

**Human-Beaver Conflicts in
Massachusetts: Assessing the
Debate Over Question One**

Massachusetts Society for the Prevention of
Cruelty to Animals

The Humane Society of the United States

Animal Protection Institute

United Animal Nations

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“A live beaver is more valuable to mankind than a dead one.”

--- Enos Mills (1913)

“Beaver are not just a natural part of the riparian landscape, they are the architects of the system. If we refined the word “nuisance” to a more tolerable level, then the costs of dealing with nuisance beaver would quickly drop. Given the flexibility of beaver behavior, perhaps we would be better to manage human activity, to use preventative measures to avoid problems with beavers and to reap the benefits of living with beavers.”

---B.A. Schulte and D. Muller-Schwarze (1999)

Summary

In 1996, a majority (64 percent) of Massachusetts's citizens voted to restrict the use of certain traps to capture wildlife for recreation, sparking a controversy that continues today. The state's Division of Fisheries and Wildlife (MassWildlife) claims that its "hands were tied" by the passage of this initiative, and wishes to see it overturned.

Animal protection and environmental advocates continue to assert that the traps it restricts inflict unacceptable pain and suffering on animals and that there are proven non-lethal approaches that are more lasting, environmentally responsible and humane. They argue that by failing to support modern techniques and approaches for wildlife conflict resolution, MassWildlife has severely hampered both its own and

the public's ability to manage conflicts with beaver.

This report addresses a series of questions raised during the long debate over Question One, much of which has taken place in the media. Its purpose is not simply to provide another set of comments on the issues, but to encourage critical thinking about them. It is necessary, after nearly a decade of controversy, to step back, review the record and evaluate the quality of the information the public has received. Deficiencies should be corrected, information gaps should be filled and inconsistencies should be clarified. The debate will undoubtedly continue, but arguments should be premised in fact rather than speculation or incomplete information.

Introduction

In 1996, a majority (64 percent) of Massachusetts's citizens voted to restrict the use of certain traps to capture wildlife for recreation.¹ The passage of the ballot initiative known as "Question One" sparked a controversy over wildlife trapping in Massachusetts that continues today. The state wildlife agency (now called MassWildlife, then called the Division of Fisheries and Wildlife) claims that its "hands were tied" by the passage of this initiative,² even though Massachusetts law continues to permit humane traps as well as allow the use of lethal traps when public health or safety is threatened or when alternatives have been tried for 15 days and proven unsuccessful.

MassWildlife actively supports Question One's repeal,³ joining with commercial and recreational trappers and pro-trapping groups to argue that without the "necessary tools" restricted by the initiative, wildlife populations cannot be managed.⁴ Animal protection and environmental advocates applauded Question One's passage, and continue to assert that the traps it restricts inflict unacceptable pain and suffering on animals. These groups have also argued that

wildlife populations were not being managed through trapping efforts prior to the referendum passing in 1996, and advocate for the use of proven non-lethal approaches in resolving human-beaver conflicts.⁵



The agency has appeared to focus its resources more on renouncing the restrictions than helping the people of Massachusetts resolve conflicts with beaver.

After nearly a decade, the controversy continues. In fact, the issue has moved to the national discourse as part of a broader debate,⁶ with the entire field of wildlife management experiencing significant change as many of its basic premises are being challenged and reexamined. Serious questions are increasingly raised regarding the efficacy of recreational trapping in wildlife population control and conflict resolution, and much greater

emphasis is now being placed on humaneness as an important principle in guiding human-wildlife interactions.

The people of Massachusetts overwhelmingly affirmed in 1996 that humane standards and concern for the welfare of wild animals -- even problem-causing animals -- were of paramount import. As a public agency, MassWildlife has pledged to follow the law and serve the public interest, while at the same time showing no hesitation in proclaiming its position that it cannot manage wildlife problems under that law.⁷ Advocates feel MassWildlife should have responded to the electorate's wishes and worked to produce a conflict resolution program that better benefited and assisted the people of Massachusetts. Instead, the agency seems to have withdrawn into a defense of traditional wildlife management concepts and tactics that include actively advising homeowners to

contact their legislators to overturn the trapping restrictions. Through both direct and oblique arguments, MassWildlife claims a beaver population beyond control in Massachusetts, and consequent increases in human-beaver conflicts that are directly attributable to the restrictions on trapping. The agency has appeared to focus its resources more on renouncing the restrictions than helping the people of Massachusetts resolve conflicts with beaver.

The animal welfare community's position is no secret: MassWildlife must move past recalcitrance to provide better public service, embrace a more positive approach to solving wildlife conflicts, listen to and include the opposing views on the issues, educate itself as to the wide range of options that exist and demonstrate real leadership by seeking long-term, economical, environmentally responsible and humane solutions to human-beaver conflicts.

How many beaver are there in Massachusetts?

The message that is heard most often by the public in Massachusetts is that the beaver population has “ballooned” or “exploded” as a result of the trapping “ban.”⁸ With the beaver population “spiraling out of control”⁹ it would seem that crisis is imminent. Is this just rhetoric or is it true?

Comment: Information quoted to the press and elsewhere on the size of the beaver population in Massachusetts reveals numbers so widely varied as to call into question the validity of both census procedures as well as subsequent estimations of population size.

The state has used fall and winter ground and aerial surveys to estimate beaver numbers since 1994 and provides estimates of the overall population size and density (number of beaver per square mile), albeit with significant information gaps in recent years (see Appendix I). Beaver surveys typically document several indicators of the animal’s presence, with winter food caches probably the most reliable evidence of colony presence.¹⁰ To be statistically valid, survey techniques must be consistent and systematic through time. Unfortunately, the state has not made its survey protocol

information available to the public, so validity cannot be confirmed.



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Any estimation of a wildlife population will include an inherent degree of uncertainty that biologists usually address by providing a calculated error figure for the size estimate or by calculating ranges around which the population average could be spread based on statistical confidence – again something the state has not provided when describing any of its population estimates.¹¹ To further complicate matters, the state reports the “density” of beaver as a function of area occupied in square miles, where almost all other research on the species speaks to

the number of colonies per linear mile or kilometer of streams.¹² This makes it difficult to compare data

from the Massachusetts beaver population with that from other areas.

Is the beaver population growing unchecked?

Closely associated with the question of how many beaver there are in Massachusetts is the question of how fast the population is growing. In its publications, MassWildlife utilizes a chart (right) modeling the theoretical growth of a beaver population from two founding members to a population of 608 descendants after a ten-year period.¹³ Can this sort of population growth occur in nature?

Comment: Claims in the press about beaver populations “spiraling out of control” may be due entirely to misinterpretation of this chart.¹⁴ Real wildlife populations, of course, are subject to mortality due to causes such as resource (e.g. food and shelter) limitation, predation, disease, accidents and various kinds of human-caused mortality. Mortality in wildlife populations is often quite high, especially among immature animals. The parameters of the Massachusetts model are not well explained, and the critical reader will correctly question why other models produce dramatically different estimates.¹⁵

Year	1	2	3	4	5	6	7	8	9	10
Adults	2	2	2	6	10	14	26	46	74	126
2 Yr Old	0	0	4	4	4	12	20	28	52	92
1 Yr Old	0	4	4	4	12	20	28	52	92	148
Kits	4	4	4	12	20	28	52	92	148	252
Total	6	10	14	26	46	74	126	218	356	608

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The beaver population in Massachusetts has been studied enough that specific demographic information on natality and mortality exists¹⁶, which, together with other known aspects of the population does allow sophisticated modeling of population growth. The most comprehensive model published to date found both colony numbers and population size stabilizing after dynamic periods of growth.¹⁷

Will the population keep growing?

