NEBRASKA
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DEPT. OF HEALTH AND HUMAN SERVICES

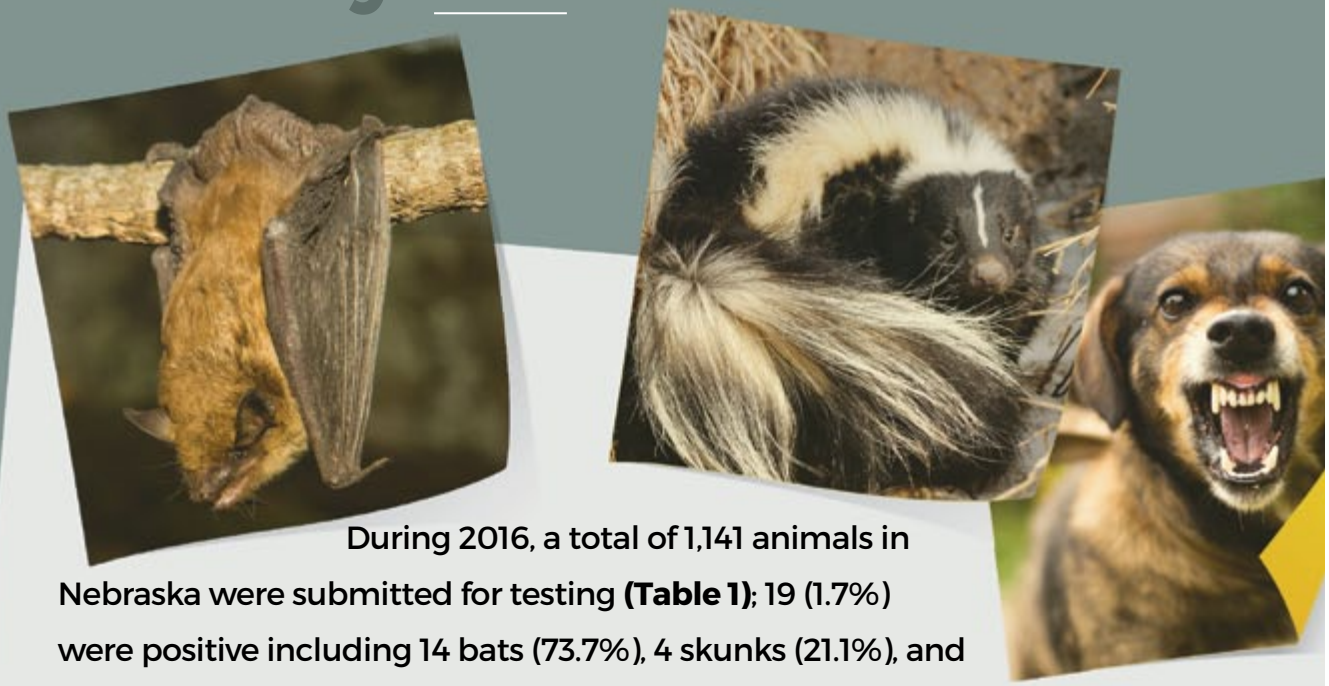
RABIES in Nebraska

Background Information

With few exceptions, rabies occurs worldwide. The World Health Organization estimates that up to 55,000 human deaths occur annually, mostly in rural areas of Africa and Asia. In the United States, the number of human deaths attributed to rabies has declined from 100 or more each year in the early 1900s to a current average of only three or fewer cases per year. Two programs have contributed to this substantial reduction. Animal control and vaccination programs started during the 1940s and more recent oral rabies vaccination programs have eliminated domestic dogs as reservoirs of rabies in the United States. Also, effective human rabies vaccines and immunoglobulins have been developed; modern day post-exposure prophylaxis (PEP) has proven nearly 100% successful. From January 2003 to June 2013, 31 cases of human rabies were recorded in the United States. On the basis of historic records at the Nebraska Department of Health and Human Services (NDHHS), the last reported human case of rabies in Nebraska likely occurred in the 1920s.

Wild mesocarnivores (e.g. raccoons, skunks, and foxes) are important rabies reservoir species among which skunks are most often found to be infected with the virus in Nebraska. In contrast to eastern US states, raccoons in Nebraska are rarely infected with rabies. Rabid bats are increasingly implicated as an important wildlife reservoir of rabies in Nebraska; transmission can occur from minor, underappreciated or unrecognized bites. Given ongoing presence of this disease in reservoir species, rabies remains a potentially serious threat to public health in Nebraska.

