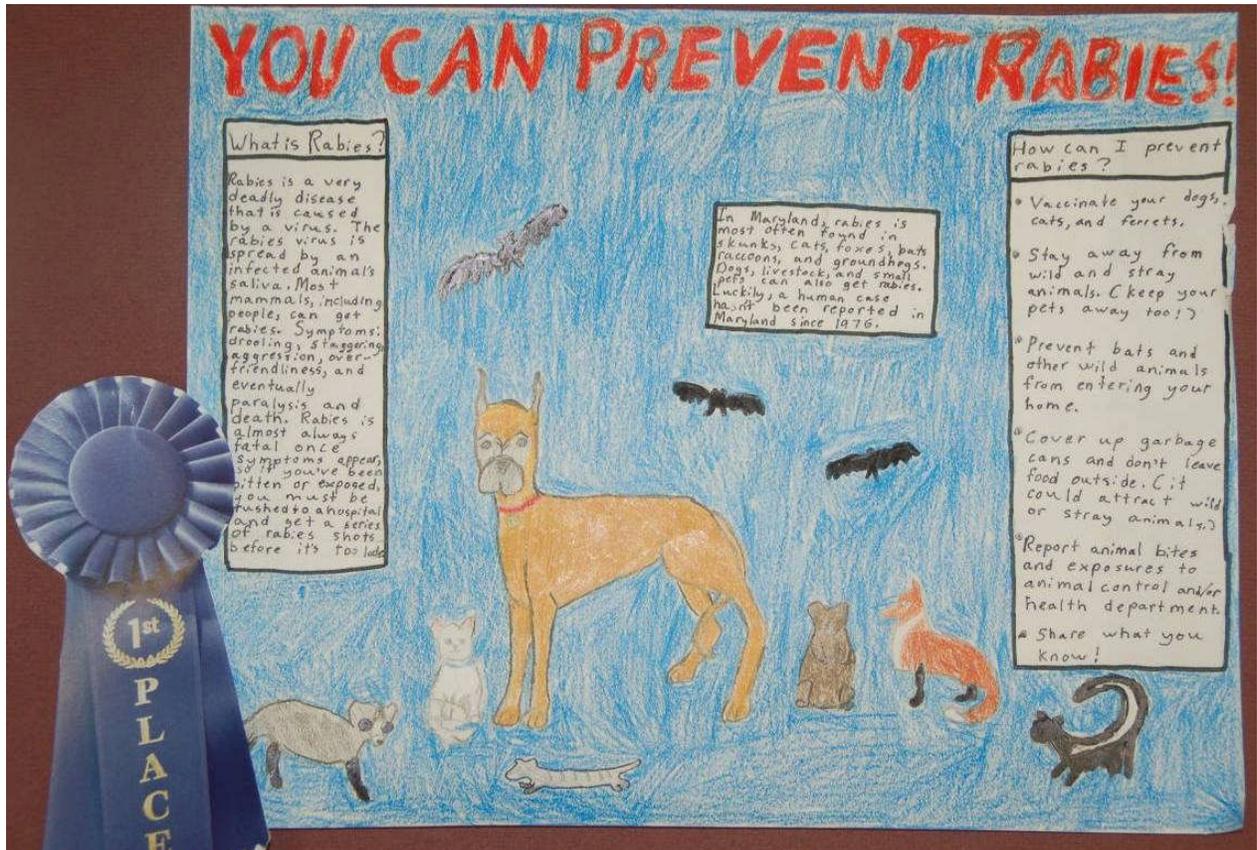


Rabies in Maryland: 2007 Annual Report

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INTRODUCTION

Rabies is a generally fatal viral disease of mammals that is endemic in Maryland, the continental United States, and throughout much of the world. The epidemiology of rabies transmission in the U.S. has changed dramatically from the 1960s when the majority of laboratory confirmed rabies cases arose from domestic animals, to the current situation in which the main reservoirs are wildlife species [1], in particular bats, raccoons, foxes, and coyotes.

The rabies virus is classified within the genus *Lyssavirus* in the family *Rhabdoviridae*, and is an RNA virus with a helical ribonucleoprotein core and a surrounding envelope, which gives it a cylindrical “bullet-like” appearance [2]. The surface of the envelope is covered with numerous glycoprotein “spikes” which are important in inducing an immune response in an infected animal.

The rabies virus is transmitted in the saliva of infected animals, and transmission occurs when an infected animal bites another mammal, which could be a human [3]. Researchers have also speculated that the virus may be spread via aerosolization of particles through mucous membranes in very dense habitats of rabid animals, such as bats in caves. Rarely, transmission may occur via transplant surgery.

Once the mammal is infected, the virus travels along the peripheral nerves to the spinal cord and ascends to the brain. It incubates in the nervous system for 3-12 weeks or longer, during which time the infected animal shows no clinical signs of disease. The virus replicates in the brain and spreads to the animal’s salivary glands, at which point it can be shed in saliva. At this time, the infected animal begins to show clinical signs of rabies infection including non-specific flu-like symptoms, which progress to encephalitis resulting in abnormal behavior, aggression, rage, paralysis, and/or stupor [3]. The animal may also present with the inability to drink water or hypersalivation, which is most likely due to the inability to swallow as a result of paralyzed throat muscles. An infected animal usually dies within 7 days of the onset of clinical signs. After the onset of clinical signs, rabies is almost invariably fatal.

Rabies infections among terrestrial animals typically occur within species and defined geographical regions. For example, the raccoon variant is enzootic along the east coast of the United States whereas skunk variants are found in the central U.S. and California. Spillover to other species can occur due to the high infection rate of the virus; however, sustained transmission within the spillover species resulting in new reservoirs is rare [4]. Due to the mobility of bats, bat variants of rabies are not limited to geographic regions; however, specific variants can be found within different bat species. Genetic analysis and monoclonal antibody reactions can differentiate specific variants and can be useful epidemiologic tools when investigating cases.

