***Section 4b(1). Permit Scope, Goals, and Objectives***

In this study, I aim to use mosquito sampling efforts to investigate the underlying mechanisms that drive mosquito abundance and distribution in the Eastern Sierra Nevada Mountains. I will sample lakes in the Sierra Nevada previously sampled by *Epanchin et al. 2010* and *Knapp et al. 2001*. Some of these lakes were historically stocked with non-native trout species, whereas others were never stocked and remained in their natural state. Additionally, to the lakes sampled by Knapp and Epanchin, I will sample lakes in Yosemite National Park that were initially stocked but within the past decade, have been cleared of fish populations, returning them to their original fish-less state. Building on this body of work by Epanchin and Knapp in these lake systems allow me to determine whether there is a correlation between mosquito population fluctuations and human-induced changes, i.e., introduced species.

Specifically, my **objectives** are to **1)** determine what mosquitoes around lakes in the Eastern Sierra Nevada Mountains feed on, **2)** how this varies by fish status, and **3)** determine what host variables explain mosquito activity at lakes 20 lakes within Inyo National Forest and Yosemite National Park.

**Question 1:** What do mosquitos in the Eastern Sierras eat?

**Hypotheses:** Mosquitos may be useful in this region for surveying the relative abundance of various host taxa (recognizing that the presence and abundance of vertebrate hosts diminishes along with increasing elevation). Potentially important wildlife hosts in the Eastern Sierra include mule deer (*Odocoileus hemionus*), yellow-bellied marmot (*Marmota flaviventris*), coyote (*Canis latrans*), pika (Ochotona spp.), various mouse species (Peromyscus spp.), and various bird species (Passeri spp.). I expect these species will be hosts for mosquitos.

**Question 2:** Does fish presence in lakes affect mosquito abundance and activity?

**Hypotheses:** Prior research and our preliminary data suggest fish may impact mosquito populations, increasing their presence around lakes with fish. Therefore, I expect that fish presence will be a significant indicator of mosquito intensity.

**Question 3:** What host community variables drive mosquito abundance and activity?

**Hypotheses:** Host density and host type (particularly humans) will also significantly influence mosquito activity and abundance. I anticipate that the lakes with higher levels of host activity have greater levels of mosquito abundance.

***Section 4b(2). Permit Need or Benefit***

One group of insects that are rarely considered in discussing human-induced impacts to ecosystems, but which may be particularly responsive to this sort of disturbance are vector insects (insects requiring a host blood meal for life cycle continuation). These insects rely on host availability (typically vertebrates) and ambient environmental conditions. As such, changes in their populations or distributions – either expansions or contractions – may offer insight both into abiotic (environmental) and biotic (vertebrate hosts) changes to an ecosystem.

One example of a vector insect are mosquitos. Mosquito population surveillance could give insight into the complexities of human disturbance in ecological communities. First, through their reliance on bloodmeals, analysis of mosquito blood content could provide rapid survey methods of host diversity, cryptic species, or the impacts of human populations as a host in a landscape (Hoyer et al. 2017; Rose et al. 2020). Secondly, the timing of mosquito emergence and the abundance and composition of this taxa could provide insight into complex changes in climate patterns over both space and time (Boser et al. 2021). Finally, the abundance and composition of this taxa may also be responsive to changes within communities (e.g., introduced species) (Reeves et al. 2018). Moreover, in addition to their role as surveillance tools, changes in the abundance and composition of these taxa will likely have important ecosystem consequences of their own: changes in their abundance or population could ultimately have impacts on disease dynamics (especially with climate change), and in the short term may have trophic consequences for regional small predators (frogs, birds, other insects) as well as effects on cross-ecosystem subsidies.

The Sierra Nevada is an excellent place to consider the role of mosquitos as sentinels of human change. While this region benefits from extremely high levels of protection, it is nonetheless experiencing important forms of disturbance (e.g., introduced species, novel diseases, climate change, and high levels of human recreation) (Briggs et al. 2010; Knapp & Matthews 2000; Winter et al. 2021). As many sites are remote, difficult to access, and protected by wilderness designation, monitoring downstream community changes from these impacts is difficult, especially using traditional time-intensive surveys. This alpine-to-subalpine system hosts some 30,000+ lakes, most of which provide excellent habitats for mosquito production.

I expect mosquito surveillance to offer a relatively simple, cost-effective ecosystem monitoring solution. This solution could be advantageous to the managers of heavily protected landscapes like the National Park Service, National Forest Rangers, and Conservancy or Easement Managers. Particularly for managers of remote landscapes, mosquito surveillance does not require significant infrastructure, or the constant human presence typically needed for monitoring studies. I anticipate an impact of our research will be the improvement in our ability to monitor these remote areas. This will, in turn, give us better insight into how, despite their remoteness or levels of conservation protection, these landscapes are faring in the era of globally induced human change.

***Section 4b(3). Study or Planned Undertaking Timeframe***

Field sampling will start in mid-June, approximately 15-20 days after the lake ice-off; this was an indicator in prior work to the beginning of mosquito activity (Owens et al. *unpublished data*). Two field teams covering twenty lake sites will sample each location three times during the field season. While not backpacking, the field team will be based at the University of California’s Natural Reserve System facility, SNARL (Sierra Nevada Aquatic Research Laboratory). The field season will end in mid to late August when mosquito activity is expected to decline to minimal levels. In the fall, blood samples from gravid mosquitos collected in the summer will be genetically analyzed via Next Generation Sequences (NGS). Sequences from this analysis can be compared to a genetic database to determine the host's genus or species. Non-blood-fed mosquito samples will be identified to genera by examining the specimens under a light microscope. During the winter, initial data analysis and visualization will be completed and presented at conferences by the field team during the spring.

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