Digital Commons @ LMU and LLS

Cities and the Environment (CATE)

Volume 8
Issue 1 *Urban Wildlife Research in Support of Conservation Management*

Article 5

4-22-2015

Coyotes Go "Bridge and Tunnel": A Narrow Opportunity to Study the Socio-ecological Impacts of Coyote Range Expansion on Long Island, NY Pre- and Post-Arrival

Mark Weckel
American Museum of Natural History, mweckel@amnh.org

Daniel A. Bogan
Siena College, dbogan@siena.edu

Russel L. Burke
Hofstra University, Russell.L.Burke@hofstra.edu

Christopher Nagy
Mianus River Gorge, chris@mianus.org

William F. Siemer
Cornell University, wfs1@cornell.edu

Timothy Green
Brookhaven National Laboratory, tgreen@bnl.gov

Numi Mitchell
The Conservation Agency, numimitchell@gmail.com

Coyotes Go "Bridge and Tunnel": A Narrow Opportunity to Study the Socio-ecological Impacts of Coyote Range Expansion on Long Island, NY Pre- and Post-Arrival

Currently, Long Island, NY is without a breeding population of northeastern coyote (*Canis latras* var.), yet recent evidence of dispersing individuals on the island, coupled with the "dogged" momentum of coyote range expansion across North America, suggests a Long Island coyote population is close at hand. We highlighted the fleeting opportunity to takes advantage of this natural experiment by developing a multidisciplinary research framework to investigate the ecological and social impacts of the coyote, pre- and post- range expansion. We reviewed coyote spatial ecology, community ecology, and human dimensions research and identified three components of future investigation: predicting future occupancy, monitoring colonization, testing hypotheses of trophic cascades by leveraging and expanding existing ecological data, and exploring attitudes towards coyotes to better understand and mitigate human-wildlife conflicts. Each proposed component will integrate for a comprehensive investigation to advance theory and applied management of northeastern coyotes.

Keywords
Canis latrans, citizen science, community ecology, human dimensions, Long Island, Lyme disease, mesopredators, New York, nest-predation, northeastern coyote, raccoons, red fox, spatial ecology

Acknowledgements
Co-authorship order reflects alphabetical sequence and relative contribution to research and writing. Dan Bogan, Russell Burke, Christopher Nagy, and William Siemer were chiefly responsible for Spatial Ecology, Community Ecology, Regional Monitoring, and Human Dimensions sections, respectively, with major contributions by remaining authors. M. Weckel's postdoctoral fellowship is supported by a grant from the Doris Duke Charitable Foundation for the American Museum of Natural History's Science Research Mentoring Program.

INTRODUCTION

Over the past two centuries, the coyote (*Canis latrans*) has undergone an amazing range expansion. Originally a species of southern Canada, northern Mexico, and the western Great Plains and Midwestern United States, coyotes are now found from the Atlantic to the Pacific and from Alaska to Panama (Gompper 2002a; Laliberte and Ripple 2004; Méndez-Carvajal and Moreno 2014). This expanded distribution parallels a widening niche as coyotes, traditionally associated with deserts and grasslands, are found across a spectrum of habitat types from high density urban development to rural agricultural landscapes (Parker 1995). Their rapidly evolving natural history coupled with this dramatic range expansion has brought a tremendous amount of interest in understanding coyote ecology and evolutionary biology. On a more practical note, coyote range expansion also brings new concerns, both real and perceived, as preventing human-coyote conflict becomes an increasingly important management concern (Baker and Timm 1998), especially in cities and suburbs where familiarity with coyotes is low and the potential for interaction high.

On Long Island, NY, there is the rare and time-sensitive opportunity to proactively tackle these issues. Long Island, including parts of New York City (NYC), is one of the last large land masses in the continental United States without a breeding population of the northeastern coyote (*var.;* Fener et al. 2005). Coyotes are well established in northern and western suburbs of New York State (NYS), Connecticut (CT), and New Jersey (NJ) and there have been at least four independent, confirmed eastern Long Island coyote sightings since 2004 (Toomey et al. 2012; J. Stiller, NYS Department of Environmental Conservation (DEC), *pers. comm.*). A breeding population on Long Island is inevitable and imminent. While several studies have explored the diet, spatial ecology, and behavior of coyotes in the eastern U.S. (see Mastro et al. 2012), Long Island affords a natural experiment by which to better understand the ecological role of coyotes, as well as spatiotemporal patterns of human-wildlife interaction, by addressing these issues through pre- and post- colonization studies.

There are several factors that make Long Island a unique area for study (Figure 1). First, at the western end of Long Island, the NYC metropolitan area is distinguished by being the most densely populated urban center in the United States (10,429.6 humans km^{-2}; U.S. Bureau of the Census 2010), well exceeding human population densities of previous coyote study sites either in the coyote's ancestral or expanded range (see Table 1 *in* Gehrt 2007). Coyotes may respond differently to varying levels of urbanization (Gompper 2002a, Gehrt et al. 2011). It is unclear whether patterns found in Chicago (see Gehrt et al. 2011) and Los Angeles (see Riley et al. 2003) will hold true for the NYC metropolitan area where the hybrid origin ancestry of the northeastern coyote reflects genetic introgression by eastern wolf (Canis lycaon or Canis lupus lycaon), domestic dog (*Canis lupus familiaris*), and gray wolf (*Canis lupus*; Monzón et al. 2014). Reflecting this admixture, the northeastern coyote has a phenotype that is intermediate on the wolf-coyote spectrum of traits (Way et al. 2010). New York City and Long Island provide the opportunity to investigate the ecology of this ecotype (Monzón 2012) across a 190 km urban-to-exurban transect marked by clines in habitat, development, and human population density.

In addition to supporting a large human population, Long Island is also socioeconomically and ethnically diverse. Attitudes towards wildlife are shaped by numerous factors, both intrinsic and extrinsic (Dickman 2010), and mediating wildlife conflict with humans is facilitated by a good understanding of how different stakeholders perceive and value wildlife, as well as the cultural and social context in which the interaction takes place (Vitali 2014). By investing in social science research before coyote colonization of Long Island, it may be possible to assess stakeholder beliefs, attitudes, and behaviors not only over space, but also over time, further advancing our understanding of how place, demographics, and experience shape humans' complex relationship with the non-human world.

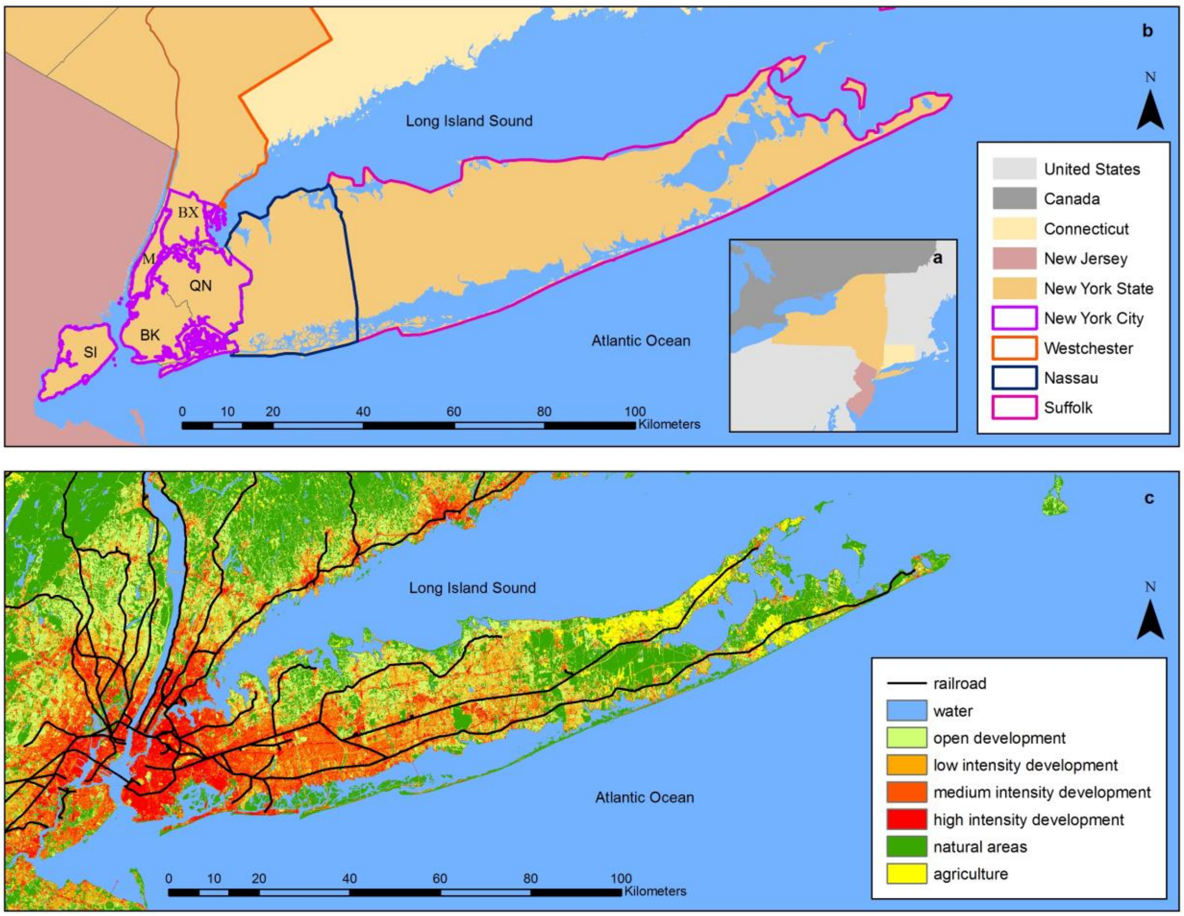

Figure 1. Map of Long Island and surrounding region (a). Included are the five boroughs of New York City [Bronx (BX), Brooklyn (BK), Manhattan (M), Queens (QN), Staten Island (SI)], the eastern Long Island counties of Nassau and Suffolk, and Westchester County, the northern suburb of NYC (b). National Land Cover Database land use types (2006) showing distribution of anthropogenic and natural habitat for the study area (c). Agricultural areas include cultivated crops and pasture/hay areas. Natural areas include all forest types, grassland, shrub and scrub, herbaceous and woody wetlands. Open development (<20% impervious surface) includes recreational areas, large-lot single family houses and golf course. Low, medium, and high intensity development are defined by 20 to 49%, 50 to 79%, and 80 to 100% impervious surface, respectively.

