



Northern Illinois  
University

## 2018-19 RESEARCH ROOKIES PROPOSAL

FOR PART OR ALL OF THE PERIOD August 2018 – April 2019

**Topic:** Ecological impacts of invasive mice on invertebrates on Midway Atoll

### I. Abstract

In this project, the effects of invasive house mice (*Mus musculus*) on island invertebrates will be studied by analyzing samples of invertebrates collected from islands of Midway Atoll National Wildlife Refuge (NWR). Mice are present on one Island, Sand Island, but absent on another, Eastern Island, providing a unique opportunity to examine the differences between invertebrate abundance and community composition. The effects of invasive mice on invertebrates have not been studied in great detail; however, it is known that mice can have irreversible and devastating effects on island ecosystems. Eradication of an established invasive species can greatly affect the other populations of the ecosystem. Therefore, it is important to study the possible outcomes and effects the eradication may cause to prevent any further environmental damage and guide management and on-going restoration efforts post-eradication.

### II. Project Description

#### a. Background & Context

Midway Atoll NWR is a collection of islands in the Northwestern Hawaiian Islands in the Northern Pacific Ocean. Midway was occupied by the U.S. Navy until the mid 1990s, when the U.S. Fish & Wildlife Service (USFWS) obtained administration rights (Nishida & Beardsley, 2002). The U.S. Navy developed a naval



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base on Midway during World War II due to its strategic location (Nishida & Beardsley, 2002). In shipping materials and transporting supplies, they inadvertently introduced many exotic species of plants, mammals, and invertebrates (Nishida & Beardsley, 2002). Eighty-three percent of the invertebrates found on Midway today are *adventive*, or accidentally introduced (Nishida & Beardsley, 2002).

*Mus musculus*, the house mouse, was one of the species accidentally introduced to Midway. Compared to rats, mice and their effects on island ecosystems have not typically been emphasized in conservation research (Angel, Wanless, & Cooper, 2007). On the last invertebrate survey of Midway (1997-1999), known native invertebrate species were detected at very low rates or were entirely absent (Nishida & Beardsley, 2002). Low recollection of native invertebrates suggests local suppression or extinction and may be correlated with the introduction and effects of *Mus musculus* (Nishida & Beardsley, 2002).

Though mice are assumed to be less harmful to ecosystems than rats, they can behave similarly to rats in ecosystems where they are the only introduced mammal, such as on Midway (Angel, Wanless, & Cooper, 2007). Within the past few years, mice on Midway have begun to attack and depredate nesting albatross, which therefore poses a threat to this seabird colony. Consequently, to protect the millions of seabirds that nest on Midway, USFWS will eradicate mice in the summer of 2019.



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Currently mice are found on Sand Island, but they are absent from Eastern Island. This makes for a unique research project, since these two islands serve as natural control and experimental units.



*Figure 1.* Close-up of the three islands composing Midway Atoll. Mice are present on Sand Island (left) and absent from Spit Island (center) and Eastern Island (right). For this study, we will compare invertebrate communities between Sand and Eastern Islands only.

### **b. Statement of Project Objectives**

The main goal of this project is to predict which invertebrate communities will likely be affected—and how they will be affected—before and after the eradication of *Mus musculus* on Midway Atoll. Additionally, this project is an opportunity to gather current data on ground-dwelling invertebrate populations on Midway, since the most recent invertebrate survey occurred more than 20 years ago (Nishida & Beardsley, 2002).



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### c. Methods

First, samples of invertebrate species from Midway were obtained using pitfall traps. A total of 63 pitfall traps (47 on Sand island, 16 on Eastern island) are sampled across seven major habitat types, and the samples are collected every six weeks. The invertebrates from each sample will then be sorted to order and counted. Invertebrate community composition and abundance will be compared between the two islands, Sand Island and Eastern Island, to understand the impacts of mice and account for temporal differences in invertebrate communities, as well as the different habitat types.



*Figure 2.* Pitfall trap sampling locations among Sand and Eastern Islands of Midway Atoll NWR.

### d. Outcomes

As a result of this project, a greater understanding of the effects of invasive mice on island invertebrates will be achieved. Moreover, in understanding the differences



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between the invertebrate communities on Sand island and Eastern island, changes in community composition and trophic shifts following the mouse eradication in 2019 may be hypothesized. The project results will be presented at Northern Illinois University's Undergraduate Research and Artistry Day and published in a relevant scientific journal.

### **e. Statement of Significance and Impact**

The effects of invasive mice on invertebrate species have not been studied in great detail, although they have been hypothesized (St. Clair, 2010). Because mice consume invertebrates along with their natural habitats and food sources, invertebrates are greatly affected by mice, directly and indirectly. Invertebrates are important for many ecosystem functions and play important roles such as pollinators, prey, primary consumers, detritivores, and predators (St. Clair, 2010). Introduced predators like house mice on Midway can impact invertebrate populations through predation. Changes in functional levels of invertebrates can have broader ecological impacts. Thus, this study will contribute to the greater understanding of the impacts of invasive rodents on island invertebrates and provide insight for effective conservation management of island ecosystems. Conservation of island ecosystems, including Midway Atoll NWR, should be greatly emphasized in conservation and restoration work, as islands are home to much of the world's biodiversity.



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### III. Literature Cited

Angel, A., Wanless, R., & Cooper, J. (2007). Review of impacts of introduced house mouse on islands in the Southern Ocean: are mice equivalent to rats? *Biol Invasions*, *11*, 1743-1754.

Nishida, G. & Beardsley, J. (2002). A review of the insects and related arthropods of Midway Atoll. *Bishop Museum Occasional Papers*, *68*, 25-69.

St. Clair, J. (2010). The impacts of invasive rodents on island invertebrates. *Biological Conservation*, *144*, 68-81.

St. Clair, J., Poncet, S., Sheehan, D., Szekely, T., & Hilton, G. (2011). Responses of an island endemic invertebrate to rodent invasion and eradication. *Animal Conservation*, *14*, 66-73.

### IV. Impact on Academic Experience

In participating in this research project, I am making myself a more competitive applicant for graduate school. Relevant research experience is an essential component for graduate school programs. This project also has potential for publication, which will further benefit my academic experience. Additionally, in this project, I am learning about the process of conservation ecology, which is a topic I will study in my future courses. Finally, this project has inspired me to direct my future studies in biology to ecology.



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**V. Timeline of Project Objectives**

<b>September 15-30</b>	Finding a mentor, signing the contract, plan meetings, read scientific articles related to the project
<b>October 1-15</b>	Begin lab work, work on Midway invertebrate guide, begin work on proposal
<b>October 15-31</b>	Sample sorting, work on rough draft proposal
<b>November 1-15</b>	Sample sorting, work on final draft of proposal
<b>November 15-30</b>	Sample sorting, working on the Midway invertebrate guide, finish final draft of proposal
<b>December 1-15</b>	Sample sorting
<b>January 15-31</b>	Sample sorting, data analysis
<b>February 1-14</b>	Sample sorting, data analysis, begin poster work for URAD
<b>February 15-28</b>	Data analysis, sample sorting, work on poster for URAD
<b>March 1-15</b>	Data analysis, sample sorting, work on poster for URAD
<b>March 15-31</b>	Work on poster for URAD, sample sorting
<b>April 1-15</b>	Work on poster for URAD, sample sorting
<b>April 15-30</b>	Present at URAD, sample sorting (ongoing), begin developing manuscript for publication