Evaluating Oyster Gardening Programs of the U.S. Gulf and Atlantic Coasts

by

Phillip Lynch Waters, Jr.

A dissertation submitted to the Graduate Faculty of
Auburn University
in partial fulfillment of the
requirements for the Degree of
Doctor of Philosophy

Auburn, Alabama
May 2, 2020

Keywords: oyster gardening, volunteer, change in knowledge, motivation, program evaluation, volunteer retention

Approved by

William C. Walton, Chair, Professor of Fisheries, Aquaculture and Aquatic Sciences Daniel R. Petrolia, Professor of Agricultural Economics
James E. Witte, Professor of Educational Foundations, Leadership and Technology
Russell A. Wright, Associate Professor of Fisheries, Aquaculture and Aquatic Sciences

Abstract

We investigated oyster gardening programs along the Gulf of Mexico and Atlantic coasts (United States) for their organization, volunteer makeup and their capacity to change the perceived knowledge of participants. Further, we investigated participant motivation to join an oyster gardening program as well as their motivations to engage in a general activity both prior to and after joining. We found that programs within our study region may benefit from an exchange of ideas, success and failures despite their varied size and structures. Additionally, we found participants increase their perceived knowledge of oysters significantly following participation up to year five. Finally, our investigations found that participants are motivated to engage in an activity, such as oyster gardening, by the opportunity to improve their environment, to learn and to improve fishing at the gardening site. The findings described may be useful to program managers who wish to improve the efficacy and efficiency of their recruiting efforts as well as demonstrate measurable program impacts.

Acknowledgments

With great appreciation for my advisors, teachers and mentors whose guidance proved invaluable throughout this process. With sincere gratitude to the Alabama Cooperative Extension System, Auburn University School of Fisheries Aquaculture and Aquatic Sciences and Sea Grant, which provided opportunity, encouragement and funding. With love and appreciation for Tabb and Emily who gave me the time to work and their faith that the journey could be completed. Finally, to the volunteers and managers of oyster gardening programs who continue to work to improve their local environment, thank you for the opportunity to look more closely at what moves you toward oyster gardening.

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List of Abbreviations

ALLL	Alabama: Little Lagoon
ALMB	Alabama: Mobile Bay
CHOP	Maryland: Choptank River Alliance
DEL	Delaware
FLAC	Florida: Atlantic Coast
FLGOM	Florida: Gulf of Mexico
GOM	Gulf of Mexico
MDCBF	Maryland: Chesapeake Bay Foundation
MS	Mississippi
NH	New Hampshire
OG	Oyster Gardening
OGP	Oyster Gardening Program
TOGA	Virginia: Tidewater Oyster Gardening Association
TX	Texas: Galveston Bay
VACBF	Virginia: Chesapeake Bay Foundation

Chapter 1
Oyster gardening programs, volunteer maintenance and their role in oyster reef restoration and education efforts

Oyster Gardening Programs

Oyster gardening programs (OGPs) are typically coordinated programs involving volunteers actively participating by providing care for juvenile oysters (spat) to produce larger individuals for planting on local or regional restoration reefs. Additionally, through their participation, volunteers become familiar with the roles of oysters and oyster reefs found in their local estuaries. These oyster gardening programs (OGPs), often led by Cooperative Extension, Sea Grant or non-governmental groups, employ a variety of approaches to achieve their restoration and educational goals. Brumbaugh et al. (2000) and Brumbaugh and Coen (2009) reported more than a dozen oyster gardening programs, considering them effective public relations and restoration tools with one location recording an increase in spat settlement following the planting of oysters produced by volunteers. Though these programs are limited in capacity by the volunteer numbers, Brumbaugh et al. (2000) pointed out the usefulness of even moderate numbers of restored oysters.

The following summary includes pertinent literature focused on volunteer recruitment and retention practices and limitations intrinsic to extension and outreach programing with specific focus on oyster gardening programs. Additionally, we discuss the use of original survey tools in this study to investigate the questions relative to these efforts employed by OGPs

Restoration Efforts in the United States

A variety of restoration efforts have been undertaken to reverse and/or mitigate ecological losses, man-made or natural, and the corresponding impacts on species, ecosystems and the services generated. A simple Google search for 'restoration project' returns 35.7 million hits (Google, 2018). Plants (Joe and Daehler, 2008), animals (Mazerolle et al., 2006), and ecosystems (Schieme et al., 1999; Bernhardt et al., 2005; Hassett et al., 2005) all have efforts dedicated to slowing or reversing degradation. Three general characteristics of these restoration efforts emerge including an objective of seeing their target (plant, animal, ecosystem, etc.) returned to a healthier state (however defined), a heavy reliance on volunteers, and a tremendous percentage of spent capital and time investment dedicated to identifying, training and maintaining their volunteer base to continue to support their objectives (Grese et al., 2001).

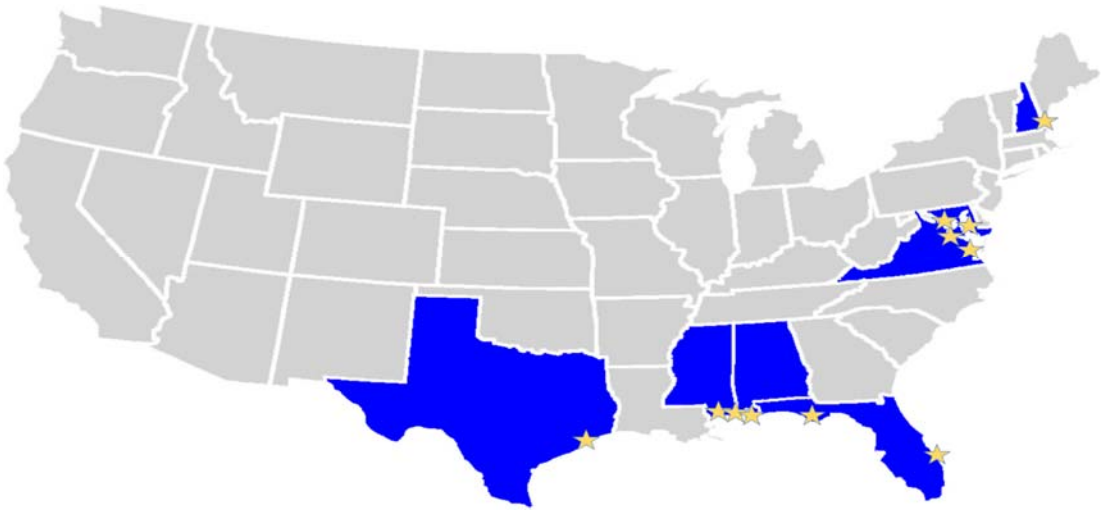

Figure 1. States within the study region which have active OGPs. Stars indicate general location of study programs.

Oyster gardening programs share many of the same concerns and objectives as other volunteer-based restoration programs. They are focused on the condition of local oyster

reefs and are volunteer dependent. As a result of this dependence, they allocate a large portion of time and capital assets to volunteer maintenance. In Alabama and Mississippi, 71% of the three-year cost for a gardening site is incurred the first year. If a volunteer leaves after the first year, a program would need to reinvest the initial startup costs in a replacement gardener to maintain gardening site numbers. Additionally, a program incurs costs associated with ongoing communication with existing gardeners (often in the form of newsletters) and routine site checks to maintain a connection with gardeners, make repairs, and to ensure that the season will be successful. Included among these costs are salary, benefits and travel related expenses that must be factored into the total cost of a program. These costs continue to rise over time resulting in greater importance to program administrators to maximize the return on investment of resources such that the priorities of a program will be met. Ensuring these investments are allocated efficiently is not only critical for the effectiveness of the program, but essential for the reputation of the program with its volunteers, supporters and funding sources.

Oyster Restoration

Lotze et al. (2006) and Airoldi et al. (2008) noted that human impact on estuarine and coastal ecosystems has increased in the last three centuries with increasing pollution, introduction of invasive species, effects of harvest, shoreline armoring, dredging, and other forms of habitat degradation and loss. As species diversity declines and habitat changes occur, a corresponding decline in at least some ecosystem services is inevitable (Dame, et al. 2002). Bivalve mollusks are vulnerable to overharvest and subsequent

depletion throughout the world's estuarine ecosystems (National Research Council, 2010). Widespread oyster reef loss has been well documented around the globe (Lotze et al., 2006; Grabowski and Peterson, 2007; Brumbaugh and Coen, 2009; Powers et al., 2009; Schulte et al., 2009). Beck et al. (2011) noted that globally 85% of oyster reefs have been lost and as much as 94% of oyster reefs are functionally extinct. Newell (1988) reported a decline in oysters from the Chesapeake, pre 19th century, of more than 99%. Ermgassen, et al. (2012) reported that in half of the estuaries of the United States' North East coast, which they surveyed, less than six percent of historical oyster extent remains. They also found declines of
86% in the Gulf of Mexico ($14/m^2$ to $2/m^2$) within their study sites. As these estuarine environments lose their populations of oysters, the loss extends beyond that of a single food source.

Brumbaugh and Coen (2009) stated that historically, oyster shell has been repurposed as walkways, driveways, roads, and jewelry, or, simply discarded as trash or debris. However, as understanding and appreciation of the value of the services provided by oysters and oyster reefs grows, particularly in communities surrounding their estuarine habitat, academia, NGOs, and local, state and national government entities, often in partnerships, have sought efficient opportunities to capitalize on the shell resource generated by consumption of oysters and support efforts focused on restoration of oyster resources. These activities include, individually or in some combination, shell recycling programs, stock enhancement, shell plantings, and citizen driven gardening programs.

Oysters provide each of the four general categories of ecosystem service, provisioning, cultural, regulating and supporting described by Fisher et al. (2007) and Raymond et al. (2009). Provisioning by oysters as a food source has been documented to the early peoples of coastal regions (Doran, 1965). Service value of oysters extends beyond their importance as food sources to include cultural roles. Defined by Raymond et al. (2009) as including a, "…sense of place…", oysters have been integral to the lives and livelihoods of humans living near estuaries for centuries as evidenced by shell mounds (Ford and Willey, 1941), shell-based tools (Steponaitis, 1986), jewelry (Brumbaugh and Coen, 2009) and shell construction materials important to local communities throughout the centuries.

Regulating services are derived from oysters' feeding and reef building activity. Oysters are filter feeders and are reported to retain 57% of particles as small as 1.7μm and exceed 90% efficiencies when particle sizes approach 3.5μm (; Haven and Morales-Alamo, 1966; Palmer and Williams, 1980). Further, the presence of oyster reefs can help dissipate wave energy and naturally armor sensitive coastal zones shoreward yielding erosion control and shoreline stabilization (Meyer et al., 1997; Stone et al., 1997 and 2005; Grabowski et al., 2012; LaPeyre et al., 2014).

Finally, supporting services are demonstrated by the habitat benefit of oyster reefs that have been described as supporting 300 species of invertebrates and vertebrates at some point in their lifecycles (Wallace, 2002; Powers, et al., 2009; Tolley and Volety, 2005; Rodney and

Paynter 2006; Benayas et al., 2009). Peterson et al. (2003) reported a 10 m^2 restored oyster reef could increase fish and crustacean as much as 50kg over a 30-year period. LaPeyre et al. (2014) reported the decline in the quality and quantity of the habitat of estuarine systems is a driving force behind many of the restoration projects along the Gulf of Mexico and Atlantic coasts of the U.S.

In addition to the ecological benefits, restored oyster reefs have an economic value that may ultimately determine the support of funding sources for a given restorative effort. Grabowski et al. (2012) established a dollar value range of $10,325 -$99,421/hectare for restored reef, protected from harvest. They pointed to the location of a reef coupled with the services provided for the wide range in value; however, they further indicated that even the low end of the range represents a value more than ten times that of the commercial value of harvest provided by a degraded reef of the same area.

Beyond an economic or ecosystem service value of a restored oyster reef, volunteers participating in the restoration effort gain value as increased knowledge and a sense of accomplishment. These values must be established, realized and maintained for volunteer longevity (Katz 1960; Kempton, et al. 1986; Clary et al., 1998).

Volunteers in Extension Programming

Extension has increasingly incorporated volunteers as conduits of information and inspiration to other potential program participants and stakeholders (Rouse and Clawson, 1992; Rohs et al., 2002; Osborne, 2005;). Programs, that rely on volunteers,

need to ensure the individuals involved are both satisfied and effective in the program. Individuals, if given the choice, are unlikely to continue to allocate time to an activity which does not return some level of benefit to the self. Kempton (1980) explored the idea of volunteers in Extension programs and surmised that the ability to further a program constitutes only one part of the motivation to volunteers. He pointed out the individual also has needs related to the volunteerism which must be met. Terry et al., 2013 drew a parallel between volunteer retention and customer loyalty. They concurred with Tyler (1966); Kempton (1980) and Hart (2005) in that successfully meeting the needs of the volunteers, manifests in improved volunteer retention.

The areas of perceived benefits to volunteers reported in Extension programming are similar to those of other, non-Extension related, volunteer opportunities. Benefits including additional knowledge, understanding, training, skill building, social, career development, and member status associated with being a part of a program are reported (Culp, 2009; Farris et al., 2009; Akin et al., 2013; Schrock and Kelsey, 2013). Fritz et al. (2003) and Culp and Schwartz (1999) noted that recognition of the program the individual volunteered for and/or the work that was done by the program or organization was perceived as a benefit to the volunteer. One of the most logical motivational reasons for volunteerism is rooted in altruism (Schmiesing et al., 2005; Farris et al., 2009; Washburn et al., 2015) as described by Clary et al. (1998) is also found in literature focused on Extension volunteerism. Volunteer opportunities that are viewed as purposeful (Rouse and Clawson, 1992), making a difference (White and Arnold, 2003), accomplishing objectives (Spoto, 1999; VanWinkle et al., 2002; Akin et

al., 2013), empowering and inspiring (Sinasky and Bruce, 2007; Akin et al., 2013), beneficial to the community (Braker et al., 2000; Cleveland and Thompson, 2007; Farris et al., 2009; Akin et al., 2013) contain attributes which satisfy the altruism based need of volunteers.

Fry and Langellotto (2013) highlighted symptoms of programs which retain problematic volunteers including overall reduction in volunteer productivity and morale leading to the loss of individual volunteers. Tyler (1966) referred to a lack of information about the volunteer need, a lack of training, a stagnation which results in a lack of opportunity to grow in the program, supervisory shortcomings, a volunteer need which is not flexible to the individual's schedule and a change in the needs of the volunteer which go unmet as contributing factors to volunteer failure. Some volunteer failure events are to be expected in each opportunity. However, understanding and meeting the needs of the volunteers (Leslie et al., 2011), providing ongoing support for the motivation behind the decision to volunteer and providing the flexibility for the individual to adapt to their changing conditions will reduce the failure rate in any program.