Through an extensive literature review of coyote spatial ecology, community ecology, and human dimensions research, and building on existing coyote research in the NYC metropolitan area, we frame a research agenda to study the ecological and social impacts of the coyote on Long Island, pre- and post- colonization. In this manuscript we identify and describe three research priorities: 1) predicting and monitoring likely colonization areas, 2) developing a framework to investigate the direct and indirect trophic impacts of coyotes, and 3) establishing human-dimensions research to proactively mitigate undesirable human-coyote interactions. Highlighting this time-sensitive opportunity, our goal is to inspire multi-disciplinary applied research and prior planning in anticipation of a major ecological change that in all probability will be contentious and will demand management action at both the local and state level.

A Brief History of Coyotes in the NYC area and Long Island

The first documented evidence of a coyote in NYC was in February of 1995 when a road-kill coyote was found on interstate 87 near the vicinity of Van Cortland Park in the Bronx, NY (Toomey et al. 2012). Unconfirmed reports suggest that dispersing coyotes may have arrived in the northern Bronx earlier in the decade. Annual camera trap surveys of several NYC parks between 2011 and 2014, have confirmed the presence of coyote social groups and evidence of breeding throughout the Bronx, including a park at the base of a major bridge connected to Long Island (Nagy and Weckel, *submitted*).

In April of 1999, the first documented coyote to make it to Manhattan was captured in Central Park (Martin 1999), followed by dispersing individuals in 2006 and 2010 (Barron 2006, Boyle 2010, Soltis 2010). In January of 2004, a coyote was observed on an ice floe off Jamaica Bay Wildlife Refuge in Queens (western Long Island; Gallahue 2004); the fate of this coyote is unknown. The first known resident Long Island coyote was documented in 2009 near the neighborhoods of St. Albans and Rochdale Village in Queens County (Frank Vincente, Wild Dog Foundation, *pers. comm.*). Subsequent camera trap monitoring between 2011 and 2014 confirmed its continued residency (Nagy and Weckel, *in prep*). A coyote was photographed on Staten Island in April 2012 in the former Fresh Kills landfill (Sedon 2012); however, this report was unconfirmed by authorities and the current status of coyotes in Staten Island is largely unknown.

In July of 2013, a coyote was photographed in Bridgehampton, a town in Suffolk County, eastern LI (Kitchen 2013) and later confirmed by NYS DEC biologists using camera traps (Josh Stiller, NYSDEC Wildlife Biologist, *pers. comm.*). Repeat sightings in the Bridgehampton area suggest the continual residency of this individual through April of 2014 (Josh Stiller, NYSDEC Wildlife Biologist, *pers. comm.*). In June of 2014, the first physical coyote specimen from Long Island was recovered alongside the Cross Island Parkway in the Bayside neighborhood of Queens (*unpublished data*). Lastly, it should be noted that as of 2011, coyotes have been documented on Fishers Island, part of the town Southhold, Suffolk County (Young 2011). While geographically part of the Fisher-Plum Island archipelago that extends from the north fork of eastern Long Island, Fishers Island is only 3 km from the mainland of Connecticut and approximately 20 km to Long Island proper.

SPATIAL ECOLOGY: PREDICTING AND MONITORING LIKELY COLONIZATION AREAS

Anticipating the inevitable coyote colonization of Long Island requires making accurate predictions to prepare for the ecological and social consequences of a novel predator in a new environment. Fortunately, coyote spatial ecology is well-studied throughout North America (Quinn 1997, Grinder and Krausman 2001, Riley et al. 2003, Way et al. 2004, Gehrt 2007, Grubbs and Krausman 2009, Prugh et al. 2009, Mitchell et al. *in prep*.) and using existing information to make predictions about the spatial ecology of coyotes across Long Island offers multiple benefits. Forecasting can be used to guide the research process by making testable predictions about where to monitor for coyotes in the near-term. Predictions can also be used to test published studies on coyote spatial ecology to validate our scientific understanding of how coyotes use available habitats and respond to human-modified landscapes. Identifying likely areas of coyote occupancy on Long Island is a prerequisite for selecting study sites to investigate trophic impacts of coyotes in a robust, pre-post research framework (see **Community Ecology**). Lastly, anticipating where coyotes may inhabit will also help to prepare for legal and regulatory considerations, while also identifying and targeting specific areas to guide public outreach programs (see **Human Dimensions**). Nevertheless, making predictions about the unique landscape of the un-colonized area of Long Island may be less robust due to errors in extrapolating to areas beyond those of published studies. Therefore, careful review and consideration of relevant studies must screen for the most appropriate information when developing predictive models about coyote spatial ecology.

Current State of Knowledge

The coyote is an opportunistic generalist species (Gompper 2002a) that inhabits several biomes and the ecosystems contained within each (Bekoff 1977). Across their geographic distribution, coyotes primarily use and select for “natural” areas (forests, grasslands, etc.), while either using anthropogenic cover types according to availability (Gibeau 1998, Grinder and Krausman 2001, Way et al. 2004), or exhibiting avoidance of development (Quinn 1997, Riley et al. 2003, Bogan 2004, 2012, Gehrt et al. 2011, Gese et al. 2012, Dodge and Kashian 2013, Mitchell et al. *in prep*.).

In the Northeast, where extirpation of the competitively dominant eastern wolf has left the region without an apex predator save for humans, coyotes can now be found across nearly all available habitat types (boreal forest, deciduous forest, agricultural, and urban; Gompper 2002b). However, because ancestral coyotes were associated with open scrublands, plains and grasslands (Parker 1995), northeastern coyotes were originally believed to be poorly adapted to large forested wilderness areas, particularly boreal forest (Tremblay et al. 1998, Richer et al. 2002). In Quebec, Canada, coyote density was lower (Richer et al. 2002) and home ranges larger (Crete et al. 2001) in boreal forest when compared to adjacent rural areas. Supporting this assertion, in New York State, coyotes colonized the periphery of the Adirondack Park before coming to occupy the interior of this dense wilderness area (Severinghaus 1974, Fener et al. 2005). However, later research in the Adirondack Park region suggested that coyote abundance was positively associated with forest habitat (Kays et al. 2008), suggesting that habitat use of northeastern coyotes is dynamic and subject to change. Within Adirondack Park, coyotes were associated with disturbed stands characterized by abundant natural edges and open canopies, presumably areas with greater availability of food resources (Kays et al. 2008).

Across their range, coyote space use is generally believed to reflect a balance between minimizing exposure to humans while meeting energetic needs (Atwood et al. 2004, Gese et al. 2012), both of which are contingent on the distribution and abundance of prey (Litvaitis and Shaw 1980, Andelt and Andelt 1981, Gese et al. 1988). Accordingly, the sizes of coyote home ranges are quite variable. Nevertheless, across urban-to-rural gradients, the mean home ranges of northeastern coyotes are inversely correlated with the level of human development with smaller ranges documented in urban and agricultural areas than in forested areas (see Table 1.1 in Monzón 2012).

Within urbanized landscapes, researchers have found that coyote home ranges increase with the level of natural area fragmentation (Riley et al. 2003, Gehrt et al. 2011, Gese et al. 2012). Whether in an urban or suburban context, natural areas likely provide a source of preferred foods (e.g., rodents, lagomorphs) and resources such as resting spots and access to den sites (Quinn 1997, Riley et al. 2003, Gehrt et al. 2011). However, larger home ranges are found where natural areas are small and disjointed, (Gehrt et al. 2009, Bogan 2012), possibly to fulfill greater energetic demands. As a consequence, urban coyotes with home ranges containing a larger percentage of anthropogenic habitat risk greater interaction with humans (Gese et al. 2012). This threat is minimized by traveling through the developed matrix primarily at night (McClennen et al. 2001, Atwood et al. 2004, Bogan 2004, Way et al. 2004, Mitchell et al. *in prep.*) and usually at greater speeds (Grinder and Krausman 2001, Gehrt et al. 2009).

Developing a Research Framework for Long Island

Forecasting

Patterns of coyote spatial ecology, particularly in response to anthropogenic disturbance, are similar across studies, space, and coyote ecotypes. Therefore an analytical framework using meta-data may improve the level of inference to make better spatial predictions of novel habitat in Long Island. In the NYC metropolitan area, we have the added benefit of independent, contemporaneous studies of coyote spatial ecology (Weckel et al. 2010, Bogan 2012, Nagy et al. 2012b) conducted in suburban Westchester County using a range of methodologies (i.e., telemetry, citizen science, and camera traps). We also have contemporaneous GPS tracking data from similar coastal habitats in Rhode Island *ca*. 60 km NE of Montauk Point (Mitchell et al.*in prep*.). These studies will help refine predictions of initial coyote establishment throughout Long Island in a meta-study approach.

Using VHS radio telemetry, Bogan (2012) measured coyote habitat use and selection for 22 coyotes approximately three decades following coyote colonization of Westchester County. The spatial analyses, conducted at 2 analysis scales, examined home range location within Westchester County and coyote movements within home ranges. Home ranges averaged 5.67 ± 3.25 (SD) km^2, ranging 1.25–13.94 km^2, comparable to other urban eastern coyotes (Monzón 2012). Coyotes primarily used and selected natural habitat categories (e.g., forest lands, shrub and crop habitat and wetland areas) while simultaneously minimizing use of low-intensity (i.e., exurban) and high-intensity (e.g., urban residential and commercial areas) developed lands.

