2007

Understanding the New York rabies epizootic 1985-2005

David Dorrell
Louisiana State University and Agricultural and Mechanical College

UNDERSTANDING THE NEW YORK RABIES EPIZOOTIC 1985-2005

A Dissertation
Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
in
The Department of Geography and Anthropology

By
David William Dorrell
B.A. East Central University 1996
M.S. Texas A&M University 1999
August 2007

This work is dedicated to my father

David J. Dorrell

January 9, 1950 – September 24, 2005

ACKNOWLEDGMENTS

There have been so many who have helped me it is difficult to know where to start and when to stop. First I would like to thank my advisor, Andrew Curtis whose tremendous patience and support prevented me from simply abandoning this project and this phase in my education. He kept me reasonably on task, a feat that has been accomplished by no one else in my lifetime. I would also like to thank Michael Kearney who helped me both with project and with tremendous moral support. Martin Hugh-Jones provided me with the necessary epidemiology and confidence to undertake this project. Kam-biu Liu and Michael Leitner have both provided assistance and flexible schedules that allowed me to finish this seemingly unending process.

In New York I was greatly aided by Ward Stone, Charles Trimarchi, Marge Pizzuti, and Richard Watt. I was particularly helped by Father Marcello Blasquez who opened his home to me as I collected data in New York State.

My family has held me together through this time. They have supported and encouraged me when things seemed bleak. My father cheered me on until the day he died, and then my step-mother, Elizabeth took up the slack. My sister, Cara, and my mother, Carol, kept me stoked with good news and my grandparents Manuel and Helen kept their faith in me. My father–in-law, Arnulfo, and my mother-in-law, Maria Esther, gave me workspace and advice

Finally, and above all others I would like to thank my wife, Dominica. She has kept me in one piece and productive since the day we met. I could never have done this without her.

TABLE OF CONTENTS

ACKNOWLEDGMENTS …….....…….…..….iv

LIST OF TABLES……...…..……..…..vi

LIST OF FIGURES……..……...…..vii

ABSTRACT……...……...…..xi

CHAPTER

1 INTRODUCTION TO EPIZOOTIC RABIES……..…..……1

2 LITERATURE REVIEW AND HISTORY.....15

3 RABIES SURVEILLANCE IN NEW YORK STATE……...…..…….31

4 ANIMAL AND DOG CONTROL OFFICERS……..……..…….55

5 COMPARING NEWS REPORTING TO RABIES SUBMISSIONS…..….96

6 CONCLUSION……...…….....……..…….139

LITERATURE CITED.....146

APPENDIX A QUESTIONNAIRE …….……153

APPENDIX B NEWSPAPER INDEXING..……..…..……..…155

APPENDIX C REGIONAL SUMMARY TABLES…….…….…..……..…157

APPENDIX D SELECTED MAPS FROM NEW YORK NEWSPAPERS ..….161

APPENDIX E RABIES MAPS BY DATE OF PUBLICATION ……...……164

APPENDIX F ATTEMPTED ANALYSES……...…….…….……166

VITA…….....169

LIST OF TABLES

Table 3.1 Counties ranked by difference between population rank and submission rank……42

Table 4.1 Estimated epizootic times……..88

Table 5.1 Newspapers ranked by circulation.……..109

LIST OF FIGURES

Figure 1.1 Year of first positive raccoon…….…….……5

Figure 1.2 Areas of surveillance interest……..……..……10

Figure 3.1 The structure of surveillance in New York……..…….31

Figure 3.2 Rabid raccoons by county 1986-2005…….…..…..…36

Figure 3.3 Rabid raccoons per county standardized by 10,000 population 1986-2005….36

Figure 3.4 Year of first positive raccoon in New York counties……..……..37

Figure 3.5 County rabies submissions compared with rabies submissions standardized to 10,000 human population, 1986-2000……39

Figure 3.6 County rabies submissions compared with rabies submissions standardized to 10,000 human population, 2001-2005……...…40

Figure 3.7 Map of population rank minus submission rank……...…….……...43

Figure 3.8 Rabies submissions by county standardized by 10,000 population, 1990-1996……45

Figure 3.9 Rabies submissions by county standardized by 10,000 population, 1997-2003……46

Figure 3.10 Rabies submissions by county standardized by 10,000 population, 2003-2005……47

Figure 3.11 Rabies positive raccoons divided by submitted raccoons, 1990-1996……...51

Figure 3.12 Rabies positive raccoons divided by submitted raccoons, 1997-2003……...52

Figure 3.13 Rabies positive raccoons divided by submitted raccoons, 2004-2005…...…53

Figure 3.14 Graph comparing submitted raccoons to rabid raccoons 1985-2005……..…53

Figure 4.1 Governmental structure of rabies surveillance…….…….……...57

Figure 4.2 Control officers by zipcode…….…..…….65

Figure 4.3 Control officers per county…….…..……..66

Figure 4.4 Control officers per county divided by county population…….…..……..67

Figure 4.5 Rabies training in the previous year by county combined with responses to questionnaire……..……..75

Figure 4.6 Perception of epizootic years by control officers……..…89

Figure 4.7 Any control officer in county has seen materials …….……91

Figure 5.1 Newspapers selected for comparison with rabies submissions…….…..109

Figure 5.2 Counties with rabies submissions that correlate with state rabies submissions 1986-2005…… …….……..…111

Figure 5.3 Binghamton Press and Sun Bulletin articles compared to rabies submissions in Broome County, New York…….112

Figure 5.4 Counties with rabies submissions that correlate to Binghamton Press Sun Bulletin articles, 1997-2005…….…….113

Figure 5.5 Elmira Star Gazette articles compared to rabies submissions in Chemung County, New York……...…….……...114

Figure 5.6 Newsday articles compared to rabies submissions in Suffolk County, New York……..……115

Figure 5.7 County with rabies submissions that correlate to Newsday articles, 1990-1996..…….……..…….116

Figure 5.8 Times Herald Record articles compared to rabies submissions in Orange County, New York……..……...……...117

Figure 5.9 Counties with rabies submissions that correlate to Times Herald Record articles,.1989-1996 and 1997-2005……..……..117

Figure 5.10 White Plains Reporter Dispatch/Journal articles compared to rabies submissions in Westchester County, New York…….……..118

Figure 5.11 Counties with rabies submissions that correlate to White Plains Reporter Dispatch/Journal articles, 1989-1996…….……...119

Figure 5.12 Albany Times Union articles compared to rabies submissions in Albany County, New York……...120

Figure 5.13 Counties with rabies submissions that correlate to Albany Times Union articles, 1989-1996…….……...121

Figure 5.14 Schenectady Gazette articles compared to rabies submissions in Schenectady County, New York……...…...121

Figure 5.15 Counties with rabies submissions that correlate to Schenectady Gazette articles, 1989-1996 and 1997-2005……..……..122

Figure 5.16 Buffalo News compared to rabies submissions in Erie County, New York……..……..123

Figure 5.17 Counties with rabies submissions that correlate to Buffalo News articles, 1989-1996 and 1997-2005…….…..124

Figure 5.18 Comparison of Rochester Democrat and Chronicle articles compared to rabies submissions in Monroe County, New York…….…….124

Figure 5.19 Counties with rabies submissions that correlate to Rochester Democrat and Chronicle articles, 1989-1996……..125

Figure 5.20 Oswego Palladium Times articles compared to rabies submissions in Oswego County, New York…….….126

Figure 5.21 Counties with rabies submissions that correlate to Oswego Palladium Times articles, 1989-1996……..……...126

Figure 5.22 Syracuse Post Standard articles compared to rabies submissions in Onondaga County, New York……..127

Figure 5.23 Counties with rabies submissions that correlate to Syracuse Post Standard articles, 1989-1996……...128

Figure 5.24 Plattsburgh Press Republican articles compared to rabies submissions in Clinton County, New York……..129

Figure 5.25 Counties with rabies submissions that correlate to Plattsburgh Press Republican articles, 1989-1996…….…...129

Figure 5.26 Watertown Daily Times articles compared to rabies submissions in Jefferson County, New York…….…...130

Figure 5.27 Counties with rabies submissions that correlate to Watertown Daily Times articles, 1989-1996 and 1997-2005……..……..131

Figure 5.28 Photograph of a rabies map in the Elmira Star Gazette from August 20, 1991……..…..133

Figure 5.29 Map from the Rochester Times Union, August 3, 1990…….…...134

Figure 5.30 Map example 1 from the Utica Observer-Dispatch from March 21, 1993……...……..134

Figure 5.31 Map example 2 from the Utica Observer-Dispatch, May 23, 1995...…..….135

Figure 5.32 Map from Rochester Democrat and Chronicle, November 22, 1991…….....135

Figure 5.33 Rabies maps per year 1990-2004……...…..…..136

ABSTRACT

Surveillance data are an important part of medical geography. These data are used to produce much of the analyses that define the subdiscipline. It is understood that surveillance data may contain biases, but there have only been limited studies devoted to determining in what ways the data are not representative of actual disease prevalence.

New York was selected for this research for several reasons. First, it has a strong rabies data set. Second, it has a centralized system of licensing animal and dog control officers. Third, it is well-represented in terms of local media.

This dissertation attempts to better understand the New York rabies epizootic, using not only rabies surveillance data, but also data collected from animal control officers and media reports, particularly newspaper articles. These data can help provide a fuller picture of the function of a rabies epizootic within a state, particularly in terms of the relationship of the disease to the society at large.

The generation of surveillance data itself is not often the subject of investigation. One part of that system that receives little attention from researchers is the part that physically collects animals-animal and dog control officers. As the lowest level in the surveillance system, control officers are often overlooked in terms of their contribution to the system.

The media presentation of the rabies epizootic is the other subject of this work. The relationship between a disease and media reports of a disease are often not clear. In New York, reporting of rabies in local newspapers often reflected the submissions of suspicious animals for rabies testing.

This research found that the levels of training found in animal and dog control officers in New York were low considering that this was a state with epizootic rabies. The attitudes of the control officers revealed that as a group they considered themselves part of the public health system, but they

were often not treated as such. The media investigation revealed that articles about rabies in small, local newspapers can reflect rabies submissions in the adjacent area. This was not true for larger newspapers.

CHAPTER 1 INTRODUCTION

This research is an examination of the spatial and temporal associations of the New York rabies epizootic during the years 1985-2005. It is also an investigation of the spatial variation of rabies surveillance itself. In other work, statistical and spatial modeling have been used as a means of describing and predicting the direction and speed of an epizootic, but the basis of these processes, surveillance data, has received little attention. Surveillance data is a human product, and as such is influenced by myriad factors outside the simple presence or absence of disease.

1.1 Justification

This research is important for a number of reasons. First and foremost, the fact that few people die from raccoon rabies is no reason to disregard the epizootic. It has the potential for loss of life, and therefore receives scarce public health resources measured in time, effort and money. It is simply more cost effective to understand the epizootic and limit its spread. It is far better to understand a disease in its earlier, more manageable stage rather than to wait until the disease has spread and is more difficult and more expensive to control. Secondly, it is possible to generalize findings on epidemic diffusion, and especially surveillance characteristics, to other disease environments and epizootic situations. More specifically, it is believed that this epizootic offers an opportunity to study a novel disease as it moves through a previously unexposed population (Childs, Curns et al. 2000). Such an opportunity is generally not available to those who exclusively study human ailments. Raccoon rabies offers a data-rich, reportable animal disease through its many phases from initial detection to various intervention schemes.

The research goal is not only the development of a working geographical understanding of the movement of the rabies epizootic across space and time, but also an attempt to better understand the production and use of surveillance data. The components of the study will include a history of the disease across the entire area, investigation of the surveillance data itself, and a detailed

examination of two informal components of surveillance, animal control officers and media input. This goal is defined by the following research questions.

1.2 Research Questions

1.2.1 Research Question 1. Rabies surveillance data, due to the nature of their production, are imperfect representations of rabies prevalence. The degree to which these data reflect the presence or absence of disease is unknown. These data can more accurately be used to determine which non-disease factors- human population, number of control officers, media input- relate to increased surveillance numbers. These non-disease factors can be used to account for much of the variation in the surveillance surface. This research question is the subject of Chapter 3.

1.2.2 Research Question 2. Animal and dog control officers in New York exert influence on the surveillance process. The contributions of control officers to the surveillance system have largely gone unnoticed in discussions of surveillance. The attitudes and levels of training of control officers can lead to a fuller understanding of the function of the surveillance system. This research question is the subject of Chapter 4.

1.2.3 Research Question 3. Rabies submissions and news media coverage are related and reinforce one another. It has been assumed that a relationship exists between local rabies submissions and local media coverage of rabies. The exact nature of this relationship is largely unknown. It is expected that local newspapers will more closely reflect rabies submissions than larger, regional newspapers. This research question is the subject of Chapter 5

1.3 Chapter Summaries

Chapter 1 introduces the subject of rabies surveillance in the context of the New York rabies epizootic. The prevailing issues surrounding rabies surveillance and research are addressed. An underlying purpose of this dissertation is a better understanding of the actual production of surveillance data. It is believed that increasing feedback to those who collect samples,

understanding the role of the media in the submission process, and accounting for the influence of the spatial structure of surveillance, will provide more context for rabies surveillance data.

1.3.1 The Surveillance System

Rabies surveillance is a formal system with formal and informal inputs. The formal system is a defined structure that ranges from the county health department to the Griffin Rabies Laboratory in Albany County. The formal input are submissions data resulting from human animal contact.

The formal structure is not free-standing; it relies on associated components to function. These associated components are the informal structure. The informal inputs are the result of flexibility in the system; judgment calls, favors, and system externalities beyond the control of official public health channels. Without municipal control officers, contract veterinarians, nuisance wildlife services, the media, and the public, the formal structure would not be able to carry out even a minimum of its duties. The public health structure has little control over these parts of the structure. The larger part of the surveillance system exists outside the formal structure.

Even within the formal structure it can be difficult to exercise control. During the early stages of the epizootic, the Dutchess County Health Department refused to allocate funds for free rabies clinics and free vaccinations for those without insurance, even though the state mandated such services be free. Dutchess County was not the only county to attempt this, but it was the only county that escalated the situation to the point that the state withheld their entire operational budget to force compliance (Poughkeepsie Journal 1993) .

Although public health systems in general are not designed for sudden, dramatic events, newspapers thrive when such novel events occur. Surveillance, the process of searching, is an integral part of the generation of news. In this respect processes of news reporting and processes of surveillance are similar. This similarity ends when the disease ceases to be novel. This is the point

where the two systems diverge. News reporting can move to other subjects, while surveillance must continue.

Although the state provides a baseline for testing with human/animal contact, these data make it clear that there are many factors that can elevate submissions and testing in an area: political power, vaccine testing, population; none of these factors are strictly based on human/animal contacts.

Chapter 2 provides a review of the literature relating to viruses in medical geography, the usage of rabies surveillance data in research, and presents a brief historical overview of the Mid-Atlantic rabies epizootic itself. It is useful to provide a brief background to this epizootic for context in reading the following sections.

1.3.2 Background to the Epizootic

The raccoon rabies epizootic of the Eastern United States is believed to have begun with the importation of rabid raccoons from Florida to the Virginia/West Virginia border in 1976 (Dobson 2000) for the purpose of hunting. The movement of the epizootic is summarized in the following map (Figure 1.1) made from data taken from the yearly rabies surveillance reports provided by the Journal of the American Veterinary Medical Association.

This transplanted rabies strain has spread mostly north and east to become a significant public health problem, although the direct health impact on humans has been relatively small. As a result of the epizootic, raccoons overtook skunks rabies as the most commonly reported rabies in the US in 1990 (Krebs, Holman et al. 1992). Even though 18,000 to 20,000 people are exposed to the virus per year (Wilson, Bretsky et al. 1997) few people now die from rabies, and fewer still die from raccoon rabies (Rotz, Hensley et al. 1998).

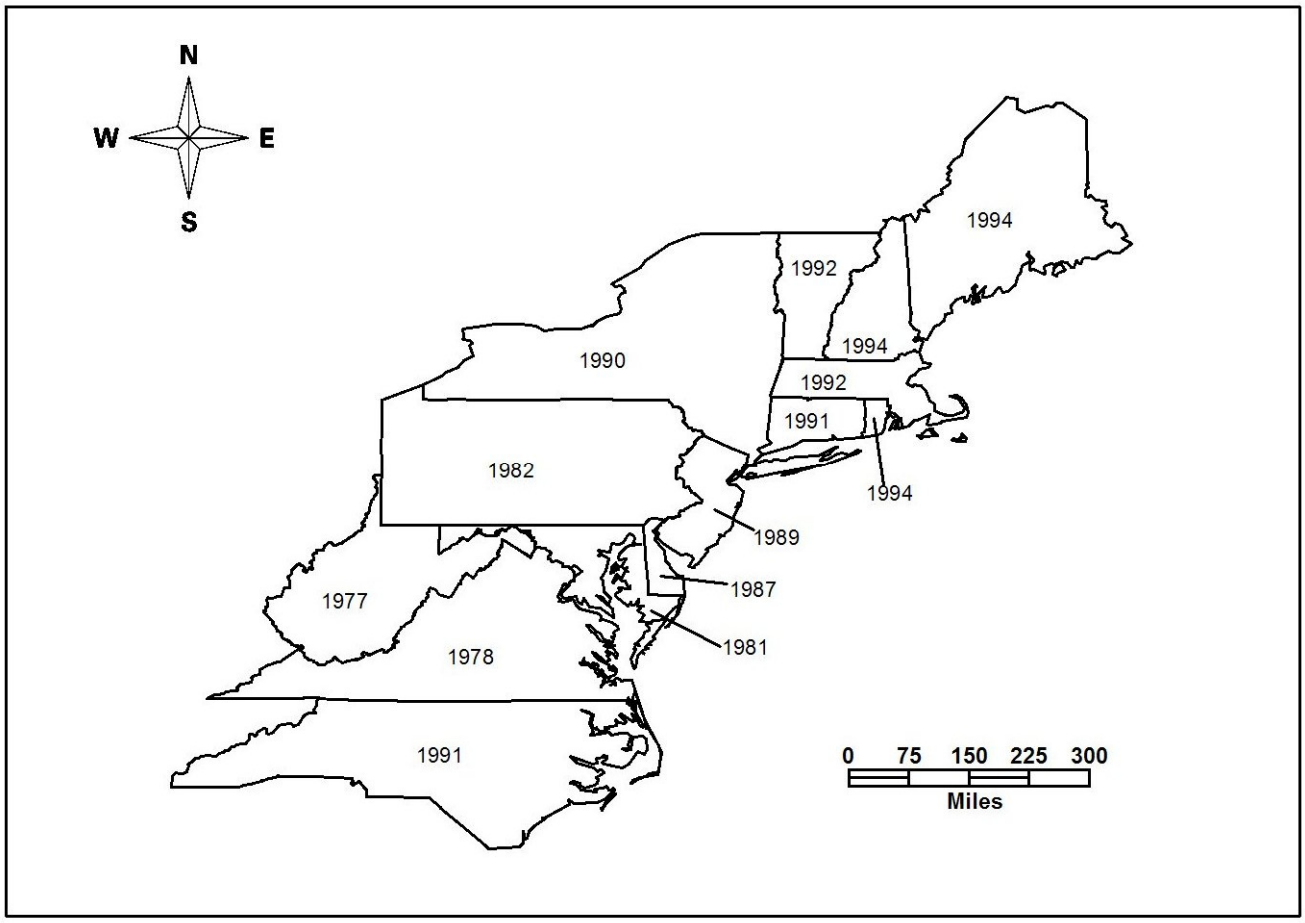


Figure 1.1 Year of first positive raccoon. Data provided by Krebs, J. W, et al. Rabies surveillance in the United States during 1991, Journal of the American Veterinary Medical Association. pp 2031-2044 and Krebs, J. W, et al. Rabies surveillance in the United States during 1995, Journal of the American Veterinary Medical Association. pp 1562-1575.

The low human death rate is not due to any inherent immunity to the disease; once it manifests, it is almost invariably fatal (Jackson 2002). Part of the reduced threat is due to the influence of Post-Exposure Prophylaxis (PEP) vaccine, first developed by Pasteur in 1885. The rabies vaccine has dramatically improved the chances of survival for humans and other mammals (Rotz, Hensley et al. 1998). The other factor that mitigates human rabies is the vaccination of those domestic animals that are the greatest rabies risk to people: cats and dogs. The epizootic has impacted society, however, both in terms of economics as well as the effects on wildlife and public health authorities. Human vaccinations are expensive (around $15,000,000 per year) (Wilson,

Bretsky et al. 1997) as is the maintenance of the surveillance used to monitor the epizootic. A further expense is associated with interventions, which are generally programs that revolve around the concept of vaccinating wild animals (usually with an oral vaccine) and domestic animals in order to reduce potential human exposure (Fearneyhough 2001). Approximately $300,000,000 is spent per year in the United States on such interventions (Uhaa, Mandel et al. 1992). One of the problems with the American system of veterinary public health is that most spending is at the state level where budgets are perennially tight (Uhaa, Mandel et al. 1992). For some poorer counties or states it may be that oral vaccination programs are simply too expensive given the available resources (New York Times 1995).

The purpose of rabies control measures is the reduction of risk of exposure to rabies. As previously stated, the biggest impact that rabies can have in terms of health care is the stress it puts on health care budgets, although it should also be remembered that rabid raccoons can infect dogs and cats and put people at risk For decades rabies control strategies focusing on dogs and cats have been successful. The vast majority of human mortalities associated with rabies acquired in the US continues to be as a result of bites from bats and not from dogs, skunks, or raccoons (Krebs, Mandel et al. 2004).

1.3.3 The Epizootic Wave

Epizootic raccoon rabies in the US provides an example of the introduction of a new virus into a previously uninfected population. That is, a population with no previous exposure to this new pathogen. All epidemic diseases require a population of susceptibles, individuals who are able to contract the disease (Rupprecht, Hanlon et al. 2004). One aspect of disease susceptibility is individual genetic immunity. This is the immunity that either prevents infection with rabies in the first place, or produces an outcome other than death for the animal (Rupprecht, Hanlon et al. 2004). It has been argued that those raccoons that seem to have natural immunity to the disease are actually

infected, but were culled for surveillance before the disease could take its course. This wide range leads to considerable difference in estimates of rabies transmissibility within the raccoon population (Torrence, Beck et al. 1995).

Further complexity occurs when a population reaches herd immunity (Jacon 2000). Susceptible populations must reach a certain critical threshold before the disease can maintain itself. Diseases can reach such populations either through new births among a previously exposed population or by accessing an immunologically naïve population. This occurs either through the disease being introduced to the population, or the population being introduced into a diseased area. If the population has enough immune individuals, then the disease cannot maintain a chain of infection and retreats. Those that have immunity to the disease actually serve as protection for those who have no immunity to rabies, so long as their numbers remain sufficient to prevent transmission. This is herd immunity. Vaccination works by this same mechanism through inflating the number of immune individuals to the point that the disease cannot maintain itself (Jacon 2000).

When an epidemic disease reaches an epidemiologically naïve population it infects all that are susceptible, or at least all the susceptibles that it reaches. Over time, this process culls those out of the population that are most susceptible to the disease, leaving behind the more resistant to reproduce. This partially explains why the disease was so severe once it was removed from Florida, since the animals that were initially exposed in West Virginia were not the descendants of survivors of the disease.

In areas with established raccoon rabies (endemic areas), the disease can be compared with human "childhood diseases" that require enough births to allow the virus to sustain itself. There has been considerable work in this field in geography by Cliff and Haggett concerning measles epidemics (Cliff and Haggett 1992; Cliff, Haggett et al. 1993). However, the situation following the introduction of raccoons into the mid-Atlantic region is more comparable to smallpox in the New

World, which impacted a population with little to no immunity to the disease (McNeill 1976). Both rabies and smallpox severely reduced the population as it spread in waves. After a wave of infection has moved through an area, the population is generally reduced to a level not allowing the infection to sustain itself. This is the case in areas with low raccoon densities once the disease has entered and culled the existing population (Real, Russell et al. 2005). What allows the disease to return is a corresponding rise in a vulnerable population. In a parallel to human childhood diseases that depend on new births to continue the chain of infection, rabies needs raccoon births in order to rebuild a population reduced by a disease. That is not the only process at work as there is a geography to the infection and re-infection potential. It is possible that a simple reduction in numbers thins the population to a point that the disease is unable to reproduce because the animals are too spatially dispersed.

The epizootic wave as experienced in the raccoon rabies epizootic is an example of diffusion across space. The type of diffusion most associated with disease is contagious diffusion, a form of diffusion requiring contact between individuals resulting in infection. Some disease movement is also explained by relocation diffusion. For example, in the raccoon rabies epizootic, the origins of the eastern seaboard infection came from animals being transported for hunting. Other examples of this type include animals accidentally being carried in garbage trucks. Diffusion as it relates to disease is more fully discussed in Chapter 2.

Chapter 3 describes the New York rabies surveillance data that form the basis of this research. These data are presented as a series of maps and graphs. The information in this chapter will be compared against the data collected both for Chapters 4 and 5.

1.3.4 Understanding the Epizootic: Using Surveillance Data

Surveillance is generally divided into two types - active and passive. Active surveillance typically involves health care workers seeking their samples, that is to say, they are canvassing an

area in order to collect samples. Passive surveillance requires that specimens (animals in this case) be sent in for testing as they are collected for other purposes. Samples are collected within the normal public health channels (Gerstman 1998). The main problem of passive surveillance is that cases are not random samples; they are biased by the reporting system. Rabies in the United States is a reportable disease, so named because all positive rabies results must be reported to the federal government. Such data are vitally important to those who use health data for research. Innumerable studies have taken advantage of surveillance results in order to produce disease maps, epidemiological studies, and other health related data products (Fischman, Grigor et al. 1993). One of the problems of using any data collected by others is that the purpose of collection may not correspond with the objectives of the research. However, these data fuel much of the research in public health, epidemiology and medical geography. Rabies surveillance in the United States has been conducted in order to assess general levels of the disease. Rabies surveillance is not being conducted specifically for the modeling of raccoon rabies.

Is a change in surveillance reporting actually due to a change in the incidence of disease? This question is central to the concept of surveillance. If the sudden change in reporting is due to a change in law, disease definition, or lab personnel, multi-year comparisons are compromised unless proper measures have been taken to account for this change. Even if temporal consistency occurs, numbers generated by active or passive surveillance cannot represent every instance of the disease within a given area (Krebs, Smith et al. 1998). The expectation is that these data are sufficiently representative (in effect a sample) of the disease occurrence so that meaningful inference can be drawn.

1.3.5 Surveillance in New York State

In terms of New York State, there are large geographic areas that have lower reported rabies than their neighbors. The most obvious data hole consists of the entire Adirondack Mountains

region (Figure 1.2), which corresponds with the low human population in that area. Other areas of low surveillance are scattered across the state. Although human risk of rabies is assumed to be highest in rural areas (due to increased interactions with animals), rabies surveillance is largely an urban activity (Haupt 1999).

One failing of surveillance is that not all suspicious animals that are collected by the responsible parties are submitted for testing. Results from this dissertation will show that for some areas relatively few animals were submitted for testing, even during the height of the epidemic. Other places have consistently submitted large numbers of animals for testing- before, during and after the epizootic passed through their county. The causes of these differences are not immediately apparent from the surveillance data.

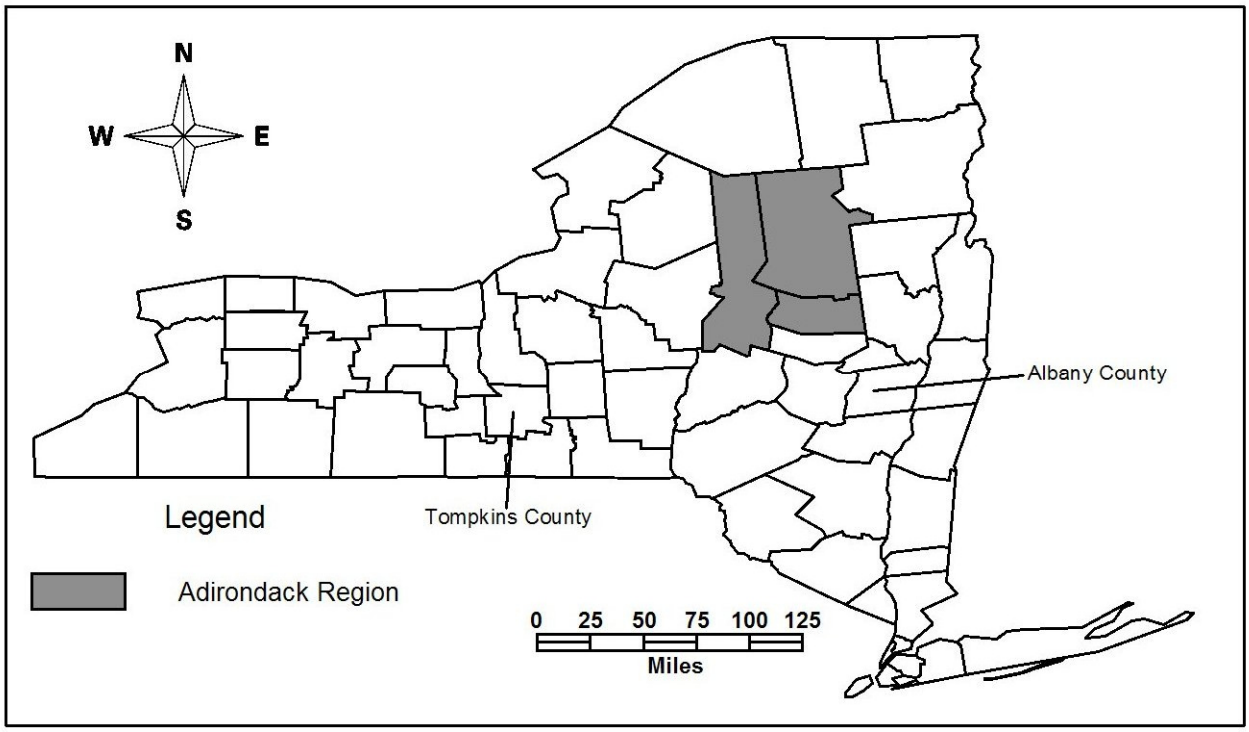


Figure 1.2 Areas of surveillance interest

Multiple factors can influence which animals are submitted for testing. Many of these animals have had some kind of interaction with human beings, meaning the most likely to be tested are either domestic or feral animals: generally dogs, cats, and livestock. During the raccoon rabies epizootic, however, these were not the animals most likely to be rabid; they were just the most accessible.

Even given the aforementioned problems, surveillance numbers can be extremely large. In Albany County, which is the location of the New York State rabies testing facility, the largest numbers of animals were submitted. These submissions were especially pronounced starting in 1992, when its southern neighbors began submitting positive raccoons, and continued even when the epizootic wave had passed through the counties to the north of Albany and the local raccoon population had been depleted by rabies and rabies surveillance.

These data at their simplest consist of positives and negatives in a county. The high percentage of positive animals experienced by Albany County can be contrasted with what occurred in Onondaga County (the county that contains Syracuse). In the latter, so many animals were submitted for testing that the pool of positive animals was essentially diluted to the point that Onondaga County had one of the lowest rates of positive submissions in the entire state. The difference between the counties was that in Onondaga the animals being submitted were cats, presumably because they were more accessible than raccoons. Sampling the wrong population can be misleading, and the results of such sampling produces can be difficult to interpret.

It is important to remember that even though rabies is a reportable disease, there is still some authority who must decide whether to submit an animal for testing or not. The circumstances of the human/animal interaction will play a role in this, but in the end, submission is still a judgment call.

Chapter 4 investigates the role of animal and dog control officers in rabies surveillance in New York. Questions range from the most basic “are you a member of the public health

structure?"or "what is your job title?" to more general questions regarding function of the surveillance system itself.

1.3.6 Control Officers and the Process of Surveillance

Passive surveillance is a product of local public health representatives collecting data, whatever their job may be. In terms of rabies, it is possible that local animal control agents (including the police and sheriff's deputies), in the absence of exposed humans, will simply kill an animal without submitting it for testing. If submission requires extra work for the agent, or if the risk of disease is believed to be small, there is little motivation to submit an animal. This would seem particularly true in places where those interacting with possibly rabid animals have little training in public health, no knowledge of the purpose of surveillance, and little feedback regarding results.

Often very little attention is paid to those who physically collect an animal, even though they are the people who often serve as the interface between the surveillance system and the general public. Their level of training, attitudes, and integration into the surveillance system are not generally the subject of scrutiny. One of the goals of this study is a better understanding of this particular link in the surveillance chain. This has been accomplished through the use of a questionnaire (Appendix A) sent to every person licensed as an animal or dog control officer in the state of New York. The responses provide insight into part of the surveillance structure that attracts little attention. This is also the first academic investigation involving the opinion of control officers in New York concerning the raccoon rabies epizootic.

Chapter 5 investigates the concept that local newspapers have a relationship to rabies submissions, without attempting to determine whether one influences the other, or to what degree this influence may be. News reporting is the means through which the public is apprised of rabies.

1.3.7 The Role Media Plays in Surveillance

Animals are submitted for testing when the public perceives a risk from animals in the environment. The public attitude is at least in part formed by the media. Just as presenting animals as anthropomorphic cartoons can make it difficult to report them to the authorities, presenting them as dangerous carriers of a deadly disease can have an equally powerful effect. Media sources have been accused of sensationalizing some disease risk while virtually ignoring others. Media reports are the source of a majority of the public's health awareness, particularly in comparison to the information that the public receives directly from health authorities. It is understandable that perceptions of disease risk can change rapidly and be out of proportion to actual risk of disease.

The exact influence of the media can be difficult to determine but understanding its influence is not outside the realm of possibility (Curtis, Heath et al. 2005). Media reports regarding rabies in these areas within the time frame (1990-2005) will be examined as the media can influence the submission of animals. This is particularly true regarding the reporting of a rabies death which occurred in New York during the study period (Kelly Ahrendt, July 1993). The primary method of educating people about rabies danger has been through normal media channels. It is hypothesized that places with relatively few rabies submissions (in comparison to their human population) have less media coverage of the rabies epizootic. Conversely, those places with significantly higher rabies submissions also have greater amounts of media coverage of the epizootic (Tuttle 1999).

Unfortunately few media sources from the earliest part of the epizootic are available due to a lack of archived resources. The only form of media that can be consistently collected are newspapers; therefore all research in this area was limited to archival searches of newspapers. Particular attention was devoted to information that portrays local animal populations as possible threats to health, which has been shown to reduce opposition to animal submissions (MMWR 1998).

The method for selecting newspapers was based on availability. Not all counties have newspapers, particularly in more remote areas. Newspapers have been experiencing a period of consolidation for some time. Those newspapers that did not survive through the period of study were excluded, as were those that were poorly archived or whose archives were significantly damaged, or simply lost. The latter category was more common than expected, possibly due to the large degree of acquisition and merger that newspapers have endured. Those newspapers that were utilized tended to be from larger markets.

1.4 In summary

This introduction has presented an overview of this dissertation. Background information regarding disease surveillance in general and rabies surveillance in particular has been presented. A brief history and geography of the New York rabies epizootic has been introduced. The contributions of animal and dog control officers and news reporting to the surveillance system has also been introduced.

CHAPTER 2 LITERATURE REVIEW AND HISTORY

2.1 Rabies as a Virus

Rabies is caused by a virus, a lyssavirus in the family Rhabdoviridae, in the order Mononegavirales (Finnegan, Brookes et al. 2002) . A virus is a small package of genetic material that can only reproduce inside cells. It gets all of its mobility from its victims. Rabies can infect any mammal, and affects the brain and central nervous system, typically resulting in death. Rabies is transmitted through bodily fluids of infected animals. Generally this fluid is saliva and transmission occurs through bites, although other means of transmission are possible since any bodily fluid may contain the virus and any open wound could allow entry. Nosocomial infections have also occurred after infected organs were used for transplantation (Anderson, Williams et al. 1984).

Rabies manifests itself in one of two ways; dumb rabies and furious rabies. Dumb rabies is the lesser recognized form that involves paralysis of the animal. Furious rabies is the form in which the animal becomes aggressive. Raccoon rabies is a strain of rabies that is particularly adapted to transmission within this population of animals, although it can also "spillover" into other species, such as dogs. Other strains of rabies have been associated with bats and skunks. Just as genetic differences have come to define different species, genetic differences define different viral strains (Real, Russell et al. 2005). Rabies strains do not behave in the same way across species, but they can and do infect other animals.

Medical geographers are interested in the distribution and movement of diseases, but viruses cannot move themselves. The connection is provided by the rest of the disease ecology, the hosts, transportation networks, climate, and other factors which comprise the disease system. The distribution of the virus or other disease agent may be unknown, but locations of sick animals can be determined or estimated. However, the true geographic distribution of the virus may not be the

same as the pattern that emerges from the surveillance data, though it does provide a logical starting point.

2.2 Disease Ecology

A central characteristic of medical geography is the concept of disease ecology. Disease ecology is the idea that disease is the result of the relationship between the components of ecology; water, soil, living organisms, and climate (May 1958; Mayer 2000; Gatrell 2002). The idea that changes in landscape (ecology) have an impact on disease outcomes is inherently geographical. However, some assumptions of disease ecology are harder to justify in some diseases, particularly diseases of wildlife. The idea that disease is a manifestation of ecological disequilibrium can be difficult to maintain when the only change in an ecology may be the addition of a previously unknown pathogen (McNeill 1976). In the case of the mid-Atlantic rabies epizootic, the primary human activity associated with the epizootic was its initiation in 1976 (Rupprecht 1995). Human activities may have had an impact on the size of particular rabies populations, but the movement of the epizootic across large areas with little human impact on the environment (for example, the Adirondacks) demonstrates that once the epizootic began, it needed no further human input to propagate.

2.3 Geography and Disease

Geography of disease is not synonymous with disease modeling. It is possible to map a disease without the use of any model. Early disease maps were illustrations of disease distribution. Maps such as these date back to the mid-nineteenth century (Foody 2006) or possibly even later. The creation of such maps was a product of the collection of disease data (Cliff, Haggett et al. 1998). Disease data may contain biases. Some forms of medical geography have been more wary of the quality of data than others. In their book on global epidemics, Cliff and Haggett (Cliff, Haggett et al. 1998) place data quality in a central role and provide associated guidelines. The

central question regards the motivation for collecting the data. Data collected incidentally during the treatment of a disease are likely to be different from data collected for the sole purpose of measuring the prevalence of a disease in the environment.

2.3.1 Viruses in Geography

The spatial pattern of viruses has generated several publications in the subdiscipline of medical geography. The spatiality of viral epidemics and epizootics are suitable for spatial modeling. A large part of geographical modeling is based on the concept of diffusion. Diffusion is a process recognized in the physical sciences, adapted to cultural geography, and eventually modeled mathematically in the nineteen-fifties by Torsten Hagerstrand (Haggett 2001). A diffusion wave is analogous to an epizootic wave in epidemiology.

Hagerstrand's model was not initially developed for disease diffusion, but it related well to the study of disease as a mobile, non-static entity. The disease-adapted model has six components. The first component is area,which in a modern context would relate to the environment of the disease. The second factor is time; the third factor is the disease agent itself. In this case that would be the rabies virus. The other three pieces of the model are origin (the initial focus of the infection), destination (where the disease was expected to go), and path (the particular way the disease was going to reach its destination). An aspect of this model was that it could account for barriers to diffusion. The function of barriers in the model would become prominent as researchers tested whether or not rivers, lakes and mountains were barriers to rabies (Perry 1987; Wilson, Bretsky et al. 1997).

Geographical diffusion can be divided into three types; contagious, relocation and hierarchical. In all three forms the primary activity is some form of interaction. The difference between them is the spatial expression of the interactions. Contagious diffusion occurs within an immediate environment. Relocation diffusion requires the removal of an infected individual to

another area. Hierarchical diffusion involves a pattern of movement within a (human) hierarchy of places, for example, from larger cities to progressively smaller cities and towns. Although human diseases such as HIV/AIDS can diffuse in any of these three modes, animal disease generally does not. Diseases in animals, particularly wildlife, are most likely to diffuse contagiously, though there are exceptions. For example, when animals are relocated (known as translocation) by humans, either purposefully or accidentally, relocation diffusion is a possibility (Moore 1999).

An early advocate of diffusion modeling in medical geography was Peter Haggett. A perspective introduced by Haggett was the idea that exposure to a virus was an interaction, and that these interactions (infections) create the wave-like form that epidemics exhibit. He held that diseases can diffuse in a manner similar to the diffusion of ideas, an idea borrowed from Hagerstrand. These quantified diffusion models began the process of spatial disease modeling. A book by Cliff, Haggett, and Smallman-Raynor, Deciphering global epidemics: analytical approaches to the disease records of world cities, 1888-1912, provides a summation of this geographical perspective of disease.

The following sections provide summaries of important works of the spatial modeling of disease, and where possible draw connections to the raccoon rabies epizootic.

Arguably the classic work of geographic disease modeling concentrates on measles. In their book Cliff and Haggett (Cliff, Haggett et al. 1993) present a logical series of justifications for the selection of a disease for study and the means to analyze it. Measles was selected because it had characteristics that lent it to geographical analysis. First, within the time frame of their analysis (1840-1990) measles was a disease with defined symptoms resulting in confidence in the diagnosis. In symptomatic individuals, the disease presents itself relatively unambiguously. Second, in some places relatively complete records of infection were kept that contained spatial and temporal fields (places and dates). Third, because infection confers lifelong immunity, epidemic measles diffuses

or travels in waves. It cannot double back and reinfect those who have already been exposed to the disease. Many epizootic and epidemic viruses spread across space in this wave-like pattern. This pattern lends itself to mapping, time series analysis, and other forms of modeling.

Poliomyelitis is a human infectious disease caused by the poliovirus. It became a particular threat to humans in the early twentieth century, asserting itself as a childhood disease causing paralysis and death. In much the same respect as measles, polio was a disease with pronounced clinical expression. Diagnosis of clinical cases, even early in the epidemic, was relatively simple. Subclinical cases, however, make up the great majority of polio infections, meaning that infection rates would be significantly under-reported (Trevelyan, Smallman-Raynor et al. 2005). This disease followed a particular infection pattern in which sporadic cases led to small outbreaks, which in turn produced large-scale epidemics. This pattern is interesting in that it is similar to the function of epizootic rabies after it has become part of the local disease ecology. This pattern is a function of a small but growing population of susceptible organisms within a much larger population of resistant organisms. In the case of poliomyelitis, the susceptible population was mostly children. In the case of rabies, susceptible animals consist of raccoons born after the most recent epizootic.

Pyle used diffusion modeling to attempt to determine the initial focus and path of a number of influenza pandemics from 1918 until 1981. The primary finding of this research was that there was not a unified pattern to the influenza outbreaks. Their speed, direction, and method of diffusion was dependent on the transportation technology at the time (Pyle 1986). Shannon and Pyle would later turn their attention to HIV/AIDS (Shannon and Pyle 1989). In a book discussing HIV/AIDS Shannon and Pyle provide a spatial description of a major and relatively recent viral threat to human health (Shannon, Pyle et al. 1991). HIV/AIDS eventually became a well-defined disease, with good record keeping. The difference between the viruses was in the manner of diffusion, which in the case of HIV/AIDS appeared hierarchical in nature, owing to its early relationship with international

travel. In this study, the analysis of the disease also included cultural elements that may have induced or inhibited the spread of the virus.

Looking back at this work is instructive considering that at the time it was written HIV/AIDS functioned differently in the United States than it does now. It tended to progress more rapidly to death and had a higher rate of new infections. The ability to provide scientific, geographical summaries of a disease allowed Shannon and Pyle to present a clear picture of a disease, even when much of the disease was still unknown.

The diffusion of HIV/AIDS in the United States was the subject of a series of studies by Lam and Liu (Lam and Liu 1994; Lam, Fan et al. 1996; Lam and Liu 1996). This research showed that the forms of diffusion found during 1982 to 1990 varied across space and time. At different places and times, the disease presented hierarchical, relocational, and contagious diffusion patterns. This was due to the particular movements and interaction patterns of people infected with the disease. These studies underscore the variability associated with viral diffusion patterns. The virus may remain unchanged, but the actions of the host organism can produce different patterns of infection. One of these articles also used spatial methods (Space-filling curves) for the production of clusters for rural AIDS research (Lam and Liu 1996).