Consistent with the theme of population explosion, and undoubtedly of great concern to the general public, is the implication that the growth of the beaver population will continue unabated.¹⁸ Is this likely to happen?

Comment: One of the best long-term data sets in the world on a beaver population comes from Massachusetts. The Metropolitan District Commission (MDC) has supported surveys of the beaver population on the Quabbin Reservoir in western Massachusetts since the late 1960s, and a number of peer-reviewed publications address the population there.¹⁹ Significantly, this beaver population was not trapped or exploited by humans during the period of these studies. The data from the Quabbin indicate that the beaver population grew slowly at first, then rapidly to a peak from which it declined and stabilized at around 23-25 percent of its former peak.²⁰ This pattern is validated by studies of other beaver populations that reveal similar trends.²¹ However, this data is not factored into any of the state's projections or referenced in its discussions concerning the beaver population in Massachusetts.



Recreational trapping, by not allowing populations to go past peak growth, could very well create conditions in which beaver populations might never reach equilibrium.

The bulk of available evidence suggests that beaver populations are largely regulated by natural mortality and limits on population growth that presumably are due to resource limitations. Initially, when resources are abundant, there is a rapid population growth that is followed by decline when resources become much more limited.

As needed food and building material does not rapidly become reestablished, beaver numbers remain at below peak levels and fluctuate around an equilibrium point.

Recreational trapping, by not allowing populations to go past peak growth and a point where, presumably, resource limitation causes population decline, could very well create conditions in which beaver populations might never reach equilibrium and therefore may be higher than non-exploited populations that have stabilized.

Further, there is data to suggest that trapped populations show higher fecundity (number of births).²² These factors suggest that trapping, beyond the obvious issues associated with the suffering it causes, is not the practical, necessary or expedient approach to resolving human-beaver conflicts some claim it to be.

Don't more beaver cause more damage?

Human-beaver conflicts lie at the heart of the controversy over Question One. MassWildlife is on record as stating "The number of complaints and the amount of damage caused by beaver in the state is directly related to the size of the beaver populations."²³ Is this true, or is the issue more complex?

Comment: Beaver "damage" can be defined as anything these animals do that conflicts with human interests or values. The term "impact" may be used more broadly to describe beaver-environment interactions to which humans do not necessarily ascribe negative value. Damage can then be highly relative and subjective, especially when people see any change in an environment they

have grown accustomed to as negative.

Mitigation strategies such as water flow devices offer long-term engineering solutions to controlling undesirable flood events.

All impacts caused by beaver are limited to discrete areas. Beaver do not forage more than a few hundred yards away from water and they are most notably present along streams of a certain size and gradient. Unlike deer, who move throughout and utilize a variety of habitats, beaver need to be close to water, both for escape cover as well as to accommodate feeding needs. Within the limited area of impact, beaver forage for the plants they eat, mostly woody growth at or

near streams and ponds. Once the initial impact has occurred and the nature of the vegetation in the area changed, the “damage” will be over. Some trees, such as aspen and willow, will re-sprout from downed trunks, and shrubby growth that is harvested by beaver on a sustainable basis will come to characterize a beaver-inhabited site. Such growth can have considerable value in providing habitat and resources for other wildlife, such as nesting songbirds.²⁴ Often, beaver will leave an area after food resources are depleted and the site will not be recolonized for some period of time, until suitable vegetation reappears. What looks like “damage” in the first stages of return is actually just an adjustment of the vegetation around streams and lakes to the presence of beaver after a long period of absence – and it is arguably a return to a condition that occurred for many millennia prior to the removal of beaver by humans.

Because they depend on proximity to water, damage from water impounded by beaver is essentially restricted to floodplains. There are many reasons why humans should avoid building in such areas, as we are learning after considerable expense and inconvenience.

While we cannot set clocks back to a time when we could have avoided occupying such areas, mitigation strategies such as water flow devices offer long-term engineering solutions to controlling undesirable flood events. Beaver are dependent on available woody materials for building their structures as well as for food; as beaver remove these materials and reshape the plant communities along waterways, the ability of these areas to sustain beaver colonies will undoubtedly change.

Modern conflict resolution strategies now aim to mitigate wildlife damage by directing efforts at (1) the animals directly causing the problem and (2) the precise place and time where problems are being caused.²⁵ The most progressive and contemporary approaches to resolving human-beaver conflicts in Massachusetts are those that focus on “conflict points,” which are the discrete locations and contexts where beaver problems arise, such as at road culverts.²⁶ There is an obvious logic and economy to this approach that also allows beaver populations to be preserved wherever they do not cause irresolvable conflicts.

Is trapping necessary?

The state claims that human-beaver conflicts are best resolved by the use of traditional trapping – i.e., the recreational and commercial taking of animals to reduce populations at little obvious cost to the public.²⁷ This claim rests in large part on the assumption that trapping can remove more animals from the beaver population than will subsequently be born or immigrate into it. But is recreational trapping the best answer to solving human-beaver conflicts? What are the pros and cons of the alternatives?

Comment: The literature strongly suggests that unexploited (non-trapped) beaver populations stabilize after passing through peak growth periods followed by sharp declines.²⁸ Until the beaver population stabilizes with respect to the available habitat and forage, it will continue along its growth curve, replacing animals trapped or killed so long as conditions remain appropriate. MassWildlife claims that recreational trapping controlled beaver numbers in Massachusetts prior to the passage of Question One. However, their own data does not support this claim. According to MassWildlife's data, the population grew from around 12,000 animals in 1993 to as many as 22,635 in 1994, at a time when trapping was

unrestricted. Recreational trapping did not manage the beaver population prior to the passage of Question One, as any close examination of the information provided by MassWildlife will reveal. Further, the use of recreational trappers to help resolve human-beaver conflicts carries with it a number of inherent contradictions.



Recreational trappers do not typically set their traps in the residential and developed areas where people are experiencing conflicts with beavers, but instead trap beavers living in remote areas where they are not causing conflicts with people.

Among these, we note that the recreational trapping season takes place during the fall and winter, while the majority of human-beaver conflicts occur during the spring and summer, coinciding with the spring thaw and rains. Recreational

trappers also do not typically set their traps in the residential and developed areas where people are experiencing conflicts with beavers, but instead trap beavers living in remote areas where they are not causing conflicts with people.

Finally, even trapping specific beavers that are causing a problem will only be a temporary solution because removing animals from good habitat only makes that habitat available to others.

Do flow devices work?

MassWildlife asserts that only a tiny fraction (usually less than 10 percent) of the problems caused by beaver in Massachusetts can actually be solved with a water level control device.²⁹ Given the authority of the agency and expertise the public concedes it as a matter of course, this would seem to end any debate about whether or not alternatives to trapping exist. Do flow devices work or not?