Summary 2016



During 2016, a total of 1,141 animals in Nebraska were submitted for testing **(Table 1)**; 19 (1.7%) were positive including 14 bats (73.7%), 4 skunks (21.1%), and 1 bovine (5.3%). These animals originated from 16 of Nebraska's 93 counties; **Figure 1** depicts the geographic distribution of 2016 cases by species. Among all positive cases in 2016, 57.9% (11/19) were associated with human contact necessitating PEP. A report listing the current year-to-date positive cases and a menu of links to data from previous years are available on the NDHHS website at the following URL: **http://dhhs.ne.gov/Pages/srd_rabies.aspx**.

TABLE 1: Number of animals submitted for rabies testing and number positive by species, 2016.

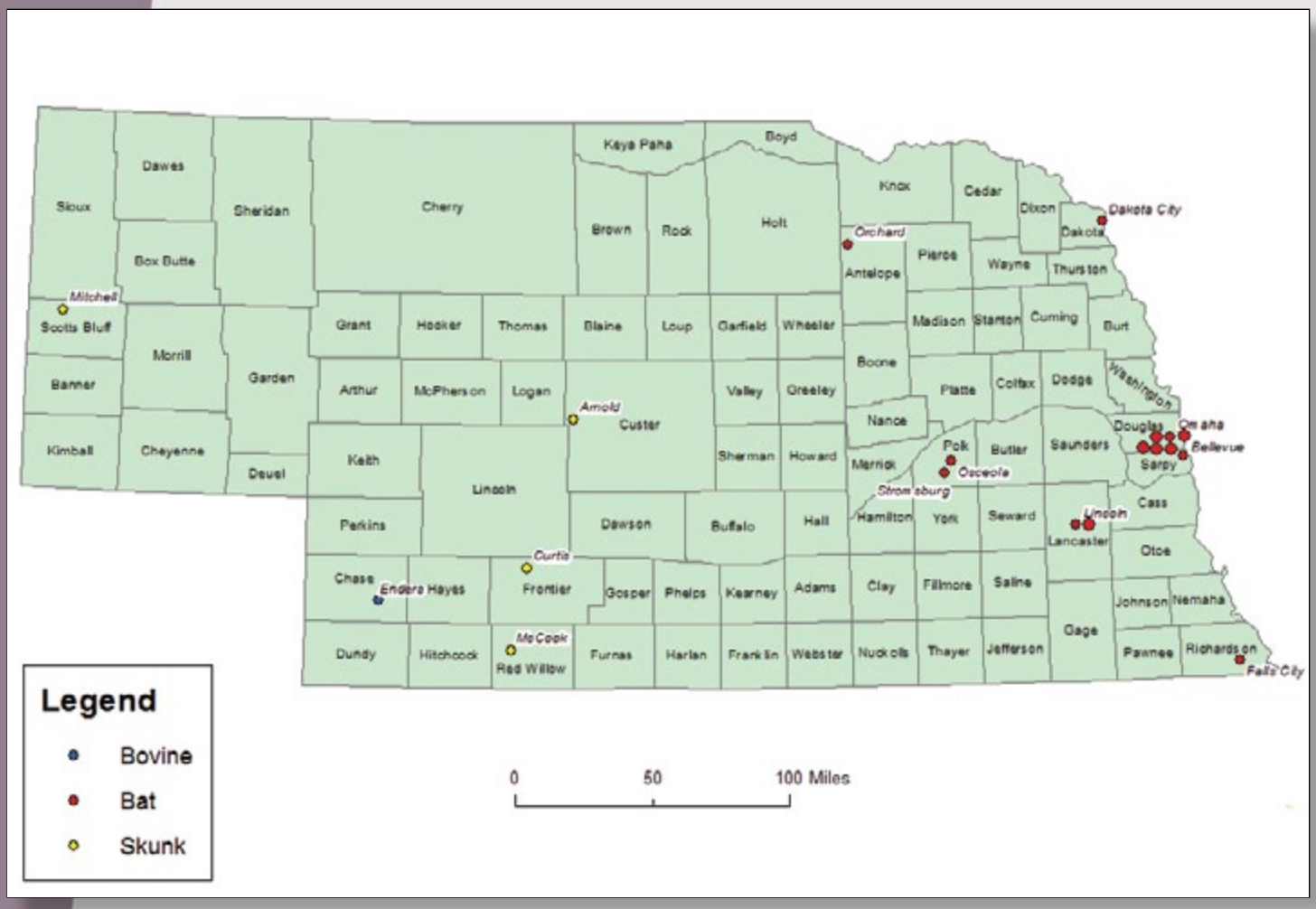
Species	Total submitted n (%)	Positive n (% of species total)
Bat	765 (67.0)	14 (1.8)
Cat	146 (12.8)	0 (0.0)
Dog	100 (8.8)	0 (0.0)
Cattle	40 (3.5)	1 (2.5)
Raccoon	29 (2.5)	0 (0.0)
Horse	8 (0.7)	0 (0.0)
Skunk	11 (1.0)	4 (36.4)
Other*	42 (3.7)	0 (0.0)
Total	**1,141**	**19 (1.7)**

*Other includes badger (1), caprine (3), cervid (1), coyote (1), donkey (1), fox (3), opossum (3), ovine (2), rabbit (1), rodent (6), squirrel (16), woodchuck (3), and one unknown.

