Primarily in Sanctuaries and Reserves, to Reducing Pollution and Revitalizing the Natural Systems of the Chesapeake Bay

	Frequency	Valid Percent	Cumulative Percent
Very Important	34	81.0	81.0
Somewhat Important	7	16.7	97.6
Not Important	1	2.4	100.0
Total	42	100.0	

This group may see more success in the restoration efforts to date than other groups, or they may feel it has simply been under-funded or undermined by harvesting. As one environmentalist put it, "you can't restore if you take out." As another suggested, "People expect to have their oysters and eat them, too. That limits water quality potential."

Recreational Fishers and Restaurant Owners: The vast majority (89%) of recreational fishers and restaurant owners believe the native oyster can be restored. For recreational users that are generally less knowledge about oysters, disease, the history of restoration, etc. there is optimism and faith in the concept of restoration, given enough resources (time, money, good science, political will, etc.) (Paolisso, Herman, and Dery 2006).

Fishers' responses to questions about restoration strategies and their potential for contributing to Bay health suggest they feel oyster restoration has a major contribution to make. More than 85% report that expanded native restoration will have a great impact in contributing to the health of the Bay (Table 5.19).

Table 5.19 Amount of Impact Increased Native Oyster Restoration Would Have on Keeping the Chesapeake Bay Healthy

	Frequency	Valid Percent	Cumulative Percent
A Great Impact	126	85.1	85.1
A Little Impact	22	14.9	100.0
Total	148	100.0	

Expand Aquaculture

Watermen: In the 2007 survey, we asked watermen whether the expansion of aquaculture of the native and non-native oysters would affect their harvesting practices. Table 5.20 presents findings on the reported impacts of expanded aquaculture with native oysters on the market for wild-harvested oysters. The results suggest that watermen do not see a clear negative or positive impact of expanded native oyster restoration on the market for their wild-harvested oysters.

Table 5.20 Expected Impact of Expanded Aquaculture of Native Oysters on the Market for Wild Harvested Oysters

		Negative Impact	Positive Impact	Both	No Impact	Total
Maryland	Count	74	54	74	58	260
	% within State of Residence	28.5%	20.8%	28.5%	22.3%	100.0%
Virginia	Count	20	30	38	20	108
	% within State of Residence	18.5%	27.8%	35.2%	18.5%	100.0%
Total	Count	94	84	112	78	368
	% within State of Residence	25.5%	22.8%	30.4%	21.2%	100.0%

Nonetheless, slightly less than ¼ of watermen felt that there would be positive benefits (and almost 30% see a mix of positive and negative impacts) of expanded aquaculture of the native oyster. It may be the case that these watermen view that fact that more oysters will be available as generally a good

thing that will stimulate demand. Still, approximately 25% of watermen, in part fearing general increased competition, believe expanded aquaculture will have a negative effect on the market for their harvested oysters.

Table 5.21 presents the reported impacts of expanded aquaculture with non-native oysters on the market for wild-harvested oysters. The results are similar to those presented in Table 5.20 for the native oyster. Based on interviews, Maryland watermen have a tendency to view aquaculture overall as not supportive of their industry. Aquaculture is seen as separate from fishing from public bottoms, and there is considerable anxiety among watermen over the costs and risks (theft, lack of market, lack of private bottom, etc.) in starting a "grower" business. As one watermen stated, "The other thing is it's risky. It takes investment to start an aquaculture business. You need money for the gear and stuff. A lot of the old gear becomes obsolete." However, we have also heard recently in discussions with some watermen that they are considering taking a risk on oyster aquaculture. Nearly 57% of watermen surveyed report that they would consider getting involved in native aquaculture.

Table 5.21 Expected Impact of Expanded Aquaculture of Non-native Oysters on The Market for Wild Harvested Oysters

		Negative Impact	Positive Impact	Both	No Impact	Total
Maryland	Count	94	50	74	41	259
	% within State of Residence	36.3%	19.3%	28.6%	15.8%	100.0%
Virginia	Count	31	20	39	19	109
	% within State of Residence	28.4%	18.3%	35.8%	17.4%	100.0%
Total	Count	125	70	113	60	368
	% within State of Residence	34.0%	19.0%	30.7%	16.3%	100.0%

It is worth noting that about ⅓ of watermen believe that aquaculture of the non-native oysters will have a negative impact on the wild oyster market. Similar to all groups, many watermen

expressed concern about the possible negative ecological consequences of introducing a non-native species, whether on public bottom or in aquaculture. These concerns are relevant for their markets as well: if a problem (e.g., ecological or human health) arises with cultivation of the non-native oyster, any drop in demand for non-native oysters may spill over to their market and negatively affect demand for the native oyster.

The results in Table 5.22 for native aquaculture expansion and Table 5.23 for non-native aquaculture are similar to each other and the general pattern throughout: most watermen (anywhere from 60% to 75% depending on state and oyster) would go harvesting the same amount, again supporting the point most watermen do not see a significant benefit of these aquaculture-oyster restoration strategies on their harvesting. Similarly, the effect of these restoration strategies appears to be slightly stronger for Virginia watermen than Maryland, in terms of either increasing or decreasing their harvesting.

Table 5.22 Expected Change in Harvesting Habits If Native Aquaculture Is Expanded

		Would Go Harvesting More	Would Go Harvesting Less	Would Go Harvesting Same Amount	Total
Maryland	Count	38	25	187	250
	% within State of Residence	15.2%	10.0%	74.8%	100.0%
Virginia	Count	28	11	65	104
	% within State of Residence	26.9%	10.6%	62.5%	100.0%
Total	Count	66	36	252	354
	% within State of Residence	18.6%	10.2%	71.2%	100.0%

Table 5.23 Expected Change in Harvesting Habits if Non-Native Aquaculture is Established or Expanded

		Would Go Harvesting More	Would Go Harvesting Less	Would Go Harvesting Same Amount	Total
Maryland	Count	46	32	169	247
	% within State of Residence	18.6%	13.0%	68.4%	100.0%
Virginia	Count	22	22	59	103
	% within State of Residence	21.4%	21.4%	57.3%	100.0%
Total	Count	68	54	228	350
	% within State of Residence	19.4%	15.4%	65.1%	100.0%

Growers: When asked about expanded native aquaculture, a majority of growers (60%) think their businesses will benefit (Table 5.24). This is not surprising, since they are native aquaculturalists. Presumably any investment in aquaculture operations would be accessible to them and they could take advantage of additional resources that are currently unavailable. The degree to which they would benefit would depend on *how* the states decide to support state assisted, managed or regulated native aquaculture. Growers who do not feel they would benefit from state expanded aquaculture also do not feel their businesses would be affected (37%). We suspect this is because many growers are already growing and selling at a desirable level, and they are already achieving success with current levels of state involvement through regulation. As one grower said, "The state has not given me a dime. I can be successful on my own. The states should not get involved in managing, no way - becoming involved through educating, funding training programs, etc. but not managing. They could make training part of a subsidy program for watermen." However, despite comments like this one, we suspect many prospective and current growers will make use of any additional resources that are available in support of aquaculture in the future.

