Tick Survival Assay - Invaded vs. Uninvaded

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# Invasive Plants and Ticks

*Background from proposal*

Recent studies demonstrate that invasive plants can alter TBD risk via both direct effects on tick survival and indirect effects mediated by tick hosts. For example, *Microstegium vimineum* has been shown experimentally to reduce survival of *A. americanum* and *Dermacentor variabilis* (American dog tick) relative to native vegetation (Civitello, Flory, and Clay 2008); conversely the removal of invasive *Berberis thunbergii* (Japanese barberry) significantly reduces the survival of *I. scapularis* (Williams and Ward 2010). Thus both positive and negative direct effects of invasive plants on tick survival have the potential to influence tick population dynamics. There is also growing evidence of indirect effects mediated by host responses to plant invasions, including increased infestation of *Peromyscus leucopus* (white-footed mice) by *I. scapularis* in mixed stands of invasive shrubs (Elias et al. 2006; Williams et al. 2009) and increased abundance of *A. americanum* due to attraction of WTD to dense thickets of *Lonicera maackii* (Amur honeysuckle) (Allan et al. 2010).

**No ecological studies have addressed the effects of plant invasions and potential interactions with climate change or fire regimes for TBD risk.**

We will perform one survival assay during 2018 to assess mortality of ticks due direct destruction by fire and its interactions with plant invasions (described below).

We will perform a second assay during 2019 to determine the effects of fire, and interactions with plant invasions, on microclimate suitability for tick survival.

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# Experimental Design - Plant invasion & microclimate suitability (2018)

For this assay we will deploy **1** mesh bag containing **10 nymph** and **10 adult** life stage *A. americanum* ticks in **12** invaded and **12** uninvaded plots (1 m x 1 m) in a pine dominated forest habitat. ~~We aim to identify forests with invaded and uninvaded habitat that were last burned during the past 12-24 months.~~

Each mesh bag will be partially buried under the existing litter and protected from wildlife predation by a cage made of hardware cloth. Bags were examined weekly to determine the number of nymphs and adults surviving until all ticks succumbed to desiccation.

We will collect microclimate data by placing a temperature/relative humidity logger adjacent to each mesh bag. Each logger was housed in a capped 18-inch length of 1.5 inch diameter PVC pipe to protect it from rainfall and direct sunlight. Holes were drilled around the bottom six inches of the pipe to allow greater airflow and better reflect ambient temperature and relative humidity. The temperature/RH logger and tick cage were secured in place by wiring them to a piece of rebar sunk Xinches into the ground.

In each plot area, we collected data on understory vegetation composition (species, functional groups), stem density, and cover of vegetation, litter, and bare ground. We also measured litter depth, vegetation height, and quantified the overstory canopy cover.

Survival results were analyzed using Cox proportional hazards regression models.

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# Experimental Design - Interaction of plant invasion and fire (2018)

To examine the combined effects of invasions and fire intensity on tick mortality, **2** non-flammable enclosures each containing **5** adult life stage *A. americanum* ticks were placed on the mineral soil layer in experimental plots (4m x 4m) with invasive cogongrass (n = 10) or native vegetation control plots (n = 10) that were exposed to fire. We quantified fire temperatures at the ground level near each tick enclosure using thermocouples. We quantified tick survival after experimental fires to determine the combined effects of invasions and fires on tick mortality.

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## Results

The experimental burns all covered at least 75% of the plot area with most plots having >90% area burned. The invasive dominated plots all had >95% area burned. Overall tick mortality was ~98%, with 100% mortality in invaded plots and 95% mortality in native plots. One bag of ticks was untouched by fire (95% mortality) in a plot with native vegetation and no pine tree cover contributing dried needles to the fine fuel load.

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# Experimental Design - Effects of interaction of plant invasion and fire on microclimate suitability (2019)

Similar to 2018 design but will explicitly address the time since fire (will expand on this in the future).

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# Materials

* 1mm gap size nylon mesh bags, 1 per plot (24 total)
* Binder clips for each bag, 72
* Temperature/RH loggers, 1 per plot (24 available)
* PVC housings as solar shield for loggers/probes
* Rebar to suspend PVC housing allowing probe to “float”
* Flags to mark plots and mesh bag locations

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# References

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