The Nebraska Department of Health and Human Services issues a Rabies Approval (RA) number for testing of animals involved in potential human rabies exposures if criteria as specified by the state's Rabies Control Program are met. Examples include persons who were bitten, had saliva contact in open wounds or mucus membranes, or were in the same room with a bat and cannot be certain that they were not bitten (e.g., sleeping person, unattended child, intoxicated person or individual who has a mental disability).[1,2] Fees for tests which qualify for an RA number are paid by the Program. This targeted testing provides rapid evaluation of risk after human exposure to potentially rabid animals. On the basis of timely results, medical professionals and public health officials are then able to make well-informed decisions and provide recommendations for the exposed person(s) regarding need for post-exposure prophylaxis which is extremely effective at preventing human rabies when administered appropriately. When test results are negative, such findings allow exposed persons to avoid expensive and time-intensive PEP. During 2016, the Nebraska Rabies Control Program issued RA numbers for 530 tests which were associated with documented potential human exposure events. Of these, 12 (2.3%), seven (1.3%), and one (0.2%) were positive, unsuitable, and indeterminate, respectively; PEP was required among exposed persons in all but three instances. The remaining 96.2% (510/530) of 2016 exposure events were associated with negative tests. Among these, PEP was avoided in a total of 806 exposed persons (median number of persons/event, 1; range [1–10]).

Figure 1:

Number of animals testing positive for rabies by species and location (N = 19), Nebraska, 2016



Ten-year Report

2006–2015

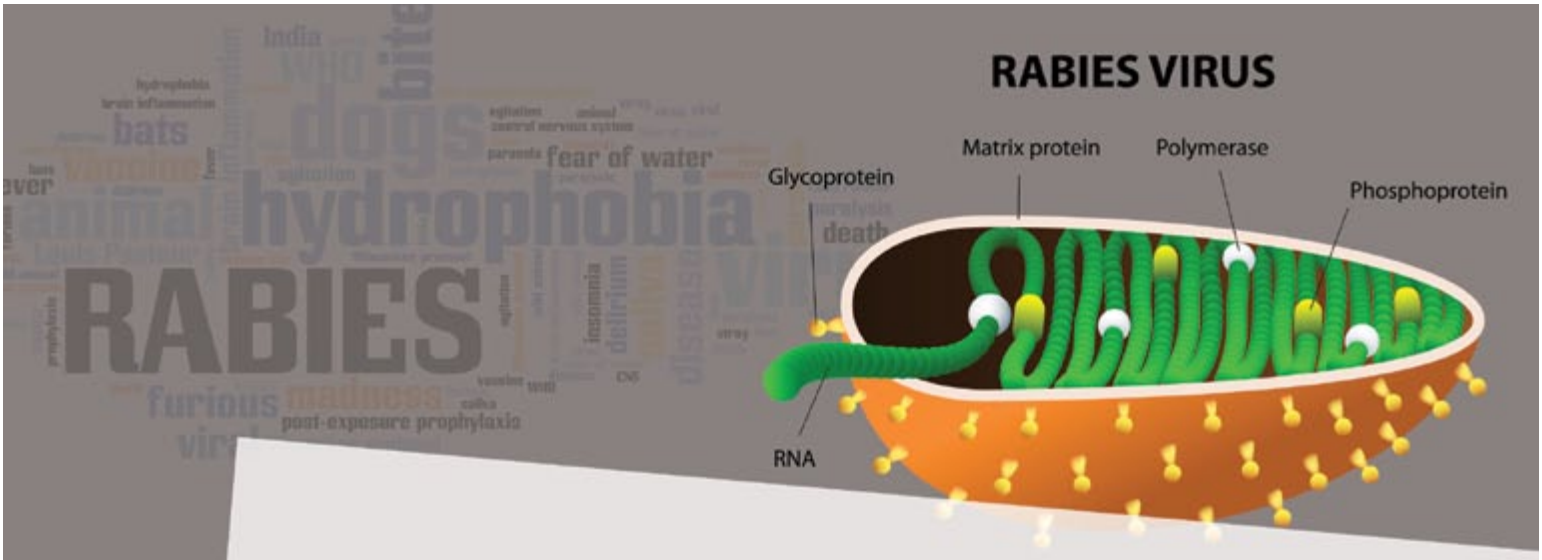
During 2006–2015, 10,438 animals from Nebraska were submitted for rabies testing of which 429 (4.1%) were positive **(Table 2)**. Over this 10-year period, bats were the most commonly submitted animal. Of 5,904 bats submitted for testing, 109 (1.8%) tested positive. The majority of bats testing positive were from counties with larger urban population **(Figure 2)**. Skunks represented the species with the largest number of positive tests. Of 296 submitted, 215 were positive (72.6%). Compared to bats, the locations of skunks and other animals that tested positive were more widely distributed throughout the state **(Figures 3 and 4)**. Please refer to **Table 5** for total numbers of tests submitted and positive results, by species, for each year, from 2006 through 2015.