Table 5.24 Expected Impact on Business of Expanded Native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	16	59.3	59.3
Business Might Decrease	1	3.7	63.0
My Business Would Probably Not Change	10	37.0	100.0
Total	27	100.0	

Growers' positive outlook on state assisted, managed, or regulated non-native aquaculture was decidedly more equivocal than their position on native aquaculture expansion (Table 5.25). Again, growers are a knowledgeable group and they are aware of the potential for extensive non-native aquaculture to result in a de facto introduction. Approximately 50% of growers in Maryland and 15% in Virginia do not feel their businesses would be impacted, but 17% in Maryland and 50% in Virginia feel they would be hurt by non-native aquaculture. The difference in state responses is likely a reflection of the condition of the aquaculture industries in each place. Virginia's aquaculture industry is more developed, and it is probable that non-native aquaculture expansion will develop competition for existing operations, which will impact Virginia relatively more, since its industry is more established. Those who expect to benefit from non-native aquaculture expansion are, in all likelihood, considering growing *C. ariakensis* (to add to their existing operations) or are diversified or integrated businesses, with other business components that could benefit from increased supply.

Table 5.25 Expected Impacts on Business of the Development of Non-native Aquaculture

		Business Might Increase	Business Might Decrease	My Business Would Probably Not Change	Total
Maryland	Count	2	1	3	6
	% within State of Business	33.3%	16.7%	50.0%	100.0%
Virginia	Count	7	10	3	20
	% within State of Business	35.0%	50.0%	15.0%	100.0%
Total	Count	9	11	6	26
	% within State of Business	34.6%	42.3%	23.1%	100.0%

Processors and Shippers:

Interviews with processors and shippers reveal support for aquaculture as an important economic strategy for maintaining and improving the health of the oyster industry. These ideas are expressed in statements like, "You have to create an atmosphere that allows people to grow." There is also recognition and appreciation for the environmental benefits that can be gleaned from aquaculture. For some, aquaculture is a production method that industry can utilize, while wild populations are focus of restoration efforts, at least for the native oyster. One industry member summarized this perspective as follows:

> Native oyster restoration should continue, but in a complimentary way. If they see positive results, they should expand. If not, they should keep it as is. Private industry will take care of aquaculture, but it [aquaculture] should be encouraged.

Another put it this way, "We can continue public efforts, but the public should also be encouraging private efforts." Yet another insisted, "In Virginia, the aquaculturalists are growing 20 million oysters. They are in the water filtering, generating disease resistance, and providing incentives for technological innovation, at no cost to the public."

Approximately 55% of the firms in both states think they will benefit from expanded native aquaculture (Table 5.26). Another 35% do not expect native aquaculture to have an impact on their businesses. Those who do expect to benefit likely feel expanded aquaculture will provide them with additional sources and a greater volume of product. Those who don't expect to be impacted may not be purchasing from aquaculture and/or they may be targeting different markets than aquaculturalists. A small number of firms think they will be hurt and these may be in direct competition with aquaculturalists. The nature of the aquaculture expansion (how will it be achieved, the degree to which state programs plan to provide assistance to upstart growers, etc., who will have access to resources, and what scale of aquaculture operations are established) will directly influence how industry is impacted.

Table 5.26 Expected Impact on Business of Expanded State Assisted, Managed, or Regulated Native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	22	55.0	55.0
Business Might Decrease	4	10.0	65.0
My Business Would Probably Not Change	14	35.0	100.0
Total	40	100.0	

We also investigated the potential impacts of establishing state-assisted, managed, or regulated non-native aquaculture (Table 5.27). The responses are less positive in Maryland than in Virginia and less positive in both states when compared with native aquaculture expansion. Approximately 27% of processors and shippers in Maryland and 44% in Virginia feel their businesses would increase if non-native aquaculture is expanded. These firms again, may be looking forward to the increased availability of oysters that expanded non-native aquaculture will produce. The 33% of firms in both states that feel they may be negatively impacted by non-native aquaculture expansion may feel that

production of the non-native could harm native markets or consumer attitudes. There is the possibility that aquaculture with triploid *C. ariakensis* will result in a de-facto introduction. If an unintended introduction did occur and commercial entities were involved, public support for the oyster industry and oyster sales could be damaged.

Table 5.27 Expected Impact on Business of Expanded State Assisted, Managed, or Regulated Non-native Aquaculture

		My Business Might Increase	My Business Might Decrease	My Business Would Probably Not Change	Total
Maryland	Count	8	10	12	30
	% within State of Business	26.7%	33.3%	40.0%	100.0%
Virginia	Count	4	3	2	9
	% within State of Business	44.4%	33.3%	22.2%	100.0%
Total	Count	12	13	14	39
	% within State of Business	30.8%	33.3%	35.9%	100.0%

Scientists and Environmentalists: Environmentalists also report that native aquaculture is important to reducing pollution and revitalizing the natural systems of the Chesapeake Bay (Table 5.28). Many environmentalists see oyster aquaculture as one of the few environmentally productive natural resource use businesses that exist. However, this attitude depends greatly on how much knowledge one has about oyster aquaculture, since some other forms of aquaculture (e.g. salmon) are considered abusive to the marine environment. For those who have the knowledge, aquaculture is a great way to get more oysters out there for environmental benefit, in the private sector. Among environmentalists, there is also a sense that aquaculture can contribute environmental benefits to the Bay, but it cannot achieve restoration alone. These ideas are evidenced by statements like, "[Aquaculture] would provide localized water quality benefits, but cages will not provide much habitat."

Table 5.28 Importance of Native Aquaculture to Reducing Pollution and Revitalizing the Natural Systems of the Chesapeake Bay.