Comment: It is possible that devices installed by the state only worked 10 percent of the time, but others who have installed flow devices in Massachusetts have found them working 97 percent of the time in all locations.³⁰ One key to ensuring that water flow devices are employed effectively is an experienced installer. The ability to “read” a conflict site and apply the appropriate technology is a skill that may take some time to acquire.³¹

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The best contemporary information on the different management approaches in Massachusetts comes from a private contractor, Michael Callahan of Beaver Solutions, Southampton, Massachusetts, who has been installing flow devices since 1998.³² Callahan and his business partners treated a total of 482 sites between November 1998 and February 2005. Of these, 413 (86 percent) were flow device installations, while trapping was chosen for the remaining 69 sites. The flow devices tested were in place for an average of more than 3

½ years, with some in service for more than six. In all a total of more than 1,200 “device-years” were evaluated. An early fence (deceiver) design was abandoned because of high failure rate, leaving a 97 percent success rate with subsequent designs at 227 sites where culverts were protected. Where piping (leveler) systems were installed, 135 of 156 sites were treated for a success rate of 87 percent.

Trapping occurred for a variety of reasons, including that a site

contained multiple conflict points or the landowner did not want beaver present. The results of trapping were not monitored in 18 of the 69 sites where it was the management option, but for the remainder was deemed to be a failure 84 percent of the time, as measured by the return of beaver after one (5 percent), two (67 percent) or three (12 percent) years. The data strongly suggest that the very low success rates experienced by state biologists from use of flow devices depended more on design failure than on other factors.

Are flow devices too expensive?

The state argues that flow devices are expensive and points out that trappers will remove beaver at no cost to state or local governments, simply for the value of fur or the recreational opportunity trapping provides.³³ Have the economics of beaver control been studied and adequately understood?

Comment: Little information exists on the subject of economics in trapping as opposed to other means of control, and this remains an area of active debate and investigation. Turning again to the reports of Michael Callahan, however, we can find some useful information to

begin understanding this aspect of beaver conflict resolution.

Callahan's figures are annualized along a 10-year horizon to produce average installation and maintenance costs of \$275 for a deceiver (culvert fence), \$290 for a deceiver and pipe system, and \$200 for a pipe system alone. Material and installation costs of these three options average \$750, \$1,400, and \$1,000, which annualize to \$75, \$140, and \$100, leaving remaining annualized costs to be taken up by scheduled site visits and maintenance. Importantly, these estimates are based on for-profit

business forecasts for installation and maintenance services. Much of work traditionally done on beaver sites is by local highway crews, or even volunteers, for whom such costs would be calculated without a profit margin.



"...the flow devices are a very cost-effective way for towns to deal with beavers."

- Animal Inspector, Templeton, Massachusetts

Many of the costs associated with traditional approaches to managing beaver conflicts remain uncalculated. One traditional approach to dealing with road

flooding in many communities has been to use heavy equipment and road crews to clear culverts – something that might have to be done several times a year. The costs of such maintenance are difficult to itemize, since both crews and equipment are part of a community's public utilities team.³⁴

The destruction of beaver dams and lodges will invariably incite rebuilding efforts by resident beaver, or, when these are removed, immigrants attracted to available habitat. Here, the "costs" in damage to standing trees may be greatly exacerbated since old building materials are seldom, if ever, reused.

Compared to the cost of daily labor and backhoe use for a highway department working to keep roadways clear, the cost of a one-time installation of a water flow device that will need minimal (once annually) maintenance and will be effective for at least 10-years appears to be highly cost-effective.

Is trapping more cost-effective than flow devices?

The state argues that recreational trappers, who by definition provide their services for free, provide the most economical approach to resolving beaver problems. Isn't this the most cost-effective solution?

Comment: While seemingly economical, recreational trapping is not the panacea it appears to be. First, for a variety of reasons, trapping is a dying industry in the United States. It would be difficult to imagine how reliance on such a rapidly diminishing activity could comprise the basis for the sort of long-term and comprehensive planning that is needed to create ecologically sound beaver conflict-resolution programs. Second, the record of trapping activity in Massachusetts provides no evidence that recreational taking of beaver ever did adequately "control" the conflicts people were experiencing with these animals.³⁵ As mentioned before, recreational trappers do not trap beaver at the time of year when the animals are necessarily causing conflicts, nor in the places where conflicts are most likely to be occurring. If they were to trap for the purpose of problem control they would both need to be licensed and would expect to be remunerated for their services. For-fee trapping

services are available in Massachusetts, and it appears at the moment that charges for such services vary widely – from as little as \$150 per beaver to as much as ten times that figure.³⁶

Billerica employs more than 40 flow devices that, according to the Conservation Land Use Assistant, "are a much more sustainable and financial way to work with the beaver."

Many towns in Massachusetts have turned to flow devices instead of trapping. The town of Templeton has five flow devices that have an annualized cost of \$163.25 prorated over a projected 20-year lifespan. Templeton's Animal Inspector has said the "the flow devices are a very cost-effective way for towns to deal with beavers"; "they save towns a lot of money"; and "they are very effective in keeping down the cost for the DPW."³⁷ Chesterfield's Public Works Director has stated that flow devices "save us a lot of money. I don't know exactly what we were spending but a backhoe and operator for 2 hours probably [costs] \$70 or \$80 an hour."³⁸ And Billerica employs more than 40 flow devices that, according to the Conservation Land Use Assistant, "are a much more sustainable and

financial way to work with the beaver."³⁹

Question One not only continued to allow lethal control of beaver in situations where public health and safety were threatened, its permitting process was further liberalized by the 2000 amendment.⁴⁰ Despite this, communities are finding that

trapping has failed to resolve their conflicts, while proving to be prohibitively expensive.⁴¹ This is further illustrated in a comparison of annualized costs from the Callahan report with his data on failure rate for trapping at problem sites, which argues strongly that flow devices are the better long-term investment.

GUIDE TO METHODS OF BEAVER MANAGEMENT*

	Trapping Colony	Culvert Protective Fence	Pond Leveler Pipes
Initial Cost	Variable. Free to \$800 per colony	Average \$700	Average \$900-\$1200
Annual Maintenance Cost	Variable. Free to \$400 per colony	\$100-\$150	\$50-\$75
Annualized Cost	Variable. \$0-\$500	\$200-\$250	\$150-175
Year-Round Protection	No	Yes	Yes
Risk of Problem Recurrence	High	Very Low	Low
Length of Effectiveness	Average 1 to 2 years	Indefinite with maintenance	Indefinite with maintenance
Avg. # of Interventions per Colony	1	1	3
Permitting	Board of Health if out of trapping season (4/16-10/31); and anytime kill traps are used	Usually not needed	Board of Health with Conservation review
Environmental Impact	Negative	Positive	Positive
Humaneness	Variable	Yes	Yes

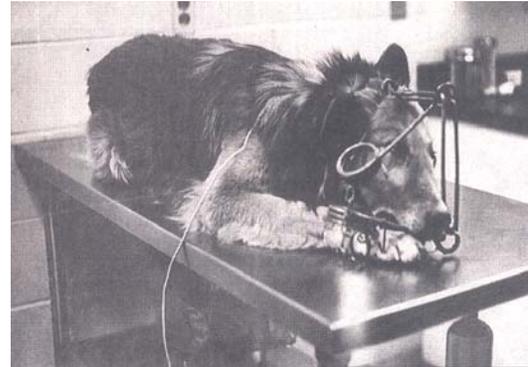
**Information in this chart compiled by Beaver Solutions*

***Note: Sometimes these methods are used in conjunction with each other.*

Is trapping humane?