Objectives for this Dissertation

This work will provide OGPs, and environmental based Extension efforts in general, insight into those values important to volunteers of such programming that may be utilized to improve recruitment and retention. From the published literature it is unclear how efficacious OGPs are in changing perceived knowledge of participants. It is also not clear what aspects of OGPs are most valuable to attract potential volunteers or what motivates exiting

volunteers to stay in a program. Addressing these gaps in information will allow managers to share knowledge among programs, report stronger accomplishments valuable to potential funders and improve programmatic recruitment and retention efforts. Two original survey questionnaires were developed to collect information from both OGP managers and participants. This work uses these questionnaires to address three primary research questions.

1) What similarities and differences exist by program, and region in terms of programmatic structure, geography and volunteer demographics? (Chapter 2)

2) Do individuals demonstrate a change in perceived knowledge by participating in an OGP? (Chapter 3)

3) What motivates individuals to initially join and continue to participate in an OGP? (Chapter 4)

Definitions

Anoxic	A condition with no measurable oxygen.
Dead zone	An aquatic area of hypoxic or anoxic conditions generally associated with excessive algae growth. They are often generated by nutrient inputs from point and non-point sources within the watershed. Mobile aquatic organisms will attempt to escape and sessile aquatic organisms will perish following extended exposure to these regions.
Ecosystem	The sum of all organisms living in an area and the non-living components with which they interact (Campbell 1993) and (Chapin et al., 2002).
Ecosystem Services	"[T]he aspects of ecosystems utilized (actively or passively) to produce human well-being." (Fisher et al., 2007, p. 5)
Estuary	"…a partially enclosed coastal body of water that is either permanently or periodically open to the sea and which receives at least periodic discharge from a river(s), and thus, while its salinity is typically less than that of natural sea water and varies temporally and along its length…" (Potter, et al. 2010; p. 497)
Hypoxic	A condition of low dissolved oxygen.

Oyster Gardening	A volunteer-based program in which individuals and groups provide protective nursery environments for hatchery reared or wild caught oyster spat before being planted on, or used to create, restoration reef sites. Oysters are generally not for consumption.
Spat	Juvenile oysters generally less than 25mm in size.
Volunteer	An individual who dedicates their time to an endeavor without the expectation of monetary compensation.

Conclusion

In response to the documented decline of oyster populations (Ermgassen, et al., 2012), OGPs are uniquely positioned to expand awareness in their volunteers of the current condition of oyster populations and engage them in active efforts to restore oyster reefs at a local level. However, OGPs, like all volunteer-based programming, must ensure that both the needs of its volunteers and its programmatic objectives are satisfied. A more complete recognition of volunteer needs will help program managers focus recruiting and volunteer maintenance efforts. The results will include a stronger volunteer base and a reduction in volunteer failure events. Further, additional program time and capital investment can be directed to program growth, rather than volunteer replacement. Finally, OGPs that can report strong impacts, both ecologically and educationally, may be more successful with ongoing funding.

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Chapter 2

Evaluating Oyster Gardening Programs for Program Organization, Operation and Participant Demographics

Abstract

We evaluated oyster gardening programs from the Gulf of Mexico and Atlantic coasts (United States) for program structure, organization and participant demographics. While geographic, intensity and general program size varied, we found similarities among programs and regions. These similarities suggest successes may be replicated across programs and regions. Consequently, sharing ideas, successes and failures may yield benefits to oyster gardening programs throughout the study region.

Key Words: oysters, oyster gardening, volunteers, restoration, program engagement, program structure

Introduction

In the United States, a variety of restoration efforts are undertaken to reverse and/or mitigate ecological losses and the corresponding impacts on species, ecosystems and the services generated for the benefit of human beings. Plants (Joe and Daehler, 2008), animals (Mazerolle et al., 2006), and ecosystems (Bernhardt et al., 2005, Hassett et al., 2005, Schiemer et al., 1999) all have efforts dedicated to slowing or reversing their degradation. Three general trends emerge, including an objective of seeing their target (plant, animal, ecosystem, etc.) returned to a healthier state, however defined,

the heavy reliance on volunteers as well as a tremendous percentage of spent capital and time investment is directed toward identifying, training and maintaining their volunteer base to continue to support their objectives (Grese et al., 2001). The US Fish and Wildlife Service (2017) reported more than 42,000 volunteers in their fisheries related activities provided more than 1.5 million hours of labor. This contribution can provide a valuable resource to project managers who face limited funding. Further, a strong volunteer base can be leveraged to create political support and public education opportunities related to the importance of the work (Leslie et al., 2004).

Throughout the U.S. Gulf of Mexico and Atlantic Coastal region, Cooperative Extension programs, Sea Grants and varied non-governmental organizations have developed volunteer-based programming which involves individuals providing care for juvenile oysters prior to their being planted on restoration sites in local waters. Though the approaches to this programming vary in style and intensity, oyster gardening as we term it, involves volunteers playing an active role in educational programming with both a learning and restorative objective. We investigated the structure and operational strategies of these programs as well as the general characteristics of participants.

Methods

An original questionnaire, approved by the Institutional Review Board at Auburn University, was developed to collect information from program managers about their program's organization and style. A second, original questionnaire was developed to collect participant information covering their interaction with their programing as well as their demographic information. The survey area included programs located along the U.S. Gulf of Mexico and Atlantic coasts (Table

1). Twelve oyster gardening programs were identified within the geographic range, eleven of which provided a completed response to the program-focused survey. Additionally, participants from eleven of the twelve identified programs within the geographic range provided responses. In total of 1,114 self-identified oyster gardeners (current and former), valid responses were received from 279 participants (25.0% overall response rate; Table 1). Face and content validation by an expert panel conducting a Delphi analysis was completed prior to electronic administration (Skulmoski et al., 2007). Program managers were contacted directly via electronic mail and/or phone conversations through which the focus of the investigation was introduced and an invitation to participate on behalf of their program was extended. Program participants engaged in the survey through electronic administration by way of an electronic mail invitation directly from the respondent's oyster gardening program. This allowed respondents to participate fully, independent of distance, without the need for an administrator and maintained respondent anonymity. The sampling procedure was probability based, stratified and random.

Respondents self-identified as current or former members of a local oyster gardening program as well as identified which program with which they associated. Respondents were then classified into regions based on their identified program affiliation. The strata were defined by program or region (Gulf of Mexico, Atlantic (less Chesapeake) and Chesapeake). Statistical analyses were conducted using IBM's Statistical Package for Social Sciences version 25.

Table 1. Survey respondents self-identified their program which was used to generate region classification for this study as well as their status as a Current or Former participant. Survey response rate was calculated based on program leadership reporting of total membership

State	Program	Reference Abbreviation	Region	Current Gardener	Former Gardener	Response Rate (Total Participants)
Texas	Galveston Bay	TX	Gulf of Mexico	13	0	15.7 % (83)
Mississippi	Mississippi	MS	Gulf of Mexico	5	0	55.5% (9)
Alabama	Mobile Bay	ALMB	Gulf of Mexico	32	11	46.7% (92)
Alabama	Little Lagoon	ALLL	Gulf of Mexico	15	0	60.0% (25)
Florida	Gulf of Mexico	FLGOM	Gulf of Mexico	4	1	33.3% (15)
Florida	Atlantic Coast	FLAC	Atlantic	45	9	25.5% (212)
Virginia	Chesapeake Bay Foundation	VACBF	Chesapeake	79	3	27.3% (300)
Virginia*	Tidewater Oyster Gardening Association	TOGA	Chesapeake	12	0	-
Maryland	Chesapeake Bay Foundation	MDCBF	Chesapeake	19	5	20.0% (120)
Maryland	Choptank River Alliance	CHOP	Chesapeake	9	0	15.5% (58)
Delaware**	Delaware	DEL	Atlantic	-	-	-
New Hampshire	New Hampshire	NH	Atlantic	17	0	8.5% (200)

*TOGA program participation limited to participants only.
** Delaware program participation limited to manager only.

Results and Discussion

Oyster Gardening Programs: Program Longevity

Oyster gardening programs can be traced back to 2001 in the study region. We found no statistically significant difference in ages of program among the regions ($F_{(2, 8)} = 0.774$, p=.493). Gulf of Mexico regions ranged in age from 1- 16 years (mean 5.4 +/- 6.43 years). Chesapeake Bay region programs reported a range in age of 6-13 years (mean 8.67 +/- 3.79 years), while the Atlantic oyster gardening programs ranged from 4 to 15 years (mean 10.3 +/- 5.69 years).

Oyster Gardening Programs: Program Size

Programs varied in size, ranging from a mean of 51.6 +/- 35.7 (range 15-92) volunteers in the Gulf of Mexico to the Chesapeake Bay region 164.7 +/- 134.7 (range 58-316) volunteers and 166.3 +/- 68.9 (range 87-212) volunteers in the Atlantic regions. This variation in program size was not statistically significant ($F_{(2, 3.144)} = 3.574$, p= .155). When considering all responding programs, 54.5% reported between 15 and 87 volunteers, and 72.7% reported less than 125 volunteers. These suggest that oyster gardening programs tend to be relatively small which may be related to the regulatory and environmental limitations required to be permitted by authorities.

Oyster Gardening Programs: Gardening Site Numbers

A variety of methods of site allocation exist among oyster gardening programs in this study. Generally, they can be grouped into two categories including community sites, whereby three or more gardening volunteers, not occupying the same residence, maintain their oysters, or are charged with the coordinated care of the oysters at a single location. The second being individual sites, whereby one or more gardener(s) manages an independent geographical location and is

charged with the maintenance of that location's oysters for the program. We found no statistically significant difference in the numbers of gardening sites by geographic region ($F_{(2, 2.68)} = 3.218$, p=.190). Gardening site numbers ranged from 4 to 46 in the Gulf of Mexico region (mean 20.8 +/- 16.4), to 4-300 for the Chesapeake Bay region (mean 120.7 +/- 157.6) and 87-212 in the Atlantic region (mean 130.0 +/- 71.04).

Oyster Gardening Programs: Spat Acquisition

Sourcing spat is necessary for an oyster gardening program. We investigated the methods programs used to acquire spat for each gardening season. Of the eleven responding programs, nine used hatchery set spat on shell while two used wild caught spat on shell.

Oyster Gardening Programs: Production

We also evaluated seasonal total oyster production of programs by region and found no significant differences ($F_{(2,7)} = 2.770$, p= .130) among the Gulf of Mexico (mean 24,195.00 +/- 16,633.25), Atlantic (mean 62,500.00 +/- 17,677.67) and Chesapeake (mean 77,333.33 +/- 54,555.78). Regional production ranges of programs each season were found for the Gulf of Mexico program (9,000- 50,000 oysters), Atlantic (50,000- 75,000 oysters) and Chesapeake Bay (30,000- 137,000 oysters) which generally follows program size as may be expected. Oyster size was statistically insignificant among regions ($F_{(2, 7)} = 0.935$, p=.437). Size ranges within the regions were found to be 5.01 +/- 1.69 cm in the Gulf of Mexico, 3.00 +/- 0.71 cm in the Atlantic and 5.08 +/-2.54 cm in the Chesapeake Bay regions.

Oyster Gardening Programs: Seasons

Eight of eleven (72.7%) programs indicated late spring-summer starts to their oyster gardening season (May-July) including all of the Gulf of Mexico programs. The remaining three programs (Maryland Chesapeake Bay Foundation (MDCBF), Maryland Choptank River (MDCHOP) and Florida Atlantic Coast (FLAC) reported late summer-fall starts (September-October). Only the Florida Gulf of Mexico (FLGOM) program and Delaware's program indicated year-round (12 month) seasons. The remainder of the programs terminate their season after 4 to 10 months. The Gulf of Mexico region, except for the FLGOM program, terminates their season in late fall to winter (October-December). Atlantic programs, except for Delaware's year-round program, terminates at a more varied schedule, likely due to weather related necessities. The FLAC program concludes in April prior to the heat of summer, while New Hampshire (NH) concludes in September, prior to the onset of winter. Delaware's activities, while year-round, start and end during the summer months of June and July. Similarly, the seasons of the Chesapeake Bay region appear to be seasonally driven, with the Virginia Chesapeake Bay Foundation (VACBF) program concluding in September, and those programs from Maryland concluding in June. No statistically significant differences were found for season lengths among regions ($F_{(2, 8)} = 0.060$, p=.942). Mean season length for Gulf of Mexico region was 7.2 +/- 2.77 months (range 5-12 months), Atlantic region 8.00 +/- 4.00 months (range 4-12 months) and in the Chesapeake regions 7.67 +/- 3.21 months (range 4-10 months).

Oyster Gardening Programs: Funding

Only one of the responding programs indicated a fee for participating in oyster gardening. The fee was modest ($25.00) and assessed each season. The fee was collected from all participants of

the program. Remaining programs rely on non-volunteer sourced capital to underwrite their respective operational costs.

Oyster Gardening Programs: Gardening Units

A variety of gardening unit types were reported by oyster gardening programs, including wire mesh boxes, soft plastic mesh bags and larger floating baskets (e.g. Taylor Floats). The majority of responding programs (81.8%) reported using smaller mesh baskets. Of the remaining two programs who did not indicate using smaller mesh baskets, one reported using the larger Taylor Float- like growing unit and one reported using soft plastic mesh bags. There was a wide range (1- 100) in the reported number of gardening units per site. However, nine of eleven programs reported a range of 1-4 gardening units per site. Two programs, Texas (TX) and MDCBF reported 100 units per site and were the same programs who each reported a total of four sites with 83 and 120 gardeners, respectively suggesting a community style gardening approach.

Production or sourcing of the gardening units was varied across the eleven reporting programs. Three programs indicated the Gardeners themselves were responsible for the construction of the gardening units, while 3 indicated the program constructed the gardening units for the Gardeners. Three programs reported having volunteers (non-Gardener) construct the gardening units while one program reported purchasing gardening units and one reported that program and gardeners together built the gardening units.

Expected time to complete construction of a gardening unit ranged from 5 to 60 minutes and averaged 27.5 minutes per unit, excluding the 0.0 minutes reported by the program which

purchases their gardening units from an outside supplier. The higher end of the range of time to construct a gardening unit (60 minutes) was reported by the program which uses the larger Taylor Float-like design, while the lower end (5 minutes) was reported by the program which uses the soft plastic mesh bags as gardening units. When considering only those programs building smaller, mesh basket style gardening units, an average of 20.0 +/- 4.69 minutes is required to produce each unit.

