Climate Change is Common for Island and Invading Fauna

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Abstract

The global distribution of wildlife is changing due to climate change. The co-occurrence patterns and interspecific interactions of native and invasive wildlife are expected to vary as a result of these distributional changes and the environmental and vegetative changes that prompted them. We worked on Sanibel Island, a low-lying barrier island in southwest Florida, the United States, that serves as a microcosm of planetary change. To the north, mangrove trees surrounded a freshwater interior on Sanibel Island. Sanibel was 50% built, 50% preserved, hydrologically degraded, encroached by shrubs, and vulnerable to flooding from sea level rise. We looked into how the co-occurrence patterns of two native island-endemic species Sanibel Island rice rat (*Oryzomys palustris sanibeli*) and insular hispid cotton rat *Sigmodon hispidus*) might change as a result of climate change using a Bayesian multispecies occupancy modelling approach.

Keywords: Climate change • Wildlife • Biodiversity • Hydroelectric dam • Glaciers

Introduction

one invasive exotic species (black rat *Rattus rattus*). We discovered that co-occurrence between cotton rats and black rats is probably going to rise, with unknown effects on interspecific relationships. Additionally, we discovered that rice rats are not threatened by climate change as long as mangrove forests are present on Sanibel Island, but cotton rats and black rats are. In general, our research shows how crucial it is to look into how co-occurrence and climate change interact when analysing current and projected wildlife distributions. In the Anthropocene, a time of fast world change brought on by humans, natural animal communities confront a variety of dangers. These modifications will probably result in a significant redistribution of species, drastically changing the make-up of many native groups. Particularly, the introduction and spread of invasive species and a fast changing environment are expected to cause changes in wildlife communities.

Wildlife species have been compelled by the planet's rising temperature to follow or relocate with acceptable climatic conditions and vegetative ecosystems. Modified rainfall patterns and a rise in extreme weather (such as drought and floods) are additional effects of climate change that wildlife must deal. Finally, the complex and poorly understood changed vegetative communities have been connected to atmospheric carbon, the primary driver of climate change. Traditional niches for species are expected to become rare or unavailable as a result of the redistribution of species brought on by climate change, leading to competition for scarce niche space, niche changes, or extirpation. The predicted rises in invasive species' prevalence and effectiveness brought on by the changing climate make this problem worse. More than native species, invasive species have a tendency to be habitat generalists, which may help them better adapt to changing environmental conditions and compete for new niches [14]. As already inhabited niches are diminished or eliminated, interspecific interactions (such as competition) between invasive and native species may increase. While there has been a lot of research on the impact of invasive species and climate change on the distribution of wildlife and interactions among species seldom have these topics been combined. Our objective was to gain a better understanding of how native and invasive species coexist and interact as a result of climatically caused changes. Dispersal-restricted species native to low-lying islands are particularly concerned about the consequences of climate change and invading species. Low-lying island people may not be able to monitor changes in their climate envelope or the vegetative ecosystems they live in, in contrast to populations on the mainland. Invasive species, which are a major factor in the extinction and population decline of island endemic species, are another threat that makes islands particularly vulnerable. In order to achieve this, we looked at the presence of invasive black rats (*Rattus rattus*) and 2 endemic rodent species on Sanibel Island: the Sanibel Island rice rat.

The insulicola hispid cotton rat (*Sigmodon hispidus insulicola*, henceforth "cotton rat"). We hypothesised that the distribution of cotton rats, which are not acclimated to aquatic habitats, will change due to flooding brought on by sea-level rise and intense rain events, which are anticipated to increase with climate change. Due to reduced groundcover (cotton rats) and food availability, we expected that shrub encroachment, which is connected to altered hydrology and increased atmospheric carbon, will have a negative impact on all 3 species (all 3 species). Similarly, we hypothesised that Southwest Florida's anibel Island is a 4,900 ha low-lying barrier island produced by sediment accretion, with linear dune systems that range in height from 0 m to 3 m above sea level. Its coordinates are 26.436394, -82.105589. The interior of the island's lower elevation is surrounded by natural sand dune ridges that create freshwater wetlands. The freshwater wetlands on Sanibel Island are protected from subsurface saltwater intrusion from the Gulf of Mexico and salty aquifers by osmotic pressure brought on by seasonal rains and a thin clay layer that lies beneath the island, respectively. In the summer and fall, when Sanibel receives 85% of its annual precipitation, these wetlands flood, and during the winter and spring dry season, the water levels drop. Therefore, Sanibel's conservation lands, which account for about 50% of its land area, are primarily restricted to the island's freshwater interior and bayside.decreasing groundcover brought on by higher mangrove density would harm cotton rats. Last but not least, we predicted that interactions between all species will be more frequent when conditions are least reminiscent of earlier times. In Sanibel's freshwater marshes, woody plants, especially buttonwood (*Conocarpus erectus*), are now prevalent where sand cordgrass (*Spartina bakeri)* had predominated. Upland areas are mostly developed for residential, commercial, and infrastructure purposes.