Question One was predicated in large part on the issue of humaneness and the argument that both the trapping devices and the means by which they were employed led to unacceptable suffering and unnecessary death in target as well as non-target animals. The indiscriminate nature of traps used to kill beaver and the risk that other animals, including companion animals, could be injured or killed by them resonated strongly with the public. Has anything about the humaneness of trapping changed?

Comment: Although there has been a concerted effort by the manufacturers and users of lethal trapping devices throughout the world to create “more humane” traps, there have been no significant technological or procedural advancements during the past decade. There are still no trapping devices in use today that can guarantee that animals will not experience distress, pain and suffering or that non-target animals will not be injured or killed as well.⁴² It is precisely in areas where human-beaver conflicts would be greatest that companion animals would also be likely to be at greatest risk. That animals suffer in traps is a point that any reasonable person must be willing to concede.



Laddie caught in Conibear trap in So. Natick.

The indiscriminate nature of traps used to kill beaver and the risk that other animals, including companion animals, could be injured or killed by them resonated strongly with the public.

Some specifics with respect to the trapping of beaver are known. Even when studied under controlled conditions, the “ideal” performance of the most popular model of “Conibear” style body-gripping traps for beaver still shows that the time to death varies from 7 to more than 9 minutes in water sets.⁴³ The American Veterinary Medical Association (AVMA) recognizes in its general considerations for euthanasia a number of factors including the time required to induce loss of consciousness and the ability of a procedure to induce loss of consciousness without causing pain and suffering⁴⁴ -- circumstances that even under controlled conditions these devices do not meet.

The use of body-gripping traps to kill animals is condoned by the AVMA only for the purpose of scientific animal collection, with the use of live trapping and other methods of euthanasia preferred. That said, the most recent AVMA panel recognized the use of kill traps as “controversial,” and noted that these devices “...do not always

render a rapid or stress-free death consistent with criteria for euthanasia found elsewhere in this document.”⁴⁵ Massachusetts still allows the use of the “controversial” traps, even though it should be recognized that they do not provide for a humane death.

Is drowning humane?

The humaneness of drowning must also be considered, because where lethal traps are permitted in Massachusetts they are typically rigged so that animals that are not immediately killed will submerge with them and subsequently drown.

“The AVMA does not recognize drowning as a humane means of administering death to any wild or domesticated animal...”

MassWildlife is quoted as saying that submerged beaver do not actually “drown,” but die as a result of carbon dioxide narcosis similar to the manner in which euthanized dogs and cats die.⁴⁶ This might lead any reasonable person to

assume that drowning does not involve animal suffering. Is this true?

Comment: The argument that beaver experience a form of carbon dioxide narcosis that is called “dry” as opposed to “wet” drowning derived from a study whose findings were contradicted by later, more comprehensive analysis of available evidence.⁴⁷ The AVMA does not recognize drowning as a humane means of administering death to any wild or domesticated animal and specifically condemns the use of drowning in companion animal euthanasia.⁴⁸ The scientific evidence concerning drowning indicates that this method of killing simply cannot be argued to be humane.⁴⁹

Do environmental benefits offset the problems beaver cause?

One point on which it seems all involved in the controversy agree is that beaver are a valuable and important wildlife species that can provide significant ecological services and benefits to humans if the conflicts they sometimes cause are properly mitigated. Is this true?



More than 20 ecological benefits have been identified by the scientific community, ranging from water storage and banking to increased movement of carbon and nitrogen through ecosystems.

Comment: The environmental services and benefits that beaver provide have been well documented in recent research on this species.⁵⁰

More than 20 ecological benefits have been identified by the scientific community, ranging from water storage and banking (in arid regions, for example, water can be made available for use by livestock or to help suppress fires) to increased movement of carbon and nitrogen through ecosystems.⁵¹ MassWildlife, on its Web site, notes this contribution: "By damming brooks beavers expand wetlands which provide filtration for groundwater as well as valuable wildlife habitat."⁵²

The Massachusetts Fish and Game Board recently ruled that the flooding of a fire road on state wetlands was not sufficient cause for "control" of beaver, given the positive values associated with their presence.⁵³ It is as important to consider the environmental and ecological benefits of beaver as the conflicts they sometimes cause, and to weigh both benefits and costs in any comprehensive effort aimed at addressing conflict management.

Conclusion

Has Question One, as MassWildlife claims, "...severely hampered the ability of the Division of Fisheries & Wildlife to control and manage beaver..."⁵⁴ Looking at the available evidence, it seems more the case that by failing to support modern techniques and approaches for wildlife conflict resolution, MassWildlife has severely hampered both its own and the public's ability

to manage conflicts with beaver. The humane purpose of Question One is again threatened by attempts to overturn it.⁵⁵ As the strongly expressed wish of the people of Massachusetts it should be retained, with positive steps taken to adopt a progressive, modern and effective approach to resolving human-beaver conflicts.

Suggestions

The following are recommendations for measures that might be helpful in resolving some of the controversy over Question One in the best interests of the citizens of Massachusetts:

Open the records. The existing data are at best confusing in understanding the biological and ecological status of beaver in Massachusetts. Without such an understanding it is impossible to make good management decisions. Further, the public is exposed to many different accounts enumerating beaver population size, number of complaints and number of animals trapped, such that it becomes difficult even for

specialists to determine what is going on. A full, complete and public sharing of information on beaver in Massachusetts, and identification of where further knowledge concerning populations is needed, is essential to establishing a basis from which to plan for managing conflicts.

Centralize the discussion. The public has heard from opposing sides on this issue for nearly ten years, but it has not heard from the scientific community. An independent special panel of scientists should be called to review and address the many questions surrounding this issue.

Endnotes

¹ Massachusetts General Laws, Chapter 131, Section 80A. "Notwithstanding any other provision of this chapter, a person shall not use, set, place, maintain, manufacture or possess any trap for the purpose of capturing fur-bearing mammals, except for common type mouse and rat traps, nets, and box or cage type traps, as otherwise permitted by law." A number of exceptions for situations in which human health and safety is an issue are granted that allow the use of body-gripping or conibear traps. Leghold traps and snares are banned under all conditions.

² For example: The Lowell Sun, 15 February 1998, "The Great Beaver Debate Rages On;" Eagle-Tribune, 3 March 1998, "Untrapped Beavers Busier Than Ever;" The Daily News, 13 July 1998, "Trap Law Leaves State Knee-Deep in Wildlife;" Hampshire Gazette, 23 January 1998 "Controlling Wildlife;" Advocate North, 1 July 2004 "Beaver Study;" Shirley Oracle, 7 July 2004, "Bill Would Allow Conibear Traps For Beaver Control."

³ MassWildlife is quoted in The Lowell Sun, 15 February 1998:

"The Massachusetts Division of Fisheries and Wildlife (MDFW) was against Question One, the ballot referendum against trapping, at the time and believes that the only real long lasting solution is to repeal the new law."