Because of the high case-fatality rate and the public health consequences of the disease, rabies prevention and control are key concerns of public health authorities in areas where rabies is endemic. Efforts towards prevention and control of rabies include conducting surveillance for the disease in animals and humans. In this report, we present surveillance data for rabies in Maryland for 2007.

METHODS

In Maryland, rabies in both humans and animals is reportable by law. Animals are submitted for rabies testing to local health departments to determine the need for human rabies post-exposure prophylaxis or for quarantine or isolation of a potentially exposed animal. The Maryland Department of Health and Mental Hygiene (DHMH) Laboratories Administration Rabies Laboratory performs the tests on the majority of the animals submitted for rabies testing. In addition, the Maryland Department of Agriculture (MDA) Animal Health Diagnostic Laboratories may also test animals suspected of having rabies, typically when there is no concern regarding human exposure.

The DHMH Rabies Laboratory and the MDA Animal Health Laboratory use the direct fluorescent antibody test (dFA) to confirm the presence of rabies virus antigen in animal specimens collected post-mortem [5]. Because the virus is found in nervous tissue, the post-mortem test requires tissue from three parts of the brain: cerebrum, hippocampus, and brainstem.

There are three possible results from the dFA test: positive, negative, and unsatisfactory. Unsatisfactory results can indicate any of the following: (1) there was no or not enough brain material available for testing, or (2) the animal was badly decomposed, or (3) the animal's brain was badly damaged and the laboratory could not identify the appropriate anatomical features to properly sample the animal. When brain material is available in either of these last two situations, laboratory technicians test the material available. If the animal is positive it is reported as such to the submitting agency or individual. However, if the animal is negative, the laboratory cannot guarantee the animal is truly negative due to the condition of the specimen and the laboratory reports these results as unsatisfactory. Unsatisfactory results are treated as positives for decisions about human post-exposure prophylaxis and animal quarantine and isolation.

Within DHMH, the Division of Rabies and Vector-borne Diseases determines the number of laboratory confirmed rabid animals for each jurisdiction by reconciling individual and monthly laboratory reports with monthly reports submitted by health departments in the 24 local jurisdictions (23 Maryland counties and Baltimore City) in Maryland. Rabid animals are reported to DHMH by the date of specimen receipt at the laboratory and by the local jurisdiction and agency submitting the animal for testing.

Data analyzed in this report include all submissions for animal rabies testing, regardless of result, from January 1, 2007 through December 31, 2007. "Domestic animals" include dogs, cats, ferrets, horses, cattle, pigs, sheep, and goats. The data are analyzed by month, jurisdiction, animal species, and result. Animal rabies incidence by jurisdiction was calculated using Maryland State Census data 2000 [6]. Statistical analysis was conducted using Microsoft® Excel® 2004 for Mac, Version 11.4.1.

RESULTS

In 2007, the 24 jurisdictions of Maryland reported a total of 431 laboratory confirmed animals with rabies. The DHMH Rabies Laboratory and the MDA Animal Health Laboratory collectively received 4799 specimens for diagnostic testing and a single Maryland animal was tested at a laboratory out-of-state, for a total of 4800 specimens from Maryland animals tested for rabies in 2007. This represents a decrease from the number of specimens submitted in 2006 (N = 5028) and 2005 (N = 5024). Despite the decrease in the numbers of animals submitted for rabies testing, there has been an increase in the number of laboratory confirmed rabid animals since 2004 (N = 336) (Table 1). This signifies a reversal of the previous trend noted from 2001 to 2004 in which there was a decrease in the number of laboratory confirmed rabid animals each year: 2001 (N = 505), 2002 (N = 396), 2003 (N = 371), and 2004 (N = 336). Similar to previous years, the largest number of submissions in 2007 occurred in June, July, and August (Figure 1). The largest number of laboratory confirmed positive animals were noted in August (N = 61) and a second peak occurred in October (N = 50) (Figure 1). There were no cases of rabies in humans in Maryland in 2007.

Animal rabies was reported from all 24 local health jurisdictions in Maryland in 2007 (Table 2). Kent (N = 7) and Calvert (N = 4) counties reported the lowest numbers of laboratory confirmed rabid animals. By comparison, the jurisdictions with the fewest rabies cases in 2006 were Kent (N = 4) and Talbot (N = 3) counties (Table 3). The largest number of laboratory confirmed cases in 2007 were reported in Montgomery (N = 54), Frederick (N = 36), and Baltimore (N = 36) counties. These three counties also had the largest number of cases in 2005 and 2006, and in each of the years from 2005 through 2007, constituted 30-34% of all confirmed rabies cases.

When the number of rabid animals was adjusted for human population size by jurisdiction, the rank order of animal rabies incidence by jurisdiction changed (Figure 2). The overall incidence of animal rabies for Maryland in 2007 was 0.8 cases per 10,000 human population. Somerset, Dorchester, and Caroline counties reported 5.7, 5, and 5 cases of laboratory confirmed animal rabies per 10,000 human population, respectively, whereas Montgomery and Baltimore counties reported 0.6 and 0.5 cases per 10,000 human population, respectively. Prince Georges County (0.4 cases/10,000 human population), Baltimore City (0.4 cases/10,000 human population), Howard County (0.4 cases/10,000 human population), and Anne Arundel County (0.3 cases/10,000 human population) reported the lowest incidences.

In Maryland, the most common species of animals determined to be infected with rabies were raccoons, bats, foxes, skunks, and cats (Table 4). Other species confirmed rabid in 2007 included groundhogs (N=6), cattle (N=3), dogs (N=3), bear (N=1), beaver (N=1), and otter (N=1). Other animals that were tested for rabies in 2007 but that did not yield positive laboratory results include chipmunks, coyotes, deer, donkeys/burros, ferrets, goats, an alpaca, a guinea pig, hamsters, horses, a jaguar, a mink, moles, mice, muskrats, opossums, pigs, a pony, rabbits, rats, sheep, squirrels, voles, and three unclassified animals listed as "other" (Table 5).

