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Chronology of Range Expansion of the Coyote, *Canis latrans*, in New York

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Coyotes (*Canis latrans*) were historically restricted to central North America. In less than two centuries, however, Coyotes have colonized most of the continent, including much of northeastern North America. Better understanding causes and proximate mechanisms of this expansion requires a detailed understanding of how Coyotes colonized areas on a fine scale. We examined the establishment of Coyotes in the State of New York by collecting and analyzing reports of their first occurrence throughout the state over the past century, and creating a detailed map of range expansion. Coyotes first entered New York from the north, circled the Adirondack region prior to colonizing it, and then expanded southward and westward at ca. 78-90 km/decade. The revealed pattern lends little support to the hypotheses that the range expansion is attributable to translocations and releases, or that Coyotes were historically present in the region and only recently expanded in numbers. Rather, the data suggest a correlative relationship between anthropogenic land use and Coyote range expansion.

Key Words: Coyote, *Canis latrans*, range expansion, northeastern North America, landscape change, land use.

The Coyote (*Canis latrans*) is one of the most widely disturbed and successful colonizing mammals in recent history. Traditionally restricted to the open grasslands and prairie ecosystems of Midwestern North America, today the Coyote is found throughout most of North America (Bekoff and Gese 2003). Eastern North America has been almost entirely colonized by Coyotes, which have become a numerically and ecologically important member of the predator community (Parker 1995; Gompper 2002a, b).

In northeastern North America, sporadic reports of Coyote-like canids in northern New England, New York, and the southeastern Canadian provinces of Ontario and Québec began in the early 1900s (Hilton 1978; Moore and Parker 1992; Parker 1995; Gompper 2002b). Through the 1930s and 1940s these reports became more frequent, and by the 1980s the Coyote was firmly established and widespread throughout the Northeast (Parker 1995). Several explanations may explain this broad and rapid range extension. Gray Wolf (*C. lupus*) extirpation throughout most of eastern North America in the 19th century is thought to have created an empty ecological niche ripe for exploitation (Parker 1995; Peterson 1996; Gompper 2002b). Extensive modification of the landscape through deforestation and agricultural development may also have facilitated range expansion (Larivière and Crête 1992; Parker 1995).

Importation and release of Coyotes into areas where they were previously nonexistent may also have aided their establishment in some regions (Parker 1995). Finally, some argue that Coyotes were always present in the Northeast, albeit in low numbers (Tullar 1992).

Current maps depicting Coyote range expansion (e.g. Parker 1995) are ideal for visualizing continental-scale range expansion, but a finer scale resolution may assist in comparing the explanations for the current existence of Coyotes in the Northeast, and provide insights into the proximate mechanisms by which Coyote populations expanded across the northeastern landscape. That is, how did these animals move through and establish themselves in the Northeast in such a relatively short period? Here we create a detailed (county-level) map of Coyote range expansion in the State of New York, and examine potential causes and mechanisms of this expansion.

Methods

To establish the Coyote colonization pattern and direction of their range extension in New York on a spatial and temporal scale, first occurrence reports and documented sightings of Coyotes were collected dating back to circa 1900. Because Coyotes were rare and undesirable newcomers in the region in the early 20th century, we believe these reports accurately depict both