⁴ For example, the Telegram & Gazette (Worcester), 3 March 1998, "Officials Gnaw Away at Anti-Trapping Law", quotes a division official as saying "...we lack the necessary tools to control the problem."

MassWildlife is also quoted in the Boston Globe, 3 March 1998, "Agency Accused of Ignoring Trapping Law", as saying "Question 1 resulted in the prohibition of all effective techniques for controlling beavers," and in the Boston Herald, 12 April 1998, "Ban Opens Floodgates", as saying "...what Question One has done is to remove all of our management tools to control beaver."

⁵ For example, the letter to the editor of the Boston Herald, 7 March 1998, from Massachusetts Society for the Prevention of Cruelty to Animals (MSPCA) Director of Advocacy, Joan Dempsey and numerous press releases from that organization.

⁶ The recent report issued by the International Association of Fish and Wildlife Agencies (2004, *Potential Costs of Losing Hunting and Trapping as Wildlife Management Tools*, R. Southwick, A. Woolley, D. Leonard, and S. Rushton) illustrates this by addressing what it refers to the consequences of stopping consumptive wildlife management on a national level.

That organization's website contains an abbreviated version of this argument issued by its Furbearer Resources Technical Workgroup at: www.furbearermgmt.org/casestudies1.asp

Further discussion of sustained use concepts in beaver management can be found in:

Organ, J. F., R. F. Gotie, T. A. Decker, and G. A. Batcheller. 1998. A case study in the sustained use of wildlife: the management of beaver in the Northeastern United States, in: H.A. van der Linde & M.H. Danskin (eds.), *Enhancing Sustainability --- Resources for Our Future*, Cambridge, UK: IUCN Publications Service Unit, pp. 125-139.

⁷ For example, in letter from Commissioner John C. Phillips to Dr. Gary Galuke dated July 2, 1998, the commissioner remarks "The Division of Fisheries and Wildlife (DFW) is fully committed to implementing the statute established by Question 1. While the agency has expressed its opinion that Question 1 makes it impossible to effectively manage certain species, the DFW has taken the steps necessary to implement the statute."

⁸ For example, Boston Herald, 12 March 1998, "Ban opens floodgates;" Hampshire Gazette, 23 January 1998, "Controlling Wildlife;" Boston Globe, 7 May 2000, "Trap Ban Gives Beaver the Run of Rural Towns;" Advocate North, 1 July 2004, "Beaver Study."

Even local populations seem to be "exploding," Eagle-Tribune, 13 December 2004, "Rains, Beaver Mean Flooding on Little River."

⁹ For example, Gloucester Daily Times, 3 March 1998, "State Wildlife Officials Oppose Ban on Leghold Traps."

¹⁰ The paper by S. Consolo Murphy and D. A. Smith (2001), "Documenting trends in Yellowstone's beaver population: a comparison of ground and aerial surveys in the Yellowstone Lake Basin," (Proceedings 6th Scientific Conference, Yellowstone Lake),

discusses survey techniques. The effort needed in producing usable population estimates can be considerable.

¹¹ The letter from MassWildlife to MSPCA's Stephanie Hagopian (30 December 1998) recognizes this when it notes: "Understand that these population numbers are estimates and represent the level of the population based on the scientific data collected." It is not clear, however, whether the sampling techniques used by the state allow for the estimation of confidence intervals for a range within which the population could lie.

¹² For example:

Muller-Schwarze, D. & B. Schulte, 1999. "Behavioral and ecological characteristics of a "climax" population of beaver (*Castor canadensis*)," In: Buscher and Dzieciolowski, (eds.), *Beaver Protection, Management and Utilization in Europe and North America*, New York: Plenum Publishers: pages 161-177. The authors argue that the minimum distance between colonies is usually around 0.9 km.

¹³ S. Jackson & T. Decker, 1993. *Beavers in Massachusetts*. University of Massachusetts, 16 pp. An updated version of this report was reissued by the state in 2004.

This article was reprinted in the volume published by Tufts University in 1996 entitled "*Living With Wildlife Report*," (A. N. Rowan and J. C. Weer, eds).

The chart appears also in an article by state biologist S. A. Langlois published in 1994 in the journal *Massachusetts Wildlife*, XLIV(4).

¹⁴ For example, Eagle-Tribune, 9 April 1998, "Busy Beavers Turn Haverhill Brooks Into Ponds;" MetroWest Daily

News, 11 November 2004, "Residents are losing battle with beaver".

¹⁵ Muller-Schwarze, D & L. Sun (2003: 93) *The Beaver: Natural History of a Wetlands Engineer* (Cornell, NY: Cornell University Press) present a similar model based on the survival of three young annually with a result that the population after ten years is 278 beaver.

¹⁶ For example, the study by Brooks et. al (Brooks, R. P., M. W. Fleming, and J. J. Kenelly. 1980. Beaver colony response to fertility control: evaluating a concept. *Journal of Wildlife Management* 44 (3): 568-575) that shows 28 percent of beaver kits in this Massachusetts study vanish annually.

¹⁷ Molini, J. J., R. A. Lancia, J. Bishir & H. E. Hodgdon. 1981. A stochastic model of beaver population growth. *World Furbearer Conference Proceedings*, J. A. Chapman & D. Pursley (eds.), Volume II: 1215-1245, Maryland: Worldwide Furbearer Conference, Inc. This model is based on data derived from a Massachusetts's beaver population.

¹⁸ A MassWildlife official is quoted as saying, for example, that "It wouldn't surprise me if [the beaver population] will be about 100,000 in five or seven years. They're rodents. They're highly productive." The Daily News, 13 July 1998, "Trap Law Leaves State Knee-Deep in Wildlife."

This argument has obviously resonated with public officials, as witness the statement by the legislative director for the Joint Committee on Natural Resources and Agriculture:

"We left nothing to cull the herd at all, and so the herd grows exponentially." (Berkshire Record, 9 September 2004).

¹⁹ For example:

Brooks, R. P., M. W. Fleming, and J. J. Kenelly. 1980. Beaver colony response to fertility control: evaluating a concept. *Journal of Wildlife Management* 44 (3).

Busher, P. E., and P. J. Lyons. 1999. Long-term population dynamics of the North American Beaver, *Castor canadensis*, on Quabbin Reservation, Massachusetts, and Sagehen Creek, California. *Beaver Protection, Management, and Utilization in Europe and North America*, Busher & Dzieciolowski (eds), New York: Plenum Publishers: pp. 147-160.

Howard, R. J., and J. S. Larson. 1985. A stream habitat classification system for beaver, *Journal of Wildlife Management* 49 (1): 19-25.

Lyons, Paul J. 1996. Beaver research and management on a public water supply. *Living With Wildlife Report*, Rowan, A. B. & J. C. Weer (eds), Tufts Center for Animals and Public Policy, pp. 141-152.

²⁰ Lyons (1996) reports this as 25 percent, Busher and Lyons (1999) as 23 percent.