Oyster Gardening Programs: Gardener Training

Six of eleven reporting programs indicated they have scheduled meetings or trainings for Gardeners. Of these six, four indicated the meetings were required, but only for new Gardeners. The remaining programs reported either having no scheduled meetings or trainings during a season, or those that were scheduled were not required for their Gardeners.

Oyster Gardening Programs: Recruitment

Grese et al., 2000 indicated recruitment and maintenance of volunteer bases were a key component to the success of a volunteer-based program and commands a significant portion of the time and capital investment of a program. We asked each of the programs to identify the avenues of recruitment they utilize among the choices provided which included word of mouth, media (TV, radio), presentations/speakers, social media and other. Three of the eleven responding programs reported taking an all of the above approach, selecting each of the four specific categories, with one also reporting an "Other" opportunity through participation in fairs and festivals. Each of the eleven programs utilize word of mouth, while two of the eleven reported using only word of mouth for recruitment. Five of eleven programs reported utilizing

traditional media (TV/Radio), and eight of eleven reported using social media outlets. Finally, eight of eleven programs reported using speakers and presentations to recruit new participants to their programs. When asked about the perceived most effective recruiting methods, eight of eleven programs reported that word of mouth, while one each reported presentations/speakers, social media and mailings.

Oyster Gardening Programs: Gardener Demographics

Gulf of Mexico Region

We investigated the demographic makeup of participants which programs were successfully recruiting into their oyster gardening efforts (Table 2). Gardeners in the Gulf of Mexico region reported a mean age of 63.76 +/- 9.64 years, which was statistically significantly higher than the Chesapeake Bay ($p \leq .001$) region but was not statistically significantly different from the Atlantic ($p=.078$) region ($F_{(2, 148.989)} = 9.014$, $p<.001$). Gulf of Mexico respondents ranged in age from 36 to 78 years at the time of the survey with more than half (53.5%) of responding gardeners reporting as aged 36-67 years. The majority of respondents (58.3%) were male. Employment status indicated that the majority of respondents (61.0%) were retired, while 29.2% were employed full time and 8.3% were employed part time. When asked about their education level, 48.6% reported finishing college, with 31.9% holding graduate or professional degrees. Gross income levels reported by respondents showed 53.8% having household incomes in excess of $100,001 whereas 10.9% of respondents reported annual household gross income levels of $20,000 to $40,000.

Table 2. Demographic responses by region and program from Oyster Gardeners.

			Education		Gross Household Income (Annual)		Gender	
	Mean Age	Age Range	Finished College	Professional/ Graduate Degree	$20,001-$40,000	Over $100,001	M	F
Gulf of Mexico	63.8 +/- 9.64 [a]	36-78	48.6	31.9	10.9	53.8	58.3	41.7
Chesapeake Bay	56.9 +/- 12.49 [b]	19-79	26.4	52.1	2.7	69.9	57.0	43.0
Atlantic	59.4 +/10.02 [ab]	27-78	37.1	37.1	1.9	51.9	41.9	58.1
Texas	64.3 +/- 7.02 [ab]	46-71	83.3	8.3	9.1	63.6	41.7	53.8
Mississippi	61.6 +/- 14.84 [ab]	36-72	100.0	60.0	25.0	50.0	60.0	40.0
Alabama Mobile Bay	63.24 +/- 9.34 [a]	44-75	44.7	39.5	13.9	58.3	55.3	44.7
Alabama Little Lagoon	67.2 +/- 9.61 [a]	41-78	53.8	23.1	10.0	50.0	92.3	7.7
Florida Gulf of Mexico	58.5 +/- 13.38 [ab]	47-72	50.0	25.0	0.0	66.7	25.0	75.0
Florida Atlantic Coast	59.7 +/- 6.93 [ab]	45-73	38.3	36.2	2.6	47.4	46.8	53.2
Virginia CBF	55.2 +/- 11.72 [b]	22-79	27.2	51.9	2.6	69.7	50.6	49.4
Virginia TOGA	63.8 +- 11.04 [ab]	41-79	18.2	45.5	0.0	43.6	63.6	36.4
Maryland CBF	56.5 +/- 15.51 [ab]	19-75	30.0	45.0	5.0	65.0	70.0	30.0
Maryland Choptank	66.0 +/- 7.19 [ab]	54-73	22.2	78.8	0.0	100.0	77.8	22.2
Delaware	*	*	*	*	*	*	*	*
New Hampshire	58.5 +/- 16.59 [ab]	27-78	33.3	35.3	0.0	64.3	26.7	73.3

*Delaware program participation limited to manager only.

[a & b] Respondents from Alabama's Mobile Bay (63.24 +/- 9.34 years) and Alabama's Little Lagoon (67.2+/- 9.61 years) were statistically significantly older (p= .015 and .019, respectively) than respondents from Virginia's Chesapeake Bay Foundation (55.2 +/-11.72 years); $F_{(10, 36.89)} = 3.296$, p =.004.

Chesapeake Bay Region

Gardeners in the Chesapeake region reported a mean age of 56.9 +/- 12.49, which was not statistically significantly different than the Atlantic region (p=.509). Chesapeake Bay respondents ranged in age from 19-79 years at the time of the survey with approximately half (50.4%) of responding gardeners reporting as aged 19-57. The majority of respondents (57.0%) were male. Respondents reported a wider variation in employment status, with 45.5% identifying as full-time employed, 11.6% as part-time employed and 37.2% identifying as retired. This is expected of a younger population. Education levels for the Chesapeake Bay region responses showed that 26.4% finished college while 52.1% held a graduate or professional degree. Gross income levels reported by respondents showed 69.9% having household incomes more than $100,001, whereas 2.7% reported annual household gross income levels of $20,000 to $40,000.

Atlantic Region

Gardeners of the Atlantic region reported a mean age of 59.4 +/- 10.02 years, statistically similar to both those from the Gulf of Mexico (p= .078) and Chesapeake Bay (p= .509) regions. Atlantic region respondents ranged in age from 27-78 years at the time of the survey with approximately half (52.5%) of respondents reporting as aged 27-60 years. The majority of respondents (58.1%) were female. Respondents reported being employed full time (33.9%), part time (17.7%) and retired (46.8%). Education levels for this region showed that 37.1% of respondents completed college and 37.1% also completed a graduate or professional degree program. Gross income levels reported by respondents of the Atlantic region showed 51.9% had an annual gross income in excess of $100,001, whereas, 1.9% reported annual household gross income levels of $20,000 to $40,000.

Educational differences among regions were statistically significant ($F_{(2, 252)} = 3.065$, p=.048), however, following post hoc analysis with Bonferroni correction, significance was lost in pairwise comparisons ($p \geq .122$). Income differences among regions were statistically significant ($F_{(2,226)} = 6.880$, p= .001). Post Hoc analysis with Bonferroni correction found that income reported from the Gulf of Mexico region was statistically significantly lower than those of the Chesapeake Bay region (p = .001) while statistically similar to that of the Atlantic region (p=.890) which were also similar to the Chesapeake region (p=.095).

Oyster Gardening Programs: Gardener Time Investment

We investigated time spent and frequency of engagement in gardening efforts for each region. Respondents from the Gulf of Mexico region primarily (80.3%) engaged with their gardens on a weekly basis, with the remaining Gardeners engaging monthly. The respondents from the Atlantic region were similarly dominated by weekly engagements (88.9%) compared to monthly engagements. The Chesapeake region, however, was more evenly split with monthly engagements being slightly higher (52.9%) than weekly.

We considered the time (number of minutes) reported for each engagement. No statistically significant differences ($F_{(2, 268)} = 2.331$, p= .099) were found among regions. Respondents from the Gulf of Mexico region reported an average of 35.6 +/- 42.5 minutes, the Atlantic region reported an average of 37.8 +/- 32.6 minutes and 27.0 +/- 35.8 minutes from the Chesapeake region for each engagement. We compared individual program reported time allocations and found statistically significant differences in the time per engagement allocated to oyster gardening efforts ($F_{(10, 40.072)} = 2.080$, p=.05). Post-hoc pairwise comparisons with Bonferroni correction indicated that MS (86 +/- 119.7 minutes) was statistically greater than VACBF (27.7 +/- 35.7 minutes; p=.035), MDCBF (20.6 +/- 16.6 minutes; p=.020) and MDCHOP (16.1 +/-

12.4 minutes; p=. 039) with all other comparisons being insignificant ($\geq$ .076). We attribute this difference to the number of schools engaged in the MS program representing 20% of MS respondents to the survey. Their reported time per engagement was likely a function of class time devoted to their gardening activity which elevated the program average. Overall, program level mean time spent per engagement ranged from a low of 16.1 +/- 12.4 minutes to a high of 86.0 +/- 119.7 minutes.

Oyster Gardening Programs: Gardener Purchase of Supplies

We asked respondents about their seasonal spending on supplies to support their gardening efforts (Table 3). Of the respondents from the Gulf of Mexico region, 55.6% indicated they had purchased supplies specifically for their oyster gardening efforts. Similarly, 46.5% of respondents from the Atlantic region purchased supplies, while 71.7% of respondents from the Chesapeake Bay region reported purchasing supplies. Of these purchases, rope (40.7% and 48.0%) dominated the Gulf of Mexico and Chesapeake regions, respectively while cleaning related supplies (31.0%) led the purchases of the Atlantic region. Only respondents from FLGOM reported no purchases of equipment to support gardening efforts, whereas the Mississippi (MS) program indicated that all participants purchased some supplies. In terms of dollars spent per season on these purchases, no statistically significant differences were found among regions ($F_{(2,155)} = 1.137$, p=.323). Respondents from the Gulf of Mexico spent an average of $29.20 +/- $92.75, Atlantic $10.04 +/- $6.61 and Chesapeake $24.65 +/- $33.48 regions on their supplies. Among programs, statistically significant differences were found ($F_{(9, 16.430)} = 4.083$, p=.007) in the total seasonal expenditures for supplies. Post Hoc analysis with a

Table 3. Percentage and type of equipment purchased by Gardeners to support gardening effort.

	Rope	Cleats	Hardware	Cleaning	Oyster Moving	Other	None	Mean Total
Gulf of Mexico	40.7	19.8	21.0	21.0	0.0	4.9	44.4	$29.195 +/- $92.754
Atlantic	9.9	15.5	5.6	31.0	1.4	2.8	53.5	$10.04 +/- $6.61
Chesapeake Bay	52.0	19.7	28.3	32.3	3.1	21.3	28.3	$24.65 +/- $33.48
Texas	15.4	15.4	15.4	0.0	0.0	0.0	84.6	$25.00 +/- $7.07
Mississippi	100.0	40.0	20.0	60.0	0.0	0.0	0.0	$134.00 +/- $260.63
Alabama Mobile Bay	44.2	9.3	14.0	20.9	0.0	7.0	37.2	$13.33 +/- $19.76
Alabama Little Lagoon	46.7	53.3	53.3	33.3	0.0	6.7	33.3	$15.70 +/- $7.92
Florida Gulf of Mexico	0.0	0.0	0.0	0.0	0.0	0.0	100.0	$0.00
Florida Atlantic	13.0	20.4	5.6	33.3	1.9	3.7	48.1	$11.22 +/- $6.54
Virginia CBF	48.8	19.5	31.7	39.0	1.2	25.6	25.6	$22.79 +/- $31.58
Virginia TOGA	66.7	0.0	33.3	41.7	16.7	41.7	25.0	$48.89 +/- $53.78
Maryland Choptank	11.1	33.3	11.1	11.1	0.0	0.0	66.7	$6.67 +/- $2.89
Maryland CBF	50.0	25.0	20.8	12.5	4.2	8.3	25.0	$21.50 +/- $24.49
Delaware	*	*	*	*	*	*	*	*
New Hampshire	0.0	0.0	5.9	23.5	0.0	0.0	70.6	$4.60 +/- $3.85

*Delaware program participation limited to manager only.

Bonferroni correction was conducted and indicated that respondents from MS spent statistically significantly more ($134.00 +/- $260.63) than their peers in Alabama Mobile Bay (ALMB) ($13.33 +/- $19.76), Alabama Little Lagoon (ALLL) ($15.70 +/- $7.92), FLAC ($11.22 +/- $6.54), VACBF ($22.79 +/- $31.58), MDCBF ($21.50 +/- $24.49), MDCHOP ($6.67 +/- $2.89), and NH ($4.60 +/- $3.85) programs.

Oyster Gardening Programs: Gardener Site Classification and Distance to Gardening Location

When considering where Gardeners are engaging an oyster gardening program, we asked respondents to classify their sites as a primary residence, vacation residence, a friend/neighbor's residence, a community/common area, a relative's residence, a school site or other. The majority of Gardeners identified their gardening location as a primary or vacation residence in the Gulf of Mexico (87.2%), Atlantic (84.1%) and Chesapeake Bay (69.4%) regions. School sites were noted only in the Gulf of Mexico (1) and Atlantic (1) regions. However, friends/neighbors and community sites were identified as comprising 5.1% (Gulf of Mexico), 7.2% (Atlantic) and 16.2% (Chesapeake Bay) regions. This suggests that while most new recruits will likely be engaging in their own residences, opportunities to develop community centered gardening sites may be appropriate and are supported by the future interest analysis presented below. Additionally, opportunities may exist for individuals to allow their residences to engage in oyster gardening efforts under the management of a neighbor or friend who may be interested but otherwise unable to engage at their primary or vacation residence.

Those respondents who indicated gardening in locations other than their primary residences were asked to report the distance from their primary residence to their gardening location. In the Gulf of Mexico region, non-primary resident Gardeners reported traveling an average of 61.27 +/-

93.85 miles to their gardening location. Respondents from the Atlantic region reported traveling an average of 175.55 +/- 458.3 miles. Respondents from the Chesapeake Bay region reported traveling an average of 109.66 +/- 513.92 miles. No significance was found among the regions (p=.996) or programs (p=.944).

Oyster Gardening Programs: Gardener Future Interest

Maintaining the interests of volunteers is key to keeping them engaged in a program (Caan and Goldberg-Glen, 1991; Kempton, 1980 and 1996; Culp, 2012; Terry et al., 2013; Tyler, 1966 and Hart, 2005). We investigated the areas of future interests among the responding gardeners (Table 4). The three regions considered were consistent in listing living shorelines as a key area of interest for future programmatic directions. Respondents from the Gulf of Mexico region also included growing oysters for personal consumption, respondents from the Atlantic region reported community gardens and alternative shellfish while those respondents from the Chesapeake Bay region also included community gardens and personal consumption in their interests for future programmatic efforts. Interestingly, though personal consumption was often included in areas of future interest by respondents, ranging from a low of 0% to a high of 60.0%, none of the eleven programs responding to the survey indicated they permitted any consumption of oysters by their Gardeners.