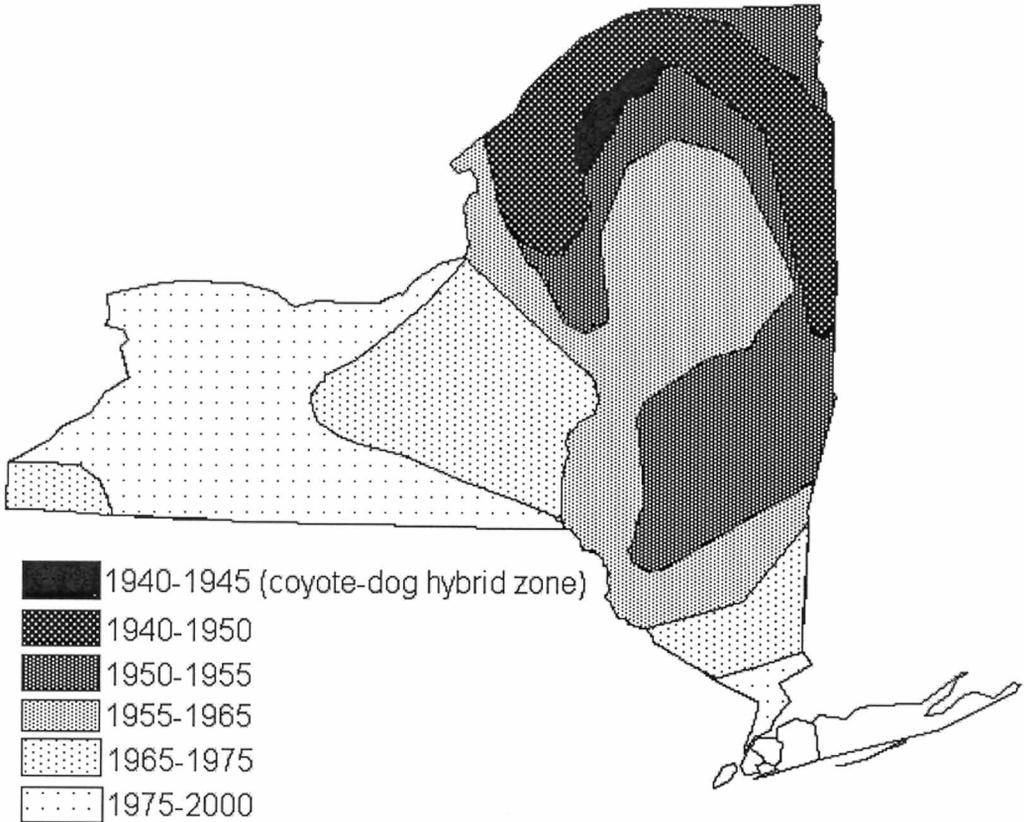


FIGURE 1. Coyote colonization pattern in New York between 1940 and 2000. A putative Coyote-feral dog hybrid population which existed along the northwestern edge of the Adirondacks is also indicated.

presence and absence in particular areas and their movement across the state. County newspapers, regional outdoor magazines (e.g., *Adirondack Life*, *New York State Conservationist*, and *Fur, Fish & Game*), and regional scientific journals (e.g., *New York Fish and Game Journal*) were examined for reports of Coyotes (time frame of search: 1880 – 2000), as were archives and collections of the American Museum of Natural History and the New York State Museum.

County Clerks' offices in northeastern New York (Albany, Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Lewis, Jefferson, Madison, Montgomery, Otsego, Rensselaer, Oswego, Saratoga, Schenectady, Schoharie, St. Lawrence, Warren, and Washington counties) were visited and canid bounty records and laws from the late 1800s and early 1900s were examined. In 2000 and 2001, field station, park, and preserve personnel from throughout New York east of and including Oswego, Oneida, Madison, Chenango and Broome counties, where contacted to establish timing of Coyote establishment in their respective sites, and interviews

(n = 38 individuals who were active with Coyote-related issues during the early stages of Coyote colonization) were conducted, with current and retired state biologists, wildlife technicians, university researchers, game wardens, professional trappers, hunters, taxidermists, fur buyers, and sheep farmers throughout eastern New York State (Fener 2001).

From this data set a series of geographic information system data layers were created using ArcView/GIS mapping software (Environmental Systems Research Institute, Redlands, CA). Coyote reports were aggregated by county and by decade over the last 100 years, and then attributed to the county polygons in the GIS.

Results and Discussion

Coyotes became established in northern New York in the early 1940s (Figure 1). Prior to that there were occasional reports of Coyotes in the region; the earliest report is of a single individual from Franklin County in 1925 (Severinghaus 1974). In the early-mid 1930s Coyotes are again reported from Franklin County as

