Analytical Methods for Ecologists - Exercises in analysing data - part 2

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29/10/2021

1. For any organism, the efficient gathering of resources is a key aspect which will impact on their evolutionary fitness. Increasing levels of habitat fragmentation is disrupting patterns of foraging in many animals. In an attempt to investigate how fragmentation may be affecting the foraging of field voles, a study attached transponders to individuals which allowed researchers to track them and estimate the distances they were travelling over two hour periods each night. The mean distance travelled was calculated for each individual. This was done for a number of different individuals (data points can be regarded as independent) in three different classes of habitat: no fragmentation (‘none’), some fragmentation (‘some’), extensive fragmentation (‘extensive’).

The data are in the tab-delimited file ‘field\_vole\_foraging.txt’. Analyse the data to see if the level of fragmentation had an impact on the mean distances that individual voles moved.

1. The morphology of individuals can affect the rate at which they lose heat. Loss of heat in colder environments can be viewed as wasted energy. A recent study has found evidence that the morphology of some species appears to be changing in response to climate change due to the altered temperature balance between the individuals and their environment. To investigate this further, a team of researchers have measured the bill surface area of individuals of the dark-eyed junco (*Junco hyemalis*) at the latitudinal extremes of its distribution. This bird species is a type of sparrow and, although some individuals migrate, within its full distribution, there is a range within which there is no migration. Individuals from the northern and southern parts of this range were captured, and their beak dimensions were measured, enabling the surface area of their beaks (a significant source of heat loss) to be calculated. Only adult females were measured to minimise the impact of confounding variables. The physiologically-based Allen’s rule suggests that we would expect the surface areas of the birds in the north (the colder region) to be less than those in the south, reducing the rate of heat lost.

The data are in the tab-delimited file ‘junco\_beak\_surface\_areas.txt’. Use the data to determine if there is a difference between the surface areas of the beaks of individuals at the two latitudinal extremes.

1. Blow flies play an important role in decomposition processes. These flies will often lay eggs alongside those of other individuals in large masses. It is thought that the large aggregations of eggs help to retain heat, increasing the metabolic rate of the developing flies leading to faster development. More recently it has been suggested that the clusters of eggs can lead to the establishment of microbial communities on the surfaces of the eggs which also speed up the development of the flies. An experiment has been run to test the effects of microbial communities and temperature on the developmental rate of a particular species of blow fly.

As soon as eggs were layed, individual eggs were isolated. Half the eggs were washed to remove the microbial community on their surface, with the other half being unwashed. The washing process did not have any other effects on the eggs other than to remove the microbial community. Within each of the treatments (with and without microbial community) half the eggs were kept at 12C and half were kept at 16C. The time (in hours) that it took for the eggs to develop through to the adults emerging was recorded.

The data are in the tab-delimited text file ‘blow\_fly\_development\_rates\_experiment.txt’. Analyse the data to assess if temperature and/or presence/absence of the microbial community affects the development rates of the individuals.

1. A recent study used GPS transponders to track individual female bar-tailed godwits on their southern migration. These birds travelled from the arctic to New Zealand in one non-stop journey. What is even more remarkable is that these birds are waders and are not shaped to be able to glide and therefore had to utilise active flight for the whole of the journey. This requires a huge expenditure of energy, whilst not being able to feed.

To complement this study a number of individual females were captured and weighed just prior to the start of their migration. They were also ringed so that individuals could be identified. Following release and migration, some of these birds were again captured and weighed, providing weights of individuals just prior to migration and just after migration.

The data are in the tab-delimited file ‘bar\_tailed\_godwit\_weights.txt’. Analyse the data to assess if there is a significant decrease in the weights of the individuals after they have migrated.

1. Explain what a ‘2-way fixed factor design’ is.
2. Explain what a ‘2-way interaction’ is.