Awareness and opinions of Maryland citizens toward Chesapeake Bay Mute Swans *Cygnus olor* and management alternatives

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Abstract

Concerns surrounding the ecological impacts from increasing numbers of non-native Mute Swans *Cygnus olor* have led some management agencies in the United States to implement control efforts directed at reducing populations of this invasive species. By 2001, concerns regarding the rapid increase in Mute Swan numbers in Maryland (USA) and their negative impacts upon Chesapeake Bay living resources (*e.g.* submerged aquatic vegetation, native waterfowl and colonial waterbirds) had become acute. An understanding of citizens' attitudes toward Mute Swans and potential management alternatives is necessary before wildlife agencies can enact socially acceptable measures to control these populations. A random telephone survey of Maryland registered voters therefore was conducted in February 2005 to assess public awareness (knowledge and attitudes) of Mute Swans in Chesapeake Bay, including the size of the swan population, preferences for swan management options and confidence in the ability of the Maryland Department of Natural Resources (MDNR) to control their numbers. A total of 625 completed surveys were obtained from respondents in seven geographical regions. Nearly all respondents (86%, n = 539) indicated they would support Mute Swan population control after they were provided evidence that this species was harmful to the Chesapeake Bay ecosystem; they felt the health of Chesapeake Bay was more important than sustaining a non-native swan population. Of the respondents that supported aggressive control measures, 62% (n = 387) supported the use of lethal methods of control, and a majority supported hunting over egg addling as a control method. Most respondents were also confident that the MDNR would implement control methods that were both humane and effective in solving the overabundance of Mute Swans in the region. The results provide useful information to wildlife professionals for management planning and communication when considering control of Mute Swan populations.

Key words: control, *Cygnus olor*, management, Maryland, Mute Swan.

Maryland's feral Mute Swan population originated from the escape of five captive birds in 1962 (Reese 1975). The population grew slowly through the 1960s and 1970s but then underwent rapid growth from *c.* 264 birds recorded in 1986 to *c.* 3,955 in 1999 (Hindman & Harvey 2004). As this population grew, so did concerns about their ecological impact on native bird populations and their habitats. In Chesapeake Bay (hereafter Bay), Mute Swans caused the abandonment of nesting areas by "state-threatened" waterbirds (likely to become endangered within the foreseeable future in the State) such as the Least Tern *Sterna antillarum* and Black Skimmer *Rynchops niger* (Therres & Brinker 2004). Large flocks of non-breeding swans also reduced submerged aquatic vegetation (SAV) at the local level (Naylor 2004; Tatu *et al.* 2007). The rise in breeding Mute Swan pairs also increased conflicts between people and breeding swans defending their nest territory and young (Hindman & Harvey 2004). Examples of conflicts include threat displays and direct attacks toward swimmers and people in small watercraft. This aggressive behaviour deters people from using riparian shorelines. Although no serious injuries to people have been reported in Maryland, there are two recorded cases of drowning involving attacks by Mute Swans elsewhere in the United States (Wisconsin Dept. of Natural Resources 2014; Steckling 2012).

In response to these increasing threats, the Maryland legislature adopted a law that in 2001 directed the Maryland Department of Natural Resources (MDNR) to control the Mute Swan population and to consider regulated hunting as a management tool (Maryland Annotated Code 2001). The Chesapeake 2000 Agreement identified the Mute Swan as one of the top priority invasive species requiring regional management (U.S. Environmental Protection Agency 2000). The agreement charged signatory agencies with developing and implementing management plans for those species deemed problematic to the restoration and integrity of the Bay's ecosystem.

In 2003 the MDNR developed a Mute Swan management plan to address the problems caused by this species (MDNR 2003). The agency recognised that any effort to control Mute Swans must occur concurrently with an effort to raise public awareness and advise Maryland citizens about potential threats posed by Mute Swans. One of the objectives in the management plan was to increase public awareness about Mute Swans and their impact to the Bay's living resources (MDNR 2003). The plan included a strategy to conduct a state-wide, random survey of citizens to determine their knowledge, perceptions and values regarding Mute Swans in Maryland (MDNR 2003). A companion strategy was to develop and implement a comprehensive Mute Swan communication programme that targeted specific demographic groups, particularly riparian shoreline owners and watershed community residents. Our survey contributed to this objective by obtaining an understanding of attitudes of Maryland citizens toward Mute Swans and their level of support for a range of management alternatives and methods required to control the swan population.

We tested the hypothesis that people who had contact with the Chesapeake Bay, defined by living and working near the Bay, were more likely to be aware of issues attributed to Mute Swans than people who did not have direct contact with the Bay. Given an awareness of issues about the Mute Swan, we predicted that a respondent from a region adjacent to the Bay was more likely to name a negative attribute of the Mute Swan than a respondent from a geographic region not adjacent to the Bay. We also predicted that respondents who were made aware of facts about the Mute Swan were more likely to support efforts to control the population. We predicted that supporters of Mute Swan population control were more likely to favour non-lethal methods of control over the use of lethal methods.

This survey was conducted to help the MDNR assess the public's awareness (knowledge and attitudes) of Mute Swans in Chesapeake Bay, including the size of the population, preferences for swan management alternatives and control methods, and also the public's confidence in the MDNR to manage the population.

Methods

In 2005, we contracted Mason-Dixon Polling and Research, Inc. (MDPR) to conduct a random telephone survey of registered voters in Maryland. The survey was developed to measure the voting public's awareness and opinions about: 1) the economic and environmental value of Chesapeake Bay to the State of Maryland, 2) the existence of various swan species in the Bay, 3) their knowledge of Mute Swans and the species impacts to Chesapeake Bay living resources (*e.g.*. submerged aquatic vegetation, native waterfowl and colonial waterbirds), 4) their support for population management alternatives to control this invasive species, and 5) the use of different control methods for reducing the swan population. An additional objective was to determine basic demographic information so the survey results could be used to inform communication efforts directed toward the public. The survey questions were reviewed by a panel of scientists from the University of Maryland (UMD), MDPR and MDNR and the survey was approved by the UMD Institutional Review Board.