There was variation within the state in the distribution of the species of confirmed rabid animals (Table 6). For example, 17 of the 49 (35%) confirmed rabid foxes were reported from the neighboring counties of Montgomery (N=11) and Frederick (N=6). Rabid raccoons were

reported from all jurisdictions, with the least number (N=2) reported from Calvert and the greatest number (N=30) reported from Montgomery. Baltimore City reported 13 of the 54 (24%) total rabid bats and Frederick County reported 10 of the 41 (24%) total rabid skunks. Two of the three (66%) rabid dogs were reported from Queen Anne's County, and Baltimore County reported the greatest number of rabid cats (4 of 19; 21%).

Wildlife species, including raccoons (N = 253), bats (N = 54), foxes (N = 49), skunks (N = 41), groundhogs (N = 6), bear (N = 1), beaver (N = 1), and otter (N = 1) accounted for 94.2% of laboratory confirmed rabid animals in Maryland during 2007, which is consistent with what has been noted since 1980 (Figure 3). Of 585 raccoons submitted for rabies testing in 2007 (12.2% of all submissions), 253 (43.3%) were rabies positive (Table 5), representing 58.7% of all laboratory confirmed animals (Table 4). Both the absolute number of rabid raccoons and the proportion of rabid animals that are raccoons decreased since 2006, when 272 of 414 rabid animals (65.7%) were raccoons. Of the 431 confirmed rabid animals in 2007, bats (N=54, 12.6%), foxes (N = 49, 11.4%), skunks (N = 41, 9.5%), and cats (N = 19, 4.4%) were the next most common confirmed rabid animals (Table 5). By comparison, in 2006 there were 44 bats (10.6% of all confirmed rabid animals), 41 foxes (9.9%), 27 skunks (6.5%), and 15 cats (3.6%) laboratory confirmed with rabies. There were 992 bats submitted for testing in 2007, representing 20.6% of all submissions (Table 5). The number of laboratory confirmed rabid bats has steadily increased since 2003, in which there were only ten: in 2004, there were 23 rabid bats, 41 in 2005, and 44 in 2006. Table 1 enumerates all species of confirmed rabid animals in Maryland for the past 20 years.

In 2007, domestic animals accounted for 5.8% of all confirmed rabies cases and included 19 cats, three cows, and three dogs (Table 4). In 2006, 15 cats, two cows, and two horses were confirmed rabid, but there were no rabid dogs. No other domestic animal species has been reported with rabies since 2003. The number of confirmed rabid domestic animals has remained fairly constant over the past 20 years with only small fluctuations from year to year (Figure 3). While cats accounted for the greatest number of submissions in 2007 of any species, domestic or wild (1566 submissions, 32.6%), only 19 (1.2% of cat submissions and 4.4% of all rabid animals) were confirmed rabid.

In 2007, 102 of 4800 submissions (2.1%) were reported as unsatisfactory, and wildlife species accounted for 91% of these. Of those with unsatisfactory results, 59 (57.8%) were for bat submissions, followed by 11 (10.8%) from foxes (Table 5).

DISCUSSION & CONCLUSION

Over 400 animals, both domestic and wild, were confirmed rabid in Maryland in 2007, and the data suggest that the incidence of rabies in animals may be increasing in the State. The distribution of rabies by species in Maryland is consistent with regional and national data [4], where the vast majority of rabid animals are wildlife species, in particular raccoons and bats.

As in previous years, there was a summer peak in 2007 for both the number of submissions for rabies testing and the number of confirmed rabid animals. Warmer months bring increased animal activity, which allows for more animal-animal interaction, thereby increasing the

opportunity for rabies transmission within vector species. Warmer months also provide increased opportunity for human-animal interactions because humans generally prefer outdoor activities, such as camping and hiking, during the summer. In contrast to previous years, however, a second peak occurred in 2007 with an increased number of submissions and confirmed rabid animals in October. The National Weather Service, National Oceanic and Atmospheric Administration reported that the weather in the Baltimore/Washington region in October, 2007 was the warmest in decades with average daily temperatures 8° F above normal [7] and it is possible that warmer weather resulted in extended summertime activities and increased human-animal interactions.

The number of laboratory confirmed animal rabies cases by jurisdiction likely varies because of several factors, including the variation in the size of the human population in each jurisdiction, the population densities of the resident wildlife species, and the availability of suitable habitat for wildlife. Counties with denser human populations may have greater opportunity for human-animal interaction resulting in a larger number of animals submitted for testing. In addition, the more populous counties may have more real estate development with subsequent disruption of wildlife habitat pushing wildlife into areas where people live. To explore the effect of population size, we adjusted for human population by jurisdiction with the result that many of the counties with the greatest number of confirmed rabid animals actually had lower incidences of animal rabies compared to less populated jurisdictions. These results suggest that the less populated jurisdictions are more rural and can thereby support a greater number and variety of wildlife species with relatively higher transmission of rabies among those populations; additionally, the results support the idea that a larger number of rabid animals reported from the more populous counties is a function of greater opportunity for human-animal interaction and submission for testing.

Historically, the western tip of Garrett County has participated in a United States Department of Agriculture (USDA) multi-state oral rabies vaccine campaign targeting raccoons for rabies vaccination with the goal of preventing the westward spread of the raccoon variant of the rabies virus. Starting in 2008, Garrett County will no longer be part of this multi-state oral rabies vaccine campaign. In addition, Anne Arundel County conducts its own oral rabies vaccination project, also with support from the USDA [8]. The Anne Arundel County project started in 1998 on one peninsula in the county, and by 2003 had grown to encompass the entire county. Anne Arundel County is the 5th most populated county in Maryland; however, it ranked 14th of 24 jurisdictions in 2007 in the number of reported rabid animals, with 13 laboratory confirmed rabid animals. When the number of cases was adjusted for the size of the human population, it had the lowest incidence of all counties. In 1997, the year before initiation of the project, Anne Arundel County reported 97 cases of rabies. The low animal rabies incidence observed in Anne Arundel County in 2007 compared to the incidence from before the initiation of the oral rabies vaccination project may be the tangible result of the aggressive and targeted vaccination campaign. In addition, the effect of the program may extend to neighboring jurisdictions (Baltimore, Howard, Prince George's and Calvert counties and Baltimore City), all of which reported the next lowest animal rabies incidences when adjusted for human population size (Figure 2).

