

Disciplinary Perspectives Handout: Are Eastern Fox Squirrels (*Sciurus niger*) ‘good’ or ‘bad’ for the greater Los Angeles, CA region?^{1 2}

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Understanding and tackling the complexities of species introductions and eventual dispersals requires multiple disciplinary perspectives. For example, not all introduced species actually become invasive (Lugo, Carlo, & Wunderle, 2012), which is important to consider as people make local, state, and national policy. As Fortwangler highlights in a recent article in the interdisciplinary journal, *Environment & Society: Advances in Research*, “Although academic scholars have disciplinary understandings that influence the direction of research and how questions are formulated, these are not stable or uniform. We also see increasing interdisciplinary conversations that soften the disciplinary edges about how to think and what to do (if anything) about introduced species” (2013, p. 42). In this case, your job is to use the perspectives and evidence from various disciplines to decide if the eastern fox squirrel (EFS) deserves the label “invasive,” and if it is “good” or “bad” for the greater Los Angeles area.

The Natural Sciences: invasion ecology; restoration ecology; zoology; “new ecology”

Invasion ecology is a field that grew out of agriculture, forestry, entomology, zoology, botany, and pathology that seeks to understand and grapple with invasive species, including mitigating and remediating their economic, human health, and environmental/economic impacts (Lockwood, Hoopes, & Marchetti, 2007). Evolutionary biologists studying invasive species might, for example, examine how quickly native species are able to adapt to new ecological circumstances brought on by nonnative species, if at all (Donihue & Lambert, 2015). Together with restoration ecologists, invasion ecologists also sometimes work to restore habitats and ecosystems to their pre-invasion states, though the impacts of thinking in “new ecology” (Schaleper, Sax, & Olden, 2011, 2012; Scoones, 1999; Zimmerer, 1994) have in some ways shifted the goals of total restoration to an approach emphasizing the value that nonnative, and even invasive species, might have. While a review of the field of ecology is outside the scope of this case, it is important to emphasize here that “new ecology” perspectives challenge prior thinking in ecology that considered natural systems as linear, deterministic, and capable of reaching a state of equilibrium (Scoones, 1999). New ecology, in contrast, emphasizes variability in time and space, spatial patterns, and dynamism, opening up a space to consider how nonnative species might become part of new socio-ecological systems. These perspectives have also led some scientists to re-think the ways in which the category of “invasive” is actually constructed.

According to ecologists Lockwood, Hoopes, & Marchetti (2007), an invasive species is one that has “demonstrable ecological or economic impact” (p. 8). The federal government (Executive Order 13112) similarly defines invasive as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”³ Invasive species are so significant of a

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³ <http://www.invasivespeciesinfo.gov/laws/execorder.shtml>

concern that the International Union for Conservation of Nature (IUCN) created a network of scientific and policy experts on invasive species called the Invasive Species Specialist Group (ISSG). Among a variety of tasks, the ISSG maintains the Global Invasive Species Database and a list of “100 of the World’s Worst Invasive Alien Species.”⁴ To illustrate how significant of an impact invasive species can have, quagga mussels (*Dreissena bugensis*) and zebra mussels (*Dreissena polymorpha*), are both species of mollusks that arrived in the US from Europe in the 1980s. In the mid 2000s, they were spotted in the western US (AZ, CA, NV). Due to a lack of predators to control their populations, they have rapidly spread in various US locations, including the Colorado River Aqueduct System that provides water to California. In the Great Lakes area of the Midwest, they cost power industries \$3.1 billion (clogging water intake structures associated with power generation facilities) and other industries, businesses, and communities \$5 billion just from the period 1993-1999 (clogging pipelines and screens, reducing pumping capabilities of water treatment facilities, clogging boat engines).⁵ Ecologically, they cause damage because they concentrate organic pollutants in their tissues and their wastes reduce oxygen levels in bodies of water, which acidifies the water and generates toxic byproducts that affect other organisms.