Professional interviewers with the MDPR completed 625 telephone interviews during 23–25 February 2005. The population for this survey was all Maryland voters. The survey respondents were selected through a random digital telephone dialling procedure with a targeted sample that was stratified based on the demographic distribution of all registered voters, from the seven geographical regions of Maryland (Baltimore City, Central Maryland, Washington D.C. Suburbs, Southern Maryland, Upper Eastern Shore, Lower Eastern Shore, Western Maryland) (Fig. 1). Pearson chi-square tests were used to test for regional differences in knowledge of Mute Swans and support for population control (Snedecor & Cochran 1989). A chi-square test was also used to compare respondent characteristics, their opinions on the desired population level, and support for a range of management alternatives and population control methods.

The telephone survey consisted of 33 questions and each interview lasted *c.* 15

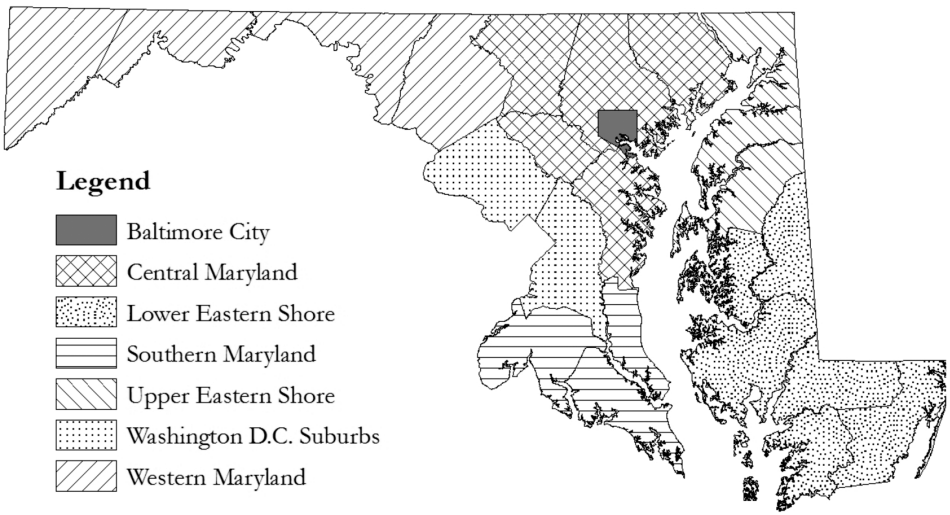

Figure 1. Geographic regions of Maryland used in a telephone survey of Maryland voters (n = 625) to assess citizen awareness of the Mute Swan population in Chesapeake Bay.

minutes. Survey interview questions included multiple choice, yes/no, Likert scale (1–5) and open-ended comments. The first section of the questionnaire measured respondents' opinions towards the importance of a healthy Bay to the State's economy and ecological health. In addition, this section established the respondents' personal experience with and participation in outdoor recreation activities related to the Bay. These activities included hunting, fishing, watching wildlife around their home, travelling at least one mile to view wildlife, camping and boating. Demographic information provided an opportunity to compare the findings by region, *i.e.* those living in proximity to the Bay regions, as opposed to those from the Central and Western regions of the State.

The second section of the questionnaire assessed the respondents' knowledge of Mute Swans and other swan species in the Bay. It also assessed the public's overall awareness of Mute Swan issues and conflicts. However, awareness in itself is difficult to measure because there are varying degrees of awareness. Some individuals may be completely unaware of the Mute Swan's existence; others may be able to recognise a Mute Swan, while others may be able to list the Mute Swan's defining features and role in the Bay ecosystem. To assess more accurately the true level of awareness, respondents were first asked if they could name any swan species in the Bay. They were then asked whether they had heard anything in the news or other information about Mute Swans and what was the source of the information (*e.g.* newspaper, television, radio, animal rights organisation, *etc.*). They were then asked about what they specifically had heard or knew about the Mute Swan (*e.g.* feeding on submerged aquatic vegetation, effects on

other wildlife, public safety concerns) (Appendix 1, question (Q) 16). Respondents were also asked about their familiarity with issues related to the Mute Swan. Finally, in this section respondents were asked about the size of the Mute Swan population on the Bay (Appendix 1, Q 19).

In the third section, respondents were read information about the Mute Swan population in Maryland that included: 1) biological facts about the species, 2) their historical introduction into the Bay, 3) the increase in population size, 4) harmful impacts of Mute Swans to SAV and certain native wildlife species, and 5) their aesthetic values. After hearing the science behind the Mute Swan issues in the Bay, respondents were asked about their level of support for different management alternatives: 1) allow the population to expand naturally, 2) control or manage the population at a reasonable level (*e.g.* minimal impact to Chesapeake Bay living resources), or 3) eliminate Mute Swans from Chesapeake Bay (Appendix 1, Q 20). Respondents were then asked about their support for aggressive action to control the swan population, and support for lethal methods including regulated hunting and egg addling (Appendix 1, Q 21–24), using a 5-point Likert scale (strongly support, moderately support, moderately oppose, strongly support, not sure) (Likert 1932).

In the fourth section of the questionnaire, respondents were asked which of two statements best described their view of Mute Swans: "The MDNR should regulate the Mute Swan population…" or "Mute Swans should be protected from any control measures…" (Appendix 1, Q 25). The order of the statements was rotated with each interview.