The increase since 2003 in the number of rabid bats reported annually may reflect increased awareness among Maryland's citizens of the role bats play in rabies transmission, with subsequent increased numbers of bats submitted for testing. Another possible reason for the increase in the number of rabid bats is a true increased prevalence of rabies in Maryland's bat populations. Limited data are available to support or refute this theory, and it will be important to continue to monitor rabies in bats and to pursue additional aspects of surveillance in bats, such as speciation of all bats submitted for testing. This need is underscored by the fact that most of the recent domestically acquired human rabies cases are attributable to bat variants [1].

Cats are currently the most commonly reported domestic animal with rabies, but the data collected do not differentiate between feral, stray, and domestic pet cats. Knowing whether rabies arises more often from one population of cats than another would be useful to help develop rabies control programs. Maryland Department of Health and Mental Hygiene regulations governing rabies prevention and control (Code of Maryland Regulations 10.06.02) require the vaccination of owned cats, and it is therefore possible that most cases of rabies in cats arise from stray or feral animals, although it is not possible to determine compliance with the regulations. Cats that are not owned and live outdoors are less likely to be vaccinated and are likely to have greater opportunity for exposure to rabies from wild animal vectors. Rabies surveillance could benefit from more detailed data regarding the classification (e.g. indoor only, indoor/outdoor, stray, or feral) and circumstances of the cats submitted for rabies testing. Trap-neuter-release programs (managed outdoor colonies of feral cats that are neutered and rabies vaccinated a single time) do exist in many Maryland communities, and these colonies pose challenges to rabies control programs, including ensuring adequate vaccination coverage and the co-mingling of animal species that results when food is consistently left outdoors.

The two percent of rabies tests that were reported as "unsatisfactory" may have occurred as a result of the methods used to terminate the animal or the condition of the submitted tissue. Wildlife species, most commonly bats, accounted for the majority of unsatisfactory results, and this may have resulted from the small size of the bat's brain. Other reasons for tissue damage that may have generated an "unsatisfactory" result include trauma (such as might occur in a hit-by-car situation or if the animal was killed by blunt trauma) or autolysis (if sufficient time had elapsed between death and testing). Proper euthanasia techniques and prompt and appropriate submission of samples will help to ensure accurate results, but given the challenges routinely encountered in identifying animals and collecting tissue for testing, it is unlikely that 'unsatisfactory' results are completely avoidable.

There were no cases of human rabies reported in Maryland in 2007 and the last reported case of rabies in a person in Maryland occurred in 1976 [9]. In 2006, there were 3 cases of human rabies in the United States in Indiana (bat variant), California (canine variant), and Texas (bat variant) [1]. The single case associated with the canine variant of the rabies virus was infected in the Philippines prior to immigration to the United States, verified by virus isolation and identification of a canine-specific rabies variant found in the Philippines [10]. The three human cases stand in contrast to the large number of individuals who receive rabies post-exposure prophylaxis following exposure to a rabid or potentially rabid animal. While exact numbers are unknown, at least 1000 Maryland residents received rabies post-exposure prophylaxis in 2007 (Center for Veterinary Public Health unpublished data), and many more presented to the medical

and public health communities for risk assessments to determine whether post-exposure prophylaxis was warranted.

The inaugural World Rabies Day was held in September of 2007, and in conjunction with the occasion, the federal Centers for Disease Control and Prevention (CDC) held a symposium on rabies. At the symposium, the CDC announced that the United States had eradicated the canine variant rabies virus [11] and attributed the eradication to rigorous animal control programs. An unintended consequence of the announcement, however, was the misperception among some of the public that dogs are no longer at risk of rabies and therefore do not need to be vaccinated against the disease, and that dog bites to humans do not require assessment for rabies post-exposure prophylaxis. Dogs are still susceptible to other rabies virus variants, such as bat and raccoon strains, and there is always the possibility of a reintroduction of the canine variant into the United States from abroad. Three rabid dogs were reported in Maryland in 2007, underscoring the susceptibility of dogs to rabies and their potential to transmit rabies to humans. Strong animal control programs, including requirements for rabies vaccination, licensing, and stray animal control, remain critical in helping reduce the potential for human exposure to rabies because domestic animals often act as a bridge between wildlife and humans. Proper bite follow-up, including risk assessment, isolation and quarantine, and administration of rabies prophylaxis, continues to be warranted after exposure to a rabid or potentially rabid dog.

In 2008 and in years to come, World Rabies Day will be held on September 28 in commemoration of the death of Louis Pasteur. The goal of World Rabies Day is to increase awareness on the global impact of human and animal rabies and activities and events are planned globally (www.worldrabiesday.org).

Despite the low incidence of human rabies cases in Maryland, hundreds of animals are confirmed rabid in the state each year and this likely represents only a small fraction of the actual number of rabid animals. These data clearly demonstrate the importance of conducting surveillance for animal rabies and highlight the need for continued vigilance and response to maintain the low incidence of rabies in humans and domestic animals. Over the years, the prevalence of animal rabies in domestic animals has remained low when compared to wildlife, and this demonstrates the effectiveness of aggressive animal control programs. Rabies in wildlife continues to be the primary source of exposure to humans, and its control will require extensive resources, as is demonstrated by Anne Arundel County's oral rabies vaccination project. By quantifying the burden of rabies in Maryland and better understanding the seasonal and geographical distribution of animal rabies cases, public health officials can enhance public awareness and target rabies prevention and control programs accordingly.