Conclusions

This work investigated the structure and organization of oyster gardening programs along the US Gulf of Mexico and Atlantic coasts as well as the demographics and characteristics of

engagement of their participants. While these areas are geographically varied, and participating programs fluctuate in site numbers and size, several similarities were found among them. This suggests that successes found by one program or region may be replicated by other programs or regions when addressing similar challenges. Consequently, sharing of ideas, successes and failures may be beneficial to oyster gardening programs throughout the study area.

Table 4. Percentage of respondents identifying an interest in a future direction for their oyster gardening program.

	Oysters for Personal Consumption	Sale	Community Gardens	More Social Interaction	Alternative Shellfish	Living Shorelines	Other
Gulf of Mexico	40.7	6.2	27.2	14.8	18.5	55.6	6.2
Atlantic	15.5	5.6	28.2	15.5	25.4	49.3	4.2
Chesapeake Bay	42.5	3.9	52.8	37.0	33.9	70.1	4.7
Texas	38.5	0.0	61.5	30.8	38.5	76.9	0.0
Mississippi	60.0	20.0	40.0	40.0	0.0	60.0	0.0
Alabama Mobile Bay	37.2	7.0	20.9	11.6	11.6	51.2	9.3
Alabama Little Lagoon	53.3	6.7	13.3	6.7	20.0	40.0	6.7
Florida Gulf of Mexico	20.0	0.0	20.0	0.0	40.0	80.0	0.0
Florida Atlantic	14.8	5.6	22.2	9.3	22.2	42.6	3.7
Virginia CBF	50.0	6.1	61.0	36.6	37.8	73.2	7.3
Virginia TOGA	41.7	0.0	41.7	58.3	33.3	66.7	0.0
Maryland Choptank	55.6	0.0	44.4	66.7	33.3	88.9	0.0
Maryland CBF	0.0	33.3	33.3	16.7	20.8	54.2	0.0
Delaware	*	*	*	*	*	*	*
New Hampshire	17.6	5.9	47.1	35.3	35.5	70.6	5.9

*Delaware program participation limited to manager only.

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Chapter 3

Do Oyster Gardening Programs Lead to Knowledge Changes?

Abstract

Oyster gardening programs are found throughout the coastal US, with change in participant knowledge of oysters' ecological role a common metric of success. We used a 5-point Likert scale (*SD-SA*) for the construct of knowledge defined by oyster reproduction, feeding, ecosystem position, as well as oysters' effects on habitat, water quality and erosion to investigate pre and post participation perceived knowledge of respondents from eleven gardening programs. We found significant increases in perceived knowledge in participants. Differences were found among levels, suggesting participants in some programs perceived their knowledge of oysters to be higher post-participation than others.

Key Words: oysters, oyster gardening, volunteers, restoration, change in knowledge, learning, program evaluation

Introduction

Throughout the U.S. Gulf of Mexico and Atlantic Coastal region, Cooperative Extension programs, Sea Grants and varied non-governmental organizations have developed programming focused on oyster restoration. Though the approaches to this programming vary in style and intensity, oyster gardening as we term it, involves volunteers playing an active role in programming with both a learning and restorative objective. Knowledge gain is a commonly utilized metric employed to evaluate efficacy of training programs in many fields (Scasta et al., 2015; Mermelstein and Riesenberg, 1992; Halm et. al, 2001; Loomis, Blair and Gonzales-Caban, 2001; Bonneau et al, 2009; McClelland et al.,

2013) including Extension efforts involving both natural resources and human dimension programming (Black et al., 2016; Hammerschmidt et al., 1995).

We evaluated oyster gardening programs' ability to change the knowledge of participants using reported perceived knowledge of oysters by participants of oyster gardening efforts along the U.S. Gulf of Mexico and Atlantic coastal regions. The findings may benefit managers of volunteer programs such as oyster gardening, by establishing the suitability of knowledge change as a metric of program success.

Methods

An original questionnaire, approved by the Institutional Review Board at Auburn University, was developed to collect information from current and former oyster gardeners along the U.S. Gulf of Mexico and Atlantic coasts (Table 1). In total, of 1,114 self-identified oyster gardeners (current and former), complete responses were received from 279 participants (25.0% overall response rate) representing eleven oyster gardening programs located in seven states (Table 1). Face and content validation of the instrument was conducted by an expert panel using a Delphi analysis (Skulmoski et al., 2007). The survey was administered via electronic mail invitation, generated through Qualtrics, and delivered directly from the respondents' oyster gardening program between 5 September 2017 and 26 January 2018. Respondents participated fully, independent of distance, without the need for an administrator and anonymously. To increase response rate, three reminders were drafted and provided to participating program managers for use in communications with their participants. Further, compensation in the form of $5.00 gift card link was provided to each respondent who completed a response. The sampling procedure was probability based, stratified and random.

Respondents self-identified as current or former members of a local oyster gardening program as well as identifying which program they associated with. Respondents were then classified into regions based on their identified program affiliation. The strata were defined by program or region (Gulf of Mexico, Atlantic (less Chesapeake) and Chesapeake). Statistical analyses were conducted using IBM's Statistical Package for Social Sciences version 25.

We evaluated the change in the distribution of median (median; inter-quartile range reported) perceived knowledge of oysters in respondents within a level (program and region) before and after oyster gardening participation. A 5-point Likert scale (1 *Strongly Disagree* to 5 *Strongly* Agree) was employed for the construct of oyster knowledge, defined by oyster reproduction, feeding, place in ecosystem, effect on habitat, effect on water quality and effect on erosion. Reliability was evaluated using Cronbach's alpha (Cronbach, L., 1951) for perceived knowledge of oysters before oyster gardening (0.923) and after oyster gardening (0.918); indicating good reliability.

Table 1. Survey respondents, self-identified program, classification (Current or Former participant) and assigned Experience level (< 3 years being classified as Inexperienced and 5 or more years being classified as Experienced).

State	Program	Reference Abbreviation	Region	Current Gardener	Former Gardener	Response Rate (Total Participants)	Inexperienced	Experienced
Texas	Galveston Bay	TX	Gulf of Mexico	13	0	15.7 % (83)	10	2
Mississippi	Mississippi	MS	Gulf of Mexico	5	0	55.5% (9)	5	0
Alabama	Mobile Bay	ALMB	Gulf of Mexico	32	11	46.7% (92)	15	21
Alabama	Little Lagoon	ALLL	Gulf of Mexico	15	0	60.0% (25)	15	0
Florida	Gulf of Mexico	FLGOM	Gulf of Mexico	4	1	33.3% (15)	5	0
Florida	Atlantic Coast	FLAC	Atlantic	45	9	25.5% (212)	32	1
Virginia	Chesapeake Bay Foundation	VACBF	Chesapeake	79	3	27.3% (300)	64	14
Virginia	Tidewater Oyster Gardening Association	TOGA	Chesapeake	12	0	*	6	5
Maryland	Chesapeake Bay Foundation	MDCBF	Chesapeake	19	5	20.0% (120)	8	12
Maryland	Choptank River Alliance	CHOP	Chesapeake	9	0	15.5% (58)	18	20
New Hampshire	New Hampshire	NH	Atlantic	17	0	8.5% (200)	5	6

*The Tidewater Oyster Gardening Association did not provide membership information for the program.

Results and Discussion

Among Regional Level Analysis

A Kruskal-Wallis test was conducted to determine if there were significant differences in the distribution of median perceived oyster knowledge scores prior to and following oyster gardening. We found no significant differences in the distribution of pre-oyster gardening median perceived knowledge of oysters among regions, indicating that respondents started from statistically similar knowledge levels prior to joining oyster gardening, regardless of location: Gulf of Mexico (4.0; 2.0-5.0), Atlantic (3.0; 2.0-4.0) and Chesapeake (4.0; 2.0-4.88), $X^2_{(2)} = 3.926$, $p = .140$.

There were differences among regions in post-oyster gardening median scores ($X^2_{(2)} = 7.750$, $p = .021$). The Gulf of Mexico respondents selected a knowledge score of 4 or higher (67.9%) less frequently when compared to their counterparts in the Chesapeake (92.1%) and the Atlantic (77.5%). Post hoc, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons (adjusted p values, median and interquartile range are presented; all subsequent post-hoc analyses follow this form). There were significant differences in distribution of median reported knowledge of oysters following oyster gardening participation between the Gulf of Mexico (5.0; 3.75-5.0) and Chesapeake (5.0; 4.63-5.0) regions ($p = .020$), with the Atlantic (5.0; 4.38-5.0) not differing statistically from either ($p \geq .144$). These differences among regions after participation is likely a function of program longevity. The GOM contained three programs which completed their first or second season at the time of our survey, compared to the Atlantic and Chesapeake regions, whose combined youngest program had completed its fourth season. It is anticipated that as programs in the GOM complete

additional seasons, the significance found in participant perceived knowledge of oysters will diminish.

Within Regional Level Analysis

After participating in oyster gardening, all regions showed an increase in knowledge. When median scores for all respondents by region were averaged, we found a significant increase in the perceived knowledge scores following participation within the Gulf of Mexico (0.863; $p \leq .001$), Chesapeake (1.194; $p \leq .001$) and Atlantic (1.508; $p \leq .001$) regions (Table 2). Interestingly, we found eight responses (10.9%) from the GOM which showed a decline in perceived knowledge of oysters following participation. This may be a result of the increase in awareness of oyster/ecosystem relationships, and a corresponding realization of a reduced understanding of this relationship compared to the respondents' assumption of knowledge prior to engaging in oyster gardening. In the Chesapeake and Atlantic regions, the percentage of this occurrence was smaller in absolute terms (1.6% and 4.8%, respectively) with very small sample sizes (n=2 and 3, respectively) rendering comparisons impractical.

Among Program Level Analysis

At the specific program level, prior to engaging in oyster gardening, significant differences were found in the distribution of median perceived knowledge of oysters ($X^2_{(10)} = 20.812$, p=.022). Respondents from Alabama Little Lagoon (ALLL) reported lower median knowledge of oysters (3.0; 1.0-3.50) compared to their counterparts in Mississippi (MS) (5.0; 4.75-5.0; p=.018). All other pairwise comparisons were not significant ($p \geq .095$).

Table 2. Averages of respondent median reported knowledge of oysters pre and post oyster gardening participation from the regional and programmatic levels.

Level Region/ Program	N	Pre OG Score	Post Oyster Gardening					z	p
			Score	Increases	Decreases	Ties	Difference		
Gulf of Mexico	73	3.44	4.30	37	8	28	0.863	5.02	<.001
Chesapeake Bay	124	3.48	4.67	76	2	46	1.194	7.641	<.001
Atlantic Coast	62	3.08	4.55	43	3	16	1.508	5.192	<.001
Texas	12	3.38	4.54	8	2	2	1.17	1.960	0.036
Mississippi	5	4.90	4.80	0	1	4	-0.10	-1.00	0.317
Alabama Mobile Bay	37	3.64	4.61	21	3	13	0.96	3.904	≤0.001
Alabama Little Lagoon	15	2.57	3.40	6	1	8	0.83	2.213	0.027
Florida Gulf of Mexico	4	3.13	3.50	2	1	1	0.38	1.089	0.276
Florida Atlantic Coast	47	3.10	4.56	33	2	12	1.49	4.567	≤0.001
Virginia CBF	82	3.36	4.68	56	1	25	1.32	6.567	≤0.001
Virginia TOGA	12	3.75	4.58	3	1	8	0.83	1.473	0.141
Maryland CBF	21	3.67	4.67	13	0	8	1.00	3.198	≤0.001
Maryland Choptank	9	3.72	4.67	4	0	5	0.94	1.841	0.07
New Hampshire	15	3.00	4.50	10	1	4	1.57	2.547	0.011

Following oyster gardening participation, significant differences in the distribution persisted among programs ($X^2_{(10)} = 31.938$, $p<.001$). ALLL respondents showed significantly lower (3.5; 3.0-4.0) perceived median knowledge of oysters than respondents of Alabama Mobile Bay (ALMB) (5.0; 4.5-5.0; $p\leq.001$), Virginia Chesapeake Bay Foundation (VACBF) (5.0; 5.0-5.0; p=.027), Maryland Chesapeake Bay Foundation (MDCBF) (5.0; 4.25-5.0 p=.004), Tidewater Oyster Gardening Association (TOGA) (5.0; 4.25-5.0; p=.03) and Florida Atlantic Coast (FLAC) (5.0; 5.0-5.0; $p\leq.001$). All other comparisons were not significant ($p\geq.15$). The differences are attributed to the relative youth of ALLL program, which, at the time of survey, had completed its inaugural season. By comparison, the next youngest program at the time of survey was FLAC which had completed its fourth season (5.0; 5.0-5.0). It is anticipated that the significance found will diminish as ALLL participants complete additional seasons.

Within Program Level Analysis

We found an average increase ($\geq$0.38) within programs in the median knowledge scores following participation in all programs except MS (-0.10). Significant differences were found within all program levels ($p\leq.036$) except MS (p=.32), FLGOM (p= .28), TOGA (p= .14) and Maryland Choptank River (MDCHOP) (p=.07; Table 2). Each of these programs had low response rates and/or is a small program that resulted in low sample numbers (n=5, 4, 12 and 9 respectively). These likely contributed to the lack of significance found, and in the case of the MS program, a decline. It is expected that with an increase in program size and sample size, these scores would demonstrate the positive significant change in line with the remaining 7 programs ($p\leq .036$).

Controlling Effect of Participation Time

To limit the effect of participation time on reported knowledge of oysters before and after oyster gardening, respondents were arranged into two distinct groups: less than three years of experience (inexperienced) and five or more years of experience (experienced; Table 1), which excluded only 21 responses of 4 years of participation. Kruskal-Wallis tests were used to compare the regions and programs within experience levels.

Among Regional Level Analysis

The inexperienced respondents' distribution of median reported knowledge of oysters prior to engaging in oyster gardening showed no significant differences among regions ($X^2_{(2)} = 4.533$, p= .104): Gulf of Mexico (3.50; 1.63- 4.5), Chesapeake (4.00; 2.13- 4.88) and Atlantic (2.75; 2.0-4.0). However, following participation, the Gulf of Mexico, Chesapeake and Atlantic regions showed statistically significant differences amongst their distributions of median reported knowledge of oysters ($X^2_{(2)} = 7.633$, p= .022). Respondents from the Gulf of Mexico reported lower median perceived oyster knowledge (4.75; 3.75-5.0) than the Chesapeake (5.00; 4.50-5.0) region (p = .026), with the Atlantic region (5.0; 4.13-5.0) not differing significantly from either ($p \geq .099$).