The fifth section of the questionnaire measured respondents' confidence in the MDNR to implement a humane and effective Mute Swan population control programme and their support for dedicating resources to advise the public about Mute Swan issues in the Bay. The questionnaire ended with six demographic questions concerning: 1) respondent's type of residential area (city/urban, suburban, small town, rural), 2) race or ethnicity, 3) education, 4) age, 5) gender, and 6) geographic region of residence within the State. Responses to these questions were used to determine if there were differences or similarities in respondents' responses based upon the demographic information they provided.

Results

Respondent awareness and opinions of Chesapeake Bay Mute Swans and opinions on the value of the Bay to the State

A total of 625 completed surveys were obtained from seven geographical regions of the State (Fig. 1) out of approximately 1,000 telephone contacts.

Environmental and economical value of the Bay to the State. Nearly all respondents (99.6%, n = 622) felt that the Chesapeake Bay was either very important or somewhat important to Maryland's economy and ecological health.

Awareness and opinions of Mute Swans. Less than one third of survey respondents (28%, n = 174) said they were able to name a

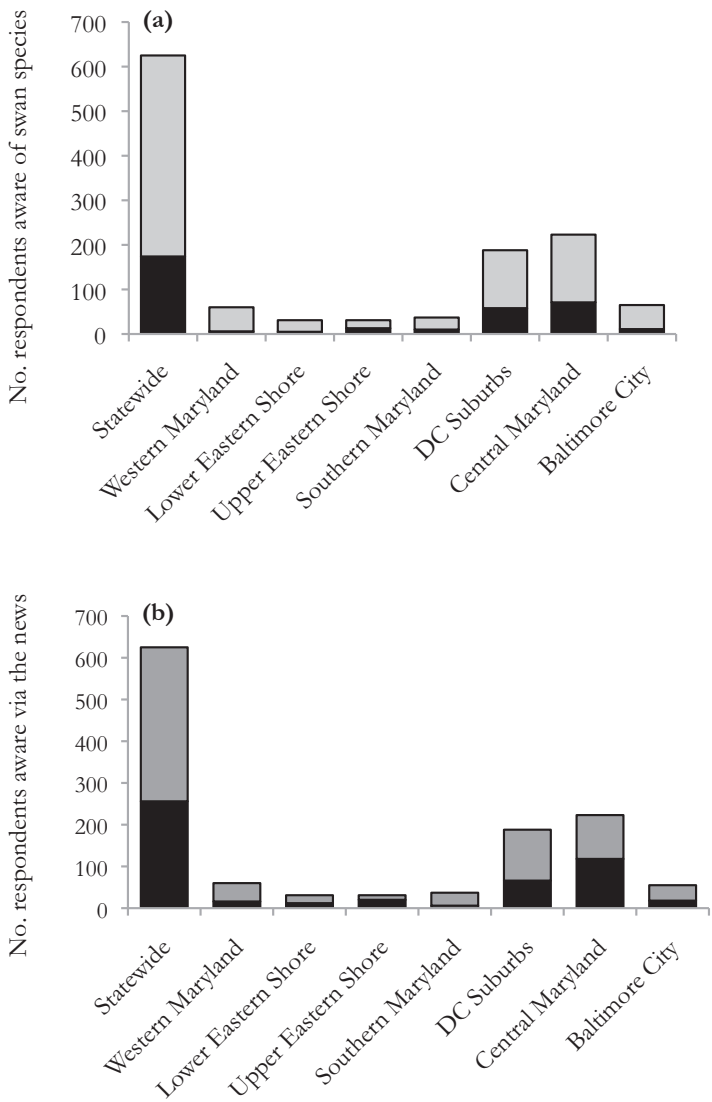

Figure 2. Statewide and regional responses of a random sample of Maryland voters (n = 625) to assess citizen awareness of swans in Chesapeake Bay. Respondents were asked if (a) they were aware of any specific swan species that live in Chesapeake Bay, and (b) if they had heard anything in the news regarding the Mute Swan? Black columns = yes responses; grey columns = no.

specific swan species inhabiting the Bay (Fig. 2). Of this group, more (49%, n = 85) were able to name the Mute Swan than any other swan species. Interestingly, more respondents (28%, n = 49) were able to name the Trumpeter Swan *C. buccinator* (rare

winter transient) than the Tundra Swan *C. columbianus* (3%, $n = 6$), the most abundant swan species (wintering) in the Bay.

Overall, our geographic analysis proved to be inconclusive. While geographic region proved to be significant in regards to awareness of a swan species (defined by the ability of respondents to identify swan species) ($\chi^2_6 = 19.01$, $P = 0.004$), adjacency to the Bay was not a significant factor ($\chi^2_1 = 0.59$, $P = 0.44$, n.s.). About 42% ($n = 13$) of Upper Eastern Shore citizens claimed that they could name a swan species inhabiting the Bay, whereas only about 10% ($n = 6$) of Western Maryland respondents could name a swan species (Fig. 2a). The Upper Eastern Shore respondents also had the highest percentage of respondents who could name the Mute Swan (39%), followed by Trumpeter Swan (10%), and Tundra Swan (7%).

Perceived impacts of Mute Swans. About 41% ($n = 256$) of the state-wide respondents had heard something in the news regarding the Mute Swan (Fig. 2b). They obtained this information largely from newspapers (54%, $n = 137$) and television (39%, $n = 99$). When asked what they had heard about the Mute Swan, 62% ($n = 159$) of the responses were considered negative (Fig. 3). The most common facts expressed were Mute Swans are invasive (29%, $n = 74$) and destructive to agriculture (18%, $n = 47$).