Habitat selection of coyotes in coastal Newport County, Rhode Island, was assessed using a continuous record GPS point locations of 21 resident and 6 transient coyotes (Mitchell et al. *in prep*). Both groups selected strongly for dense cover (forest and brushland) during the day and increased use of open areas at night. All coyotes avoided medium to high-density residential development, residents more than transients. Resident coyotes selected heavily for pastures and cropland (prime foraging sites) while transients strongly avoided them, thereby avoiding territorial residents. Because resident groups defend habitat against solitary transients, resident selection was taken to reflect coyote habitat preferences (Mitchell et al *in prep*).

Weckel et al. (2010) developed landscape models predicting human-coyote interaction (HCI) by comparing anecdotal coyote sightings (presence/pseudo-absence data) from private residences in Westchester County to proximity to habitat features. Complementing Bogan's (2012) findings and those of Mitchell et al. (*in prep*), coyote sightings were associated with forest and grassland, and negatively associated with middle to high-density development. While these results may be interpreted as modeling detection (e.g., habitat types where residents are most likely to see coyotes), and not occupancy (e.g., areas coyotes actually inhabit), the HCI model was subsequently validated as a surrogate for habitat occupancy using camera traps (Nagy et al. 2012b).

However, Nagy et al. (2012b) suggested that for dense urban environments, whether or not a given site is occupied by coyotes was less dependent on how suitable the property is (beyond some minimum criteria) and more the difficulty of reaching it. This is made even more relevant for Long Island and the greater NYC metropolitan area owing to the geographic complexity of the region (several islands connected by complex infrastructure). It is here that combining the results of the aforementioned studies can be most productive in generating more biologically relevant models by taking advantage of the different approaches of each study.

For example, Weckel et al.'s (2010) HCI models, while validated for Westchester parks, were built from "backyard" observations. Therefore, these results may more accurately reflect conditions of the suburban matrix (e.g. permeability to coyote movement) than they reflect core habitat suitability. In contrast, by monitoring individual coyotes over several seasons, data from Bogan (2012) and Mitchell et al. (*in prep.*) can be used to tease out the probability of use of generalized habitat categories and identify potential core areas and low use or travel corridors within the landscape matrix. This will be particularly useful when extrapolating to similar habitats in suburban and exurban landscapes of eastern Nassau County and Suffolk County, LI.

While habitat use data from a population adjacent to Long Island may allow for promising forecasting, there are several challenges in making predictions about coyote colonization. First, colonizers are likely to be immature transients, and information on the spatial ecology of young coyotes is limited (Gehrt 2007, but see Way 2007); however, results from Mitchell et al. (*in prep*) would lead one to predict that habitat selection for colonizing transients would be similar to resident selection in the absence of defense by established coyote packs. The aforementioned Westchester and Rhode Island models may therefore be very appropriate, though they do not reflect space use in non-traditional habitat (e.g., industrial spaces) where coyotes may reside; but were not monitored. Second, temporal patterns of coyote occupancy will largely depend on how coyotes colonize Long Island and the locations of initial successful breeding pairs. While models may be accurate in predicting the equilibrium distribution of coyotes, they may not be accurate in identifying areas likely to be colonized first. Dispersing coyotes can travel hundreds of kilometers (Harrison 1992), making all parts of Long Island theoretically reachable from current breeding populations in New York and Connecticut.

Regional Monitoring: the Role of Citizen Science

Long Island poses a needle-in-a-haystack challenge of detecting a rare event (a dispersing coyote) across a 2849 km^2 land mass. Detecting the presence of a few individuals in the early phases of coyote range expansion – even with a good model of where to look – will prove challenging. While it is not necessary to document every colonization event, maximizing detection will provide important information regarding how and where coyotes first become established, as well as documenting the genetic and morphological traits of a founding population. From there, continued monitoring can be used to estimate occupancy dynamics (extinction/colonization probabilities), residency status (transients vs. breeding pairs), and ultimately the rate of coyote colonization across the island – an exceptional opportunity in studying the population biology of a novel predator.

While camera traps (Séquin Larrucea et al. 2007, Kelly and Holub 2008, Nagy et al. 2012b), scent stations (Randa and Yunger 2006), scat (Morey et al. 2007, Kays et al. 2008), and call-back surveys (Petroelje et al. 2013) have proved very useful in monitoring coyotes, it may be difficult to employ these techniques across Long Island. We believe that participatory research offers the most cost-effective, regional solution for monitoring Long Island. Several existing citizen science studies for studying the distribution of coyotes may serve as models for Long Island including the Stanley Park Ecological Society's Co-existing With Coyotes Program in Vancouver (Worcester and Boelens 2007), the Narragansett Bay Coyote Study and Coyote Smarts program in Rhode Island, and the WildSuburbiaProject in Westchester County, NY. Here we take the opportunity to define the possibilities and challenges of using citizen science as a monitoring tool for Long Island.

Particularly in densely populated places, the cumulative "eyes and ears" of local residents may be one of the most efficient tools available (White et al. 2005, Bonney et al. 2009, Weckel et al. 2010, Scott et al. 2014). Traditional sampling in fragmented landscapes dominated by residential properties would require obtaining permission for access, an immense logistical effort (White et al. 2005, Colding 2007). Citizen science methods can alleviate the amount of work required for permitting and sampling in the field by recruiting the owners and residents of the study area as, in essence, field technicians.

While novice volunteers may have difficulty collecting extremely detailed or technical data in some cases (Dickinson et al. 2010), a Long Island coyote citizen science project would be initially focused primarily on the collection of "presence" information, and where possible, reliable "absence" data. Presence/absence data – regardless of its source – have inherent problems associated with non-detections of present targets (false negatives) and misidentifications (false positives). With regard to citizen science projects, rates of both kinds of errors are problematic and can vary across types of participants (e.g. hunters vs. naturalists vs. school-aged children) and across communities (e.g., rural vs urban; Dickinson et al. 2010).

False positives, or misidentifications, are a particular concern where the participant has little familiarity with the species in question (Genet and Sargent 2003). One can anticipate numerous false alarms from Long Island citizenry unfamiliar with coyotes. With that said, it should be noted that all four coyotes documented on Long Island – including the first specimen collected – were first observed by residents, emphasizing the role that public participation can play.

False negative issues can be surmounted by quantifying the rate of species detection via multiple surveys at every location (MacKenzie et al. 2002), however, information taken from chance sightings, as is the case in documenting coyotes based on anecdotal observation, may not lend itself easily to this type of analyses. Techniques exist that can address this, including independent validation of models built from sightings data (Dickinson et al. 2010, Nagy et al. 2012a, 2012b), quantification of observation "reliability" that allows filtering of low-quality observations, follow-up interviews with the volunteer observer (Cooper et al. 2005, Bonney et al. 2009, Bonter and Cooper 2012), or limiting analytical inferences or assumptions (Cooper et al. 2005, Weckel et al. 2010, Scott et al. 2014).

Ultimately, the above issues become important only if the citizen science data are used to model coyote habitat selection or occupancy. At a minimum, a citizen science program is valuable simply as an early detection network to document any possible first dispersers, with more systematic methods to follow. The success of a coyote citizen science project on Long Island depends on maximizing the number of enthusiastic participants over space and over time. Retaining interest in a coyote citizen science project will be a challenge owing to the rarity of coyote sightings. It may be beneficial to survey concurrently for additional species, such as the more abundant red fox (*Vulpes vulpes*), a species that may be directly or indirectly impacted by the arrival of coyotes (see **Community Ecology**).

Arguably, the strongest asset of citizen science is its inherent integration of data collection with stakeholder involvement and outreach (Cooper et al. 2007, Couvet et al. 2008). Stakeholder attitudes and local involvement are key to the success of management efforts (Lidskog 2008). Becoming involved with data collection and research may lead to greater cooperation and receptiveness for management policy (Conrad and Hilchey 2011), especially where wildlife is a polarizing issue and policy recommendations can seem authoritative, out-of-touch, or at odds with the values or expectations of the local stakeholders (Rhoads et al. 1999, Naughton-Treves et al. 2003, Riley et al. 2003). Involving stakeholders in the first stages of research on the species in their area may help prevent negative interactions and perhaps even instill a positive value for coyotes and other wildlife in the community (Low et al. 2009, Toomey and Domroese 2013). Nevertheless, greater environmental concern or involvement and other attitudinal changes are not guaranteed just because a person participates in a citizen science project (Brossard et al. 2005, Toomey and Domroese 2013), and broad attitudinal changes are generally more difficult to encourage than specific interests (e.g., environmental stewardship versus an interest in bird watching). Citizen science studies that successfully educate and motivate participants towards substantial attitudinal changes typically stress the scientific and analytic aspects of the study as much as the natural history, provide high quality education materials, and maximize the interaction between professional researchers and volunteers (Brossard et al. 2005, Toomey and Domroese 2013). If coupled with social science research (see **Human Dimension**), Long Island affords the opportunity to evaluate the role, if any, participation and exposure to citizen science can play in influencing attitudes and behaviors.

COMMUNITY ECOLOGY

Complementing the diversity of biomes and habitats they inhabit, coyotes have an extremely broad diet that includes fruits, insects, small mammals, ungulates, and livestock (Mastro et al. 2012), and individual coyotes readily adapt to available food sources (Andelt et al. 1987). Owing to their generalist tendencies and dietary flexibility, coyotes have multifaceted and difficult to predict interactions with other animal species to whom the coyote can serve as predator, competitor, or both.

We can expect coyote diet to differentiate across Long Island in response to prey abundance and distribution, itself shaped by the diversity of habitats and gradients of human population density. Feral cats (*Felis catus*), raccoons (*Procyon lotor*), Virginia opossums (*Didelphis virginiana*), and Eastern cottontail rabbits (*Sylvilagus floridanus*) occur throughout Long Island. Red fox (*Vulpes vulpes*) are widespread in Suffolk and restricted to coastal areas in Nassau and a few parks in Queens. Gray fox (*Urocyon cinereoargenteus*) and Northern river otter (*Lontra canadensis*) are rare and found only in limited to sections of Suffolk (Bottini 2009; NYS DEC 2014). White-tailed deer (*Odocoileus virginianus*) occur in Suffolk County, where they are often abundant, but are poorly represented in eastern Nassau County, and locally extirpated in Queens (NYS DEC 2014). Wild turkey (*Meleagris gallopavo*) – reintroduced in the 1990s – are widespread in both eastern counties, whereas striped skunks (*Mephitis mephitis*), ruffed grouse (*Bonasa umbellus*) and bobwhite quail (*Colinus virginianus*) are overall rare (NYS DEC 2014).