Dengue Fever is a viral disease that infects tens of millions of people per year. A form of Dengue Fever is Dengue Hemorrhagic Fever, in which the fever is complicated by encephalopathy and other factors. Although Dengue Fever has an arthropod vector (mosquitoes), it can manifest spatially in classic diffusions pattern when introduced into a place. Relocational and contagious diffusion patterns were evident during an outbreak of the disease in Thailand (Cummings, Irizarry et al. 2004). The infected individuals transported the disease in their bodies in the same manner as raccoons transport rabies, the only difference being in distance traveled and means of transport. The interaction of infected individuals with vector mosquito populations added an extra degree of

complexity to the model, since mosquito populations are not distributed equally and different mosquito species may or may not transmit the disease.

West Nile Virus (WNV) is another disease that has attracted the interest of geographers. Like Dengue Fever it has a mosquito vector, and like rabies it affects wildlife, predominantly birds. It is different, however, in the fact that WNV has produced large numbers of human infections. WNV provides a complication to modeling due to its association with migratory birds and mosquitoes. As birds can rapidly transport the virus long distances, efforts to utilize geographic techniques center around understanding the habitat of the mosquito vector with which the disease is associated (Tachiiri, Klinkenberg et al. 2006).

Foot and Mouth Disease (FMD) is a highly infectious virus that affects domestic animals. It can result in large economic losses. It is similar to epizootic rabies in that it has little impact on human health, but it is different in the respect that its economic impact is far more severe than a disease in wildlife. An outbreak in the United Kingdom in 2001 initiated a surveillance and response program that demonstrated the possibilities of modern surveillance and geographic techniques (Ilbery 2002) (Keeling, Woolhouse et al. 2001). However, the primary motivating factor behind such an organized response- dramatic financial losses- is absent in the raccoon rabies epizootic. Nevertheless, the FMD outbreak provides an example of the upper limit of animal disease surveillance.

Human diseases remain the primary focus of medical geography. This is not surprising given the nature of geography as a discipline. An interest in humanity defines the work of many geographers. However, considering the similarities between diseases of people and diseases of animals, the geographic perspective has lent itself to the study of epizootics. This is not to imply that human diseases are exactly the same as animal diseases, nor does it mean that all diseases function in the same way within a host, or that one model applies to all diseases. For example,

viruses that kill their hosts will have a different impact on their ecology than those that do not. This difference requires that models be adapted for each different virus.

Medical geographers also have a long-standing tradition of working with surveillance data. One area that has merited some geographic attention has been the identification of "holes" in surveillance data. It has long been recognized that data collection is not uniformly consistent across space. One possible manifestation of a lapse in data collection is a data hole. A data hole is simply where disease reporting within an area is significantly less than those in the areas surrounding it. These holes are not necessarily due to poor surveillance techniques, nor are they always caused by an actual lower incidence of disease (Curtis 1999) These holes can be interpolated using a variety of techniques, most of which involve some form of mean of that particular area's neighbors (Curtis 2001; Curtis, Heath et al. 2005).

2.4 Modeling Populations Associated with Rabies

Some research (Rupprecht, Smith et al. 1995; Childs, Curns et al. 2001; Russell, Smith et al. 2005) has attempted to estimate raccoon populations both before and after an epizootic wave has passed. The difficulty in this operation is that few large scale surveys of raccoon populations have been attempted, meaning that estimates must necessarily be vague. Deal used dynamic modeling to simulate the population dynamics of fox rabies in Illinois. Instead of using surveillance data and modeling fox interactions with humans, this study used characteristics of foxes, including breeding rates, expected mortality from rabies, and pre-epizootic population estimates to predict the likely size of fox populations at given times during an epizootic. This method is important because it provides an estimate for animal populations. Most surveillance does not provide such a number (Deal, Farello et al. 2000).

Coyne, Smith, and McAllister used a non-dynamic population model in Pennsylvania to model raccoon population in order to produce a cost benefit analysis for culling or vaccinating

animals. Whether or not to cull animals through hunting and trapping is often a contentious issue, but the model suggests that either can be an effective strategy (Coyne, Smith et al. 1989). In this instance surveillance data were combined with local raccoon population numbers to extrapolate the total raccoon population.

2.5 Rabies in Geography

From a general perspective, it is possible to conduct rabies research using the guidelines provided by Cliff and Haggett for measles. First, rabies is a well-defined disease, and laboratory testing of the disease is precise (Rudd, Smith et al. 2005). Second, spatial data are available. Finally, although there are no islands which can limit the routes of introduction of a disease, the richness of data sets and the speed of travel of epizootic rabies in North America has allowed states to prepare for its introduction. In the case of New York, the state had several years to prepare for its arrival. This made possible the collection of surveillance data that clearly showed the speed and directionality of the epizootic.

As previously mentioned, geographers have contributed to the spatial investigation of different viruses, including rabies. Tinline and MacIness (2004) use passive raccoon rabies surveillance data to produce rabies risk maps and time-series analyses in southern Ontario, Canada (Tinline and Maciness 2004). These analyses are similar to those used by Cliff and Haggett, displaying a continuity of analysis regarding viruses. It is worth noting that rabies risk maps are particularly well-suited to surveillance data, due to the fact that these data are collected from human-animal contacts. It is important to address the influence of Canada on Rabies Surveillance in New York. According to the article, Ontario had been experiencing a fox rabies epizootic since the 1950s. Just as the fox rabies epizootic was being controlled by oral vaccination in the early nineteen-nineties, raccoon rabies entered New York. Alarmed by the idea of having to eventually combat two different epizootics, Canada provided assistance to New York in the hope of preventing

the raccoon rabies epizootic from entering Canada (Charatan 1995). Raccoon rabies eventually entered Canada in 1999 (Krebs, Rupprecht et al. 2000).

Curtis also used rabies as a means of demonstrating spatial and statistical techniques on viral surveillance data (Curtis 1999; Curtis 2001; Curtis, Heath et al. 2005). Studies such as this one are important in that they present a means of identifying inconsistencies in surveillance data as well as providing techniques for modifying data so that they are more representative of the disease under investigation.

2.5 Spatial Epidemiology of Rabies

Geographers are not the only researchers who have interest in the spatial aspect of a viral disease. Medical professionals have found the distribution and diffusion of rabies to be a fruitful subject of research. Veterinarians in particular have shown interest in the spatial characteristics of rabies. This is likely due the fact that rabies in humans and domestic animals in the United States has become a somewhat rare event, leaving only the study of wildlife.

Rabies in wildlife has an advantage over other diseases in that, until aerial vaccination programs began, it was an unmanaged virus in largely unmanaged wildlife populations. This provided unique opportunities for epidemiological study. The movement of the virus through wildlife populations within individual states was addressed by Wilson and Bretzky in Connecticut (Wilson, Bretsky et al. 1997; Smith, Lucey et al. 2002), Torrence in Virginia (Torrence 1992), Fischman in Maryland (Fischman 1992) and Moore in Pennsylvania (Moore 1999), among others. Northeastern states in the United States have been particularly fertile ground for this research, due to the presence of the rabies epizootic and its regular movement across space.

Wilson used county-level data to investigate the relationship between landscape, specifically rivers, and the speed and direction of the epizootic. The characteristics of the data used are similar to those collected in New York, although numbers are smaller as Connecticut is a much smaller

state than New York. Rivers were found to be effective in slowing the progression of the epizootic, a finding that was replicated by the work of Dobson (Dobson 2000).

Similarly Smith, et al. used Connecticut for the production of a model that accounted for the function of large rivers as barriers, but also included the effect of translocation of raccoons in the model (Smith, Lucey et al. 2002). The addition of translocation is important due to the fact that human relocation of raccoons is implicated in the rapid expansion of the epizootic across space, particularly when spikes of the epizootic move well ahead of the rest of the wave.

In Pennsylvania, Moore used methods acquired from geographers (Bailey and Gatrell 1995) as well as personal assistance from Peter Gould to produce a trend surface analysis of rabies spread across the state (Moore 1999). The direction of the epizootic brought the epizootic through the valleys of Pennsylvania, following paths dictated by the topography of the landscape. Extreme topography, such as mountain chains, limits the ability of raccoons to move and spread the virus. They may also limit the ease of human translocation.

Virginia has had epizootic rabies since the beginning of the mid-Atlantic epizootic. In a trend different from other states, rabies in Virginia moved generally to the east and south (Torrence, Jenkins et al. 1992). This was due to its position on the southern end of the epizootic. The Torrence article makes the case for the use of percentage positive as a measurement of the epizootic for a particular place rather than the use of total positive raccoons. Percentage positive provides a more consistent number across time and space, since during epizootics rates of sampling at different places and times are often divergent. Percentage positive should be less sensitive to over- and under-sampling of raccoons across space (though in Chapter Three a further problem, that of bias towards "positives" only is discussed). The article also makes a case for an expanded nationally-based surveillance program. This article included a discussion of the still-disputed degree of possible immunity to rabies, either due to a preexisting genetic immunity or antibodies from an

exposure to rabies. These estimates range from none (no immunity is possible) to 20% (Torrence, Jenkins et al. 1992).

An expanded Virginia surveillance data set was used in other research to determine which raccoon encounters were most likely to carry rabies risk. The most significant addition to the surveillance form that is submitted with samples for testing was the addition of a time stamp for each collection. Animals that were collected during the day or near dusk were much more likely to be rabid (Jenkins, Perry et al. 1988).

In New York, Chang, et al., used maps showing first positive raccoon to demonstrate the spatial-temporal movement of the epizootic (Chang, Eidson et al. 2002). Rabies submissions were compared by county to human postexposure treatments (PET) in order to better demonstrate the relationship rabies in the environment and human risk. This research is also notable in that it used the percent of positive raccoons as an estimate of disease prevalence.

These studies have all been conducted at the micro scale due to the (lack of) precison in surveillance data. Other studies have collected more macro-level geographic data. For example, in Maryland, the specific locational risks of rabies were calculated. It was discovered that the place most associated with exposure to raccoon rabies was in private homeowners' yards (Fischman, Grigor et al. 1993). The data used in this study went well beyond what is available in most surveillance data sets. Each record contained fields for characteristics such as time of day and location of sample, estimated age of animal sampled, and number of humans exposed. Such data would be very useful in other studies of rabies but are rarely available.

The connection to all of the proceeding rabies studies was the employment of some form of spatial analysis due to the fact that when dealing with wildlife disease, geographic techniques can be used to fill the considerable gaps in knowledge regarding prevalence, incidence, population, or many other variables important to the understanding of the disease.

2.6 Rabies Spillover

Rabies spillover is the transfer of the rabies epizootic from one species to another. For example, from the raccoon population to the skunk population. Spillover was directly addressed by Guerra (Guerra, Curns et al. 2003). This research involved comparing outbreaks of raccoon rabies in northeastern United States counties with outbreaks of rabies in the skunk population. Data utilized were county-level surveillance data. Both geographical and temporal analyses show a direct connection between outbreaks. This connection is defined as spillover. One possible issue in this study is the fact that data collected across seven states involving two very different animals were treated equally.

Another attempt to measure spillover, this time in woodchuck populations, took place using data from most of the northeastern United States (Childs, Colby et al. 1997). The study showed that epizootics in raccoons and skunks were often responsible for corresponding increases in rabies cases in rodents such as woodchucks. These data were similar to those from other studies; county level rabies submissions to state rabies testing laboratories. These data were used solely for determining the presence of rabies. It was not used to calculate any other number, such as percent positive, and absence of surveillance data was not used as proof of absence of rabies.

2.7 Local Studies

The most common level of geographic analysis is the state, followed by the city, although even smaller, more rigidly controlled studies have been conducted (Riley, Hadidian et al. 1998). The preponderance of studies at coarse geographic scales are probably due to the fact that the most easily utilized data are usually those generated by state agencies, or by people working with state governments. One issue not frequently addressed is whether there is geographic (or rather state) variation in these data, with differences in the collection system raising the question of whether

data may not be directly comparable between states. As is the case in New York, even data within one state may not be directly comparable.

When the geographic extent of the research space is limited, active surveillance, or at the very least, a more tightly controlled passive surveillance, can be used. Using one rural county in Virginia allowed Hubbard to more accurately determine the locations of rabid raccoons within their particular landscapes. This study included animals which had human contact, but added to these animals which had been killed on the roads and trapped locally (Hubbard 1985).

In another example, local land use associations were compared with raccoon populations in an effort to determine if they have an influence on raccoon morbidity/mortality in Baltimore (Anthony and Childs 1990). Wildlife agents used a method that is much closer to active surveillance for this study. Animals were trapped, hunted, and tested for rabies. Animals killed on roads and found dead were also tested for rabies. This is possible in a relatively compact urban area. Maps of land cover and usage were produced and compared to maps made from locally generated rabies surveillance data. Pre-epizootic animal populations were estimated and used to calculate associations with landscape structures. A percentage of positive raccoons was estimated for each type of land use. Certain structures were associated with higher percentages of rabid raccoons. Most notably, private, single family structures were associated with rabid raccoon attacks. This article and the previously mentioned Fischman article are among the few that directly associate human risk of attack from rabid raccoons with a particular type of human dwelling.

A national park in Washington D.C. was the site of work by Riley, Hadidian, and Manski (Riley, Hadidian et al. 1998) which varied from the other studies discussed in that raccoon rabies was not directly measured. Raccoon densities were calculated prior to the epizootic reaching the Washington D.C area and animals were radio collared for tracking. This allowed the raccoon population to be monitored for eight years throughout the epizootic as the disease entered the area,

and later when it resurged in the park. The most striking finding of this article was that raccoon survival of the epizootic was high for all groups except young raccoons. This seems to run counter to most research that contends that the rate of survival of rabies is low (Torrence, Jenkins et al. 1992). It is possible that environmental factors such as a high degree of fragmentation in the environment could be responsible for raccoon survival, and not any immunity on the part of raccoons. In such a situation, raccoons are not infected because they do not contact other raccoons.

2.8 Recurring Publications

Rabies is considered important enough that from 1989 to the present, the Journal of the American Veterinary Medical Association has produced a yearly update of the current state of rabies in the United States. All of these articles have a section on the mid-Atlantic epizootic. Each update provides statistics and maps, as well as a section dedicated to human deaths from the disease. The maps and statistics used in these updates are supplied by the Centers for Disease Control and Prevention, who are in turn supplied by the individual states. Each yearly update provides a thorough review of human and veterinary components of the disease as well as examinations of particular epizootics as classified by space and species. (Reid-Sanden, Dobbins et al. 1990; Uhaa, Mandel et al. 1991; Krebs, Holman et al. 1992; Krebs, Strine et al. 1993; Krebs, Strine et al. 1994; Krebs, Strine et al. 1995; Krebs, Strine et al. 1996; Krebs, Smith et al. 1997; Krebs, Smith et al. 1998; Krebs, Smith et al. 1999; Krebs, Rupprecht et al. 2000; Krebs, Mondul et al. 2001; Krebs, Noll et al. 2002; Krebs, Wheeling et al. 2003; Krebs, Mandel et al. 2004; Krebs, Mandel et al. 2005)

The problem of inconsistency in these data has not passed unnoticed. As early as 1990 these updates make note of the differences in terms of data collection and reporting by states. The central problem is the lack of consistent funding, regulation, and training across the states involved. The condition of data at the present reveals that little progress has been made in this respect to date.

Recent work at the Centers for Disease Control and Prevention may start the process of improving the quality of rabies surveillance data. The surveillance associated with oral vaccine programs is often insufficient to determine the effectiveness of the vaccination program (Blanton, Manangan et al. 2006). This article suggests not only that surveillance quantity be increased, but also that Geographical Information Science (GIS) and Global Positioning Systems (GPS) be used to increase the spatial utility of the data. The suggestions also include more active sampling in areas that are conducting oral vaccine programs, as well as the increased collection of local demographic data. In many ways the suggestions echo those made by Curtis and Heath in their book chapter on the limitations of surveillance data (Curtis, Heath et al. 2005).

2.9 Conclusion

The assumption that a (rabies) dot on a map in New York is analogous to a dot on a map in West Virginia is problematic. There are many epidemiological factors that are unknown, including the size of wildlife populations, collection rates, survival rates, training and funding of collectors, and the influence of the public. These unknown factors can produce a surveillance system that functions as a black box: animals go in and numbers come out, but with little understanding of the process in a particular city, county, or state. Geographical techniques exist to improve the utility of the data after it has been produced, but many geographers, veterinarians, and epidemiologists are calling for an improvement in the quality of the data itself.

This research seeks to add depth to our understanding of surveillance itself. Through an improved understanding of animal control officers, it is believed that the first part of the process of surveillance can be better understood.

CHAPTER 3RABIES SURVEILLANCE IN NEW YORK STATE

3.1 Introduction

This chapter presents rabies surveillance data collected in New York State from 1986 to 2005. The data are described, contextualized, and examined in detail. These are the data that will be used comparatively in Chapters 4 and 5.

One of the common complaints made by the public and found in the news reports is a lack of clear authority regarding rabid animals. Obviously, this also has an effect on any surveillance surface and on the data used for spatial analyses. This lack of authority is due to the overlapping jurisdictions and protocols regarding rabid animals and rabies exposure. Figure 3.1 presents the structure of rabies surveillance in New York State. It also provides the possible paths taken by a submitted animal. Unfortunately, it is impossible to track a submission through this system without some form of identification code, which has implications for spatial analyses.

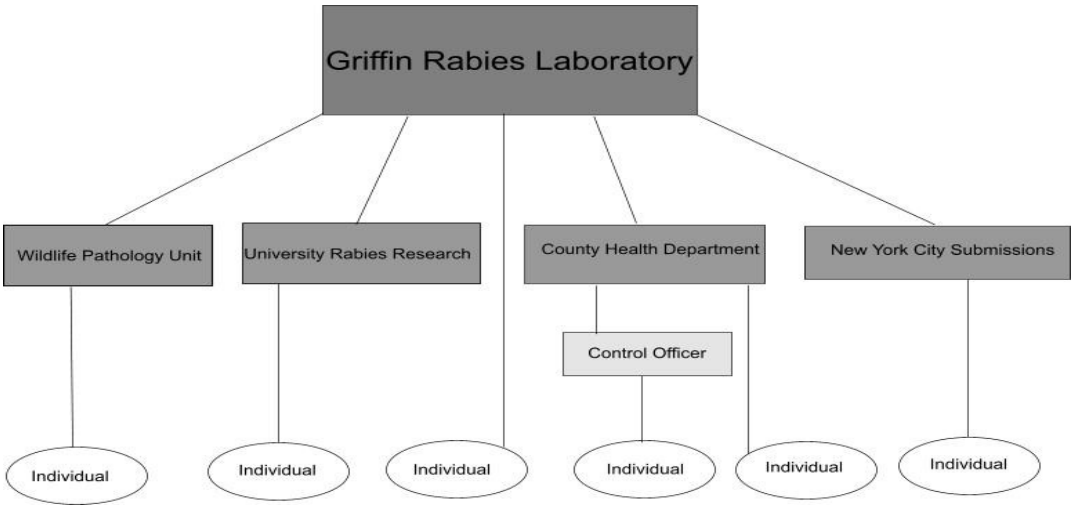


Figure 3.1 The structure of surveillance in New York

In the surveillance process, animals are collected, processed, and tested. In a hypothetical situation, a raccoon attacks a person and hides in a garage. An animal control officer is called, comes to the location, and traps or kills the animal. The county health department is also called and

a sample arranged to be taken, typically by a local veterinarian. The animal is euthanized, and depending on its size, either its head or a sample of brain tissue is removed and prepared (Rudd 2005). The sample is shipped to Griffin Rabies Laboratory in Albany County where it is analyzed, the results of which are recorded and sent back to the county health department. All rabies testing in New York State outside of New York City, which operates under its own system, falls under the authority of the Wadsworth Center's Griffin Laboratory. This laboratory is in Guilderland, a suburb of Albany. The rabies data produced there are rarely forwarded to the animal control officer who started the process.

The type of surveillance used in this context is passive surveillance. Data are collected when animals showing symptoms of a disease present themselves in some manner. This is contrasted with active surveillance in which animals are sought, caught and tested. Although active surveillance would render better data regarding the locations of rabies, especially if appropriate spatial sampling strategies are employed, it is far more expensive and difficult to maintain in terms of logistics. No states in the United States conduct statewide active rabies surveillance.

The previous scenario describes the surveillance system as it is conceptualized- simple and direct. In reality, it is neither. If there has been no contact with a person or domestic animal, the health department generally will not sanction a rabies test. Because of budgetary constraints, all suspicious animals cannot be tested, so county health departments are left to decide which specimens pass into the surveillance system.

It is possible for an individual to ensure a rabies test. The most direct route is that the complainant agrees to personally reimburse the health department for costs incurred. Another possibility is that a person takes the animal directly to Griffin Laboratory himself where there is a drop-box at the entrance. Samples can also be sent to the Wildlife Pathology Unit at Five Rivers, where the state wildlife pathologist is known for his willingness to serve those who have exhausted

other means of testing (Stone 2005). This presents a spatially skewed effect on the state submission surface with so many rabid animals appearing to originate in the Albany area due to individual submissions to the Griffin Rabies Laboratory and the Wildlife Pathology Unit.

The surveillance system is further complicated if contact is made with an animal in an area without an animal control officer or the person on duty only works part-time, and cannot come and retrieve the animal until many hours later, by which time the animal may have left. The spatial coverage for animal control is uneven. Although adjoining municipalities are required by law to provide reciprocal agreements for dog or animal control,, this is not common in practice (Watt 2004). For rural areas, there is often no available service. Any suspect animal that has not attacked a human or domestic animal will not be reported due to the absence of a systematic reporting mechanism. Even an animal exhibiting classic symptoms of furious rabies; for example, attacking fence posts, or twitching and convulsing will usually not be tested unless it has attacked a human or a domestic animal. Rural residents may be expected to dispatch the animal themselves and then bury it. This response can complicate matters later if it is decided that an animal was possibly rabid and the person had been exposed to it. Often by the time an official has exhumed the carcass it is too late for testing to be effective (comments to this effect are found in Questionnaire 486 and Questionnaire 658).

3.2 Rabies Data in New York State

3.2.1 Submission Data Quality

Rabies submissions in New York State vary predictably through the year due to two main factors. The first is that many wild mammals become less active as temperatures fall (Goldman 1950). Secondly, people are also less active in the winter and therefore less likely to come in contact with animals. Seasonal variation provides no real indication of long-term trends. For this reason data are aggregated to the yearly temporal interval, as opposed to the month or season. It is

worth remembering that only animals exhibiting the dumb form of rabies, since paralytic animals do not usually attack other animals.

3.2.2 Data for this Dissertation

Data are supplied to the public by the state of New York through the Griffin Rabies Laboratory, a division of the Wadsworth Center in Albany. The data range from mid-1985 through 2005. Data from 1985 to 1995 were aggregated to the sub-county level. Data from 1986 to 2005 were aggregated to the county level. The difference was due to a changing standard for the privacy of people exposed to rabies. It is important to remember that each entry in the data set often represents a person who has had an interaction with a suspicious animal. The sub-county level data are then aggregated to the county level. The merged data set is treated as a single unit of analysis with over 150,000 observations.

These data have serious limitations for spatial display and analysis, partly due to the fact that they were not collected for these purposes. Their collection is incidental to the response to a health risk. In addition, there are no data regarding denominator raccoon populations, and without such data it is not possible to calculate rabies prevalence. These limitations have not stopped the academic analysis of these data, partly due to the apparent richness, and that these are the only data available for rabies analysis. As an example, in 2000 these data were used to produce maps showing the leading edges of the disease in New York (Wyatt 2000). In another example addressing the impact of the rabies epizootic on human public health, New York State rabies data were used to produce maps depicting dates of first positive raccoon and graphs of suspected rabid raccoons to confirmed positive cases (Chang 2002)

Data of the sort provided by New York, as well as several other states, have been used to associate outbreaks of rabies between skunks and raccoons in the northeastern United States. The research by Guerra, et al. (2003) consisted of temporal and spatial analyses of the distributions of

both raccoon and skunk rabies. Interestingly, only the data for positive animals was used, with general submission data being ignored. The motivation behind this study was not necessarily to determine where the disease may have been, but instead to determine if skunk and raccoon rabies tended to coincide spatially and temporally. The article utilized county-level maps of the 11 states in the study, presenting the extents of both raccoon rabies and skunk rabies epizootics (Guerra, Curns et al. 2003). It should be noted that uneven surveillance data is not limited to New York State as no other state has an ongoing active rabies surveillance system – though this is occasionally activated at smaller scales in times of emergency. Again, academic studies have been reliant on state passive surveillance data.

3.3 Spatial Patterns in Surveillance

Even given the previous limitations of the surveillance data, it remains the only means to understand any spatial pattern in the epizootic spread that occurred in New York State. It is therefore useful to determine what are the limitations and biases involved. The following maps display the type of surfaces that are often generated by these data to display total and subsection spatial rabies patterns. Figure 3.2 maps confirmed rabid raccoons by county from 1985 through 2005. Figure 3.3 standardizes the rabies surface by standardizing the number of rabid raccoons by 10,000 human population.

Comparing the two maps, Albany County consistently had the most submissions followed by Tompkins County. The fewest submissions originated from a region defined by the Adirondack Mountains, and Long Island, which was largely rabies free. For these data, rabies submissions in a county can be partly explained by a series of non-epidemiological functions. The first is human population. Outside of New York City, which functions semi-autonomously in the public health system, and Long Island, which largely avoided epizootic rabies until 2004 a population map of New York looks similar to a submissions map of rabies in New York.

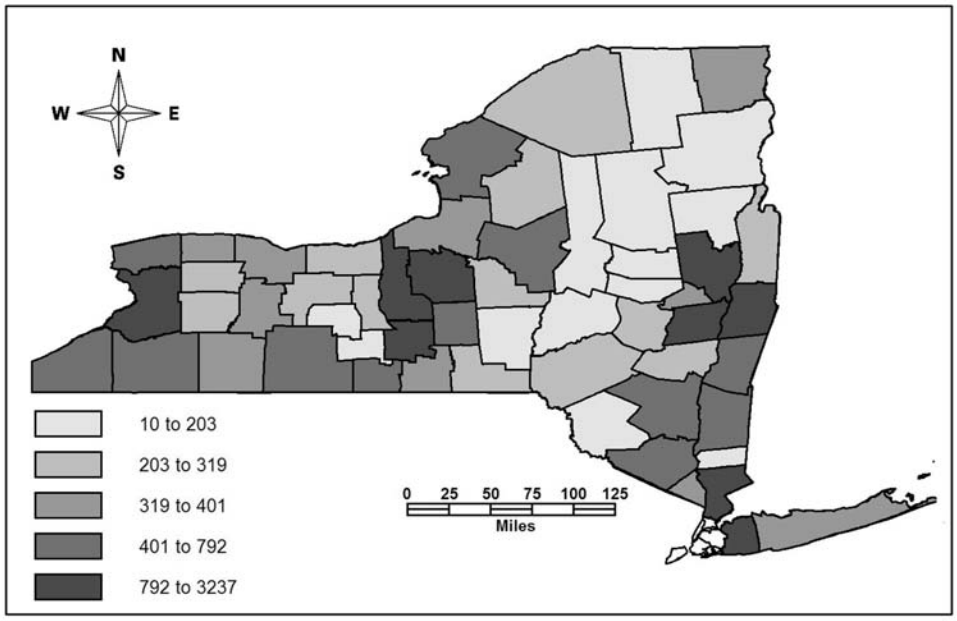


Figure 3.2 Rabid raccoons by county 1986-2005

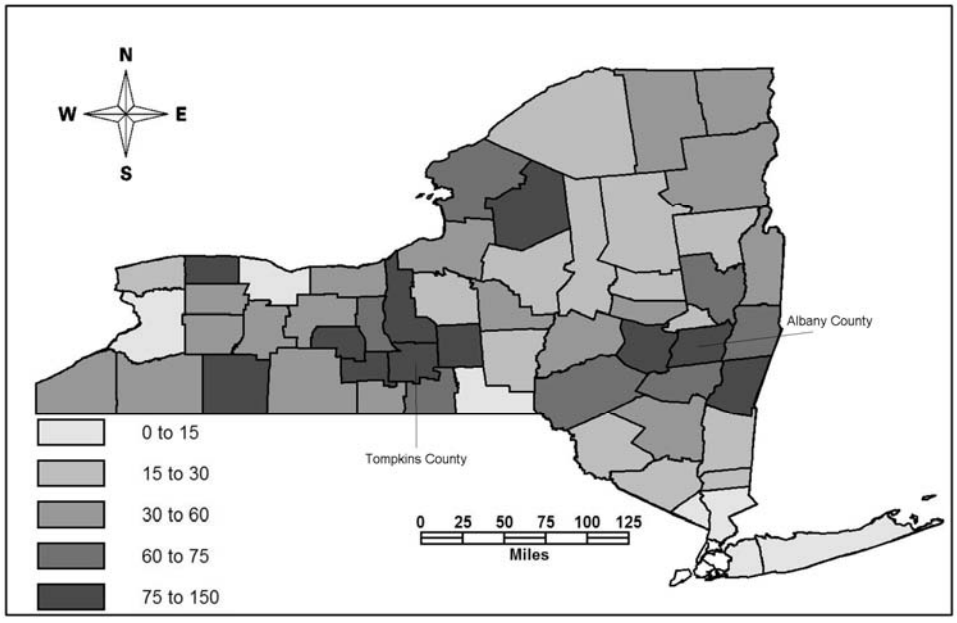


Figure 3.3 Rabid raccoons per county standardized by 10,000 human population 1986-2005

The Spearman rank correlation between the 2000 human population per county from the United States Census Bureau and rabies submissions for the years 1995-2005 is r =.71448, p<.0001.

3.4 Mapping the Epizootic

Figure 3.4 displays the date of the first verified rabid raccoon per county. The geographic movement or diffusion of the disease is evident in this map. Once the epizootic wave had passed, the second phase of raccoon rabies, the enzootic phase began. This is the reason behind the difference in the length of intervals in Figure 3.4.

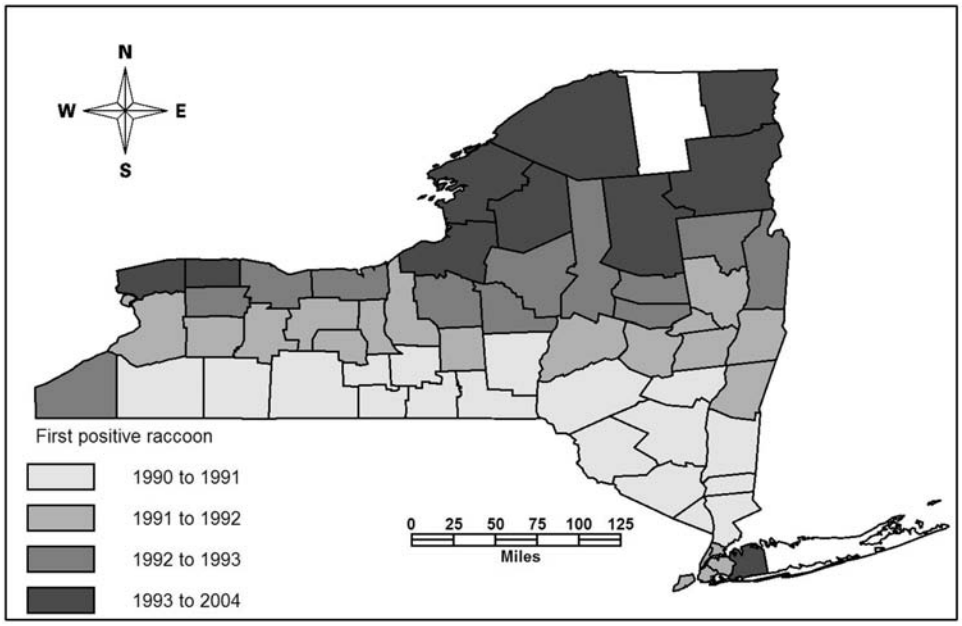


Figure 3.4 Year of first positive raccoon in New York counties

After 1993, there were few counties remaining that had not reported rabid raccoons. Once the disease is seeded into the ecology, raccoon rabies will cycle between enzootic and epizootic phases at approximately four-year intervals (Childs, Curns et al. 2000). These particular phases are determined by the size of raccoon populations (Bacon 1985). As mentioned in Chapter 2, the size of the raccoon population, as well as the density of the animals, will impact the likelihood of susceptible animal contact, especially after the rabies wave has thinned said population. The phase of the next wave is dependent on when the rebounding susceptible population recovers to a level allowing for efficient contagion contact. The following brief summaries describe different temporal episodes of the epizootic.

3.4.1 Rabies from 1986-1990

Even before epizootic raccoon rabies entered New York in 1990, other strains of rabies were present. The northern parts of the state had been experiencing an incursion of fox rabies from Canada between 1986 and 1989. This fox rabies epizootic had been active in Canada since the nineteen-fifties (Tinline and Maciness 2004). In addition, sporadic cases of non-epizootic rabies are present in the data set as well as a constant level of bat rabies.

3.4.2 Rabies from 1991-1995

The next interval encompasses the time period in which the majority of New York first experienced the epizootic. The most notable difference between this map (within Figure 3.5) and the previous one is that those counties that were part of the initial introduction of the disease have begun to lose their prominence. In addition the fox epizootic in the north had ended.

3.4.3 Rabies from 1996-2000

This period saw the epizootic wave cover the state and marked the beginning of both enzoonicity and occasional resurgent, localized epizootics. Albany and Westchester County became the two most submitting counties. Jefferson, Saint Lawrence, Lewis and Essex counties in the north experienced their raccoon rabies epizootics at this time, which is reflected in the map. These northern counties have elevated levels of surveillance due to the oral vaccination campaign directed by the veterinary school at Cornell University. This location was not coincidental, since the campaign was partly funded by the Canadian government in order to prevent an incursion of raccoon rabies into Canada (MacInnes 1995).

3.4.4 Rabies from 2001-2005

The last map of this series occupies a time when nearly all of the state had experienced the epizootic, except for Long Island (Nassau and Suffolk counties), which managed to avoid it until 2004 (Nassau). Aside from this detail, it is not appreciably different from the previous map.

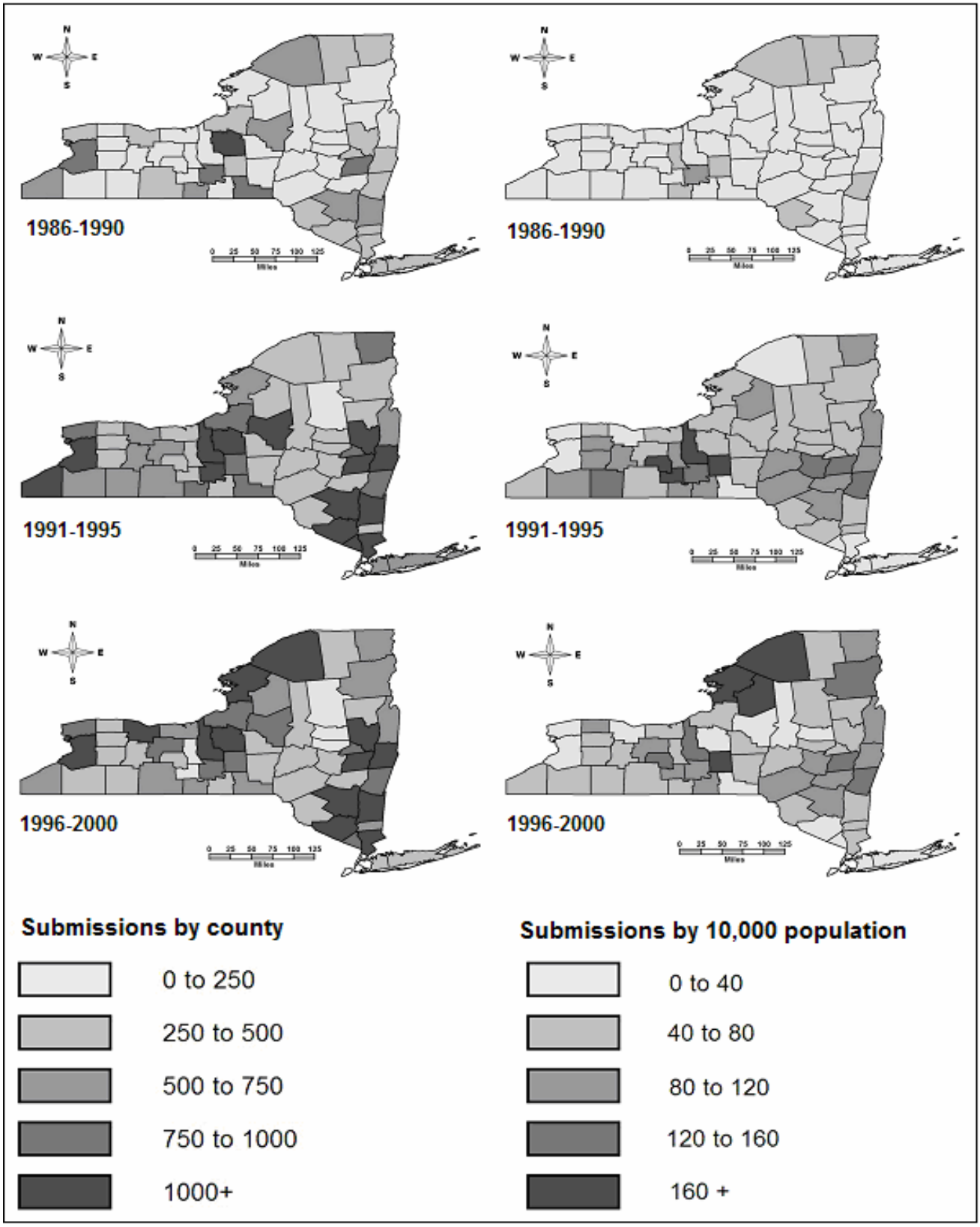


Figure 3.5 County rabies submissions compared with rabies submissions standardized to 10,000 human population, 1986-2000

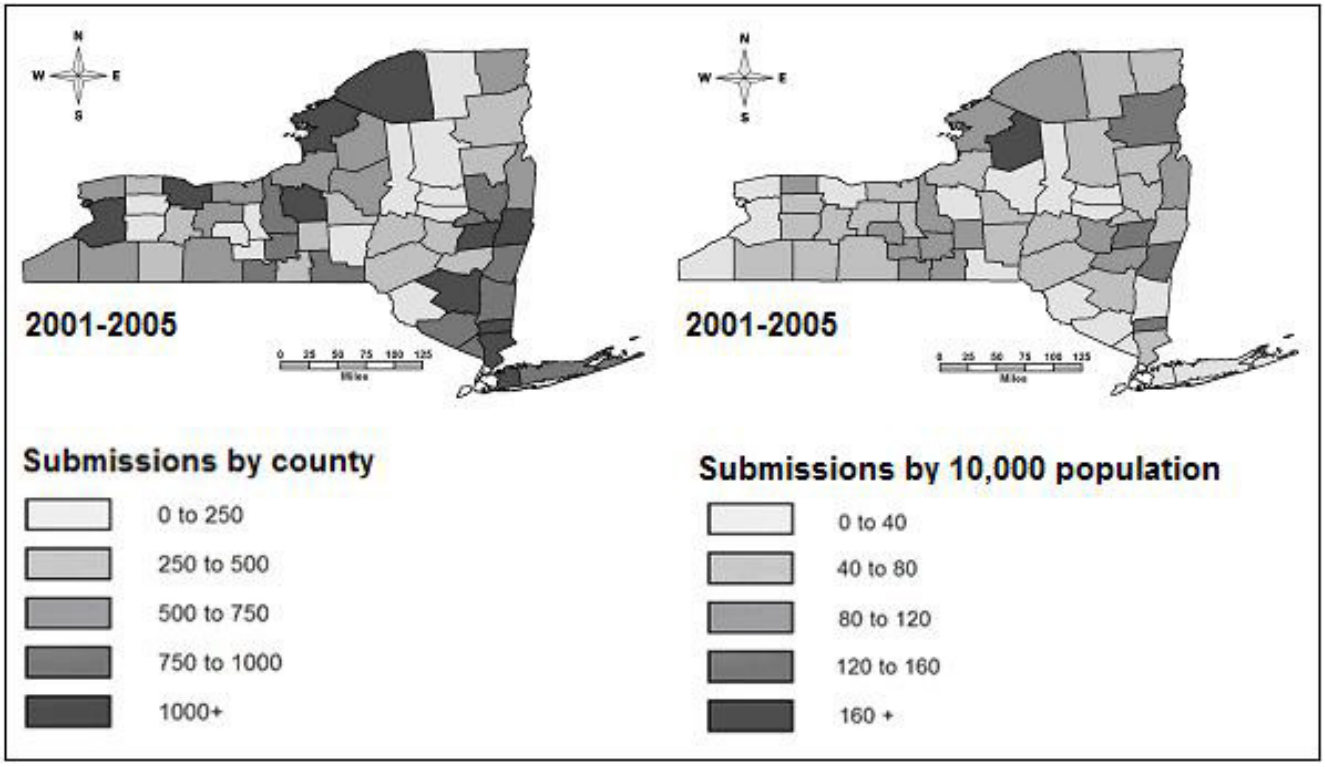


Figure 3.6 County rabies submissions compared with rabies submissions standardized to 10,000 human population, 2001-2005

Those areas with the most population tend to submit the most animals, rural places submit fewer animals and the most rural counties submit practically none at all. This was particularly true of Hamilton County which is defined as being 100 percent rural. In order to appreciate this relationship, a rank of both submissions and total population can be used to show where the greatest difference exists between these two correlated variables. In other words, it can be useful to show those counties which have greater than rank expectation in submissions, and those with fewer than expected submissions.

Table 3.1 ranks the counties with the greatest difference in both directions. Figure 3.7 maps these counties. The three areas that are notable in terms of over-submissions are the Greene and Columbia county area, the Tompkins, Cortland, Cayuga area, and the Jefferson and Lewis area. The Tompkins area is likely due to the effect of the Cornell School of Veterinary Medicine, and the Lewis and Jefferson area is likely due to the previously mentioned oral vaccination campaign. A

possible explanation for the Greene and Columbia area is that they have relatively low populations, but are close enough to Albany that submission is relatively easy.

This table shows clearly that population is not the sole determinant of submissions. There are counties with large populations that submit relatively few submissions. The two most obvious examples are Suffolk and Nassau counties. In all likelihood, this stems from the late introduction of rabies onto Long Island. A possible explanation for the position of Herkimer County near the top of this list is the fact that there are no large towns in Herkimer County, creating the situation in which the population is sufficiently dispersed and distant from the county health department. It is also notable that Herkimer County has an unusual elongated shape, with the population and government heavily weighted toward the southern end. It is possible that the same dynamic that suppresses submissions in Hamilton County also applies to its neighbor, Herkimer County.

Among the highly-submitting counties there is a trend of continuously increasing surveillance pressure over the course of twenty years. The state protocol regarding testing animals cannot explain these differences. One explanation is that the surveillance systems in these places simply produce more submissions, irrespective of the background levels of rabies. The fact that these places carry a large share of the state's population helps to explain the following graph. Although the epizootic had largely passed by 1995, and much of the state had shifted to dealing with raccoon rabies as an enzootic disease, in some areas, surveillance remained high. As a result the state aggregate submission number remained elevated, even if for most counties submissions had decreased. Some of this can be explained by oral vaccination programs across the state.