Citizens who lived adjacent to the Bay, while unable to name any swan species better than their non-adjacent counterparts, had in fact heard more about Mute Swans ($\chi^2_6 = 39.00$, $P = < 0.001$). When asked to cite a negative fact they had heard about the Mute Swan, geographic region was unrelated to the respondent's awareness of Mute Swans ($\chi^2_1 = 1.15$, $P = 0.76$, n.s.).

Other factors influencing awareness of Mute Swans and related issues. Overall, involvement in outdoor recreational activities involving the Bay had a strong, positive relationship with swan awareness. There was a strong distinction between responses involving awareness of Mute Swan issues with those respondents who participate regularly in 0 (3%, $n = 5$), 1–3 (67%, $n = 106$), or 4–6 (30%, $n = 48$) outdoor activities ($\chi^2_2 = 9.90$, $P = 0.007$). Those who participated in more activities had a higher level of awareness of swans. In general, the more activities respondents participated in, the more likely they believed that the Mute Swan population was too high ($\chi^2_4 = 16.69$, $P = 0.002$).

Respondent's level of education was also correlated with their awareness of Mute Swan-related issues. There was a significant difference in awareness between those who had graduated college and those who had not ($\chi^2_1 = 18.20$, $P = < 0.001$. Only 22% ($n = 54$) of those who had not graduated college were able to name a swan species, whereas 33% ($n = 120$) of college graduates could name a swan species in the Bay. Those who had completed higher education levels (*e.g.* college, graduate school) were more aware of Mute Swan issues than those who had not.

Opinions about the Mute Swan population and management alternatives

Opinions about the Mute Swan population. Most survey respondents (57%, $n = 356$) were not

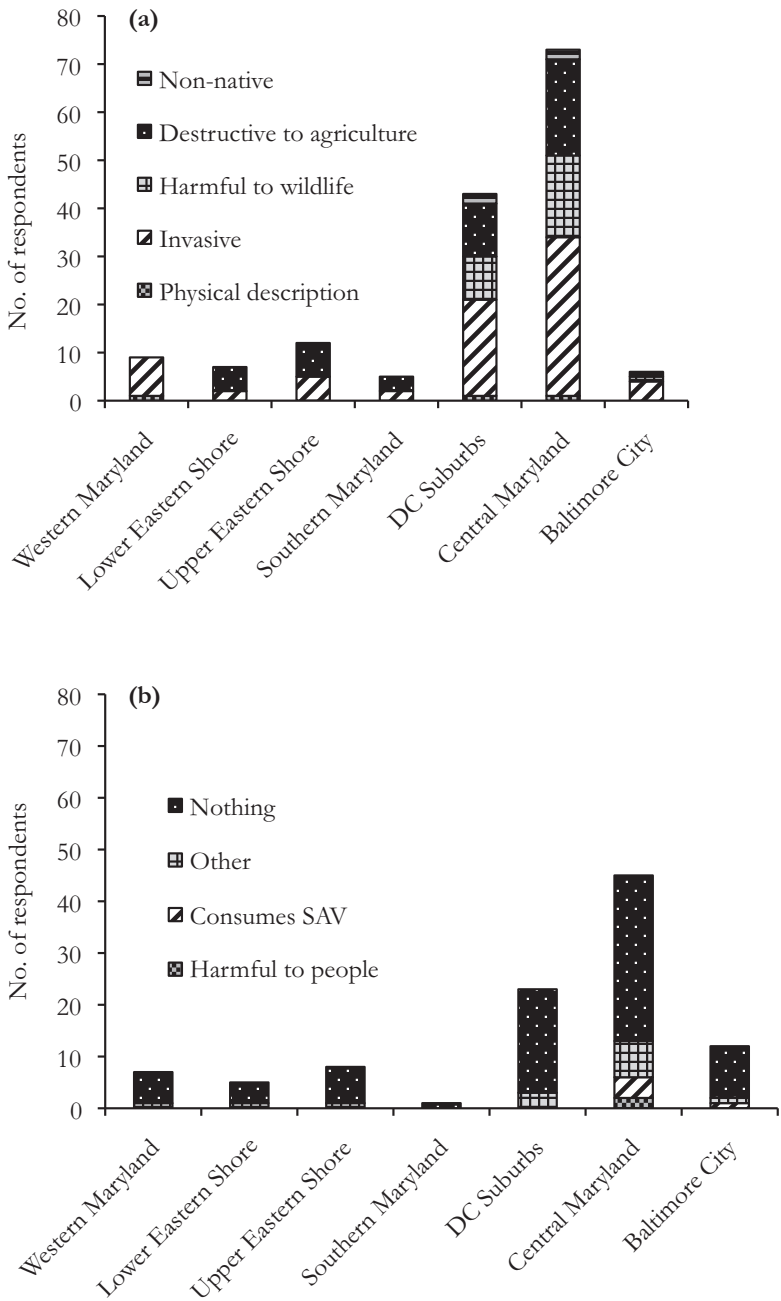

Figure 3. Regional and statewide responses (n = 256) of Maryland voters who had heard something about Mute Swans and what they had heard.

sure if the Mute Swan population was close to the optimum population size (Fig. 4). However, 26% (n = 163) of the respondents felt the Mute Swan population in the State was too high. A higher proportion (52%, n = 16) of Upper Eastern Shore respondents indicated that the population was too high compared to the overall, state-wide response.