Variation in prey availability and habitat type may further interact with the unique ancestry of colonizing northeastern coyotes. Despite the recent arrival of coyotes in the northeast (<100 yrs), Monzón (2012) was able to detect fine-scale genetic structure in relation to land use and deer density, suggesting the possibility of rapid adaptive evolution in coyotes. Similar evolutionary processes can be expected as colonizing coyotes experience different selection pressures along the urban–exurban gradient of Long Island. In other words, coyote feeding ecology, and attendant impacts on the larger wildlife community, can be expected to change following colonization.

Current State of Knowledge

Studies investigating the trophic impact of coyotes can be classified as one of three general types: descriptive, manipulative, and natural experiments. Descriptive studies (e.g. Crooks and Soulé 1999, Newsome and Ripple 2014) tend to examine patterns of predator-prey abundance and distribution over space to make inferences on the role of predation in shaping community properties. More powerful manipulative studies (e.g. Henke and Bryant 1999) depend on the lethal removal of coyotes and attendant monitoring of prey response variables. Natural experiments, such as the opportunity we have on Long Island, take advantage of a disturbance to the system (e.g. the arrival of coyotes) to compare changes to a system in a pre-post framework.

With coyotes' larger body sizes and broad dietary niches, it is reasonable to expect interference competition with, and possibly predation on, extant mesopredators: red foxes, feral cats, raccoons, and Virginia opossums. However these interactions are complex and few relevant studies have been conducted, especially for northeastern coyotes in urban and suburban habitats. In some of the earliest support for the mesopredator release hypothesis, Crooks and Soulé (1999) showed that along a suburban-rural gradient in California, the relative abundances of gray fox, cat and opossum declined where coyote relative abundance increased. Furthermore, the presence of coyotes was negatively associated with cat, opossum, and raccoon relative abundances. However, Crooks and Soule (1999) did not account for detection probability in generating indices of coyotes or mesopredator abundance and therefore their results need to be interpreted cautiously. The apparent absence of a coyote may be a failure to detect, and similarly, declines in relative abundances of mesopredators may reflect changes in detection probability (e.g. avoidance behavior; Cove et al. 2012).

Free-roaming and feral cat populations are a major management concern especially in fragmented landscapes (Calver et al. 2011) and as predicted by the mesopredator release hypothesis, coyotes may aid in controlling feral cat populations. The importance of cats in coyote diet (as expressed by the % of scats containing cat remains) is generally low (Morey et al. 2007, Bogan 2012, Lukasik and Alexander 2012). However, while monitoring radio-collared coyotes in urban Tucson, AZ, Grubbs and Krausman (2009) showed that the coyotes could be significant predators of free-roaming cats and could impact feral cat behavior. Interestingly, Grubbs and Krausman (1999) found that most cats were killed in residential areas, not natural areas. Complementing these findings, a telemetry study of both free-roaming cats and coyotes in Chicago showed little overlap in core areas of these two species (Gehrt et al. 2013). Cats selected for developed areas such as residential dwellings, while coyotes continued their pattern of selecting for natural areas (Gehrt et al. 2013). Limited use of natural areas by cats – where felids presumably have their biggest impact on song birds – is thought to result from direct predation by coyotes or avoidance behavior (Gehrt et al. 2013).

Coyotes are known to kill other canids [gray, red, and swift foxes (*Vulpes velox*); Ritchie and Johnson 2009)] and recent isotopic analyses confirm broad dietary overlap with both gray and red foxes in NYS, setting the stage for competition (Warsen et al. 2014). Numerous studies show that coyotes can reduce *Vulpes spp.* numbers through direct predation or by influencing fox spatial ecology (Gompper 2002b, Ritchie and Johnson 2009, Levi and Wilmers 2012) with the most exhaustive research being carried out on kit fox. With regard to red fox, the most common non-domesticated canid currently on Long Island, there is strong evidence for coyotes impacting red fox space use. In rural Maine, red fox territories were clustered at the boundaries of adjacent coyote territories and never overlapped coyote core areas (Harrison et al. 1989). Similarly, Gosselink et al. (2003) found red fox preferred human-associated habitat, presumably to avoid direct competition with and predation by coyotes.

With regard to non-canid mesopredators, specifically raccoons, opossum, and striped skunks, there is considerably less evidence of coyote impact. Gehrt and Clark (2003) and Gehrt and Prange (2006) found no evidence that coyotes in the Midwest either predated or affected the behavior of raccoons or skunks. Similarly, Cove et al. (2012) found no evidence for coyotes influencing detection or abundance of raccoons, opossum, and striped skunks in Missouri. An exception was found in Maine, where O'Connell et al. (1992) found raccoon remains in 39% and 48% of spring and autumn scats in a study of an insular population of northeastern coyote. However, raccoon was considerably less represented in the diet of adjacent mainland coyotes, where presumably the prey base was broader.

Levi et al. (2012) combined data on the impacts of coyotes on red fox, red fox on small mammal [*Peromyscus* spp. (mice) and *Sorex* spp. (shrews)] populations, and small mammal populations on Lyme disease, to suggest that the spread of coyotes may be responsible for the increase in Lyme disease in New York. White-tailed deer abundance and small mammal abundance clearly have impacts on Lyme disease prevalence (Barbour and Fish 1993, Ostfeld et al. 2006, Ostfeld and Keesing 2012). Levi et al. (2012) showed that above a commonly-achieved threshold density, deer had only a weak effect on Lyme disease prevalence, and they speculated that above this density small mammal abundance drove Lyme disease prevalence dynamics. By displacing or predating red fox, a major small mammal predator, coyotes could increase the number of *Borrelia*-infected black-legged ticks (*Ixodes scapularis*). Way and White (2013) criticized Levi et al (2012) on several points, including their lack of acknowledgement of the importance of small mammals in coyote diets (thus they may augment or replace red fox as small mammal control) and for relying on coyote harvest numbers to estimate coyote density.

Many suburban and urban areas have large populations of white-tailed deer and Canada geese, leading many to question the impact coyote may have on these problem species. Coyotes can be important predators of Canada geese eggs and adults (Fitzner and Rickard 1983). In Chicago, coyotes are believed to have decreased goose population growth by 5% (Brown 2007); however, population growth was still positive. Coyote impact on deer populations is contextual and strongly dependent on external factors (Ballard et al. 2001). Deer are often commonly represented in coyote scat across the northeast (Morey et al. 2007, Mastro et al. 2012); however, questions as to whether this represents scavenging, compensatory, or additive mortality preclude inference (Bogan 2012). Across their range, coyotes are effective predators of fawns and can strongly limit recruitment (Stout 1982, Vreeland et al. 2004, Saalfeld and Ditchkoff 2007, VanGilder 2008, Robinson et al. 2014); however overall impacts on deer population dynamics will depend on deer density relative to carrying capacity (Ballard et al. 2001).

Developing a Research Framework for Long Island

Long Island has a somewhat complicated urban-suburban-exurban habitat gradient superimposed over locations with different combinations of meso-predators and potential coyote prey. This makes the region well suited for pre-post observational studies that explore the direct and indirect effects of coyotes on meso-predators through predation and competition. Furthermore, there are several existing and contemporary studies that can be leveraged to examine the trophic impact of coyotes through pre-post colonization studies.

Coyotes' effects on the behavior and numbers of raccoons, feral cats, and red fox will be of particular concern on Long Island because these species are important predators on shore birds [e.g., piping plovers, (*Charadrius melodus*), roseate terns (*Sterna dougallii*), least terns (*Sternula antillarum*), and common terns (*Sterna hirundo*)]. Doherty and Heath (2011) found that direct depredation and nest abandonment (e.g., desertion or death of adults) due to predator disturbance (primarily red fox), contributed to the low hatching success in Long Island piping plovers. Feral cats also contributed to nest abandonment. Coyotes may increase nest success by predating on red fox and feral cats or by causing behavioral shifts in these mesopredators that limits their impact on shorebirds. In contrast, coyotes may prey directly on shorebirds, compounding or replacing the impact of fox and cat. The published research of Doherty and Heath (2011) and others working on Long Island shorebirds (see Cohen et al. 2006, McIntyre et al. 2010) coupled with long-term monitoring of several shorebird species along the north and south shores of Long Island (see National Park Service's Piping Plover Monitoring and Protection Program and Audubon New York's Long Island Bird Conservation Program) provide a ready-made opportunity to investigate the ecological role of the northeastern coyote.

Raccoons are now the primary nest predators of most North American turtle populations (Wilbur and Morin 1981) and raccoons can also be important predators of ground nesting birds (Staller et al. 2005, Parsons et al. 2013) and song birds (Thompson 2007, Lumpkin et al. 2012). As hypothesized for fox, coyotes may depredate raccoons, may cause behavioral shifts in raccoons resulting in lower predation on turtle and bird nests, and may depredate turtle and bird nests directly. The only study of turtle nest predation on Long Island (Feinberg and Burke 2003; Burke *unpub. data*) found that raccoons resulted in 85-100% nest loss in diamondback terrapins. The near total nest failure primarily because of a single species would make for an interesting follow-up study should coyotes colonize the study area. Starting in 2015, researchers will be monitoring the success of ground nesting birds at Brookhaven National Laboratory (T. K. Lynch, Hofstra University, *pers. comm*.) providing comparable baseline (e.g. pre-coyote) data for upland birds as well.

