The impacts of rodent's spatiotemporal activity patterns on survival rates

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1 Keywords

Rodents, behavioural adaptations, survival, predation risk, microhabitats, movement

2 Introduction

Behavioural strategies exist amongst a wide range of taxa and are the results from adaptations to environmental fluctuations [5]. They significantly affect survival rates, which is one of the most crucial components for studying population biology and the understanding of population dynamics [6]. Throughout an individual's lifetime, it will have disparate spatial and temporal movement patterns depending on the resource availability, intensity of competition and predation risks. Recognizing these movement patterns will help explain and predict dissimilar survival rates between conspecifics and species with similar niches [7].

Our study incluudes 3 woodland rodent species: the wood mouse (*Apodemus sylvaticus*), the yellow-necked mouse (*Apodemus flavicollis*) and the bank vole (*Myodes glareolus*). Rodents are commonly known to have negative impacts on human societies as they are agricultural pests and are vectors of diseases for both humans and other domestic species. Similarly, they play important roles in the regulation of other ecosystem processes, such as influencing forest regeneration through seed-dispersal or through transferring energy from primary producers to higher food trophic levels, as they are stable food source for many aerial and terrestrial predators [3]. Moreover, these small mammals are known as income breeders, with typical life history traits of shorter life spans, larger litter sizes and reaching maturation early [1]. These traits make them especially suitable models organism to explore questions on the drivers of survival in the wild, as their short life span allows complete life trajectories to be traced during the 10-11 months. Likewise, their high densities in the study site will allow sufficient data to construct reliable models to derive robust survival rate estimates, and driver effects. (Aurelio Malo, communication).

Here, we will be investigating the effects of individual-level variation in activity patterns (both spatial and temporal) on the survival rates of three different species. Our main focus will be on the rodent's behaviours in minimizing predation risks and competition in Nash's Corpse. The quality of space use will be determined by the presence of *Rhododeendrum ponticum*, it is an invasive plant which provides a refuge from tawny owls (their primary predator), thus has a positive effect on rodent survival [3]. While rodents exhibit predator avoidance behaviours and are active during times when predators are less active [2], rodent's temporal activity patterns are also affected by abiotic factors, therefore, we will be recording their activity periods along with the moonlight illumination proportion (Quantified as percentage of total illumination). Previous studies have displayed moonlight to alter rodent foraging activities as brighter nights escalate predatory success [4]. Furthermore, we will be investigating behaviours under the interactions of spatial (microhabitat usage) and temporal variations with environmental factors in an attempt to elucidate their interacting effects on survival rates. We **hypothesize** that individuals with the highest spatiotemporal activity in *Rhododendrum* and beneath low moonlight illumination will have the highest survival rates. We also **hypothesize** that individuals in *Rhododendrum* will be more active under high moonlight illumination than individuals in open woodlands due to the dense protective cover shielding from predators. Finally, we will also assign a thermal stress value and a food abundance value to each spatio-temporal location a given rodent is exposed to, in attempt to understand the relative effects on survival of different axes of survival.

3 Proposed methods

We will be conducting trapping seesions weekly to capture individuals. The study site will be divided into 243 $100m^2$ quadrats and Sherman traps will be placed in randomly chosen quadrats. A trap will be used to maximise the number of captured individuals within the area and will be PIT-tagged and released afterwards. Subsequently, peanut oil rubbed data loggers with a single peanut inside will be placed in randomly chosen quadrats, individuals who enter these data loggers will have their unique PIT-tag identified along with their entry time and the ambient temperatures recorded. A data logger will not be placed consecutively on the same quadrat to avoid behavioural bias.

Both, the trapping and the data logger data sets will be used to construct individual capture-recapture files (a matrix with one individual per row, and one column per time interval, filled in with zeros and ones, in which captures or detection of individuals for a particular time interval (day) are reflected with a “1” and absences are recorded as “0”). Survival rates will be calculated using E-Surge, Program MARK and RMark.

4 Anticipated outputs and outcomes

Outputs: Datasets of activity patterns of all captured individuals, featuring where they were active, time of activity, moonlight illumination intensity, temperature and precipitation. We will be using R in assessing any statistical significance in the effects of space use, temporal use and space use X temporal use on individual behaviours and survival rates.