	Frequency	Valid Percent	Cumulative Percent
Very Important	29	67.4	67.4
Somewhat Important	12	27.9	95.3
Not Important	2	4.7	100.0
Total	43	100.0	

Environmentalists are less convinced that non-native aquaculture would contribute to pollution reduction (Table 5.29). Many environmentalists do not feel comfortable with the use of a non-native, even in restricted settings such as an aquaculture operation. For those who are willing to consider the use of a non-native, aquaculture is more appealing than an introduction, since aquaculture is inherently more controlled and easier to monitor than the natural environment.

Table 5.29 Importance of Non-Native Aquaculture to Reducing Pollution and Revitalizing the Natural Systems of the Chesapeake Bay.

	Frequency	Valid Percent	Cumulative Percent
Very Important	4	9.8	9.8
Somewhat Important	17	41.5	51.2
Not Important	20	48.8	100.0
Total	41	100.0	

Additionally, if the use of the non-native fails to be profitable, it will likely be discontinued. In other words, the use of the non-native in aquaculture seems less risky to many stakeholders than an outright introduction. This belief persists despite an understanding of the likelihood of triploid reversion. As we heard repeatedly, particularly among scientists, the widespread use of triploid oysters will result in a default introduction.

More than ½ of scientist respondents think a medium amount of research will be needed to support science-based restoration through native aquaculture (Table 5.30), and 47% think it can be achieved with the same amount of funding that currently exists (Table 5.31).

Table 5.30 Amount of Additional Research Required to Support Science-based Restoration Through Native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
A Large Amount of Additional Research Needed	4	13.3	13.3
A Medium Amount of Additional Research Needed	17	56.7	70.0
A Small Amount of Additional Research Needed	9	30.0	100.0
Total	30	100.0	

Our questions did not investigate what type of research should be prioritized. In the case of aquaculture with either species, research needs could include hatchery improvements, continued development of disease resistance, or economic development research. Non-native aquaculture will include other research needs specific to biological and ecological performance of the oyster.

Table 5.31 Amount of Additional Funding Required to Support Science-based Restoration Through Native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
The Same Amount that Currently Exists	14	46.7	46.7
More than Currently Exists	13	43.3	90.0
Less than Currently Exists	3	10.0	100.0
Total	30	100.0	

Accordingly, more scientists felt a large amount of research and additional funding would be needed to support non-native aquaculture than native aquaculture (Table 5.32, 5.33).

Table 5.32 Amount of Additional Research Required to Support Science-based Restoration Through Non-native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
A Large Amount of Additional Research Needed	13	43.3	43.3
A Medium Amount of Additional Research Needed	11	36.7	80.0
A Small Amount of Additional Research Needed	6	20.0	100.0
Total	30	100.0	

Table 5.33 Amount of Additional Funding Required to Support Science-based Restoration through Non-native Aquaculture

	Frequency	Valid Percent	Cumulative Percent
The Same Amount that Currently Exists	9	30.0	30.0
More than Currently Exists	17	56.7	86.7
Less than Currently Exists	4	13.3	100.0
Total	30	100.0	

Among scientists, there was a general consensus throughout our interviews that oyster aquaculture with either species would be incapable of making Bay-wide ecological improvements. Yet, most scientists interviewed stated that aquaculture could provide localized ecological benefits. Informants differed as to whether these benefits could be maintained indefinitely or would require a periodic restocking of oyster biomass to sustain regional improvements. Likewise, many of the scientists were conflicted about the role of aquaculture as an economic development strategy. Several informants argued that the legal and ecological circumstances of the Chesapeake would prohibit a competitive oyster harvest vis-à-vis other national and international regions. Others argued that

aquaculture is the future of marine harvest, and that it would behoove regional planners to "catch up to the rest of the world" (Paolisso, Herman, and Dery 2006). As one scientist suggested, "Industry needs something now. Aquaculture gives industry immediate return. With either species, restoration will take a decade."

Recreational Fishers and Restaurant Owners: A majority of recreational fishers (85%) also see native aquaculture as having a great impact on the health of the Bay. Approximately 52% of fishers feel non-native aquaculture will have a great impact on Bay health, and 42% think it will have a little impact (Table 5.34).

Table 5.34 Amount of Impact Non-native Aquaculture Would Have on Keeping the Chesapeake Bay Healthy

	Frequency	Valid Percent	Cumulative Percent
A Great Impact	71	51.8	51.8
A Little Impact	57	41.6	93.4
No Impact	9	6.6	100.0
Total	137	100.0	

The smaller degree of support for non-native aquaculture's contribution to Bay health is likely tied to fishers' divided views on the use of the non-native in general, with some feeling the non-native will have negative consequences on Bay health.

A little more than ½ (56%) of restaurant owners feel they can sell more if customers know they are eating natives grown in aquaculture to support local industry (Table 5.35). Only 25% of owners think they can sell more oysters if their customers know they are eating non-natives grown in aquaculture to support local industry (Table 5.36).

Table 5.35 Ability to Sell More Oysters If Customers Knew They Were Eating Natives Grown in Aquaculture to Support Local Industry

	Frequency	Valid Percent	Cumulative Percent
Yes	9	56.3	56.3
No	7	43.8	100.0
Total	16	100.0	

There could be perceptions among consumers that shellfish raised in aquaculture have a different taste or texture, or other aesthetic differences they connect to quality. Taste tests conducted show that consumers rate *C. virginica* as tastier than *C. ariakensis* when consumed raw, and comparable when cooked (Bishop and Peterson 2005; Grabowski et al. 2003).

Table 5.36 Ability to Sell More Oysters If Customers Knew They Were Eating Non-natives Grown in Aquaculture to Support Local Industry

	Frequency	Valid Percent	Cumulative Percent
Yes	4	25.0	25.0
No	12	75.0	100.0
Total	16	100.0	

Harvest Moratorium

Watermen: Another oyster restoration strategy under consideration, either alone or in conjunction with the restoration strategies discussed above, is an oyster harvest moratorium. Clearly, a harvest moratorium will directly affect harvesting in terms of effort and catch. To assess the impact of an oyster harvest moratorium on watermen we asked a series of questions about how difficult it would be to return to the fishery depending on the length of the moratorium. Specifically, we asked, "how

difficult would it be for you to return to the fishery when the moratorium is lifted," for the time periods of 2-3 years, 3-4 years, 5-6 years, and 7+ years. Not surprisingly, as the length of moratorium increased, watermen reported increased difficulty in returning to the fishery. The data in Table 5.37 show that overall about 42% of watermen report that it would be very difficult to return to the fishery after a moratorium of only 2 to 3 years. Another 31% report that it would difficult; only 27% of watermen overall report they would have no difficultly returning to the fishery after a 2-3 harvest moratorium.