Levi et al.'s (2012) model linked coyote invasion to increased Lyme disease through reduction of red fox predation on small mammals, increases in small mammals, increases in *Ixodes* ticks, and increased Lyme exposure to humans. This series of testable hypotheses would be particularly valuable on Long Island given the prevalence of Lyme disease, especially in Suffolk and eastern Nassau. Suffolk County Vector Control has been recently tasked by the Suffolk County legislature to prepare plans for a County-wide tick control program, which will include establishing permanent monitoring plots where tick populations (e.g. the number and percentage of *Borrelia*-infected black-legged ticks) will be surveyed (Ilia Rochlin, Laboratory Director, Suffolk County Vector Control, *pers. comm.*). There is a timely opportunity to evaluate Levi et al's (2012) predictions by scaffolding surveys of small mammal abundance – in areas with and without foxes, pre- and post-coyote colonization – onto tick monitoring.

Lastly, the NYSDEC has recently attempted to increase Long Island populations of game birds, specifically, ruffed grouse, bobwhite quail, and turkey (NYS DEC 2014). Bobwhite quail, in particular, are valuable game species that occur in low numbers on Long Island and where limited restoration efforts are underway (see Great South Bay Audubon Society). It is not known what factors caused population declines in quail and what factors currently limit population growth, although habitat loss is a major limiting factor. Coyotes are known to consume bobwhite adults and eggs (Ozoga and Harger 1966, Guthrey 1995, Rader et al. 2007). However, in a review of coyote removal studies, (Guthrey 1995) found mortality to be largely compensatory with little impact on population dynamics. Guthrey (1995) further suggested that coyotes may actually benefit upland game birds through trophic cascades, a hypothesis that can be addressed through studies of Long Island's small populations of bobwhite quail and ruffed grouse.

HUMAN DIMENSIONS

Wildlife managers and conservation organizations often promote a goal of coexistence with coyotes in urban ecosystems, for two reasons. First, coexistence is promoted in contexts where carnivores are considered a native or naturalized species and where carnivores are valued because of beliefs that they contribute to biological diversity and resilience of an ecosystem. Gompper (2002b), for example, suggests that messages from wildlife professionals should be designed to help residents "… realize that the presence of coyotes in the Northeast represents a natural range expansion of the species, not an exotic invasion, and that the species is here to stay." To that point, the coyote is rarely labeled as invasive either in the scholarly literature (see Witczuk et al. 2013 and Warsen et al. 2014 for an exception) or by state agencies. A review of websites operated by state natural resources found only the multi-agency Georgia Invasive Species Task Force listing the coyotes as an invasive species.

Second, coexistence is a common goal because management agencies and communities do not have the capacity to eradicate or substantially suppress an established coyote population (Knowlton et al. 1999, Gompper 2002b). Coyotes have demonstrated a capacity to adapt to a range of urban and suburban environments and are expected to persist in many locales on Long Island. Eradication of coyote populations will not be possible once they are widely distributed, and long term suppression of coyote populations will be cost prohibitive in most Long Island communities. Area residents will have little choice but to learn to live with the presence of coyotes. The degree to which communities can minimize negative coyote-human or coyote-pet interactions, and thus comfortably coexist with coyotes, will depend upon the efficacy of interventions to inform, educate, and empower individuals and communities to take problem prevention and mitigation actions.

If coexistence with (or tolerance for) coyotes is the management goal, outreach efforts should focus on: (1) developing a public appreciation for the ecological benefits that coyote presence affords, (2) helping Long Island residents to form accurate perceptions of the risks coyotes pose to people and pets, and ultimately (3) empowering people to prevent problem interactions with coyotes. A comprehensive outreach program would include messages for all residents, as well as messages targeted toward residents who have or are experiencing negative interactions with coyotes.

Current State of Knowledge

To fully understand and respond to human-coyote conflicts in urban areas, wildlife agencies and community organizations will need to fill not only ecological, but also human dimensions (HD) information gaps. The human dimensions of wildlife management pertain to "discovering, understanding, and applying insights about how humans value wildlife, how they want wildlife to be managed, and how humans affect, or are affected by, wildlife and wildlife management decisions" (Decker et al. 2012). HD information needs exist at all stages of the wildlife management process, from defining goals to evaluating management alternatives. Siemer et al. (2007) identified a set of needs related specifically to stages in an urban coyote management process, nevertheless, HD research on urban carnivore management is quite limited and many information gaps exist (Wieczorek Hudenko et al. 2010). HD research before and after coyote colonization on Long Island provides a unique context to address three particular information gaps identified by both Wieczorek Hudenko et al. (2010) and Siemer et al. (2007): (1) identifying factors that influence coyote-related risk perceptions, (2) identifying factors that influence acceptance capacity (tolerance) for coyotes, and (3) clarifying the efficacy of outreach programs to promote problem prevention behaviors by key stakeholder groups.

Public concerns about coyote-related risks to pets and children (risk perception) can become a prominent feature of public discourse about urban coyote (Alexander and Quinn 2012). Studying either cognitive (e.g., perceived probability of events like pet attacks) or affective risk perceptions (e.g., concern about attacks) can provide valuable information about key stakeholders in a wildlife management issue (Gore et al. 2005) and can inform management objectives and actions. Understanding coyote-related risk perceptions also is important because studies suggest that elevated risk perceptions are associated with reduced wildlife acceptance capacity, reduced problem prevention behavior, and reduced acceptance of wildlife management actions (Decker et al. 2002).

Wildlife acceptance capacity (WAC; Decker and Purdy 1988) refers to the wildlife population level that any given stakeholder group is willing to tolerate. Management experience and research suggest that WAC is situation specific, and is a function of the positive and negative impact levels that people recognize and experience (Carpenter et al. 2000). A range of socio-demographic traits (e.g., age, gender, urban-rural background) influence perceptions of impacts, and thus WAC. Furthermore, perceptions of carnivore-related impacts are subject to change with time (Zimmermann et al. 2001) due to new information gained through personal experience, interpersonal communication, or exposure to messages in mass media. Zinn et al. (2008) speculated on a process of human habituation by which people may change their perceptions of a species like coyote colonizing an area over time. They argued that research to better understand the process of human habituation to wildlife could help interventionists predict, and perhaps influence, beliefs about and behaviors toward wildlife. WAC also has been linked to perceived ability to control negative impacts (self-efficacy; Treves and Karanth 2003). Perceived ability to control negative interactions with coyotes is an important factor to consider in urban ecosystems, where removal of problem coyotes is often difficult, and many stakeholders may oppose lethal control of wildlife (Zinn et al. 1998).

Finally, monitoring suggests that problem interactions with urban coyotes can often be attributed to food attraction/conditioning (Gehrt 2006, White and Gehrt 2009) and exposure of pets to encounters with coyotes. Thus, an important component of resolving urban coyote issues is providing outreach to encourage individuals to take problem prevention actions, such as preventing coyote access to anthropogenic food sources, taking other actions to reduce coyote attraction and habituation to humans, and taking actions to safeguard pets. Yet, despite the fact that they are commonplace, problem prevention outreach activities are seldom evaluated with regard to effectiveness in changing the targeted behaviors. Careful evaluation can reveal that efficacy of education programs can be quite low, even in communities experiencing human-wildlife conflicts (Gore et al. 2008). Fundamental questions such as, "what messages work best with different audiences" and "when will stakeholders begin responding to said messages" is largely unknown.

Developing a Research Framework for Long Island

A series of three surveys of residents in two study areas in Westchester County (Wieczorek Hudenko et al. 2008a, 2008b, Siemer and Decker 2011, Siemer et al. 2014), conducted in fall 2006, fall 2010 and winter 2011 can serve as a local model for social science research on Long Island. Through phone surveys and interviews, Wieczorek Hudenko et al. (2008c, 2008b) found that neutral and negative experience were significant predictors of coyote-related attitudes and risk perceptions. In those areas where coyotes had been present the longest, residents expressed more positive attitudes and lower perceived risk than residents living in areas where coyotes are more recent arrivals.

Siemer and Decker (2011) found an increase in concerns about coyotes between fall 2006 and fall 2010, just after July 2010 incidents in which two children in the county had been injured in coyote attacks. Elevated concerns persisted into 2011, even though area residents experienced a relatively constant level of coyote interactions (Siemer and Decker 2011). Siemer and Decker (2014) found that elevated risk perceptions and reduced acceptance capacity persisted even after media attention to the events subsided, and hypothesized that residents of the locale where the coyote attacks occurred revised their mental model of coyotes to include the belief that coyotes do present a low, but real threat to safety of young children (i.e., the attacks may have had a long-term effect on their cognitive risk perceptions).

Findings from this series of attitude surveys provided time series (change) information, but the study design was opportunistic and limited. Coyote colonization on Long Island presents an opportunity to study the same phenomenon using a stronger research design. Furthermore, Long Island also provides a unique opportunity to explore the efficacy of problem prevention interventions even before negative human-coyote interaction begins. An ideal approach to addressing most of these information needs would be through a multi-year panel study, with multiple study sites selected to represent expected coyote occupation areas and a gradation in socio-demographics of study site residents. Initially the panel study would focus on obtaining baseline measures of attitudes toward coyotes, risk perceptions, WAC, and awareness of coyote-related impacts through surveys and select in-depth interviews. Subsequent surveys - and specific objectives – would be contingent on patterns of coyote occupancy, media attention, outreach campaigns, and incidents of human-coyote conflict.

Carefully designed studies in selected research sites, before and after coyote range expansion, could contribute greatly to theory on wildlife-related risk perception (Slovic 1987) and risk communication (Morgan et al. 2001), wildlife acceptance capacity (Decker and Purdy 1988, Carpenter et al. 2000), impact dependency (Wieczorek Hudenko et al. 2010), and other concepts central to urban carnivore management. In addition to those academic contributions, a well-designed social science agenda would provide a research-based foundation for information, education, and outreach efforts to promote problem prevention behaviors, realistic perceptions of coyote risks to human and pet safety, greater understanding of why negative human-coyote interactions occur, and greater tolerance of coyote presence in suburban and urban areas.

CONCLUSION

In proposing a research initiative to study coyote colonization of Long Island we have, up to this point, ignored a logical question. If models are sufficiently accurate to be reliably predictive and early-detection monitoring proves sensitive enough to discover rare colonization events, should this information be used to forestall range expansion, rather that study it?