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Table 1. Laboratory Confirmed Rabies Cases by Species in Maryland, 1987-2007

Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Annual Average	TOTAL 1987-2007
Bat	18	21	26	14	13	17	9	5	10	11	11	8	4	17	27	35	10	23	41	44	54	20	418
Bear																					1	0.05	1
Beaver					1						1		1					1	1		1	0.3	6
Cat	2	13	16	11	15	22	21	9	17	19	23	12	19	18	23	11	21	13	28	15	19	16.5	347
Cattle	2	2		2	1			1	2	2	1	3	1	2	1	2	2	2	1	2	3	1.5	32
Chipmunk															1							0.05	1
Deer		1														1		1		1		0.2	4
Dog	4		2	1	2	2	3	2	2	1	1	2		1	1	1	2	1	1		3	1.5	32
Ferret								1									1					0.1	2
Fox	18	21	23	17	18	27	21	30	36	34	44	27	22	28	38	30	39	24	38	41	49	30	625
Goat		1																				0.05	1
Groundhog	2	5	4	4	10	6	6	4	6	13	6	5	7	9	5	7	12	5	2	10	6	6.4	134
Horse			3	1	1	1	2	1	1					2	1	3	1			2		1.0	20
Muskrat							1															0.05	1
Opossum									2		1			1			1					0.24	5
Otter				1			1			1											1	0.2	4
Pig																	1					0.05	1
Rabbit												2										0.1	2
Raccoon	384	255	295	382	467	413	501	412	326	512	494	346	311	313	366	272	263	244	242	272	253	349	7323
Sheep			1							1												0.1	2
Skunk	20	19	19	35	51	65	59	55	39	44	37	34	26	24	42	34	16	22	26	27	41	35	734
Weasel													1									0.05	1
TOTAL	450	338	389	468	579	553	624	520	441	638	619	439	394	413	505	396	371	336	380	414	431	462	9696

Figure 1. Laboratory Confirmed Rabid Animals (N = 431) and Total Animals Tested for Rabies (N = 4800) by Month in Maryland, 2007

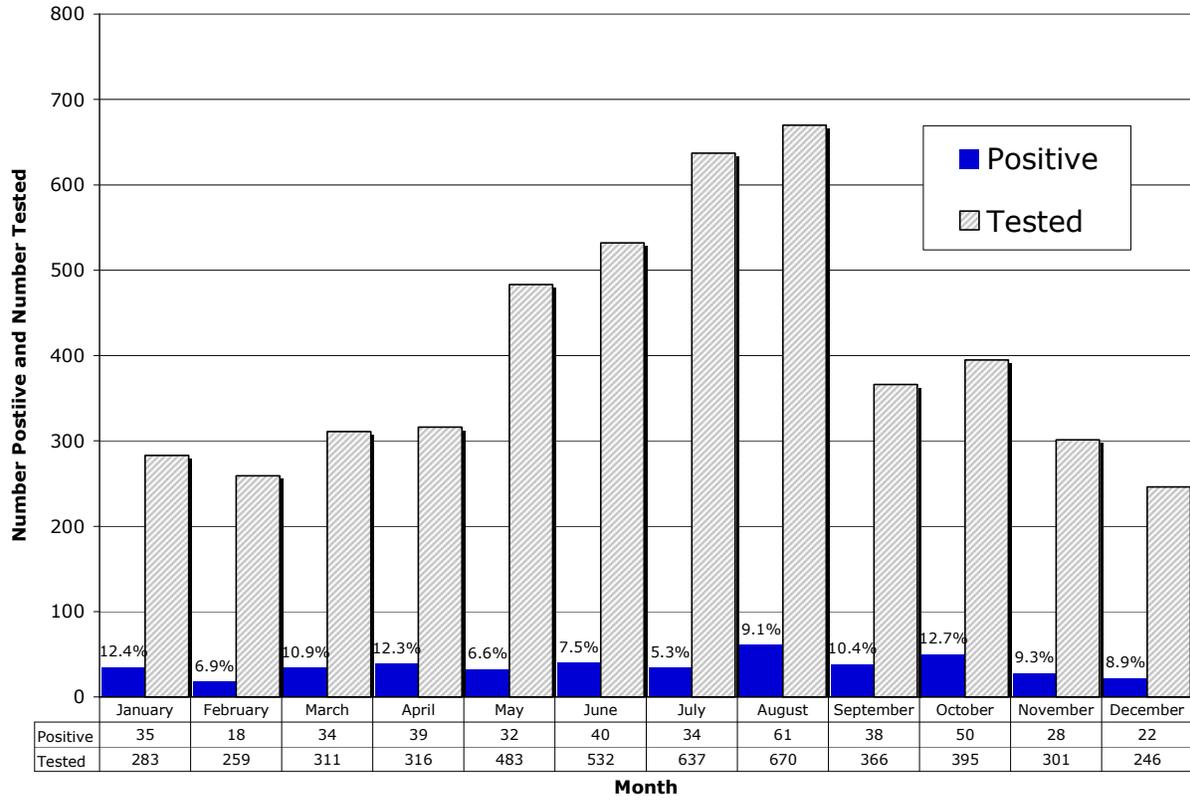


Table 2. Laboratory Confirmed Cases of Animal Rabies by Jurisdiction and Species in Maryland, 2007

Jurisdiction	Bat	Cat	Cow	Dog	Fox	Groundhog	Raccoon	Skunk	Bear	Beaver	Otter	TOTAL
Allegany						1	5	2				8
Anne Arundel	5				1	1	6					13
Baltimore	7	4			2		22			1		36
Baltimore City	13				2		8					23
Calvert		1			1		2					4
Caroline					1		8	5				14
Carroll	4	3			2		7	1				17
Cecil		3					6	1				10
Charles	1				4	1	16	7				29
Dorchester					1		12	2				15
Frederick	2	2			6	1	15	10				36
Garrett	1						5	1	1			8
Harford	1	2			1		25					29
Howard		1			3	1	4					9
Kent	1						5	1				7
Montgomery	10		2	1	11		30					54
Prince George's	4				3	1	19	3				30
Queen Anne's				2			9					11
Somerset		1			2		11					14
St. Mary's							4	5				9
Talbot	1				2		5					8
Washington		1	1		1		15	2				20
Wicomico	2	1			2		9	1			1	16
Worcester	2				4		5					11
TOTAL Positive	54	19	3	3	49	6	253	41	1	1	1	431