Tale 5.37 Difficulty Returning to the Oyster Fishery If there is a 2-3 year Moratorium On Oyster Harvests

		Very Difficult	Somewhat Difficult	Difficult	Not Difficult at All	Total
Maryland	Count	100	52	25	71	248
	% within State of Residence	40.3%	21.0%	10.1%	28.6%	100.0%
Virginia	Count	48	16	18	25	107
	% within State of Residence	44.9%	15.0%	16.8%	23.4%	100.0%
Total	Count	148	68	43	96	355
	% within State of Residence	41.7%	19.2%	12.1%	27.0%	100.0%

Table 5.38 reports data similar to the information in Table 5.37, but the time length of the moratorium is 7 years or more. Not surprisingly, the overall percentage of watermen who reported it would be very difficult has increased to 67% and those who reported it would be difficult dropped to about 15%. Only 18 % overall reported that they would have no difficulty returning to the fishery after a 7 year or more moratorium.

Tale 5.38 Difficulty Returning to the Oyster Fishery If there is a 7+ year Moratorium On Oyster Harvests

		Very Difficult	Somewhat Difficult	Difficult	Not Difficult at All	Total
Maryland	Count	157	16	21	49	243
	% within State of Residence	64.6%	6.6%	8.6%	20.2%	100.0%
Virginia	Count	76	5	9	13	103
	% within State of Residence	73.8%	4.9%	8.7%	12.6%	100.0%
Total	Count	233	21	30	62	346
	% within State of Residence	67.3%	6.1%	8.7%	17.9%	100.0%

Growers: We also asked growers how they expected their businesses to be impacted by a harvest moratorium (Table 5.39). A small number did not feel they would be impacted, but most did. Their responses were strikingly different in each of the states. A majority of Virginia growers (62%) and some Maryland growers (29%) felt their businesses would decrease if there is a harvest moratorium on the native. Some of these growers are diversified, with part of their businesses reliant on wild harvest. Still others may be concerned that a harvest moratorium will send a message about the health of oyster populations that reduces consumer demand. Those who feel they will benefit from a moratorium may be anticipating reduced competition and/or increased opportunities for grown oysters in markets currently served by wild harvests.

Table 5.39 Expected Impacts of Harvest Moratorium on Business

		Business Might Increase	Business Might Decrease	My Business Would Probably Not Change	Total
Maryland	Count	4	2	1	7
	% within State of Business	57.1%	28.6%	14.3%	100.0%
Virginia	Count	7	13	1	21
	% within State of Business	33.3%	61.9%	4.8%	100.0%
Total	Count	11	15	2	28
	% within State of Business	39.3%	53.6%	7.1%	100.0%

Processors and Shippers: Processors and shippers are very likely to be negatively impacted by a harvest moratorium. The duration and scope of the moratorium will influence the degree to which those impacts are experienced. Level of dependence on wild harvests will also dictate how firms are affected. Approximately 63% of our sample (2007 survey) relies on the wild harvest to produce 50% or more of the Chesapeake oysters they handle. This suggests industry would be substantially impacted by a moratorium. Their responses to our survey question regarding a moratorium support this assertion. Approximately 81% of respondents feel a moratorium would hurt their businesses (Table 5.40).

In addition to their direct dependence on wild harvest, there is a sense of loyalty among industry members and support for all aspects of the industry (including wild harvest) that contributes to their opposition to a harvest moratorium (Dery and Paolisso 2006).

Table 5.40 Expected Impacts on Business of a Harvest Moratorium

	Frequency	Valid Percent	Cumulative Percent
Business Might Increase	3	8.1	8.1
Business Might Decrease	30	81.1	89.2
My Business Would Probably Not Change	4	10.8	100.0
Total	37	100.0	

Scientists and Environmentalists A solid majority of both scientists (97%) and environmentalists (86%) are in favor of harvest reductions. They clearly feel harvests, however negligible, are hurting restoration efforts and need to be reduced, if not eliminated. Several informants raised concerns about the ability of native populations to develop natural disease resistance if harvests remove the oysters that may live slightly longer prior to gene contribution (reproduction). The majority of scientists (75%) also maintain that economic factors should not be considered in determining how much harvests should be reduced (Table 5.41). This suggests they feel ecological factors should dictate resource use. While economic and ecological benefits can be wrought from restoration and need to be considered, ecological health must be secured and prioritized.

Table 5.41 Economic Factors Should Influence How Much Harvest Levels Are Reduced, If It Is Necessary to Reduce the Commercial Harvest of Oysters to Accomplish Successful Oyster Restoration

	Frequency	Valid Percent	Cumulative Percent
Not Applicable	1	3.6	3.6
Yes	6	21.4	25.0
No	21	75.0	100.0
Total	28	100.0	

The majority (61%) of environmentalists hold that economic factors should be considered in setting harvest reduction levels (Table 5.42). While they too believe that ecology is primary, they may be willing to consider usage rates or family income levels in a compensation scenario, or otherwise attend to the harvesters' positions. This response suggests a willingness on the part of environmentalists to pay for environmental benefit (public good), especially if they can create what is perceived as a "win win" situation that will please their constituents.

Table 5.42 Economic Factors Should Influence How Much Harvest Levels Are Reduced, If It Is Necessary to Reduce the Commercial Harvest of Oysters to Accomplish Successful Oyster Restoration

	Frequency	Valid Percent	Cumulative Percent
Not Applicable	4	9.8	9.8
Yes	25	61.0	70.7
No	12	29.3	100.0
Total	41	100.0	

Further, some environmentalists we interviewed exhibited empathy for the harvesters and an appreciation for having watermen on the water. As one informant said, "… loss of harvest totally from this culture is a degree of disconnection from our natural resources. Connections like that motivate people to care, to change their behavior with sustainable alternatives."

Recreational Fishers and Restaurant Owners: Recreational fishers also responded positively to the idea of a moratorium. When asked if they think it is necessary to reduce the commercial harvest of oysters in order to accomplish successful oyster restoration in the Chesapeake Bay, 88% say yes. Of those that think a harvest moratorium is necessary, 42% think economic factors should influence how much commercial harvest is reduced, suggesting support for some type of graduated reduction and/or compensation.