The answer to this question can only be played out at the intersection of applied science, policy and public opinion, the latter of which is mixed and nuanced. Indeed, in 1990, a bill to allow year-round hunting of coyotes in northern NYS was withdrawn following prolonged debate and controversy (NYSDEC 1991). NYSDEC found no clear biological or social justification in support of the bill: the majority of the public did not support year-round hunting; coyote problems were local, not regional; New York State's existing Environmental Conservation Law allows for managing "nuisance" or "damaging" coyotes; and random removal of coyotes would not limit coyote population growth (NYSDEC 1991).

As of this writing, NYSDEC manages coyotes as a protected furbearer. As of 2013/2014, coyote hunting and trapping is permitted in all counties save for those of NYC and Long Island (NYSDEC 2014). Hunting and trapping seasons do not extend into summer months to prevent harassing breeding and reproducing wildlife, and follows with the North American Model of Wildlife Management (i.e., coyotes harvested in winter are valued for their fur, while coyotes harvested in summer have no economic value). Since 2005, NYSDEC monitors sightings and human-coyote conflicts statewide (Bogan 2012). To prevent problems and improve coexistence, NYSDEC recommends preventing intentional and unintentional feeding, and hazing, and lethal control by permit as a last resort. There is no policy to prevent coyote range expansion into the remaining NYC or Long Island.

Despite our best efforts at eradication in the Midwestern United States during the 19th century, the coyote has responded by expanding its range and numbers (Prugh et al. 2009). With this in mind, it is likely that coyotes will eventually expand into Long Island, NY. Ultimately, understanding and managing the social and ecological impacts of coyote range expansion must come from comprehensive research and outreach agendas that study this phenomenon as a coupled human-ecological system. It is on this premise that we have presented an argument for prior planning through predicting coyote habitat, and using the opportunity of contemporaneous range expansion to better understand how a new predator responds to new territory, and how human individuals and communities respond to a new predator. By providing an ecological and social science foundation for interventions, the research agenda proposed here could provide guidance to any city or urban community searching for mechanisms to improve coexistence with coyotes.

LITERATURE CITED

Alexander, S. M., and M. S. Quinn. 2012. Portrayal of interactions between humans and coyotes (Canis latrans): Content analysis of Canadian print media (1998-2010). Cities and the Environment (CATE) 4:9.

Andelt, W. F., and S. H. Andelt. 1981. Habitat use by coyotes in Southeastern Nebraska. The Journal of Wildlife Management 45:1001–1005.

Andelt, W. F., J. G. Kie, F. F. Knowlton, and K. Cardwell. 1987. Variation in coyote diets associated with season and successional changes in vegetation. The Journal of Wildlife Management 51:273–277.

Atwood, T. C., H. P. Weeks, T. M. Gehring, and J. White. 2004. Spatial ecology of coyotes along a suburban-to-rural gradient. Journal of Wildlife Management 68:1000–1009.

Baker, R. O., and R. M. Timm. 1998. Management of conflicts between urban coyotes and humans in southern California. Pages 299–312 Proceedings of the Vertebrate Pest Conference. University of California, Davis.

Ballard, W. B., D. Lutz, T. Keegan, L. H. Carpenter, and J. C. deVos. 2001. Deer-predator relationships: A review of recent North American studies with emphasis on mule and black-tailed deer. Wildlife Society Bulletin 29:99–115.

Barbour, A. G., and D. Fish. 1993. The biological and social phenomenon of Lyme disease. Science 260:1610–1616.

Barron, J. 2006, March 23. A coyote leads a crowd on a Central Park Marathon - New York Times. Newspaper. http://www.nytimes.com/2006/03/23/nyregion/23coyote.html. Accessed 20.10.2014

Bekoff, M. 1977. Mammalian dispersal and the ontogeny of individual behavioral phenotypes. American Naturalist 111:715–732.

Bogan, D. 2004. Eastern coyote home range, habitat selection and survival in the Albany Pine Bush Landscape. Master of Science, University at Albany, State University of New York.

Bogan, D. 2012. The suburban coyote syndrome, from anecdote to evidence: Understanding ecology and human safety to improve coexistence. Doctor of Philosophy, Cornell University.

Bonney, R., C. B. Cooper, J. Dickinson, S. Kelling, T. Phillips, K. V. Rosenberg, and J. Shirk. 2009. Citizen Science: A developing tool for expanding science knowledge and scientific Literacy. BioScience 59:977–984.

Bonter, D. N., and C. B. Cooper. 2012. Data validation in citizen science: a case study from Project FeederWatch. Frontiers in Ecology and the Environment 10:305–307.

Boyle, C. 2010. Not wily enough: Cops corral roving Tribeca coyote along West Side Highway. Daily News. http://www.nydailynews.com/new-york/wily-cops-corral-roving-tribeca-coyote-west-side-highway-article-1.173486. Accessed 20.10.2014

Bottini, M. 2009. The status and distribution of the river otter (Lontra canadensis) on Long Island, NY. http://www.lisser.us/2008OtterStudyFinal.pdf. Accessed 20.10.2014

Brossard, D., B. Lewenstein, and R. Bonney. 2005. Scientific knowledge and attitude change: The impact of a citizen science project. International Journal of Science Education 27:1099–1121.

Brown, J. L. 2007. The influence of coyotes on an urban Canada goose population in the Chicago metropolitan area. Master of Science, The Ohio State University.

Calver, M. C., J. Grayson, M. Lilith, and C. R. Dickman. 2011. Applying the precautionary principle to the issue of impacts by pet cats on urban wildlife. Biological Conservation 144:1895–1901.

Carpenter, L. H., D. Decker, and J. F. Lipscomb. 2000. Stakeholder acceptance capacity in wildlife management. Human Dimensions of Wildlife 5:5–19.

Cohen, J. B., J. D. Fraser, and D. H. Catlin. 2006. Survival and site fidelity of piping plovers on Long Island, NY. Journal of Field Ornithology 77:409–417.

Colding, J. 2007. "Ecological land-use complementation" for building resilience in urban ecosystems. Landscape and Urban Planning 81:46–55.

Conrad, C. C., and K. G. Hilchey. 2011. A review of citizen science and community-based environmental monitoring: issues and opportunities. Environmental Monitoring and Assessment 176:273–291.

Cooper, C. B., J. Dickinson, T. Phillips, and R. Bonney. 2007. Citizen science as a tool for conservation in residential ecosystems. Ecology and Society 12:11.

Cooper, C. B., W. M. Hochachka, and A. A. Dhondt. 2005. Latitudinal trends in within-year reoccupation of nest boxes and their implications. Journal of Avian Ecology 36:31–39.

Couvet, D., F. Jiguet, R. Julliard, H. Levrel, and A. Teyssedre. 2008. Enhancing citizen contributions to biodiversity science and public policy. Interdisciplinary Science Reviews 33:95–103.

Cove, M. V., B. M. Jones, A. J. Bossert, D. R. Clever, R. K. Dunwoody, B. C. White, and V. L. Jackson. 2012. Use of camera traps to examine the mesopredator release hypothesis in a fragmented midwestern landscape. The American Midland Naturalist 168:456–465.

Crete, M., J.-P. Ouellet, J.-P. Tremblay, and R. Arsenault. 2001. Suitability of the forest landscape for coyotes in northeastern North America and its implications for coexistance with other carnviores. Ecoscience 8:311–319.

Crooks, K. R., and M. E. Soulé. 1999. Mesopredator release and avifaunal extinctions in a fragmented system. Nature 400:563–566.

Decker, D., T. B. Lauber, and W. Siemer F. 2002. Human-wildlife conflict management: A practitioner's guide. Northeast Wildlife Damage Management Research and Outreach, Cornell University Cooperative, Ithaca, NY.

Decker, D., and K. G. Purdy. 1988. Toward a concept of wildlife acceptance capacity in wildlife management. Wildlife Society Bulletin 16:53–57.

Decker, D., S. J. Riley, and W. Siemer F. 2012. Human dimensions of wildlife. 2nd edition. The Johns Hopkins University Press, Baltimore, MD.

Dickinson, J. L., B. Zuckerberg, and D. N. Bonter. 2010. Citizen science as an ecological research tool: Challenges and benefits. Annual Review of Ecology, Evolution, and Systematics 41:149–172.

Dickman, A. J. 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human-wildlife conflict: Social factors affecting human-wildlife conflict resolution. Animal Conservation 13:458–466.

Dodge, W. B., and D. M. Kashian. 2013. Recent distribution of coyotes across an urban landscape in southeastern michigan. Journal of Fish and Wildlife Management 4:377–385.

Doherty, P. J., and J. A. Heath. 2011. Factors affecting piping plover hatching success on Long Island, New York. Journal of Wildlife Management 75:109 –115.

Feinberg, J. A., and R. L. Burke. 2003. Nesting ecology and predation of diamondback terrapins, Malaclemys terrapin, at Gateway National Recreation Area, New York. Journal of Herpetology 37:517–526.

Fener, H. M., J. R. Ginsberg, E. W. Sanderson, and M. E. Gompper. 2005. Chronology of range expansion of the coyote, Canis latrans, in New York 119:1–5.

Fitzner, R. E., and W. H. Rickard. 1983. Canada goose nesting performance along the Hanford Reach of the Columbia River, 1971-1981. Northwest Science 57:267–272.

Gallahue, P. 2004, January 27. Queens coyote goes with floe. Newspaper. http://nypost.com/2004/01/27/queens-coyote-goes-with-floe/. Accessed 20.10.2014

Gehrt, S. D. 2006. Urban coyote ecology and management: The Cook County, Illinois, coyote project. Extension Bulletin 929, Ohio State University.

Gehrt, S. D. 2007. Ecology of coyotes in urban landscapes. Wildlife Damage Management Conferences - Proceedings 63:303–311.

Gehrt, S. D., C. Anchor, and L. A. White. 2009. Home range and landscape use of coyotes in a metropolitan landscape: conflict or coexistence? Journal of Mammalogy 90:1045–1057.