3.5 Maps by Year

Using the data in the form of yearly maps provides insight into the phases of disease between 1990 and 2005. As the standardized submissions are mapped, they provide an index of the direction and speed of the epizootic. After the initial epizootic passes, this pattern becomes less

Table 3.1 Counties ranked by difference between population rank and submission rank

County	Population	Population Rank	Submissions	Submission Rank	Difference
Suffolk	1321864	57	2174	30	-27
Nassau	1287348	56	2220	31	-25
Herkimer	65797	25	838	4	-21
Fulton	54191	18	635	2	-16
Monroe	713968	53	2977	41	-12
Niagara	220756	46	2498	34	-12
Montgomery	51981	16	875	5	-11
Sullivan	69277	27	1432	16	-11
Rockland	265475	49	2809	39	-10
Chenango	51768	15	957	6	-9
Madison	69120	26	1443	18	-8
Steuben	99088	36	2115	28	-8
Wayne	89123	32	1688	25	-7
Livingston	62372	23	1442	17	-6
Warren	59209	19	1216	13	-6
Ontario	95101	34	2138	29	-5
Oswego	121771	39	2546	35	-4
Schenectady	149285	41	2647	37	-4
Cattaraugus	84234	30	1971	27	-3
Oneida	250836	47	3248	44	-3
Orange	307647	51	3979	48	-3
Broome	212160	45	3233	43	-2
Chautauqua	141895	40	2734	38	-2
Franklin	46540	11	1061	9	-2
Genesee	60060	21	1453	19	-2
Saratoga	181276	44	3464	45	1
Schuyler	18662	2	736	3	1
Seneca	33683	6	1001	7	1
Wyoming	42507	9	1079	10	1
Onondaga	468973	52	6593	54	2
Otsego	60517	22	1524	24	2
Westchester	874866	54	10076	56	2
Delaware	47225	12	1388	15	3
Dutchess	259462	48	4395	51	3
Orleans	41846	8	1180	11	3
Putnam	83941	29	2432	32	3
Chemung	95195	35	2898	40	5
Clinton	85969	31	2610	36	5
Tioga	52337	17	1522	22	5
Yates	22810	3	1016	8	5
Allegany	50470	14	1478	20	6
Washington	59330	20	1902	26	6
Albany	292594	50	11780	57	7
Essex	37152	7	1357	14	7
Schoharie	31859	5	1184	12	7
Ulster	165304	43	4391	50	7
Rensselaer	154429	42	4508	52	10
Jefferson	110943	37	4023	49	12
Greene	44739	10	1523	23	13
Tompkins	94097	33	3788	47	14
St Lawrence	111974	38	4636	53	15
Lewis	26796	4	1489	21	17
Cayuga	82313	28	3634	46	18
Columbia	62982	24	3095	42	18
Cortland	48963	13	2434	33	20

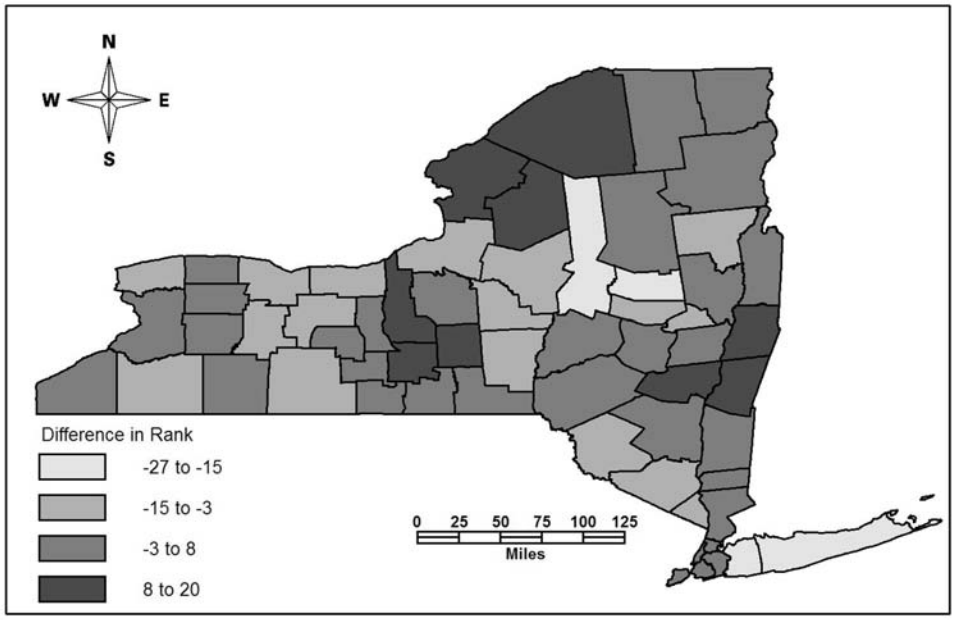


Figure 3.7 Map of population rank minus submission rank

distinct. This is partly due to the epizootic wave not being a continuous front; it has gaps in it. These gaps can be accommodated as long as the general trend is evident on the maps, but when this trend becomes diversified, extrapolation of the missing pieces becomes much more difficult. The main cause of these gaps is the low rate of submissions from some counties. As the rank map (Figure 3.7) displayed, certain counties do not submit many animals. These gaps are in many cases a result of the system as designed. Submissions are a product of human contact with suspected rabid animals, these contacts generate the data under discussion. If there are no contacts, or if individuals see no need to report an animal, then no data are generated.

Another reason for the difference in the described pattern is the change in the raccoon population itself. In the initial, epizootic stage of the disease, there are many raccoons that are available for infection. Through infection and recovery, or the death of raccoons, this population falls. Eventually there will not be enough raccoons to sustain the epizootic. When the raccoon

population falls below this threshold, the disease enters its enzootic phase. In the case of New York, this happens in the mid nineteen-nineties.

In order to see more defined trends in the data, the surfaces are now presented by year. It should be noted that by 1993 the well-defined epizootic wave had begun to dissipate. By 1997, a pattern emerges in which yearly patterns begin to look similar. The fact that this pattern persists until the present indicates stability in the submission of animals suspected of having rabies. It also makes clear that even though rabies submissions rise and fall, they generally do not return to pre-epizootic levels.

3.6 Possible Factors Influencing Submission

Surveillance is influenced by factors other than the presence or absence of disease. In this instance, rabies data represent contacts between humans and animals. There are other non-related factors that also must be considered. These include, but are not limited to:

1. Human population
2. Government structures
3. Research institutions
4. Media outlets
5. Personality and training of people involved in the surveillance system

Human population influences surveillance directly. Having more people often leads to more animal contacts. More contacts produce more submissions. For this reason, and has been seen throughout this chapter, submission can be normalized by population. However, this manipulation does not explain the entire surveillance surface.

The influence of government structure on surveillance is also significant on many levels. Government creates requirements for animal control and defines jurisdiction. Local government funding enables animal control. County Health Departments exert influence regarding which animal calls merit submission. At the state level, rabies resources tend to be concentrated in a few places,

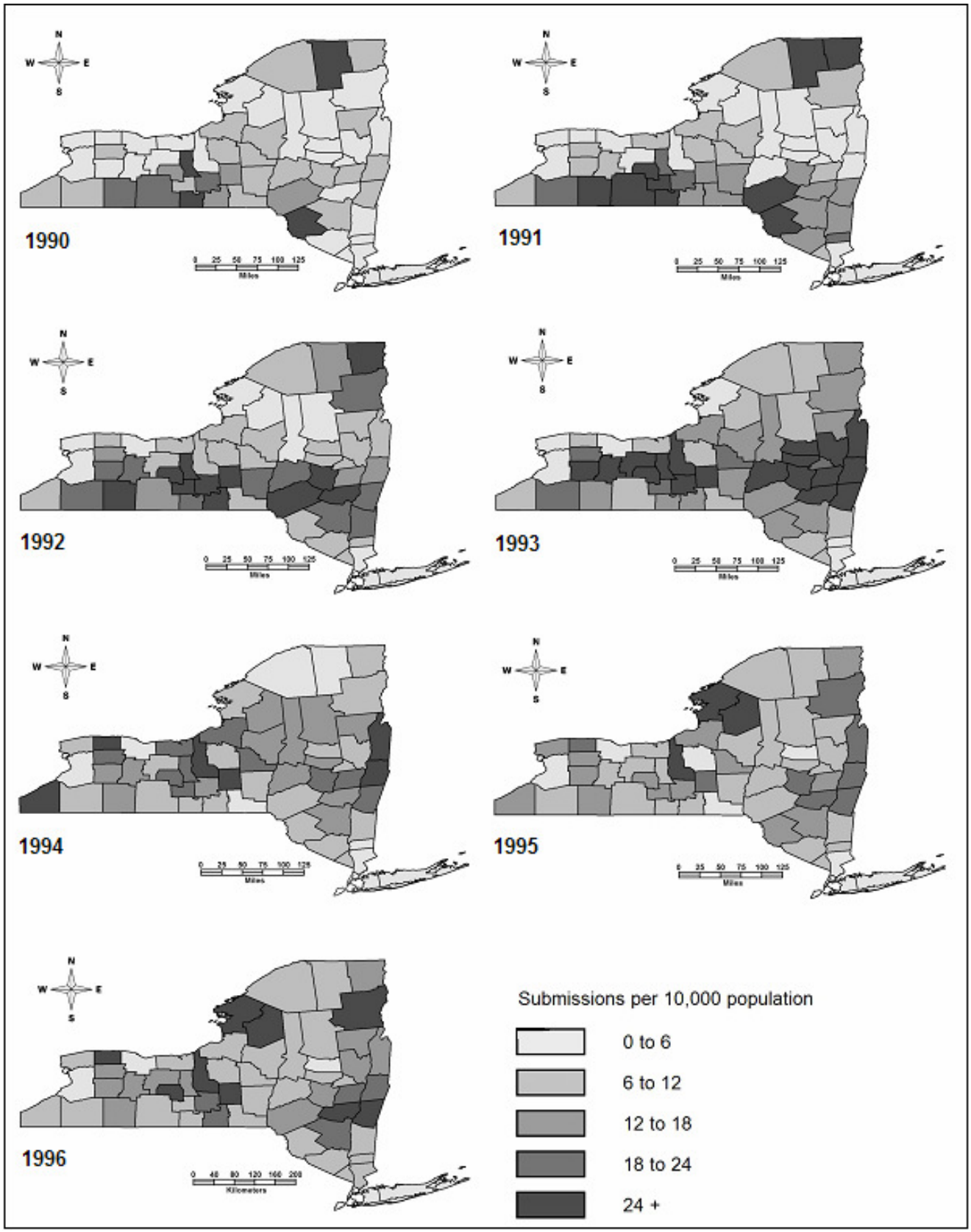


Figure 3.8 Rabies submissions by county standardized by 10,000 human population, 1990-1996

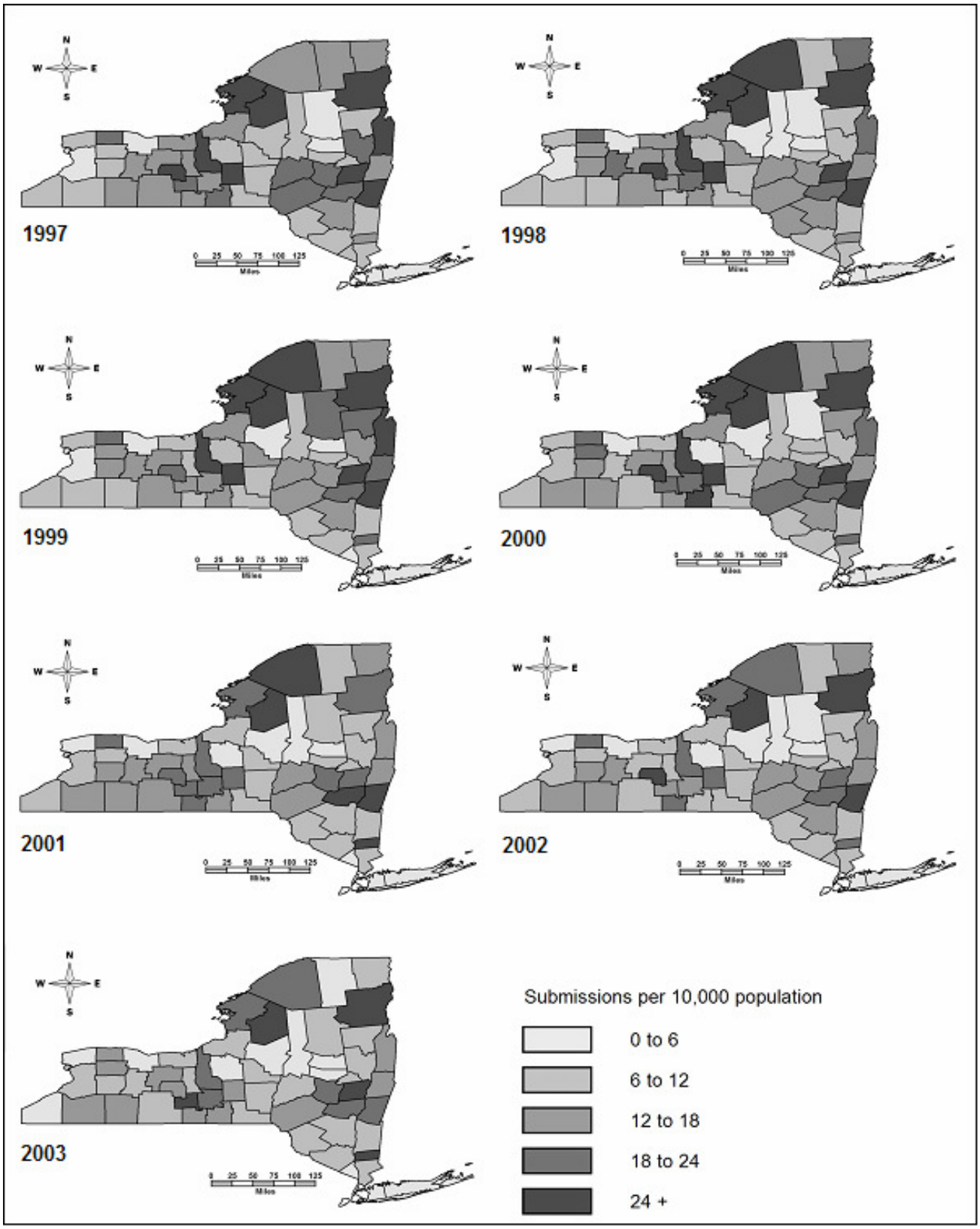


Figure 3.9 Rabies submissions by county standardized by 10,000 human population, 1997-2003

Figure 3.10 Rabies submissions by county standardized by 10,000 human population, 2003-2005

increasing the influence of those places. The greatest example of this in New York is that there is only one place for rabies testing, Griffin Rabies Laboratory in Albany County.

Research institutions such as universities also produce submissions. As previously mentioned, The College of Veterinary Medicine at Cornell University appears to have exercised an influence on the surrounding counties. This is understandable considering the role that it has played in the development of the New York wildlife rabies vaccination program. (New York Department of Health 2006;New York Times 1995). The relationship between the institution and the local population can lead to increased submissions. This may be in the form of students in classes, faculty outreach into the community, or even researchers actively searching for animals to submit for testing. For example, in both Albany and around Ithaca, the presence of health institutions has

created a situation that is closer to an active surveillance program than a passive surveillance program. These places use researchers and members of the general public to seek animals for testing (Bigler and Lein 1997). Situations such as these are not typical but are not formally noted in the surveillance data.

Media inputs are likely to have the least influence, especially for prolonged periods of time. However, if rabies appears in the news, it is possible that it will induce a temporary increase in submissions. This influence is investigated in Chapter 5.

As the capital of New York, Albany carries political, and by extension, financial weight to decisions affecting rabies policy. It is also the center of many divisions of the government with interest in rabies. The first is the Griffin Rabies Laboratory which is where most of the state (New York City has its own laboratory) are supposed to send their animals for testing. It is also the central clearinghouse for all rabies-related activities. The Griffin Rabies Laboratory is a division of the Wadsworth Center, a facility funded by the New York Department of Health for health science research involving both humans and animals. The Griffin Laboratory also has an effect on the control officers in the immediate area. It provides training to control officers and accepts animals for rabies testing directly from them.

Social structure, individual personalities, political influence and even geophysical characteristics all can influence the submission surface. The personality and training of people within the surveillance system is the last input. This component is hard to measure, but the influence is certain. Individual control officers, veterinarians, public health workers, to name but three, all apply judgment to situations that can influence whether or not an animal is submitted. The acknowledgment of the contributions of individuals within the surveillance network adds yet another consideration. For example, Ward Stone, a wildlife pathologist, attempted to gain some understanding of rabies in wildlife, not only in the raccoon population, but also possible spillover

into other populations, as well as other concurrent epizootics (fox rabies, bat rabies, and skunk rabies). He used the raccoon rabies epizootic to secure a radio program heard across the state (Stone 2005). One of the functions of this program was rabies education. Listeners were encouraged to bring their animals to the Wildlife Pathology Unit at Five Rivers (near Albany) for testing. It is unlikely that another wildlife pathologist would have responded in the combative but effective manner of Ward Stone.

Similarly, the former director of the Griffin Rabies Laboratory and current director of the entire Wadsworth Center, Charles Trimarchi, also plays a larger role than would be expected. Like Ward Stone, he gained statewide exposure through the rabies epizootic. These are examples of personalities who have impacted both the quantity and location of submissions. Generally, the personalities most involved with rabies surveillance were in Albany County.

In addition to low population density, rugged terrain can also make surveillance difficult and more expensive. The largest such area is the Adirondacks, which comprises a large section of the state but generates low levels of rabies surveillance. The Catskills region provides a similar situation, although it contains a much smaller area and is much closer to the population centers of New York. Due to these different limitations and biases of surveillance data, many studies use the proportion of positives to total submission as a means to capture a more accurate impression of the disease. This manipulation has the effect of removing some of the noise (for example random animals and cat submissions) from the data. It also helps standardize the data set which accounts for large differentials in submissions.

3.7 Raccoons Submitted and Positive Raccoons

The epizootic under study is specifically a raccoon rabies epizootic. Although it is possible to consider the entire set of collected data in order to gauge the scope of surveillance, it is also reasonable to analyze the primary animal target by itself. This analysis is best represented by a

series of maps involving submitted and positive raccoons by year. The year 1990 (within Figure 3.10) provides an example of the extent of raccoon rabies at the beginning of the epizootic. Although a sizeable number of raccoons were submitted for testing, few were actually found to be positive. Upon the incursion of the epizootic in 1990, only the Southern Tier shows positive raccoons.

Once raccoon rabies has been introduced into a landscape, there is a strong possibility that it will persist there for some time. The following maps make this point evident. After the first wave of the epizootic, many counties enter into a pattern of having few positive raccoons followed by a secondary re-emergence. The first counties in New York to experience this were Broome, Chenango, and Delaware; counties among the first to experience the epizootic wave in the state. Chenango in particular cycled between several epizootics. This apparent cycling could also be due to the low numbers of raccoons submitted. As numbers tend to fall, percentage positives will be vulnerable to the law of small numbers. For some counties such as Hamilton, a few animals may be submitted. If just one animal is rabid then that year will have a high percentage of rabid submissions.

In those places that show a decline in rabies, the decline may be caused by a more educated public, a less panicked public, or a tighter reign by the county health departments than an actual decline in the disease, since the inclusion of animals for testing is so closely related to human exposure. One of the most important factors of the rabies epizootic is that the longer it persists, the better human beings become adapted to it. Once it ceases to be new, it becomes just another of the pathogens in the larger backdrop of disease, taking its place with Lyme disease, West Nile Virus, and other diseases that have gained prominence in recent decades. Although rabies submissions have not returned to pre-epizootic levels, they have not returned to the levels seen in 1993, either. This current phase of the epizootic could last indefinitely.

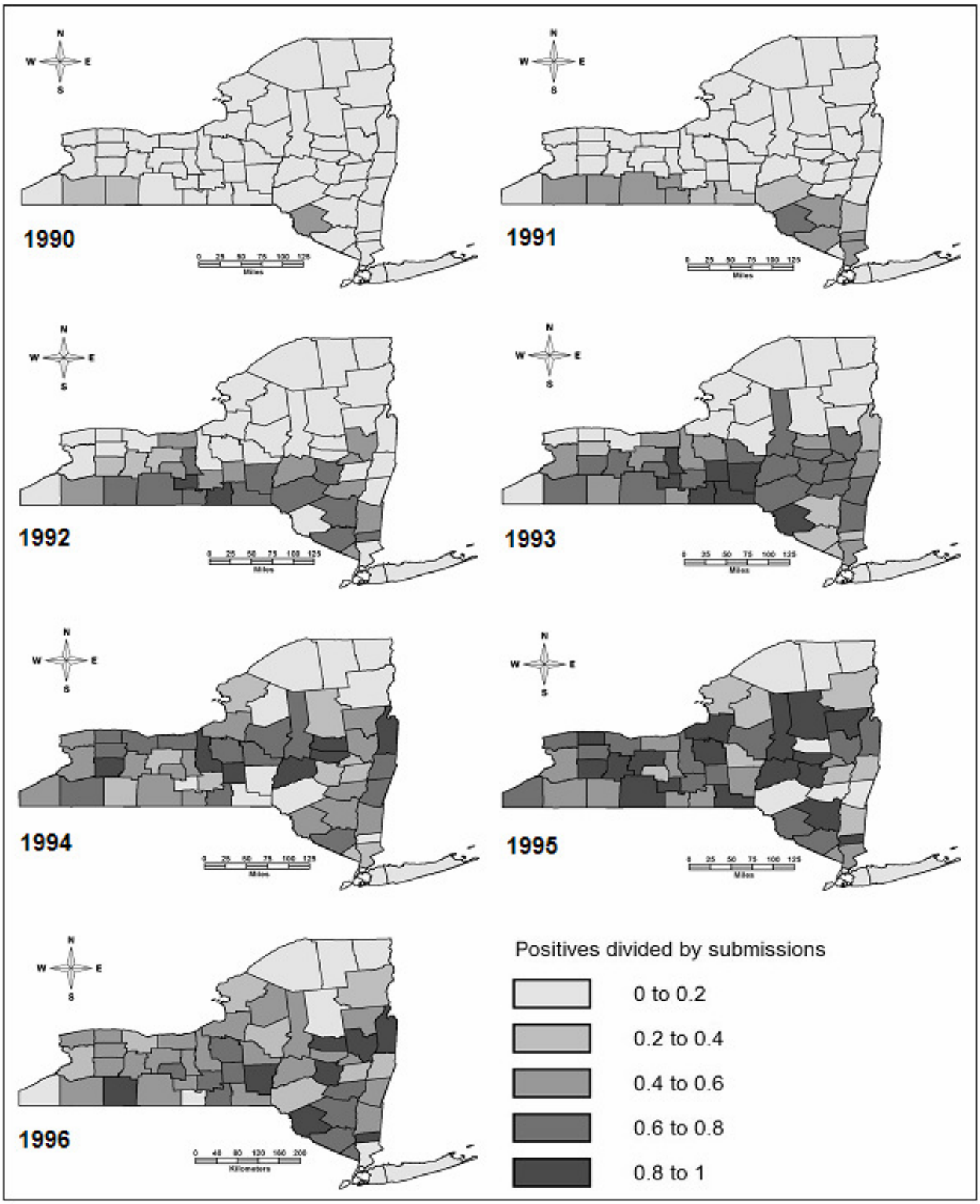


Figure 3.11 Rabies positive raccoons divided by submitted raccoons, 1990-1996

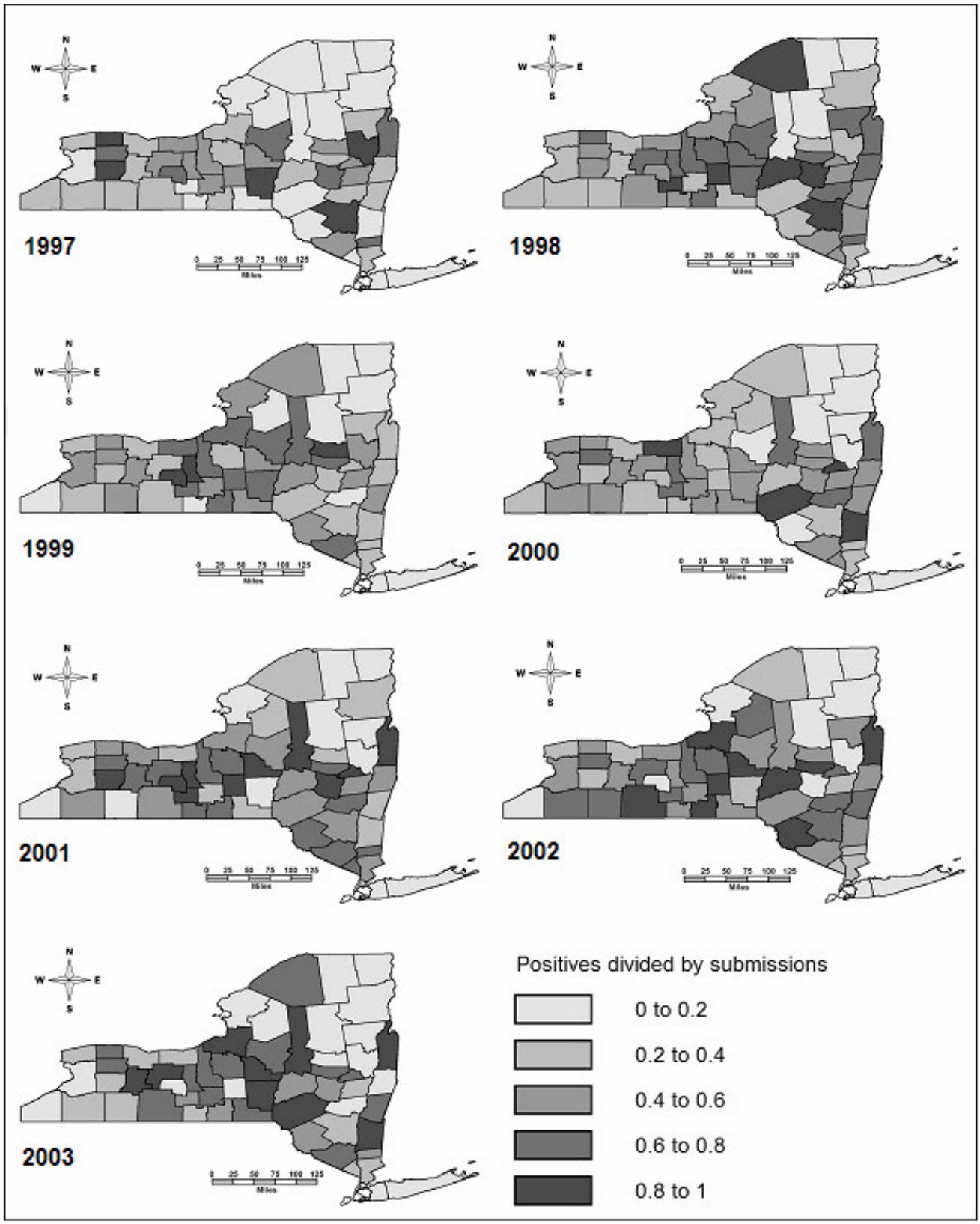


Figure 3.12 Rabies positive raccoons divided by submitted raccoons, 1997-2003

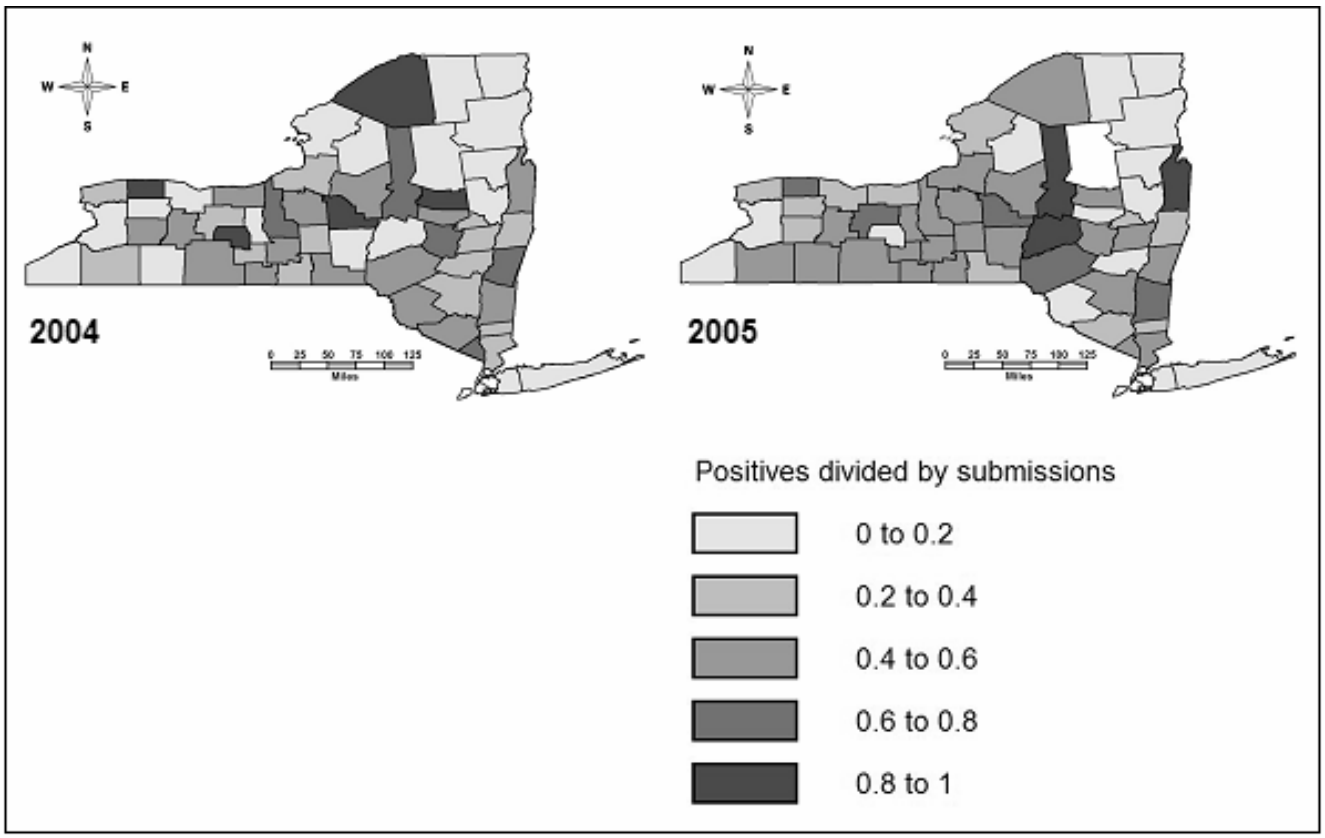


Figure 3.13 Rabies positive raccoons divided by submitted raccoons, 2004-2005

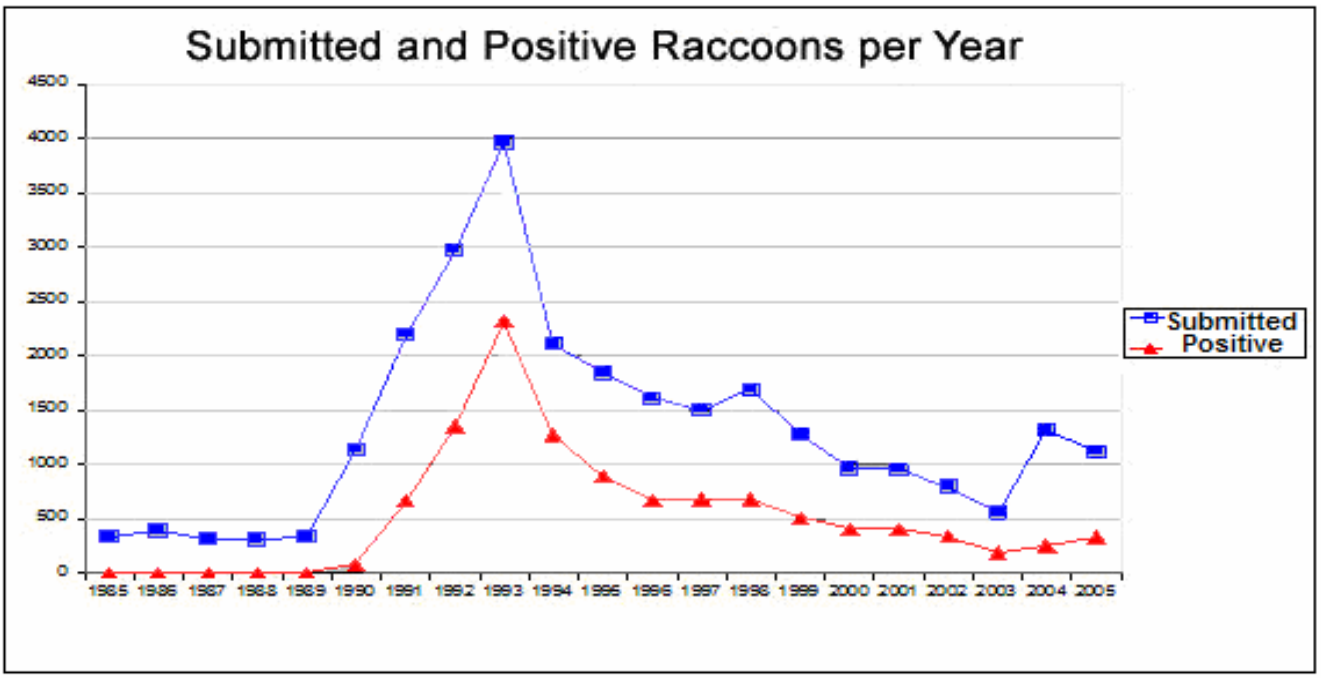


Figure 3.14 Graph comparing submitted raccoons to rabid raccoons 1985-2005

It is interesting to note that Northern Tier counties, which received the epizootic last and where most of the oral vaccination campaigns have occurred, have managed to reduce their percentage of positive raccoons. The vaccination programs seem to have been at least partially effective in this area.

3.8 The Temporal Sequence of Epizootic Raccoon Rabies

In terms of percentage positive, the year with the greatest percentage of positive rabid raccoons was 1994 with 60%, which followed the year with the greatest number of submissions of raccoons, 1993 with 3959 submissions and 2320 positives. Between 1993 and 1994, the submission of raccoons for testing fell by nearly 50% from 3959 to 2107, shown in Figure 3.12.

3.9 Conclusion

The surveillance process behaves divergently across the state of New York. Numbers of submissions by county from 1986 to 2005 range from 89 in Hamilton County to 11,780 in Albany County. Percentage of positive raccoons for that time period (excluding Nassau and Suffolk) ranges from 2% for Clinton County in the north of the state to 68% for Wayne County in the west. Population is important in terms of submissions, but much less so in terms of finding rabid raccoons. The system is not designed to find rabid raccoons but to document exposures. Considering this limitation, these data still posses a great deal of utility, though not regarding the location of rabies in the environment, as separate from the location of people in the environment. Although these data have been used in spatial analyses, it is clear that there is a potential for misuse, particularly if the biases in these data are not acknowledged and accommodated. The most important accommodation would simply be the recognition that these data were collected by a system that was designed to protect the health of people and domestic animals, not a system designed to collect data for future spatial and statistical analyses.

CHAPTER 4 ANIMAL AND DOG CONTROL OFFICERS

4.1 Introduction

This chapter is an investigation into the attributes of control officers as reported in a questionnaire mailed to them in the summer of 2005. The questionnaire was used to determine the attitudes and training levels of control officers and to collect suggestions from them regarding ways to improve surveillance. The questions in the document specifically targeted the locations of the control officers, their connections within the surveillance structure, their opinions of newspapers and their knowledge of local rabies history.

4.2 Aggregated Control Officer Statistics

Questionnaires returned by control officers were aggregated by county. Not included in these aggregations were counties that had no control officers and those which supplied no questionnaires. Also not included were non-county political entities, such as the boroughs of New York City. New York City lies outside of the control officer system for the state of New York. The largely spontaneous comments that were added by the respondents have been used to reinforce particular responses to questions.

4.2.1 Control Officers and the Process of Surveillance

In the state of New York, the position of dog control officer is required by state law, whereas animal control officers are not. Dog control officers are only responsible for the control of dogs; animal control officers have responsibility for dogs, cats, and some other animals. Many municipalities only have state mandated dog control, a bare minimum of protection. Calls for other animals will often not be answered. Animal control is more likely in areas large enough to afford the expanded service.

4.3 The Legal Structure of Rabies Surveillance

Law is one layer of the surveillance structure that receives little attention. However, in the case of New York, it is perhaps the most important layer. Law requires that some towns have dog control officers, law defines the jurisdictions of cities, and law determines the functions of government agencies. The areas that are not covered by law, the gaps in jurisdiction or ambiguous definitions of responsibilities all provide uncertainties in the surveillance structure. Surveillance in New York does not function perfectly or consistently. This is partly due to the fact that each government entity, from the control officers at the bottom to the Griffin Laboratory at the top, has weak connections to every other piece in the surveillance structure. The Griffin Laboratory has no direct influence over control officers. Control officers cannot demand that animals be tested for rabies. Even the state health department has great difficulty in getting county health departments to abide by state law. Each division of government is able to carry out its duties with little consideration for the surveillance system as a whole.

Within the context of New York, there are several layers of legal oversight- federal, state, county, and local (village, town, or city). The federal layer does not directly concern this study and therefore will be ignored. That is not to say that this level has no significance, it is simply outside the scope of this research. New York State law sets the parameters of responsibility for dealing with diseases such as rabies, but these parameters were not designed to specifically address rabies, nor were they specifically designed to create a surveillance network. In addition, New York is a state that allows but does not require the municipal licensing of dogs. The enforcement of dog licensing falls to the dog control officer. The relationship between dog licensing and control is more than just the enforcement of laws, however, since the budget for paying and provisioning a control officer usually comes from municipally-issued dog licenses. According to state law, municipalities are not required to pay their control officers any more money than is taken in as license fees.

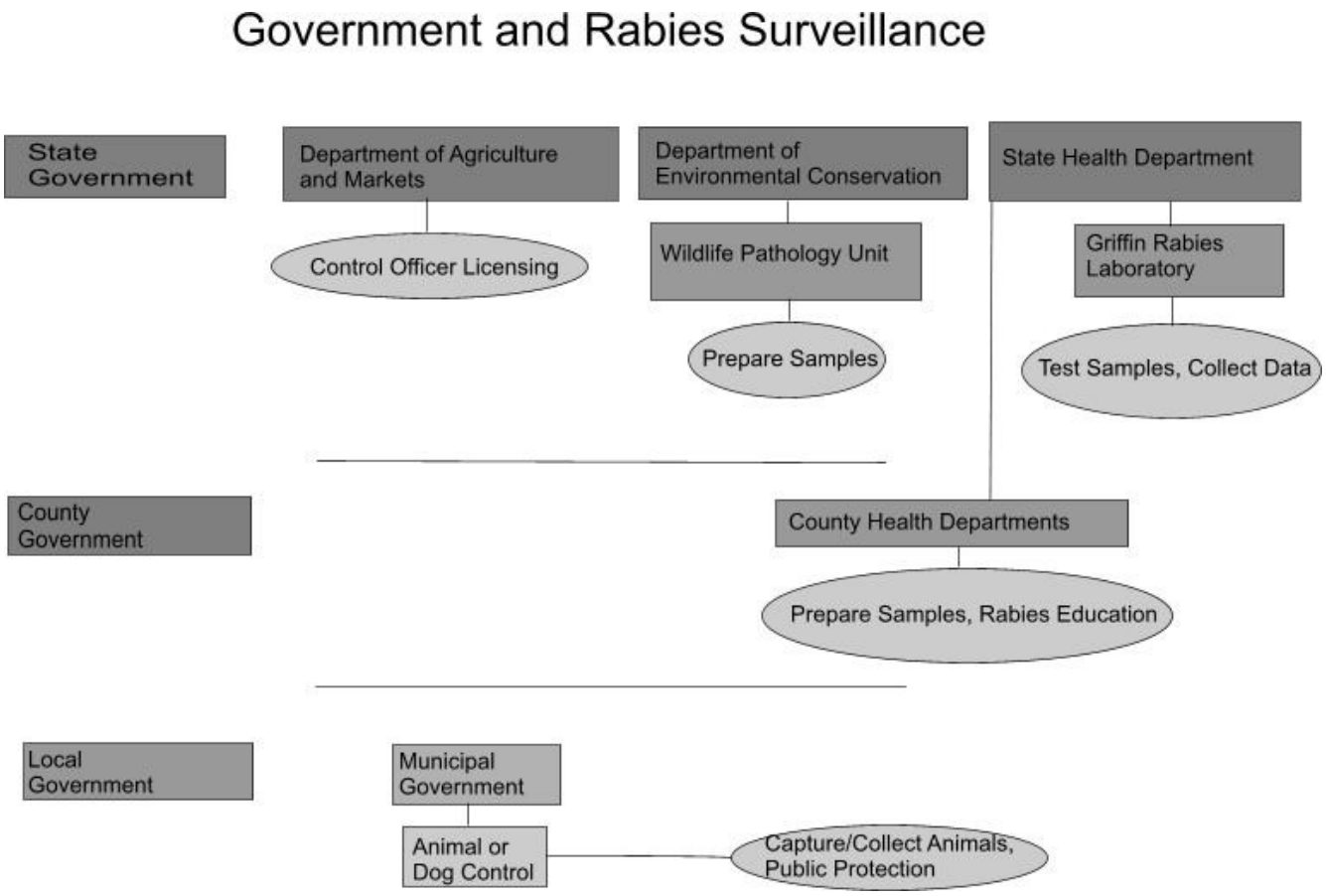


Figure 4.1 Governmental structure of rabies surveillance

4.4 Governmental Segments of the Surveillance Network

4.4.1 State Contribution

Animal and dog control licensing falls under the aegis of the New York Department of Agriculture and Markets, an organization concerned with the regulation of animal and plant industries. Control officer licensing relates to few of the other segments of the surveillance network, if at all. This poorly related function serves as the first in a series of disjunctions in the surveillance network. Aside from licensing control officers, there is little apparent interaction between the license grantor and the licensees. For this study, the list of control officers supplied by the New York Department of Agriculture and Markets contained significant errors, which may

indicate a lack of contact between the New York Department of Agriculture and Markets, municipalities, and control officers.

The New York State Department of Health directs the county health departments at the state level. County health departments have some degree of autonomy regarding the provisioning of resources. The New York State Department of Environmental Conservation is yet another separate but contributing organization that is charged with monitoring the health of wildlife through the actions of its Wildlife Pathology Unit at Five Rivers in Delmar, near Albany (Stone 2005). Finally, the governor and state legislature, the source of state law, is tasked with the production and organization of laws. The Court of Appeals of New York, the highest court in the state, has the final word on the legal issues in the state. One of the notable spatial elements of this system is the fact that all of these state-level organizations are based within the Albany area, meaning both testing and decision making is heavily skewed toward Albany and its environs.

4.4.2 County Contribution

Nested within the state are laws pertaining to each county. Counties also have particular duties that have been established by state law, such as the operation of county health departments. Rabies response is allocated to county health departments. Health departments, which are county-level extensions of state government, have no legal or financial connection to the municipalities within them. This lack of a clear legal relationship leads to the ambiguous position of control officers within the surveillance structure. Health departments, unlike many other county agencies, are under state control. Local governments have no input into the operation of such a department. This lack of local input is most evident with regards to rabies testing. The general trend exhibited in the surveys and in the newspaper articles is that individuals would prefer a less restrictive protocol for testing suspect animals. Budgetary restraints within the health department require that testing have a defined protocol

and instances outside that protocol be rejected. This highlights the general conflict between a desire for better disease data and fiscal limits.

4.4.3 Local Contribution

Within the counties are numerous municipalities. These are the organizations which have direct control over the animal and dog control officers with whom they have contracted. This is to say that animal control officers and dog control officers do not work for the health department, although they may be a functioning part of the collection process. Some health departments send their own representatives to collect suspicious animals, particularly in those places that have no animal control services (see Questionnaire #208). In these places the control officers provide little to the surveillance process, since their normal role is supplanted by the health department. The exact job of a control officer is defined by the contract that creates that position within the local government. There is no standard contract; therefore the duties of a control officer may not be reflected in the title associated for that job (that is to say that some dog control officers will also respond to animal calls). In many places, however, dog control is strictly limited to dogs. In such a place without animal control it is possible that a disease of wildlife could pass unnoticed and unrecorded at the state level.

The operational area of a control officer is limited to the jurisdiction of the locality that issues the contract, meaning that the boundary of that town, for example, is the boundary for that officer. This can be confused by the fact that some control officers are contracted by several different entities; leading to a patchwork of coverage by one individual. This problem is further compounded when considering the distinction between a full-time control officer and part-time control officers designation, since it is possible to be a part-time control officer for several different places. Since each position is defined solely by a local contract, any comparison between them is impossible. Each municipality could have different requirements for part-time control officers.

4.5 Animal Control and Law

The State of New York defines the activities and requirements for dog control officers in Article 7 of the Agriculture and Markets Law (New York Department of Agriculture and Markets 2005). Many of these requirements have spatial implications for surveillance, particularly those relating to licensing, identification and control of dogs and animal population control programs. New York State law sets a simple standard for dog control, but municipalities are free to provide more comprehensive services. For example, many places provide animal control, which is considered beyond the minimum necessary for compliance.