Like recreational fishers, restaurant owners express support for the harvest moratorium alternative. Owners report that 81% of their customers would pay more for oysters purchased in support of a moratorium that is part of a restoration effort (Table 5.43).

Table 5.43 Customers' Willingness to Pay More for Oysters to Support a Harvest Moratorium that Aims to Restore Oyster Populations?

	Frequency	Valid Percent	Cumulative Percent
Yes	13	81.3	81.3
No	3	18.8	100.0
Total	16	100.0	

Conclusions

We found that watermen do not believe the proposed action being evaluated by the EIS will improve their harvests: the reserves and sanctuaries for non-native oysters would be relatively small (and closed to harvests for some time). Watermen largely do not view restoration alternatives focused on aquaculture as affecting their harvesting practices, either. The restoration alternatives that they see as having the largest effect on their current harvesting practices are expansion of native oyster restoration and, of course, a harvest moratorium. Desired native expansion would focus on repletion and replenishment of public oyster beds, as well as sanctuaries and reserves. Finally, many watermen report that implementation of an oyster harvest moratorium would make it difficult for them to return to the fishery once the moratorium was lifted.

Overall, growers do not exhibit solid agreement about the expected impacts of specific restoration actions as clearly as other direct user groups do. Variations appear by state, which is reasonable considering the variability within the aquaculture industries in Maryland and Virginia. The impacts growers anticipate are also very closely related to the type of business they are engaged in, and what markets they are serving. There are consistently favorable views of expanding native aquaculture and at least maintaining native restoration at current levels. There is clearly a negative impact

associated with harvest moratoriums. We also suspect some growers are currently operating at levels significantly beneath their capacity and/or potential. There are a variety of reasons why a grower may choose to operate at these levels, which could be personal (part-time employment in aquaculture does not provide their primary source of income), practical (many wish to gradually increase their investments over time), or technical (reliable access to seed, etc.). Regardless, there seems to be a sense that there is room for growth.

Instead of voicing support for one particular approach to restoration, members of our study group advocate for a multi-faceted approach. The ones we spoke with are ready to use many of the restoration techniques available. This is evidenced by statements from a processor like, "We should use all of the techniques available to us except the harvest moratorium. We've got to develop a comprehensive program," and, "We have to develop a comprehensive approach, native restoration and non-native restoration." There are consistent levels of agreement expressing a willingness to consider a range of restoration strategies, as long as those strategies include commercial utilization of the oyster resource (Dery and Paolisso 2006).

Overall, scientists report that additional research is needed before introducing a non-native or expanding native oyster restoration. This indicates that regardless, more knowledge can be gained and used. Even in private aquaculture, science can contribute to technological innovation and otherwise improve commercial productivity with additional knowledge. As one scientist said, "We just don't know enough." Environmentalists generally favor native restoration, expanded and in aquaculture. There is less agreement on the use of a non-native, either in aquaculture or via an introduction. In the end, the socioeconomic impacts of restoration action(s) to both these groups will be relatively minimal. They may receive additional resources to continue their work under various alternative restoration scenarios, but this will not likely result in major income fluctuations.

The immediate impacts of restoration on seafood consumers and recreational fishers are largely cultural. We want to reiterate that conceptual changes are very important factors in determining political support, support for various types of publicly funded activities, and for shaping what our Bay will be in the future, what it means to us, and how we relate to it and the larger natural environment. Consumers seem willing to support restoration, particularly with the native and through a moratorium, with their dollars. Consumers may change their purchasing habits, but few fishers will alter the amount of fishing they do in the Bay.

Across restoration strategies, it should be noted that any human health concerns that may arise from either an introduction or continued decline of the native species could have adverse affects on consumer demand, particularly if new pathogens are introduced along with the non-native oyster. There is a system in operation in both Virginia and Maryland to enforce native oyster bed closures when contamination and potential human health problems are a possibility. ICES protocols are in place to ensure the safety of any introduced oysters that may be used in restoration. Further, the EIS includes studies that evaluate human health concerns. Environmental health is also of concern with regards to demand. Failure in restoration with either species, accompanied by continued population declines could reduce the demand for oysters, especially if *C. virginica* becomes widely known (not even officially designated) as a threatened species.

Finally, members of all the study groups expressed a sense of urgency that's almost palpable when discussing oyster restoration. This sense of urgency may contribute to some willingness to consider use of the non-native. There may also be reduced anxiety surrounding the potential invasiveness of the oyster as the scientific studies underway are completed and shed light on some of the questions surrounding *C. ariakensis*. We heard this opinion in statements like, "Clearly we have to make a decision with some residual uncertainty but I believe we will be able to have some reasonable confidence."

Still, we find an overall loyalty to the native oyster, coupled with very pragmatic concerns about its future (Paolisso, Herman and Dery 2006). We heard statements such as, "There is something special about the native oyster, it is important to the imagery of the Bay, and people around here care about it. No one wants to lose the native." Also, those who are knowledgeable about the plight of the oysters recognize that there are other factors besides disease that are hurting the Bay, including pollution, sewage treatment, residential-based chemical runoff, agriculture, etc. In this context, the importance of the native oyster is as a symptom or sign of the Bay's larger problems.

6. Conclusions

In this report, we have presented findings on the cultural value of oyster restoration and the socioeconomic importance of different approaches to oyster restoration for a diverse range of Chesapeake Bay stakeholder groups. These stakeholder groups include commercial watermen, aquaculture growers of oysters, shellfish processors and shippers, scientists investigating oysters and marine-estuary ecosystems, environmentalists who are active in Chesapeake restoration, recreational fishers, and owners of seafood restaurants in the region.

We consider each of these groups to have a vested interest in oyster restoration. Watermen, growers, processors/distributors and restaurant owners all draw some amount of income or revenue from the sale of oysters. Recreational users access the Chesapeake for pleasure or enjoyment, and they have a strong voice in Bay politics. Scientists spend their lives studying oysters and/or Bay ecology, and the information they produce is used to determine policy. Environmentalists are often directly involved in restoration projects, lobbying for restoration policies they support, or otherwise taking actions that affect oyster populations. For each of the seven groups, we pursued parallel lines of inquiry in both Maryland and Virginia.