To read various expert (mostly ecologists) thoughts and opinions on invasive species, visit the following “Global Roundtable” discussion on “The Nature of Cities” website.⁶

While the EFS has not been officially designated an invasive species in the state of California, it is listed on the Invasive Species Council of California’s (ISCC) website as one of 1700 species that threaten the state. This list is designed to support outreach and strategic planning, but is not regulatory.⁷ Since the early 2000s, a team of biologists at California State University, Los Angeles has dedicated itself to understanding the introduction, dispersal, and impacts of the EFS on the greater Los Angeles area.⁸ Through survey techniques, empirical observations, mapping, specimen analysis, and DNA haplotype analysis, they have learned that while the introduction of the EFS was intentional, its spread eastward has been facilitated by both intentional and unintentional human action, including dispersal along structures like power lines, the trapping and relocation of unwanted EFS, and the release of rehabilitated squirrels dropped off at wildlife rehabilitation facilities (Claytor, Muchilinski, & Torres, 2013; King, Chung Sue, & Muchilinski, 2010).

While evidence collected using the ecologist’s tools of visual survey analysis suggests that the EFS is replacing the native western gray squirrel (WGS, *Sciurus griseus*) in many locations, including the California State Polytechnic University, Pomona campus, scientists emphasize that there is not enough data to designate this “tree squirrel species swapping” as competitive exclusion (Muchilinski, Stewart, King, & Lewis, 2009). This means that biologists cannot yet be sure if the WGS population decline is in some ways caused by the EFS or if the EFS is simply filling in habitat and niche space

⁴ Global Invasive Species Database: <http://www.issg.org/database/welcome/> and 100 of the World’s Worst Invasive Alien Species: <http://www.issg.org/database/species/search.asp?st=100ss&fr=1&str=&lang=EN>

⁵ http://resources.ca.gov/docs/quagga/080519_Quagga-Zebra_Mussel_Fact_Sheet.pdf and <https://www.wildlife.ca.gov/Conservation/Invasives/Quagga-Mussels/Incident-Description>

⁶ <http://www.thenatureofcities.com/2014/07/07/how-much-should-we-worry-about-exotic-species-in-urban-zones-how-do-we-reduce-damage-from-exotic-invasives-when-management-resources-are-limited-are-there-conflicts-between-management-or-eradication/>

⁷ <http://ice.ucdavis.edu/invasives/>

⁸ See the “Southern California Western Gray Squirrel Research Project” at <http://instructional1.calstatela.edu/amuchli/squirrelform2.htm> and “The Southern California Fox Squirrel Research Project” at <http://instructional1.calstatela.edu/amuchli/squirrelform.htm>.

vacated by the WGS for a variety of other reasons (Cooper & Muchilinski, 2015). Research has demonstrated, for example, that in small to medium size habitat patches, WGS had a high probability of going extinct within 10-40 years. The presence of the EFS made extinction happen more quickly, suggesting that EFS might play a role in WGS declines, but that habitat patch size and quality matter, too (. And finally, other scientific studies focusing specifically on California's EFS have examined how to use immunocontraception as a means to control EFS populations (Krause, Kelt, Van Vuren, & Gionfriddo, 2014) and have considered the role EFS resource collection behavior (i.e. how EFS feed, often directly from humans) in the spread of disease (Fong, 2013).

Environmental Social Sciences & Humanities

Although researchers and scholars in the environmental social sciences and humanities have written extensively about invasive species in urban spaces, and more specifically about a variety of invasive squirrel case studies, they have yet to examine the case of the EFS in the greater Los Angeles area, or anywhere in the western United States, for that matter. (See below for a discussion of Perry (2004) on the nonnative American eastern gray squirrel (*Sciurus carolinensis*) in Northern Italy and Coates (2015) on the nonnative American eastern gray squirrel (*Sciurus carolinensis*) in the United Kingdom (UK). In both places, native red squirrel populations (*Sciurus vulgaris*) have substantially declined). Due to the lack of published research in the social sciences and humanities on the case of the EFS in California, we will draw from similar cases and more generally from theories in these disciplines.