TABLE 2: Number of animals submitted for rabies tests and number positive by species, 2006–2015.

	Totals		Positive		
Species	**N**	**median/year (range)**	**n**	**(%)**	**median/year (range)**
Skunk	296	26 (13–63)	215	(72.6)	16 (7–53)
Bat	5,904	625.5 (460–715)	109	(1.8)	11.5 (3–16)
Cat	1,884	186.5 (157–218)	33	(1.8)	2.5 (0–9)
Dog	1,157	113 (101–142)	6	(0.5)	1 (0–1)
Cattle	391	39 (27–62)	42	(10.7)	4 (1–8)
Raccoon	340	32 (22–55)	2	(0.6)	0 (0–1)
Horse	115	11 (5–21)	16	(13.9)	1 (0–4)
Other	351*	39 (22–45)	6**	(1.7)	0.5 (0–2)
Total	**10,438**	**1,051 (895–1,165)**	**429**	**(4.1)**	**35 (21–90)**

*Other species submitted includes African wild dog (1), alpaca (2), badger (10), beaver (4), bobcat (2), coati mundi (1), coyote (22), deer (6), donkey (4), elk (1), ferret (8), fox (16), gerbil (1), goat (19), ground squirrel (4), groundhog (1), harbor seal (1), llama (5), mink (7), mole (2), mountain lion (1), mule (1), muskrat (9), opossum (49), prairie dog (5), rabbit (9), reindeer (1), rodent (32), sheep (15), shrew (3), squirrel (86), swine (4), vole (4), weasel (2), woodchuck (9) and 4 non-recorded species.

**Other species testing positive include fox (3), ferret (1), llama (1), and sheep (1).



During 2006–2015, NDHHS issued a total of 4,402 Rabies Approval numbers (median/year, 445.5; range 371–477) **(Table 3)**. Of these, 109 (2.5%) were positive (median/year, 11; range 7–16 [1.6–4.1%]), 74 (1.7%) were unsuitable (median/year, 7.5; range 4–10 [0.9–2.3%]), and 4,219 (95.8%) were negative (median/year, 428; range 354–461 [95.4%–96.6%]). Among the exposure events with a corresponding negative test, all potentially exposed individuals were thus found not at risk for rabies. Therefore, each of the exposed persons could confidently avoid costly post-exposure prophylaxis as a direct result of State-funded rapid testing, corresponding timely reporting of the negative results, and evidence based public health recommendations.

TABLE 3: Count of Rabies Approval (RA) numbers and corresponding results by year, 2006–2015.

		Positive	Negative	Unsuitable
Year	**N**	**n (%)**	**n (%)**	**n (%)**
2006	455	11 (2.4)	440 (96.7)	4 (0.9)
2007	450	7 (1.6)	436 (96.9)	7 (1.6)
2008	436	12 (2.8)	414 (95.0)	10 (2.3)
2009	394	16 (4.1)	370 (93.9)	8 (2.0)
2010	371	12 (3.2)	354 (95.4)	5 (1.3)
2011	441	11 (2.5)	420 (95.2)	10 (2.3)
2012	474	13 (2.7)	455 (96.0)	6 (1.3)
2013	438	10 (2.3)	420 (95.9)	8 (1.8)
2014	466	8 (1.7)	449 (96.4)	9 (1.9)
2015	477	9 (1.9)	461 (96.6)	7 (1.5)
TOTAL	**4,402**	**109 (2.5)**	**4,219 (95.8)**	**74 (1.7)**

Human Exposure and Treatment 2012–2016

Beginning in 2012, NDHHS began collecting detailed records in advance of animal rabies testing to document all potential human exposures when an RA number was issued. Regardless of test result, local health department staff are then asked to document the post-exposure treatment recommendations which are provided to the exposed person(s) in each event. During 2012–2016, an annual median of 455 RA numbers were assigned (range, 420–530). Of 160 total animals with positive results in this time period, 59 (36.9%) were associated with human exposure thus necessitating PEP. Of these, 44 had been reported in advance to the Nebraska Rabies Control Program and were assigned RA numbers **(Table 4)**. Overall, post-exposure prophylaxis was recommended to 128 persons on the basis of positive tests; median number of exposed persons requiring PEP per positive test was 1.5 (range, 1–9). Also during 2012–2016, PEP recommendations were documented among an additional 47 persons exposed to 33 animals whose specimens were unsuitable for testing and thus exposure could not be ruled out.