Among the experienced group (5+ years of participation), there were no significant differences in distribution of median reported oyster knowledge prior to participating in oyster gardening among the Gulf of Mexico (4.00; 2.75-5.0), Chesapeake (4.00; 2.38-5.0) and Atlantic (1.50; 1.0-4.25) regions, ($X^2_{(2)} = 3.143$, p=.208). Similarly, no significant differences were found following participation among the Gulf of Mexico (5.0; 4.63-5.0), Chesapeake and Atlantic (5.0; 5.0-5.0;

respectively), $X^2_{(2)} = 1.652$, p= .428. These findings suggest that significant increases in median perceived knowledge of oysters may be found with increasing experience up to year five.

Among Program Level Analysis

At the specific program level, the inexperienced respondents showed significant differences in the distribution of median reported knowledge of oysters prior to oyster gardening participation were found among programs ($X^2_{(9)} = 22.296$, p= .008). The ALLL program (2.0; 1.0- 3.5) and the FLAC program (2.75; 2.0- 4.0) median reported knowledge were lower than the MS program (5.0; 4.75- 5.0; p= .007 and .044, respectively) All other comparisons among programs were insignificant ($p \geq .326$).

Following oyster gardening participation, we found differences among program levels in the inexperienced group ($X^2_{(9)} = 29.220$, p= .001). The ALLL median reported knowledge of oysters (3.50; 3.0-3.75) was found to be lower when compared to respondents from the FLAC (5.00; 5.0-5.0; $p \leq .001$), Texas (TX) (5.00; 4.38-5.0 p= .049) and VACBF (5.00;4.50-5.0; $p \leq .001$) programs. All other comparisons were insignificant ($p \geq .127$). The differences among ALLL and other programs may be a result of a lower initial median perceived knowledge for the inexperienced group (2.0; 1.0-3.5), a program style which resulted lower knowledge transfer, or some combination of variables.

We investigated the differences (post-pre) in median knowledge for the inexperienced group and found the change in perceived knowledge ranged from a low of 0.00 (MS, ALLL and TOGA) to a high of 2.00 (FLAC). A Kruskal Wallis test found significance in the differences among specific programs ($X^2_{(9)} = 16.393$; p=.05). Significance was lost with post-hoc analyses following the application of a Bonferroni correction ($p \geq .07$).

The experienced group (5+ years of participation), showed no significant differences in distribution of median reported oyster knowledge before participation, $X^2_{(6)} = 9.778$, p=.134, or following participation, $X^2_{(6)} = 6.155$, p= .406. Similarly, to the regional level findings, this suggests that significant increases in median perceived knowledge of oysters may be found with increasing experience up to year five.

Conclusions

We have demonstrated that volunteer-based programs such as oyster gardening can be effective tools to increase participant knowledge. The hands-on engagement with the ecological role of oysters, inherent to germinal participation in oyster gardening results in an increased perceived knowledge of oysters, thus increasing the total knowledge gain for a level. In particular, oyster gardening programs appear to increase participant perceived knowledge of the ecological role of oysters up to year five, after which significance generally diminishes. This suggests programs utilizing knowledge gain as a reporting metric should take steps to ensure new potential volunteers have a clear avenue to join.

Across geographic regions, an increase in perceived knowledge was found after participation. However, in absolute terms, respondents from the GOM exhibited a smaller increase when compared to their peers in the Chesapeake and Atlantic regions. The ALLL program was responsible for a large portion of this difference, which may be the result of a comparably conservative self-assessment of oyster knowledge, program management variations, or a combination of these. Volunteer-based programs, such as oyster gardening, may be able to improve knowledge gain by considering a number of variables which may influence participants

and seek to replicate success of other volunteer-based programs with a participant learning objective.

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Chapter 4

Participant Motivations to Join an Oyster Gardening Program

Abstract

Oyster gardening programs' ability to attract and retain volunteers is critical to success. We asked participants to select motivations that influenced their decision to join and to engage in an activity at their site before and after joining. We found environmental improvement was a stronger motivation than learning and fishing improvement, both of which were generally greater than social motivations. We found oyster gardening participation was not significant in changing motivation to engage in an activity at the gardening site, suggesting a focus on initial motivators for engaging may be key to both recruiting and retention efforts.

Key Words: oysters, oyster gardening, restoration, volunteers, recruiting, retention, motivation

Introduction

In nearly every state within the U.S. Gulf of Mexico and Atlantic Coastal region, Cooperative Extension programs, Sea Grants and varied non-governmental organizations have developed programming focused on community involvement with oyster restoration, including 'oyster gardening'. Though the approaches to this programming vary in style and intensity, oyster gardening as we term it, involves volunteers playing an active role in educational programming with both a learning and restorative objective. The volunteer has made the decision to join an oyster gardening program by completing a process of being aware of and considering the available

options, then making a choice among them (Beach and Mitchell, 1977; March, 1978; Payne, 1982; Mardani et al., 2015).

We investigated the motivations supporting this decision to join and continue with an oyster gardening program. Our study included eleven programs in seven states in which volunteers provide care for juvenile oysters in preparation for planting on restoration sites in local waters in hopes of improving subsequent survival of the oysters. A typical oyster gardening experience would involve individuals receiving juvenile oysters, or "spat", from a hatchery as well as one or more growing units for holding the spat through some specified period of time to allow additional growth. The care provided by the gardener could include predator removal and elimination of any fouling materials such as sediments and algae found within and affixed to the growing unit. At the conclusion of the grow-out period, oysters would be transported typically from the gardening site to one or more restoration sites.

We sought to determine if a hierarchy of motivations to engage in an oyster gardening program exists. With this information, program leaders may improve the efficiency and efficacy of their recruiting and retention efforts. Clary et al. (1998) and Clary and Snyder (1999) identified six motivational areas within which an individual may find benefit to the self, concurrent with the act of volunteering, including learning and social motivations. Further, knowledge of these primary motivations to engage in an activity may provide a foundation for the recruiting efforts of other program types whose reliance upon volunteers consumes both the temporal and capital resources of organizations such as oyster gardening (Cleveland, L., 2007).

Methods

An original questionnaire, approved by the Institutional Review Board at Auburn University, was developed to collect information from current and former oyster gardeners along the U.S. Gulf of Mexico and Atlantic coasts (Table 1). In total, the 1,114 oyster gardening participants of the eleven-program study area were asked to complete the survey. Completed responses were received from 279 respondents representing a 25% response rate. Face and content validation of the instrument was conducted by an expert panel using a Delphi analysis (Skulmoski et al., 2007). The survey was administered via electronic mail invitation, generated through Qualtrics, and delivered directly from the respondents' oyster gardening program between 5 September 2017 and 26 January 2018. Respondents participated fully, independent of distance, without the need for an administrator and anonymously. To increase response rate, a total of three reminders were drafted and provided to participating program managers for use in newsletters or direct communications with their participants. Further, compensation in the form of $5.00 gift card link was provided to each respondent who completed a response. The sampling procedure was probability based, stratified and random.

Respondents self-identified their gardening status (current or former) and which program they associated with. Respondents were classified into regions based on their identified program affiliation. The strata were defined by program and region (Table 1). Respondents were then asked to select three of six provided motivations (Environmental Improvement, Fishing Improvement at the gardening site, Meeting New People, Spending Time with Friends/Family, Learning New Things and Other) for them to join a local oyster gardening program and all applicable motivations to engage in an activity before and following their participation in oyster

gardening. Statistical analyses were conducted using IBM's Statistical Package for Social Sciences version 25.

Results and Discussion

We investigated respondent's reported motivations to join an oyster gardening program as well as to engage in an activity at the gardening site prior to and following participation in an oyster gardening program.

Within Regions and Programs

When we asked about their decision to join an oyster gardening program, we found respondents generally gravitated to environmental motivations followed by learning and fishing improvement. Respondents appeared comparably less motivated by social opportunities suggesting a motivational preference rather than a random distribution (Fig. 1). Analysis indicated respondents at each regional and all but three specific program levels selected at least two categories of motivation at a rate which varied significantly from the expected distribution ($p \leq .022$; and $p \leq .020$, respectively). Only Alabama Little Lagoon (ALLL) ($p \geq .071$), Mississippi (MS) ($p \geq .375$) and Florida Gulf of Mexico (FLGOM) ($p \geq .623$) programs showed no difference in observed and expected selections of motivations by respondents (Fig. 1). These programs were less than two years old, were comparably smaller with 25, 9 and 15 participants, and had small sample sizes (n= 15, 5 and 5), respectively, which were likely contributors to the lack of significance found.

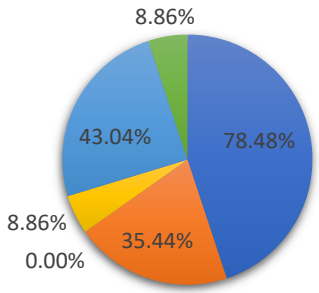
With a preference of motivation established, we explored each region and specific program to determine if a hierarchy could be identified. Significant differences among motivations for joining an oyster gardening program were found within the Gulf of Mexico ($X^2_{(5)} = 156.83$, $p \leq .001$), Atlantic ($X^2_{(5)} = 165.14$, $p \leq .001$) and Chesapeake regions($X^2_{(5)} = 311.87$, $p \leq .001$). Post-hoc, pairwise comparisons using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons (adjusted p values presented; all subsequent post-hoc analyses follow this form) showed respondents from each region were most likely to be motivated by Environmental Improvement opportunities, selecting this option more frequently than any other option ($\geq$78.5%; $p = \leq .001$, respectively). After Environmental Improvement, Learning New Things ($\geq$ 43.4%) and Fishing Improvement ($\geq$ 35.4%) were selected similarly within each region (p=1.00, respectively). Further, both were selected statistically significantly more frequently than the social motivators of Meeting New People ($\leq$ 4.8%, $p \leq .001$, respectively) Recreational Time with Friends/Family ($\leq$ 8.9%, $p \leq .001$, respectively) as well as the general category: Other (8.9%, $p \leq .001$; 20.3%, p= .015; 12.7%, $p \leq .001$, respectively). Similarly, we found differences among motivations within each program level ($p \leq .044$) except for the FLGOM ($X^2_{(5)} = 6.30$, p= .278) and MS ($X^2_{(5)} = 8.64$, p=.124). We suspect this lack of significance is a result of the small sample sizes (n=5 and 4, respectively)

Table 1. Survey respondents self-identified their program which was used to generate region classification for this study as well as their status as a Current or Former participant. Survey response rate was calculated based on program leadership reporting of total membership

State	Program	Reference Abbreviation	Region	Current Gardener	Former Gardener	Response Rate (Total Participants)
Texas	Galveston Bay	TX	Gulf of Mexico	13	0	15.7 % (83)
Mississippi	Mississippi	MS	Gulf of Mexico	5	0	55.5% (9)
Alabama	Mobile Bay	ALMB	Gulf of Mexico	32	11	46.7% (92)
Alabama	Little Lagoon	ALLL	Gulf of Mexico	15	0	60.0% (25)
Florida	Gulf of Mexico	FLGOM	Gulf of Mexico	4	1	33.3% (15)
Florida	Atlantic Coast	FLAC	Atlantic	45	9	25.5% (212)
Virginia	Chesapeake Bay Foundation	VACBF	Chesapeake	79	3	27.3% (300)
Virginia	Tidewater Oyster Gardening Association	TOGA	Chesapeake	12	0	*
Maryland	Chesapeake Bay Foundation	MDCBF	Chesapeake	19	5	20.0% (120)
Maryland	Choptank River Alliance	CHOP	Chesapeake	9	0	15.5% (58)
New Hampshire	New Hampshire	NH	Atlantic	17	0	8.5% (200)

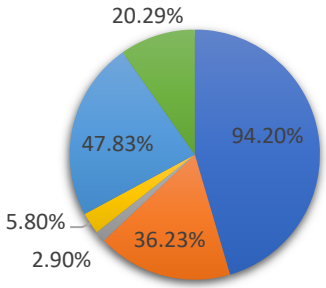
*The Tidewater Oyster Gardening Association did not provide membership information for the program.

Gulf of Mexico



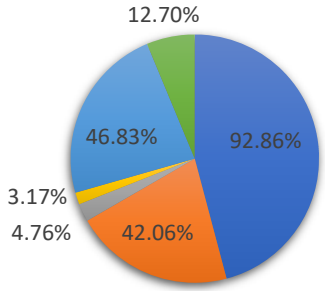
Environment (p≤.001) Fish (p =.01)
Meet People Family/Friends (p≤.001)
Learn (p=.216) Other (p≤.001)

Atlantic



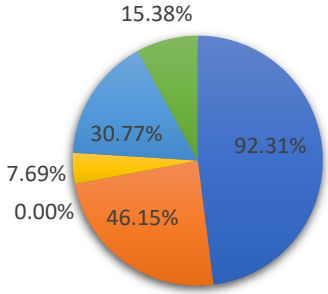
Environment (p≤.001) Fish (p =.022)
Meet People (p≤.001) Family/Friends (p≤.001)
Learn (p=.718) Other (p≤.001)

Chesapeake



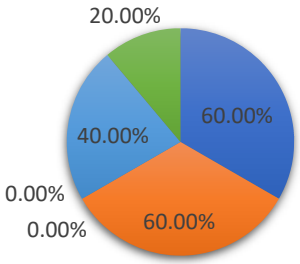
Environment (p≤.001) Fish (p =.075)
Meet People (p≤.001) Family/Friends (p≤.001)
Learn (p=.476) Other (p≤.001)

Texas



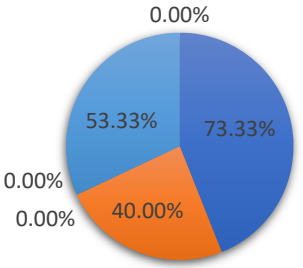
Environment (p=.002) Fish (p =.782)
Meet People Family/Friends (p=.002)
Learn (p=.166) Other (p=.013)

Mississippi*



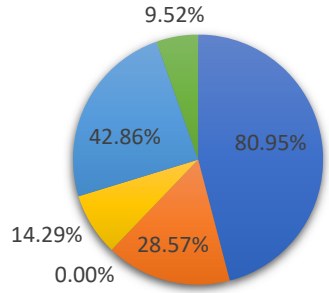
Environment (p=1.00) Fish (p =1.00)
Meet People Family/Friends
Learn (p=1.00) Other (p=.375)

Alabama Little Lagoon



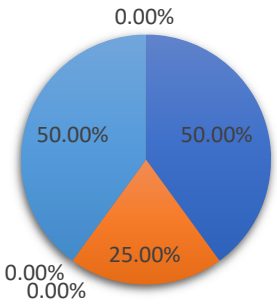
Environment (p= .071) Fish (p =.439)
Meet People Family/Friends
Learn (p=.796) Other