One modification of the surveillance surface allows New York City to operate semi-autonomously from the rest of the state in respect to its animal and dog control laws, separating it from the rest of the surveillance network. The second departure from the surveillance surface involves the variable manner of meeting the state requirements for mandatory licensing and vaccination of dogs. Municipalities classified as villages that do not require dog licensing are not required to provide dog control because they are small and have insufficient budgets. Spatially this is observed in places with low population densities, none of which are large enough to pass a threshold requiring dog control. If the population were more concentrated in a particular area, then it would likely result in more control officers, and possibly more submissions.

There is great flexibility in the law regarding the definition of dog control. Some control officers are employees of the municipality, some are independent contractors, in one instance they were sub-contractors, and some municipalities were served by local societies for the prevention of cruelty of animals (SPCA). This adds variation to the qualifications of persons performing this duty. Since municipalities are not obligated to pay more for dog control than they receive in license fees, small places will necessarily have small budgets (New York Department of Agriculture and Markets 2005).

These laws relate to one of the more common criticisms expressed on the comments sections of the questionnaires. In many municipalities, the provision of dog control exists solely to meet state requirements. The function of the job is seen as either incidental or even detrimental to the legal system. Many control officers found that issuing a ticket or summons invariably lead to dismissal of charges and one was even reprimanded for wasting judicial resources (Pizzuti 2000). Such attitudes may have an impact on the ability of an officer to effectively perform any duties.

Separate from the other laws is Section 78.2 from Article 26 of the New York Agriculture & Markets Law which requires that the state be notified when dog control positions are vacated (New York Department of Agriculture and Markets 2005). This section of the law is essentially unenforceable. It requires that municipalities, which are supposed to provide control services, contact the Department of Agriculture and Markets within 30 days of any changes. It provides for no punishment in the event of violation. Violation typically occurs when a municipality loses its control officer and is unable to find a replacement. In places which collect few dog licenses and consequently have small animal control budgets, it is often hard to find an individual willing to accept a job that may pay as little as $1500 per year (Watt 2004). Officials at the Department of Agriculture and Markets estimate that 40 percent of the positions were unfilled, meaning that a large percentage of their database was not current (Huse 2004; Trimarchi 2005). This particular issue became evident when trying to distribute questionnaires.

4.6 Animal/Dog Control Officers

In the state of New York, the position of animal control officer or dog control officer is a political appointment. The criteria for the job are not designated by the state, and the actual contracts and qualifications are decided by each political unit. Local politics has influence on this system. This influence can lead to the possibility that the position will not be granted to the person most qualified for the job. Political, economic, and legal factors make control officers an

exceedingly diverse group as regards their backgrounds. Within this group are a range of educational levels (Watt 2005). In terms of coverage, some of the officers serve only one town, while others serve several towns or municipalities.

4.7 The Questionnaires

Primary data were collected to support these general observations about the quality of the animal control component of rabies surveillance (see Appendix A). A questionnaire containing 34 questions, as well as geographic fields for zipcode, town, and the initials of the control officer was distributed to every control officer in the state of New York as identified by the New York Department of Agriculture and Markets. Surveys were numbered in order for tracking purposes. These numbers are also used to cite particular responses or comments, in order to preserve the confidentiality of respondents. Some of the survey responses were not returned by the person identified in the file supplied by the New York Department of Agriculture and Markets, but instead by the person who had assumed the position of control officer. The names of the animal control officers and dog control officers were supplied through a Freedom of Information request to the New York State Department of Agriculture's Department of Weights and Measures. A problem with acquiring the list in this way is that animal control officers and dog control officers are not separated in the file due to both being equivalent in the eyes of the New York legal statutes, even though they are completely dissimilar jobs.

An initial batch of 20 questionnaires was sent to randomly selected individuals on the list. They were asked to not only answer the questions on the list but also to comment on them. Of the 20 questionnaires mailed only four were completed and returned, the rest were returned as undeliverable. A subsequent request to the New York State Department of Agriculture and Markets resulted in a more current file.

4.8 Data Problems and Inconsistencies

The two New York State files of animal and dog control officers' contact information contained multiple discrepancies between one another. The first file contained 722 records, not all of which contained officers. Some officers were listed for each town they contracted. Many were listed as a group of control officers under the town, county, or village where they were contracted. However, neither of these methods of classification was consistent throughout the document. There seemed no obvious system to the method of classification. Some of the officers were referenced only by their first and last initials, making contact difficult. Some of the entries were organizations or businesses without a person's name. Many of the names had obvious spelling mistakes, as they contained characters other than letters embedded in them. There were also numerous notes within records, missing records, and most problematic-the confusion of fields within a record

Some entries contained the comment “no dog control officer since” followed by a year, or the name of a municipal supervisor followed by “no dog control officer.” This indicated that the position was unfilled when the entry was made. As the years given extended back to 2000, this indicated that this position had gone unfilled for one-half decade during a rabies epizootic. The files (both versions) contain numerous comments attached to the records within them, as well as many duplicate entries, most of which are identical entries. As this document represents the only known means of contact between New York State and its animal and dog control officers it appears unlikely that it is ever used as such, and subsequent responses from the questionnaires seem to support this conclusion. The collection of these data are merely used to satisfy the state's legal requirements for filling positions.

There are 1022 municipalities within New York, but the second, updated file appeared to contain 647 entries, reinforcing the fact that many of these positions remain unfilled. This is interesting considering that a dog controller is required by New York State law, and these represent

only two-thirds of the positions. It was evident that many entries contained more than one control officer within them, and so these were separated. An issue that immediately became apparent from the file was the spatial difference regarding the distribution of control officers. Seven counties (Schuyler, Orleans, Genesee, Wyoming, Livingston, Ontario, and Yates) had one officer and two counties (Jefferson and Tompkins) had only two. Jefferson, which contains Watertown, is a geographically large county (1,857 mi^2).

The file did not contain any animal or dog control officers for New York City. New York City operates outside the animal/rabies infrastructure of the rest of the state. All the functions that elsewhere would be found across multiple levels of state and local government are combined within New York City government. It has its own methods of animal control, and testing facilities. It is in no way comparable to other areas in the state, and is therefore not studied.

After cleaning and separating information in the file, 684 records remained. Comparing the first file with the second revealed that in the year separating the two versions of the file there had been 175 individuals who had been removed from the database and 137 who had been added. Considering that 52 of the responders started as control officers before 1990, this means that some municipalities have changed control officers frequently. This degree of turnover is not inconsequential and may provide some explanation for the results that follow. The following map (Figure 4.2) shows the frequency of questionnaire response by county. Responses are scattered across the state, providing visual confirmation of dispersal of the respondents. Rates of response varied by county and have no visible patterns relative to population per county or median income per county. Figure 4.3 represents the number of control officers per county according to the file released in May 2005. It is interesting that the numbers of control officers is not directly related to population, nor are they related to any other known epidemiological, economic or social factor.

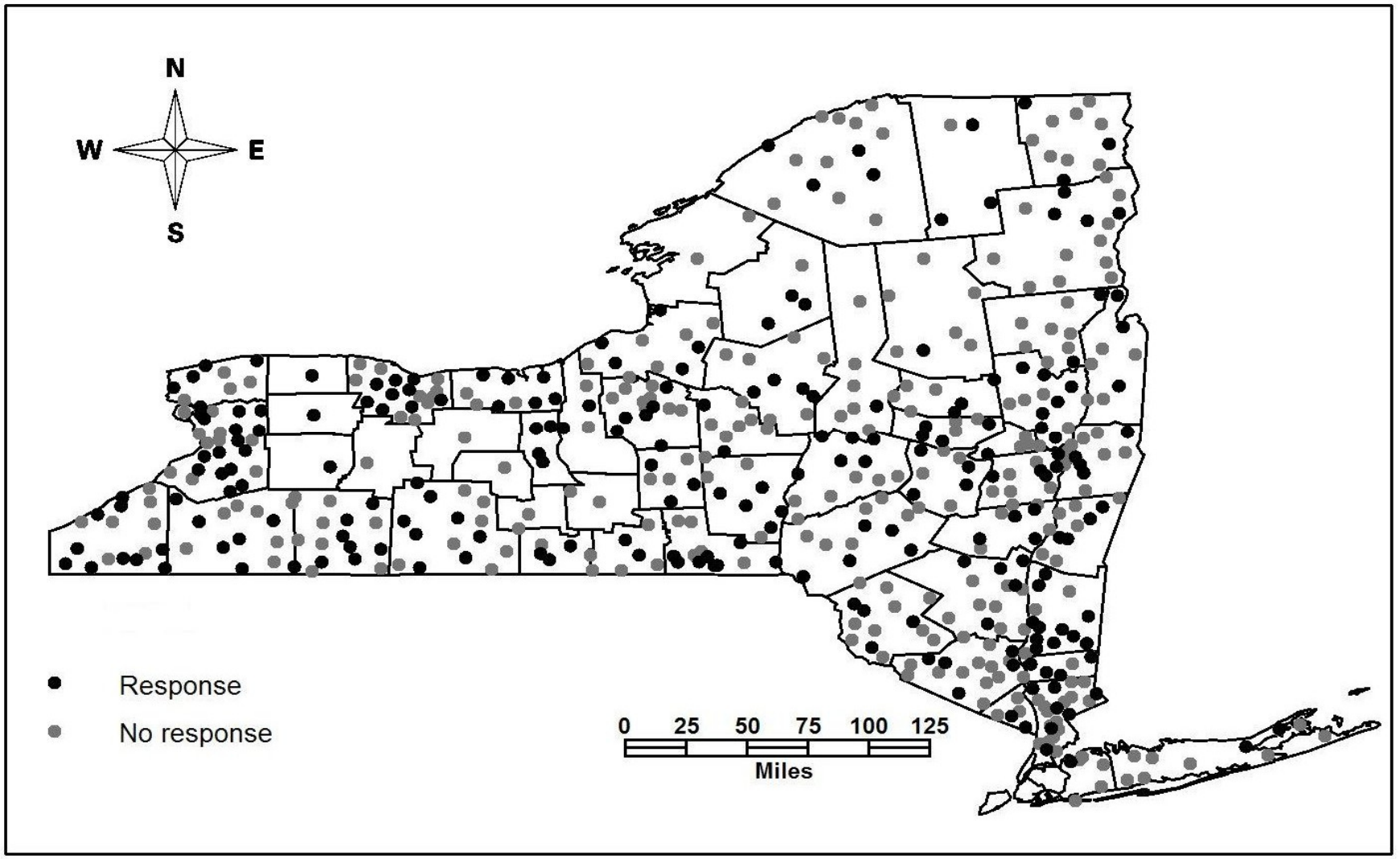


Figure 4.2 Control officers by zipcode

There were 247 responses. There are 7 counties for which there were no responses: Livingston, Ontario, Yates, Schuyler, Tompkins, Nassau, and Jefferson. All but the last two form a contiguous region roughly coincident with the Finger Lakes Region. Jefferson is a large county in the northern part of the state bordering Lake Ontario, and Nassau is a county on Long Island bordering the New York City borough of Queens

Figure 4.2 should only be seen as an approximate surface of individual respondents largely due to the fact that some control officers (8 in this study), because of the part-time and sporadic nature of the work, can contract with many places at once, and therefore several municipalities are attributable to a single person. This can cause the illusion of a high density of responses in an area, when in reality it is just one individual.

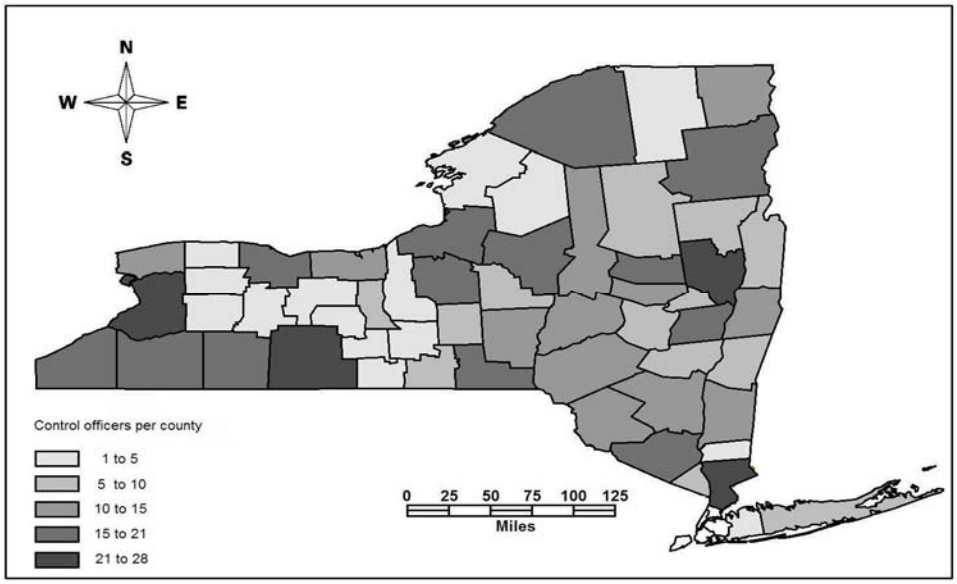


Figure 4.3 Control officers per county

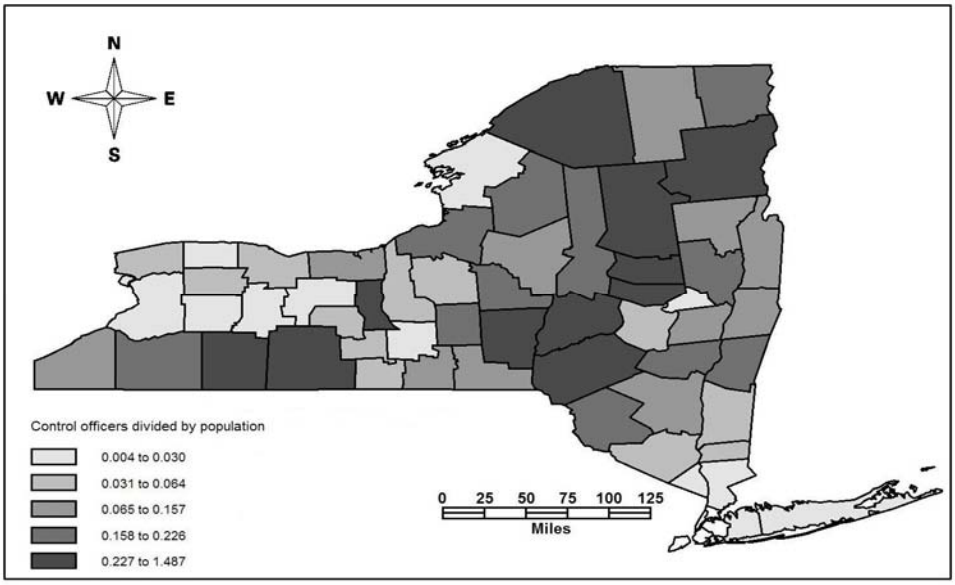


Figure 4.4 Control officers per county divided by county population

Perhaps the most useful information is gathered by studying both Figures 4.3 and 4.4. Some counties are represented similarly on both maps. On the low end of the scale, Jefferson, Schenectady, Livingston, Ontario, Yates, Tompkins, Wyoming, Genesee, and Orleans counties have the lowest number of control officers per population and control officers per square mile, while St. Lawrence, Franklin, and Montgomery have high ratios. Not surprisingly, those counties with the lowest ratios also tend to supply the fewest animals for rabies testing, except for Tompkins and Jefferson counties. These two counties have two control officers each, yet provide large numbers of animals for testing. These submitted animals are possibly related to oral vaccination campaigns (Bigler and Lein 1997).

It should also be noted that from this first round of returned questionnaires, many envelopes also contained additional items: two contained maps, and four contained extra data, most of which had been extracted from the Wadsworth laboratory website. One of the returned questionnaires contained pages from a book written by one of the animal control officers about the job. The respondents appeared to take interest in the process itself by providing their own context to the system.

From the second round of questionnaires, 247 or 36% responded, though it should be remembered that it is difficult to know the exact population of animal control officers and dog control

officers in New York, as it is commonly believed within the surveillance system that a sizeable percentage of the positions are unfilled at any given time, the consensus being 40% (Huse 2004; Trimarchi 2005). The reason for this, as previously mentioned, is that although each town is required to have a dog control officer many places have great difficulty filling this position. There is no one tasked with the job of checking for compliance, therefore many towns simply wait until the position is filled to let the state know of a change in personnel. Therefore if we accept 40%, of the supplied addresses were actually invalid, the return percentage of the questionnaires rises to 45%.

The responses were collected into an excel spreadsheet, imported into the SAS statistics package and frequencies of responses were calculated. These responses are summarized in the following section in the form of tables and graphs. Comments made by respondents, being usable data as well, were also included in the spreadsheet.

4.9 Summary of Responses to the Questions

1. What is your job position? (Q1)

There were two main choices for this category; animal control officer and dog control officer or a combination thereof. Some referred to themselves as dog or animal wardens, a term that the state has not used in many years. Other non "dog" or "animal" titles included shelter operator, police officer, or office manager, In terms of those who responded, there were 153 dog control officers, 81 animal control officers, and 5 others. Eight people did not answer this question.

Q1	**Frequency**
animal control officer	81
dog control officer	153
other	5
Total responses	239

Most respondents (64%) classified themselves as dog control officers, which stems from the fact that dog control is the state minimum for a municipality. The number of animal control officers

(34%) is meaningful considering the fact that the state does not explicitly require their services, although county and local ordinances may. There were also two police officers who responded, and two individuals charged with running local animal shelters. One town sub-contracted dog control to an outside firm, which did not appear to be a common occurrence.

2. When did you start doing this job? Broken into Question 2 Month (Q2M) and Question 2 Year (Q2Y)

This question provided a greater than expected range of values, particularly in terms of the longevity of some of the careers of the respondents. One of the animal control officers started his job in 1964. He was not the only individual whose career extended into decades, while 50 other respondents began their jobs before 1990, the first year of the epizootic in New York. Most of the respondents have been employed in their jobs less than five years, well after the introduction of the disease into the southern tier of the state in 1990.

3. Please circle which animals you encounter in the course of this job. (Q3A-Q3G)

Dogs Cats Livestock Other Domestic Animals Feral Animals Wild Animals

Other:_____

This section was split into seven variables, one for each circled response. Typically, dog control officers are expected to be responsible only for the control of dogs, while animal control officers have a much wider range. Interestingly these job distinctions were not evident through the responses. Fifty-eight (38%) of the people who responded as dog control officers listed more animals than just dogs; meaning that the title of animal control would more accurately describe their activities. The category "Other" included animals that are susceptible to rabies, such as some exotics, bats, deer, and ferrets; as well as those that are not- reptiles and emus.

Dogs	Frequency	Percent
yes	247	100

Cats	Frequency	Percent
no	102	41.46
yes	144	58.54

Livestock	Frequency	Percent
no	181	73.58
yes	65	26.42

Other Domestic Animals	Frequency	Percent
no	165	67.07
yes	81	32.93

Feral Animals	Frequency	Percent
no	143	58.37
yes	102	41.63

Wild Animals	Frequency	Percent
no	129	53.09
yes	114	46.91

Other	Frequency	Percent
no	230	99.14
yes	2	0.86

There were also two who responded to the "Other" category with "all,"

Comments that were added to the question:

"Mostly dogs, occasionally all of the above" Questionnaire 454

"I'm only supposed to do dogs and rabies response" Questionnaire 654. This respondent had checked every category available.

4. Are you a uniformed police officer of the law or a uniformed wildlife agent?

Thirty-eight respondents identified themselves as uniformed police officers or uniformed wildlife agents. Eighteen did not supply a usable variable. One of the issues that some animal control officers and dog control officers promote is the movement of these positions into the realm of

deputized peace officers, with the hope that this will increase pay scales and public/legal perceptions (Watt 2005). In many places, the connection between control officers and law enforcement is extremely distant. Many of the comments left by respondents referenced the weak links between local law enforcement, the local legal system, and animal and dog control.

Since few places deputize their control officers. 83% of the respondents are not uniformed officers of the law. Non-uniformed officers of the law in New York State are typically classified as peace officers and have equivalent legal standing to parking meter attendants– power to cite violators of the law but no power to arrest.

Q4	**Frequency**	**Percent**
Yes	38	16.59
No	191	83.41
Total Responses	22	

Comments that were added to the question included:

"I'm a peace officer for the SPCA" Questionnaire 076. Local societies for the prevention of animals (SPCA) can provide dog or animal control in the place of individuals.

"Nuisance Wildlife Control Officer" Questionnaire 379. Nuisance Wildlife control functions as a private business in New York, but the business can contract animal control services.

5. How would you rank rabies surveillance in terms of importance to your job?

The scale for this question ranged from 1- not important, to 5-most important. Seven people did not answer this question. Over one-half responded that rabies surveillance was very important to their jobs. The mean response was 4.08, a rather high value. Many of the respondents expressed a belief that rabies is indeed important to their jobs. This number does not seem to reconcile with the values given for other questions, particularly to questions six (feedback), seven (training) and twenty-

nine (access to maps and graphs). Responses suggest that the respondents believed rabies surveillance to be an important part of their jobs, though they were not typically trained to respond to rabies nor did they receive feedback or information regarding the current rabies situation.

Q5	Frequency	Percent
1	10	4.17
2	17	7.08
3	44	18.33
4	45	18.75
5	124	51.67
Total Responses	240	

6. Approximately how many times per year do you receive feedback from state officials concerning rabies?

61 responses were non-numeric, with the preponderance of these representing either non-answers or non-numeric responses. This was the first question in which respondents may have provided ranges of numbers for answers instead of single numbers. In order to account for this, the ranges were split into three separate computations. The first involved using only the lowest values in the ranges (L). The second involved using the means of the range values given (M), and the last involved using the largest values in the ranges (H). Not all responses were ranges, indeed most responses were not. This method was utilized in order to use as many responses as possible, without distorting or greatly manipulating the data supplied. Normally the ranges provided were small.

For example, if a respondent provided the "0 to 30" as an answer, then the first number would be used to calculate Q6L, 30 would be used to calculate Q6H, and 15 would be used to calculate Q6M. This method was also used in Questions 7, 13, 19, 22, and 31. Only the mean (M) values are presented in the tables, due to the fact that the differences in values were negligible. For the first set of responses, noted as Q6L (question six lower values), the values ranged from 0 to 365, with the mean

being 7.1 and the mode 0. For Q6M (question six mean values), the mean was 7.4. For Q6H (question six higher values) the mean was 7.5. Irrespective of how this is calculated, for an activity that is deemed important to the job of a control officer, the amount of feedback is not large with 63% of the respondents receiving fewer than 2 incidents of feedback per year and over one-fourth receiving none

Q6M	**Frequency**	**Percent**
0	49	26.49
>0 to 2	68	36.76
>2 to 5	35	18.91
5+	33	17.82
Total Responses	185	

Comments that were added to the question included sources of potential rabies feedback. The most often mentioned feedback was newspaper articles, followed by state government seminars.

7. Approximately how many days of rabies training do you receive per year?

The responses to this question also stand in contrast to the responses to question five, which asked the control officers to rank the importance of rabies surveillance to their jobs. Although respondents generally consider rabies surveillance important to their jobs, they appear to receive little if any feedback or training from the state. A possible reason for this is the fact that this duty, like much of the responsibility for rabies, largely falls on the county departments of health. This is also the branch of government the respondents blame most often for impediments to accurate rabies surveillance (Question 17). Whether this criticism is deserved is difficult to determine, since individual counties have different priorities, and will therefore differ in terms of their approaches to dealing with rabies.

There were 45 non-responses. For section Q7 answers ranged from 0 to 12, presumably representing never to one day per month. The mean of the numeric values for Q7L (lower limit) was

.40. The mean of the numeric values for Q7M (mean) was .43. The mean of the numeric values for Q7H (higher limit) was .46. The mode was 0, with 0 making up 161 of the responses. 80% of the responses were 0, meaning that the preponderance of control officers receive no rabies training in a given year. Figure 4.5 depicts counties in which any control officer had received any training compared to those counties in which no control officers had received training.

Q7M	**Frequency**	**Percent**
0	161	80.1
>0	40	19.93
Total Responses	201	

The comments reflect the low general level of feedback with responses citing the literature provided by the New York State Department of Wildlife Conservation, New York State Health Department, or Griffin Laboratories. All these entities supplied their own rabies literature.

8. Do you yourself provide rabies education?

This question had 11 non-respondents. 105 answered in the affirmative, 131 in the negative. Many commented that their provision of rabies education, often involved simply dispensing information that they themselves had researched, or handing out brochures that had been provided by other sources such as the county health department. The education component was included in order to determine to what degree control officers are used as a community resource for rabies information. This question, combined with the results of question seven, indicates that rabies information provided by the various state agencies may not be adequately reaching the public. This is not due to a lack of effort at the state level. Each year, the state supplies training for control officers in the state capital, Albany. However, since many control officers lack even basic supplies for doing their jobs, it is unlikely that they are given the financial resources to attend these courses. The responsibility for

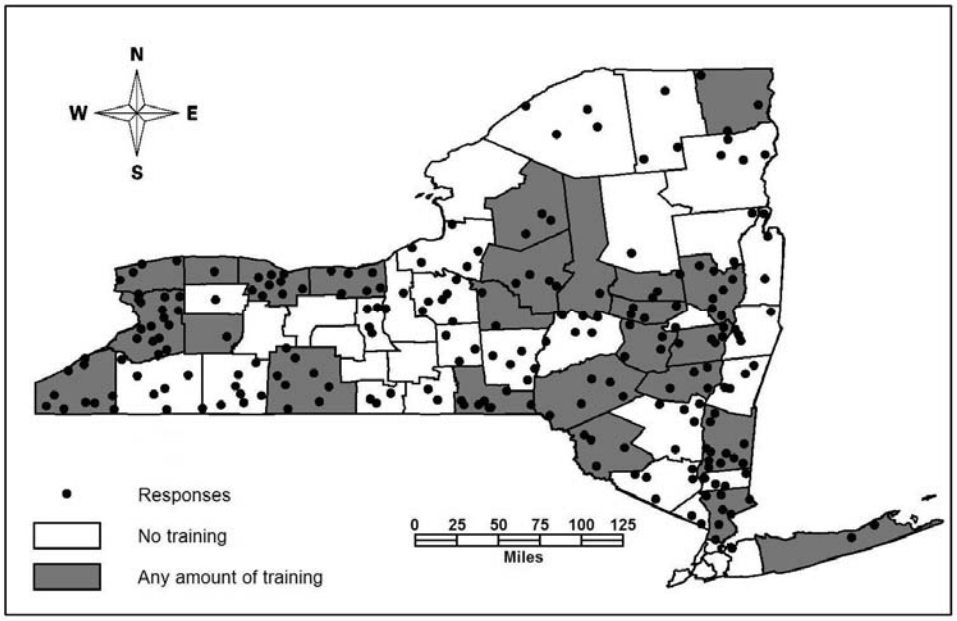


Figure 4.5 Rabies training in the previous year by county combined with responses to questionnaire

funding animal control officers or dog control officers is strictly local and limited. Many budgets for animal and dog control are small, with the control officer often supplying his/her own equipment and vehicle.

Q8	Frequency	Percent
Yes	105	44.49
No	131	55.51
Total Responses	236	

The comments indicate that control officers who provided rabies education generally did so only when called to collect an animal and that their rabies education efforts were minimal.

9. What is your opinion of media coverage of rabies?

The scale in this question ranged from 1- very low, to 5- very high. This question had 14 non-numeric responses. The mean was 2.58. Although the mode was 1 with 66 responses, signifying the lowest opinion, the range of responses demonstrates differing opinions regarding the perceptions of

media coverage of rabies. This was explained in some questionnaires as a slight tendency toward exaggeration, or a lack of gravity in reporting. Interestingly, local newspapers sometimes used control officers in their articles as local experts on the subject of rabies.

Q9	Frequency	Percent
1	68	29.18
2	47	20.17
3	65	27.9
4	23	9.87
5	30	12.88
Total Responses	233	

Most comments centered on the perception that news reports of rabies tend to be overly dramatic. Those commenting positively on rabies reporting stated that it was often the only rabies education provided to the general public.

10. Do you believe that your job is helped or hindered by media coverage?

There were 17 (7%) non-responses. There were 77 in the "Helped" category , 29 in the "Hindered", 83 in the "No Effect", and 41 for "Unknown" . Comparatively few respondents believe that media coverage of rabies is a problem as it relates to their jobs as control officers. The greatest percentage of respondents believe that media coverage has no effect. The second highest response indicated that it helps. Combining the responses for No Effect with those for Unknown effect provides over one-half of the responses. Considering that media coverage is the most common means of providing rabies education, this is not a forceful endorsement of the utility of media coverage. Reconciling these responses with Question 9 leads to the conclusion that the common perception is that media does not have much influence over rabies surveillance. Chapter 5 addresses the relationship between media and surveillance further.

Q10	Frequency	Percent
Helped	77	33.48

Hindered	29	12.61
No Effect	83	36.09
Unknown	41	17.83
Total Responses	230	

The following response is representative of most of the comments to this question.

"Sometimes helped, hindered when public is given wrong info, makes them scared, excited, etc" Questionnaire 662. Almost all of those who responded "Unknown" commented on the fact that the news can be sensible and informative or sensationalistic and disturbing.

11. What, if any, local newspaper do you read?

This question was asked in order to gain some understanding of the spatial distribution of news outlets. It is assumed that the control officers represent the general consumption of local print media in the areas under study.

12. Have you noticed any relationship between the amount of media coverage and the amount of calls for collection that you receive?

The scale ranged from 1 –no relationship, to 5- a direct relationship. Media coverage has been associated with increased public interest in rabies control. This question was included in order to determine if control officers believed this to be true. There were 23 non-responses. The responses have a mean of 2.12. 58% of respondents believe that media coverage had no relationship with the amount of animal calls they received. This corresponds with the previous question regarding the efficacy of media coverage as it relates to rabies. A possible confounding influence in this question is the fact that most respondents were dog control officers and may not have received calls regarding other animals such as raccoons. According to the respondents the relationship between media coverage and animal submissions was more apparent than real. There were essentially no comments made for this question.

Q12	Frequency	Percent
1	131	58.48
2	11	4.91
3	33	14.73
4	15	6.7
5	34	15.18
Total responses	224	

13. Approximately how many animal calls do you get per month?

This question provided a wide range of responses, which is understandable as calls necessarily decline during the cold weather, since many of the animals have become dormant, and people are less likely to be active in areas where interactions with animals most frequently occur. The mean for Q13L was 50.68 and the mode was 100. The mean for Q13M was 56.77. The mean for Q13H was 61.95. The range is perhaps more useful in this instance, from a low of 0 to a high of 1200 calls per month. In extremely remote and rural areas the demands made on a dog control officer will necessarily be quite low. In urban areas, the demands made on animal control officers can be tremendous.

Q13M	Frequency	Percent
0 to 50	170	75.15
51 to 100	30	13.25
101 to 150	5	2.2
150+	21	9.26
Total Responses	226	

Comments added to this question were mostly statements about the great degree in the variability of submissions.

14. How active a collector are you?

The scale ranged from 1 –not active, to 5- very active. The mode was five with 113 responses. There were 38 non-responses. The mean was 3.91. Collectors are apt to believe that they are very

active. This is likely due to the nature of this job. Calls within the stated jurisdiction must be answered, even if they are answered many hours after the call when the control officer leaves his or her full-time employment.

Q14	Frequency	Percent
1	30	14.35
2	7	3.35
3	30	14.35
4	29	13.88
5	113	54.07
Total Responses	209	

15. Are other collectors as active as you?

The scale ranged from 1 –not active, to 5- very active. This question was asked in the interest of determining the opinion that control officers of others in their profession. The respondents appear to be willing to be diplomatic regarding their colleagues. There were 116 non-responses. The mean was 3.52. The mode was 3 with 42 responses, with 130 responses in total. The plurality of responses in the exact middle category seems to indicate that this question carries little weight.

Q15	Frequency	Percent
1	10	7.69
2	16	12.31
3	42	32.31
4	23	17.69
5	39	30
Total Responses	120	

16. Does distance influence your likelihood of collecting an animal?

The scale ranged from 1 –never, to 5- always. This question was posed to determine the geography of animal collection with respect to distance decay. There is an established belief in the literature that distance to a testing facility affects the number of submissions. This question was asked to determine if a similar process was at work in the surveillance system. There were 39 non-responses. The mode was 1 with 159 responses. The mean was 1.63. 77 percent responded that distance was

never a consideration in animal collection. This response was explained by many of the respondents who wrote in the margins of the pages. Distance was not generally an issue, since most dog control officers and animal control officers were constrained by the terms of their contracts to never operate outside the confines of their city or town. The exceptions to this were complementary arrangements between two or more control officers to help one another, and those control officers who worked in several different places, or under different capacities, e.g. as nuisance animal removers.

Q16	**Frequency**	**Percent**
No	160	76.92
Yes	9	4.33
3	13	6.25
4	5	2.4
5	20	9.62
Total Responses	207	

17. How could the process of collection be improved?

This category was an open-ended write-in section. 120 of the responses were either unanswered or the answers were unintelligible. The remaining responses fell into a series of well-defined categories. The first category involved improvement in the compensation of control officers. Closely related to this was improving the ability of the respondents to do their jobs; better equipment, a vehicle, and more training opportunities. General communication and education between the county Health Departments, control officers, and the public was also a common suggestion. Some respondents felt that the current situation is satisfactory.

Reflecting the fact that local regulations regarding animals are highly variable, many respondents believe that laws regarding animal and dog control should be standardized as part of a greater input (including monetary input) from the state. Another common suggestion was that the public should be less inclined to deal with animals themselves, since dealing with an animal oneself typically involves killing the animal and burying it. Control officers reported that because of this

tendency, they sometimes found themselves conducting exhumations after an animal had attacked someone on the chance that an animal could still be accurately tested.

None of the suggestions were remarkably complicated, nor were most particularly expensive. Some of them, notably the ones suggesting free rabies clinics for domestic animals had been state law for several years, although some counties were in violation due to budgetary restrictions. This was best exemplified by the adoption of a law in 2005 requiring free rabies vaccinations in New York (New York Division of Agriculture and Markets 2005). This law was not the first law requiring this, but it was the first law providing financial punishments for counties that either did not provide the free clinics, or charged a required donation for a "free" clinic. Many control officers simply wanted more public participation and more respect from the legal structure.

Q17categorized	**Frequency**	**Percent**
Education/Communication	19	14.96
Law/Protocol	18	14.17
Miscellaneous	19	14.96
Money/Resources	47	37.01
Public Participation	12	9.45
Total Responses	127	

Select comments are supplied below:

"Awareness, caring, and not viewing this as a lowly job" Questionnaire 088

"Make public aware that animals should be tested. We get calls about bites days after occurrence in some cases and sometimes animal has been killed, and needs exhumation" Questionnaire 486

"More information shared between police and state agencies. Too much lapsed time. " Questionnaire 413

"Communication between county health dept and DCOs" Questionnaire 76

"Have radio hookup with Police Dept or cell phone. I have no communication at all with PD." Questionnaire 296

"Weekend & holiday collection" Questionnaire 348

“Make DCO full-time position. Most calls I receive are during the day when I'm at work, making collections hard “ Questionnaire 456

“If I were not working a full-time job during the day. “ Questionnaire 564

“More news on tv and radio. “ Questionnaire 248

“Municipalities should equip their DCOs with all the necessary tools/equipment to do their jobs effectively. “ Questionnaire 107

“More education for all“ Questionnaire 482

18. How do you feel about the budget for rabies surveillance in this county?

The scale ranged from 1- much too low, to 5- much too high. There were 84 non-responses. The mean was 2.5, which can be interpreted that the budget is generally perceived as somewhat inadequate. The mode was 3 with 64 responses, but nearly 30 percent believed that the county budget for rabies surveillance was much too low. Only 16 percent believed that the budget for rabies surveillance was high or too high. Once again, these results appear to contradict opinions regarding the importance of rabies surveillance as it pertains to the job of a control officer. This question produced no useful comments.

Q18	**Frequency**	**Percent**
1	48	29.45
2	25	15.34
3	64	39.26
4	15	9.2
5	11	6.75
Total responses	163	

19. Approximately how many animals with rabies have you collected?

This number is dependent on certain conditions. First, it is expected that the longer an officer is on the job, the more animals he or she will have collected. Second, that the control officer was employed in their position while epizootic (or at least enzootic) rabies was present. There were 119

non-responses. Numbers ranged from 0 to 500. The mode was 0 with 87 responses. This is not surprising since a large percentage of control officers began their jobs after the initial wave of the epizootic had passed. For Q19L the mean was 11.15. For Q19M, the mean was 12.18, and for Q19H, the mean was 13.21. It is understandable that people who feel that their connection to the state and local government is weak would have a good chance of being unaware of the number of rabid animals, if any, that they had caught, or even being unaware if they had ever submitted rabid animals. Interestingly, 10 of the respondents who provided a number of rabid animals answered on Question 32 that they were not part of the surveillance system.

Q19M	**Frequency**	**Percent**
None	83	60.58
More than None	54	39.42
Total responses	137	

Most comments centered on the lack of rabid animals collected. One responder was far more precise than most. "One cat, three raccoons, and a skunk." Questionnaire 094

20. How much does this county value rabies surveillance?

The scale ranged from 1- much too low, to 5- much too high. There were 41 non-responses. The mean was 3.85. The mode was 5 with 109 observations. Once again, this is a value that is difficult to reconcile with the provision of resources and feedback. The responses were similar to the following question, possibly indicating that there is little separation in the minds of control officers between the county and state governments. There were two major strains of comments for this question. The first was the idea that the county was doing very little. The other strain noted that the county provided free rabies clinics for domestic animals and that there was no human threat.

Q20	Frequency	Percent
1	20	9.71
2	20	9.71
3	36	17.48
4	29	14.08
5	101	49.03
Total responses	206	

21. How much does this state value rabies surveillance?

The scale ranged from 1- much too low, to 5- much too high. The question had 51 non-responses with a mean of 4.02. The mode was 5 with 99 observations. Although fewer officers responded to question 21 than to question 20, more responded positively, indicating that the state is considered slightly more interested in rabies surveillance than the officers' county. There were no salient comments.

Q21	Frequency	Percent
1	11	5.61
2	14	7.14
3	38	19.39
4	34	17.35
5	99	50.51
Total Responses	196	

22. Approximately what percentage of your job consists of catching rabid animals?

There were 85 non-responses. Q22L had a mean of 6.69, Q22M had a mean of 6.75, and Q22H had a mean of 6.81. The mode was 0 with 79 observations. These numbers would necessarily be small, but it is surprising that in a state that has been enzootic for raccoon rabies for over 15 years nearly half of the control officers would respond that none of their time was spent catching rabid animals. Alternatively, of those who responded to this question, over one-half spent some amount of time catching rabid animals.

Q22M	Frequency	Percent
Zero	79	49.07
More than Zero	82	50.92
Total Responses	161	

23. Have you been vaccinated for rabies?

There were 5 non-responses. 165 answered "yes" and 76 answered "no". 31 percent of the respondents had not been vaccinated for rabies. 13 of those who had not been vaccinated for rabies have submitted rabid animals, according to their answers on Question 19. Although referencing Question 22 shows that rabies is not an overarching concern for control officers, it nonetheless is a serious risk for those whose employment may put them in contact with rabid animals.

Q23	Frequency	Percent
Yes	166	68.6
No	76	31.4
Total Responses	242	

24. If you have been vaccinated, was it a condition for your position as animal/dog control officer?

Once again, this response reveals a possible lack of organization or interest on the part of the municipalities. The fact that a rabies vaccine is not required for this position could indicate that rabies is not considered a hazard of this job, even though the state was experiencing a rabies epizootic. Alternatively it could indicate an official apathy to the job itself.

Q24	Frequency	Percent
Yes	113	59.47
No	77	40.53
Total Responses	190	

25. Did you personally have to pay for the vaccination?

Very few of those who were vaccinated were expected to pay for the vaccinations.

Q25	Frequency	Percent
Yes	8	4.3
No	178	95.7
Total Responses	186	

26. Was the risk of rabies in this county ever significant?

This question establishes a baseline of rabies awareness. By the release of this questionnaire, rabies had been epizootic in all counties of New York save two, Suffolk and Franklin. Many counties had experienced several resurgent epizootics since 1990. A 31% negative response, even accounting for possible variation in the word "significant" indicates a lack of education regarding the recent history of rabies in New York.

Q26	Frequency	Percent
Yes	147	69.01
No	66	30.99
Total Responses	213	

27. If so, what year did it become so?

The results of this question have been compared to the known progression of the disease across New York from the time period of 1986 through 2005. Of all respondents, many did not provide a particular year, but instead answered with a range of years. Seventy-seven answered numeric years which have been placed as labels on the provided map (Figure 4.6). Twenty-one responded with dates that preceded their hire as a control officer. Table 4.1 demonstrates that from all respondents only eleven (14%) correctly provided the year of the beginning of the epizootic. Two of these correct

responses were given by people hired after the year that they provided as the beginning of the epizootic.

Since the first positive raccoon does not necessarily signal the exact beginning of an epizootic in an area, the responses are given a buffer of plus or minus one year. These results produce twenty-three (29%) near matches. Six of these correct responses were given by people hired after the year answered. There was not an appreciable difference between those who personally experienced the epizootic and those who did not. Those who were control officers before the epizootic reached their counties provided 73% of the responses, 82% of the correct responses, and 74% of the near responses. Often the responses were far later than the beginning of the epizootic within the county of the control officer. These numbers may reflect secondary or tertiary waves of the epizootic.