TABLE 4: Human exposure to animals testing positive with and without Rabies Approval (RA) numbers by year, 2012–2016.

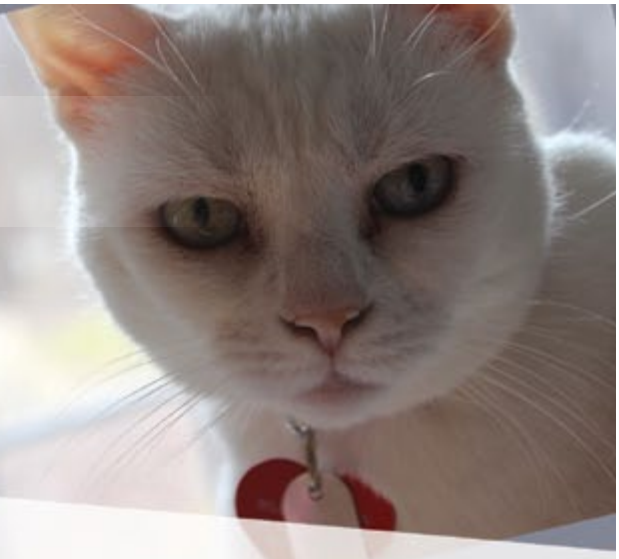
Events with PEP recommended				No. of persons		
Year	No RA n	RA n	Total N	No RA n	RA n	Total N (median per event, range)
2012	3	10	13	5	14	19 (1, 1–4)
2013	6	10	16	14	25	39 (2, 1–6)
2014	3	6	9	11	13	24 (2, 1–9)
2015	2	8	10	4	17	21 (1.5, 1–5)
2016	0	10	10	0	25	25 (1, 1–7)
TOTAL	14	44	58	34	94	128

Wildlife

Skunks and bats remain the two primary wildlife reservoirs for the rabies virus in Nebraska. During 2016, four of 11 skunks tested (36.4%) were positive for rabies (Table 1). During 2006–2015, the median number of skunks testing positive was 16 per year (range, 7–53). Due to the high prevalence of the virus among the skunk population in Nebraska, all skunks should be considered a potential source of the virus. Any bite by a skunk or other wild carnivore or exposure to saliva from such animals should be considered a possible rabies exposure and reported to the regional local health department. All wounds should be thoroughly cleaned with soap and water immediately. Exposed persons should also contact their physician for appropriate medical care. In such instances of exposure, the local health department can provide consultation regarding risk and, if indicated, the Nebraska Rabies Control Program should be contacted for an RA number to facilitate rabies testing if the exposing wild animal can be captured safely.

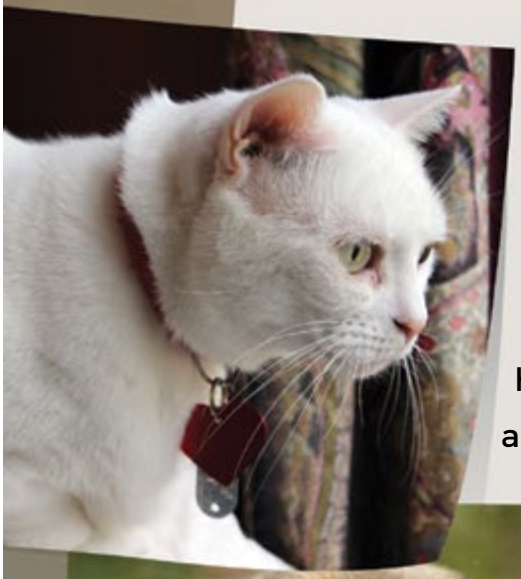
Transmission of rabies from bats can occur from seemingly minor or unrecognized bites. Bites, scratches, or mucus membrane exposures from bats should be considered potential rabies exposures. Any instance where a person is in the same room as a bat and cannot declare with certainty that they were not bitten should also be considered a potential exposure. Such instances include persons sleeping in a room with a bat in it or an adult witnessing a bat in the room with a child who was unattended, a person with a mental

Wildlife



disability, or an intoxicated person.[1,2] During 2016, 14 of 765 bats submitted (1.8%) were positive for rabies **(Table 1)**. During 2006–2015, the median number of bats testing positive per year was 11.5 (range, 3–16). Given their hibernation behavior, bats often enter homes in late summer and early fall. A correspondingly higher level of testing is generally observed during these time periods as are relatively higher numbers of rabid bats. Because capture of bats from homes drives testing, bats with positive test results were more frequently encountered in counties with urban populations **(Figure 2)**.