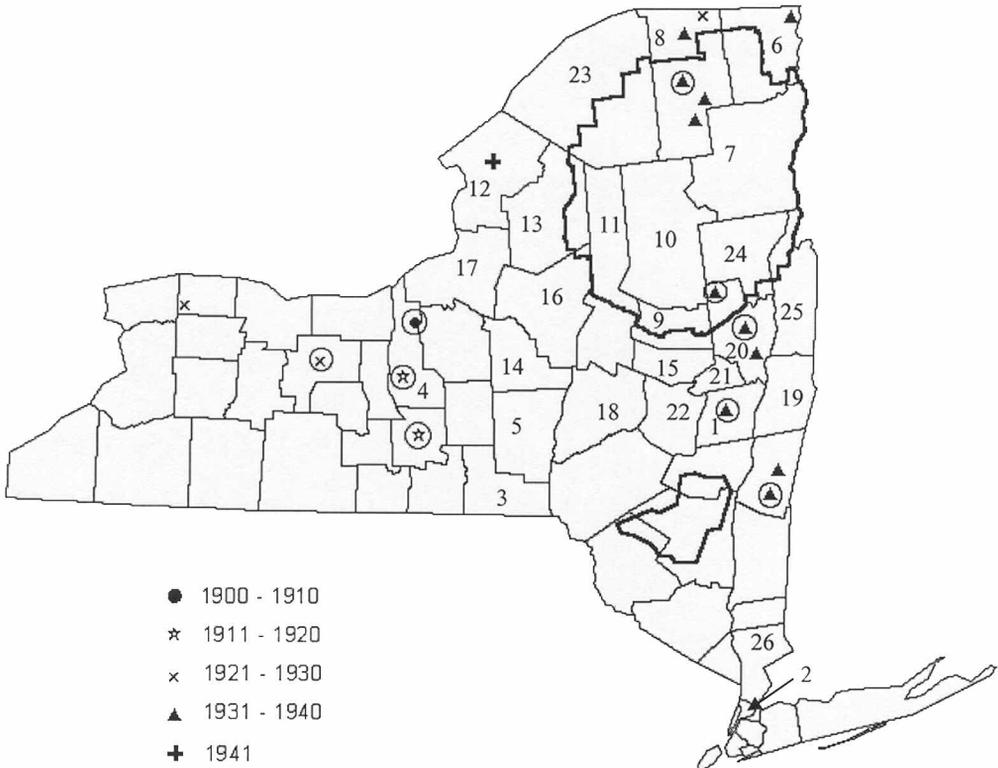


FIGURE 2. Localities of reports of Coyotes that were likely introduced or released in New York. Symbols indicate decade in which Coyotes were reported. Circled symbols indicate known releases. Non-circled symbols were likely released animals based on proximity to known release sites. These original reports were all followed by extended periods of absence of Coyotes from the regions. Counties mentioned in text are numbered (1. Albany; 2. Bronx; 3. Broome; 4. Cayuga; 5. Chenango; 6. Clinton; 7. Essex; 8. Franklin; 9. Fulton; 10. Hamilton; 11. Herkimer; 12. Jefferson; 13. Lewis; 14. Madison; 15. Montgomery; 16. Oneida; 17. Oswego; 18. Otsego; 19. Rensselaer; 20. Saratoga; 21. Schenectady; 22. Schoharie; 23. St. Lawrence; 24. Warren; 25. Washington; 26. Westchester). Dark lines outline Adirondack State Park in northern New York and Catskill State Park in southern New York.

well as neighboring Clinton County to the east. It is unclear, however, if these pre-1940s reports are valid (see below). Nonetheless, following the initial entry into New York from Québec or Ontario over the St. Lawrence River, Coyotes extended their range east into Vermont, and southwest along the St. Lawrence River towards Lake Ontario. This expansion occurred primarily along the periphery of Adirondack State Park, and in the early 1940s there was reportedly also a Coyote-domestic dog (“coydog”) hybrid zone along the northwestern periphery of the Adirondacks (Fener 2001; see also Severinghaus 1974) (Figure 1). By the early 1950s the range had expanded south along the New York/Vermont border and west back into New York State into the Albany area south of the Adirondacks. Coyotes did not show up in the Adirondacks in appreciable numbers until the late 1950s. In the 1960s, Coyotes were reported with increasing frequency in

the Catskill region, and by the early 1970s had moved as far west as Cayuga County and as far south as Westchester County. In the 1980s Coyotes were commonly found throughout the state, excluding New York City and Long Island. In the 1990s Coyotes occurred in Bronx County of New York City, and a transient individual reached Central Park in Manhattan in 1999. As of 2002, only Long Island in southeast New York was not colonized by Coyotes.