Q27	Frequency	Q27	Frequency
1975	1	1980s	2
1986	1	1990s	4
1990	12	91-93	1
1991	4	Always	2
1992	5	Before 2002	1
1993	6	Early 1980s	1
1995	17	Early 1990s	1
1996	5	Late 1990s	3
1997	3	Mid 1980s	2
1998	4		
1999	3		
2000	8		
2001	3		
2002	3		
2004	2		
2005	1		

Table 4.1 Estimated epizootic times

County	Reported Year of Rabies Epizootic	Beginning of Epizootic	Correct	Within One Year of Epizootic	
Albany	1975, 1990*, 1993*, 1995(2)*	1992	0	1	
Broome	2000	1991	0	0	
Cattaraugus	1990*	1990	1	1	
Chautauqua	1996(2)*, 1999	1993	0	0	
Chemung	1991	1990	0	1	
Chenango	2000*, 2002	1991	0	0	
Clinton	1995, 2000(2)	1995	1	1	
Columbia	1990, 1993, 2000	1992	0	1	
Delaware	1990*, 2000, 2001	1991	0	1	
Dutchess	1990(2), 1995(3)*	1991	0	2	
Erie	1990*, 1997, 2002	1992	0	0	
Fulton	1992*	1993	0	1	
Genesee	1996	1993	0	0	
Greene	1991	1991	1	1	
Hamilton	1998	1994	0	0	
Lewis	1986 (Fox)	1995	0	0	
Madison	1990*	1993	0	0	
Monroe	1990*, 1993(2), 1995, 1998	1993	2	2	
Montgomery	1992, 1998, 2005	1993	0	1	
Nassau	2004	2004	1	1	
Niagara	1999*	1994	0	0	
Oneida	1995, 2002	1993	0	0	
Onondaga	1990, 1992, 1995*	1993	0	1	
Orange	1995, 2004	1990	0	0	
Otsego	1993*, 1995*, 1998*	1992	0	1	
Putnam	1995*	1991	0	0	
Rensselaer	1997	1992	0	0	
Rockland	1991, 1992	1991	1	2	
Saratoga	1991, 1995(2)*, 2000(2), 2001	1992	0	1	
Schenectady	1992*	1992	1	1	
Schoharie	2001	1992	0	0	
Seneca	1995(2)	1992	0	0	
St.Lawrence	1997	1997	1	1	
Steuben	1990	1990	1	1	
Tioga	1996	1991	0	0	
Ulster	1995	1991	0	0	
Wayne	1990*, 1993	1993	1	1	
			11	**23**	Total

* Represents a year that occurred before the hiring of Control Officer

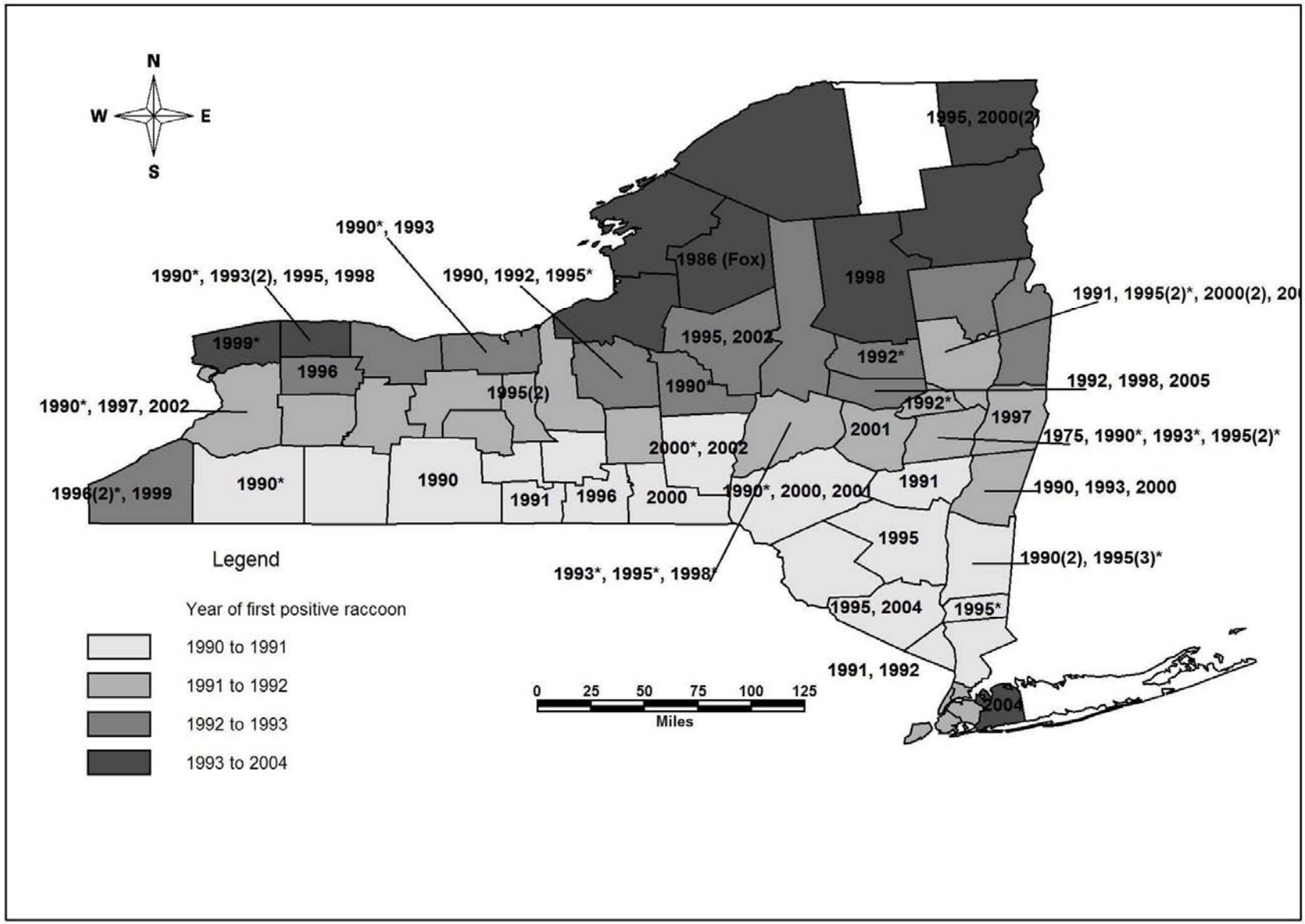


Figure 4.6 Perception of epizootic years by control officers

There were 78 numeric responses and 17 range responses to this question. Figure 4.6 consists of a base map of the raccoon rabies epizootic overlaid with the numeric values assigned by control officers for their respective counties.

28. How do you think the public perceives your job?

There were 13 non-responses. 115 answered "Positively," 27 answered "Negatively," 65 answered "Unknown" and 26 answered "Other." Half of the respondents believe the public perceives their job positively. Most of the "Other" category consisted of people who responded that the public had both negative and positive perceptions regarding animal control.

Q28	**Frequency**	**Percent**
Positively	115	50
Negatively	27	11.74
Unknown	65	28.26
Other	23	10
Total Responses	230	

Comments on this question developed the idea that public perception of the job was dependent on particular situations.

"They're positive if I'm picking up a stray, negative if they own an unlicensed dog" Questionnaire 545

"Thankless" Questionnaire 033

"They do not have a high regard for what we do" Questionnaire 399

29. Have you ever seen materials (maps, graphs, etc) created from the rabies data collected by dog control officers/animal control officers?

Most of the control officers had not seen materials produced by rabies surveillance. It is interesting that these materials are available on-line through the Griffin Laboratory, and have been so

for many years. According to an interviewed animal control officer (Questionnaire 191) in the past these materials had been mailed to all control officers, but the practice ceased at the turn of the century (2000), under the assumption that it was no longer necessary to mail them. Figure 4.7 shows counties in which any of the responding control officers had seen materials made from rabies data.

Q29	Frequency	Percent
Yes	78	33.19
No	157	66.81
Total Responses	235	

Comments in this section were generally restatements of the low level of feedback received by control officers.

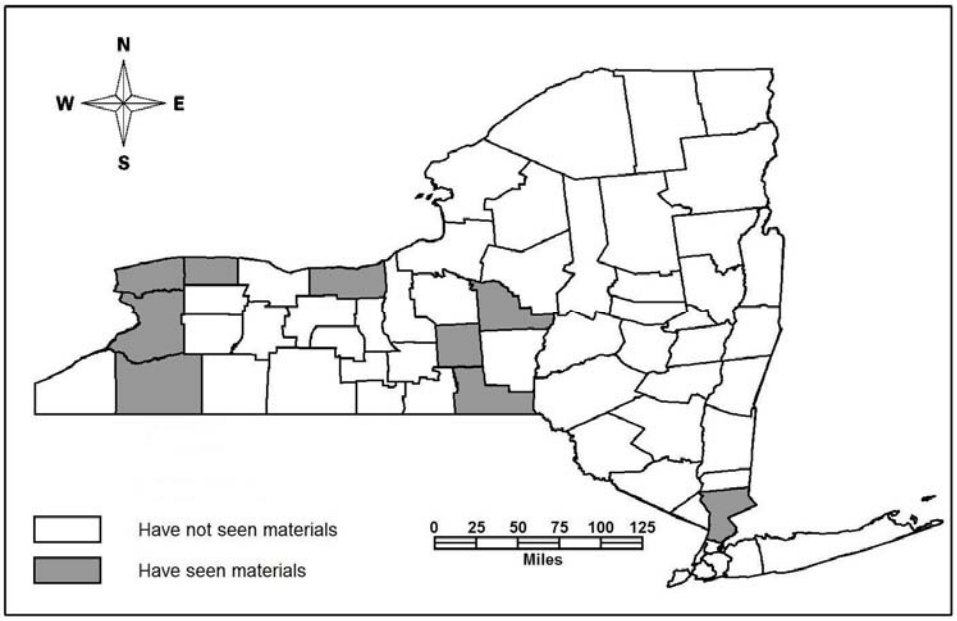


Figure 4.7 Any control officer in county has seen materials

30. What is the name of the veterinarian to whom you send suspected rabid animals?

This question was asked in order to determine if the control officers were even aware of the contact most responsible for initial processing of any rabies sample. 41% provided the name of a local

veterinarian, followed by the local health department. Interestingly, 9 percent provided the state rabies laboratory. This is perhaps a partial explanation of the fact that tremendous numbers of animals submitted for testing are submitted directly to Albany County.

Q30_ordered	Frequency	Percent
Local Health Department	35	14.17
Local Humane Society	6	2.43
Local Veterinarian	102	41.3
NY State Rabies Lab	22	8.91
Other	14	5.67
Total Responses	179	

31. Approximately how many other animal or dog control officers do you know?

Ranges of numbers were the usual response. The same method was used as for Questions 6,7,13, and 22. The mean of each range were used in place of the range, creating the "M" value. This was used to preserve as many responses as possible with a minimum of manipulation of the data. The means were 6.59 for Q31L, 6.76 for Q31M, and 6.91 for Q31H. The mode was 3 with 37 observations. In a job with little formal training or preparation, informal methods of training and communication can be very useful (Hugh-Jones 1976). One possible means of doing this is by communicating with other control officers. Most control officers have contact with other control officers.

Q31M	Frequency	Percent
0 to 3	43	19.65
>3 to 6	104	47.49
>6 to 10	43	19.64
10+	29	13.26
Total Responses	219	

32. Do you consider yourself part of the public health structure?

There were 21 non-responses. 187 answered yes and 39 answered no. The preponderance of control officers do consider themselves part of the public health structure, even if they are not paid or trained as such. Not all control officers are involved in the process of securing animals for testing. It is likely that those who responded positively to this question are involved in the surveillance process in their counties.

Q32	**Frequency**	**Percent**
Yes	187	82.74
No	39	17.26
Total Responses	226	

33. May I contact you again?

Most of the people who made the effort to complete this survey would like to be kept current of the state of this research.

Q33	**Frequency**	**Percent**
Yes	206	97.17
No	6	2.83
Total Responses	212	

34. In your opinion, what are the impediments to accurate rabies surveillance (numbers) in your area? These comments were not as easily categorized as were those in question seventeen. Law and local protocol, particularly regarding animal submissions were the most common suggestions. Most prominent was the suggestion that more animals should be submitted for testing, although this was accompanied with an understanding of the expense of such an undertaking.

"Too many agencies involved at the county and state levels. Too difficult to cut through red tape. Many people just shoot them-no reporting. " Questionnaire 375

“Failure of the health dept to pickup dead animal carcasses for testing. I had 2 dead raccoon kits from dead mother. Refusal to pick up. Others had same problem. “ Questionnaire 362

“I, being just dog control don't have the exposure to all other animals, like an ACO, or wildlife nuisance animal control. “ Questionnaire 197

“There really is no rabies surveillance in the county, only emergency response. “ Questionnaire 662

“I am only dog control, but I receive many calls for feral cats and nuisance wildlife so no info is being forwarded. “ Questionnaire 208

“Bureaucratic BS“ Questionnaire 210

“No one to collect sick animals-only 3 ACOs in county and I'm the only one available 24/7. “Questionnaire 445

“Rural area, most suspected animals are shot and buried no report made. “ Questionnaire 545

“When I was hired nothing was said about rabies. “ Questionnaire 426

“#1 impediment is an ignorant DOH, they tell people to put live bats in the freezer“. Questionnaire 680

Q34categorized	**Frequency**	**Percent**
Education/Communication	19	17.18
Law/Protocol	32	28.82
Miscellaneous	33	29.73
Money/Resources	12	10.81
Public Participation	15	13.51
Total Responses	111	

4.10 Conclusion

The results of the survey present an unclear picture. Control officers as a rule consider themselves part of the surveillance structure, but they are not regularly trained, inadequately equipped, or even supplied with information regarding their rabies submissions from the state government. Control officers operate within local government, but must often cooperate with the county health department. Their position within the surveillance system is evident in the provision of resources for

them. Media coverage, the prime means of educating the public on the subject of rabies, is seen as having little influence.

Much of the problem of keeping control officers informed stems from the fact that budgets for animal control are variable across space. The rate of turnover among control officers can produce a population that has a minimal knowledge of rabies, and rapid turnover may serve as a disincentive for municipalities to invest in rabies training.

The rate of rabies vaccinations (Question 23) are a good metric for judging the perceived risk of rabies for control officers, both by their employing municipality and by the officers themselves. It is also indicative of the way the municipality considers the job itself. It is unlikely that a control officer who felt threatened by rabies would continue his or her service while not vaccinated for rabies.

In summation, it is difficult to justify the assumption that data generated across the state of New York is unbiased in its likelihood of initial submission. Whether or not animal control is available or on duty, or trained to retrieve a rabid animal, will certainly affect whether the animal is submitted for testing. Although local health departments cover the most basic rabies necessities, the deficiencies highlighted including spatial bias in the dog and animal control system are likely to have a major impact on any passive rabies surveillance system.

CHAPTER 5 COMPARING NEWS REPORTING TO RABIES SUBMISSIONS

5.1 Introduction

When trying to gain insight into an epidemic or epizootic, it is important to understand not only the distribution of cases, but also the public's perception of the disease. This chapter investigates this perceptual surface by concentrating on a major contributing impact, the role of the media.

Local news is skewed toward human interest rather than an accurate portrayal of the current disease situation. For example, there is far more human interest in discussing an animal attack, or showing a photograph of a dog getting a rabies vaccination, than an objective statistical breakdown of disease presence. It is notable that in rabies related stories, photographs of animals, which impart very little information, far surpass the number of informative maps. Unfortunately, a large portion of the public's source of health information originates from broadcast and print media. Other sources of information, such as word of mouth, or pamphlets provided by government sources are in the first case often inaccurate and in the second, rarely utilized and inconsistently distributed.

To some degree there is feedback between the public, the public health (surveillance) structure, and the media regarding health news in general. It is presumed that public interest drives the actual production of media reports, and media reports can, in turn, spark public interest. However, neither of these can generate news regarding rabies without input from the surveillance structure. There is a difference between an animal behaving suspiciously and a rabid animal. Public health authorities provide the necessary verification of disease presence. In terms of rabies the connection between surveillance and media dissemination often begins with a media outlet being given the news that a local animal has tested positive for the disease, or that in areas that have become accustomed to rabies, there is an upswing of positive cases.

The expected goal of alerting the public about a health risk is that the people concerned will educate themselves and respond to the potential disease threat in a sensible and appropriate manner. However, reactions often depend on what and how information is presented. Perceived risk of rabies is often higher in those places in which it is not present. This is due to the fact that diseases that seem unusual or exotic (like rabies) generate more fear than a disease that has far greater mortality potential, but is also more mundane (like accidents in the home). Unfortunately, media plays a large role in the creation of these irrational fears about the exotic or improbable. As previously suggested, there is even a geography to this irrationality, as media coverage about an event may be far from the actual source of infection. This was seen in Kentucky where the reporting of a human rabies death on the Tennessee border generated irrational concern in the form of elevated bat surveillance for the area surrounding Lexington, where the largest readership of the paper resided (Curtis, Heath et al. 2005). It has long been recognized that disease panic can be in and of itself a significant social problem. A disease panic that occurs in an area without that disease can have few positive consequences.

An integral part of the public/media information cycle are the officials involved in dealing with the epizootic, as discussed in Chapter 3. This group sits between the public and the media. The media is reliant on information provided by this group, and the resulting skill in disseminating this information to the public will in turn affect public perception, which may in turn increase or modify public inputs into the surveillance process (such as the increase in bats being submitted for testing in Kentucky). This group will also interact with the public via animal calls, or general questions about rabies. Unfortunately, and as was seen in Chapter 4, local surveillance officials who work directly with the public (control officers) are often the least trained for this activity and physically the farthest away from the centers of information and the experts who reside there. This is not a criticism of the system in New York per se; it is simply a general statement of the structure of the dynamic process of disease

surveillance. It is understandable that in such a spatially variable information surface, public perception is almost wholly informed by the media.

5.2 Alternatives to Newspapers

Newspapers remain the only real method of dispensing rabies information at a county or local level as during the period of the epizootic rural connectivity to the Internet was sparse, and *local* television stations originated from the closest large city, which could be hundreds of miles distant. Even today, although some county health departments have devoted web space to rabies education, the coverage is far from uniform, and tends to fall along the line of general education. Only the Wadsworth Center provides a report of the current rabies situation, and that is only at the state level. Information regarding rabies is not sent from government agencies directly to the general public, nor usually is it even sent to the control officers. Indeed, the usual channels of information dissemination are through existing media outlets. This represents another intersection between the formal and informal portions of the surveillance structure. The weakness of this connection is the fact that newspapers can choose not to run articles on the current rabies situation if it is not deemed "newsworthy". This is what typically occurs after the initial shock of the epizootic is over.

5.3 Newspapers in New York

New York is a national information distributor. The New York Times and Wall Street Journal cater to national or even international audiences. That also means that newspapers produced in New York City also carry a great deal of market gravity within the state market. To some degree, this adds a non-spatial element to this study. Particularly newsworthy rabies news from across the state is concentrated in New York City. For example, the various wildlife vaccination schemes, notably vicious animal attacks, and rabies deaths within the United States are all represented in the New York Times. Local newspapers are not likely to carry such articles. However, this situation is better than for

many other states as much of the news appearing in the New York newspapers is generated in New York. Many other states look to New York for their news, but as the top of the news hierarchy, New York looks to no other state. This has the benefit of limiting the influence that rabies reporting in other places may have on New York. Of course, particularly "newsworthy" stories from other states, especially those concerning human fatalities, will still be reported.

During the period under study (1986-2006) there were several national newscasts which discussed rabies. Bearing in mind that many national newscasts originate in New York, these newscasts could have served to make the New York rabies epizootic seem like a national rabies epizootic (which in fact it was). Even more than newspapers, New York broadcast news provides a means of distributing local news to the rest of the country.

5.3 Newspapers

It has been previously recognized that the relationship between surveillance positives and the actual rabies surface is suspect, largely due to the biases inherent in surveillance operational structure. Therefore, the media reports of this chapter are compared to submission numbers rather than positives. This comparison is useful because both these quantities are known, and submissions are important in that they represent public participation in the surveillance network. Although neither public activity nor news reporting should impact the percentage of positive raccoons, since this is a biological process, media coverage can influence public perception, which in turn can increase surveillance numbers and change the number of collected positives.

5.5 Local Versus National Reporting

Certain events occurred during the time span of this research that are reflected in the news reporting about the disease. The four most notable occurrences are the death of Kelly Ahrendt (Altman 1993), an unnamed Ghanaian professor (2000), an idea regarding the death of Edgar Allen Poe (NYT

1996), and the story of Jerome Andrulonis (Faber 1989). Since these events as a group have an impact on the reporting of rabies in New York, they deserve some explanation. In 1993, Kelly Ahrendt, a 14-year-old girl from Connecticut, died of bat rabies. In September 1996, the idea that Edgar Allen Poe died of rabies was presented to the world. September 2000 brought the news of an unidentified Ghanaian professor who died from rabies shortly after entering the United States. The story of Jerome Andrulonis enters public record in 1977 when an accident at Griffin Laboratory exposed him to an aerosolized live rabies vaccine. Although partially immunized, he contracted the disease. He did not die, but did experience significant brain damage. His wife sued Griffin Laboratories, and consequently, the State of New York. She won the initial case and all subsequent appeals and was eventually awarded a large sum of money for the care of her husband. Interestingly, the sole known human death to be attributed to the raccoon rabies variant in 2003 generated little coverage, probably because it occurred in Virginia and not New York. These stories, particularly that of Kelly Ahrendt, elevated the status of rabies in the media in a way that raccoon deaths could not. It was coincidence that her death was at the height of the rabies epizootic in New York, but it is likely that the death of a child had an impact in terms of public interest.

Although newspapers have been subject to competitive pressures for some time and mergers have produced some degree of uniformity in management, at least among components of large publishing firms, local newspapers remain idiosyncratic. Even considering news feeds from the Associated Press and other homogenizing factors, local differences are still apparent. In a manner that bears little relationship to population size, readership, or socio-economic circumstances, rabies reporting is locally variable.

Regarding the actual reporting of local cases, there was a general script that was followed by many of the newspapers. As the disease approached there was a tendency to report each new case until

it reached the city or town of the publisher. This first stage was accompanied by public service announcements regarding rabies safety, particularly as it related to dealing with wildlife and caring of domestic animals. Rarely did the rabies enumeration last beyond the single digits; there were no headlines of "20th raccoon in found area." Typically by the time it had reached this level it had ceased being news, especially as cases in the surrounding areas were also becoming more commonplace. Once the wave had passed, generally in the spring, headlines bearing a message similar to "Rabies remains a threat" would begin to appear and remain as occasional fixtures to the present being presented in a similar context to Lyme disease and West Nile Virus.

Certainly the relationship between newspapers and levels of rabies submissions may be complex, indirect, or even tangential, but some relationship is evident in many of the following graphs (Figures 5.2 to 5.27). Rabies submissions increased across the state during most of the period, meaning that as time passed more and more animals were sampled.

5.6 The Tone of Articles

Typically the articles were not panicked in their tone or message. In fact some articles urged calm and warned against over-reacting. While many are dry presentations of facts and figures, others develop their messages beyond simple warnings or dispassionate presentations of data. A few provide maps of the advancing epizootic. Many of the pictures that accompanied the articles were of cats or dogs awaiting vaccination.

There was an interesting social context to rabies in the early nineteen-nineties. Although New York had witnessed an epizootic of fox rabies that ended at roughly the same time as the introduction of raccoon rabies into New York (Chang 2002), it was much smaller in terms of spatial extent and quantities of submitted animals than the raccoon rabies epizootic. Rabies as a true threat to people had practically disappeared with the successful vaccination programs of the 1950s, the result being that

although rabies was still present it had lost much of its ability to inspire fear. However, when rabies re-emerged it was contextualized in the form of a re-emerging "threat". It was an old familiar disease, believed conquered, that had returned. It was almost new again, and it certainly was exotic. The articles often have an incredulous tone that the disease could be making a comeback.

Due to the fact that as a disease that generally does not affect humans, and therefore seems less serious, the emphasis of many of the stories was on control and prevention. Articles report on "doggone shots" or "sticking it to rabies, or "Take a bite out of rabies," but the most immediate and instructive turn of phrase was the following, "Rabies attacked by air and land." This phrase related to the manner in which oral rabies vaccines were distributed, either by hand or airdrop. Martial language is not uncommon in articles of disease, but this sentence became for a time the most common headline regarding rabies. It was even quoted without attribution in some of the surveys of the animal and dog control officers. The similarities between articles indicate that much of what was presented as news were in fact press releases from various wildlife or health authorities. This situation had been bolstered by the fact that much of what is published in local newspapers is not local, but instead gathered, prepared, and distributed by news services, or simply by large, consolidated media companies such as the Associated Press.

The epizootic had some unexpected results in terms of animal public health in New York. In many places it elevated the status of members of the surveillance system into a type of celebrity status. This status, of course, presents itself as a spectrum ranging from the local animal control officer in the small local newspaper to the head of the Wadsworth Center being interviewed for the New York Times. The most notable of these rabies celebrities was the previously mentioned Ward Stone, the director of the Wildlife Pathology Unit at Five Rivers in Delmar, New York, a suburb of Albany. He appeared regularly in newspapers during the height of the rabies epizootic, and was also a vocal critic

of the restrictive policy of testing utilized by many health departments. These were policies that he himself helped circumvent (Stone 2005). Mr. Stone became well enough known because of the rabies epizootic that he was able to develop a weekly radio show devoted to environmental concerns on National Public Radio affiliated stations in the northeast. This show, In Our Backyard, is available as a podcast to the rest of the world (Stone 2006).

Charles Trimarchi, the former director of the Griffin Rabies Laboratory and current director (as of 2006) of the Wadsworth Center which contains Griffin, was a frequent contributor to the media, and used the media interest in rabies as a chance to instruct the public on animal disease in general. In this way celebrity status associated with rabies surveillance actually facilitated a means to educate the public in a way that simply would not have occurred in the absence of media interest. At the local level, many newspapers would interview the person they felt was most knowledgeable regarding rabies. This was not generally a representative from the health department, but a local control officer. This is understandable given the association between dog and animal control and animal disease.

As news becomes more homogenized it necessarily becomes less local. It is evident that Health authorities have an understanding of the media, at least insofar as it can be used to serve the public interest in disseminating health information. Newspaper editors, however, are the people who decide what is printed and what is not. Charles Trimarchi (Trimarchi 2005) made the point that often good articles were either published with misleading headlines, or simply not published at all.

5.7 Public Input

The public has few outlets to express their opinions and observations. One of those outlets is the opinion column. Opinion columns are not a true public forum in that they are managed by the newspapers themselves. Nevertheless, they provide some insight into the social context in which the newspaper operates. Of course there is a bias associated with opinion columns; only particularly

motivated people write to them. Therefore these columns cannot be considered representative of the population at large, though they are likely to demonstrate (usually more extreme) common perceptions of the period. The overarching concern demonstrated by writers to opinion columns is a belief that the government response to the epizootic was inadequate. This attitude was not isolated to the opinion columns, as demonstrated in the following article appearing in the Syracuse Post Standard titled "Rabies encounter is a maddening experience: One woman's ordeal in the case of rabies and red tape." (Jackson 1993). This article makes two major points that are echoed in numerous opinion columns. The first is that it can be difficult to find the person responsible for removing dangerous animals, if such a person even exists for that particular place. The second is the fact that even if the animal seemed rabid, and the person who called was fearful for his or her personal safety, without a contact the animal would not be tested. This sentiment is understandable given the official warning concerning the epizootic. The public had been told about the dangers of the disease, and yet the limitations on testing only allowed particular animals to be examined. Another problem highlighted was response time; there was almost universal condemnation of the amount of time it took local authorities to respond.

One social struggle that displays itself in the public sphere is the animosity between hunters/trappers and animal rights activists, a struggle that relates to animal control. There are two general types of control officers, those who see animals as resources and those who see them as fellow creatures with rights. This division is mirrored in New York society, with public opinion generally divided between these two poles. Since rabies testing requires killing the animal to be tested, many expressed the opinion that testing for rabies was immoral and was essentially the same as hunting. The usual course of events would involve a trapper who would write an article offering trapping as a form of rabies control. Trapping and hunting have historically been used as rabies control, but in recent

times they have become distasteful to some. The response to such an "offer" would be concerns regarding the efficacy of trapping as a form of rabies control, and invariably a declaration that trapping was cruel and inhumane. Such public conversations were found in many newspapers, but in each case the conversation only occurred once. It seems likely that newspapers exercised their control over the forum to forestall what has the capacity to be an endless and acrimonious argument.

Two opposing themes describe an interesting ambivalence in the public. Within one theme, two factors are working together; decades of a lack of rabies danger, and a significant increase in the idea of animal rights (Singer 2003). It may be difficult for many to consider that animals can be a threat in any way. The other theme is simple fear, particularly fear of a devastating disease. Fear of disease is a powerful motivator both in terms of individual action, but also politically, as it can be utilized to spur improved systems of surveillance or better funding of public health projects. An article in the Syracuse Post Standard was dedicated to this debate between animals rights and rabies control (Standard 1993)

As an example of how this fear could manifest, another common theme in the opinion columns was the concern about a perceived lack of rabies testing. This complaint centered particularly on the health departments' testing protocol. The testing protocol required that any unvaccinated suspected rabid animal that had contact with a human or domestic animal be tested for rabies. During rabies epizootics, this protocol provides little solace to a heightened public fear of the disease, which can manifest itself in unreasonable ways. The most common manifestation of this fear is a desire to test any animal that presents itself. When writers to newspapers expressed anger that a particular animal had not been tested, their complaint was really their need to provide relief from rabies anxiety rather than a condemnation of existing protocol logic.

5.8 Spatial Reporting

In terms of reporting rabies cases, local newspapers will, obviously, concentrate on local positive rabies cases either within their area of readership, or proximate to it, resulting in an interesting geographic pattern to the stories. During the epizootic, cases were generally reported when approaching from the south, with reports shifting to cases within the county, then in the immediate neighboring counties, before the number of stories dramatically declined, even if the epizootic raged in other parts of the state.

News stories also follow patterns of reporting within the newspaper. By examining the New York Times for the years 1985-2005 it was observed that stories about diseases, like those of other topics, tend to have a life span. They originate in the back pages, sometimes rise to prominence in the headlines, and then recede back into the depths of the newspaper, eventually disappearing. Analysis is made more difficult by the fact that there are strong non-temporal and non-geographic elements to the surveillance data. The fact that Albany, Erie, and Westchester counties have continuously increasing rabies submissions across time is problematic. The fact that many smaller counties submit almost nothing adds another confounding influence.

5.9 Methods

5.9.1 Selection of Newspapers

There were over 40 daily newspapers in New York that were initially available for this study. These are scattered across the state, and range dramatically in readership. Each newspaper was analyzed separately for the period specified, with attention being paid to the relationship between the presentation of rabies or raccoons and the progress of the epizootic. The newspapers selected for this part of the study had to meet certain criteria, listed as follows:

1. They must be daily newspapers, providing a source of news essentially without a break during the entire period between 1990 and 2003, at a minimum. In keeping with this requirement, it was also considered important that the paper did not significantly change its position within a community within the period in question. This is to say that it wasn't bought and transformed into a branch of another newspaper. Such a change could potentially introduce a discontinuity that has little to do with local events. Like many places in the United States, New York has experienced significant media consolidation. Many newspapers merged or simply disappeared during the 1990s. A news source that did not survive the period of study is not included in the analysis, but may be used as a source for maps and graphics.

2. Archival copies must be available for the entire time period. Many smaller news sources do not index their older issues, and in fact keep poor records of their previous editions (see Appendix B for a detailed description of the indexing problems associated with New York newspapers). Without newspapers for the entire time, it would be difficult to determine changes in the level of reporting on rabies.

Not all counties or boroughs have daily newspapers, and some counties or boroughs have more than one. The distribution of newspapers in New York is spatially uneven. Every effort was made to find suitably representative newspapers for the entire state. Some parts of the state do not have high levels of newspaper coverage, notably the Adirondack region and parts of western New York, excluding the Buffalo and Rochester areas. Other parts of the state have much higher levels of coverage, particularly around New York City. Each newspaper was compared across time in terms of the progression of the epizootic. This had the added benefit of studying the response of each newspaper as the epizootic reached its own particular county. Particular attention was directed toward those newspapers that were listed as local newspapers by the animal and dog control officers in the

survey (reported in Chapter 4). The newspapers most often listed by the control officers were the Syracuse Post-Standard and the Buffalo News. There is no obvious reason for this, other than the possibilities that they do not have significant competition within their zones of circulation, and they are associated with sizable cities within the state.

Another problem discovered in locating data is one of simple physical existence. Some of the local newspapers were either never microfilmed, microfilmed inconsistently, or some of the only existing microfilm was lost or ruined. Remarkably, even the state archive in Albany was regularly unable to locate a particular microfilm within the state, necessitating a trip to that newspaper's office. Although New York City produces more newspapers than any other part of the state, newspapers such as the New York Times or the Wall Street Journal are actually national news sources. They do, however, make up part of the news sources that are available to New York readers. After considering all limitations, thirteen newspapers were selected for this study. As a group they are representative of newspapers in New York, ranging from small local dailies in Oswego to the New York Times, a flagship newspaper for the entire country. They are represented spatially in Figure 5.1.

There is more to understanding newspapers than their spatial distribution. Readership is also a relevant factor in terms of a newspaper's ability to broadcast a message, as well as the fact that larger newspapers may have more resources to devote to a rabies epizootic. The circulation data are represented in Table 5.1

5.9.2 Selection of Articles

It is important to establish a working definition of a rabies article. First, the article must actually be in some way about the disease of rabies, and is not simply using rabies as a metaphor, or for humorous effect. The language surrounding rabies has passed into popular culture through the use of terms like “rabid sports fan” or to a lesser extent “mad dog”. A simple text-based search of the term “rabid” in a

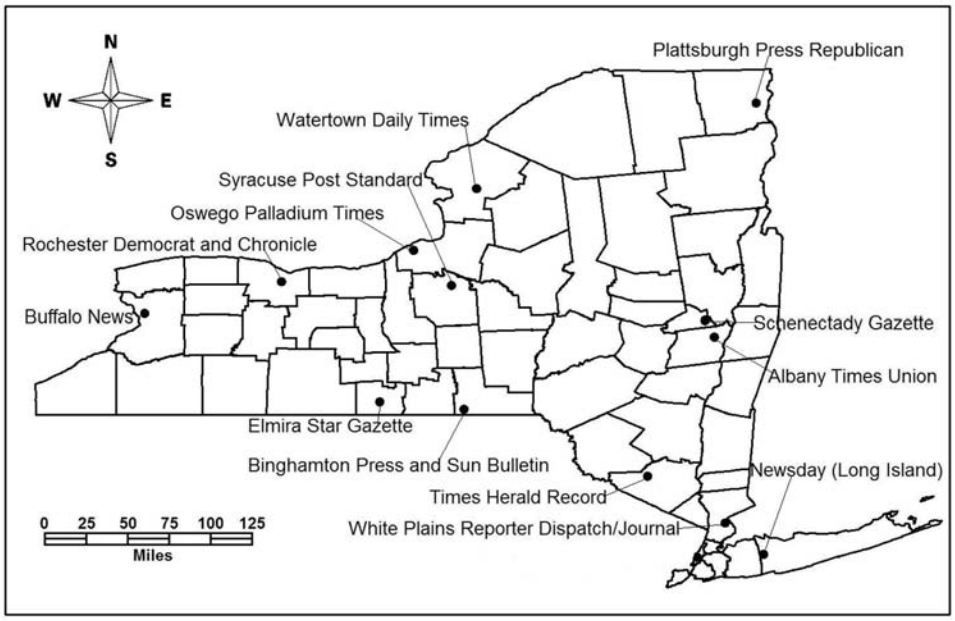


Figure 5.1 Newspapers selected for comparison with rabies submissions

Table 5.1 Newspapers ranked by circulation. Source: *Standard Periodical Directory,* New York: Oxbridge Communications. 1995

Oswego Palladium Times	9882
Plattsburgh Press Republican	23263
Elmira Star Gazette	35170
Times Herald Record (Middletown)	40996
White Plains Reporter Dispatch/Journal	55084
Schenectady Gazette	61503
Binghamton Press and Sun Bulletin	71126
Syracuse Post Standard	91629
Albany Times Union	109710
Rochester Democrat and Chronicle	133239
Buffalo News	314800
Newsday	720352
New York Times	1187950

news database will return more non-health related results (mostly for sports) than actual articles about the disease. Second, the article cannot be in the form of a community calendar or similar product. This is due to the fact that these calendars often repeat and would inflate the number of rabies articles for the time period. Third, the articles cannot be about pet adoption, which often includes a mention of rabies in a legal disclaimer.

For each newspaper selected, all rabies articles were summed to yearly values and recorded as records in a spreadsheet. Added to this data were the number of rabies submissions by county per year in New York State, and the number of rabies submissions for the entire state per year. The spreadsheet contained two sets of data, broken into two time periods; 1989-1996 and 1997-2005. This was done in order to account for the change in the disease itself, as it shifted from an epizootic to an enzootic phase in New York State. The document produced was imported into the SAS statistical package version 9.1.3 (SAS 1999). Proc corr with the Spearman option was used to produce Spearman rank correlation coefficients for each newspaper in each temporal category (1989-1996, 1997-2005). Those counties with correlation coefficients greater than 0.7 and $p < .009$ were retained as highly correlated to the number of rabies articles from that newspaper. The highly correlated counties were used to produce maps depicting the correlated counties in relation to the site of each newspaper. Not all newspapers had numbers of articles that correlated with counties' rabies submissions, and some of those that did correlate did so in spatially unexpected ways.

5.10 Results

It is useful to compare by year the number of rabies articles from a newspaper and the number of rabies submissions made in the county containing that newspaper. This comparison is presented in the form of a graph for each newspaper. In order to scale the data into more useful graphs, rabies submissions and number of rabies articles are transformed into their natural log values. These graphs

demonstrate visually the relationship between a newspaper and the rabies submissions in the county in which the newspaper is located.

There is a degree of homogeneity in rabies reporting in New York across this time. In terms of rabies submissions at the state level 17 counties show a high correlation ($r > .70$, $p < .009$) with state rabies submissions from 1986-2005 (Figure 5.2). It is notable that these counties represent a nearly contiguous line across the state from west to east. The pattern of the map is similar to the map of rabies submissions in 1993 standardized by 10,000 human population (Figure 3.8). 1993 had the largest number of rabies submissions and the highest percentage positive of any year.

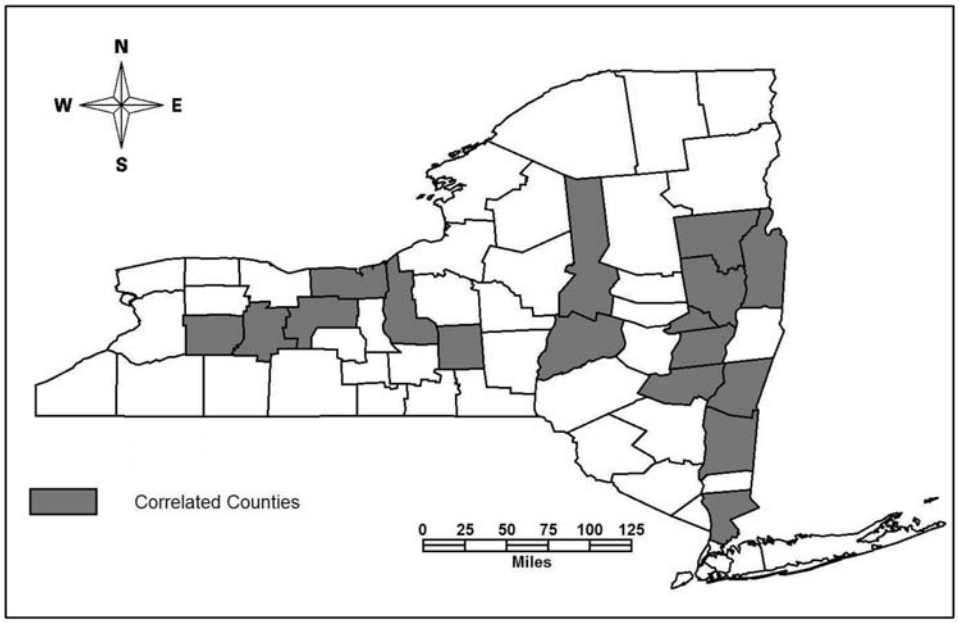


Figure 5.2 Counties with rabies submissions that correlate with state rabies submissions 1986-2005

The newspapers have been divided spatially into regions; Southern Tier, Southeastern, Capitol Area, Western, Northwestern, and Northern Tier. These regions are presented in roughly the order in which the epizootic arrived. Within each regional section, each newspaper is described and its respective results presented. The regional data are summarized in Appendix C.

5.10.1 Southern Tier

- **Binghamton Press and Sun Bulletin**

The Binghamton Press and Sun Bulletin is a newspaper with a circulation of 71,126 and serves the Broome county area. This county borders Pennsylvania, and consequently was among the first counties to experience the epizootic in New York. The newspaper has an online index that is only available from the Broome County Public Library. The index does not include the year 1990, which would provide the most useful data. It would appear that after the initial shock of the epizootic passed, so did rabies reporting, only to resurge later for indeterminate reasons.

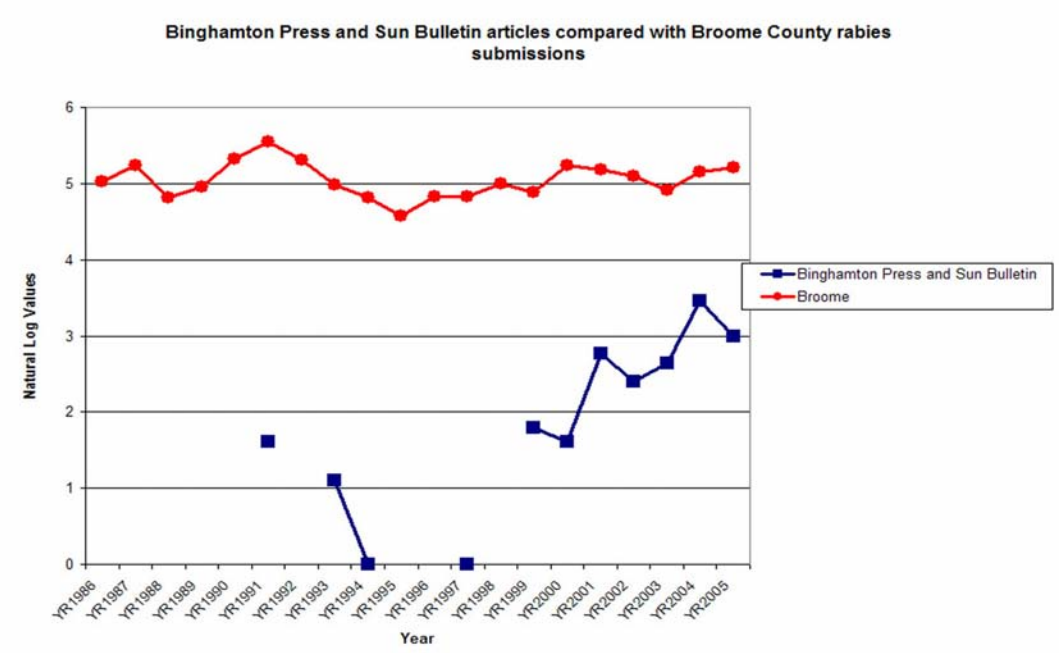


Figure 5.3 Binghamton Press and Sun Bulletin articles compared to rabies submissions in Broome County, New York

There is little evidence of any relationship between numbers of articles in the Binghamton Press and Sun Bulletin for the 1989-1996 time period and any county's animal submissions, possibly due to the very early peak of the epizootic relative to the rest of the state (Figure 5.3). Interestingly, this newspaper only showed correlations in the 1997-2005 period. Rabies submissions from Putnam

County (r =.8833, p =.001) and Suffolk County (r =.9000,p= .0009) were correlated to rabies articles from the Binghamton Press and Sun Bulletin (Figure 5.4).

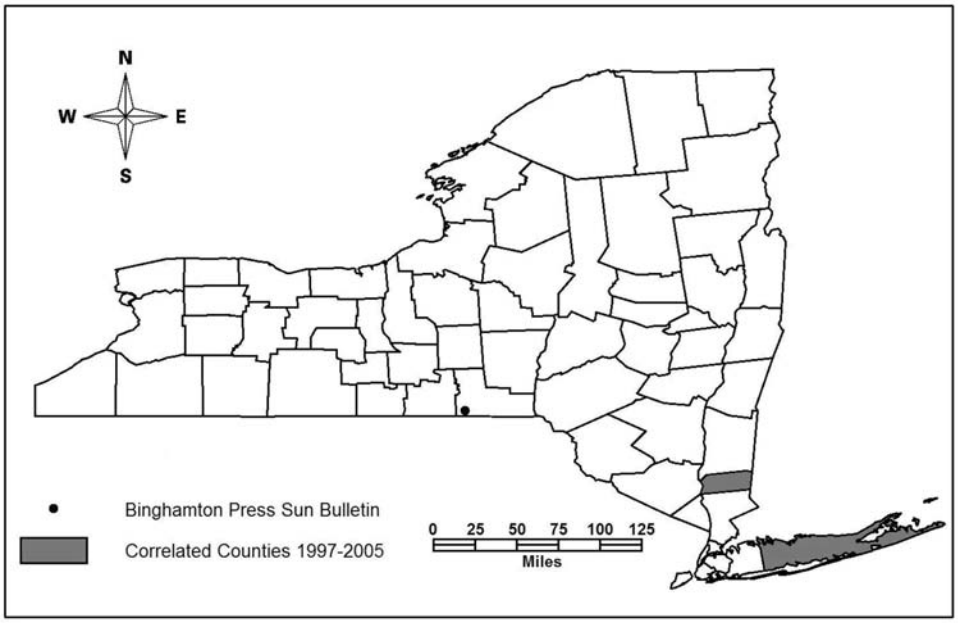


Figure 5.4 Counties with rabies submissions that correlate to Binghamton Press Sun Bulletin articles, 1997-2005

- **Elmira Star Gazette**

Also along the Southern Tier of New York, the Elmira Star Gazette has a circulation of 35,170. Its index extends further and supplies useful data back to 1986. The index is in the form of a typed and cross-referenced card file in the Elmira Pubic Library. Hardcopies are generally not available in the New York State Archives.

The relationship between the Star Gazette and rabies submissions in Chemung County is evident in Figure 5.5, on which the beginning of the epizootic in the state is apparent in 1990. The values roughly correspond, although it is clear that in this instance rabies submissions change more gradually. This is understandable considering that newspapers are controlled by a small number of editors, whereas rabies submissions are much more complex products. Unlike many of the other counties, rabies submissions in Chemung County do not correlate with rabies submissions for the state.

