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DO OYSTER GARDENING PROGRAMS LEAD TO KNOWLEDGE CHANGES?

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ABSTRACT

Extension programs, such as oyster gardening, employ change in participant knowledge as a metric of success. A 5-point Likert scale (*SD-SA*) was used to measure respondents' perceived oyster knowledge defined by oyster reproduction, feeding, ecosystem position, effects on habitat, water quality and erosion, before and after participation in oyster gardening. Responses from eleven gardening programs of the Gulf of Mexico and Atlantic coasts were collected. Significant increases in perceived knowledge in participants was found in early periods of engagement. Differences were found among levels, suggesting participants in some programs perceived their knowledge of oysters to be higher post-participation than others.

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 type of programming vary in style and intensity, "oyster gardening", involves volunteers playing an active role in programming with learning and restorative objectives. Knowledge gain is a commonly utilized metric employed to evaluate efficacy of training programs in many fields (Scasta, Weir and Engle, 2015; Mermelstein and Riesenberg, 1992; Halm et. al, 1999; Loomis, Blair and Gonzales-Caban, 2001; Bonneau et. al, 2009; and McClelland, Jayaratne and Bird, 2013), including Extension efforts involving both natural resources and human dimension programming (Black et. al, 2016 and Hammerschmidt et al., 1995). Extension programs that offer volunteers a hands-on engagement opportunity may result in an increase in perceived knowledge within participants. However, this increase may be time limited, particularly in programs with long-term volunteer participants. Program value may be maximized by identifying the period(s) of prime knowledge transfer within a program volunteer lifespan.

The ability of oyster gardening programs to change the knowledge of participants was evaluated 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 knowledge change as a metric of program success.

METHODS

A questionnaire 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. 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 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 and identified the 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.

The change in the distribution of median (median; inter-quartile range reported) perceived knowledge of oysters in respondents was evaluated within levels (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 for perceived knowledge of oysters before oyster gardening (0.923) and after oyster gardening (0.918); indicating good reliability.

Table 1. Distribution of completed survey responses and corresponding program and regional strata[1].

State	Program	Program Abbreviation	Region	Current Gardener Respondents	Former Gardener Respondents	Program[2] Response Rate (Total Program Participants)	Inexperienced[3] Responding Gardeners (> 3 years)	Experienced[3] Responding Gardeners (5+ years)
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

[1] Survey respondents self-identified their program and current or former participant status. These were used to generate region classification. [2]Survey response rate was calculated based on program leadership reporting of total membership. [3]Experience level of a respondent was determined using respondent self-reported years in program with less than 3 years being classified as Inexperienced and 5 or more years being classified as Experienced.

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

RESULTS AND DISCUSSION

Among Regional Level

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. No significant differences in the distribution of pre-oyster gardening median perceived knowledge of oysters were found 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 that 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, a significant increase in the perceived knowledge scores following participation was found 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). Eight responses (10.9%) from the GOM showed a decline in perceived knowledge of oysters following participation. This decline may be a result of the increased exposure to oyster/ecosystem relationships via participation and a corresponding reduction of confidence in their knowledge of these relationships. In the Chesapeake and Atlantic regions, the percentage of this occurrence was smaller in absolute terms (1.6% and 4.8%, respectively) with 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 ALLL reported lower median knowledge of oysters (3.0; 1.0-3.50) compared to their counterparts in 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 or Program	N	Pre OG[1] Score[2]	Post Oyster Gardening					Z	p
			Score[3]	Increases[4]	Decreases[5]	Ties[6]	Difference[7]		
Gulf of Mexico	73	3.44	4.30	37	8	28	0.86	5.02	≤.001
Chesapeake Bay	124	3.48	4.67	76	2	46	1.19	7.641	≤.001
Atlantic Coast	62	3.08	4.55	43	3	16	1.51	5.192	≤.001
Texas	12	3.38	4.54	8	2	2	1.17	1.960	.036
Mississippi	5	4.90	4.80	0	1	4	-0.10	-1.00	.317
Alabama Mobile Bay	37	3.64	4.61	21	3	13	0.96	3.904	≤.001
Alabama Little Lagoon	15	2.57	3.40	6	1	8	0.83	2.213	.027
Florida Gulf of Mexico	4	3.13	3.50	2	1	1	0.38	1.089	.276
Florida Atlantic Coast	47	3.10	4.56	33	2	12	1.49	4.567	≤.001
Virginia CBF	82	3.36	4.68	56	1	25	1.32	6.567	≤.001
Virginia TOGA	12	3.75	4.58	3	1	8	0.83	1.473	.141
Maryland CBF	21	3.67	4.67	13	0	8	1.00	3.198	≤.001
Maryland Choptank	9	3.72	4.67	4	0	5	0.94	1.841	.070
New Hampshire	15	3.00	4.50	10	1	4	1.57	2.547	.011

[1]Oyster Gardening; [2]Pre- OG average median score;[3]Post-OG average median score; [4]Count of positive changes in scores Pre to Post OG; [5]Count of negative changes in scores Pre to Post OG; [6]Count of no changes in scores Pre to Post; [7]Median score difference

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 ALMB (5.0; 4.5-5.0; p≤.001), VACBF (5.0; 5.0-5.0; p=.027), MDCBF (5.0; 4.25-5.0 p=.004), TOGA (5.0; 4.25-5.0; p=.03) and FLAC (5.0; 5.0-5.0; p≤.001). All other comparisons were not significant (p≥.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

An average increase (≥0.38) was found 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≤.036) except MS (p=.32), FLGOM (p= .28), TOGA (p= .14) and MDCHOP (p=.07; Table 2). Each of these programs had low response rates and/or was a small program that resulted in low sample numbers (n=5, 4, 12 and 9, respectively). Low response rates and program size 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≤ .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≥.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 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≥.326).

Following oyster gardening participation, differences among program levels were found 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<.001), TX (5.00; 4.38-5.0 p= .049) and VACBF (5.00;4.50-5.0; p<.001) programs. All other comparisons were insignificant (p≥.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.

Differences in median knowledge (post-pre) for the inexperienced group showed 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

Oyster gardening programs appear to increase participant perceived knowledge of the ecological role of oysters up to year five, after which significance generally diminishes. 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.

Extension programming that offers participants a hands-on engagement opportunity may result in an increase in perceived knowledge within participants. However, this increase may be time limited. Volunteer based programs, such as oyster gardening, should self-evaluate efficacy of participant knowledge gain to identify the prime learning time(s) in the life of a program volunteer. This may be especially important to those programs whose volunteers remain engaged for long periods of time or multiple consecutive program cycles. In particular, for oyster gardening programs within the study area, a need to ensure new potential volunteers have a clear avenue to join is evident. Successful recruitment of new participants can result in continued demonstration of program value by maximizing change in the participant perceived knowledge metric. Such value can be important to Extension programs both in administrative and legislative evaluation, as well as by demonstrating program efficacy to potential extramural funding sources.

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