As Fortwangler (2013) highlights, social scientists examine how people think about invasive species in social and cultural terms, how they categorize and cognize introduced animals, and how strictly scientific views of invasive species can compromise traditional or local resource use. Further, research in the social sciences and humanities has explored people's perspectives and attitudes toward introduced animals, including whether or not they belong in certain spaces and how to eradicate them, if perceived necessary. And finally, these perspectives also explore ethical and moral obligations to animals, the sociocultural dimensions regarding how non-native and introduced species become part of urban [eco]systems (Palmer, 2003; Wolch, West, & Gaines, 1995), and, like some ecologists/conservation biologists, challenge the notion that biodiversity is a static concept. Holm (2012, 2015), in particular, problematizes popular disdain for urban animals like squirrels and possums, examining how they are posed as "anti-nature" and invasive, even in cases where scientific evidence does not support the label of "invasive," as it is legally defined. Holm (2012, 2015) and Thomson (2007) also point to how urban spaces can be sites of ecological flourishing for native and nonnative organisms if we re-think what it means to have nature in the city. Below are summaries of several exemplars of this kind of research.

Sociologist, Clark (2015), shows how an eradication team of various ecologists and biologists removed and killed thousands of different animals arriving on a dislodged dock at the Oregon Coast after Japan's tsunami. The dock, which originated in Japan, harbored over 100 different species, including two on the "100 of the World's Worst Invasive Alien Species" list: the wakame (*Undaria pinnatifida*) and the Northern Pacific sea star (*Asterias amurensis*). Clark demonstrates how an eradication team was established to remove the organisms in order to prevent the spread of possible invaders. After extensive interviews with the team's members, he finds that they did not consider animal welfare or ethics as they performed the removal and ultimately killing, but were instead driven by a desire to halt the spread of possible invasive species that might hybridize with native species and rapidly spread disease. That is, the scientists viewed the organisms from the perspective of invasion ecology—the organisms on the dock represented a potential threat to native ecosystems

and needed to be eliminated. An environmental ethics perspective, as Clark (2015) highlights, would also have considered the lives of the individual animals, including how they might be more humanely removed or even killed. Although these animals were not deliberately introduced to the Oregon Coast like the EFS to southern California, this research raises important questions about invasive species management.

There are two published studies examining squirrel invasions from a sociocultural and philosophical perspective; both also consider the role of scientific evidence. The eastern gray squirrel (EGS) was first introduced to Europe beginning in the mid to late nineteenth century, with subsequent introductions occurring until the late twentieth century. Italy is the only country in continental Europe where EGS reside; the other populations occur in the UK. Philosopher Perry's (2004) study of the EGS in Italy shows how conservation biologists wanted to eradicate the EGS, as it was perceived to be a threat to the native red squirrel through displacement, while animal rights groups were vehemently opposed to any action. Ultimately, animal rights' group halted trapping and euthanasia of the EGS through mobilizing public support and winning court battles. This case demonstrates the complex ways in which the interests of conservation biologists sometimes conflict with the interests of animal welfarists. Perry (2004) also highlights the importance of the role of economic matters in invasive species management. Although conservation biologists promoted plans to sterilize and relocate, rather than euthanize the EGS, animal welfarists charged that this would be too costly and instead insisted on scrapping any EGS population management. In historian Coates' (2015) study of the EGS in the UK, he demonstrates how: (1) scientific evidence does not actually support the assertion that EGS populations are displacing the native red squirrel in the UK; (2) efforts to control the EGS in the UK occurred for both economic and ecological reasons, and (3) popular scorn for the EGS is culturally tied to anti-American sentiments, more generally. Coates' (2015) research raises important concerns Fortwangler (2013) and Raffles (2011) echo regarding the ways in which nonnative and/or invasive animals are sometimes xenophobically constructed as outsiders in a fashion similar to human migrants/immigrants.⁹

⁹ See Raffles (2011) article here: http://www.nytimes.com/2011/04/03/opinion/03Raffles.html?_r=0 and a response by Bennett (2011) here: <http://www.nytimes.com/2011/04/10/opinion/10species.html>.

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