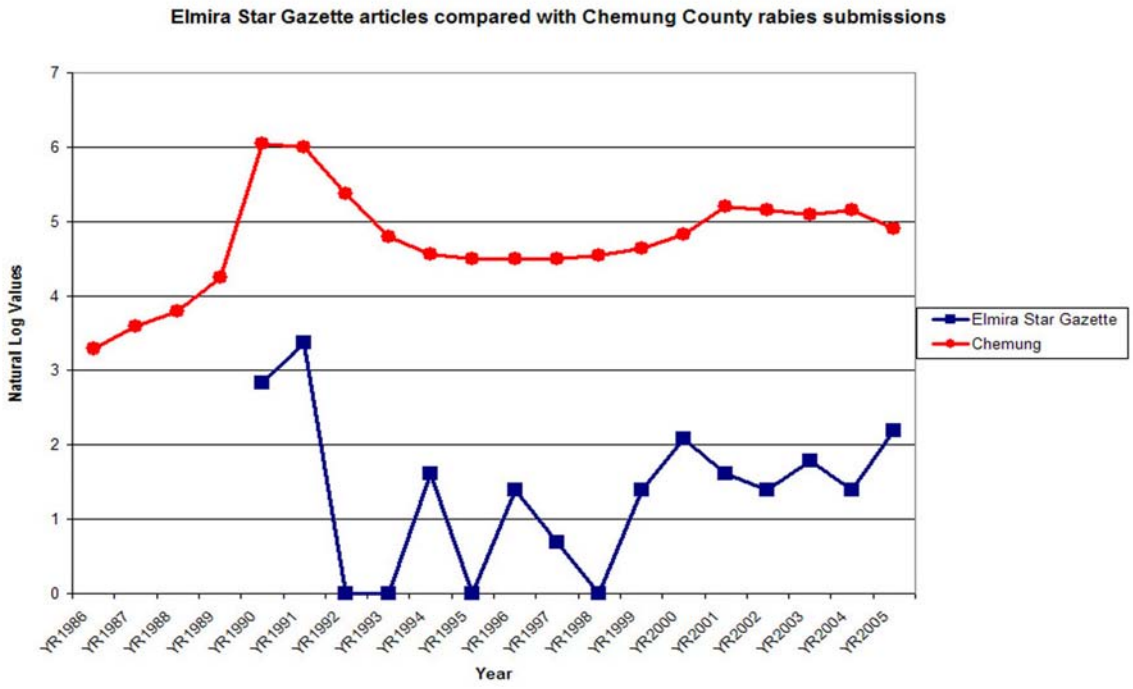


Figure 5.5 Elmira Star Gazette articles compared to rabies submissions in Chemung County, New York

This is perhaps due its position at the beginning of the epizootic in New York and the fact that at that particular time epizootic rabies was new and exotic. The Elmira Star Gazette did not correlate highly to any counties for either the 1989-1996 or the 1997-2005 periods.

5.10.2 Southeastern New York

- **Newsday**

Newsday, in Suffolk County, has a circulation of 720,352, making it the second largest within this group. It is also the only newspaper selected with a nationally known health writer, Laurie Garrett, author of The Coming Plague and Betrayal of Trust. Suffolk County, on Long Island, avoided raccoon rabies until 2004, longer than any other part of the state. This makes Figure 5.6 all the more interesting, in that it represents an area without any local raccoon rabies cases.

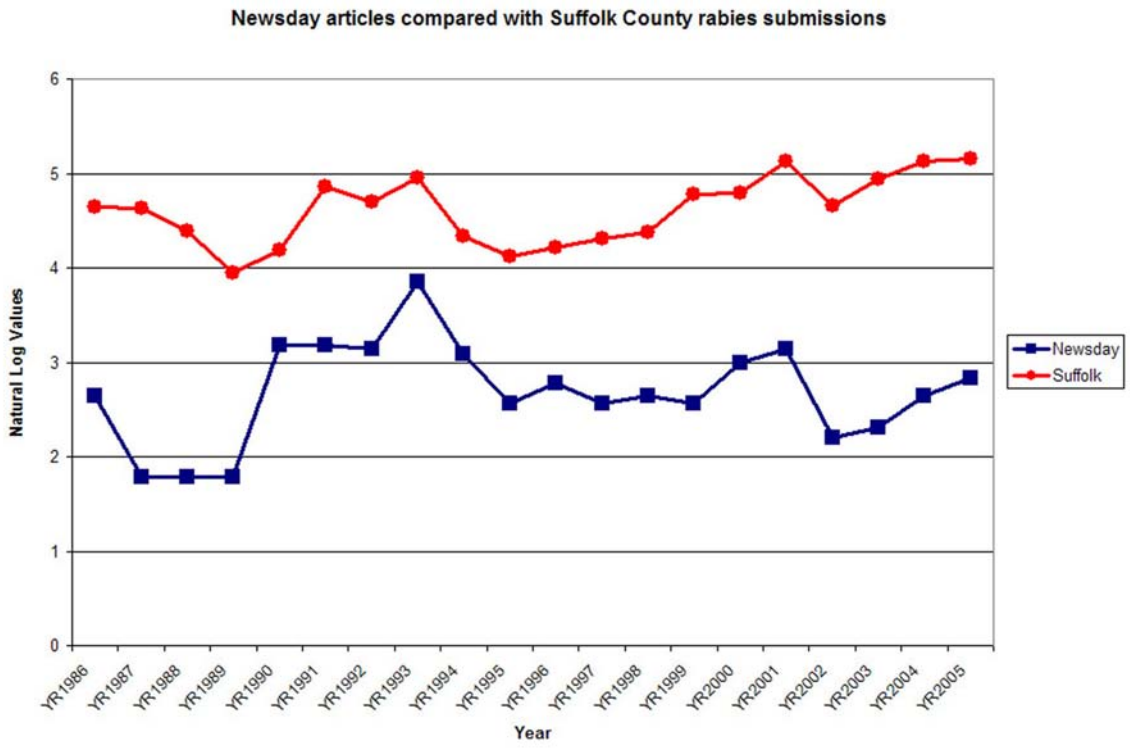


Figure 5.6 Newsday articles compared to rabies submissions in Suffolk County, New York

Rabies reporting in this newspaper cannot be a function of a local outbreak, but instead the reporting of rabies and rabies submissions seems to be a function of what is happening on the mainland in terms of the counties and cities nearest Long Island on, as well as overall state trends of the disease. Eventually the level of rabies reporting at Newsday fell, possibly due to the fact that the disease had yet to reach Long Island. A valuable conclusion that can be drawn from this example is that rabies reporting can be more a function of a neighboring county's circumstance than local events. However, Newsday correlated highly with only one county, Seneca (r =.8503, p =.007), which was not its county of residence, nor was this county even proximate (Figure 5.7).

- **Times Herald Record**

The Times Herald Record in Orange County has a circulation of 40, 966. Once again, the earlier trend is similar between submissions and reporting, but the two begin to diverge in the

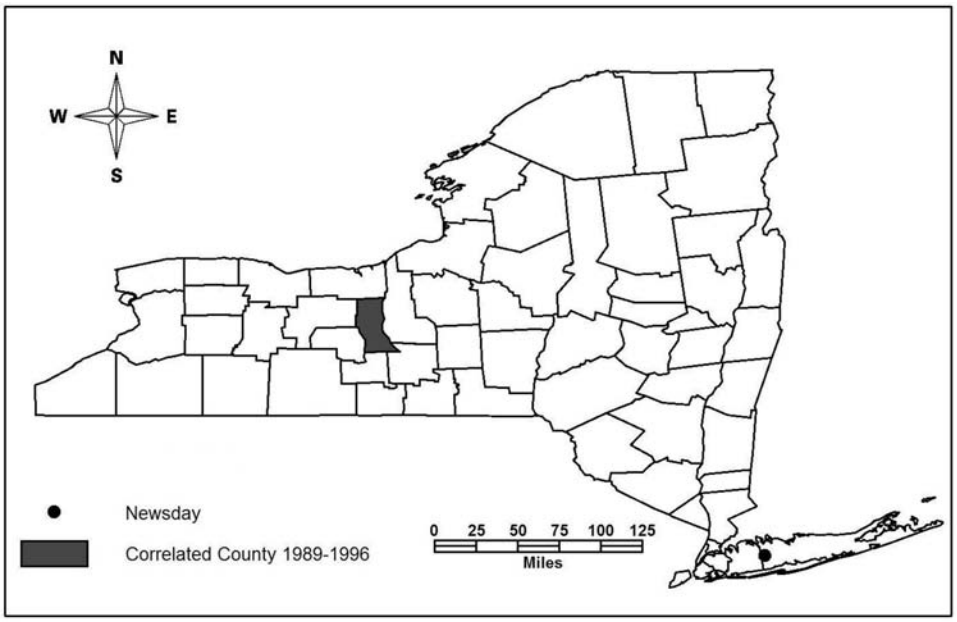


Figure 5.7 County with rabies submissions that correlate to Newsday articles, 1990-1996

middle nineteen-nineties (Figure 5.8). The Times Herald Record correlated highly to four counties for the 1989-1996 time period; Clinton County (r =.9761, p< .0001), Putnam County (r =.9761, p< .0001), Rockland County (r =.9285, p =.0009) and its county of residence, Orange (r =.8809, p =.003). The Times Herald Record correlated highly to seven counties for the 1997-2005 period outside its county of residence. These counties were Washington County (r =.9958, p< .0001) Jefferson County (r =.9538, p< .0001), Dutchess County (r =.9500, p< .0001), Sullivan County (r =.8836, p =.001), Cortland County (r =.8666, p =.002) Cayuga County (r =.8666, p =.002), and Herkimer County (r =.8535, p <.0001). These results are shown in Figure 5.9.

- **White Plains Newspapers**

The White Plains Reporter Dispatch and White Plains Journal News are actually two separate newspapers, the latter being the successor to the former. The circulation of the Reporter Dispatch was 55,084, the Journal News is 138,539. The combined index for both of these is only available at the

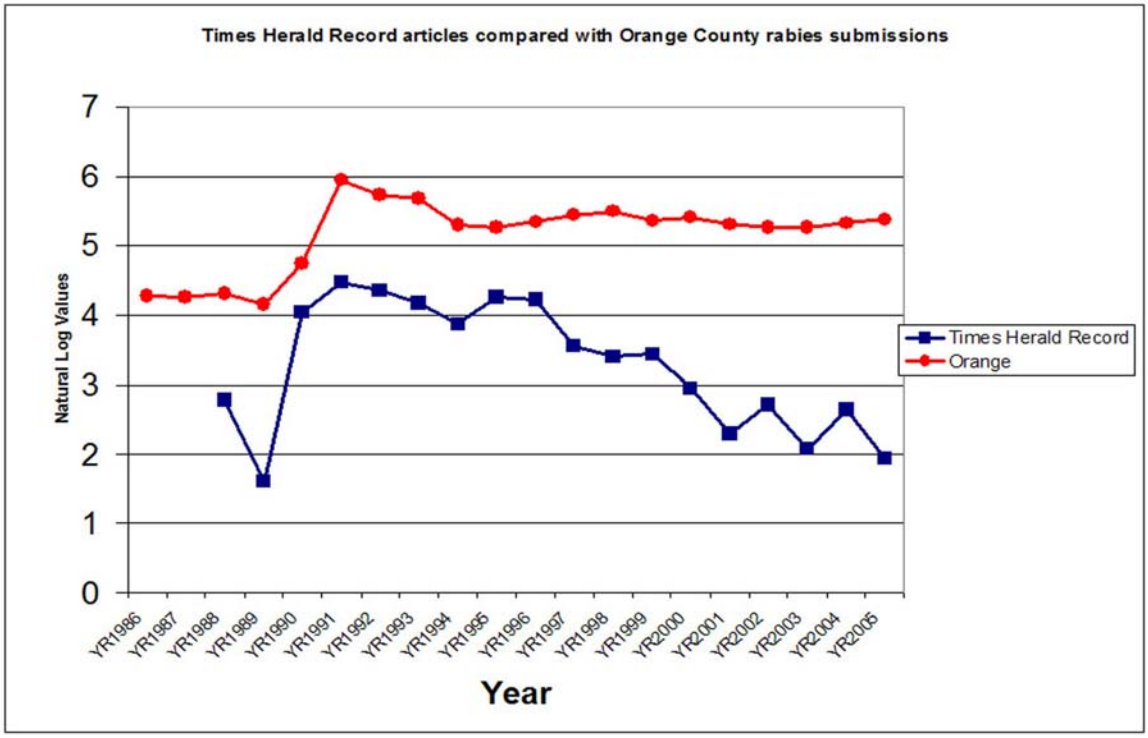


Figure 5.8 Times Herald Record articles compared to rabies submissions in Orange County, New York

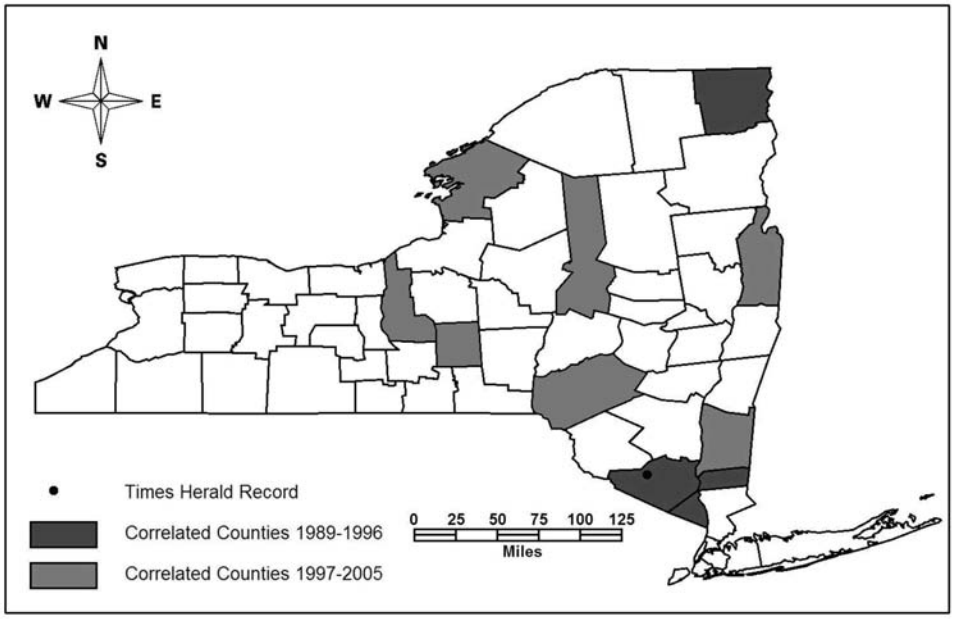


Figure 5.9 Counties with rabies submissions that correlate to Times Herald Record articles, 1989-1996 and 1997-2005

White Plains Public Library. This is also the only publicly accessible archive of all available microfilm copies of these newspapers. The transition between newspapers occurred in 1997 when the White Plains Reporter Dispatch was purchased and reorganized with other newspapers into the Journal News. This disruption can be seen in the data from 1996 through 1998 as the newspaper transitioned (Figure 5.10), but the pattern seen with these two newspapers is not appreciably different to that seen in other news sources.

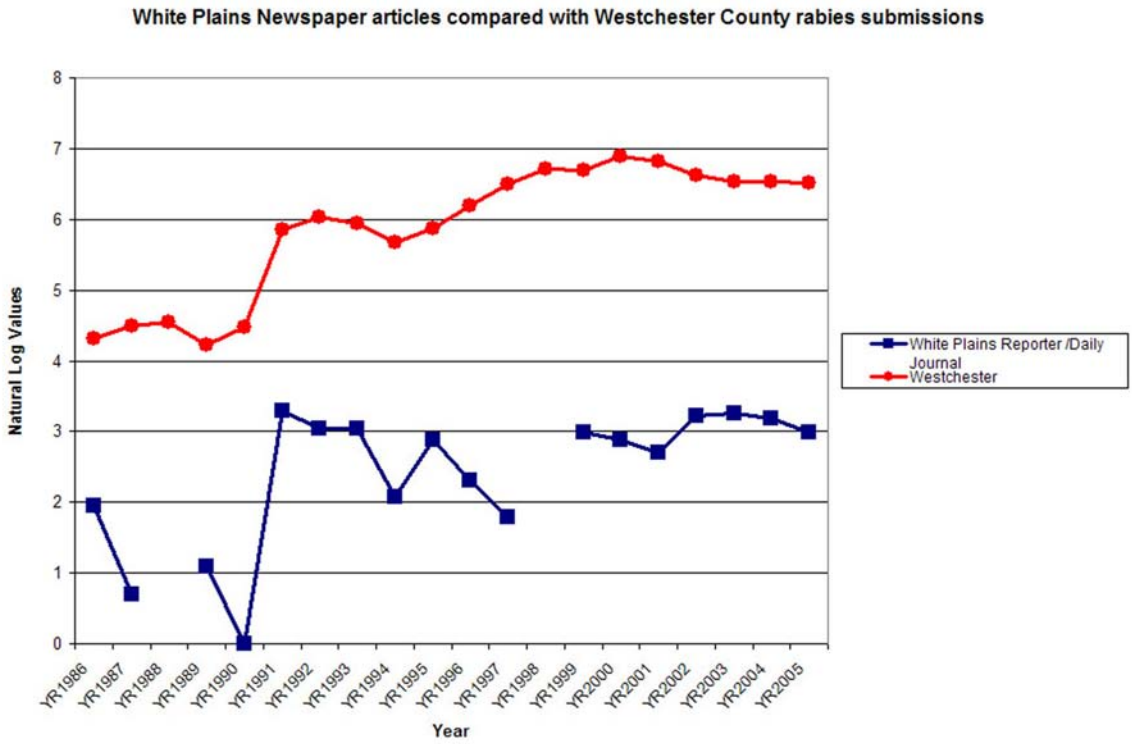


Figure 5.10 White Plains Reporter Dispatch/Journal articles compared to rabies submissions in Westchester County, New York

The variation in the reporting compared to the state rabies submissions is difficult to explain. It could simply be a function of financial difficulties at the newspaper, culminating in its bankruptcy. It could also simply be a function of the variability of news reporting. Irrespective of the cause, there is an observable transitory period between the two newspapers. The White Plains Reporter

Dispatch/Journal correlated highly to five counties for the 1989-1996 time period, Orange County (r =.9461, p =.0004), Dutchess County (r =.9201, p =.001), Suffolk County (r =.9341, p =.0007), Clinton County (r =.8862, p =.003) and Cattaraugus County (r =.8855, p =.003), none of which were its county of residence (Figure 5.11).

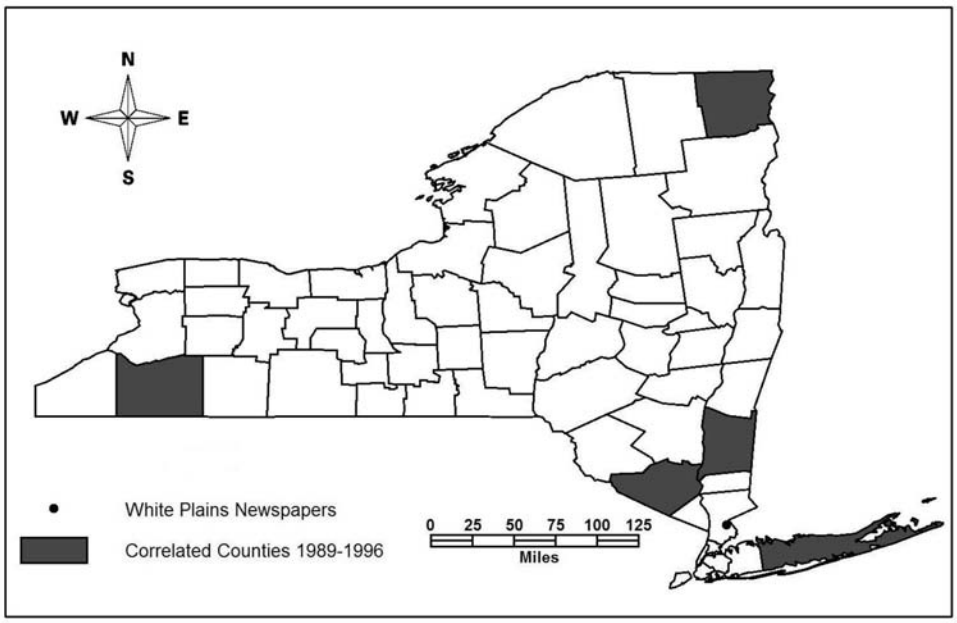


Figure 5.11 Counties with rabies submissions that correlate to White Plains Reporter Dispatch/Journal articles, 1989-1996

5.10.3 Capitol Area

- **Albany Times Union**

The Albany Times Union has a circulation of 109,710, and serves the area around the capital of the state, and therefore encompasses much of the surveillance structure itself. This newspaper is indexed electronically from 1986 through the present and copies are available from the New York State Archives. As can be seen in Figure 5.12, rabies reporting remained relatively stable across the period of study, with an increase that signaled the height of the raccoon rabies epizootic. The Albany Times Union did correlate to the rabies submissions of three counties (Figure 5.13), but none were proximate.

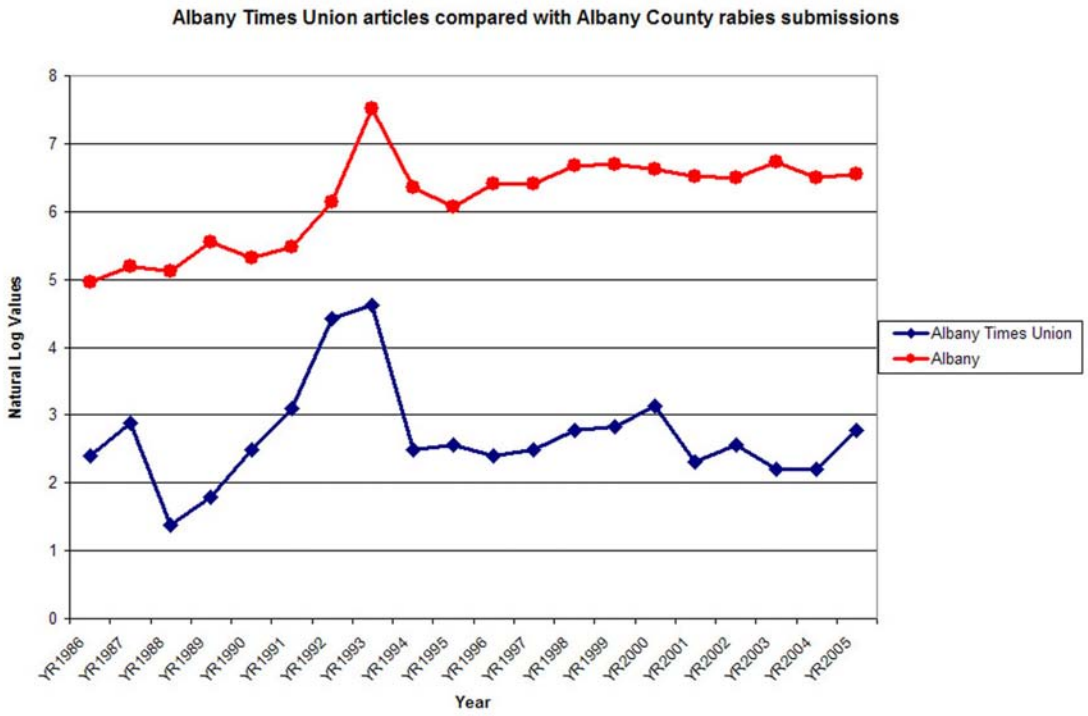


Figure 5.12 Albany Times Union articles compared to rabies submissions in Albany County, New York

The three counties are Nassau County (r =.9341, p =.0007), Suffolk Count (r =.8982, p .002), and Schuyler County (r =.8862, p =.003).

- **Schenectady Gazette**

The Schenectady Gazette, with a circulation of 61,503, is indexed on site at the Schenectady Public Library. Unlike most of the other news sources, after the epizootic period, rabies reporting did not decline to pre-epizootic levels (Figure 5.14), but continued with a similar pattern to rabies submissions. It is possible that its extreme proximity to Albany influenced its interest in rabies.

The Schenectady Gazette correlated highly to seven counties for the 1989-1996 period (Figure 5.15); Schoharie County (r =.9910, p <.0001) Fulton County (r =.9642, p =.0005), Wyoming County (r =.9642, p =.0005), Livingston County (r =.9642, p =.0005), Otsego County (r =.9549, p =.008), and Genesee County (r =.9189, p =.003), including its resident county, Schenectady (r =.8928, p =.006).

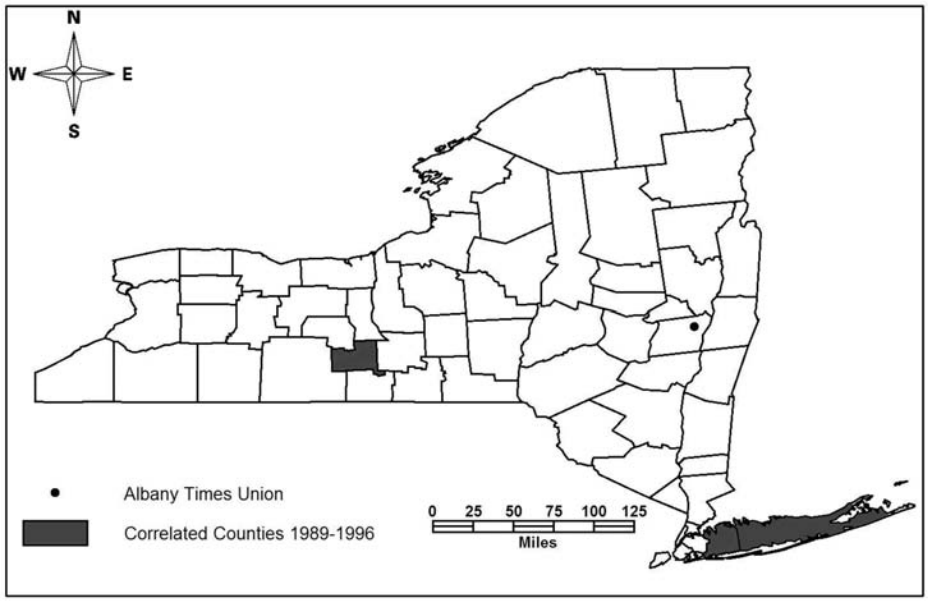


Figure 5.13 Counties with rabies submissions that correlate to Albany Times Union articles, 1989-1996

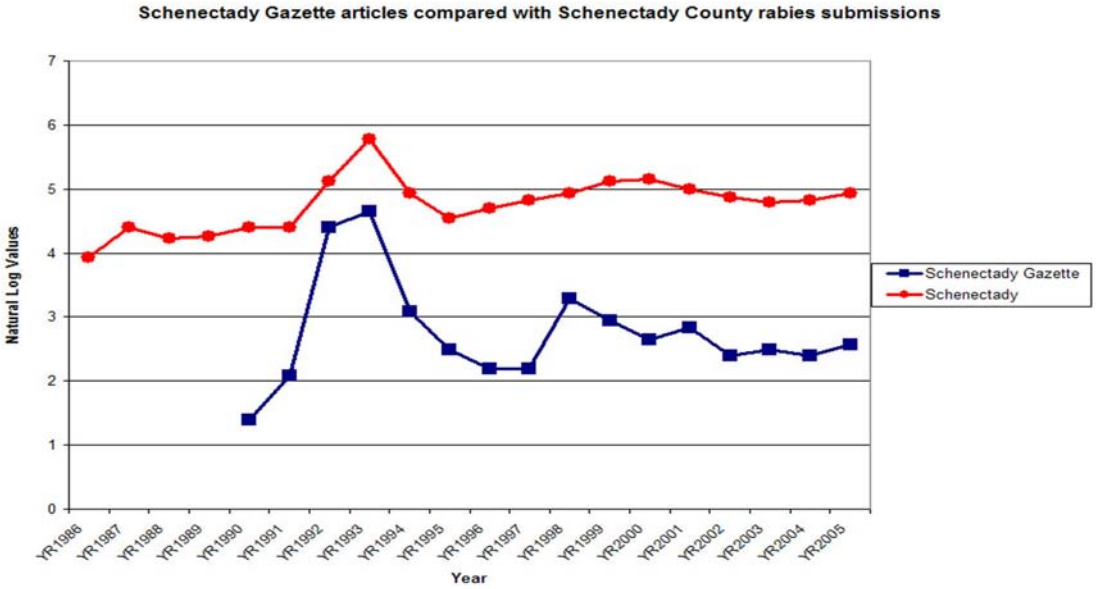


Figure 5.14 Schenectady Gazette articles compared to rabies submissions in Schenectady County, New York

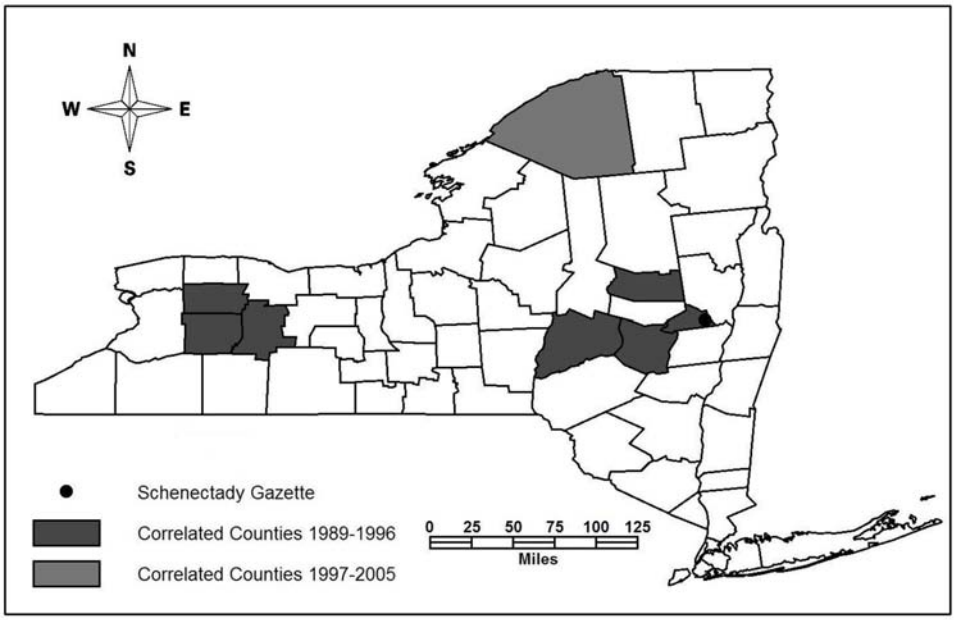


Figure 5.15 Counties with rabies submissions that correlate to Schenectady Gazette articles, 1989-1996 and 1997-2005

5.10.4 Western New York

- **Buffalo News**

The Buffalo News in Erie County covers the largest population outside of the New York City area. The newspaper has a circulation of 314,800, making it a large newspaper, third in size within this study. It is indexed online and bound in volumes. It is available in microfilm in the New York State Archives. In the early years of the epizootic, articles increased greatly, but then dipped in the period of time between the entrance of the disease into the state (1990) and the emergence of the disease within the area of circulation (1992). In a manner consistent with many of the other newspapers media interest in rabies flags while rabies submissions, particularly in a densely populated area like the greater Buffalo metropolitan area, continues to rise, eventually stabilizing at a level far higher than pre-epizootic levels (Figure 5.16). The Buffalo News correlated highly to counties well outside its area of circulation for both the 1989-1996 and 1997-2005 time periods (Figure 5.17).

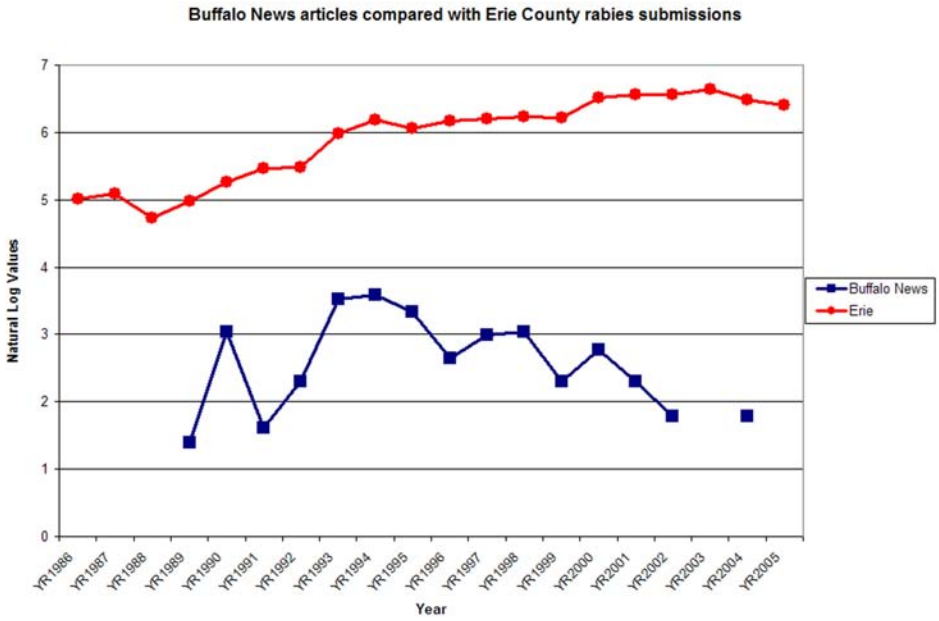


Figure 5.16 Buffalo News compared to rabies submissions in Erie County, New York

For the 1989-1996 period, Madison County (r =.9524, p =.0003) and Oswego County (r =.8809, p =.003) correlated. For the 1997-2005 period, Clinton County (r =.9277, p =.0009), Cortland County (r =.9277, p =.0009), Cayuga County (r =.9157, p =.001), Onondaga County (r =.9157, p .001), Wayne County (r =.9085, p.001), and Sullivan County (r =.8196, p =.002)

- **Rochester Democrat and Chronicle**

The Rochester Democrat and Chronicle in Monroe County has a circulation of 133,239. It is indexed with a thorough clippings file that dates back into the nineteen-thirties. This file, which is accessible at the Rochester Public Library, consists of referenced intact articles. As was seen with other newspapers the similarities between reporting and submissions continue in to the middle of the nineteen-nineties, when rabies submissions continue to increase or at least hold steady and reporting experiences a rapid decline (Figure 5.18). The Rochester Democrat and Chronicle does not correlate highly to its county of residence, but it does correlate to three neighboring counties (Figure 5.19); Genesee County (r =.9271, p =.0009), Livingston County (r =.9047, p =.002) and Wyoming County (r =.9047, p =.002), and to

four other counties, Fulton County (r =.9523, p =.0003), Schoharie County (r =.9221, p =.001), Cayuga County (r =.9047, p =.002) and Otsego County r = (.8982, p =.002).

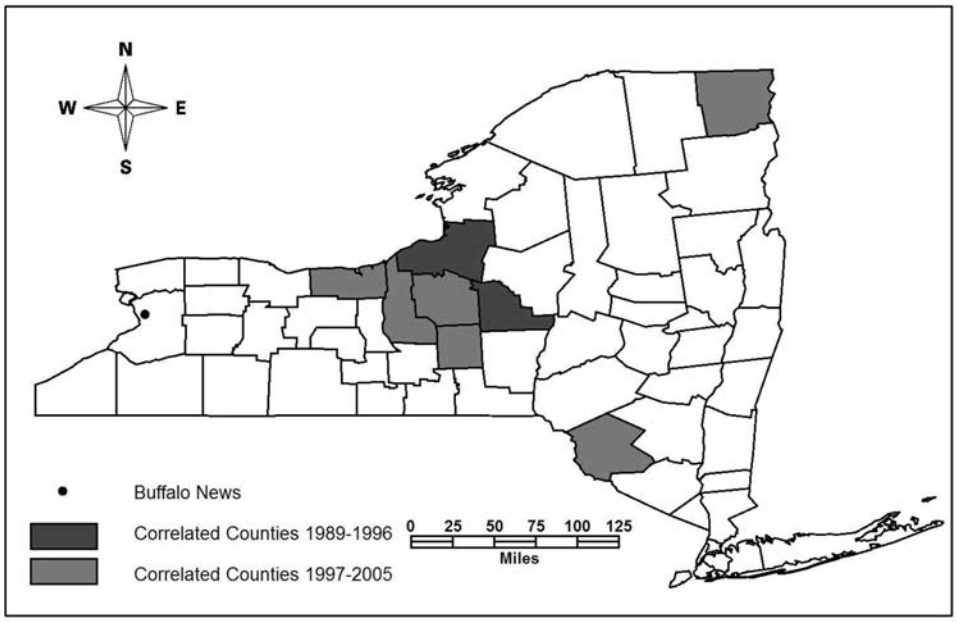


Figure 5.17 Counties with rabies submissions that correlate to Buffalo News articles, 1989-1996 and 1997-2005

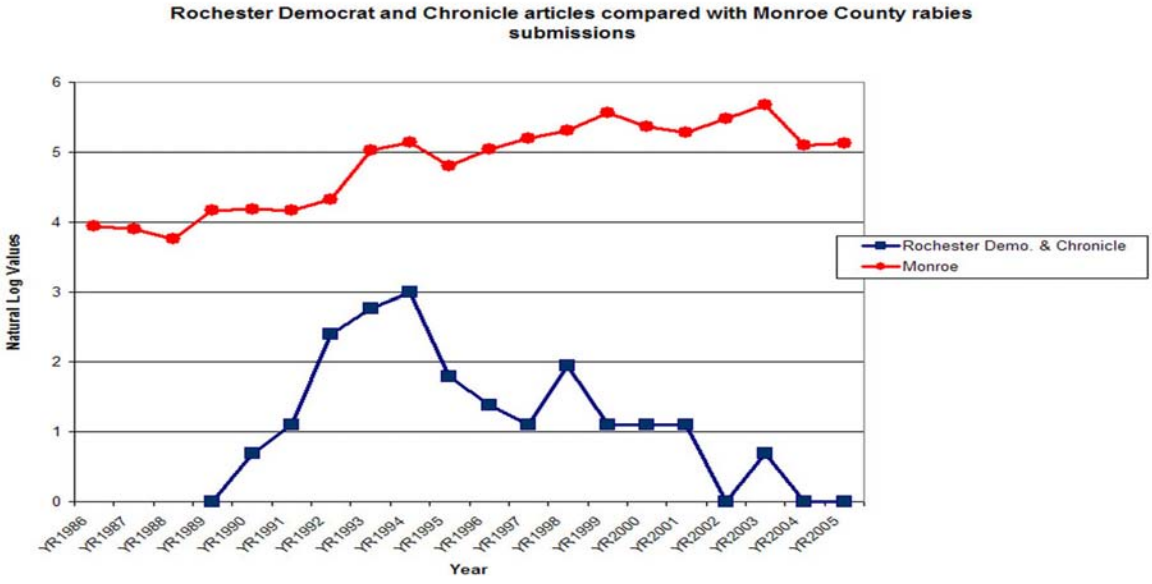


Figure 5.18 Comparison of Rochester Democrat and Chronicle articles compared to rabies submissions in Monroe County, New York

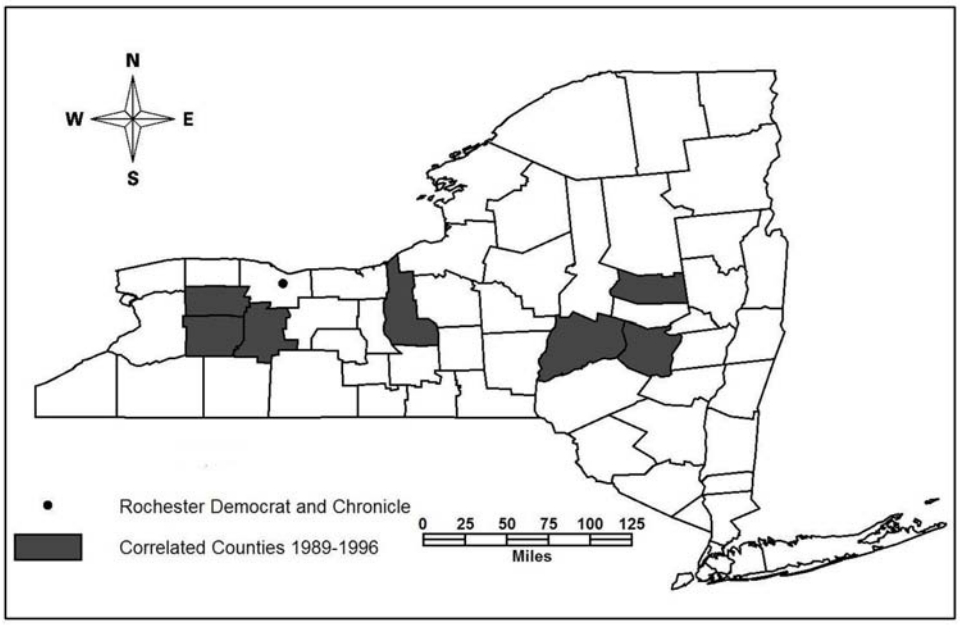


Figure 5.19 Counties with rabies submissions that correlate to Rochester Democrat and Chronicle articles, 1989-1996

5.10.5 Northwestern New York

- **Oswego Palladium Times**

The Oswego Palladium Times in Oswego County presents many of the characteristics of the smaller market newspapers studied- a focus on small local articles announcing upcoming rabies clinics and local contacts with rabid animals- combined with press releases from Albany.

Apart from the circumstances regarding the indexing of this newspaper (Appendix B), the Oswego Palladium Times is also the smallest newspaper by circulation in this group, with a readership of only 9,882. Fig 5.20 also illustrates the fact that Oswego County had its peak rabies submissions one year later than the state as a whole. The newspaper correlated highly to four counties for the 1989-1996 time period (Figure 5.21); Madison County ($r = .9285$, $p = .002$), Cayuga County ($r = .8928$, $p = .006$), Washington County ($r = .8928$, $p = .006$), and its county of residence, Oswego County ($r = .9285$, $p = .002$).