Table 3a (Table 3 continued on next page). Laboratory Confirmed Animal Rabies by Jurisdiction in Maryland, 1972 - 1989

Jurisdiction	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	TOTALS
Allegany	0	0	1	0	3	0	0	0	0	18	37	22	3	10	6	9	17	16	142
Anne Arundel	1	1	0	4	4	0	3	7	3	2	2	9	46	75	109	34	18	31	349
Baltimore	3	4	4	2	9	3	3	8	8	5	3	3	54	244	92	26	46	69	586
Baltimore City	1	1	3	2	3	0	3	2	3	1	1	2	5	30	74	8	5	9	153
Calvert	0	0	0	0	0	0	0	1	1	0	0	0	1	32	34	28	7	8	112
Caroline	2	1	0	0	1	2	0	0	0	0	0	0	1	1	1	0	1	0	10
Carroll	0	1	0	2	4	1	0	0	3	3	0	5	148	78	17	21	25	17	325
Cecil	1	0	2	0	10	0	1	1	0	0	0	1	1	1	1	95	20	44	178
Charles	0	0	0	1	0	0	0	2	0	1	0	3	7	43	28	3	7	7	102
Dorchester	0	0	0	0	2	2	0	2	0	0	0	0	0	0	0	0	0	0	6
Frederick	0	1	1	0	0	0	1	1	1	2	8	192	247	38	18	43	66	45	664
Garrett	0	0	0	0	0	5	0	0	0	0	0	18	23	17	9	6	5	7	90
Harford	0	0	3	0	3	0	0	2	1	2	1	2	0	27	181	27	10	27	286
Howard	0	0	0	0	1	0	0	1	1	0	0	29	175	29	4	34	15	21	310
Kent	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	2	5
Montgomery	2	5	7	2	0	6	1	4	3	4	72	434	119	26	34	70	53	26	868
Prince George's	3	0	2	1	0	2	5	6	2	2	1	16	239	79	21	16	14	32	441
Queen Anne's	0	0	0	1	1	0	0	0	1	0	1	0	0	0	2	0	0	0	6
Somerset	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	5
St Mary's	0	0	0	0	0	0	0	0	1	0	0	3	0	24	50	14	6	4	102
Talbot	2	0	1	0	0	0	3	0	2	2	0	1	0	0	1	0	0	1	13
Washington	0	0	0	0	0	0	0	0	6	7	26	98	30	6	1	14	22	22	232
Wicomico	3	2	0	1	0	0	2	0	1	0	0	0	0	0	0	1	0	0	10
Worcester	0	0	3	0	2	0	0	1	0	1	0	0	1	0	0	0	0	1	9
TOTALS	19	16	27	16	47	21	22	39	37	50	152	838	1100	760	683	450	338	389	5004

Table 3b. Laboratory Confirmed Animal Rabies by Jurisdiction in Maryland, 1990 - 2007

Jurisdiction	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	TOTALS
Allegany	11	15	12	11	26	6	8	7	7	7	18	13	10	1	3	9	9	8	223
Anne Arundel	27	57	15	13	20	38	89	97	73	40	41	36	28	21	24	26	18	13	759
Baltimore	45	27	31	25	41	35	65	52	30	38	51	58	30	23	32	34	27	36	821
Baltimore City	3	2	10	9	13	0	3	5	6	2	4	10	5	2	5	20	16	23	160
Calvert	18	10	6	15	14	6	17	17	20	6	5	21	14	13	8	5	5	4	247
Caroline	10	66	40	9	7	22	13	12	10	10	4	15	19	9	14	7	10	14	292
Carroll	12	18	16	17	22	28	26	25	13	19	20	17	21	18	14	28	16	17	410
Cecil	24	18	15	21	24	7	6	2	10	6	6	10	12	16	13	11	7	10	377
Charles	8	5	11	5	4	5	13	11	8	3	7	8	9	8	7	10	25	29	193
Dorchester	0	0	55	43	5	4	15	19	14	16	19	12	4	16	4	2	7	15	250
Frederick	28	68	79	48	58	74	105	72	41	54	42	72	52	57	46	40	50	36	1176
Garrett	45	26	10	12	18	17	10	14	9	9	12	3	11	9	4	5	15	8	255
Harford	41	18	24	18	27	17	15	17	23	19	25	23	28	21	15	24	15	29	463
Howard	14	10	14	14	15	11	24	16	11	13	15	14	9	11	7	9	12	9	298
Kent	57	20	2	2	14	6	1	6	2	1	2	6	6	2	1	2	4	7	145
Montgomery	23	31	31	25	25	42	47	66	41	35	42	55	50	52	52	41	64	54	925
Prince George's	41	22	26	26	30	35	41	37	30	23	20	26	24	24	19	23	22	30	561
Queen Anne's	41	77	31	10	21	22	19	20	6	11	8	14	18	12	9	12	8	11	350
Somerset	0	0	0	54	58	9	7	20	9	11	18	10	4	9	7	7	7	14	244
St Mary's	4	5	2	5	6	2	11	9	10	6	3	5	7	7	9	15	21	9	160
Talbot	0	54	63	14	9	16	15	10	20	16	4	20	8	7	12	8	3	8	288
Washington	16	30	27	19	16	31	19	22	16	14	6	14	13	7	10	15	15	20	368
Wicomico	0	0	33	137	9	7	46	39	15	26	24	19	9	17	9	11	22	16	440
Worcester	0	0	0	71	38	2	21	24	15	9	17	24	5	9	12	16	16	11	291
TOTALS	468	579	553	623	520	442	636	619	439	394	413	505	396	371	336	380	414	431	9696

Figure 2. Laboratory Confirmed Animal Rabies Cases (N = 431) per 10,000 Human Population, by Jurisdiction in Maryland, 2007