²¹ In addition to the studies cited from Massachusetts, a study by Muller-Schwarze, and Schulte (1999) reports on an unexploited beaver population in the Adirondacks of New York. ("Behavioral and ecological characteristics of a "climax" population of beaver (*Castor canadensis*)") in Busher and Dzieciolowski, eds., *Beaver Protection, Management and Utilization in Europe and North America*, New York: Plenum Publishers: pages 161-177) and the thesis by D. Taylor, *Growth, decline and equilibrium in a beaver population at Sagehen Creek*,

California, (Ph.D.Thesis, University of California, Berkeley, 1970) contains more data on a western population.

The beaver population of Gatineau Park in Ontario is not trapped and described on their website (www.canadascapital.gc.ca/gatineau/pdf/beaver_e.pdf) as "...high, but stable." The report goes on to state "...we are far from the time when the beaver was an uncontrolled menace and trapping was the only solution."

²² Several studies suggesting this are cited in the review article by Milan Novak published in *Wild Furbearer Management and Conservation in North America*. eds M. Novak, J. A. Baker, M. E. Obbard, and B. Malloch, 1987, pages 282-313. Ontario, Canada: Ministry of Natural Resources.

²³ Langlois, S. A. and T. A. Decker. *The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts*. MA Division of Fisheries and Wildlife, 1997, p. 2. This was revised and reissued in 2004 with this declaration appearing unchanged.

²⁴ See, for example: S. Albert and T. Trimble (2000), Beavers are partners in riparian restoration on the Zuni Indian restoration. *Ecological Restoration* 18 (2): 87-92.

²⁵ Conover, M. 2002. *Resolving Human-Wildlife Conflicts: The Science of Wildlife Damage Management*. New York: Lewis Publishers, outlines the contemporary approach to wildlife damage management in the first text published on this area.

²⁶ For example:

Muller-Schwarze, D. & L. Sun, 2004, *The Beaver: Natural History of a Wetlands Engineer*, Cornell University Press;

and more specifically:

Lisle, S. 2001. "Beaver management at the Penobscot Indian Nation, USA: Using Flow Devices to Protect Properties and Create Wetlands" In: Czech, A. & G. Schwab (eds.), *The European Beaver in a New Millennium*, Krakow: Carpathian Heritage Society, pp 147-156.

and

Lisle, S. 2003. The use and potential of flow devices in beaver management. *Lutra* 46 (2): 211-16.

²⁷ For example MassWildlife's comment that:

"With the extirpation of wolves and the lack of any diseases in our region of the country that affect beaver on a large scale, the only factor left that can control beaver numbers today is regulated trapping by fur harvesters." ("Beaver in the Present & Future," Massachusetts Wildlife XLIV, no. 4(1994): 22-27; 30-32);

and:

"The number of beaver in Massachusetts has typically been controlled by the number of beaver harvested by the public under regulated trapping seasons." (Langlois, S. A. and T. A. Decker. 1997. The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts. MA Division of Fisheries and Wildlife, page 2)

²⁸ This is shown, for example, in the Quabbin studies of Busher and Lyons

cited above; the data from Sagehen Creek in California cited by Busher and Lyons (1999), the work of Muller-Schwarze and Schulte, and reports on the unexploited beaver population in Gatineau National Park in Canada (www.canadascapital.gc.ca/gatineau/pdf/beaver_e.pdf).

²⁹ The figure is usually given as “less than” 10 percent has been given (e.g. The Lowell Sun, 15 February 1998, “The Great Beaver Debate Rages On;” The Daily News, 13 July 1998, “Trap Law Leaves State Knee-Deep in Wildlife;” Wakefield Observer, 12 March 1998, “The trouble brought by beavers;” Enterprise, 14 March 1998, “Ballot petition performs as predicted;” Concord Weekly, 2 April 1998, “You can’t just leave it to beaver.”)

Elsewhere a slightly different way of expressing this is given as the percentage of times problems can actually be solved:

“One significant drawback [to water flow devices] is that very few beaver problems (only 4.5 percent in Massachusetts; 3 percent in New York) can actually be solved with a water level control device.”

S.A. Langlois & T.A. Decker, 1997, The Use of Water Flow Devices and Flooding Problems Caused by Beaver in Massachusetts. (MA Division of Fisheries and Wildlife, page 7). This same quote appears in the 2004 rewrite of this publication.

³⁰ Callahan, M. 2005. Best management practices for beaver problems. *Association of Massachusetts Wetland Scientists Newsletter* 53: 12-14.

See also H. Y. Kwon’s 1997 overview (The return of the beaver. *Watershed Protection Techniques* 2, no. 3: 405-10) which cites 79-82 percent success for water flow devices. Kwon, H.Y. 1997.

Dozens of installations on the Penobscot Nation lands in Maine and for a large-scale project for the Virginia Department of Transportation (VDOT) suggest at least a 90 percent success rate, if not higher (S. Lisle, personal communication).

³¹ This is outlined in two papers:

Lisle, S. 2001. Beaver management at the Penobscot Indian Nation, USA: Using Flow Devices to Protect Properties and Create Wetlands. *The European Beaver in a New Millennium*, A. Czech, and G. Schwab (eds.), Krakow: Carpathian Heritage Society, pp 146-157.

Lisle, S. 2003. The use and potential of flow devices in beaver management. *Lutra* 46, no. 2: 211-16.

³² There are two reports:

Callahan, M. 2003. Beaver management study. *Association of Massachusetts Wetland Scientists Newsletter* 44: 12-15.

Callahan, M. 2005. Best management practices for beaver problems. *Association of Massachusetts Wetland Scientists Newsletter* 53: 12-14.

³³ For example, MassWildlife is quoted in the Berkshire Eagle, 12 August 1998, “State wildlife officials swamped with complaints about beaver dams” as saying the pipes are expensive and cost the state up to \$25,000 for each one.

³⁴ Some of these sorts of costs are elucidated in the publication of the

IAFWA report in 2004 and press coverage surrounding that.

For example, the State House News Service, 14 December 2004, notes that Spencer highway crews spent \$25,000 in 2001 to free drainage systems of "beaver-related" debris and that 100 Massachusetts municipalities spent \$500,000 to repair roads and infrastructure damaged by beaver in 2004.

³⁵ As for estimated population size, the total number of beaver trapped for recreational purposes are reported annually. No breakdown is given of the age and reproductive condition of trapped animals, parameters that would be important in estimating the effect of trapping on population growth.

³⁶ For example, the Sentinel & Enterprise, 4 October 2004, "Animal Welfare Group Offers Alternative to trapping Beavers" gives a figure of \$150 per beaver for a trapper taking 18 animals from a swampy area in Lunenburg; the Telegram & Gazette, 1 April 1999, "Pondering the fate of beaver dams" quotes Representative Gauch of the Legislative Committee on Natural Resources and Agriculture as saying trapping costs range from \$500 to \$1,500 per beaver, while a local problem animal control agent is quoted as saying it cost \$875 to remove three beaver from two locations in Shrewsbury; the State House News Service, 14 December 2004, "State Beaver Population Has Tripled Since Trapping Law Passed" cites costs of \$75-100 per beaver or \$1,000 per colony.

³⁷ Joanne Klauer, Tempelton Animal Inspector. *Solving Human-Beaver Conflicts in Massachusetts*, MSPCA Video, 2004.