Opinions about management options. After hearing information regarding the Mute Swan from an interviewer, the majority of respondents (79%, n = 486) felt the MDNR should take aggressive steps to control the Mute Swan population. A high proportion (86%, n = 539) felt that Mute Swans should either be controlled (n = 432) or eliminated

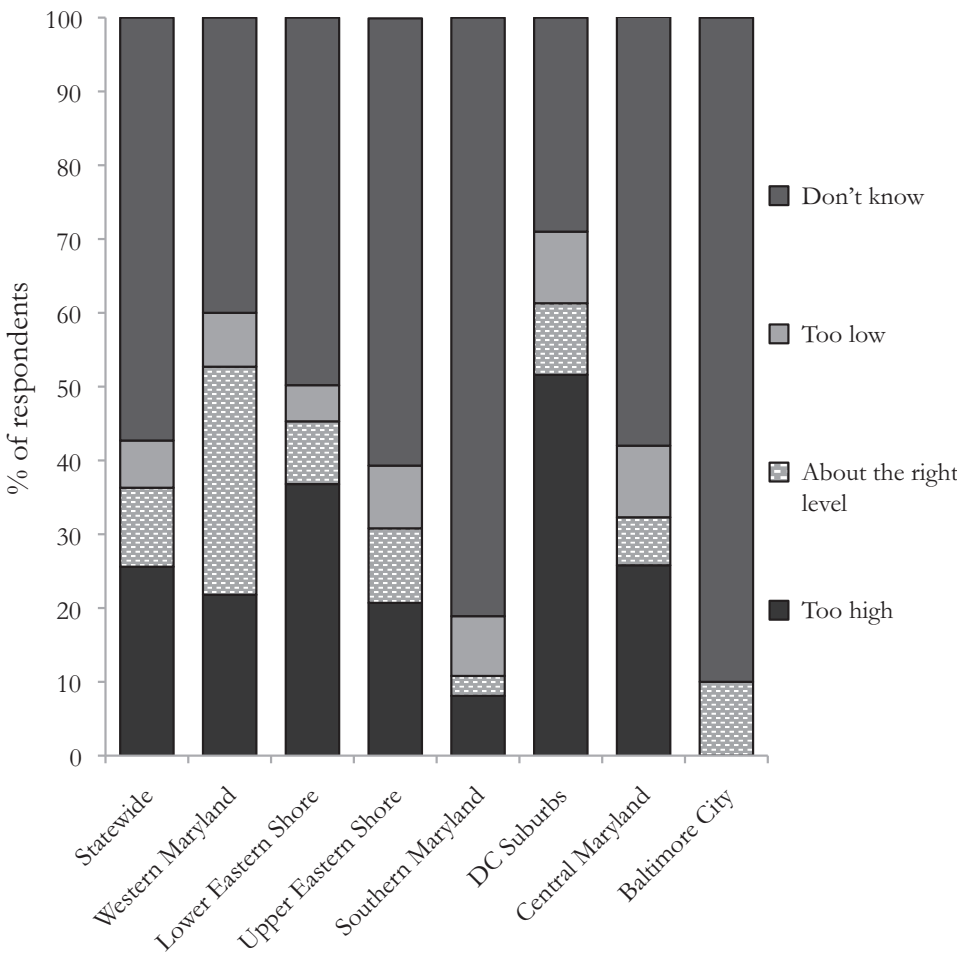

Figure 4. Statewide and regional responses (%) of a random sample of Maryland voters (n = 625) to assess citizen awareness of Mute Swan population size in Chesapeake Bay. Respondents were asked if the population was too high, about the right level or too low?

from the Bay (n = 107; Fig. 5). No one surveyed strongly opposed the MDNR taking aggressive measures to control Mute Swans.

Overall, the majority of survey respondents (62%, n = 387) supported the MDNR using lethal methods to control the Mute Swan population (Fig. 6). Of the 86% (n = 539) of respondents who opted for swan control, 65% (n = 350) supported the use of lethal methods. Of those who supported the elimination of Mute Swans in the Bay, 77% (n = 82) opted for lethal methods. The region with the largest percentage of respondents opposed to lethal control methods was Western Maryland (50%, n = 30) (Fig. 6). The region with the least percentage of respondents opposed to lethal methods was Central Maryland (18%, n = 40).