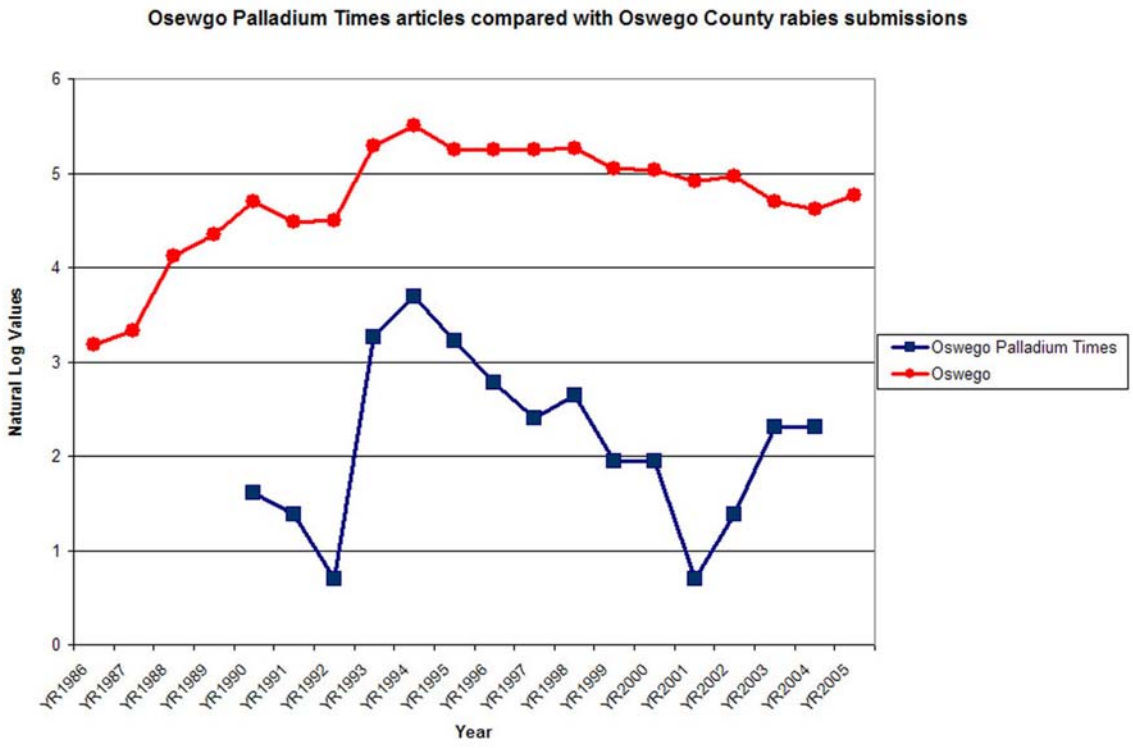


Figure 5.20 Oswego Palladium Times articles compared to rabies submissions in Oswego County, New York

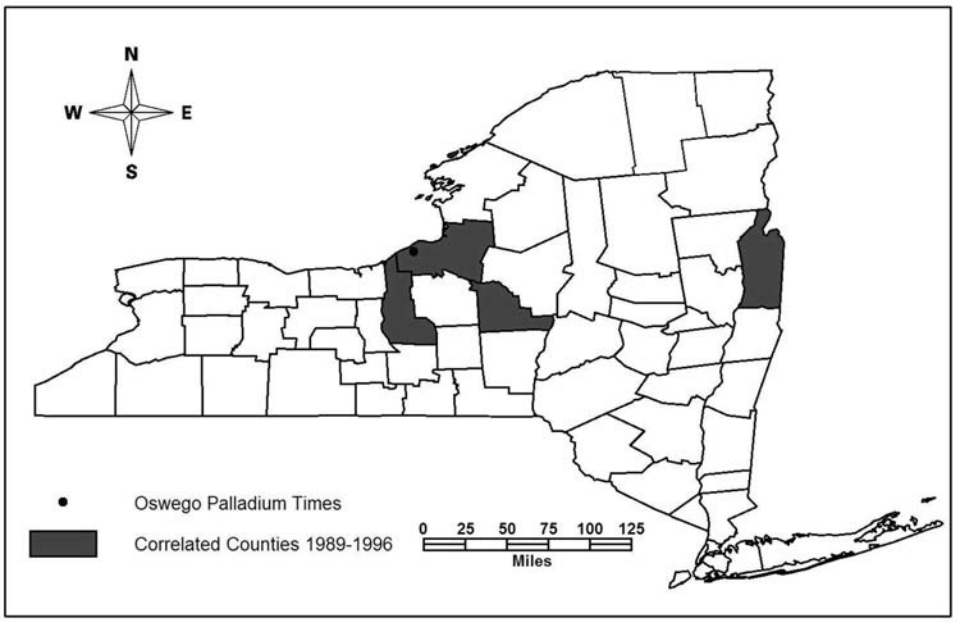


Figure 5.21 Counties with rabies submissions that correlate to Oswego Palladium Times articles, 1989-1996

- **Syracuse Post Standard**

The Syracuse Post Standard, in Onondaga County, has a circulation of 88,587. Rabies reporting reached a peak in 1993 when the disease became a local concern, followed by two subsequent peaks in 1997-1998 and 2002-2003 (Figure 5.22). The secondary and tertiary peaks serve to realign rabies reporting to submissions in a way that was generally not seen in other newspapers.

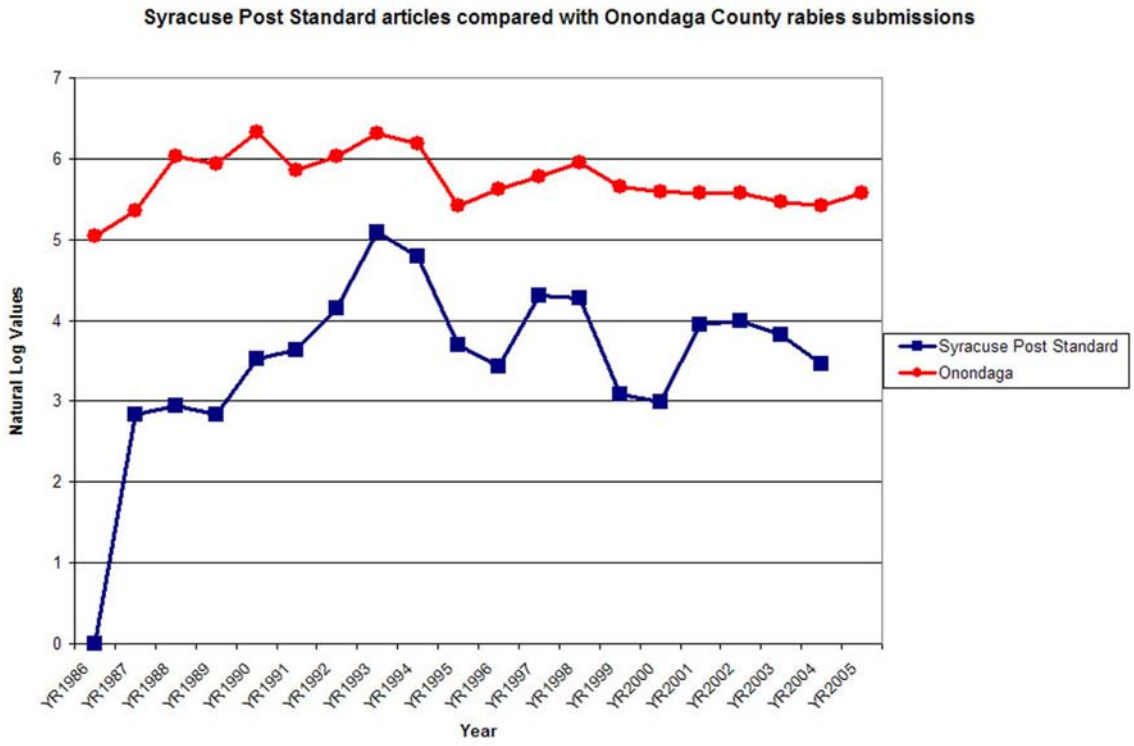


Figure 5.22 Syracuse Post Standard articles compared to rabies submissions in Onondaga County, New York

As seen for several of the other newspapers, the number of rabies articles slowly returns to values near their pre-epizootic level, but submissions do not, neither at the local county level, nor the state level. The Syracuse Post Standard correlated highly with the surveillance numbers of three counties for the 1989-1996 period, but not those from its county of residence (Figure 5.23). The counties represented are Oneida County ($r = .9762$, $p < .0001$), Schoharie County ($r = .9341$, $p = .0007$), and Otsego County ($r = .8503$, $p = .007$).

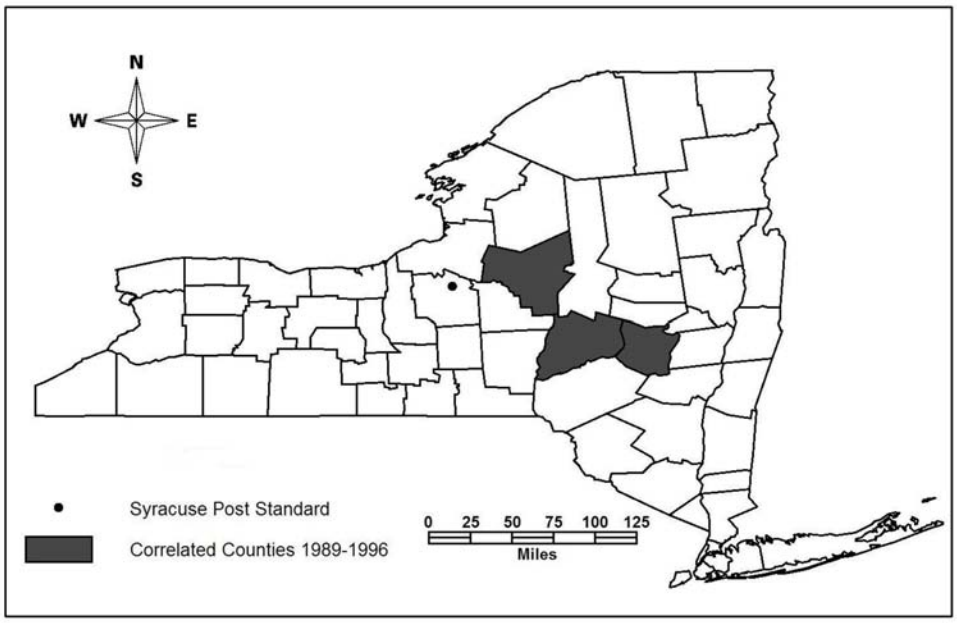


Figure 5.23 Counties with rabies submissions that correlate to Syracuse Post Standard articles, 1989-1996

5.10.6 Northern Tier

- **Plattsburgh Press Republican**

The Plattsburgh Press Republican in Clinton County is the northernmost newspaper under consideration. It has a circulation of 23,263, making it among the smaller newspapers under consideration. It is indexed online through the State University of New York at Plattsburgh.

Figure 5.24 demonstrates a close relationship from 1988 to 1994. As is true for many of the newspapers, the closest relationship between reporting and submissions is found in the earlier years of the epizootic. The change in newspaper reporting represents the shift from a disease that is epizootic to one that is enzootic. Enzootic diseases are less likely to cause alarm, and are therefore less likely to be the subject of media or public interest. The Plattsburgh Press Republican correlates highly with its county of residence, Clinton County ($r = .8503$, $p = .007$) for the time period 1989-1996 only (Figure 5.25).

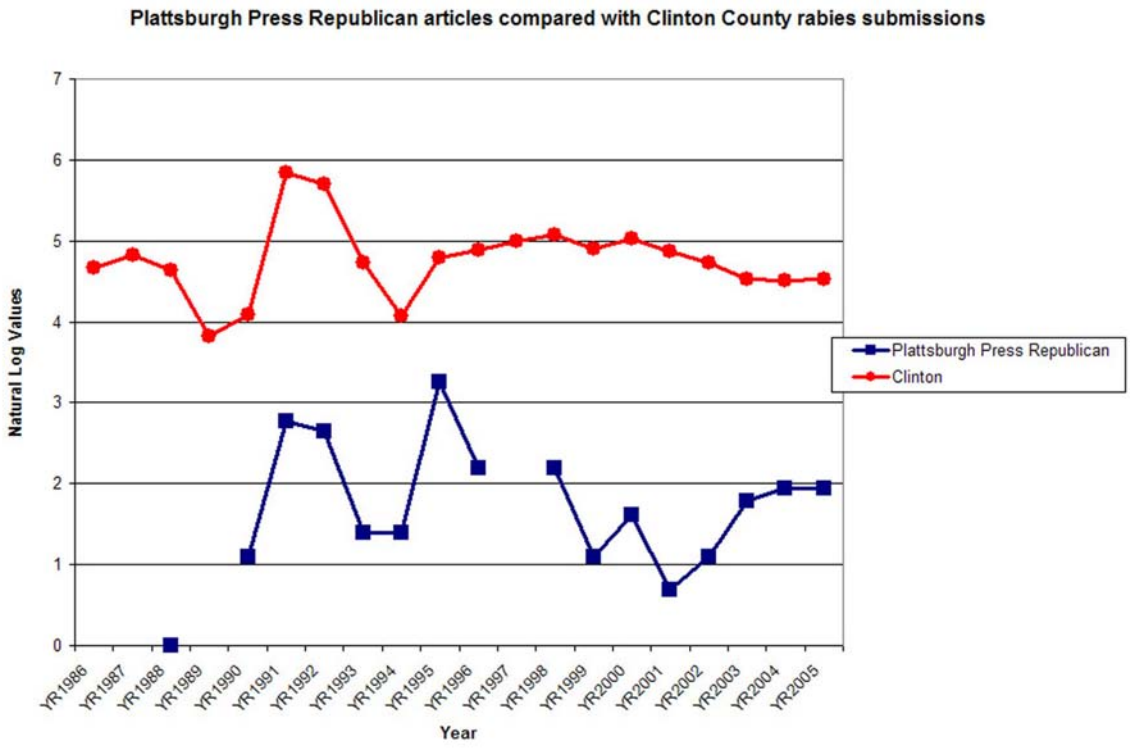


Figure 5.24 Plattsburgh Press Republican articles compared to rabies submissions in Clinton County, New York

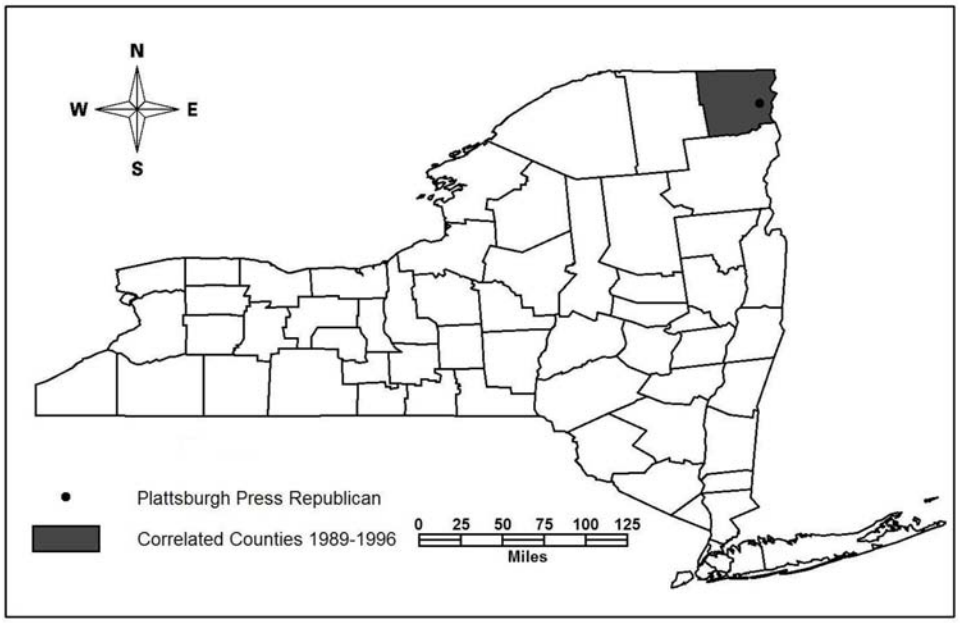


Figure 5.25 Counties with rabies submissions that correlate to Plattsburgh Press Republican articles, 1989-1996

- **Watertown Daily Times**

The Watertown Daily Times in Jefferson County serves the northwestern part of the state. The circulation of the newspaper is 41,492. This is also one of the counties that had no control officers as of 2005. The newspaper is indexed electronically from 1989 to the present (2006) and is available directly from the newspaper.

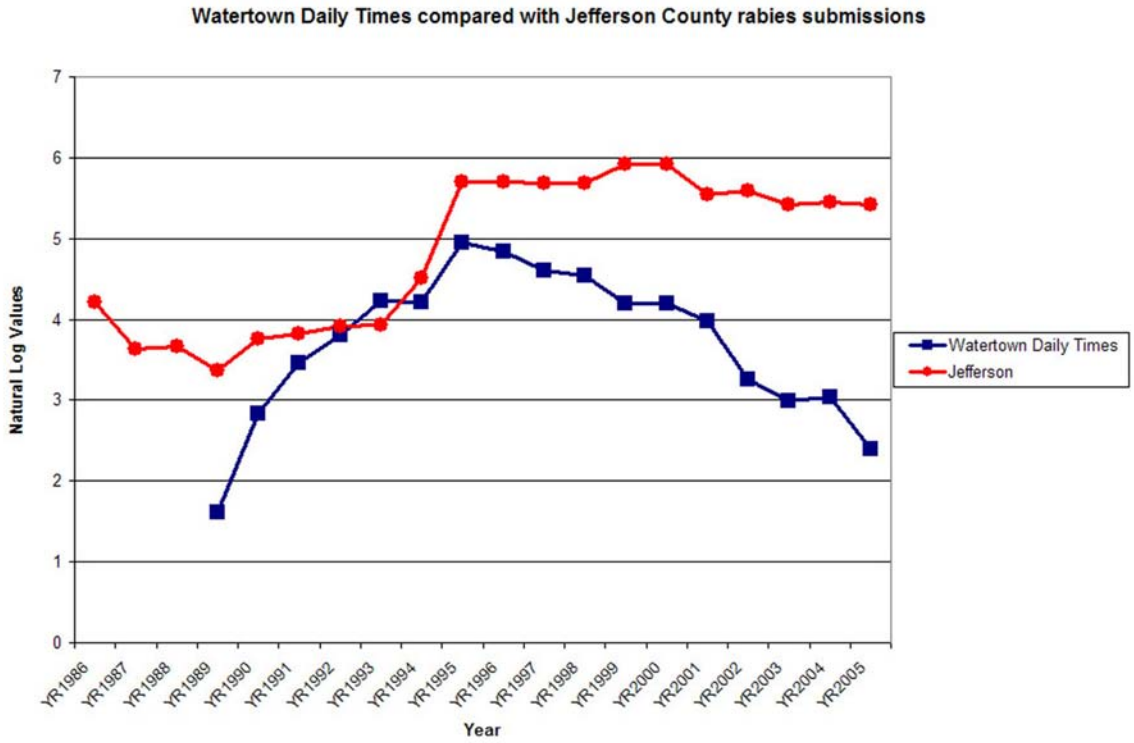


Figure 5.26 Watertown Daily Times articles compared to rabies submissions in Jefferson County, New York

As the pattern in Figure 5.26 reveals, reporting of rabies and positive rabies follow similar trends until 1995. The Watertown Daily Times is the only newspaper which sometimes has greater numbers of rabies articles than rabies submissions over the time of study. Possible reasons for this include fact that like some other northern counties, Jefferson County had experienced a fox rabies epizootic in the nineteen-eighties and was a location for vaccination schemes. The peak of raccoon

rabies in Watertown occurred two years after the statewide peak. After its peak, rabies reporting does move toward its pre-epizootic levels. The Watertown Daily Times correlates to rabies submission in its county of residence as well as many others, for both the 1989-1996 and 1997-2005 time periods (Figure 5.27). The counties within the 1989 period are Jefferson County (r =.9523, p =.0003), Niagara County (r =.9523, p =.0003), Lewis County (r =.8742, p =.004), Erie County (r =.8571, p =.006), Westchester County (r =.8571, p =.006), Orleans County (r =.8383, p =.009). Counties with 1997-2005 rabies submissions that correlate to 1997-2005 Watertown Daily Times articles are Cortland County (r =.9833, p< .0001), Cayuga County r = (.9667, p < .0001), Dutchess County (r =.9500, p< .0001), Jefferson County (r =.9288, p =.0003), Sullivan County (r =.9166, p =.0005), Clinton County (r =.8833, p =.001), Washington County (r =.8786, p =.001), Ontario County (r =.8666, p =.002), Yates County (r =.8333, p =.005), Rockland County (r =.8333, p =.005), Oswego County (r =.8284, p =.005), and Orleans County (r =.8333, p =.005).

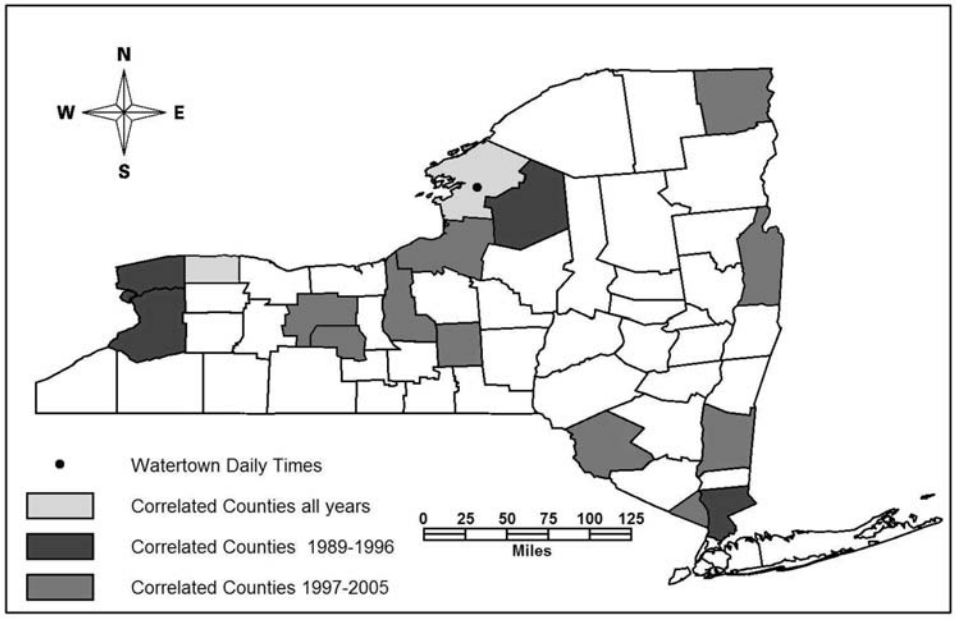


Figure 5.27 Counties with rabies submissions that correlate to Watertown Daily Times articles, 1989-1996 and 1997-2005

5.10 Rabies Maps

Although many of the newspapers under investigation supplied photographs, generally of dogs and cats waiting for vaccination, there were relatively few maps, and most were found during the early phase of the epizootic. Fewer still supplied maps that did not originate from some branch of the government. Interestingly, some newspapers that generated relatively few rabies articles actually produced some of the original maps of rabies submissions (Utica Observer and Dispatch). This further illustrates the variability in styles used to present the rabies situation.

Providing maps requires some expenditure of resources. Smaller newspapers did not have maps (though The Elmira Star Gazette included a photograph of a man pointing at a map) as they would have neither the available staff nor the budget to support cartographic production. This was especially true when the epizootic arrived in New York in 1990, predating the arrival of inexpensive mapping programs. Larger newspapers would have a different impediment. A newspaper with a national circulation is not likely to devote space to a map of local rabies submissions. It should also be noted that in many instances rabies articles would share page space with maps for other stories. One explanation for the scarcity of maps is due to the fact that local newspapers tend to report on the immediately proximate, for which no map would be necessary. The total number of maps or near-maps was less than fifty out of thousands of articles.

The quantity of maps provided was highly variable, but the timing of when maps appeared was less variable. Maps tended to be used most often when the epizootic was at its peak, during 1991-1993, particularly in 1993 the year of the height of the epizootic. A common source of maps was the New York Department of Health. The Health Department tailored maps to the place in which it would be published, demonstrating an explicit connection between the New York Department of Health and at least some newspapers. Rabies maps have definite themes, including the location of vaccination

campaigns or places with exotic rabies positives. However, the most common theme is the presentation of the disease as an advancing threat, which mirrors the tone of many of the articles. The following are examples of maps published by New York newspapers during the rabies epizootic.

The most modest use of a map comes from the Elmira Star Gazette from August 20, 1991 (Figure 5.28). It consists of a photograph of a map made from a county map with pins stuck in it. This may exemplify the state of available technology for some county health departments in 1991.

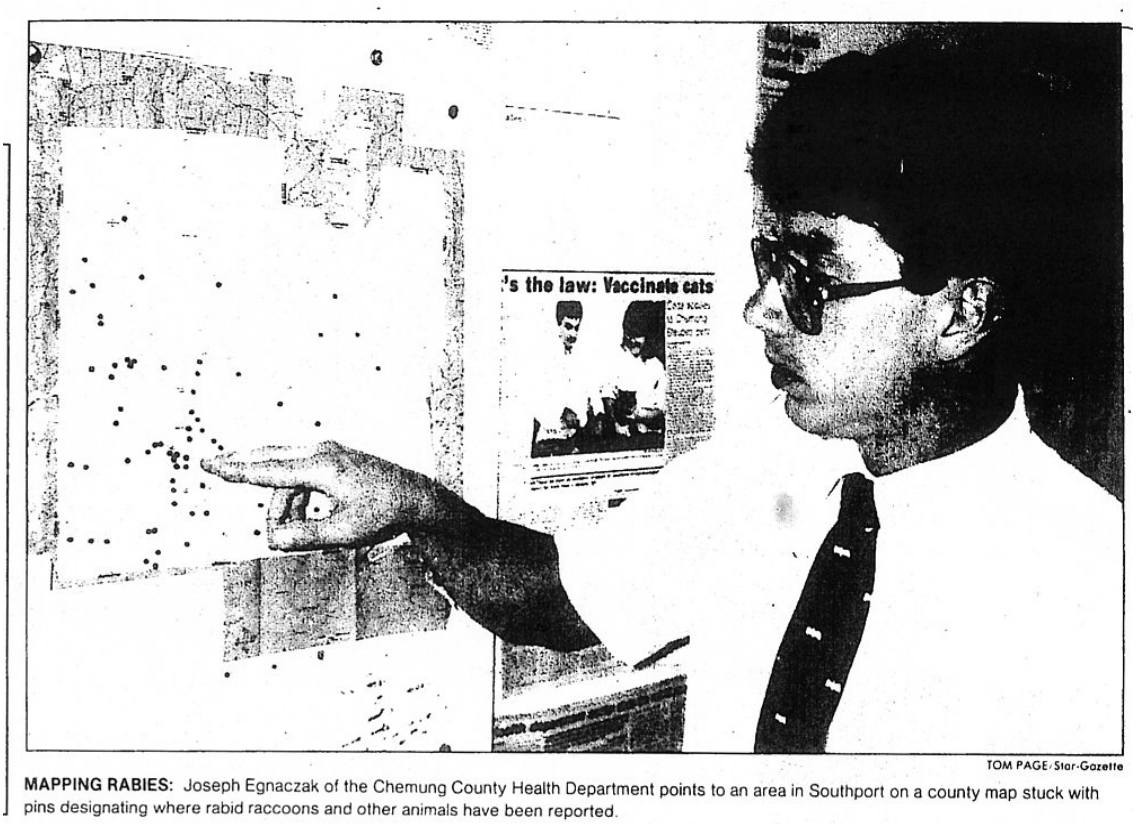


Figure 5.28 Photograph of a rabies map in the Elmira Star Gazette from August 20, 1991

The Rochester Times-Union of August 3, 1990 carried the following map (Figure 5.29) and graphic named Raccoon Rabies. It provides a predicted timeline for the advance of the disease. The park represented in the map was an area was described as having a large raccoon population.

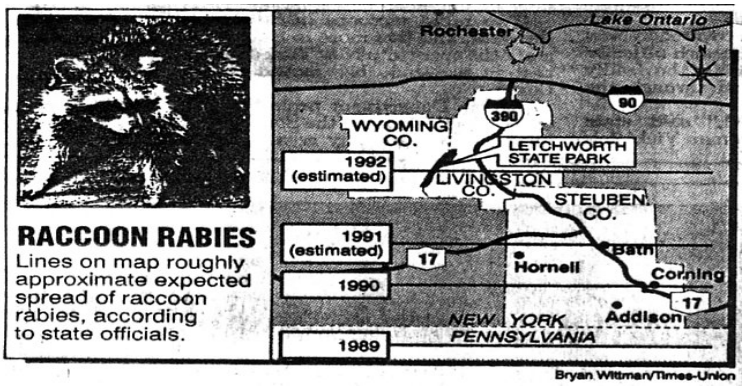


Figure 5.29 Map from the Rochester Times Union, August 3, 1990

Maps similar to the one found in the Utica Observer-Dispatch March 21, 1993 (Figure 5.30) are the most common. Normally maps are not used when the epizootic is still a large distance away. Maps showing the leading edge of the epizootic are more common, possibly due to their dramatic effect.

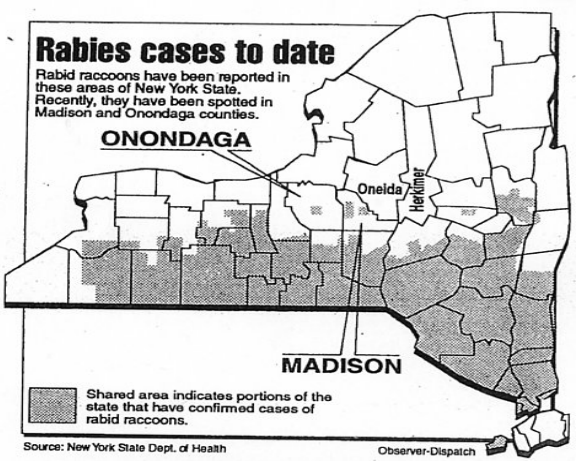


Figure 5.30 Map example 1 from the Utica Observer-Dispatch from March 21, 1993

In the Utica Observer-Dispatch, May 23, 1995, this single county map (Figure 5.31) shows the general directionality of the epizootic across Oneida County, which was the same northeastward trend as the rest of the state.

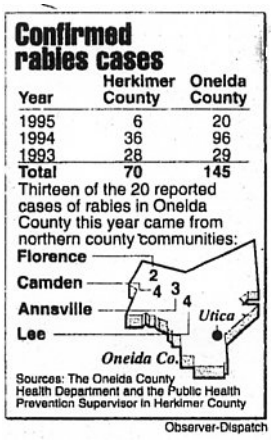


Figure 5.31 Map example 2 from the Utica Observer-Dispatch, May 23, 1995

The Rochester Democrat and Chronicle of November 22, 1991 (Figure 5.32) carried the following detailed map of confirmed rabies cases for the entire state.

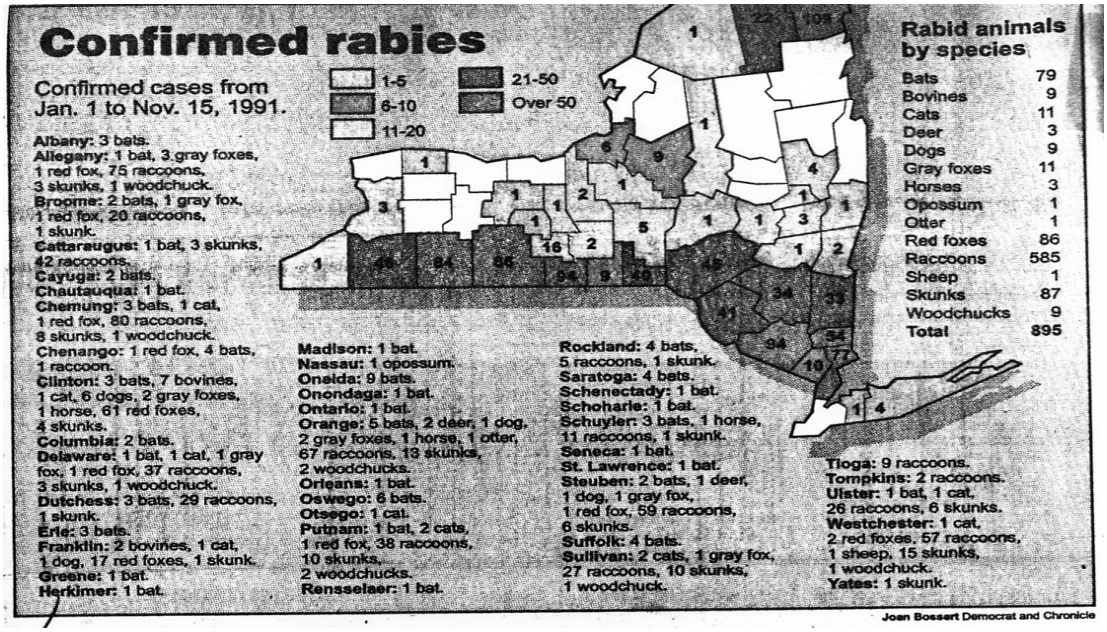


Figure 5.32 Map from Rochester Democrat and Chronicle, November 22, 1991

The previous maps are not the only possible maps, but they are representative of most of the maps printed in the newspapers. More examples of maps presented in newspapers are available in Appendix

D. The number of maps and the fact that some newspapers did not use any maps at all suggest that although they can be useful, they are not perceived as strictly necessary for rabies reporting. Figure 5.33 shows the number of rabies maps per year from 1990 to 2004. In particular, Figure 3.33 shows that rabies maps are produced in rough approximation to rabies reporting itself, with the peak year for maps in 1993. Appendix E contains a table presenting rabies maps by year of publication.

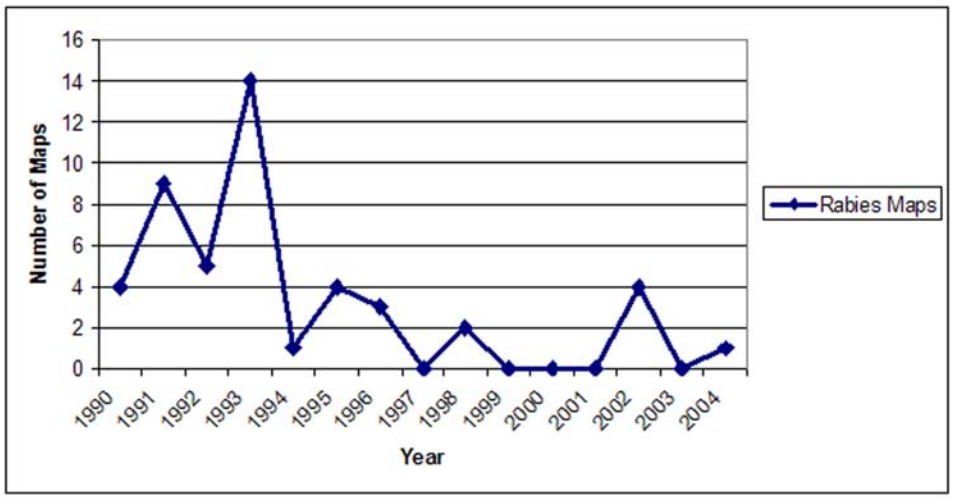


Figure 3.33 Rabies maps per year 1990-2004

5.11 Conclusions

By considering rabies reporting in the previously described newspapers, certain trends become evident. In the early years of the epizootic, rabies reporting generally tracked well with animal submissions. The divergence between the two patterns becomes evident in the middle of the nineteen-nineties. What occurs in most instances is that news reports return to a pre-epizootic level, but submissions either do not or begin a decline at a much slower pace. Two explanations for this divergence include the lack of public interest in a disease which is now ever-present, and because it is ever-present, a likelihood of submissions which will exceed pre-epizootic levels. Unfortunately newspaper reporting will mirror public interest; the disease is no longer exotic, it is no longer an

invader, and no local person became ill and died. This is unfortunate as just like West Nile Virus, or even HIV AIDS, the public needs to be constantly updated even if it is no longer "news".

Since relatively small sums of money from local and state health departments are devoted to funding public service announcements regarding rabies, the state has relied on newspapers to fill the gap. Newspapers have markedly different priorities than state and county health departments. Nevertheless, this system has been largely successful. People were educated to the existence of the disease and given appropriate actions to address its risk. Whether this system could be usefully reused for any other disease is much less clear, since the factors surrounding reporting were variable and parochial.

Some innovations are possible. Once rabies has become established in the ecology, some mechanism for periodically producing news stories as reminders would serve to continuously revitalize interest in the disease. Perhaps this could be carried out by one of the state agencies with responsibility for rabies education, for example the New York Department of Health, or the Department of Environmental Conservation. Some form of monitoring rabies reporting at the state level would be a useful addition. It would enable the state to direct resources toward places that were not receiving the necessary education to address the disease. Periodically checking the background level of rabies awareness would allow decision makers to determine whether or not any of this reporting is being received and understood. The fact that an article has been published does not mean that it has been read and understood, or that it was persuasive enough to change human behavior.

This does not mean that the subject of rabies reporting is necessarily local. In many instances, in New York at least, it is not. As has been discussed previously, rabies as a social, economic, and political entity is highly centralized in the state within the Albany area. As defined earlier, this area has a greater surveillance density, which in turn influences the larger local newspapers. In some instances,

comparing the amount of news reporting on rabies to the amount of rabies quickly demonstrates that local submissions and local positive rabies results have little impact on local reporting. On others, state-wide reporting seems to have a great deal of impact. Many of the newspapers track closely to statewide rabies statistics, even when those statistics bear little relationship to local conditions.

Among the smaller local newspapers a different dynamic seems to be operating. In these newspapers, the chief determinant is whether or not an exotic event has occurred. An exotic event could be defined as an attack by a rabid animal, or an animal that is not generally considered at risk for rabies such as a horse or goat that tests positive, or the fact that the epizootic wave is approaching. Interest wanes as the disease becomes less exotic.

In 1996 many newspapers display a noticeable decline in rabies reporting that does not necessarily correspond with a decline in rabies submissions. This is particularly true of the Buffalo News and the Albany Times Union. These two newspapers represent counties that had nearly continuous increases in surveillance over the time involved. The reason that 1996 should prove to be definitive in terms of this divergence between news reporting and submissions is unknown.

In Chapter 4 control officers were surveyed regarding whether or not they had seen materials produced from rabies submissions (Question 29), two-thirds answered that they had not. In response to Question 9, fifty-five percent did not provide rabies education themselves. Control officers neither receive rabies information, nor do they generally present it. This leaves the media as the main source of rabies information for the general public and for animal control. Just as with rabies submissions, there is a geographic variability in the quantity and quality of rabies information originating from the print media.

CHAPTER 6 CONCLUSION

Medical geography and spatial epidemiology are driven by surveillance data. Surveillance data are products of a process. That process is complex and varies greatly across space. Medical geography would benefit from more interest in the processes that produces surveillance, particularly those parts of the process that express themselves spatially as well. These things include not only the distribution and attributes of control officers and newspapers, but also the governance of county health departments and state budgeting guidelines. The details of surveillance can provide context to the data. This context allows for a fuller understanding of this data, and could lead to better spatial models and better surveillance systems.

Surveillance systems do not operate in isolation; they are part of the society that sustains them. They receive their funding and their data from that society, and in turn provide information back in the form of news articles, public service announcements, and pamphlets.

6.1 Understanding Surveillance

Surveillance data are the core of this research, which has as its goal an expansion of what is considered the rabies surveillance system. The formal parts of the surveillance system are generally well-defined and well-understood. The informal parts of surveillance systems are not nearly as well-defined and understood. This lack of definition even characterizes whether or not an informal input into the surveillance actually is considered part of the surveillance network.

Chapter three investigated rabies surveillance data for New York over the course of two decades, from 1985 through 2005. It was demonstrated that the surveillance data had strengths and weaknesses. In terms of strength, the data could be used to produce not only maps of the epizootic wave, but also could be used to determine areas with the greatest likelihood of human-animal interaction, since that is generally what these data represent.

There is more to an epizootic than the surveillance data suggest. Rabies not only had an impact on those people who were attacked by animals or worked in the Griffin Rabies Laboratory. Rabies had an impact on control officers, who were expected to handle animals that may have been infected with rabies. Rabies had an impact as well on those who read newspapers and gained an understanding (or a misunderstanding) of the disease.

6.2 Control Officers

In their own estimation, control officers are part of the surveillance network. Chapter four demonstrated that many are involved in securing animals for testing. To varying degrees, most of them contribute to the surveillance system. They see the surveillance system from a perspective that is not available to those who process and collect the data. They are the part of the surveillance network that interacts with the public. This important function has been left to people who know the least about the disease, and are unlikely to receive feedback regarding rabies. This research allows those who direct rabies surveillance systems to improve the education of control officers by directing more educational materials to them.

6.3 News Reporting

News reporting has been considered relevant in terms of rabies surveillance, but the exact behavior of newspapers and other media sources during an epizootic have proven difficult to determine. This research has summarized newspaper reporting in New York State during an epizootic. Local newspapers do have a greater tendency to reflect rabies submissions within a state, at least within the context of the state of New York. The question of whether or not submissions are driving reporting or reporting is influencing submissions remains unanswered.

6.4 A Subjective Conception of Submissions

A map of a subjective conception of submissions would perhaps be instructive, but the surface of New York rabies surveillance was sufficiently variable that any map would require a depth of understanding of local conditions that simply is not possible. However, a more general subjective understanding of submissions is possible and can be concisely described. To a large degree, rabies surveillance is a process of looking, not finding. Rabies is only found in those places where people are searching for it. In all the other places, unless it makes itself known in a particularly obvious manner, rabies will not be noted. Those places not looking for the disease are generally the places with low population, and a populace who are accustomed to interacting with (killing) animals. In these places, people have taken care of rabid animals themselves.

6.5 Further Research

6.5.1 Improvements in Surveillance Data

There are many ways to improve surveillance data, from an increase in the quantity of samples taken to the inclusion of more fields in the record of submission; such as the time the sample was taken, and the reason the sample was taken. There is also the movement toward greater spatial resolution (Blanton, Manangan et al. 2006), although this can present its own problems (Curtis, Mills et al. 2006) in terms of confidentiality. Another way to improve surveillance data is simply to better record the circumstances under which it was collected (part of an oral vaccination program, attack, abnormal behavior, found dead) and what kind of place the animal may have been in.

Another possible way to improve the quality of surveillance data is training of animal and dog control officers. The results of Chapter 4 would indicate that a relatively modest amount of educational materials could improve the quality of the work performed by control officers. It is not realistic to

expect people who have little understanding of rabies to function effectively within a surveillance system.

Comparisons with control officers in other states during a rabies epizootic could provide insight into the commonalities of this particular job, and the relationship of rabies to animal control beyond state boundaries. It is possible that observations made in New York State have no application in other places. There is also the possibility that the definition of control officer in other places is different enough that reasonable comparisons cannot be made.

Besides control officers, other people within the surveillance system would be worthy of study. It would perhaps be instructive to survey county health department workers regarding their attitudes regarding rabies and their training levels. In states without a central rabies laboratory, such as California, it might be useful to interview the workers at each laboratory and compare the findings across space. In the places with more than one rabies laboratory, it would be interesting to investigate the distribution of submissions in order to determine is distance decay were a factor.

Another approach would be tracking a "typical" case from the bottom up through a surveillance system. Important questions regarding the actual route taken through the system could be answered, such as who secured, prepared, and processed the sample, and what eventually happened to the data produced, if anything.

This research is at its core an investigation into the parts of a surveillance network that receive little attention, but there are other aspects. Outside of New York City, New York State has one rabies testing lab. Other states, such as California, have one in each county. Does accessibility or the lack of accessibility contribute to spatial variation? Different states have different surveillance and testing systems, the impact of these different systems on the surveillance data merits investigation.

6.6 Social and Legal Issues Regarding Animal Populations

The connection between law and surveillance deserves attention. Laws limit and empower. Although law governs animal control and the function of surveillance, it does not control public opinion, nor does it control news reporting on the subject of rabies. Since laws regarding are highly variable, they likely have an impact on surveillance data.

An issue regarding rabies submissions that likely had less prominence in the past is the issue of animal rights. The relationship between animal rights activities and animal submissions was glimpsed during this research. It seems likely that places with very strong attitudes toward the idea of animal rights, and related subjects such as animal rehabilitation and translocation, would submit fewer animals for testing. Even with the force of law on its side, the State of New York proved unwilling to prosecute people who violated animal ordinances in the name of animal protection (Melvin 1991).

The control officers, who in many places are responsible for collecting rabid animals, are themselves individuals who may have different constraints on their behavior. Whether or not they are trappers or members of the Humane Society likely has an impact on the way their job is performed. Whether or not a job is part-time and the pay received is also a variable that merits further investigation.

A question that must be answered is whether or not the state of New York is a special case in terms of rabies surveillance, and that observations here may not apply in other places. All places are unique in some respects, New York is no exception. New York is large, wealthy, and it borders another country. It has legally-mandated dog control, and health officials who became prominent statewide during the rabies epizootic. New York still has many local newspapers, and is a center for news production. Any of these characteristics can be applied to other places either by themselves or in combinations.

In order to better understand the function of a rabies epizootic it will be necessary to make comparisons with media reports in other states during a rabies epizootic. New York had a large number of local newspapers and an extensive epizootic. It is unknown if a reduction in the availability of local newspapers or a milder epizootic would have an impact on the relationship between newspaper articles and rabies submissions. It would also be useful to investigate whether or not the type of epizootic; raccoon, skunk, fox, or coyote, would have an impact on news reporting.

The influence of the media on disease reporting is a subject that is elusive. Comparisons with media in other states involving other diseases would be illuminative. Media reports of West Nile Virus, Chronic Wasting Disease, Severe Acute Respiratory Syndrome (SARS) and other historic and emerging diseases elicit national and international attention. This appears particularly true during epizootics/epidemics. This particular line of research would lend itself to technologies such as Promed (http://www.promedmail.org), which provides a global system for reporting outbreaks of diseases, and electronically archived news sources.

Disease maps provided by newspapers are another avenue of investigation. These maps are among the most important pieces of rabies information that the public receives. These maps are also comparatively rare, even in large newspapers such as the Buffalo News and the New York Times. Certain questions present themselves in regard to disease maps. What commonalities exist between disease maps from different states? Are there certain instances that are more likely to convince a newspaper to publish a disease map? Are human diseases, even non-fatal ones, more likely to be associated with mapping in newspapers?