³⁸ Edward Dahil, Chesterfield Public Works Director. *Solving Human-Beaver Conflicts in Massachusetts*, MSPCA Video, 2004.

³⁹ Tony DaSilva, Billerica Conservation Land Use Assistant. *Solving Human-Beaver Conflicts in Massachusetts*, MSPCA Video, 2004.

⁴⁰ Reed, Jennifer. The Lowell Sun, 4 March 1998, "Five Beavers Killed Under Chelmsford's Special Permit."

⁴¹ The Ayer Public Spirit, 29 December 2004, "Conservation Group to Prepare Plan For Control of Beavers" quotes Dave Bodurtha of the Ayer Conservation Commission:

"I don't think trapping is one of the options we'll be using for now," he said. "We've spent \$15,000 over the past few years trapping and it hasn't made dent -- there's too many of them."

The town of had 36 beaver removed in 2003 by a trapper and had budgeted \$4,000 to remove 50 more in 2004 (Paxton News, 22 November 2004, "Beaver Budget Booming").

⁴² See Fox, C. H. & C. M. Papouchis (eds.), 2004. *Cull of the Wild: A Contemporary Analysis of Wildlife Trapping in the United States*, Sacramento, CA: Animal Protection Institute, for a comprehensive survey and analysis of contemporary trapping tools, techniques and methods.

⁴³ These data are from a study by Milan Novak published in 1981 ("Capture tests with underwater snares, leg-hold, Conibear, and Mohawk traps." Canadian Trapper, April, pp 18-23) as given in the International Association of Fish

and Wildlife Agencies 1997 report, *Improving Animal Welfare in U.S. Trapping Programs*.

⁴⁴ AVMA. 2001. 2000 Report of the AVMA Panel on Euthanasia. *Journal of the American Veterinary Medical Association* 218, no. 5: 669-96.

⁴⁵ AVMA, 2001: 684.

⁴⁶ For example, Wakefield Daily Item, 13 March 1998, "Trapping cruelty case could test state law."

⁴⁷ The 1981 study by F.F. Gilbert & N. Gofton ("Terminal dives in mink, muskrat and beaver," *Physiology and Behavior* 28: 835-840) is reviewed and critiqued with updated information in the Ludders et. al (1999) paper.

⁴⁸ AVMA. 2001.

⁴⁹ Ludders, J. W., R. H. Schmidt, F. J. Dein, and P. N. Klein. 1999. Drowning is not euthanasia. *Wildlife Society Bulletin* 27: 666-70.

⁵⁰ For example, see review articles by:

Hammerson, G. A. 1994. Beaver (*Castor canadensis*): Ecosystem alterations, management, and monitoring. *Natural Areas Journal* 14, no. 1: 44-57.

and

Kwon, H. Y. 1997. The return of the beaver. *Watershed Protection Techniques* 2, no. 3: 405-10.

⁵¹ Summarized in the Hammerson (1994) and Kwon (1997) articles and referenced in numerous other papers, books and reports on the species.

⁵²

http://www.mass.gov/dfwele/dfw/dfw_beaver_law.htm

⁵³ Notes of the Massachusetts Fish and Game Board Meeting, July 19, 2004.

⁵⁴ Langlois, S.A. & T.A. Decker. 1997. *The Use of Water Flow Devices and Flooding Problems caused by Beaver in Massachusetts*. MA Division of Fisheries and Wildlife, page 2.

⁵⁵ For example, Telegram & Gazette, 9 February 2005, "Trapping limits revisited."

APPENDIX I

Massachusetts Beaver Information, Estimates by Year From Public Sources

These data often appear in multiple sources, but duplicate cites are not reported here. Usually, the figures given by the state refer to the total number of individuals in the statewide beaver population. At times, however, specific reference is made to estimates of numbers of *colonies*, which is quite sometime else. We have noted where this occurs. In these cases the total number of animals being estimated would be anywhere from 6 to 10 times that of the figures given, since colony sizes will generally vary around those numbers. Thus, an estimate of 22,000 colonies would mean anywhere from 132,000 to 220,000 beaver.

	Population Estimate	Complaints	Numbers Trapped
"Ideal"	18,000 ¹ 16,000 – 21,000 ²		
1985			1044 ³
1986			1371 ⁴
1987			1695 ⁵
1988			1055 ⁶
1989	24,000 ⁷	154 ⁸ 157 ⁹	1368 ¹⁰
1990		199 ¹¹	1108 ¹²
1991		204 ¹³	1223 ¹⁴
1992	10,000 ¹⁵	253 ¹⁶ 256 ¹⁷	1086 ¹⁸
1993	12,000 ¹⁹ 12,800 ²⁰	270 ²¹	1017 ²²
1994	15,300 ²³ 22,000 ²⁴ 22,000 colonies ²⁵ 22,500 ²⁶ 22,635 ²⁷	388 ²⁸	2,083 ²⁹
1995	18,000 ³⁰ 18,500 ³¹	310 ³⁵ 352 ³⁶	1133 ⁴⁰ 1136 ⁴¹

	Population Estimate	Complaints	Numbers Trapped
	20,000 ³² 22,500 ³³ 23,187 ³⁴	338 ³⁷ 365 ³⁸ 405 ³⁹	
1996	17,000 ⁴² 18,000 ⁴³ 20,000 ⁴⁴ 22,000 ⁴⁵ 23,000 ⁴⁶ 23,500 ⁴⁷ 23,739 ⁴⁸ 24,000 ⁴⁹ 30,000 ⁵⁰	352 ⁵¹ 477 ⁵² 482 ⁵³	623 ⁵⁴
1997	24,000 ⁵⁵ 29,398 ⁵⁶ 31,250 ⁵⁷ 36,000 ⁵⁸	200 ⁵⁹ 405 ⁶⁰ 477 ⁶¹ 482 ⁶² 631 ⁶³ 670 ⁶⁴	98 ⁶⁵
1998	27,000 ⁶⁶ 32,000 ⁶⁷ 34,000 ⁶⁸ 35,000 ⁶⁹ 36,000 ⁷⁰ 42,785 ⁷¹ 50,000 ⁷²	482 ⁷³ 690 ⁷⁴ 704 ⁷⁵	114 ⁷⁶
1999	30,000+ ⁷⁷ 43,000 ⁷⁸ 47,796 ⁷⁹ 50,000 ⁸⁰ 52,000 ⁸¹ 52,600 ⁸² 54,000 ⁸³ 100,000 ⁸⁴	656 ⁸⁵ 670 ⁸⁶ 691 ⁸⁷	312 ⁸⁸
2000	48,000 ⁸⁹ 60,000 ⁹⁰ 61,195 ⁹¹ 65,000 ⁹² 70,000 ⁹³	532 ⁹⁴ 556 ⁹⁵	556 ⁹⁶ 558 ⁹⁷
2001	"incomplete" ⁹⁸ 60,000 ⁹⁹ 65,000 ¹⁰⁰ 65,000 ¹⁰¹ 70,000 ¹⁰² 72,000 ¹⁰³ 125,000+ ¹⁰⁴	unknown ¹⁰⁵ >700 ¹⁰⁶	1172 ¹⁰⁷