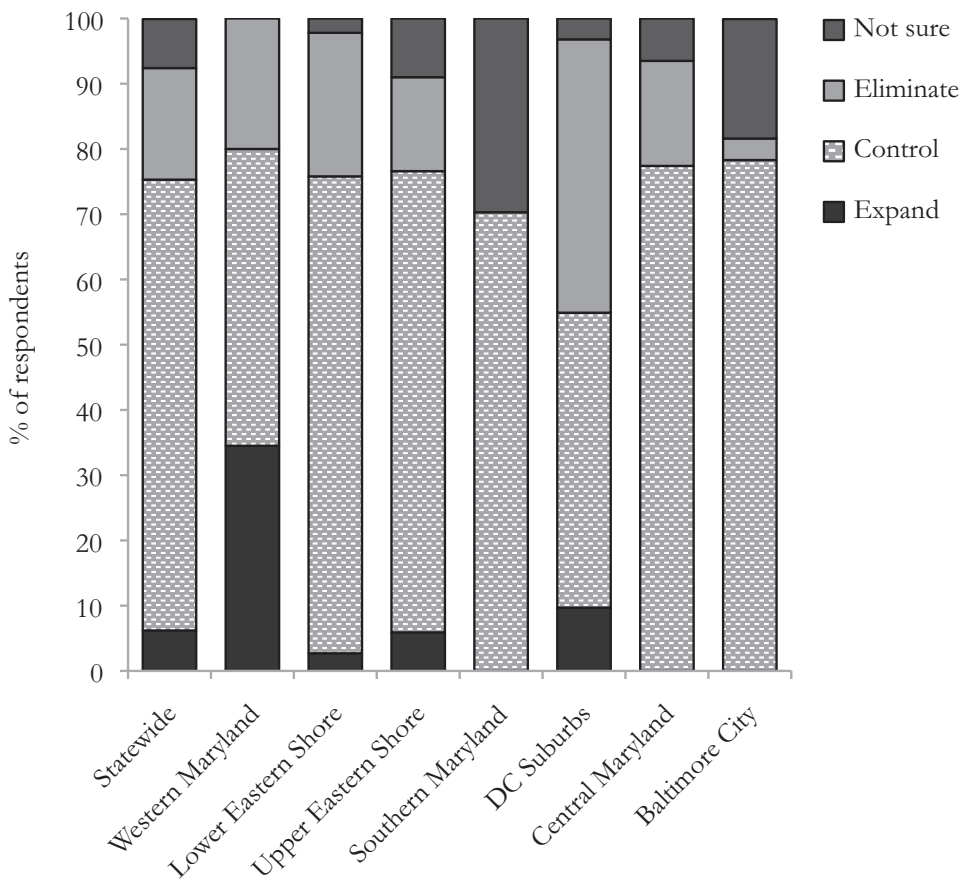

Figure 5. Statewide and regional responses (%) of a random sample of Maryland voters (n = 625) to Mute Swan management alternatives in Chesapeake Bay. Respondents were asked if they believed the Mute Swan population should be allowed to expand naturally, controlled by MDNR or eliminated?

Regulated hunting received the highest approval (76%, n = 476) as a Mute Swan control method (Fig. 6). The percentage of respondents from Baltimore City (*i.e.* urban) who strongly opposed hunting was more than three times the state-wide response (27%, n = 15 *vs.* 9%, n = 55). No respondent who had participated in hunting during the past year opposed hunting as a control method. Ironically, a large proportion of respondents (44%, n = 17) who stated the Mute Swan population should be allowed to expand naturally also felt hunting should be used as a swan control method.

A majority of respondents (64%, n = 402) supported egg addling as a control method (Fig. 6). Upper and Lower Eastern Shore citizens expressed the strongest regional response, strongly supporting egg addling (58% and 43%, respectively).

Attitudes toward the MDNR in managing the Mute Swan population

The majority of respondents (83%, n = 519) believed that the MDNR should manage the

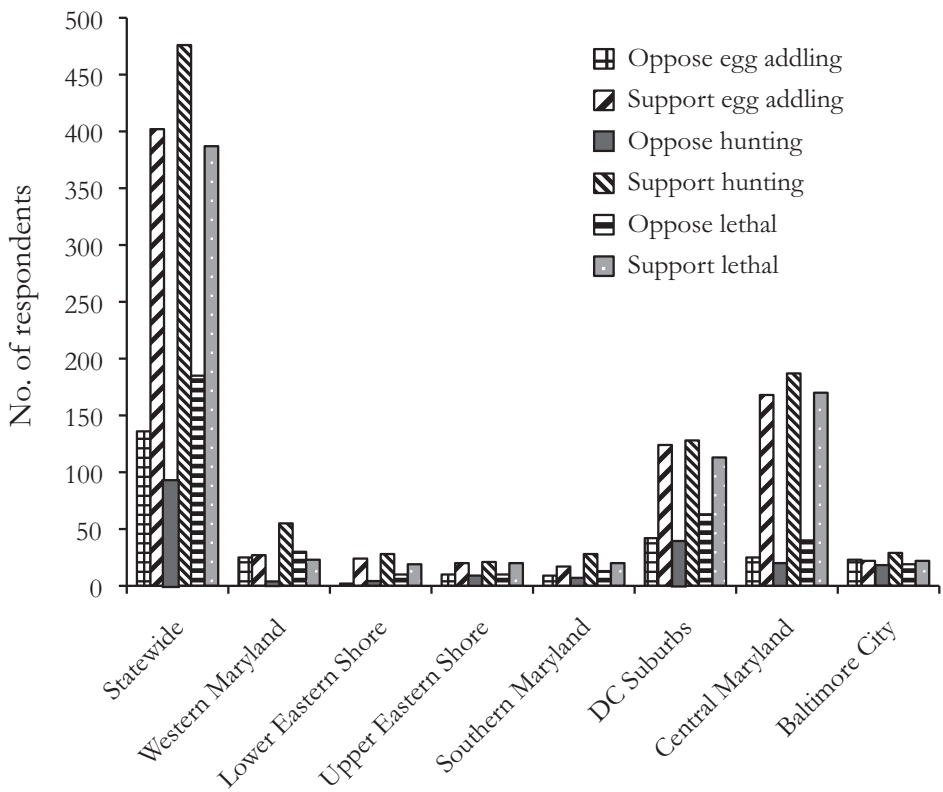

Figure 6. Statewide and regional responses (n = 625) of a random sample of Maryland voters concerning their support for the use of lethal contol, regulated hunting and egg addling to control the Mute Swan population in Chesapeake Bay.

Mute Swan population. Most respondents (72%, n = 449) indicated that they were confident that the MDNR could implement a humane and effective Mute Swan population control programme. Further, a high proportion of respondents (90%, n = 565) also supported the MDNR dedicating resources to raise public awareness about the Mute Swan issues in Chesapeake Bay.