From the beginning of our research in the summer of 2004, we have been committed to a holistic and comparative approach that would allow us to collect and analyze comparable information across a wider range of stakeholder groups concerned with the Chesapeake oyster population and fishery than have been studied in the past. Our ethnographic approach includes literature reviews, informal and structured interviews, extensive participant observation, and two cumulative surveys. The first survey, distributed in 2004, was designed to collect information on different groups' views of oysters and oyster restoration. Some of the perceptions we captured were at a general level, reflecting both stakeholder interest in the topic and a desire for more detailed knowledge of oysters and oyster

restoration. The second survey, distributed in January of 2007, was designed to obtain additional descriptive information about our stakeholder groups. We also refined and tested ideas about possible cultural models of oyster restoration and investigated the existence and distribution of hypothesized impacts of the EIS action and the alternatives.

The stakeholder groups we studied have socio-demographic and economic characteristics that are relevant to the delineation of cultural value and socioeconomic impacts. First, the watermen, growers, processors, who are the stakeholders most dependent on the outcomes of oyster restoration for the livelihoods, are generally middle age and upward, experienced and very knowledgeable, economically and personally committed to harvesting, growing and/or processing oysters, hopeful that the native oyster can be restored and ambivalent about introducing a non-native oyster now, supportive of restoration for ecological reasons (as the necessary base for their economic livelihood), and entrepreneurial in their spirit and belief that with hard work and commitment, supported by good science and the right policies, oysters can support families and communities and provide ecological services.

The respondents in our scientist study group are also very experienced with oyster restoration and other estuary environmental issues. As a group, they believe that restoration with the native oyster can be achieved, though they also feel that such restoration can only be accomplished at a much smaller scale and for particular locations, which would provide valuable scientific insights and local environmental benefits. Scientists were in strong agreement that we should not introduce a non-native oyster at this time, and that much more research needs to be undertaken before such an introduction, which would require significant funding levels.

The environmentalists who participated in our study represent diverse interests within a network of non-governmental organizations actively engaged in addressing a wide range of environmental concerns for the Chesapeake. They tend to be slightly younger and with fewer years

experience with the Chesapeake Bay compared to scientists. They are supportive of native oyster restoration, but not completely against a non-native oyster, though very concerned about "knowing enough" before proceeding. They are supportive of maintaining the wild fishery and aquaculture as restoration alternatives, and value small or localized restoration actions that result in localized reductions in pollution and improvement in water quality.

Recreational fishers and owners of seafood restaurants, the latter as proxies for the seafood eating public, are representative of the public that has contact with the Chesapeake Bay through recreation and the consumption of seafood. They exhibit only a very general level of understanding of oysters and oyster restoration. Rather, they value oysters as part of a broader, healthy and economically-productive Chesapeake Bay. Members of this group are split on whether to continue to restore the native oyster population or introduce a non-native oyster. They simply do not know, but are hopeful that science can provide guidance on which course of action will be most productive with the least amount of risk.

Finally, it should be noted that all of the stakeholder-study groups felt that some form of oyster restoration was necessary. Regardless of level of experience, economic dependence, position on native versus non-native oyster, all felt that the current low levels of oysters in the Bay, coupled with the Bay's water quality and habitat-ecological problems, necessitated human intervention that hopefully one day would result in a self-sustaining population, once the problems of the oysters' environment in the Bay were addressed.

Cultural Value of Oyster Restoration

Because of this interest in and benefit from oysters and oyster restoration across all stakeholders, we also focused on the cultural value of oysters and oyster restoration. Of the many approaches to the study of culture and to defining cultural value we selected the cultural model

approach for a number of reasons. First, we wanted to investigate how similar or different were our study groups in their beliefs and values about oyster restoration. This investigation was done at two levels. At a very explicit and descriptive level: what did informants tells us about what they knew, believed or valued about oysters and oyster restoration? At another level, what is it that they have to know or believe in order to tell or show us what they did? In the latter focus, our interest is in identifying cognitive schemas or templates for organizing the explicit information. As we described in Chapter 3, cognitive templates or cultural models are more tacit than explicit. They are the knowledge and information that people assume or take for granted. It is what they do not question explicitly.

Applying the approach described in Chapter 3, we identified what we feel is an important cultural model for oyster restoration. We have labeled this cultural model "Oyster Restoration for Multiple Needs." A diagram of this model is presented in Figure 4.1. What we believe is significant about this cultural model, and to a degree implicit and tacit, is not that it includes well-known oyster restoration benefits of ecology, economy and culture, or that it includes well-known factors or requirements such as policy, science and recognition of natural cycles, but that these factors and benefits are understood by all stakeholders as an integrated whole, if oyster restoration is to be successful. Ethnographically, our understanding is that you can increase oysters, perhaps in aquaculture or on managed reserves and sanctuaries alone, but that is not the restoration that stakeholders implicitly understand as what is needed for the Chesapeake Bay, based on their responses to our questions and our observations. Rather, oyster restoration should be an integrated approach, that provides ecological, economic and cultural benefits, and it will take science, policies and recognition that nature will have its management role, too, to accomplish it. We found widespread agreement and support across study groups for the importance of these benefits and requirements (80-98% of study groups agreed). Individual stakeholders and their groups do exhibit preferences or even priorities, consistent with their relationship to the Chesapeake and oyster restoration. For example, watermen

place emphasis on oyster restoration to bring about economic improvement in the fishery, but they do not do so at the cost of de-valuing or not supporting restoration for ecological and cultural benefits. Comparable weightings of preferences within an integrated mix of benefits can be found for all our study stakeholder groups.

Moreover, we found evidence of a shared system of underlying cultural beliefs for this model of restoration for multiple benefits, through the cultural consensus analysis. Because the cultural consensus analysis evaluates agreement across all questions, the findings further support results from interviews and specific survey questions that showed high support for ecological, economic and cultural significance of the oyster. Respondents reported all benefits (ecological, economic or cultural) as important. Restated, respondents place high value on the oyster's multiple benefits, which explains why this natural resource is so important to Chesapeake Bay stakeholders. Correspondingly, there is strong agreement that today's oyster populations in the Chesapeake Bay are not self-sustaining, given the environmental and harvest pressures, past and present. Thus, there needs to be science-based policies and consideration of natural cycles.