5 Project feasibility and timeline

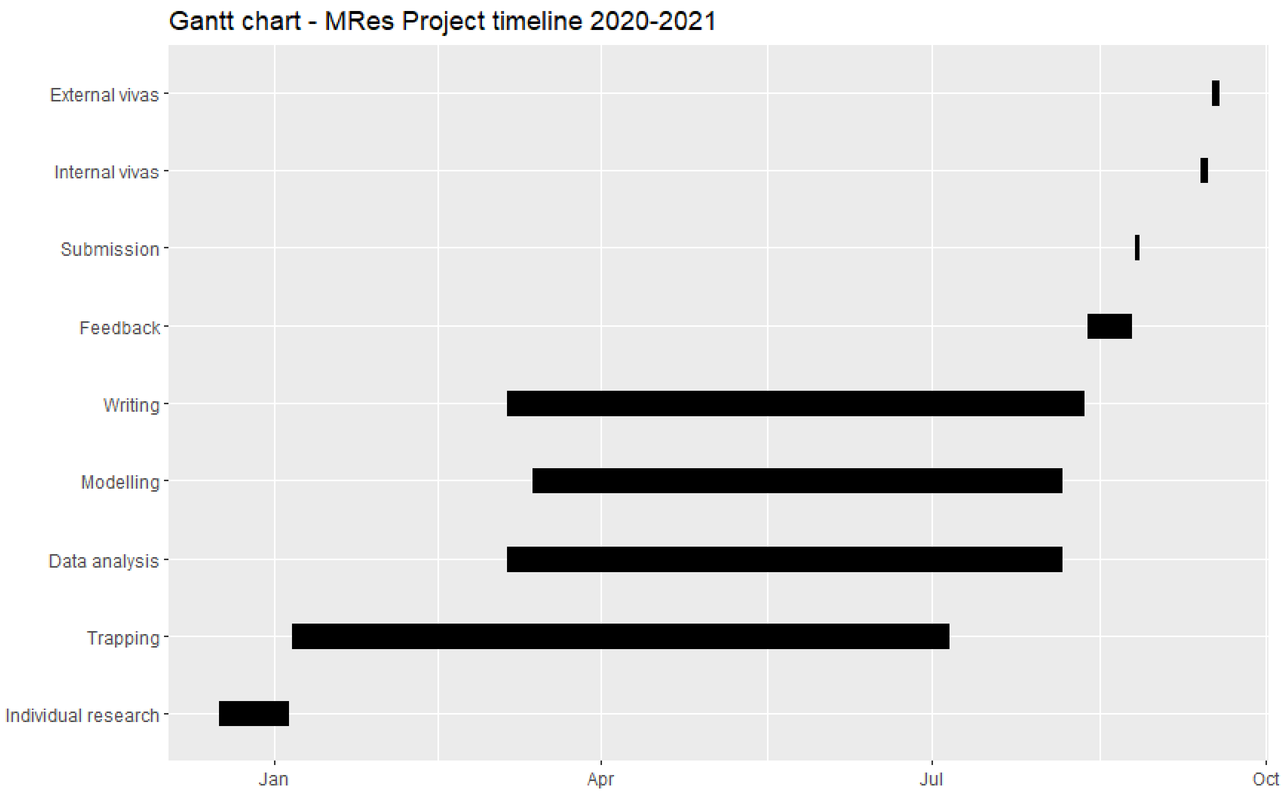

Figure 1: Gantt chart showing the experimental timeline for MRes CMEE Masters project.

6 Itemized budget

Items	Estimated costs	Items	Estimated costs
150 RFID PIT tags	202.5	1L ground nut oil	4.20
3 boxes of latex gloves	9.50	Four 750ml bleach	2.60
8 temperature data loggers	176	Cotton wools	30
Ethanol	10	10kg of peanuts	27
15kg of apples	37.5	500g of wood chips	7
Weighting scales	10.10		

Total estimated cost: 516.4

References

[1] Mario Díaz and César Luis Alonso. Wood mouse apodemus sylvaticus winter food supply: density, condition, breeding, and parasites. *Ecology*, 84(10):2680–2691, 2003.

[2] Jens Jacob and Joel S Brown. Microhabitat use, giving-up densities and temporal activity as short- and long-term anti-predator behaviors in common voles. *Oikos*, 91(1):131–138, 2000.

[3] Aurelio F Malo, Ben Godsall, Clare Prebble, Zoe Grange, Samantha McCandless, Andrew Taylor, and Tim Coulson. Positive effects of an invasive shrub on aggregation and abundance of a native small rodent. *Behavioral Ecology*, 24(3):759–767, 2013.

[4] Luís Pedro Pratas-Santiago, André Luis Sousa Gonçalves, AMV da Maia Soares, and Wilson Roberto Spironello. The moon cycle effect on the activity patterns of ocelots and their prey. *Journal of Zoology*, 299(4):275–283, 2016.

[5] Michael A Steele, Steve Manierre, Theresa Genna, Thomas A Contreras, Peter D Smallwood, and Michael E Pereira. The innate basis of food-hoarding decisions in grey squirrels: evidence for behavioural adaptations to the oaks. *Animal Behaviour*, 71(1):155–160, 2006.

[6] Robert H Tamarin and Spencer R Malecha. The population biology of hawaiian rodents: demographic parameters. *Ecology*, 52(3):383–394, 1971.

[7] Shannon L White and Tyler Wagner. Behaviour at short temporal scales drives dispersal dynamics and survival in a metapopulation of brook trout (salvelinus fontinalis). *Freshwater Biology*, 2020.

7 Statement and signature

I have seen and approved the proposal and the budget.

Supervisor: Dr Aurelio Malo

Signature:

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