Gehrt, S. D., J. L. Brown, and C. Anchor. 2011. Is the urban coyote a misanthropic synanthrope? The case from Chicago. Cities and the Environment (CATE) 4:3.

Gehrt, S. D., and W. R. Clark. 2003. Raccoons, coyotes, and reflections on the mesopredator release hypothesis. Wildlife Society Bulletin 31:836–842.

Gehrt, S. D., and S. Prange. 2006. Interference competition between coyotes and raccoons: a test of the mesopredator release hypothesis. Behavioral Ecology 18:204–214.

Gehrt, S. D., E. C. Wilson, J. L. Brown, and C. Anchor. 2013. Population ecology of free-roaming cats and interference competition by coyotes in urban parks. PLoS ONE 8:e75718.

Genet, K. S., and L. G. Sargent. 2003. Evaluation of methods and data quality from a volunteer-based amphibian call survey. Wildlife Society Bulletin 31:703–714.

Gese, E. M., P. S. Morey, and S. D. Gehrt. 2012. Influence of the urban matrix on space use of coyotes in the Chicago metropolitan area. Journal of Ethology 30:413–425.

Gese, E. M., O. J. Rongstad, and W. R. Mytton. 1988. Home range and habitat use of coyotes in Southeastern Colorado. The Journal of Wildlife Management 52:640.

Gibeau, M. L. 1998. Use of urban habitats by coyotes in the vicinity of Banff Alberta. Urban Ecosystems 2:129–139.

Gompper, M. E. 2002a. The ecology of northeast coyotes: Current knowledge and priorities for future research. Working Paper, Wildlife Conservation Society.

Gompper, M. E. 2002b. Top carnivores in the suburbs? Ecological and conservation issues raised by colonization of North-eastern North America by coyotes. Bioscience 52:185–190.

Gore, M. L., B. A. Knuth, C. W. Scherer, and P. D. Curtis. 2008. Evaluating a conservation investment designed to reduce human-wildlife conflict: Evaluating conservation investment. Conservation Letters 1:136–145.

Gore, M. L., W. Siemer F., J. E. Shanahan, D. Schuefele, and D. Decker. 2005. Effects on risk perception of media coverage of a black bear-related human fatality. Wildlife Society Bulletin 33:507–516.

Gosselink, T. E., T. R. V. Deelen, R. E. Warner, and M. G. Joselyn. 2003. Temporal habitat partitioning and spatial use of coyotes and red foxes in east-central Illinois. The Journal of Wildlife Management 67:90–103.

Grinder, M. I., and P. R. Krausman. 2001. Home range, habitat use, and nocturnal activity of coyotes in an urban environment. The Journal of Wildlife Management 65:887–898.

Grubbs, S., and P. R. Krausman. 2009. Use of urban landscapes by coyotes. The Southwestern Naturalist 54:1–12.

Guthrey, F. S. 1995. Coyotes and upland gamebirds. Symposium Proceedings-Coyotes in the Southwest: A Compendium of our Knowledge (1995). Paper 31:104–107.

Harrison, D. J. 1992. Dispersal characteristics of juvenile coyotes in maine. The Journal of Wildlife Management 56:128–138.

Harrison, D. J., J. A. Bissonette, and J. A. Sherburne. 1989. Spatial relationships between coyotes and red foxes in eastern Maine. The Journal of Wildlife Management 53:181–185.

Henke, S. E., and F. C. Bryant. 1999. Effects of coyote removal on the faunal community in western Texas. The Journal of Wildlife Management 63:1066–1081.

Kays, R. W., M. E. Gompper, and J. C. Ray. 2008. Landscape ecology of eastern coyotes based on large-scale estimates of abundance. Ecological Applications 18:1014–1027.

Kelly, M. J., and E. L. Holub. 2008. Camera trapping of carnivores: trap success among camera types and across species, and habitat selection by species, on Salt Pond Mountain, Giles County, Virginia. Northeastern Naturalist 15:249–262.

Kitchen, P. 2013. Coyote sighting in Bridgehampton. Newsday. http://www.newsday.com/long-island/suffolk/coyote-sighting-in-bridgehampton-1.5605415. Accessed 20.10.2014

Knowlton, F. F., E. M. Gese, and M. M. Jaeger. 1999. Coyote depredation control: an interface between biology and management. Journal of Range Management 52:398–412.

Laliberte, A. S., and W. J. Ripple. 2004. Range contractions of North American carnivores and ungulates. BioScience 54:123–138.

Levi, T., A. M. Kilpatrick, M. Mangel, and C. C. Wilmers. 2012. Deer, predators, and the emergence of Lyme disease. Proceedings of the National Academy of Sciences 109:10942–10947.

Levi, T., and C. C. Wilmers. 2012. Wolves-coyotes-foxes: A cascade among carnivores. Ecology 93:921–929.

Lidskog, R. 2008. Scientised citizens and democratised science. Re-assessing the expert-lay divide. Journal of Risk Research 11:69–86.

Litvaitis, J. A., and J. H. Shaw. 1980. Coyote novements, habitat use, and food habits in southwestern Oklahoma. The Journal of Wildlife Management 44:62–68.

Low, B., S. R. Sundaresan, I. R. Fischhoff, and D. I. Rubenstein. 2009. Partnering with local communities to identify conservation priorities for endangered Grevy's zebra. Biological Conservation 142:1548–1555.

Lukasik, V. M., and S. M. Alexander. 2012. Spatial and temporal variation of coyote (Canis latrans) diet in Calgary, Alberta. Cities and the Environment (CATE) 4:8.

Lumpkin, H. A., S. M. Pearson, and M. G. Turner. 2012. Effects of climate and exurban development on nest predation and predator presence in the southern Appalachian Mountains (U.S.A.): Climate, development, and nest predation. Conservation Biology 26:679–688.

MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle, and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83:2248–2255.

Martin, D. 1999, April 2. Wild (and unleashed) coyote is captured in Central Park - New York Times. Newspaper. http://www.nytimes.com/1999/04/02/nyregion/wild-and-unleashed-coyote-is-captured-in-central-park.html. Accessed 20.10.2014

Mastro, L. L., E. M. Gese, J. K. Young, and J. A. Shivik. 2012. Coyote (Canis latrans), 100+ years in the east: A literature review. Addendum to the Proceedings of the 14th Wildlife Damage Management Conference.

McClennen, N., R. R. Wigglesworth, S. H. Anderson, and D. G. Wachob. 2001. The effect of suburban and agricultural development on the activity patterns of coyotes (Canis latrans). The American Midland Naturalist 146:27–36.

McIntyre, A. F., J. A. Heath, and J. Jannsen. 2010. Trends in piping plover reproduction at Jones Beach State Park, NY, 1995–2007. Northeastern Naturalist 17:493–504.

Méndez-Carvajal, P., and R. Moreno. 2014. Mammalia, Carnivora, Canidae, Canis latrans (Say, 1823): Actual distribution in Panama. Check List 10:376–379.

Monzón, J. 2012. Rapid evolution of northeastern coyotes. Doctor of Philosophy, Stony Brook University, State University of New York.

Monzón, J., R. Kays, and D. E. Dykhuizen. 2014. Assessment of coyote-wolf-dog admixture using ancestry-informative diagnostic SNPs. Molecular Ecology 23:182–197.

Morgan, M. G., B. Fischhoff, A. Bostrom, C. J. Atman. 2001. Risk communication: a mental models approach. Cambridge University Press, UK.

Morey, P. S., E. M. Gese, and S. Gehrt. 2007. Spatial and temporal variation in the diet of coyotes in the Chicago metropolitan area. The American Midland Naturalist 158:147–161.

Nagy, C., K. Bardwell, R. F. Rockwell, R. Christie, and M. Weckel. 2012a. Validation of a citizen science-based model of site occupancy for eastern screech owls with systematic data in suburban New York and Connecticut. Northeastern Naturalist 19:143–158.

Nagy, C., M. E. Weckel, A. Toomey, C. Burns, and J. Peltz. 2012b. Validation of a citizen science-based model of coyote occupancy with camera traps in suburban and urban New York, USA. Wildlife Biology in Practice 8:23–35.

Naughton-Treves, L., R. Grossberg, and A. Treves. 2003. Paying for tolerance: Rural citizens' attitudes toward wolf depredation and compensation. Conservation Biology 17:1500–1511.

Newsome, T. M., and W. J. Ripple. 2014. A continental scale trophic cascade from wolves through coyotes to foxes. Journal of Animal Ecology. DOI: 10.1111/1365-2656.12258

NYS DEC. 1991. The status and impact of eastern coyotes in northern New York. Bureau of Wildlife, Division of Fish and Wildlife, New York State Department of Environmental Conservation and Cornell Cooperative Extension, Department of Natural Resources, Bureau of Wildlife, Division of Fish and Wildlife, New York State Department of Environmental Conservation and Cornell Cooperative Extension, Department of Natural Resources.

NYS DEC. 2014. Hunting on Long Island. http://www.dec.ny.gov/outdoor/8373.html. Accessed 20.10.2014

O'Connell, A. F., B. Harrison, B. Connery, and K. B. Anderson. 1992. Food use by an insular population of coyotes. Northeast Wildlife 49:36–41.

Ostfeld, R. S., C. D. Canham, K. Oggenfuss, R. J. Winchcombe, and F. Keesing. 2006. Climate, deer, rodents, and acorns as determinants of variation in Lyme-Disease Risk. PLoS Biology 4:e145.

Ostfeld, R. S., and F. Keesing. 2012. Effects of host diversity on infectious disease. Annual Review of Ecology, Evolution, and Systematics 43:157–182.

Ozoga, J. J., and E. M. Harger. 1966. Winter activities and feeding habits of northern Michigan coyotes. The Journal of Wildlife Management 30:809–818.

Parker, G. 1995. Eastern coyote: The story of its success. Nimbus Publishing.

Parsons, A. W., T. R. Simons, A. F. O'Connell, and M. K. Stoskopf. 2013. Demographics, diet, movements, and survival of an isolated, unmanaged raccoon Procyon lotor (Procyonidae, Carnivora) population on the Outer Banks of North Carolina. Mammalia 77:21–30.