The qualitative and quantitative information presented in this report supports the argument that stakeholders across the study groups value the ecological, economic and cultural benefits of oyster restoration. From a cultural model perspective, the results suggest that in thinking about oyster restoration, what is taken-for-granted, or more implicit than explicit, is that efforts to increase the number of oysters in the Bay should be designed to create ecological, economic and cultural benefits. If efforts to restore oysters, through policies and science and attention to natural cycles, do not result in some "triple" benefit, then culturally, according to the model presented here, they are not what people really mean by oyster restoration. That is not to say that there cannot be increases in oysters, with ecological or economic or cultural benefits. However, such independent benefits do not fit respondents' shared cultural model of oyster restoration for multiple benefits.

Socioeconomic Impacts of Oyster Restoration

We asked each stakeholder group about the impacts of the proposed EIS action (introduce a non-native oyster into sanctuaries or reserves with continuation of native oyster restoration) and alternatives to this action (e.g., maintain existing restoration practices, expand native oyster restoration, expand aquaculture of native and/or non-native oyster, impose a harvest moratorium). The criteria we used to evaluate impacts varied by each stakeholder group. For watermen, we asked about impacts on harvesting; for growers, processors and shippers, we asked about impacts on profitable business activity; for scientists and environmentalists, we asked about impacts on research and environmental advocacy, and for recreational fishers and restaurant owners, we asked about impacts on recreational use and consumption of seafood, respectively. What is common to all these questions is a focus on the impact that most directly or indirectly affects each group's involvement with oyster restoration. For some groups and for some questions, the reported impacts did not vary significantly, or the impact was not considered of any magnitude. However, there were a number of noticeable impacts, as described below.

For the action of introducing a non-native oyster (*C. ariakensis)* into sanctuaries/reserves with or without continuation of native restoration, we found that watermen do not believe that this restoration will increase harvests of oysters and may in fact, if native oyster restoration strategies are discontinued, result in a decrease in oyster harvests. The oysters that will be available on the reserves to be harvested will be too few and the fuel and time costs will be too high. Similarly, about 40% of the growers reported that they did not anticipate any increase in business resulting from the introduction. Processors, however, were a little more optimistic, with about half seeing a business benefit, and about half not seeing economic gains from this restoration action. And, as mentioned earlier, scientists expressed concern that the introduction would require much more research at a

significant cost, and were almost uniformly opposed to the action until such research could be completed.

For the EIS alternative of expanding native oyster restoration, again primarily in sanctuaries and reserves, we again found that most watermen did not see any immediate or near-term economic benefit of this alternative. Growers and processors held views similar to their perspectives on introducing a non-native into the reserve and sanctuary system, although a slight majority of growers believed their business would increase. Scientists felt that this strategy presented few ecological risks and would be the least costly in terms of research needs and funding. We also found that recreational fishers and restaurant owners were supportive of expanding native oyster restoration. We do not feel that members of either of these two groups were sufficiently informed to understand any of the harvesting limitations associated with reserves or that the sanctuary and reserve system is very small compared to the area in public oyster bottom.

In terms of the expand aquaculture alternative, for both native and non-native oysters, watermen were equally divided on whether the market for wild oysters would be positively or negatively affected. Growers and processors, not surprisingly, did see clear benefits from expanded state efforts to support oyster aquaculture. Both scientists and environmentalists believed that there probably was sufficient research to guide the expansion of oyster aquaculture, which they also felt could provide local environmental benefits.

Finally, in terms of the harvest moratorium alternative, almost half of watermen report it would be very difficult to return to the fishery after only 2-3 years of a harvest moratorium; after seven years the percentage increases to 68%. Most of the growers in Maryland and about 1/3 of the growers in Virginia believe a harvest moratorium will negatively affect their businesses. About 80% of processors see their business being negatively affected by a harvest moratorium. From the positive side, scientists and environmentalists are in favor if it is to accomplish necessary ecological goals, and

recreational fishers and restaurant owners are also in favor of a harvest moratorium, with the latter seeing consumers willing to pay more for seafood so as to compensate watermen for their lost income.

Cultural and Socioeconomic Combined

We have attempted in this report to present much of the background, descriptive and cultural model information on the cultural and socioeconomic impacts of oyster restoration in general, and the proposed action and alternatives under evaluation by the EIS specifically. This report provides a baseline of descriptive and analytic information that can be used to refine and develop more specific analyses, particularly as the action and alternatives are better defined by inclusion of the ecological risk and economic modeling information. As such, it has emphasized the presentation of variability and summary findings, rather than selected, focused analyses. Such analyses at the action and alternative level, with detailed ecological and economic data, represent the next stage in our analysis.

In conclusion, it is helpful to step back a little from the details of the data presented above to offer some overarching conclusions. First, as we have progressed through this research, we have come to believe that oyster restoration means many things to many people (Paolisso, Dery and Herman 2006). There are dimensions of scale and time frame; there are variations in knowledge and involvement with oysters; and there is a shared sense of oysters as an indispensable part of the Chesapeake Bay, and therefore their restoration can only be a positive. Thus, there is widespread support and willingness to allocate public funds, but "the devil is in the details." Still, there is a recognized value to all of the multiple roles that oysters play, and a belief that oyster restoration should and can achieve that holistic goal.

Related, our ethnographic sense is that there are no "great oyster expectations" among stakeholders, but rather that stakeholders seek modest and incremental improvement, a sense that we are "headed in the right direction." Oyster restoration in the Chesapeake Bay has been a challenging

undertaking for decades, with short-term successes too often followed by unanticipated problems that have led to long-term declines in population and harvests. There is a palatable feeling of frustration, coupled with a longing and hope that "if we could just 'fix' [x] problem, we'd be much better off." Most of this hope and expectation is localized, where stakeholder groups or combination of stakeholder groups represent potential sites for a combination of oyster restoration strategies. These localized restoration strategies and efforts could also benefit from the significant increase in dissemination of research findings on the ecology, economics and cultural aspects of oyster restoration that has been produced by the EIS.

Finally, more than any other species in the Chesapeake, and perhaps more than any other natural resource (e.g., clean water), oysters and their restoration have great potential to connect diverse groups to the Chesapeake Bay. This connection can occur along many pathways and carry multiple messages and types of information. The Chesapeake Bay's environmental challenges are significant, and require an active and informed citizenry to support and participate in efforts to restore, use and preserve the natural and cultural heritage of the Chesapeake. An approach to oyster restoration that is holistic, with focus on the ecological, economic and cultural, is a powerful medium through which to foster stakeholder involvement and ownership of efforts to protect and manage the Chesapeake in a sustainable and inclusive manner.