6.7 Final Section

This research is just the beginning of research into informal components of surveillance. Disease surveillance and the issues surrounding it are complex enough that the research is interesting,

but not so complex that the research is nearly impossible. There is sufficient material to provide for an entire career, and technology allows more methods of research into these topics than were available before.

LITERATURE CITED

Altman, L. K. (1993). THE DOCTOR'S WORLD; A Fatal Case of Rabies, and How It Nearly Went Undetected. New York Times. New York.

Anderson, L. J., L. P. Williams, et al. (1984). "Nosocomial rabies: investigation of contacts of human rabies cases associated with a corneal transplant." American Journal Public Health **74**(4): 370-372.

Anon (1993). Political Newcomer Challenges Lafayette Supervisor. Syracuse Post Standard. Syracuse, New York**:** B3.

Anon (1993). Refusal to pay rabies bill cost Dutchess aid. Poughkeepsie Journal. Poughkeepsie, New York**:** 1a.

Anon (1995). Rabies funds diverted. New York Times. New York. **26**.

Anon (1996). Poe's Death Is Rewritten as Case of Rabies, Not Telltale Alcohol. New York Times. New York.

Anon (2000). "Human rabies--United States, 2000." MMWR Morbidity Mortality Weekly Report **49**(49): 1111-5.

Anthony, J. A. and J. E. Childs (1990). "Land use associations and changes in population indices of urban raccoons during a rabies epizootic." Journal of Wildlife Disease **26**(2): 170-179.

Bacon, P. J. (1985). Population Dynamics of Rabies in Wildlife New York, Academic Press.

Bailey, T. and A. Gatrell (1995). Interactive Spatial Data Analysis. New York, Wiley.

Bigler, L. A. and D. H. Lein (1997). Oral Rabies Vaccination of Raccoons in the St. Lawrence, Niagara, and Erie Regions of New York State and the Champlain Region of Vermont. 1997 Rabies in the Americas Conference. Kingston, Ontario, Canada.

Blanton, J. B., A. Manangan, et al. (2006). "Development of a GIS based, real-time Internet mapping tool for rabies surveillance." International Journal for Health Geographics **5**(47): 8.

Chang, H. H., Eidsen, M., Trimarchi, C.V., Noonan-Toly, Rudd, R., Wallace, B.J., Smith, P.F.,Morse, D.F. (2002). "Public Health Impact of Reemergence of Rabies, New York." Emerging Infectious Disease **8**(9): 909-913.

Charatan, F. (1995). "New York attacks raccoon rabies from the air." British Medical Journal **311**: 1184-1185.

Childs, J. E., L. Colby, et al. (1997). "Surveillance and spatiotemporal associations of rabies in rodents and lagomorphs in the United States, 1985-1994." Journal of Wildlife Disease **33**(1): 20-7.

Childs, J. E., A. T. Curns, et al. (2001). "Rabies epizootics among raccoons vary along a North-South gradient in the Eastern United States." Vector Borne Zoonotic Disease **1**(4): 253-67.

Childs, J. E., A. T. Curns, et al. (2000). "Predicting the local dynamics of epizootic rabies among raccoons in the United States." Proceedings of the National Academy of Science U S A **97**(25): 13666-71.

Cliff, A. D. and P. Haggett (1992). Atlas of Disease Distributions. Oxford, Blackwell.

Cliff, A. D., P. Haggett, et al. (1993). Measles: An historical geography of a major human viral disease. . Cambridge, Blackwell.

Cliff, A. D., P. Haggett, et al. (1998). Deciphering global epidemics: analytical approaches to the disease records of world cities, 1888-1912. Cambridge, Cambridge University Press.

Coyne, M. J., G. Smith, et al. (1989). "Mathematic model for the population biology of rabies in raccoons in the mid-Atlantic states." American Journal of Veterinary Research **50**(12): 2148-54.

Cummings, D. A. T., R. A. Irizarry, et al. (2004). "Travelling waves in the occurrence of debgue haemorrhagic fever in Thailand." Nature **427**(January 2004): 344-347.

Curtis, A. (1999). "Using a Spatial Filter and a Geographic Information System to Improve Rabies Surveillance Data." Emerging Infectious Disease **5**(5).

Curtis, A. (2001). Identifying spatial holes in a rabies surveillance surface: comparing results from cartographic visualization to spatial filter analysis. Geography and Medicine. T. A. Flahault, L., and A.J. Valleron Elsevier**:** 40-48.

Curtis, A., S. Heath, et al. (2005). GIS Investigations of Epizootics: The Limitations of Surveillance Data. Wildlife Diseases: Landscape Epidemiology. Spatial Distribution and Utilization of Remote Sensing Technology. S. K. Majumdar, Huffman, J., Brenner, F., and I.A. Panah. Easton, PA, The Pennsylvania Academy of Science**:** 459-474.

Curtis, A. J., J. W. Mills, et al. (2006). "Spatial confidentiality and GIS: re-engineering mortality locations from published maps about Hurricane Katrina." International Journal of Health Geographics **5**(44): 12.

Deal, B., C. Farello, et al. (2000). "A Dynamic Model of the Spatial Spread of an Infectious Disease: The Case of Fox Rabies in Illinois." Environmental Modeling and Assessment, **5**: 47-62.

Dobson, A. (2000). "Raccoon rabies in space and time." PNAS **97**(26): 14,041-14,043.

Faber, H. (1989). Judge Orders U.S. to Pay $5.98 Million to Rabies Survivor. New York Times. New York.

Fearneyhough, M. G. (2001). "Rabies postexposure prophylaxis. Human and domestic animal considerations." Veterinary Clinicians North American Small Animal Practice **31**(3): 557-72.

Finnegan, C. J., S. M. Brookes, et al. (2002). "Rabies in North America and Europe." Journal of Research of Social Medicine **95**(1): 9-13.

Fischman, H., J. Grigor, et al. (1993). "Epizootic of rabies in Maryland from 1981-1987." Journal of the American Veterinary Medical Association **201**(12): 1883-1886.

Foody, G. M. (2006). "GIS: Health applications." Progress in Physical Geography **30**(5): 691-695.

Gatrell, A. C. (2002). Geographies of health: an introduction. Oxford, Blackwell.

Gerstman, B. (1998). Epidemiology kept simple : an introduction to classic and modern epidemiology. New York, Wiley**:** 12-22.

Goldman, E. A. (1950). Raccoons of North and Middle America. Washington, D.C., United States Department of the Interior.

Guerra, M. A., A. T. Curns, et al. (2003). "Skunk and raccoon rabies in the eastern United States: temporal and spatial analysis." Emerging Infectious Disease **9**(9): 1143-50.

Haggett, P. (2001). Geography: a global synthesis. New York, Prentice Hall.

Haupt, W. (1999). " Rabies - Risk of exposure and current trends in prevention of human cases." Vaccinia **17**(13-14): 1742-1749.

Hubbard, D. R. (1985). "A descriptive epidemiological study of raccoon rabies in a rural environment." Journal Wildlife Disease **21**(2): 105-10.

Hugh-Jones, M. E. (1976). "Studies on the 1967-68 Foot and Mouth Disease epidemic. The reporting of suspected disease." Journal of Hygeine **77**: 299-306.

Huse, J. (2004). Currency of Control Officer Database. D. Dorrell. Albany.

Ilbery, B. (2002). "Geographical aspects of the 2001 outbreak of Foot and Mouth Disease in the UK." Geography **87**(2): 142-148.

Jackson, A. C. (2002). Rabies. New York, Academic Press.

Jacon, J., Reuben, S. (2000). "Herd immunity and herd effect: New insights and definitions." European Journal of Epidemiology **16**(7): 601-606.

Jenkins, S. R., B. D. Perry, et al. (1988). "Ecology and epidemiology of raccoon rabies." Review of Infectious Disease **10 Suppl 4**: S620-5.

Keeling, M. J., M. E. J. Woolhouse, et al. (2001). "Dynamics of the 2001 UK Foot and Mouth Epidemic: stochastic dispersal in a heterogeneous landscape." Science **294**(5543).

Krebs, J. W., R. C. Holman, et al. (1992). "Rabies surveillance in the United States during 1991." Journal of the American Veterinary Medical Association **201**(12): 1836-48.

Krebs, J. W., T. W. Strine, et al. (1993). "Rabies surveillance in the United States during 1992." Journal of the American Veterinary Medical Association **203**(12): 1718-31.

Krebs, J. W., T. W. Strine, et al. (1994). "Rabies surveillance in the United States during 1993." Journal of the American Veterinary Medical Association **205**(12): 1695-709.

Krebs, J. W., T. W. Strine, et al. (1995). "Rabies surveillance in the United States during 1994." Journal of the American Veterinary Medical Association **207**(12): 1562-75.

Krebs, J. W., T. W. Strine, et al. (1996). "Rabies surveillance in the United States during 1995." Journal of the American Veterinary Medical Association **209**(12): 2031-44.

Krebs, J. W., J. S. Smith, et al. (1997). "Rabies surveillance in the United States during 1996." Journal of the American Veterinary Medical Association **211**(12): 1525-39.

Krebs, J. W., J. S. Smith, et al. (1998). "Rabies surveillance in the United States during 1997." Journal of the American Veterinary Medical Association **213**(12): 1713-28.

Krebs, J. W., J. S. Smith, et al. (1999). "Rabies surveillance in the United States during 1998." Journal of the American Veterinary Medical Association **215**(12): 1786-98.

Krebs, J. W., C. E. Rupprecht, et al. (2000). "Rabies surveillance in the United States during 1999." Journal of the American Veterinary Medical Association **217**(12): 1799-811.

Krebs, J. W., A. M. Mondul, et al. (2001). "Rabies surveillance in the United States during 2000." Journal of the American Veterinary Medical Association **219**(12): 1687-99.

Krebs, J. W., H. R. Noll, et al. (2002). "Rabies surveillance in the United States during 2001." Journal of the American Veterinary Medical Association **221**(12): 1690-701.

Krebs, J. W., J. T. Wheeling, et al. (2003). "Rabies surveillance in the United States during 2002." Journal of the American Veterinary Medical Association **223**(12): 1736-48.

Krebs, J. W., E. J. Mandel, et al. (2004). "Rabies surveillance in the United States during 2003." Journal of the American Veterinary Medical Association **225**(12): 1837-49.

Krebs, J. W., E. J. Mandel, et al. (2005). "Rabies surveillance in the United States during 2004." Journal of the American Veterinary Medical Association **227**(12): 1912-25.

Lam, N. S.-N., M. Fan, et al. (1996). "Spatial-temporal spread of the AIDS epidemic: A correlogram analysis of four regions of the United States." Geographical Analysis **28**(2): 93-107.

Lam, N. S.-N. and K. B. Liu (1994). "Spread of AIDS in rural America, 1982-1990. ." Journal of Acquired Immune Deficiency Syndrome **7**: 485-490.

Lam, N. S.-N. and K. B. Liu (1996). "Use of space-filling curves in generating a national rural sampling frame for HIV/AIDS research. ." The Professional Geographer **48**(3): 321-332.

MacInnes, C. (1995). "MNR Participates in New York State Aerial Bait Drop for Raccoon Rabies." Ministry of Natural Resources News.

Markets, N. Y. D. o. A. a. (2005). Article 7 of the New York Agriculture & Markets Law (Chapters 220 & 221), Laws of 1978, revised January 2005. N. Y. D. o. A. a. Markets, State of New York. **Article 7:** 3-7.

Markets, N. Y. D. o. A. a. (2005). Section 78.2 from Article 26 of the New York Agriculture & Markets Law , revised January 2005. N. Y. D. o. A. a. Markets, State of New York**:** 5-6.

May, J. (1958). Ecology of Human Disease. New York, MD Publications.

Mayer, J. D. (2000). "Geography, ecology, and emerging infectious diseases." Social Science and Medicine **50**: 937-952.

McNeill, W. H. (1976). Plagues and Peoples. New York, Monticello Books.

Melvin, T. (1991). Resolution is sought in release of raccoons. New York Times. New York.

MMWR (1998). "Public Opinion About Public Health-California and the United States, 1996." MMWR **47**(4): 69-72.

Moore, D. (1999). "Spatial diffusionof raccoon rabies in Pennsylvania, USA." Preventative Veterinary Medicine **40**: 19-32.

Perry, B. D. (1987). "Rabies." Vet Clin North Am Small Anim Pract **17**(1): 73-89.

Pizzuti, M. (2000). Dog Tails. New York, Xlibris Corporation.

Pyle, G. F. (1986). The diffusion of influenza. Totowa, NJ, Rowman and Littlefield.

Real, L. A., C. Russell, et al. (2005). "Spatial dynamics and molecular ecology of North American rabies." Journal of Heredity **96**(3): 253-60.

Reid-Sanden, F. L., J. G. Dobbins, et al. (1990). "Rabies surveillance in the United States during 1989." Journal of the American Veterinary Medical Association **197**(12): 1571-83.

Riley, S. P., J. Hadidian, et al. (1998). "Population density, survival, and rabies in an urban national park." Canadian Journal of Zoology **76**: 1153-1164.

Rotz, L. D., J. A. Hensley, et al. (1998). "Large-scale human exposures to rabid or presumed rabid animals in the United States: 22 cases (1990-1996)." Journal of the American Veterinary Medical Association **212**(8): 1198-200.

Rudd, R. (2005). Rabies Surveillance. D. W. Dorrell. Albany, New York.

Rudd, R. J., J. S. Smith, et al. (2005). "A need for standardized rabies-virus diagnostic procedures: effect of cover-glass mountant on the reliability of antigen detection by the fluorescent antibody test." Virus Research **111**(1): 83-8.

Rupprecht, C., Smith, JS, Fekadu, M, Childs, JE (1995). "The Ascension of Wildlife Rabies: A Cause for Public Health Concern or Intervention?" Emerging Infectious Disease **1**(4).

Rupprecht, C. E., C. A. Hanlon, et al. (2004). "Oral vaccination of wildlife against rabies: opportunities and challenges in prevention and control." Developmental Biology (Basel) **119**: 173-84.

Rupprecht, C. E., J. S. Smith, et al. (1995). "The ascension of wildlife rabies: a cause for public health concern or intervention?" Emerging Infectious Disease **1**(4): 107-14.

Russell, C. A., D. L. Smith, et al. (2005). "Predictive spatial dynamics and strategic planning for raccoon rabies emergence in Ohio." PLoS Biology **3**(3): e88.

SAS (1999). SAS/STAT Users Guide. Cary, North Carolina, SAS Institute.

Shannon, G. W. and G. F. Pyle (1989). "The Origin and Diffusion of AIDS: A View from Medical Geography." Annals of the Association of American Geographers **79**: 1-79.

Shannon, G. W., G. F. Pyle, et al. (1991). The Geography of AIDS: Origins and Course of an Epidemic. New York, Guilford.

Singer, P. (2003). Animal Liberation at 30. The New York Times Review of Books. **50**.

Smith, D., B. Lucey, et al. (2002). "Predicting the spatial dynamics of rabies epizootics on heterogenous landscapes." Proceedings of the National Academy of Science **99**(6): 3668-3772.

Stone, W. (2005). Rabies submissions. D. W. Dorrell. Del Mar, New York.

Stone, W. (2006). "In Our Backyard." from http://www.wamc.org/inourbackyard.html.

Tachiiri, K., B. Klinkenberg, et al. (2006). "Predicting outbreaks: a spatial risk assessment of West Nile virus in British Columbia." International Journal Of Health Geographics **5**: 21.

Tinline, R. R. and C. D. Maciness (2004). "Ecogeographic Patterns of rabies in southern Ontario based on time series analysis." Journal of Wildlife Disease **40**(2): 212–221.

Torrence, M., A. Beck, et al. (1995). "Raccoon rabies in the Mid-Atlantic (epidemic) and southeastern states (epidemic), 1970-1986:an evaluation of reporting methods." Preventative Veterinary Medicine **22**: 197-211.

Torrence, M., S. Jenkins, et al. (1992). "Epidemiology of raccoon rabies in Virginia 1984 to 1989." Journal of Wildlife Diseases **28**(3): 369-376.

Trevelyan, B., M. Smallman-Raynor, et al. (2005). "The spatial dynamics of poliomyelitis in the United States: from epidemic emergence to vaccine induced retreat, 19190-1971." Annals of the Association of American Geographers **95**(2): 269-293.

Trimarchi, C. V. (2005). Rabies surveillance. D. W. Dorrell. Albany, New York.

Tuttle, M. (1999). "Rabies: Economics vs. Public Safety." Batmag **17**(2): 3-7.

Uhaa, I. J., E. J. Mandel, et al. (1991). "Rabies surveillance in the United States during 1990." J Am Vet Med Assoc **200**(7): 920-9.

Watt, R. A. (2004). Bethlehem Police Department Animal Control Division Annual Report 2004. Bethlehem, New York**:** 32.

Watt, R. A. (2005). Animal control. D. W. Dorrell. Bethlehem, New York.

Wilson, M. L., P. M. Bretsky, et al. (1997). "Emergence of raccoon rabies in Connecticut, 1991-1994: spatial and temporal characteristics of animal infection and human contact." Am J Trop Med Hyg **57**(4): 457-63.

Wyatt, J. D., Barker, W.H., Human Rabies Postexposure Prophylaxis during a Raccoon Rabies Epizootic in New York, 1993 and 1994Bennett, N.M.,and Cathleen A. Hanlon (2000). "Human Rabies Postexposure Prophylaxis during a Raccoon Rabies Epizootic in New York, 1993 and 1994." Emerg Infect Disease **5**(3).

APPENDIX A QUESTIONNAIRE

Questionnaire Please select a number when available Your Initials
_____

2. What is your job position? Your Town _____
ZipCode _____

3. When did you start doing this job?

3. Please circle which animals you encounter in the course of this job.

Dogs Cats Livestock Other Domestic Animals Feral animals Wild Animals Other:_____

4. Are you a uniformed police officer of the law or a uniformed wildlife agent?
1=yes 2=no No Answer

5. How would you rank rabies surveillance in terms of importance to your job?
Not important 1 2 3 4 5 Most Important No Answer

6. Approximately how many times per year do you receive feedback from state officials concerning rabies?
No Answer

7. Approximately how many days of rabies training do you receive per year?
No Answer

8. Do you yourself provide rabies education?
1=yes 2=no No Answer

9. What is your opinion of media coverage of rabies?
Very Low 1 2 3 4 5 Very High No Answer

10. Do you believe that your job is helped or hindered by media coverage?
1=Helped 2=Hindered 3=No Effect 4=Unknown No Answer

11. What, if any, local newspaper do you read?
No Answer

12. Have you noticed any relationship between the amount of media coverage and the amount of calls for collection that you receive?
No Relationship 1 2 3 4 5 Direct Relationship No Answer

13. Approximately how many animal calls do you get per month?
No Answer

14. How active a collector are you?
Not active 1 2 3 4 5 Very Diligent No Answer

15. Are other collectors as active as you?
Never 1 2 3 4 5 Always No Answer

16. Does distance influence your likelihood of collecting an animal?
Never 1 2 3 4 5 Always No Answer

17. How could the process of collection be improved?

18. How do you feel about the budget for rabies surveillance in this county?

Much too low 1 2 3 4 5 Much too high No Answer

19. Approximately how many animals with rabies have you collected?

Unknown No Answer

20. How much does this county value rabies surveillance?

Not at all 1 2 3 4 5 Very much No Answer

21. How much does this state value rabies surveillance?

Not at all 1 2 3 4 5 Very much No Answer

22. Approximately what percentage of your job consists of catching rabid animals?

No Answer

23. Have you been vaccinated for rabies?

1=yes 2=no No Answer

24. If you have been vaccinated, was it a condition for your position as Animal/Dog Control Officer?

1=yes 2=no No Answer

25. Did you personally have to pay for the vaccination?

1=yes 2=no No Answer

26. Was the risk of rabies in this county ever significant?

1=yes 2=no No Answer

27. If so, what year did it become so?

No Answer

28. How do you think the public perceives your job?

1=Positively 2=Negatively 3=Unknown 4=Other: _____ No Answer

29. Have you ever seen materials (maps, graphs, etc) created from the rabies data collected by DCO/ACOs?

1=yes 2=no No Answer

30. What is the name of the veterinarian to whom you send suspected rabid animals?

No Answer

31. Approximately how many other Animal or Dog Control officers do you know?

No Answer

32. Do you consider yourself part of the public health structure?

1=yes 2=no No Answer

33. May I contact you again? No Answer

34.In your opinion, what are the impediments to accurate rabies surveillance (numbers) in your area?

For further information see the web site: http://www.gisinhealth.org Please feel free to add additional comments

APPENDIX B NEWSPAPER INDEXING

There is no central system describing which newspapers have been indexed, where these indices may be, or who owns them. Some of these indices were found in local and state libraries, some in historical societies, and some are the property of the newspapers themselves. This was surprising given the existence of the New York Newspaper Project, with the avowed goal of organizing and preserving the state's historical news resources (New York State Newspaper Project 2005).

Indexing, or more accurately, a lack of indexing was another problem in dealing with the large quantity of information found in these news sources. Some New York newspapers, particularly those serving large urban areas, were completely indexed. Some of the smaller newspapers had no index . The necessity of indices for a study of this nature is self-evident, since a researcher's effort to index several years of a single newspaper posses a tremendous amount of work. Many of the newspapers in New York State are indexed electronically from 1999 onward, with most of these indices available to the public. For sources older than this, indexing is more scarce. By the late 1990s, most newspapers, even smaller operations, had switched to a computer based production system, which meant that electronic indexing was relatively simple. Prior to the use of these systems, indexing generally required the use of a person, usually a newspaper archivist or librarian, to sort these data and collect them into a usable form. Such a position was simply too expensive for the smaller newspapers.

Some newspapers, such as the Poughkeepsie Journal, were only indexed for a short time. In the case of this newspaper, it was only indexed for the year 1993, the year in which a local librarian attempted to create an index. It took two years to produce the 1993 index as a card catalog before the project was abandoned. Other newspapers produced their own index files. These files were highly dependent upon the person who was assembling them and were not as consistent as those collected by the historians. The Batavia Daily News, the Utica Observer and Dispatch, The Geneva Finger Lakes

Times, and the Rome Sentinel all had essentially "home-made" indices that had been assembled through the cooperation of the local newspaper and a local library. None of these were complete enough for inclusion, as a close examination revealed that their systems were incomplete and missing many articles.

The Oswego Palladium Times stands by itself in the manner in which it was indexed. This newspaper was indexed through the work of one man, Tom Tryniski, who used a microfilm scanner and software applications to scan, digitize and index several newspapers. This technical solution is likely to be the way that non-indexed newspapers will be converted into indexed, electronic sources. There were some technical problems with this source. The software for optical character recognition (OCR) sometimes garbles the text of the articles in the index, but the quality was easily sufficient to search by title and manually exclude the extraneous entries. In other words, the problem is one of specificity and not sensitivity of the search, since the fuzzy logic indices were set at a level to collect anything remotely related to rabies, such as a person named Raby.

One form of indexing that was utilized in such places as Rochester and Little Falls was the clip file or morgue. This involves a person or group of people collecting all the clippings from a local newspaper and keeping them in a file by subject. The Rochester clip file contained rabies articles dating from the 1950s, and was extremely well-organized. The other clip files were not as impressive, once again due to a lack of resources.

APPENDIX C REGIONAL SUMMARY TABLES

Southern Region	1989	1990	1991	1992	1993	1994	1995	1996
Binghamton Press Sun Bulletin articles			5	0	3	1	0	0
Elmira Star Gazette articles		17	29	1	1	5	1	4
Broome County Submissions	141	204	257	202	145	124	97	125
Chemung County Submissions	70	420	403	214	121	95	90	90
Chenango	16	43	65	117	67	34	32	53
Cortland County Submissions	53	84	70	230	290	127	92	188
Delaware County Submissions	15	60	162	151	71	53	44	58
Schuyler County Submissions	6	21	76	130	40	39	30	20
Steuben County Submissions	35	210	263	154	99	83	98	100
Tioga County Submissions	25	67	94	156	79	52	61	102
Tompkins County Submissions	151	179	192	504	243	153	158	176
Yates County Submissions	6	28	70	147	65	50	40	87

Southern Region	1997	1998	1999	2000	2001	2002	2003	2004	2005
Binghamton Press Sun Bulletin articles	1	0	6	5	16	11	14	32	20
Elmira Star Gazette articles	2	1	4	8	5	4	6	4	9
Broome County Submissions	125	149	133	188	177	163	136	174	183
Chemung County Submissions	90	94	103	124	180	174	163	172	135
Chenango	58	61	53	50	58	52	55	44	51
Cortland County Submissions	233	174	149	166	116	109	82	73	64
Delaware County Submissions	90	69	75	87	82	76	63	70	84
Schuyler County Submissions	39	30	33	42	37	31	54	48	44
Steuben County Submissions	132	125	119	104	126	98	116	95	78
Tioga County Submissions	102	87	81	126	91	61	79	93	98
Tompkins County Submissions	169	183	120	175	191	165	190	202	199
Yates County Submissions	70	62	52	71	54	55	37	46	49

Southeast Region	1989	1990	1991	1992	1993	1994	1995	1996
Newsday articles	6	24	24	23	47	22	13	16
Times Herald Record articles	5	57	87	78	65	48	70	68
White Plains Papers articles	3	1	27	21	21	8	18	10
Dutchess County Submissions	80	116	325	560	300	169	183	298
Nassau County Submissions	29	73	80	129	155	68	96	70
Orange County Submissions	64	115	385	308	291	199	237	270
Putnam County Submissions	33	46	177	78	50	43	51	67
Rockland County Submissions	36	73	222	274	171	164	182	214
Suffolk County Submissions	52	66	129	110	141	76	80	78
Sullivan County Submissions	33	191	176	55	92	66	84	76
Ulster County Submissions	83	151	267	396	278	224	276	322
Westchester County Submissions	68	88	349	418	383	291	453	711

Southeast Region	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Newsday articles	13	14	13	20	23	9	10	14	17
Times Herald Record articles	35	30	31	19	10	15	8	14	7
White Plains Papers articles	6	0	20	18	15	25	26	24	20
Dutchess County Submissions	289	244	254	240	212	209	191	203	188
Nassau County Submissions	78	57	60	36	43	49	52	652	332
Orange County Submissions	213	241	211	222	201	192	193	204	217
Putnam County Submissions	103	149	159	181	233	189	208	212	204
Rockland County Submissions	189	160	149	151	147	173	109	119	95
Suffolk County Submissions	82	79	119	120	168	105	140	168	174
Sullivan County Submissions	81	122	83	68	52	50	45	47	39
Ulster County Submissions	234	266	265	243	181	221	196	220	203
Westchester County Submissions	736	826	800	976	923	748	684	687	675

Capitol Region	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Albany Times Union articles	6	12	22	83	101	12	13	11
Schenectady Gazette articles		4	8	81	105	22	12	9
Albany County Submissions	258	205	238	463	1847	570	483	611
Columbia County Submissions	58	71	109	118	350	143	133	176
Fulton County Submissions	17	14	18	39	131	53	31	20
Greene County Submissions	26	22	66	110	165	71	81	115
Montgomery County Submissions	18	29	17	44	178	86	46	59
Otsego County Submissions	27	44	30	141	175	76	65	65
Rensselaer County Submissions	103	137	81	228	595	409	298	287
Saratoga County Submissions	83	65	78	195	446	199	148	234
Schenectady County Submissions	71	81	82	167	324	139	116	149
Schoharie County Submissions	25	26	48	87	232	62	61	48
Washington County Submissions	36	27	26	40	156	304	122	77

Capitol Region	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Albany Times Union articles	12	16	17	23	10	13	9	9	16
Schenectady Gazette articles	9	27	19	14	17	11	12	11	13
Albany County Submissions	732	790	812	756	673	665	831	663	694
Columbia County Submissions	173	164	163	264	233	203	125	206	171
Fulton County Submissions	29	24	29	36	28	30	28	24	34
Greene County Submissions	104	90	107	84	126	81	84	71	60
Montgomery County Submissions	56	34	44	41	35	41	29	41	43
Otsego County Submissions	117	82	107	98	77	80	69	80	99
Rensselaer County Submissions	237	228	281	220	194	262	260	216	279
Saratoga County Submissions	328	196	247	203	186	150	161	173	209
Schenectady County Submissions	176	139	167	172	147	131	121	125	139
Schoharie County Submissions	60	48	48	60	59	53	76	61	65
Washington County Submissions	145	131	143	121	100	105	100	103	93

Western Region	1989	1990	1991	1992	1993	1994	1995	1996
Buffalo News articles	4	21	5	1	34	36	28	14
Rochester Dem. & Chron. articles	1	2	3	11	16	20	6	4
Allegany County Submissions	13	97	278	175	82	63	68	76
Cattaraugus County Submissions	22	59	186	186	159	88	82	95
Chautauqua County Submissions	86	108	162	98	126	445	195	159
Erie County Submissions	146	192	237	240	396	482	427	475
Genesee County Submissions	47	47	47	103	132	131	76	79
Livingston County Submissions	17	30	39	126	172	101	69	83
Monroe County Submissions	64	65	64	75	153	170	121	155
Monroe County Submissions	64	65	64	75	153	170	137	229
Niagara County Submissions	52	45	61	93	112	164	381	169
Orleans County Submissions	11	10	11	28	32	109	93	113
Wyoming County Submissions	12	23	43	94	154	76	54	63

Western Region	1998	1999	2000	2001	2002	2003	2004	2005
Buffalo News articles	21	10	16	10	6	0	6	
Rochester Dem. & Chron. articles	7	3	3	3	1	2	1	1
Allegany County Submissions	48	42	81	71	70	61	53	72
Cattaraugus County Submissions	97	81	106	123	128	111	103	111
Chautauqua County Submissions	127	128	115	149	164	77	75	81
Erie County Submissions	506	505	676	703	705	759	653	603
Genesee County Submissions	89	96	109	54	62	77	70	50
Livingston County Submissions	124	95	70	77	84	69	55	70
Monroe County Submissions	202	262	214	196	238	291	163	168
Monroe County Submissions	202	262	214	196	238	291	163	168
Niagara County Submissions	161	150	170	98	102	123	134	165
Orleans County Submissions	96	85	89	96	79	73	67	65
Wyoming County Submissions	63	65	60	67	74	50	37	40

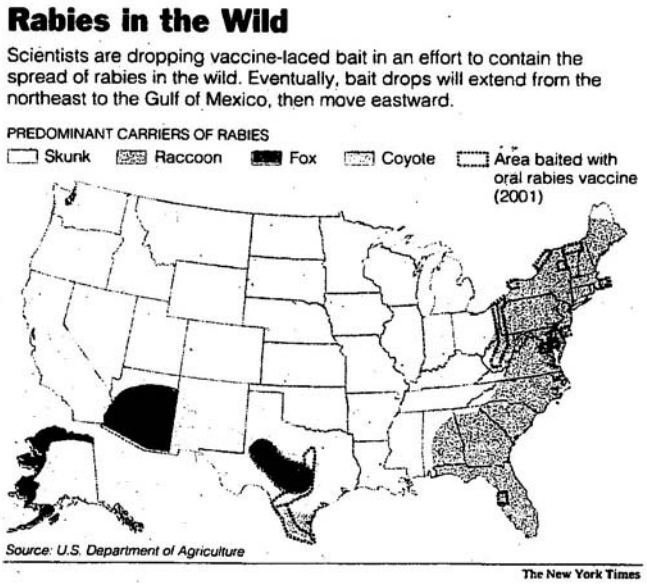
Northwest Region	1989	1990	1991	1992	1993	1994	1995	1996
Oswego Palladium Times articles		5	4	2	26	40	25	16
Syracuse Post Standard articles	17	34	38	63	162	121	40	31
Cayuga County Submissions	28	45	43	69	359	571	312	253
Madison County Submissions	47	81	52	49	155	137	85	77
Oneida County Submissions	114	173	197	200	372	358	247	153
Onondaga County Submissions	378	559	347	416	553	483	248	285
Ontario County Submissions	27	28	38	112	250	107	94	151
Oswego County Submissions	77	110	89	90	198	245	212	146
Seneca County Submissions	17	96	63	123	97	62	26	57
Wayne County Submissions	24	48	66	58	104	171	95	101

Northwest Region	1998	1999	2000	2001	2002	2003	2004	2005
Oswego Palladium Times articles	14	7	7	2	4	10	10	0
Syracuse Post Standard articles	72	22	20	52	54	46	32	0
Cayuga County Submissions	245	218	263	193	184	152	155	154
Madison County Submissions	119	84	68	68	56	62	65	63
Oneida County Submissions	144	124	149	123	111	118	87	152
Onondaga County Submissions	385	287	267	264	263	236	224	265
Ontario County Submissions	159	153	165	144	110	138	128	106
Oswego County Submissions	193	156	153	136	143	110	101	118
Seneca County Submissions	50	37	55	59	39	38	31	41
Wayne County Submissions	136	97	103	103	100	88	97	105

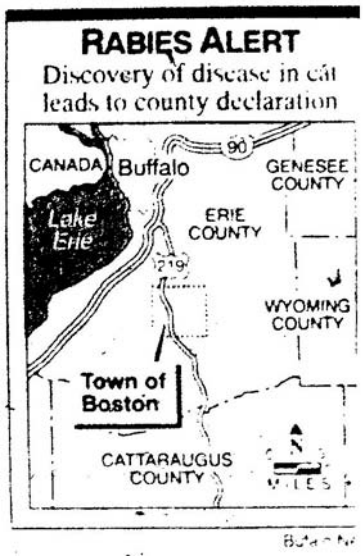
Northern Region	1989	1990	1991	1992	1993	1994	1995	1996
Plattsburgh Press Repub. articles	0	3	16	14	4	4	26	9
Watertown Daily Times articles	5	17	32	45	69	68	140	127
Clinton County Submissions	46	60	344	301	113	59	121	132
Essex County Submissions	26	21	38	68	46	35	68	105
Franklin County Submissions	19	143	158	59	35	25	37	40
Hamilton County Submissions	2	0	2	3	5	7	5	5
Herkimer County Submissions	20	20	39	37	102	99	71	46
Jefferson County Submissions	29	43	46	50	51	91	299	299
Lewis County Submissions	11	16	12	12	21	42	166	198
St Lawrence County Submissions	72	89	107	77	103	64	80	124
Warren County Submissions	30	41	34	39	98	86	48	92

Northern Region	1998	1999	2000	2001	2002	2003	2004	2005
Plattsburgh Press Repub. articles	9	3	5	2	3	6	7	7
Watertown Daily Times articles	94	66	67	53	26	20	21	11
Clinton County Submissions	161	135	153	130	113	92	91	93
Essex County Submissions	120	92	98	79	116	102	71	80
Franklin County Submissions	42	58	69	46	37	20	50	60
Hamilton County Submissions	2	12	3	6	2	6	9	7
Herkimer County Submissions	38	53	56	29	35	22	36	35
Jefferson County Submissions	294	374	374	255	266	227	231	226
Lewis County Submissions	85	69	159	101	113	109	80	72
St Lawrence County Submissions	902	622	517	355	247	227	176	197
Warren County Submissions	63	115	104	66	49	70	79	65

APPENDIX D SELECTED MAPS FROM NEW YORK NEWSPAPERS



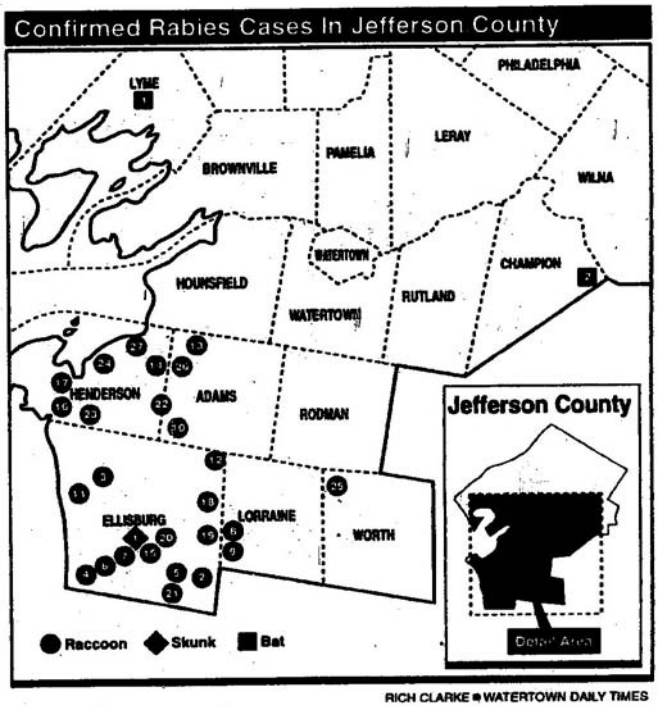
From a New York Times, August 13, 2002 article entitled "Predominant carriers of rabies in the United States."



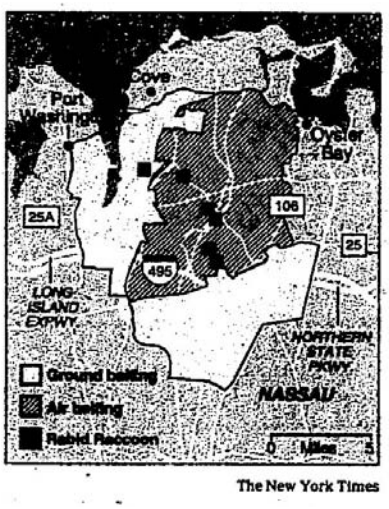
Buffalo News, December 3, 1993, from an article entitled "Barnyard cat triggers alert in county."

An estimated 25,000 people attended the Tioga County Fair.

New York Times August 29, 1996 from article entitled, "Fairgoers get mass alert over rabies in baby goat."



Watertown Daily Times, May 21, 1995, from article entitled "Rabies info number gives callers tips on killing, handling critters."



From New York Times, September 19, 2004. From an article entitled Nassau fights arrival of rabid raccoons.

APPENDIX E RABIES MAPS BY DATE OF PUBLICATION

Newspaper	Maps	Date
Times Herald Record	Route of rabid raccoons - late 1970s, mid 1980s, 1989	30-Jan-90
Times Herald Record	Map - route of rabid raccoons (Rabid Raccoon found)	5-Jul-90
Times Herald Record	Path of rabies through Pennsylvania 1982-1990	29-Jul-90
Times Union	Raccoon rabies (in Steuben)	3-Aug-90
Reporter Dispatch	The rabies toll (map)	21-Apr-91
Times Herald Record	Area Horse Destroyed; Rabies Cited (Small map of Orange County)	16-Aug-91
Star Gazette	Photograph of a man pointing at map	20-Aug-91
Times Herald Record	Site of otter attack	30-Aug-91
Times Herald Record	Location of rabies cases in the tri-county area	20-Sep-91
Democrat and Chronicle	Rabid Deer found in Steuben	9-Oct-91
Times Herald Record	Area rabies cases (Rabies scare hits Monticello Family)	10-Oct-91
Post Standard	Rabies outbreak has been regional	10-Nov-91
Democrat and Chronicle	Rabies epidemic spreading into NY	22-Nov-91
Reporter Dispatch	Steps to control rabies must go on- rabies toll map p. 14	21-Apr-92
Democrat and Chronicle	Raccoon rabies spreading	23-Apr-92
Democrat and Chronicle	Health officials bracing	6-May-92
Post Standard	Rabies?	26-May-92
Post Standard	Towns reporting raccoon rabies through Aug. 4	20-Aug-92
Post Standard	Rabies on the rise	8-Jan-93
Democrat and Chronicle	Area on Alert	4-Mar-93
Observer Dispatch	Raccoon rabies 'moving quicker than expected'	21-Mar-93
Times Union	Hunt for killer viruses	23-May-93
Democrat and Chronicle	Rabies confirmed cases	26-Jun-93
Democrat and Chronicle	Questions about rabies persist	5-Jul-93
Buffalo News	Rabies Spreading - Moving Steadily North	13-Jul-93
Post Standard	Wildlife control agents	6-Aug-93
Times Herald Record	Sullivan, Ulster, Orange County - Ahrendt home	8-Aug-93
Times Union	Unpublicized vaccine can help hunters	5-Sep-93
Newsday	Rabies cases 1990-1993	14-Sep-93
Post Standard	NY state deer rabies cases in 1993	11-Nov-93
Times Union	Rabies Past Peak	1-Dec-93
Buffalo News	Rabies Alert-Discovery of disease in cat leads to county declaration	3-Dec-93
Democrat and Chronicle	Rabies in Monroe	11-Sep-94

Post Standard	Fox attacks	28-Apr-95
Daily Times	Rabies line	21-May-95
Observer Dispatch	Confirmed rabies cases	23-May-95
Post Standard	Site of attack by rabid raccoon	25-Apr-96
New York Times	York showing location of the Tioga County Fair (Rabid Goat)	29-Aug-96
Daily Times	Volunteers take bait in rabies fight	15-Sep-96
Reporter Dispatch	Home of rabid dog on Edgepark	10-Dec-96
Buffalo News	A growing problem (map and table of rabies cases)	20-Sep-98
Daily Times	Wider rabies bait drop	28-Sep-98
Post Standard	Confirmed rabies cases	9-Aug-02
New York Times	Predominant carriers of rabies in the United States.(Source: U.S. Department of Agriculture)	13-Aug-02
Post Standard	Vaccine drop area	9-Sep-02
New York Times	Ground baiting, air baiting and rabid raccoons	19-Sep-04

APPENDIX F ATTEMPTED ANALYSES

In the initial stages of exploration into rabies surveillance it can be useful trying many different analyses. Attempts were made to connect social, economic, and agricultural conditions to rabies submissions. Other analyses attempted to distill control officers to their most salient characteristics. Taken as a whole, these activities provide insight into surveillance by demonstrating avenues of exploration that did not lead to breakthrough discoveries or even tangential relationships. All of the following analyses utilize the county level of aggregation.

Analyses of Surveillance Data

These analyses were conducted in order to better understand the relationship between surveillance data and other available variables. The first means of exploring data was through correlation. It was expected that this narrowing process of excluding variables would quickly focus attention of the most important aspects of rabies surveillance.

Pearson correlation coefficients were used to investigate relationships among variables. Total animal submissions, number positive, percent positive, human population, positive raccoon submissions, percent urban, and control officers per county.

The relationship between social and environmental factors and rabies submissions was the basis of several regression models which used rabies submissions as the dependent variable. The independent variables included acres in corn, wheat, oats, and hay, as well as population in 2000, percentage of poverty in the county, average size and value of houses, median income, number of farms, and percentage of vacant houses per county, and percentage urban by county. The stepwise regression analyses performed were useful for comparing the relative contribution of these variables.

No attempt was taken to address collinearity in the model, due to its exploratory nature. The result was that the only variable with utility for further study in this respect was population per county.

The relationship between the epizootic and other animal population was also investigated. Although the relationship between raccoons and skunks had already been established, finding a link between other animals was more difficult. New York sampled large numbers of cats during the epizootic. It was believed that cat sampling may be used as an indicator to the risk that raccoon rabies posed for humans. The

Descriminant analysis using only the X coordinates and year of submission was also performed in order to quantify the directionality of the epizootic but this analysis is only effective during the wildfire portion of the epizootic, and not once rabies is established in the landscape.

Analyses of Questionnaire Data

The importance of determining which characteristics were most descriptive of animal and dog control officers was the motivation behind several different analyses. Certain questions were considered the best candidates for categorizing control officers. The responses to these questions were the bases of a series of logistic regressions that used the answers to these questions as the dependent variable and all other responses as independent variables. Job title was one such question, as were questions regarding training, feedback, participation in the public health system and others. None of these models converged due the highly variable responses to the questionnaire.

Factor analysis was also used in an attempt to distill the questionnaire data set into its most important characteristics. Both transformed and untransformed factor analysis was used. The transformations were the form of correlation substitutions (using Proc Prinqual). The factor analysis used the following

rotations: equamax, orthomax, quartimax, parsimax, and varimax. None produce usable factors with sufficient explanatory power. Once again this was likely due to the variability in responses to the questionnaires.

VITA

David Dorrell earned a Bachelor of Arts degree in history from East Central University in Ada, Oklahoma, in 1996. He earned a Master of Science in geography at Texas A&M University in 1999, with a thesis investigating tuberculosis in the southwestern United States. He is currently an assistant professor in the History and Social Sciences Department at Nicholls State University in Thibodaux, Louisiana.