	Population Estimate	Complaints	Numbers Trapped
2002	"incomplete" ¹⁰⁸ 60,000 ¹⁰⁹ 65,000 ¹¹⁰ 70,000 ¹¹¹	unknown ¹¹²	495 ¹¹³
2003	60,000 ¹¹⁴ 65,000 ¹¹⁵ 70,000 ¹¹⁶ 80,000 – 100,000 ¹¹⁷ 30,000 – 120,000 ¹¹⁸	"not readily available" ¹¹⁹	647 ¹²⁰
2004	60,000 ¹²¹ 65,000 ¹²² 60,000 – 70,000 colonies ¹²³ 70,000 ¹²⁴ 70,000+ ¹²⁵ 70,000 colonies ¹²⁶ 80,000 ¹²⁷		
2005	70,000+ ¹²⁸		

Appendix Endnotes

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- ¹ Eagle Tribune, 3/3/98
 - ² Telegram & Gazette, 3/3/98
 - ³ MassWildlife to Hagopian, 12/30/2003
 - ⁴ MassWildlife to Hagopian, 12/30/2003
 - ⁵ MassWildlife to Hagopian, 12/30/2003
 - ⁶ MassWildlife to Hagopian, 12/30/2003
 - ⁷ Telegram & Gazette, 3/3/1998
 - ⁸ MassWildlife to Hagopian, 12/30/2003
 - ⁹ Boston Globe, 3/3/98
 - ¹⁰ MassWildlife to Hagopian, 12/30/2003
 - ¹¹ MassWildlife to Hagopian, 12/30/2003
 - ¹² MassWildlife to Hagopian, 12/30/2003
 - ¹³ MassWildlife to Hagopian, 12/30/2003
 - ¹⁴ MassWildlife to Hagopian, 12/30/2003
 - ¹⁵ Lowell Sun, 1/11/2001
 - ¹⁶ MassWildlife to Hagopian, 12/30/2003
 - ¹⁷ Telegram & Gazette, 3/3/1998
 - ¹⁸ MassWildlife to Hagopian, 12/30/2003
 - ¹⁹ Boston Globe, 4/5/1999
 - ²⁰ Eagle-Tribune, 4/9/98
 - ²¹ Eagle-Tribune, 4/9/98
 - ²² MassWildlife to Hagopian, 12/30/2003
 - ²³ Boston Herald, 4/12/98
 - ²⁴ Winchester Star, 12/16/04
 - ²⁵ North Adams Transcript, 12/16/2004

26 Boston Globe, 12/29/2004
27 Westford Eagle, 4/18/2002
28 Boston Globe, 12/29/04
29 The Evening News, 3/3/98
30 Wakefield Observer, 3/12/98
31 Boston Herald, 4/12/98
32 Sentinel & Enterprise, 6/30/04
33 MassWildlife to Hagopian, 12/30/2003
34 Westford Eagle, 4/18/2002
35 Winchester Star, 12/16/04
36 Sanctuary, 3/1/99
37 Westford Eagle, 4/18/2002
38 Boston Globe, 3/3/98
39 Sanctuary, 3/1/99
40 Telegram & Gazette, 4/4/98
41 MassWildlife to Hagopian, 12/30/2003
42 Gazette Net, 12/14/1999
43 Berkshire Eagle, 8/12/98
44 ABC News, 12/13/04
45 Shirleyoracle.com, 1/5/05
46 Hampshire Gazette, 1/23/98
47 Boston Herald, 4/12/98
48 Westford Eagle, 4/18/2002
49 Boston Globe, 5/7/00
50 Athol Daily News, 9/28/04
51 Westford Eagle, 4/18/2002
52 Sanctuary, 3/1/99
53 Eagle-Tribune, 4/9/98
54 MassWildlife to Hagopian, 12/30/2003
55 MassWildlife to Hagopian, 12/30/2003
56 Westford Eagle, 4/18/2002
57 Boston Herald, 4/12/98
58 Sanctuary, 3/1/99
59 Eagle Tribune, 11/30/1999
60 Westford Eagle, 4/18/2002
61 Sunday Republican, 4/21/2002
62 Daily Evening Item, 2/10/1998
63 Sanctuary, 3/1/99
64 MassWildlife to Hagopian, 12/30/2003
65 State House News, 12/14/04
66 Telegram & Gazette, 3/3/98
67 Eagle Tribune, 4/9/98
68 The Daily News, 7/14/98
69 The Evening News, 3/3/98; Eagle Tribune, 3/3/98
70 MassWildlife to Hagopian, 12/30/2003
71 Westford Eagle, 4/18/2002
72 Berkshire Eagle 8/12/98
73 Westford Eagle, 4/18/2002
74 MassWildlife to Hagopian, 12/30/2003
75 Sunday Republican, 4/21/2002
76 MassWildlife to Hagopian, 12/30/2003
77 Boston Globe, 4/5/1999

78 MassWildlife to Hagopian, 12/30/2003
79 Westford Eagle, 4/18/2002
80 Malden Evening News, 4/1/1999
81 Eagle-Tribune, 12/22/99
82 Lowell Sun, 4/1/1999
83 Boston Globe, 3/29/99
84 Boston Globe, 4/5/1999
85 Sunday Republican, 4/21/2002
86 MassWildlife to Hagopian, 12/30/2003
87 Westford Eagle, 4/18/2002
88 Sentinel & Enterprise, 8/2/04
89 MassWildlife to Hagopian, 12/30/2003
90 Lowell Sun, 12/4/2000
91 Westford Eagle, 4/18/2002
92 Boston Globe, 7/14/2002
93 Boston Globe, 12/12/2002
94 MassWildlife to Hagopian, 12/30/2003
95 Sunday Republican, 4/21/2002
96 Sentinel & Enterprise, 8/2/04
97 Westford Eagle, 4/18/2002
98 MassWildlife to Hagopian, 12/30/2003
99 Ware River News, 3/8/2001
100 Winchester Star, 12/16/04
101 North Adams Transcript, 12/16/2004
102 Landmark, 12/11/2003
103 Chicago Tribune, 8/6/2001
104 Lowell Sun, 1/11/2001
105 MassWildlife to Hagopian, 12/30/2003 – data not collected from local boards of health
106 Boston Globe, 12/29/04
107 MassWildlife to Hagopian, 12/30/2003
108 MassWildlife to Hagopian, 12/30/2003
109 Hamilton-Wenham Chronicle, 8/22/2002
110 MassWildlife to Hagopian, 12/30/2003
111 Republican, 5/14/2004
112 MassWildlife to Hagopian, 12/30/2003 – data not collected from local boards of health
113 MassWildlife to Hagopian, 12/30/2003
114 Telegram & Gazette, 11/22/2003
115 Townsend Times, 3/31/04
116 Sentinel & Enterprise, 6/30/04
117 Southbridge Evening News, 11/6/2003
118 Ibid.
119 MassWildlife to Hagopian, 12/30/2003
120 MassWildlife e-mail to Cheryl Jacobson, 12/8/2004
121 Daily News, 7/24/2004
122 Townsend Times, 3/31/2004
123 Metro West Daily News, 11/22/2004
124 Daily News, 1/5/05
125 Sentinel & Enterprise, 6/30/2004
126 Winchester Star, 12/16/2004
127 Boston Herald, 4/28/2004
128 The Boston Globe, 7/14/2005