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Appendix 1: Methodological Notes

1. The EIS process itself has been modified over time, with adjustments made to the schedule for public release based on the availability of certain data (e.g. oyster larval transport model results). Accordingly, the time available for our data collection and analysis has also been amended. A draft EIS is now scheduled for release in May 2008. A final EIS is anticipated in the fall of 2008.

2. In our cultural model work over the past five years, we have not argued against a community-based approach to cultural analysis, but rather argued for two related, more specific points: First, the dominant focus on place-based/community culture has biased our cultural understandings to communities that we link somehow to our heritage, such as watermen or farmers, or more broadly to geographic place, with something called "Bay Cultures." While these cultures are certainly present and the community-based approach is of great value, it also leaves a lot out. Of significant interest to us is that it leaves the "cultures" of the increasing number of users (for recreation and ecological reasons), of managers/scientists, and of the diverse "public" out of the culture equation, if you will. Accordingly, we feel culture should be a very specific variable in our scientific research in support of Chesapeake Bay restoration and management.

3. Stakeholder specific methods were used to identify survey recipients and were geared toward maximizing response rates. We refined our sampling strategy in the second survey to pursue those stakeholders that were best able to respond knowledgeably to our questions.

Watermen: In the first survey, watermen from Maryland were identified by the possession of a Maryland Department of Natural Resources issued license, entitling them to oyster commercially.[6] In the second survey, we refined this sample to those who held licenses and reported harvest in the past five years. In both surveys, Virginia watermen were identified by a Virginia Marine Resources Commission license entitling the licensee to be in possession of oyster harvesting equipment.[7] Many were returned by watermen who were no longer oystering, growers who had not been growing oysters, processors who were not processing oysters, and members of all groups who had relocated.

Recreational Users: Recreational fishers were also identified by possession of a recreational boat registration and a recreational fishing license to catch in tidal areas. In both surveys, separate random samples of fishers residing in Maryland and Virginia were selected from a Maryland database of recreational license holders. In Virginia, recreational fishers are allowed to catch one bushel of oysters and one pot of crabs per day without a license. There was consequently no comprehensive way to access those fishers who are active in Virginia, with the exception of those who hold licenses in Maryland.

Environmentalists: In the first survey, environmentalists were identified by their membership or employment in either the Chesapeake Bay Foundation, a non-profit that works on environmental issues bay-wide, or the Tidewater Oyster Gardeners Association, which is a Virginia-based non-profit supporting recreational aquaculture. In the second survey, only environmentalists working for or volunteering for a list of 44 environmental groups were

[6] This license is called an OYH License. It costs the licensee $50.00 annually and is part of the limited enrollment program. License holders are subject to day and time restrictions on harvest.

[7] Virginia oyster licenses are issued according to equipment type. In order to use an oyster dredge on public ground, a licensee must pay $50.00 annually. In order to use double patent tongs, a licensee must pay a fee of $70.00 and a fee of $35.00 to use single patent tongs. Hand tongs require a licensing fee of $10.00.

included. Each of these 44 groups works on water quality issues or oyster restoration specifically. We received responses from people working or volunteering at 18 of the 44 organizations.

Scientists: In the first survey, scientists were identified through their association with scientific groups who are actively working on Bay issues, including the Blue Crab Technical Advisory Committee (44), the Bay Program's Living Resources Committee plus additional members from the Scientific and Technical Advisory Committee, and participants in the workshop hosted by the Bay Program in December of 2003, entitled *Identifying and Prioritizing Research Required to Evaluate Ecological Risks, Benefits, and Alternatives Related to the Potential Introduction of Crassostrea ariakensis to Chesapeake Bay.* In the second survey, only scientists who are members of STAC or who are actively producing research for the EIS were included. We felt these scientists were better equipped to respond to questions about oyster restoration than those in the broader scientific community.

Seafood Consumers: In the first survey, the seafood eating public was identified by their participation in the annual Maryland Seafood Festival, held on September 10-12, 2004 in Sandy Point State Park in Annapolis, Maryland. We set up a table at the festival, with information regarding the proposed action and alternatives for oyster restoration. We spoke with people who were interested and requested they respond to the survey. There are no calculations of how many people attended the festival. In the second survey, we sought out restaurant owners or managers who have substantial knowledge of their customers' preferences and concerns. We felt that using this "expert" approach would yield a more homogenous and reliable sample. Restaurants listed in the *Chesapeake Bay Restaurant Guide and Recipe Book: A Selection of the Best from the Upper, Middle, and Lower Bay, Its Tributaries and the Eastern Shore* (Eanes 1996) were included.

Industry Members: In the first survey, industry members in both Maryland and Virginia were identified by the possession of a license entitling them to ship shellfish across state lines. A list of license holders was compiled and provided to us by the Interstate Shellfish Commission. Accordingly, the industry members who received the agreement questionnaire included not only processors, but also oyster retailers, wholesalers, and shippers of shellfish. We aimed to include only those industry members dealing directly with oysters in the second survey. Oyster processors in Virginia are licensed specifically as oyster shucking houses so we were able to target them directly. In Maryland, no such specific license exists. Rather, shellfish firms are licensed with one of the following designations: Shucker/Packer, RP-Repacker, SS-Shellstock Shipper, or RS-Reshipped. Since no distinction is made between firms processing or distributing oysters and those processing or distributing other shellfish, we asked all licensed firms to respond, but only included those that are oystering in the final sample.

Aquaculturalists: Oyster growers (second survey only) in Maryland were identified with the help of the Aquaculture Coordinator at the Maryland Department of Agriculture. While we were able to obtain a list of all Chesapeake Bay bottom leaseholders in Maryland, the great majority of these leaseholders is not actively engaged in aquaculture and would have therefore been inappropriate respondents. Oyster growers in Virginia hold a specific oyster planting ground lease. Although this is a lease specific to oyster ground, many leaseholders hold leases that are not actively involved in oyster aquaculture. Upon the recommendation of the Fisheries/Aquaculture Specialist at VIMS, we selected those leaseholders who were holding their leases in the name of a seafood business to receive the survey. Despite this attempt to capture the correct sample, some targeted respondents were not growing oysters.

4. Versar, Inc. is responsible for producing the Ecological Risk Assessment, while Dr. Doug Lipton at the University of Maryland College Park is responsible for conducting the Economic Assessment. Each of the three assessment teams will be involved in developing a comprehensive, integrated analysis for the EIS. All of the research projects conducted in support of the EIS and each of the assessments benefit from peer review.