Coyotes colonized the ca 470 km North-South axis of New York in 60 yrs (1940-2000), or approximately 78 km/decade. Excluding New York City, Coyotes colonized the entire region (ca 450 km) by 1990 (90 km/yr). Periods of maximal range extensions include 1950-1960 when Coyotes expanded approximately 190 km southeast, and 1970-1980 when Coyotes expanded westwards by approximately 145 km. Estimating rates of range expansion in western New York are compli-

cated by the mixing of two expanding fronts. The original front of range expansion from northern New York via northern Ontario or Québec resulted in Coyotes throughout eastern New York in the 1960s and west-central New York in the 1970s. A second colonization wave apparently entered New York from southern Ontario or northwestern Pennsylvania in the late 1960s-early 1970s (Figure 1). These two colonizing fronts met, such that by the 1980s all of western New York was occupied by Coyotes.

Our results support the premise that Coyotes colonized New York through a range expansion from outside the region, and not via expansion of a low-density population already existing in the state (Tullar 1992). Indeed, Parker's (1995; pages 23-24) review of Coyotes in Ontario shows that the province was colonized in the 1920s and 1930s, suggesting Ontario, rather than Québec (colonized in the early 1940s; Parker 1995) as the source for the northern New York range expansion. There is minimal support for a colonization of New York prior to the 1930s, as most reports between 1900 and 1930 were of released animals or occurred near sites of known releases (Figure 2; see also Fener 2001). In addition, Coyotes remained absent from areas in which they were initially encountered in the 1920s and 1930s for several decades thereafter. The possible exceptions to this are reports from the mid 1920s-early 1930s in far northern New York (see below). Two primary areas of Coyote releases occurred. Four of five reports of Coyotes in west-central New York between 1900 and 1930 can be linked to releases (Figure 2). In east-central New York there are six reports of Coyotes from the 1930s, four of which are directly linked to releases. Following these reports, however, Coyotes are not reported from these regions until the 1960s and the 1950s, respectively (Figure 1). Similar patterns have been observed in the southeastern United States, where some releases may have resulted in the establishment of isolated, local populations, but many other releases did not (Hill et al. 1987).

Two additional releases in northern New York deserve special attention because of their temporal and spatial proximity to the expanding Coyote front of the 1940s. These releases occurred in Franklin (1934) and Jefferson (1941) counties. In Jefferson County, the release occurred after Coyotes had already colonized northern New York. Thus the release may have facilitated the range expansion in counties east of Lake Ontario. The Franklin County release of 1934 may account for the observations of Coyotes in northern New York in the 1930s, as the species is not reported again from Franklin County until 1946. If this is the case – that is, that the 1930s observations of Coyotes in New York are based on introduced animals (see also Severinghaus 1974) – then the only report of a putatively naturally-colonizing Coyote in the state prior to the 1940s is a single animal from Franklin County in 1925 about 20 km south of the Québec border (Sev-

eringhaus 1974). Southern Québec, however, was not colonized by Coyotes until 1944 (Parker 1995). It is therefore possible that this animal was also an escaped or released captive.

The last documented Wolves in New York were killed in St. Lawrence and Franklin counties in the late 1890s (Fener 2001), well before Coyotes entered the region. Thus the fine-scale pattern of Coyote range expansion offers little insight on the potential link between northeastern Wolf extirpation and Coyote range expansion. The absence of Wolves from New York may, however, have increased the rate of range expansion in optimal Coyote habitat such as open areas, in turn allowing Coyotes to expand into suboptimal habitats such as heavily forested areas. Coyotes generally prefer open or agricultural lands to heavily forested habitat (Post 1975; Samson and Crête 1997; Tremblay et al 1998; Crête et al. 2001). The pattern of range expansion in and around the Adirondacks of Northern New York suggests that Coyotes first expanded in agricultural areas followed by entry into more heavily forested regions.

Fener (2001) proposed that it was not the availability of open habitat per se that facilitated rapid expansion of Coyotes in New York, but rather the increase in abandoned farmlands which were in early successional stages of forest reestablishment when Coyotes entered the region. From 1920 to 1950, upwards of 2 million hectares of farmland were abandoned in New York. Farmland loss continues to the present, such that over the past century approximately 3 million hectares have been abandoned and left to regenerate naturally or been acquired and replanted by state reforestation programs (Alerich and Drake 1995; Stanton and Bills 1996). These habitats likely contain high densities of prey species for Coyotes. Thus the rapid expansion of Coyotes through New York may have been aided by entry into the region during a period when abandoned farmlands and early successional stages of forest were dominant landscape components.

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