Domestic Animals



Seventeen cattle and 14 other domestic animals tested positive for rabies in 2012–2016 (feline, 9; canine, 3; equine, 1; llama, 1). All but the llama were of a species in which a licensed vaccine is currently available. Of particular concern, these 12 cats and dogs and the horse were either reported as not vaccinated or had unknown vaccination histories. Further, nine of these rabid animals were associated with documented human exposure including seven events involving cats in which humans were reportedly bitten. As a result of exposure to these nine animals, potentially avoidable PEP was required among 24 exposed persons because irresponsible owners failed to vaccinate animals in their care.

Vaccination of domestic animals is required by Nebraska statutes and continues to be a critical, safe, and cost-effective component of rabies control to safeguard both animal and public health from this fatal virus.

In each of these exposure events involving domestic animals, appropriate vaccination would likely have prevented rabies, thus reducing or eliminating the associated human risk and corresponding necessity for PEP. Equally troubling are the total numbers of domestic animals in Nebraska that must be tested for rabies because of inadequate vaccination. Of 1,007 RA numbers issued in

Domestic Animals

Nebraska during 2015 and 2016, 287 involved 322 persons who were potentially exposed by 204 cats, 83 dogs, and 1 ferret. Of these, 94.4% (271/287) were either not current or had unknown vaccination status. Vaccination of domestic animals is required by Nebraska statutes and continues to be a critical, safe, and cost-effective component of rabies control to safeguard both animal and public health from this fatal virus.[3] All persons keeping domestic animals should consult their veterinarian to establish and maintain an appropriate vaccination schedule to prevent rabies.

Vaccination

Vaccine-preventable Diseases

REFERENCES:

1. Nebraska Department of Health and Human Services. *Nebraska Rabies Investigation Guideline.* Available at: http://dhhs.ne.gov/publichealth/Documents/Nebr_Rabies_Inv_Guide.pdf. Accessed August 25, 2016.

2. Manning SE, Rupprecht CE, Fishbein D, et al. *Human rabies prevention—United States, 2008: Recommendations of the Advisory Committee on Immunization Practices.* MMWR Recomm Rep 2008; 57 (RR-3): 1–28.

3. National Association of State Public Health Veterinarians. *Compendium of Animal Rabies Prevention and Control, 2016.* JAVMA 2016; 248 (5): 505–517.

Table 5:

Number of animals submitted for rabies testing and number positive by species and year, 2006–2015

	2006		2007		2008		2009		2010	
Species	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**
Skunk	22	15 (68.2)	20	13* (65.0)	35	25* (71.4)	63	53* (84.1)	36	28* (77.8)
Bat	489	3 (0.6)	460	14 (3.0)	527	10 (1.9)	478	14 (2.9)	658	13* (2.0)
Cat	218	5 (2.3)	203	1 (0.5)	193	1 (0.5)	185	9 (4.9)	216	6 (2.8)
Dog	112	0 (0.0)	124	1 (0.8)	126	0 (0.0)	142	1 (0.7)	105	1 (1.0)
Cattle	44	8* (18.2)	27	1 (3.7)	29	4 (13.8)	33	7* (18.8)	38	4 (10.5)
Horse	18	3 (16.7)	12	1 (8.3)	17	2 (11.8)	21	4 (19.0)	12	1 (8.3)
Other	61	1*** (1.6)	49	0 (0.0)	64	1*** (1.6)	79	2*** (2.5)	63	1*** (1.6)
Total	**964**	**35 (3.6)**	**895**	**31 (3.5)**	**991**	**43 (4.3)**	**1,001**	**90 (9.0)**	**1,128**	**54 (4.8)**

	2011		2012		2013		2014		2015	
Species	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**	**N**	**Positive n (%)**
Skunk	30	17* (56.7)	44	35* (79.5)	17	14* (82.4)	13	7* (53.8)	16	8** (50.0)
Bat	660	10* (1.5)	715	13 (1.8)	666	6 (0.9)	642	10 (1.6)	609	16 (2.6)
Cat	185	2 (1.1)	171	5* (2.4)	157	3 (1.9)	168	0 (0.0)	188	1 (0.5)
Dog	109	0 (0.0)	114	1 (0.9)	101	1 (1.0)	109	0 (0.0)	115	1 (0.9)
Cattle	42	2 (4.8)	40	3* (2.6)	40	7* (17.5)	62	4 (6.5)	36	2 (5.6)
Horse	10	4 (40.0)	8	0 (0.0)	5	1 (20.0)	6	0 (0.0)	6	0 (0.0)
Other	88	0 (0.0)	73	2*** (2.7)	59	1*** (1.7)	57	0 (0.0)	98	0 (0.0)
Total	**1,124**	**35 (3.1)**	**1,165**	**59 (5.1)**	**1,045**	**33 (3.2)**	**1,057**	**21 (2.0)**	**1,068**	**28 (2.6)**