Sanibel Island and its fauna are susceptible to the effects of climate change because it is a low-lying barrier island. Increased flooding is anticipated in this region as a result of forecasted increases in frequency and intensity of heavy rainfall events. Because of the higher underlying water table caused by sea level rise, which limits or prevents precipitation entry into the soil and increases flood potential, coastal habitats are particularly sensitive to floods. As the water table rises above that of low-lying places, their vulnerability to surface flooding increases. Sea-level rise alone, without altered rainfall patterns, can do this. Woody species

especially buttonwood (*Conocarpus erectus*), are now prevalent in Sanibel's freshwater marshes where sand cordgrass (*Spartina bakeri*) had predominated. residential, business, and. Through flooding and indirect effects on the composition and structure of vegetative species, such modifications to hydrologic patterns have an impact on the distribution of wildlife. The interior marshes of Sanibel Island were grass-dominated, periodically submerged, and vulnerable to saltwater intrusion during storms and high tides during the dry season when seawater may enter through the wetland's natural outfall. The encroachment of shrubs, which is facilitated by shortened hydroperiods, dewatering projects and the plugging of the wetland's natural outfall, changes in salinity, the suppression of wildfires, and elevated atmospheric CO_2 concentrations have changed the composition and structure of grassy systems, such as the freshwater interior marshes of Sanibel Island. The freshwater inner marshes of Sanibel Island, however, are not likely to support this unique vegetative community for very long. Within the next century, sea level rise is anticipated to inundate Sanibel Island's freshwater interior wetlands, enabling the shift to mangrove forests, as has already been seen elsewhere in south Florida.

On Sanibel Island, rice rats, black rats, and cotton rats coexist. The distinct ecological differences between rice rats and cotton rats reduce niche overlap, enabling sympatric dispersion across much of the southeastern United States. Cotton rats are herbivorous but rice rats are omnivorous which may reduce competition for food supplies. However, due to the seasonal diet flexibility of both species and resource availability, there may be seasonal dietary overlap and resource-related competition. Although it has been hypothesised that cotton rats and rice rats avoid each other in specific areas , species-specific habitat preferences most likely explain this trend. Although rice rats and cotton rats normally inhabit wetter and drier regions, there is significant spatial overlap between the two.

Black rats are widespread invaders that most likely originated in modern-day India but have since spread to all continents except Antarctica and many islands. Black rats have decimated and competed with native species as an invasive species, causing population declines, extinctions, and subsequent trophic cascades. Although they have coexisted since at least 1984, interspecific interactions between black rats and the native animals of Sanibel Island have not been studied. Additionally, because to significant nutritional and geographic overlap, black rat and rice rat competition in the Florida Keys (200 km from Sanibel) has been hypothesized and recently investigated. As sea level rise promotes mangrove invasion, mangrove density is anticipated to rise into Sanibel Island's interior, as has already been seen throughout south Florida's coastal wetlands. During the first field season (summer 2015), we counted the number of mangrove stems within a 4 m^2 quadrat at a spatially standardised subset of 9 of the 25 trap points per site (these 9 places are referred to as "environmental sampling points" from On buttonwood and sand cordgrass sites (n = 36), we repeated mangrove stem counts every year because these sites were potentially vulnerable to mangrove invasion and because managed fire and mechanical shrub removal altered the vegetation composition. Stem counts on mangrove sites (n = 18) were not repeated annually since these regions were They remained steady over the course of the study and were not vulnerable to fire or mechanical shrub removal. We did not distinguish between red (*Rhizophora mangle*), white (*Laguncularia racemosa*), or black (*Avicennia germinans*) mangroves. To calculate the mangrove density for each site, we averaged the nine stem counts. Wildlife species have been compelled by the planet's rising temperature to follow or relocate with acceptable climatic conditions and vegetative ecosystems. Modified rainfall patterns and a rise in extreme weather (such as drought and floods) are additional effects of climate change that wildlife must deal with.

Last but not least, the primary cause of climate change, atmospheric carbon, has been linked to altered vegetative communities, which have complicated and poorly understood effects on local wildlife. Traditional niches for species are expected to become rare or unavailable as a result of the redistribution of species brought on by climate change, leading to competition for scarce niche space, niche changes or extirpation. The predicted rises in invasive species' prevalence and effectiveness brought on by the changing climate make this problem worse. More than native species, invasive species have a tendency to be habitat generalists, which may help them better adapt to changing environmental conditions and compete for new niches. As already inhabited niches are diminished or eliminated, interspecific interactions (such as competition) between invasive and native species may increase. While there has been a lot of research on the impact of invasive species and climate change on the distribution of wildlife and interactions among species seldom have these topics been combined. Our objective was to gain a better understanding of how native and invasive species coexist and interact as a result of climatically caused changes. Dispersal-restricted species native to low-lying islands are particularly concerned about the consequences of climate change and invading species. Low-lying island people may not be able to monitor changes in their climate envelope or the vegetative ecosystems they live in, in contrast to populations on the mainland. Islands are particularly susceptible to invasive species, which are a major factor in the extinction and decline of island endemic species.

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