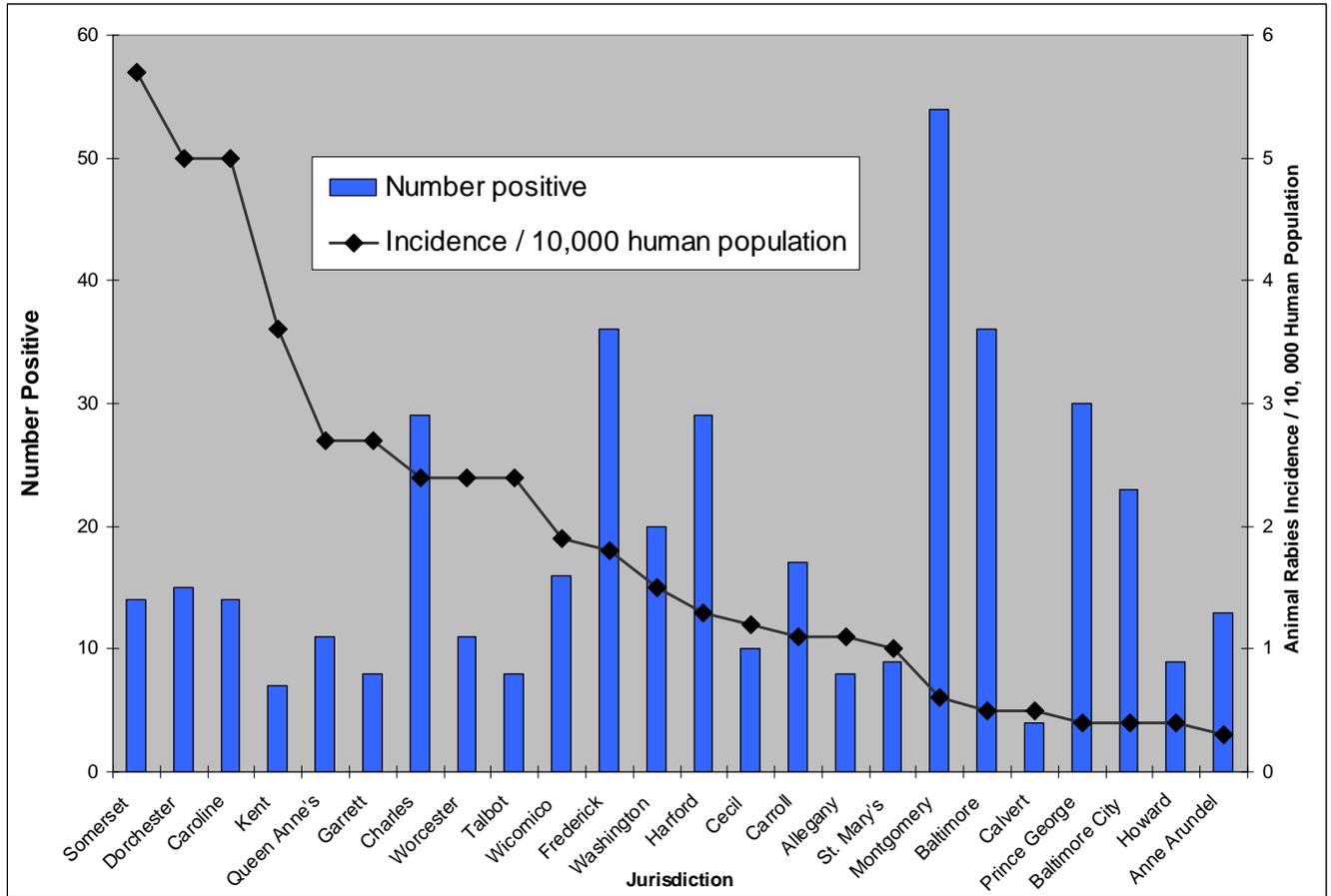


Table 4. Laboratory Confirmed Cases of Animal Rabies by Species in Maryland, 2007

Species	Frequency	Percent of Total
Raccoon	253	58.7
Bat	54	12.6
Fox	49	11.4
Skunk	41	9.5
Cat	19	4.4
Groundhog	6	1.4
Cow	3	0.7
Dog	3	0.7
Bear	1	0.2
Beaver	1	0.2
Otter	1	0.2
TOTAL	431	100

Table 5. Animals Submitted for Rabies Testing in Maryland, 2007

Species	Total Submitted	Positive	Negative	Unsatisfactory	% All Submissions (N=4800)	% Positive of All Positives (N=431)
Alpaca	1	0	1	0	0.02	0
Bat	992	54	879	59	20.67	12.6
Bear	1	1	0	0	0.02	0.2
Beaver	3	1	2	0	0.06	0.2
Cat	1566	19	1542	5	32.63	4.4
Chipmunk	16	0	16	0	0.33	0
Cow	25	3	22	0	0.52	0.7
Coyote	1	0	1	0	0.02	0
Deer	17	0	17	0	0.35	0
Dog	798	3	791	4	16.63	0.7
Donkey/Burro	2	0	2	0	0.04	0
Ferret	11	0	11	0	0.23	0
Fox	192	49	132	11	4	11.4
Goat	20	0	20	0	0.42	0
Groundhog	167	6	155	6	3.48	1.4
Guinea Pig	1	0	1	0	0.02	0
Hamster	5	0	5	0	0.1	0
Horse	13	0	13	0	0.27	0
Jaguar	1	0	1	0	0.02	0
Mink	1	0	1	0	0.02	0
Mole	4	0	4	0	0.08	0
Mouse	21	0	21	0	0.45	0
Muskrat	2	0	2	0	0.04	0
Opossum	95	0	92	3	2	0
Other	3	0	3	0	0.06	0
Otter	1	1	0	0	0.02	0.2
Pig	1	0	1	0	0.02	0
Pony	1	0	1	0	0.02	0
Rabbit	40	0	38	2	0.83	0
Raccoon	585	253	326	6	12.19	58.7
Rat	28	0	28	0	0.58	0
Sheep	7	0	7	0	0.15	0
Skunk	72	41	28	3	1.5	9.5
Squirrel	104	0	101	3	2.17	0
Vole	3	0	3	0	0.06	0
TOTAL	4800	431	4267	102	100	100