Discussion

This is the first study to measure citizen knowledge of Mute Swans, their ecological impact and citizen support for Mute Swan population management and control methods on Chesapeake Bay. Survey findings revealed that most of Maryland's citizens felt that a healthy Bay was important. However, despite the Bay being one of the most important wintering areas for migratory waterfowl, they generally were not familiar with swan species found in the Bay. Given the news media attention Mute Swans have received in recent years (Baltimore Sun 2002), it was not surprising to learn that respondents were more familiar with Mute Swans than other swan species. However, most citizens knew very little about Mute Swans and their impact on the Bay's living resources. Respondents identified damage to agriculture as one of the negative impacts linked to Mute Swans; however, this species does not forage in agricultural fields in the Bay region (L. Hindman, pers. obs.). The ecological impact most often attributed to this species in the Bay by published research is their consumption and destruction of SAV (Naylor 2004; Perry *et al* 2004; Tatu *et al*. 2007; Sousa *et al*. 2008).

Our analysis indicated that people who had lived and worked near the Bay, were more aware of issues attributed to Mute Swans than those who did not have direct contact with the Bay. This awareness, in part, was likely to be the result of local media coverage (television and newspaper) from communities around the Bay. Two items that provided the focus of media coverage were: 1) the MDNR Mute Swan Management Plan objective of removing swans from important Bay habitats and 2) the legal challenges in federal courts concerning the legal status and management of Mute Swans in Maryland and the Atlantic Flyway (Cucuzzella 2004). Respondents' ability to name a negative attribute of Mute Swans was not linked to the distance from the Bay at which they lived or worked. Once respondents were provided with information about the ecological impact of Mute Swans and, most respondents supported the management of the swan population by MDNR and supported the use of lethal control, including hunting.

Mute Swan control efforts have often been initiated by wildlife management agencies without basic knowledge of public opinion about rising Mute Swan numbers, their effects on natural resources and how they view population control actions. These control programmes have often been met with strong objection by animal rights organisations and a vocal portion of the general public. More recently, management agencies have made attempts to inform and raise public awareness about the impacts of Mute Swans on native plant and animal species prior to reducing Mute Swan numbers (Michigan Dept. Natural

Resources 2014; Ohio Division of Wildlife 2014). However, local news media plays a significant role in constructing perceptions of wildlife problems and how they are best resolved, with people often becoming more aware of Mute Swan-related issues through widespread media attention.

The idea of controlling or using lethal methods to reduce or eliminate Mute Swans in various areas in the United States (U.S.) has elicited considerable public reaction (Odonell 2003; Moody 2014). Most control efforts have been met with opposition: 1) in the form of petitions (New Jersey, New York and Toronto, Canada: Change.org. Inc. 2014), 2) legislation (New York: Moody 2014; Blain 2014), and 3) legal challenges (U.S. Court of Appeals, U.S. District Court, Maryland: McGhee 2004; Cucuzzella 2004). However, in 2001, the Maryland General Assembly (legislature) directed the MDNR to control the State's Mute Swan population (Maryland Annotated Code 2001). The MDNR encountered legal action when the programme was initiated and control was suspended in 2004 (McGhee 2004). It was resumed on the litigation being resolved and on the U.S. Congress enacting the Migratory Bird Treaty Reform Act of 2004 (Wisch 2005), which removed federal protection for Mute Swans in the U.S.

As people experience negative encounters or perceive problems with wildlife, they often become more supportive of management actions to address these conflicts, including use of invasive or lethal techniques (Zinn *et al.* 1998). In addition, support for lethal control techniques often becomes stronger, depending upon the type and severity of the problem (Loker *et al.* 1999; Coluccy *et al.* 2001; Koval & Mertig 2004). Coluccy *et al.* (2001) found that landowners who reported property damage caused by Canada Geese *Branta canadensis* were more supportive of lethal alternatives. As in most situations involving native wildlife, many variables may account for conflicting attitudes toward Mute Swans. Public opinion may change with the amount and type of information that people receive on the issues and the circumstances within wildlife populations – particularly when the populations of certain species greatly increase (Duda & Jones 2008).

Opinions expressed during surveys can be influenced even when a small amount of information is included (Reiling *et al.* 1988; Fishkin 1995; Bright & Manfredo 1997; McComas & Scherer 1999; Lauber & Knuth 2000). With most of the Maryland public unaware of Mute Swans and their impacts, the information presented about Mute Swans during the survey interviews clearly influenced respondents' opinions. However, it was extremely valuable to learn how respondents felt about Mute Swan management and alternative management scenarios and control methods. We had predicted that supporters of Mute Swan population control were more likely to favour non-lethal methods of control over the use of lethal methods. However, the survey suggested that support for lethal control of Mute Swans, including regulated hunting, was greater among survey respondents than for non-lethal control methods like egg addling. The results suggested that it would be possible for MDNR waterfowl managers to implement some form of control management with few conflicts.

In 2003, when Maryland's Mute Swan management plan (MDNR 2003) was made available for public review, there was some limited interest in hunting Mute Swans (L. Hindman, pers. obs.). Though waterfowl hunting is a major outdoor activity in the area, there has been no recent history of hunting swans in the State; swans were last hunted in Maryland prior to the passage of the Migratory Bird Treaty Act in 1918. Although Mute Swans are unprotected in many areas of the U.S., and may be legally taken by hunters, no U.S. state or Canadian province (the swans are protected in Canada) has proposed a hunting season for the species. Many states allow the legal take of Mute Swans where the species is considered a deleterious, invasive or unprotected species (Atlantic Flyway Council 2003). In adjoining states (*e.g.* Delaware, Pennsylvania, Virginia) where Mute Swans are "unprotected", the number of Mute Swans harvested by hunters is very low (R. Hossler in Delaware, unpubl. data; I. Gregg in Pennsylvania, unpubl. data). A small, incidental harvest (< 50) of Mute Swans occurs each year in Virginia during legal Tundra Swans hunting seasons (G. Costanzo, unpubl. data).