*Rabies tests performed at laboratories other than Kansas State University Rabies Laboratory (KSU RL) were only reported if positive as follows: 2006, 1 bovine; 2007, 1 skunk; 2008, 9 skunks; 2009, 1 bovine, 11 skunks; 2010, 1 bat, 1 skunk; 2011, 1 bat, 1 skunk; 2012, 5 skunks, 1 cat, 1 bovine; 2013, 2 bovines, 4 skunks; 2014, 2 skunks.

**During 2015, in addition to KSU RL, University of Nebraska-Lincoln Veterinary Diagnostic Center began reporting both positive and negative rabies results for all animals tested including 2 skunks that tested positive.

***Other species testing positive: 3 foxes (2008, 2009, 2012); 2 raccoons (2006, 2012); 1 ferret (2009); 1 llama (2013); 1 sheep (2010).

Figure 2:

Number of bats testing positive for rabies by county (N = 109), Nebraska, 2006–2015

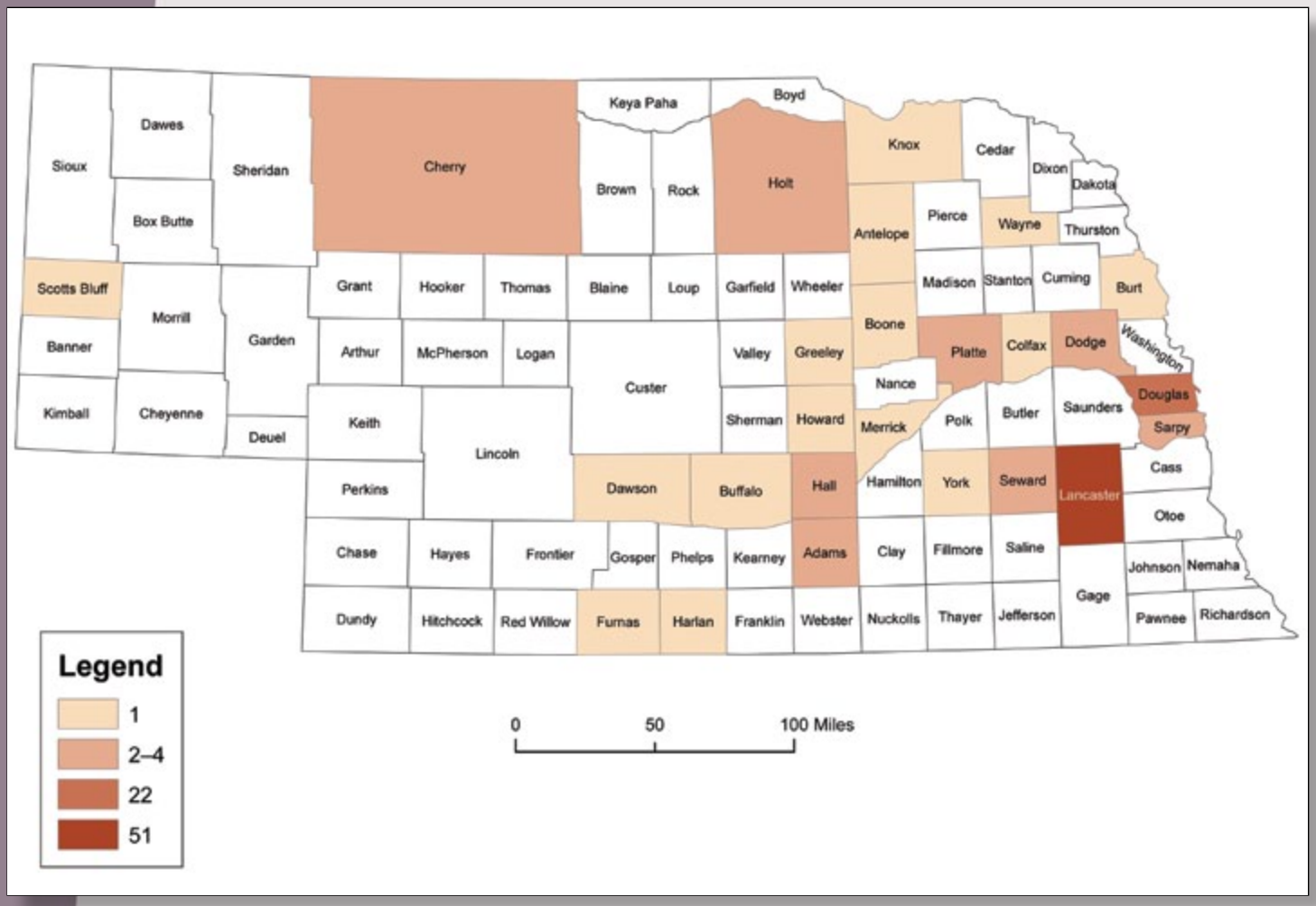


Figure 3:

Number of skunks testing positive for rabies by county (N = 215), Nebraska, 2006–2015

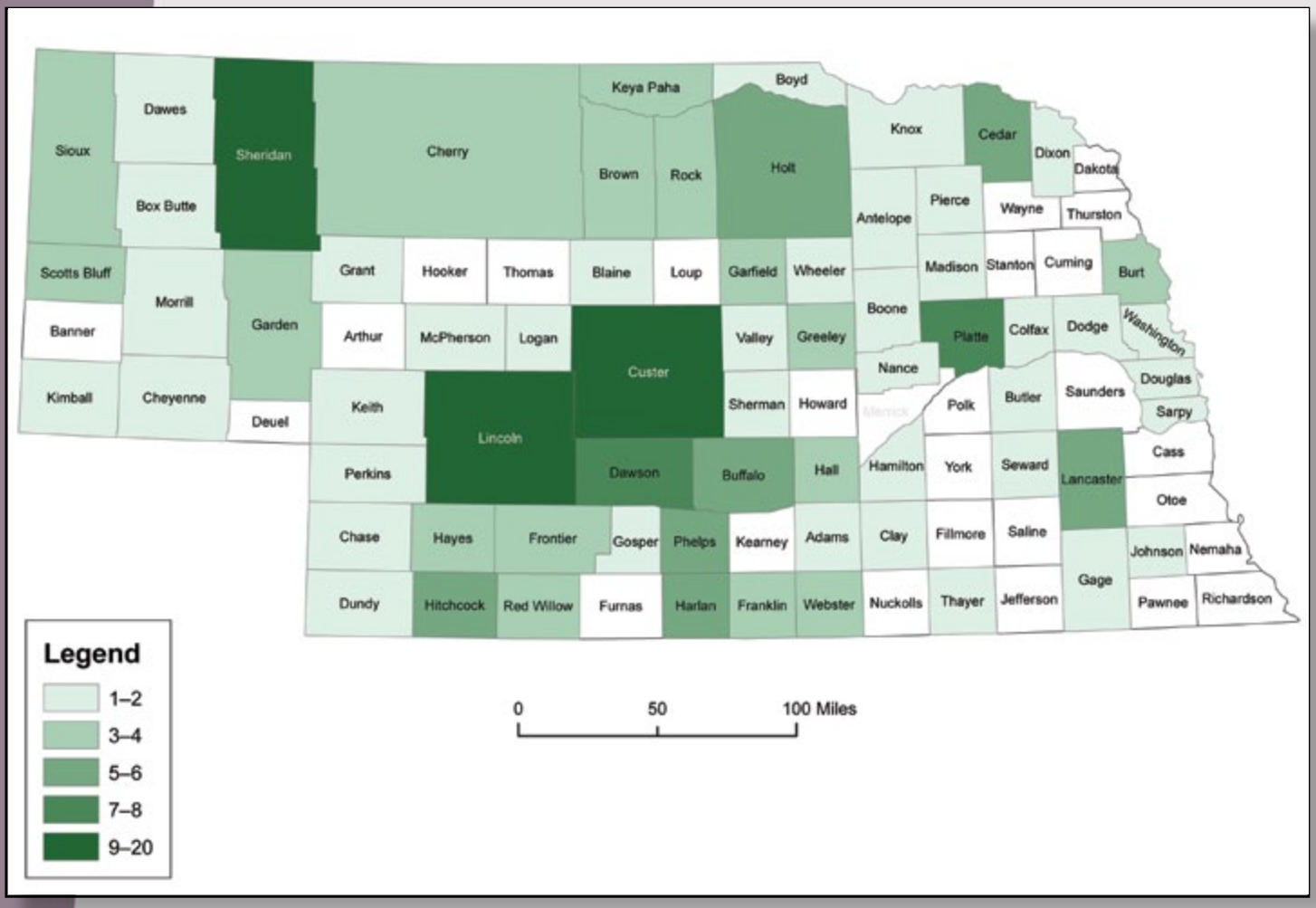


Figure 4:

Number of animals (other than skunks or bats) testing positive for rabies by species and county (N = 105), Nebraska, 2006–2015