Table 6. Laboratory Confirmed Cases of Animal Rabies by Jurisdiction and Most Common Species in Maryland, 2007

	Cat	Dog	Bat	Fox	Raccoon	Skunk	
Jurisdiction	+ / Tested (%)	+ / Tested (%)	+ / Tested (%)	+ / Tested (%)	+ / Tested (%)	+ / Tested (%)	TOTAL
Allegany	0 / 44 (0)	0 / 13 (0)	0 / 11 (0)	0 / 0 (0)	5 / 8 (62.5)	2 / 4 (50)	7 / 80 (8.6)
Anne Arundel	0 / 137 (0)	0 / 107 (0)	5 / 141 (3.5)	1 / 21 (4.8)	6 / 44 (15.9)	0 / 0 (0)	12 / 450 (2.9)
Baltimore	4 / 178 (2.3)	0 / 97 (0)	7 / 76 (9.2)	2 / 13 (15.4)	22 / 36 (58.3)	0 / 0 (0)	35 / 400 (8.5)
Baltimore City	0 / 168 (0)	0 / 131 (0)	13 / 188 (6.9)	2 / 15 (13.3)	8 / 65 (12.3)	0 / 0 (0)	23 / 567 (4.1)
Calvert	1 / 17 (5.9)	0 / 6 (0)	0 / 2 (0)	1 / 1 (100)	2 / 5 (40)	0 / 0 (0)	4 / 31 (12.9)
Caroline	0 / 12 (0)	0 / 10 (0)	0 / 3 (0)	1 / 5 (20)	8 / 12 (66.7)	5 / 5 (100)	14 / 47 (29.8)
Carroll	3 / 91 (3.3)	0 / 10 (0)	4 / 30 (13.3)	2 / 7 (28.6)	7 / 19 (36.8)	1 / 2 (50)	17 / 159 (10.7)
Cecil	3 / 50 (6)	0 / 19 (0)	0 / 1 (0)	0 / 0 (0)	6 / 6 (100)	1 / 2 (50)	10 / 78 (12.8)
Charles	0 / 63 (0)	0 / 43 (0)	1 / 15 (6.7)	4 / 9 (44.4)	16 / 31 (51.6)	7 / 12 (58.3)	28 / 173 (16.2)
Dorchester	0 / 15 (0)	0 / 8 (0)	0 / 5 (0)	1 / 3 (33.3)	12 / 17 (70.6)	2 / 2 (100)	15 / 50 (30)
Frederick	2 / 137 (1.5)	0 / 46 (0)	2 / 30 (6.7)	6 / 23 (26.1)	15 / 36 (41.7)	10 / 16 (62.5)	35 / 288 (12.6)
Garrett	0 / 11 (0)	0 / 6 (0)	1 / 9 (11.1)	0 / 1 (0)	5 / 11 (45.5)	1 / 4 (25)	7 / 42 (16.7)
Harford	2 / 92 (2.2)	0 / 52 (0)	1 / 26 (3.9)	1 / 3 (33.3)	25 / 31 (80.7)	0 / 0 (0)	29 / 204 (14.2)
Howard	1 / 75 (1.3)	0 / 19 (0)	0 / 13 (0)	3 / 6 (50)	4 / 13 (30.8)	0 / 0 (0)	8 / 126 (6.4)
Kent	0 / 7 (0)	0 / 6 (0)	1 / 9 (11.1)	0 / 0 (0)	5 / 5 (100)	1 / 1 (100)	7 / 28 (25)
Montgomery	0 / 172 (0)	1 / 68 (1.5)	10 / 195 (5.1)	11 / 39 (28.2)	30 / 94 (31.9)	0 / 0 (0)	52 / 568 (9.2)
Prince George's	0 / 124 (0)	0 / 55 (0)	4 / 177 (2.3)	3 / 17 (17.7)	19 / 57 (33.3)	3 / 4 (75)	29 / 434 (6.7)
Queen Anne's	0 / 17 (0)	2 / 13 (15.4)	0 / 11 (0)	0 / 5 (0)	9 / 24 (37.5)	0 / 0 (0)	11 / 70 (15.7)
Somerset	1 / 8 (0)	0 / 3 (0)	0 / 0 (0)	2 / 3 (66.7)	11 / 11 (100)	0 / 0 (0)	14 / 25 (56)
St. Mary's	0 / 29 (0)	0 / 8 (0)	0 / 3 (0)	0 / 1 (0)	4 / 7 (57.1)	5 / 10 (50)	9 / 58 (15.5)
Talbot	0 / 17 (0)	0 / 7 (0)	1 / 5 (20)	2 / 6 (33.3)	5 / 10 (50)	0 / 0 (0)	8 / 45 (17.8)
Washington	1 / 46 (2.2)	0 / 31 (0)	0 / 9 (0)	1 / 5 (20)	15 / 19 (79)	2 / 8 (25)	19 / 118 (16.1)
Wicomico	1 / 32 (3.1)	0 / 23 (0)	2 / 17 (11.8)	2 / 4 (50)	9 / 13 (69.2)	1 / 2 (50)	15 / 91 (16.5)
Worcester	0 / 20 (0)	0 / 13 (0)	2 / 16 (12.5)	4 / 5 (80)	5 / 11 (45.5)	0 / 0 (0)	11 / 65 (16.9)
*Out of State	0 / 4 (0)	0 / 4 (0)	0 / 0 (0)	0 / 0 (0)	0 / 0 (0)	0 / 0 (0)	0 / 8 (0)
TOTAL	19 / 1566 (1.2)	3 / 798 (0.4)	54 / 992 (5.4)	49 / 192 (25.5)	253 / 585 (43.3)	41 / 72 (56.9)	† 419 / 4205 (10)

* Out of state animals tested in Maryland laboratories.

† Total number of confirmed rabid animals in 2007 is 431. Additional animals include; groundhogs (6), cattle (3), bear (1), beaver (1), and otter (1).

Figure 3. Number of Laboratory Confirmed Animal Rabies Cases in Maryland, 1945-2007