Alabama Mobile Bay



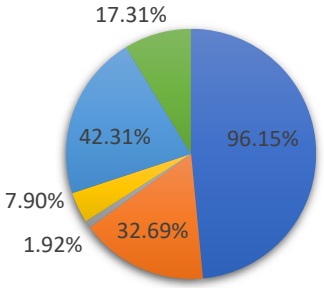
Environment (p≤ .001) Fish (p =.005)
Meet People Family/Friends (p≤ .001)
Learn (p=.355) Other (p≤ .001)

Florida Gulf of Mexico*



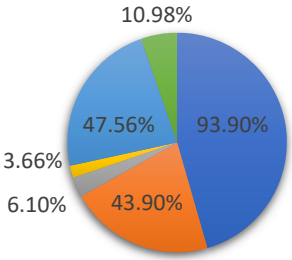
Environment (p= 1.00) Fish (p =.623)
Meet People Family/Friends
Learn (p=1.00) Other

Florida Atlantic Coast



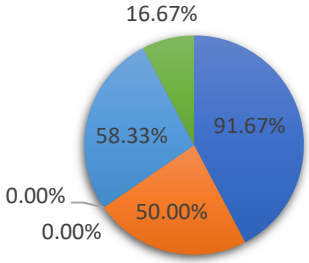
Environment (p≤ .001) Fish (p =.013)
Meet People (p≤ .001) Family/Friends (p≤ .001)
Learn (p= .267) Other (p≤ .001)

Virginia CBF



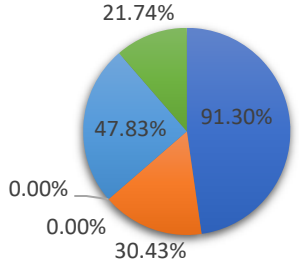
Environment (p≤ .001) Fish (p =.269)
Meet People (p≤ .001) Family/Friends (p≤ .001)
Learn (p= .659) Other (p≤ .001)

Virginia TOGA



Environment (p=.004) Fish (p =1.00)
Meet People Family/Friends
Learn (p= .564) Other (p=.021)

Maryland CBF



Environment (p≤ .001) Fish (p =.061)
Meet People Family/Friends
Learn (p= .835) Other (p=.007)

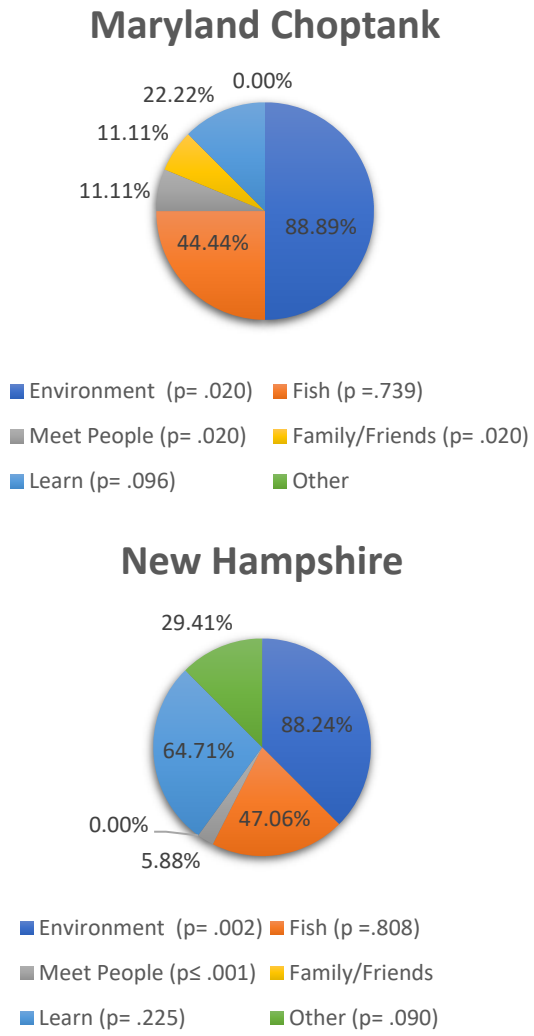


Figure 1. Chi Square Goodness of Fit to determine if the proportion of respondents (regional and program level) selecting motivations to join an oyster gardening program deviated from the expected probability of selection. Motivational categories include Environmental Improvement, Fishing Improvement, Meeting New People, Recreational Time with Friends and/or Family, Learning New Things and Other.

* All expected cell frequencies were not greater than five. Monte Carlo procedure (Mehta and Patel, 1989) was used to estimate exact p values and reported.

discussed earlier. Pairwise, post-hoc comparisons generally reflected our regional findings with Environmental Improvement being selected statistically more frequently ($\geq$ 54.5%) than Learning New Things ($\leq$ 64.7%) in five of the remaining program levels ($p \leq .035$). Further reflecting the regional findings, the opportunity of Learning New Things (selection rate $\geq$ 22.2%) was statistically equivalent to Fishing Improvement at the gardening site within each program level (selection rate $\leq$ 47.1%; p=1.00, respectively; Table 2).

We investigated the effect, if any, that ongoing participation in oyster gardening had on motivations to engage in an activity at the gardening site within each region and specific program. To identify any changes in motivation with ongoing participation, we first sought to identify motivations prior to joining an oyster gardening program. We asked respondents to identify their motivations to engage in a general activity at their gardening site prior to their participation in oyster gardening (Fig. 2).

We found some motivations were selected at a higher rate than others within each region: Gulf of Mexico ($p \leq .001$, respectively), Atlantic ($p \leq .001$, respectively) and Chesapeake Regions ($p \leq .001$, respectively). This suggests a hierarchy of motivations existed prior to engaging in oyster gardening that was similar to those motivations that led a respondent to engage in oyster gardening as was expected. We found individuals were already motivated to engage in a general activity by Environmental Issues (selection rate $\geq$ 74.7%) within the regional level ($p \leq .001$, respectively; Table 3), suggesting that oyster gardening participation did not generate this interest, nor that motivations substantially changed after participation.

Table 2. Cochran's Q test results (Cochran, 1950) with Post Hoc, pairwise comparisons using Dunn's (1964) procedure with Bonferroni correction for multiple comparisons to identify differences in oyster gardener selection rate (by region/program) between Learning New Things and the five presented options when asked for reason(s) for joining oyster gardening Adjusted p values are presented.

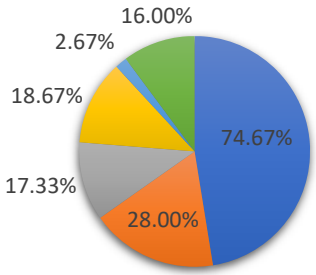
Level (Selection %)	Improve Environment	Fishing Improvement	Meet New People	Recreational Time Friends/Family	Other
GOM (43.04%) $X^2_{(5)} = 156.83$, $p \leq .001$	78.5% $p \leq .001$	35.4% p=1.00	0.0%, $p \leq .001$	8.9% $p \leq .001$	8.9% $p \leq .001$
Atlantic (47.8%) $X^2_{(5)} = 165.140$, $p \leq .001$	94.2% $p \leq .001$	36.2% p=1.00	2.9% $p \leq .001$	5.8% $p \leq .001$	20.3% $p \leq .001$
Chesapeake (46.8%) $X^2_{(5)} = 311.87$, $p \leq .001$	92.9% $p \leq .001$	42.1% p=1.00	4.8% $p \leq .001$	3.2% $p \leq .001$	12.7% $p \leq .001$
AL LL (53.3%) $X^2_{(5)} = 36.9$, $p \leq .001$	73.3% p=1.00	40.0% p=1.00	0.0% p=.022	0.0% p=.022	0.0% p=.022
AL MB (45.5%) $X^2_{(5)} = 11.39$, p =.044	54.5% P = 1.00*	45.5% P= 1.00*	0.0% P=.34*	18.2% P= 1.00*	18.2% P= 1.00*
FL Atlantic (42.3%) $X^2_{(5)} = 131.02$, p <.001	96.2% $p \leq .001$	32.7% p=1.00	1.9% $p \leq .001$	7.7% p=.004	17.3% p=.13
FL GOM (50.0%) $X^2_{(5)} = 6.30$, p =.278	50.0% -	25.0% -	0.0% -	0.0% -	0.0% -
MD CBF (47.8%) $X^2_{(5)} = 58.03$, $p \leq .001$	91.3% p= .035	30.4% p=1.00	0.0% p=.012	0.0% p=.012	21.7% p=1.00
MD Choptank (22.2%) $X^2_{(5)}$ 21.67, $p \leq .001$	88.8% p=.04	44.4% p=1.00	11.1% p=1.00	11.1% p=1.00	0.0% p=1.00
MS (40.0%) $X^2_{(5)} = 8.64$, p =.124	60.0% -	60.0% -	0.0% -	0.0% -	20.0% -

NH (64.7%) $X^2_{(5)} = 38.49$, $p \leq .001$	88.2% p=1.00	47.1% p=1.00	5.9% p=.011	0.0% p =.003	29.4% p=.647
TX (30.8%) $X^2_{(5)} = 31.92$, $p \leq .001$	92.3% p = .017	46.2% p=1.00	0.0% p=1.00	7.7% p=1.00	15.4% p=1.00
VA CBF (47.6%) $X^2_{(5)} = 206.1$, $p \leq .001$	93.9% $p \leq .001$	43.9% p=1.00	6.1% $p \leq .001$	3.7% $p \leq .001$	10.9% $p \leq .001$
VA TOGA (50.0%) $X^2_{(5)}$ 12.27, p =.031	83.0% p= 1.00*	33.3% p= 1.00*	0.0% p= 1.0*	0.0% p=1.00 *	33.3% p=1.00*

*indicates significance lost with Bonferroni correction

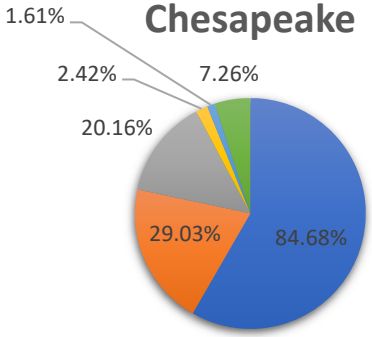
GOM = Gulf of Mexico; LL = Little Lagoon; MB = Mobile Bay; CBF= Chesapeake Bay Foundation.

Gulf of Mexico



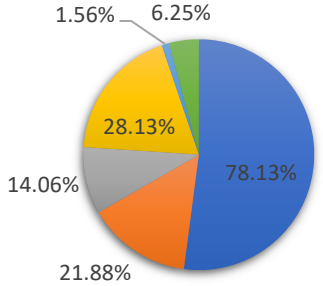
Environment (p≤ .001) Family (p= .001)
Friends/Neighbors (p≤ .001) Self (p≤ .001)
Business (p≤ .001) Other (p≤ .001)

Chesapeake



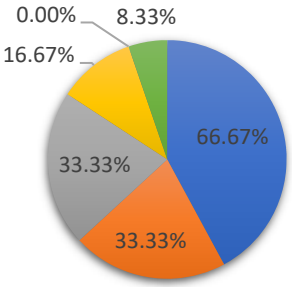
Environment (p≤ .001) Family (p≤ .001)
Friends/Neighbors (p≤ .001) Self (p≤ .001)
Business (p≤ .001) Other (p≤ .001)

Atlantic



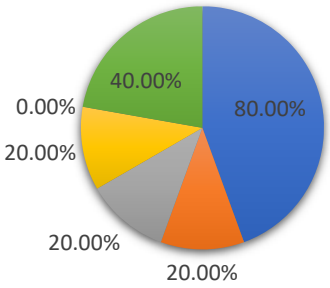
Environment (p≤ .001) Family (p≤ .001)
Friends/Neighbors (p≤ .001) Self (p≤ .001)
Business (p≤ .001) Other (p≤ .001)

Texas*



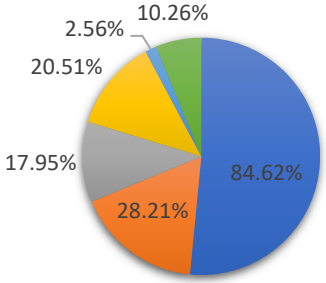
Environment (p= .392) Family (p= .392)
Friends/Neighbors (p=.392) Self (p=.037)
Business Other (p=.006)

Mississippi*



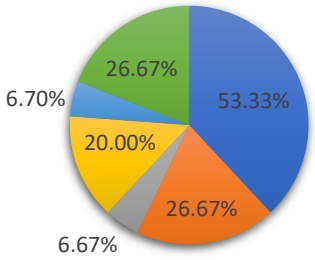
Environment (p= .379) Family (p=.379)
Friends/Neighbors (p= .379) Self (p= .379)
Business Other (p= 1.00)

Alabama Mobile Bay



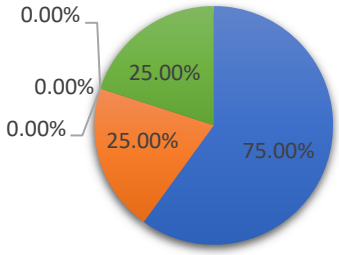
Environment (p≤ .001) Family (p= .006)
Friends/Neighbors (p≤ .001) Self (p≤ .001)
Business (p≤ .001) Other (p≤ .001)

Alabama Little Lagoon



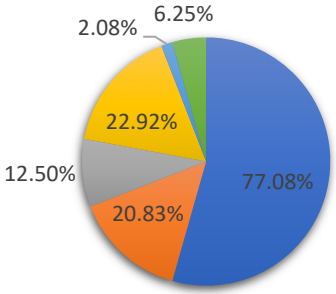
Environment (p= .796) Family (p= .071)
Friends/Neighbors (p= .001) Self (p= .02)
Business (p= .001) Other (p= .071)

Florida Gulf of Mexico*



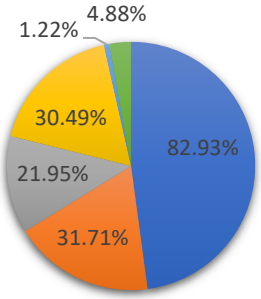
Environment (p= .630) Family (p= .630)
Friends/Neighbors Self
Business Other (p= .630)

Florida Atlantic



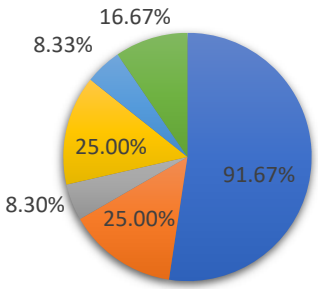
Environment (p≤ .001) Family (p≤ .001)
Friends/Neighbors (p≤ .001) Self (p= .013)
Business (p≤ .001) Other (p≤ .001)