Petroelje, T. R., J. L. Belant, and D. E. Beyer. 2013. Factors affecting the elicitation of vocal responses from coyotes Canis latrans. Wildlife Biology 19:41–47.

Prugh, L. R., C. J. Stoner, C. W. Epps, W. T. Bean, W. J. Ripple, A. S. Laliberte, and J. S. Brashares. 2009. The rise of the mesopredator. BioScience 59:779–791.

Quinn, T. 1997. Coyote (Canis latrans) habitat selection in urban areas of western Washington via analysis of routine movements. Northwest Science 71:289–297.

Rader, M. J., T. W. Teinert, L. A. Brennan, F. Hernández, N. J. Silvy, and X. B. Wu. 2007. Identifying predators and nest fates of bobwhites in southern Texas. Journal of Wildlife Management 71:1626–1630.

Randa, L. A., and J. A. Yunger. 2006. Carnivore occurrence along an urban-rural gradient: A landscape-level analysis. Journal of Mammalogy 87:1154–1164.

Rhoads, B. L., D. Wilson, M. Urban, and E. E. Herricks. 1999. Interaction between scientists and nonscientists in community-based watershed management: emergence of the concept of stream naturalization. Environmental Management 24:297–308.

Richer, M.-C., M. Crete,, J. Rivest, and J. Huot. 2002. The low performance of forest versus rural coyotes in northeastern North America: Inequality between presence and availability of prey. Ecoscience 9:44–54.

Riley, P. D., R. M. Sauvajot, T. K. Fuller, E. C. York, and A. Denise. 2003. Effects of urbanization and habitat fragmentation on bobcats and coyotes in southern California. Conservation Biology 17:566–576.

Ritchie, E. G., and C. N. Johnson. 2009. Predator interactions, mesopredator release and biodiversity conservation. Ecology Letters 12:982–998.

Robinson, K. F., D. R. Diefenbach, A. K. Fuller, J. E. Hurst, and C. S. Rosenberry. 2014. Can managers compensate for coyote predation of white-tailed deer? The Journal of Wildlife Management 78:571–579.

Saalfeld, S. T., and S. S. Ditchkoff. 2007. Survival of neonatal white-tailed deer in an exurban population. Journal of Wildlife Management 71:940–944.

Scott, D. M., M. J. Berg, B. A. Tolhurst, A. L. M. Chauvenet, G. C. Smith, K. Neaves, J. Lochhead, and P. J. Baker. 2014. Changes in the distribution of red foxes (Vulpes vulpes) in urban areas in Great Britain: Findings and limitations of a media-driven nationwide survey. PLoS ONE 9:e99059.

Sedon, M. 2012, April 5. Coyote sighted at former landfill on Staten Island. Newspaper. http://www.silive.com/news/index.ssf/2012/04/coyote_sighted_at_former_landf.html. Accessed 20.10.2014

Séquin Larrucea, E., P. F. Brussard, M. M. Jaeger, and R. Barrett. 2007. Cameras, coyotes, and the assumption of equal detectability. The Journal of Wildlife Management 71:1682–1689.

Severinghaus, C. W. 1974. Notes on the history of wild canids in New York. New York Fish and Game Journal 21:117–125.

Siemer, W. F., D. Daniel, J. E. Shanahan, and H. A. Wieczorek Hudenko. 2014. "How do suburban coyote attacks affect residents' perceptions? Insights from a New York case study. Cities and the Environment (CATE) 7:2. Siemer, W. F., and D. Decker. 2011. The new norm: Westchester County residents' risk perceptions and experiences before and after local coyote attacks. Human Dimensions Research Unit Series Publication 11-4, Department of Natural Resources, Cornell University, Ithaca, NY.

Siemer, W. F., H. Wieczorek Hudenko, and D. Decker. 2007. Coyote management in residential areas: Human dimensions research needs. Pages 421–430 The Wildlife Damage Management Working Group of The Wildlife Society. Corpus Christi, TX.

Slovic, P. 1987. Perception of risk. Science 236:280–285.

Soltis, A. 2010, February 9. A howling good time in Gotham. Newspaper. http://nypost.com/2010/02/09/a-howling-good-time-in-gotham/. Accessed 20.10.2014

Staller, E. L., W. E. Palmer, J. P. Carroll, R. P. Thornton, and D. C. Sisson. 2005. Identifying predators at northern bobwhite nests. Journal of Wildlife Management 69:124–132.

Stout, G. 1982. Effects of coyote reduction on white-tailed deer productivity on Fort Sill, Oklahoma. Wildlife Society Bulletin 10:329–332.

Thompson, F., R. 2007. Factors affecting nest predation on forest songbirds in North America. Ibis 149:98–109.

Toomey, A. H., and M. C. Domroese. 2013. Can citizen science lead to positive conservation attitudes and behaviors? Human Ecology Review 20:50–62.

Toomey, A., M. Weckel, C. Nagy, L. Gormezano, and S. Silver. 2012. The last frontier: eastern coyotes in New York City. The Wildlife Professional Spring:54–57.

Tremblay, J.-P., M. Crete,, and J. Huot. 1998. Summer foraging behaviour of eastern coyotes in rural versus forest landscapes: A possible mechanism of source-sink dynamics. Ecoscience 5:172–182.

Treves, A., and K. U. Karanth. 2003. Human-carnivore conflict and perspectives on carnivore management worldwide. Conservation Biology 17:1491–1499.

U.S. Bureau of the Census. 2010. State and County Quick Facts. http://quickfacts.census.gov/qfd/index.html Accessed 12.6.2014

VanGilder, C. L. 2008. Coyote and bobcat food habits and the effects of an intensive predator removal on white-tailed deer recruitment in northeastern Alabama. Master of Science, University of Georgia.

Vitali, C. 2014. A frame-analytical perspective on conflict between people and an expanding wolf Canis lupus population in central Italy. Oryx 48:1–9.

Vreeland, J. K., D. R. Diefenbach, and B. D. Wallingford. 2004. Survival rates, mortality causes, and habitats of Pennsylvania white-tailed deer fawns. Wildlife Society Bulletin 32:542–553.

Warsen, S. A., J. L. Frair, and M. A. Teece. 2014. Isotopic investigation of niche partitioning among native carnivores and the non-native coyote (Canis latrans). Isotopes in Environmental and Health Studies 50:1–11.

Way, J. G. 2007. Movements of transient coyotes, Canis latrans, in urbanized eastern Massachusetts. The Canadian Field-Naturalist 121:364–369.

Way, J. G., I. M. Ortega, and E. G. Strauss. 2004. Movement and activity patterns of eastern coyotes in a coastal, suburban environment. Northeastern Naturalist 11:237–254.

Way, J. G., L. Rutledge, T. Wheeldon, and B. N. White. 2010. Genetic characterization of eastern “coyotes” in eastern Massachusetts. Northeastern Naturalist 17:189–204.

Way, J. G., and B. N. White. 2013. Coyotes, red foxes, and the prevalence of Lyme disease. Northeastern Naturalist 20:655–665.

Weckel, M. E., D. Mack, C. Nagy, R. Christie, and A. Wincorn. 2010. Using citizen science to map human–coyote interaction in suburban New York, USA. Journal of Wildlife Management 74:1163–1171.

White, L. A., and S. D. Gehrt. 2009. Coyote attacks on humans in the United States and Canada. Human Dimensions of Wildlife 14:419–432.

White, P. C. L., N. V. Jennings, A. R. Renwick, and N. H. L. Barker. 2005. Questionnaires in ecology: a review of past use and recommendations for best practice. Journal of Applied Ecology 42:421–430.

Wieczorek Hudenko, H., W. Siemer F., and D. Decker. 2008a. Humans and coyotes in suburbia: Can experience lead to sustainable coexistence? Human Dimensions Research Unit Series Publication 08-9, Cornell University.

Wieczorek Hudenko, H., W. Siemer F., and D. Decker. 2008b Living with coyotes in suburban areas: Insights from two New York State Counties. Human Dimensions Research Unit Series Publication 08-8, Cornell University.

Wieczorek Hudenko, H., D. Decker, and W. Siemer F. 2008c Stakeholder insights into the human-coyote interface in Westchester County, New York. Human Dimensions Research Unit Series Publication 08-1, Cornell University.

Wieczorek Hudenko, H., W. Siemer F., and D. Decker. 2010. Urban carnivore conservation and management: the human dimension. Pages 21–33 Urban Carnivores: Ecology, Conflict, and Conservation. The Johns Hopkins University Press, Baltimore, MD.

Wilbur, H. M., and P. J. Morin. 1981. Life history evolution in turtles. Pages 388–439 in Biology of the Reptilia. Alan R. Liss, New York.

Witczuk, J., S. Pagacz, and L. S. Mills 2013. Disproportionate predation on endemic marmots by invasive coyotes. Journal of Mammalogy 94:702–713.

Worcester, R. E., and R. Boelens. 2007. The co-existing with coyotes program in Vancouver, BC. Wildlife Damage Management Conferences–Proceedings 79:393–397.

Young, B. 2011. Fishers Island man to town: Coyotes are killing our cats. The Suffolk Times. http://suffolktimes.timesreview.com/2011/08/17687/fishers-island-man-to-town-board-coyotes-are-killing-our-cats/. Accessed 20.10.2014

Zimmermann, B., P. Wabakken, and M. Dötterer. 2001. Human-carnivore interactions in Norway: How does the re-appearance of large carnivores affect people’s attitudes and levels of fear? Forest Snow and Landscape Research 76:1–17.

Zinn, H. C., M. J. Manfredo, and D. Decker. 2008. Human habituation and conditioning to wildlife: A different perspective on a long-standing concern. Human Dimensions of Wildlife 13:388–399.

Zinn, H. C., M. J. Manfredo, J. J. Vaske, and K. Wittmann. 1998. Using normative beliefs to determine acceptability of wildlife management actions. Society and Natural Resources 11:649–662.