Although the Maryland legislature had directed the MDNR to implement a Mute Swan control programme and to consider hunting as a management tool (Maryland Annotated Code 2001), a Mute Swan hunting season in Maryland would most certainly have elicited public opposition from within the State and other regions of the U.S. Further, with *c.* 16,000 Tundra Swans wintering in Maryland's portion of the Bay (U.S. Fish and Wildlife Service 2014), allowing the legal take of Mute Swans during regular waterfowl hunting seasons would likely result in misidentification and incidental, illegal kill of some Tundra Swans which are protected along the Atlantic Flyway except in North Carolina and Virginia (Serie *et al.* 2002).

We had hypothesized that respondents to the survey who supported population control would express greater support of non-lethal forms such as egg addling. The results however showed that they were generally less supportive of addling swan eggs than of regulated hunting (64% *vs.* 76% respectively). Lower support for egg addling may be linked to the public being less familiar with this method as a population control tool. Although egg addling is more socially accepted (*i.e.* considered humane) than lethal control for overabundant species such as Canada Geese (Laycock 1982), lower support for egg addling by Maryland citizens was likely to be influenced by differences in news media coverage. Citizens are more likely to experience and recall news media coverage of swan control involving the lethal removal of swans rather than egg addling (L. Hindman, pers. obs.). Another possible explanation for lower support for egg addling could be that the exact meaning of egg addling, even after being given a definition, was not clearly understood and therefore avoided by respondents.

Support for using hunting to control the Mute Swan population in Maryland may also have been influenced by the public's support for using hunting to control other overabundant species like White-tailed Deer *Odocoileus virginianus* (Responsive Management 1993, 2004). White-tailed Deer

also carry the tick responsible for Lyme disease; thus, public concern for Lyme disease could lead to more positive attitudes toward hunting. In recent years the news media in Maryland has covered special managed deer hunts and the expansion of deer hunting on Sundays is being considered by the Maryland legislature (Herald-Mail Media 2014). Recent evidence suggests that people living near abundant wildlife populations may be more supportive of lethal management alternatives (Loker *et al.* 1999).

Application of the survey's findings to management of Mute Swans

Although respondents to the survey and the Maryland legislature expressed support for hunting as a method of Mute Swan control in the Bay, the MDNR declined to use hunting as a lethal management alternative in its swan management. Rather, the agency used an integrated programme of combining oiling swans eggs with the culling of adult swans by shooting, supplemented with euthanasia by mechanical cervical dislocation (using an emasculatome) to reduce the State's Mute Swan population (MDNR 2011; Hindman *et al.* 2014; American Veterinary Medical Association 2000, 2007). Numbers were thus reduced from *c.* 3,995 birds in 1999 to *c.* 41 in 2014. This management alternative was consistent with survey respondent support for control of Mute Swans in the Bay using both lethal (shooting) and non-lethal methods, and there was very little public opposition to the methods and level of control during the years (2005 through 2014) that the MDNR implemented its swan control programme.

This survey demonstrated that most people felt that a healthy Bay was essential to the economic and ecological well-being of the State and more important than maintaining a feral population of Mute Swans. The survey provided substantial evidence that the Maryland public would support lethal methods of control implemented by MDNR to reduce the State's Mute Swans population. Since public support for lethal wildlife management varies by management situation, managers need to consider public attitudes in specific lethal management situations. The survey findings and the management of the Bay's Mute Swans as a result of this survey provides useful information to wildlife professionals for planning communication and management alternatives when considering control of introduced (non-native) Mute Swan populations in other areas.

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Appendix 1. Prominent questions asked of Maryland voters (n = 625) about Mute Swans and their support for management alternative and population control methods in Chesapeake Bay Maryland, 2005. Question numbers correspond to the order in which they were read to respondents during telephone interviews.

Question 16. What have you heard or do you know about the Mute Swan? (first mention).
Is there anything else you know or have heard about the Mute Swan? (second mention).

Question 19. Based on what you do know, would you say the Mute Swan population in Maryland is too high, too low, about the right level or not sure?

The following questions were asked of survey respondents after they were read information about Mute Swans in Chesapeake Bay:

Question 20. Now that you have been presented with the scientific facts about Mute Swans in the Chesapeake Bay, do you believe the Mute Swan should be allowed to expand naturally, controlled to a reasonable population by the Maryland Department of Natural Resources (MDNR), eliminated from the Chesapeake Bay or don't know?

Question 21. In Maryland, there are legal hunting seasons for native waterfowl like Canada Geese and Black Ducks. Do you support or oppose regulated hunting as a way to control Mute Swan populations in Maryland? Is that strongly support, moderately support, moderately oppose, strongly oppose or not sure?

Question 22. Egg addling terminates the development of an embryo by shaking, oiling or freezing the eggs. Egg addling ensures that the female continues to incubate, thus preventing re-nesting. Do you support or oppose addling Mute Swan eggs as a population management option? Is that strongly support, moderately support, moderately oppose, strongly oppose or not sure?

Question 23. Do you support or oppose the MDNR taking aggressive steps to control the invasive Mute Swan population in the Chesapeake Bay?

Question 24. Do you support or oppose the MDNR using lethal methods to control the Mute Swan population in Maryland? Is that strongly support, moderately support, moderately oppose, strongly oppose or not sure?

Question 25. Please choose the statement that most closely describes your view: 1) The MDNR should regulate the Mute Swan population. Based on scientific evidence, the invasive, non-native Mute Swan is contributing to the decline of the health of the Chesapeake Bay and the issue of population control should be appropriately addressed, or 2) Mute Swans are a part of the Chesapeake Bay ecosystem and should be protected from any population control measures. Mute Swans have intrinsic and aesthetic value which adds to the beauty of the Chesapeake Bay. These birds have an innate right to reside in the Chesapeake Bay, or 3) not sure.