Virginia CBF



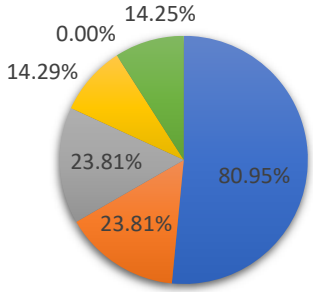
Environment (p≤ .001) Family (p= .001)
Friends/Neighbors (p≤ .001) Self (p≤ .001)
Business (p≤ .001) Other (p≤ .001)

Virginia TOGA



Environment (p= .004) Family (p= .083)
Friends/Neighbors (p= .004) Self (p= .083)
Business (p= .004) Other (p=.021)

Maryland CBF



Environment (p= .005) Family (p= .016)
Friends/Neighbors (p= .016) Self (p= .001)
Business Other (p= .001)

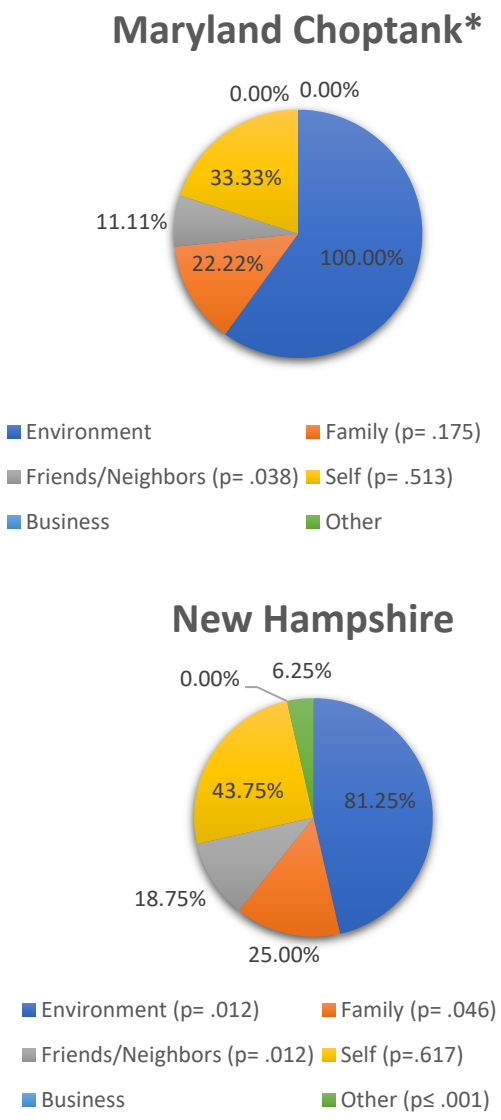


Figure 2. Chi Square Goodness of Fit to determine if the proportion of respondents (regional and program level) selecting motivations to engage in an activity at their oyster gardening site before joining oyster gardening deviated from the expected probability of selection for the six motivational categories. Motivational categories include Environmental Issues, Recreational Time with Family, Friends and/or Neighbors and Individual Recreational Time as we well as Business opportunities and Other.

* All expected cell frequencies were not greater than five. Monte Carlo procedure (Mehta and Patel, 1989) was used to estimate exact p values and reported.

Table 3. Cochran's Q test (Cochran, 1950) with Post Hoc pairwise comparison using Dunn's (1964) procedure with Bonferroni correction conducted within regions of oyster gardening programs to assess the Environmental Issues motivation to engage in an activity at the oyster gardening site before participating in oyster gardening compared to five alternative motivations.

Region	Selection Rate	Cochran's Q	Recreational Time With				
			Family	Friends	Individual	Business	Other
Gulf of Mexico	74.7%	$X^2_{(5)} = 115.391$ $p \leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$
Chesapeake	84.7%	$X^2_{(5)} = 248.476$, $p \leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$
Atlantic	78.1%	$X^2_{(5)} = 121.071$ $p \leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$	$\leq .001$

The specific program level investigation reflected regional findings. Statistically significant deviation of observed selections compared to expected were found for all motivational categories considered in the Florida Atlantic Coast (FLAC) ($p \leq .013$), Virginia Chesapeake Bay (VACBF) ($p \leq .001$) and Alabama Mobile Bay (ALMB) ($p \leq .006$) programs with seven of the eight remaining programs showing significance in at least one motivational category ($p \leq .038$). Only MS showed no statistically significant deviation from the expected probability of selection for any of the motivational categories considered ($p \geq .379$), likely a function of sample size (Fig. 2). These indicate the motivations that drive the decision to join an oyster gardening program are similar to those driving the decision to engage in a general activity at the gardening site prior to oyster gardening.

When we investigated the motivation selection rates, we found that Environmental Issues was the strongest motivator at the specific program level for ALMB, FLAC, Maryland Chesapeake Bay Foundation (MDCBF), Maryland Choptank River (MDCHOP), New Hampshire (NH), VACBF and Tidewater Oyster Gardening Association (TOGA) ($p \leq .001$, respectively). No significance was found in Texas (TX) when compared to the social motivations of Recreational Time with Family ($p=.471$) and Friends ($p=.147$). Further, participants in the newer programs were not motivated by one factor more than another: ALLL ($p= .051$), FLGOM ($p=.113$) and MS ($p=.102$). Finally, only VACBF selected the social motivations Individual Recreational time (Selection rate = 30.5%) and Family Recreational Time (Selection rate = 31.7%) higher when compared to Business opportunities at the gardening site (Selection rate = 1.2%; $p = .01$ and $\leq .001$, respectively) and the motivational category Other (Selection rate = 4.9%; $p= .008$ and .004, respectively).

To better understand the motivation to continue in an oyster gardening program, we asked respondents to identify their motivations to engage in a general activity at the gardening site following participation in oyster gardening. The observed selection of motivations significantly deviated in each category from the expected selection within all regional levels ($p \leq .005$, respectively). Within each specific program level, only MS and FLGOM continued to show no significant deviation ($p \geq .375$) from the expected distribution for any of the six motivation areas considered. These findings were consistent with those prior to joining oyster gardening suggesting the hierarchy of motivations was not influenced by participation.

We, again, explored the selection preferences among motivations within each region and program level. Our findings indicated that participation in an oyster gardening program generally did not influence the motivation to engage in an activity at the gardening site. We found significant differences among motivations within the Gulf of Mexico ($X^2_{(5)} = 120.357$, $p \leq .001$), Atlantic ($X^2_{(5)} = 142.05$, $p \leq .001$) and Chesapeake ($X^2_{(5)} = 300.736$, $p \leq .001$) regions indicating a hierarchy in motivations remained. Pairwise, post-hoc comparisons showed Environmental Issues continued to be selected higher in the Gulf of Mexico (77%), Chesapeake (94%) and Atlantic (89%) than the remaining five motivational areas ($\leq$ 34%) for each region ($p \leq .001$, respectively; Table 4). Additionally, similarly to the findings prior to joining oyster gardening, social motivations were generally found to be selected at higher rates compared to Business opportunities in each region ($p \leq .029$; Table 5).

Within specific programs, we found significant differences continued, among the majority of motivations (Table 4) when comparing Environmental Issues (Selection rate $\geq$ 53.0%) and the remaining motivations (Selection rate $\leq$ 42.0%; $p \leq .029$). However, social motivations were found to be similarly strong for some respondents including Recreational Time with Family (TX

41.7%, p= .471 and ALLL 20.0%, p= .41), Friends (TX 33.3%, p=.147) and Individual (ALLL 13.3%, p=.121 and TOGA 41.7%, p=.141).

Only Alabama's Little Lagoon program demonstrated a change in significance among Environmental Issues and other motivation categories before oyster gardening participation ($X^2_{(5)}$ =11.044; p=.051) and following participation ($X^2_{(5)}$ =15.130 p=.01). Post-hoc comparisons showed Environmental Issues were selected at a significantly higher rate (53.3%) following oyster gardening participation compared with selection of recreational time with Friends (0.0%, p=.006) and Business opportunities (6.7%, p=.03), with the remaining comparisons insignificant ($p \geq .121$). FLGOM ($X^2_{(5)} = 8.913$, p= .113) and MS ($X^2_{(5)} = 8.75$, p= .119) continued to show no significance among any motivation category, consistent with prior to participating in oyster gardening, which is attributed to small sample size (n= 5 and 5, respectively).

Among Regions and Programs

We assessed the association among region and selection of a motivation to join an oyster gardening program as well as engage in an activity at the gardening site prior to and following participation in oyster gardening. A Bonferroni correction for multiple comparisons was applied to generate an adjusted significant p value of .0167 for the regional level, and .00091 for the specific program level.

Table 4. Cochran's Q test (Cochran, 1950) with Post Hoc pairwise comparison using Dunn's (1964) procedure with Bonferroni correction conducted within oyster gardening programs to assess the Environmental Issues motivation to engage in an activity at the gardening site after participation in oyster gardening compared to five alternative motivations.

			Recreational Time With				
Region/Program	% Selection	Cochran's Q	Family	Friends	Individual	Business	Other
Gulf of Mexico	77.0	$X^2_{(5)} = 120.357$ p<.001	<.001	<.001	<.001	<.001	<.001
Chesapeake	94.0	$X^2_{(5)} = 300.736$, p<.001	<.001	<.001	<.001	<.001	<.001
Atlantic	89.0	$X^2_{(5)} = 142.05$ p<.001	<.001	<.001	<.001	<.001	<.001
Texas	83.0	$X^2_{(5)} = 25.741$ p< .001	.471	.147	.002	<.001	.002
Alabama Little Lagoon	53.0	$X^2_{(5)} = 15.130$ p= .010	.410	.006	.121	.030	.410
Alabama Mobile Bay	84.0	$X^2_{(5)} = 73.213$ p<.001	<.001	<.001	<.001	<.001	<.001
Florida Atlantic	87.0	$X^2_{(5)} = 109.23$ p<.001	<.001	<.001	<.001	<.001	<.001
Florida Gulf of Mexico	75.0	$X^2_{(5)} = 8.913$ p =.113	-	-	-	-	-
Maryland CBF	91.0	$X^2_{(5)} = 51.621$ p<.001	<.001	<.001	<.001	<.001	<.001
Maryland Choptank	100.0	$X^2_{(5)} = 30.714$ p<.001	.001	.029	.029	<.001	<.001
Mississippi	80.0	$X^2_{(5)} = 8.75$ p=.119	-	-	-	-	-
New Hampshire	93.0	$X^2_{(5)} = 33.318$ p< .001	.011	.001	.011	<.001	<.001
Virginia CBF	94.0	$X^2_{(5)} = 203.134$ p<.001	<.001	<.001	<.001	<.001	<.001
Virginia TOGA	92.0	$X^2_{(5)} = 28.250$ p<.001	.001	<.001	.141	<.001	.001

Table 5. Cochran's Q test (Cochran, 1950) with Post Hoc pairwise comparison using Dunn's (1964) procedure with Bonferroni correction conducted within oyster gardening regions to assess significance found for selection of motivations to engage in an activity at the gardening site after participation in oyster gardening (excluding Environmental Issues, see Table 6). Minimum, statistically insignificant p values (Post Hoc) for all pairwise comparisons by program are presented in the right column.

Program	Motivation (% Selection)	Motivation (% Selection)	p Value	All other comparisons $p \geq$
Gulf of Mexico	Business (6.8)	Family (31.1)	.015	1.56
Chesapeake	Business (1.6)	Family (33.6)	$\leq .001$	.251
	Business (1.6)	Friend (21.6)	.013	
	Business (1.6)	Individual (33.6)	$\leq .001$	
	Other (7.2)	Family (33.6)	$\leq .001$	
	Other (7.2)	Individual (27.4)	$\leq .001$	
Atlantic	Business (0.0)	Family (22.5)	.029	.101
	Business (0.0)	Individual (28.2)	.002	

The Gulf of Mexico region selected the motivation Environmental Issues at a significantly lower percentage (78.5%) than their peers of the Chesapeake region (92.9%; $X^2_{(1)} = 9.062$, p = .003; Cramer's V = .21) and the Atlantic region (94.2%; $X^2_{(1)} = 7.48$, p=.006; Cramer's V= .25). No statistical significance was found between the Atlantic and Chesapeake regions ($X^2_{(1)} = 0.103$, p=.719; Cramer's V =.03). Significance was lost using the adjusted p values above for remaining categories ($p \leq .047$). Additionally, among the specific program levels, we found no statistically significant associations with selection of motivation to join an oyster gardening program using the adjusted significance levels ($p \geq .02$).

When considering the motivation to engage in an activity at the gardening site, prior to participating in oyster gardening, we found no statistically significant associations among regions ($p \geq .052$) or specific program level (Monte Carlo procedure, Mehta and Patel, 1989; exact p values reported; $p \geq .018$) using the adjusted significance values for multiple comparisons (Table 6).

Finally, when considering the motivation to engage in an activity at the gardening site following oyster gardening participation, the motivation Environmental Issues continued to be selected by respondents from the Gulf of Mexico at a statistically significantly lower percentage (77.0%) than their peers of the Chesapeake region (93.6%; $X^2_{(1)} = 11.623$, p =.001; Cramer's V = .24). These findings suggest that participants in programs of the Chesapeake Bay region find environmental issues to be a greater motivator of decision making than those respondents of the Gulf of Mexico. The GOM region's lower rate was driven by ALLL (53.0%) and its regional peer programs, which consistently selected this motivation ($\leq$ 84.0%), in absolute terms, lower than any program of the Atlantic ($\geq$ 87.0%) or Chesapeake ($\geq$ 91.0%) regions. No statistical significance was found between the Atlantic (88.7%) and either the Gulf of Mexico (p= .075;

Cramer's V = .15), or the Chesapeake (p= .246; Cramer's V= .09) regions. Further, using the adjusted significance levels for multiple comparisons, no statistical significance was found among the regional levels($p \geq .037$) or the specific program level ($p \geq .017$) for the remaining motivations considered.

Pre-Post Oyster Gardening Participation: Change in Motivation Selection

No statistically significant changes were found in respondent selections of motivation (pre/post oyster gardening participation) in the Gulf of Mexico ($p \geq .25$) or the Atlantic ($p \geq .07$) regions. The Chesapeake region showed statistically significant differences in pre and post selection of Environmental Issues category ($X^2_{(1)} = 7.562$, p=.004). This change was the result of an increase in the respondent proportion selecting Environmental Issues following participation in oyster gardening (.944) compared to before oyster gardening participation (.847). This change was driven by VACBF which was the only program to show statistically significant differences between selection proportions of Environmental Issues before and after oyster gardening ($X^2_{(1)} = 5.818$, $p = .012$). The VACBF change was the result of an increase in the proportion selecting Environmental Issues following participation in oyster gardening (.944) compared to before oyster gardening participation (.829). All other program level comparisons were not significant ($p \geq .07$). These results suggest that participation in oyster gardening does not generally influence motivations to engage in an activity at the gardening site, rather those motivations likely already exist and may drive the individual to engage in an activity such as oyster gardening.

Table 6. Pairwise post-hoc comparisons at the specific program level of motivations to join an oyster gardening program as well as motivations to engaging in an activity before and after participation. Significances were lost following application of a Bonferroni correction (adjusted significance level p= .00091), however results indicate some association of program and motivational selection may exist.

Timing	Motivation Category	Level (Selection Rate)	Level (Selection Rate)	p	Cramer's V
Join	Environment	FLAC (96.2%)	MS (60.0%)	.035	.40
			ALMB (54.5.0%)	.022	.25
			FLGOM (50.0%)	.022	.46
			ALLL (40.0%)	.002	.33
		VACBF (93.9%)	MS (60.0%)	.050	.29
			ALMB (54.5.0%)	.033	.20
			FLGOM (50.0%)	.032	.34
			ALLL (40.0%)	.03	.26
Pre-Participation	Environment	ALLL (53.3%)	ALMB (84.6%)	.03	.33
			VACBF (82.9%)	.018	.22
			TOGA (91.7%)	.043	.42
			MDCHOP (100.0%)	.022	.50
	Other	VACBF (4.9%)	MS (40.0%)	.036	.32
			ALLL (26.7%)	.018	.29
		FLAC (6.3%)	ALLL (26.7%)	.049	.28
Post-Participation	Environment	ALLL (53.0%)	ALMB (84.0%)	.032	.32
			FLAC (87.0%)	.010	.36
			VACBF (94.0%)	$\leq$.001	.45
			TOGA (92.0%)	.043	.42
			MDCBF (91.0%)	.017	.43
Post-Participation Continued			MDCHOP (100.0%)	.022	.50
			NH (93.0%)	.035	.45
	Recreational Time Family	MS (20.0%)	VACBF (39.0%)	.046	.09
	Recreational Time Friends	ALLL (0.0%)	TX (33.0%)	.028	.47
			MDCHOP (11.0%)	.042	.49

	Business Opportunities	ALMB (11.0%)	FLAC (0.0%)	.036	.25
			VACBF (5.0%)	.034	.32

Conclusions

We found a hierarchy of motivations to join an oyster gardening program within each region and all but three specific program levels. Environmental Improvement was a consistently stronger motivation than Learning New Things and Fishing Improvement, both of which were generally greater than social motivations. We found these preferences were generally consistent within regions and programs both before and after participation in oyster gardening. Within specific program levels, we found instances of social motivations rising to a statistical equivalent to Environmental Improvement. The TX program demonstrated this (Family and Friends) before and after participation in oyster gardening while ALLL (Family and Individual) and TOGA (Individual) were found following participation in oyster gardening. These findings suggest some motivations to engage in an activity are stronger than others and generally do not change as a result of participation.

We considered the change in motivation within each region and program before and after oyster gardening participation. We found a significant increase in the selection of Environmental Issues in the Chesapeake region. This change was driven by the VACBF program which was the only program to show a significant change in selection proportion for a motivational category. These findings suggest participation in oyster gardening generally did not play a significant role in shaping motivation to engage in a general activity at the gardening site, rather, these motivations (Environmental) already existed and remain strong.

When considering the association among regions and selection of a motivation to join oyster gardening, we found respondents from the GOM selected Environmental Issues at a lower rate than those of the Chesapeake. This suggests that, while Environmental Issues were important, alternative motivations played a role in GOM respondents' decision to engage in an activity at

the gardening site, including oyster gardening. These alternatives include recreational time with Family, Friends and Individual as found within TX and ALLL.

Clary et al. (1998) established broad categories of motivation that drive an individual to engage in a volunteer opportunity. The identification of these motivators may lead to expanding volunteer numbers and longevity. We have demonstrated that individuals in coastal regions, who are interested in environmental issues, will use that as a motivation to engage and remain in programming with an environmental focus such as oyster gardening. We do not believe this to be intrinsic to coastal applications alone. Rather, themes of general interest may be sufficient motivation for an individual to engage and, if that programming is perceived to positively impact the subject, continue. This suggests that managers of volunteer programming would benefit from focusing recruiting and communication efforts on the theme(s), e.g. environmental improvement, that motivated an individual to initially engage in an activity. Program leaders may improve their recruiting and retention by ensuring clear links between volunteer engagement and positive impacts on identified central ideas exist.

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Appendix I

Research Method

Procedure

Two original survey questionnaires were developed to collect information from both OGP managers and OGP volunteers. Surveys were approved by the Auburn University Institutional Review Board prior to being administered to respondents. Details of both instruments as well as the instruments themselves can be found in Appendix I.

Oyster gardening programs were identified and contacted in Texas, Mississippi, Alabama (Mobile Bay and Little Lagoon), Florida (Gulf of Mexico and Atlantic coast), Virginia (Chesapeake Bay Foundation and Tidewater Oyster Gardening Association, Maryland (Chesapeake Bay Foundation and Choptank River Alliance), Delaware, New Hampshire, Maine, New York/New Jersey and Massachusetts. Upon establishment of contact with the program leaders, an introduction to this work and its authors was made, and an invitation to participate was extended. Participation by programs was voluntary, and compensation in the form of program specific results was offered. Participation involved the program completing two steps. The first step involved program leader(s) completing a survey (Survey I). The second step involved program leaders contacting their volunteers, current and former, and introducing the project, and providing an electronic link (provided by this work) to their participants with the encouragement to complete Survey II. The programs were contacted during the Spring of 2017, and the survey instrument was prepared and distributed during the Fall and Winter of 2017/2018. In total, eleven programs from seven states (Texas, Mississippi, Alabama (2), Florida (2), Virginia (2), Maryland (2) and New Hampshire) agreed to participate.

Participants

The intended respondents, adults age 19 and above, were asked to identify as current or former oyster gardeners and to identify their state and oyster gardening program. This information allows sorting by program, region and sub-region and ensures that each participating program will have a complete data set at the conclusion of the project. Sampling procedure was probability based, stratified and random. Each participant, regardless of classification, had an equal chance of participating when compared to other individuals of the same group. Follow up communication with program managers were conducted following the closing of the survey portal. Demographic profiles of respondents of the respective program were provided to the manager who was asked to confirm the representativeness of the demographic profile relative to their overall volunteer base at the time of the survey. All indications received suggested that the demographic profiles generally matched the existing volunteer base at the time of the survey. Three strata were formed defined by program and region (Gulf of Mexico, Chesapeake and Atlantic (less Chesapeake)).

A low response rate was found in all programs and regions from respondents who identified as Former participants. No efforts to improve response rate of this group were feasible due to incomplete or invalid contact information post separation. As a result, no comparisons were made between current and former participant groups and conclusions focused on respondents identifying as former participants are informational only. Compensation for participation was made in the form of a $5 Amazon gift card via Qualtrics for completed responses to either Survey I or Survey II. Individuals who responded to Survey I as a non-program leader or to Survey II as neither a current or former participant were thanked for their time and exited from the instrument with no compensation.

Survey Instruments

Two original questionnaires were developed to collect information from two distinct groups of interest to this work (Survey I and Survey II). The first group was comprised of the managers/leaders of the twelve participating oyster gardening programs located in the Gulf of Mexico and Atlantic coasts of the United States (Survey I). The second group was comprised of the volunteer oyster gardeners who participate in one of the tweve participating oyster gardening programs or have participated in the past (Survey II). The surveys were designed to address the four research questions central to this work. The questionnaires were face and content validated by an expert panel conducting a Delphi analysis.

The survey was administered electronically by Qualtrics by way of e mail invitation directly from the participant's oyster gardening program and provided the opportunity for respondents located at a distance to participate fully without the need for an administrator. The text of the invitation was provided by this project to the program leaders and included a link to the survey providing a consistent introduction and information letter and approach to each potential participant. This process maintained the anonymity of participants of each survey. Reminder notifications were sent to each program leader participating at approximately three-week intervals. Data was downloaded in aggregate and securely stored on the primary investigator's hard drive.

Survey I

The survey contained a total of 23 questions and estimated 10 minutes for completion. Each respondent would only be presented with relevant questions. Relevance was based on responses

to prior questions and driven by way of skip logic. Each of the questions referred to the program the respondent lead rather than the opinions of the respondent themselves.

The first section requested information pertaining to the location of the program and the age of the program.

Section two requested information pertaining to the current methods of recruitment of new volunteers are utilized and their efficacy.

Section three requested information about the program which individual volunteers would not necessarily know, including the total number of participants, total number of sites, average number of oysters produced, average oyster size, source of oyster spat, and season duration.

Section four focused on allowable consumption, and if allowed the rules of the program governing unconsumed oysters.

Section five focused on finances of the program including the fees charged, frequency of fees, who pays the fees and the amount of the fee.

Section six requested information pertaining to the gear used by the volunteers, gear amounts allocated to each gardening site, source of the gear, and time investment constructing the gear.

Finally, Section seven requested information about program meetings and trainings including classifying the meetings as mandatory or voluntary, and who is required to attend. The questions were a mixture of choose one and fill in the blank from which frequency distribution and statistical analysis were conducted.

Survey II

The survey contained a total of 45 questions and estimated less than 15 minutes for completion. Each respondent would only be presented with relevant questions. Relevance was based on responses to prior questions and driven by way of display logic.

The first section collected data from all respondents first asked the respondent to identify as a current or former participant in an oyster gardening program. If a respondent identified as a current or former respondent, they were asked to identify the state in which they garden, the body of water on which they garden and the number of years they have been participating.

Section two requested that those participants who identified as former gardeners identify the primary reason, they chose to leave their oyster gardening program. They were then asked which two, from a list of options, would have maintained their interest in their oyster gardening program.

Section three requested those respondents who identified as a former gardener and who responded that a program change in section two was the reason, they separated from their program to identify the change which prompted their separation.

Section four requested those respondents who identified as a former gardener and who responded that their program disqualified their site in section two to be the reason they separated from their program to identify the reasons provided by the program for the disqualification.

Section five requested those respondents who identified as former gardeners to provide any additional information which could have prevented their separation from their oyster gardening program.

Section six requested all respondents how they first learned about their oyster gardening program. Further, it requested respondents rank (drag and drop) their preferred information sources when considering decisions pertaining to volunteering their time. Respondents were then asked to select (up to three) from a provided list the motivations behind their decision to initially join their oyster gardening program. Respondents were then asked to rank the three choices they selected as reasons for initially joining their oyster gardening program. Respondents were then asked to classify their gardening site as primary, vacation/secondary residence, a friend/neighbor's residence, a community or common site, a relative's residence, a school site or other. Respondents who classified their gardening site as anything other than their primary residence were asked to indicate how many miles they traveled to their gardening site from their primary residence. Respondents were asked to report how frequently they participate in gardening related activities and the average amount of time they allocate to each occurrence. Respondents were asked to consider any necessary additional trips related to their oyster gardening activities (meetings, trainings, etc.) and to provide the estimated number of miles traveled per season for such events. Respondents were asked to consider any expenses related to supplies they incur for their oyster gardening activities and estimate a dollar amount spent each season on these additional supplies.

Section seven asked respondents (current and former) to indicate their level of agreement using a 5-point Likert scale (1 *strongly disagree* to 5 *strongly agree*) on questions related to their knowledge of oysters and oyster ecology prior to joining their oyster gardening program. Respondents were then asked to select all that applied from a provided list (including other) the motivation behind their decisions to engage in an activity at their gardening site prior to joining

oyster gardening. Respondents were then asked to rank all selected responses related to motivators to engage in an activity at their site prior to joining oyster gardening.

Section eight asked respondents (current and former) to indicate their level of agreement using a 5-point Likert scale (1 *strongly disagree* to 5 *strongly agree*) on questions related to their knowledge of oysters and oyster ecology prior to after their oyster gardening program. Respondents were then asked to select all that applied from a provided list (including other) the motivation behind their decisions to engage in an activity at their gardening site after to joining oyster gardening. Respondents were then asked to rank all selected responses related to motivators to engage in an activity at their site after to joining oyster gardening.

Section nine asks respondents (current and former) to rate on a 5 point Likert scale (1 *Not effective at all* to 5 *Extremely effective*) their opinion of the efficacy of participation in their oyster gardening program related to their ranked motivations for engaging in an activity at their gardening site.

Section ten asked respondents (current and former) who selected Environmental Issues or Recreational time as a motivation to engage in an activity at their gardening site to rate (*Increased, Stayed the same, Decreased*) any change in Fishing days, Fish caught, Number of crab traps in use, Crabs caught and Swimming frequency at their gardening site. Respondents were then asked to enumerate these changes if *Increase* was selected.

In Section eleven respondents (current and former) were asked to enumerate the individuals who participate in gardening activities at their gardening site. Respondents were then asked to identify their relationship to these individuals (spouse, children, grandchildren, etc.). Finally, respondents were asked to select (*Yes* or *No*) if they were not engaged in oyster gardening related

activities, would they allocate the same minutes to alternative recreational activities with the individual(s) listed as participants at their gardening location.

In Section twelve respondents who identified as current participants were asked to select from a list including other all areas of interest for future directions of their oyster gardening program. They are then asked to rank those areas which were selected.

In Section thirteen, respondents, who identified they were current participants and indicated an area of interest from Section twelve included growing oysters for sale, were asked about the commercial opportunities their participation in oyster gardening activities afforded them. A 5 point Likert scale (1 *Strongly Disagree* to 5 *Strongly Agree*) was used to measure agreement levels of respondents to statements including "Oyster Gardening helped/will help me decide to grow oysters commercially", "Oyster Gardening helped/will help me meet people wo can help me grow oysters commercially", and "Oyster Gardening is/will offset(ing) costs associated with growing oysters commercially".

In section fourteen, respondents (current and former) were asked open ended questions pertaining to additional information about their oyster gardening program which they enjoyed and disliked.

In section fifteen, respondents (current and former) were asked questions pertaining to their demographics including age, gender, ethnicity, employment status, education and income level.

Data Analysis

All data were collected and aggregated by survey (I and II) for analysis using Qualtrics reports. Within surveys, data were further aggregated by program, region and sub-region as required.

Excel (Microsoft Office 365) and SPSS version 25 were used for inferential statistical calculations and graphical representation s of aggregated responses for descriptive statistical reporting.

Assumptions

The following assumptions are made:

1) The responding participants (n = 279) are representative of the volunteers of participating Oyster Gardening Programs (n =1,114), current and former, along the United States' Atlantic and Gulf of Mexico coasts.

2) The responses provided by the participants are truthful.

3) The responses provided by the participants are independent and free of restriction or suggestion by their respective program leaders or other participants