Prawn Post Release Mortality Experiment

A picture containing map, text, screenshot

Description automatically generated

Figure 1. Prawns were collected at different sites around the Broughton Archipelago.

Experiment Methods

For a given trial, we set 10 traps, let them soak for ~24 hours and pulled them. We immediately placed the prawns into a saltwater filled fish tote.

**Treatment Stage**

We distributed the prawns into (usually) 5 treatment groups (0 minutes, 30 minutes, 60 minutes, 90 minutes, 120 minutes). Each group received a different colour rostrum band. The prawns were left on the boat deck for their assigned treatment time. After their time was up, they were placed in a bag and hung over the side of the boat until all treatment times were done (~2 hours).

**Release Stage**

We pulled all the bags out of the water and distributed the prawns haphazardly among six traps with the ends tied shut. These traps were set for ~24 hours.

**Data collection**

After we hauled the traps, we assessed the state of the prawns. They were assigned as alive (0 if dead, 1 if alive), dead (0 if alive, 1 if dead and intact), or), or scavenged (0 if alive, 1 if dead and scavenged). Stage data (0=juvenile, 1=male, 2=transitional, 3=female, 4=egged female, 5=spent female) and carapace length (if intact) was collected for all prawns. Their band colour (and therefore treatment) was also recorded, or NA (unbanded).

All alive prawns were assessed for 10 reflexes (0 if absent, 1 if present).

A picture containing text, screenshot, diagram, colorfulness

Description automatically generated

Figure 2. After the treatment and release stages, prawns were classified as alive, dead or scavenged. This plot shows the number of prawns in each condition, for each trial.

Analysis Plan

Our working plan is to analyse the data using a binomial (logistic) regression with random intercept effects. We plan to have one random effect for trial x trap, shown as in equation 1. We want to account for variation in mortality caused by the trap a prawn was in for the release stage. Each time a trap was placed on the bottom, mortality may have been affected by the position of the trap, salinity, presence of predators, etc. We expect variation in the odds of survival depending on the specific trial x trap that the prawn was in.

There were 21 trials each with 6 traps, so there are 126 levels of the random effect.

Equation 1:

**Cox proportional hazard**

It also might be appropriate to use a survival model to analyse the data. One option that came up at lab meeting is to fit both models (Cox and binomial) and compare the two model fits. It would be great to discuss this on Monday.

Issues

**Lost Prawns**

We **lost some prawns** during the treatment stage, such that the total number of prawns-per-treatment at the end of the trial did not always match the number of prawns-per-treatment at the start of the trial. The mechanism for loss could have been through the mesh bags hanging off the boat during the experiment or through escape from the traps during the 24 hour period after the experiment (Figure 3). We also have some prawns which **lost their bands** during the trial, so we cannot assign them to a treatment. We can only count the number of banded prawns before and after to estimate treatment loss. Therefore, at a treatment level, ‘lost’ prawns could have been truly lost or have lost their band (Figure 4).

We can probably assume that band loss was random with respect to treatment, but we want to account for the possibility that prawn loss was biased with respect to treatment.

**Question:** Should we have a threshold for loss above which we don’t use a trial?

**Proposed answer:** We think not, due to limited data and subjectivity in which to exclude.

**Question:** What should we call the total for estimating the proportion that survived? The total in each treatment before the ‘release’ stage? The total banded prawns after the traps were pulled up?

**Proposed answer:** Our current plan is to disregard lost prawns. We think that whether death, and therefore treatment, is correlated with loss: lost prawns will have minimal impact on relative survival across treatments (Table 1).

A picture containing diagram, design

Description automatically generated

Figure 3. In each trial, prawns were counted before the treatment stage and in the data collection stage. The y-axis shows lost prawns, which was calculated as the pre-treatment count minus the total (alive, dead and scavenged) remaining in the data collection stage.

A picture containing text, diagram, screenshot, number

Description automatically generated

Figure 4. The prawns remaining in each treatment group was counted as prawns remaining with that colour band. Prawns were lost from treatment groups in two ways, by losing there band, or by escaping the trap. This plot shows the proportion that were lost from each treatment in either of these ways, for each trial.

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | 0 | 60 | 120 |
| Starting number | 100 | 100 | 100 |
| True number Alive | 90 | 60 | 10 |
| **True survival rate** | **0.9** | **0.6** | **0.1** |
| Observed Total | 98 | 92 | 82 |
| Observed Alive | 90 | 60 | 10 |
| **Observed survival rate** | **0.92** | **0.65** | **0.12** |

Table 1. Alive and dead prawns may have been lost at different rates. This table shows how a scenario where 20% of dead prawns are lost impacts estimates of survival. Number at start is the number of prawns in the treatment group at the start. True number alive is the number of prawns after the release stage that remain alive, including lost prawns. Observed total is all the prawns remaining in the trap after the experiment.

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | 0 | 60 | 120 |
| Number at start | 100 | 100 | 100 |
| True Alive | 90 | 60 | 10 |
| **True survival rate** | **0.9** | **0.6** | **0.1** |
| Observed Total | 82 | 88 | 98 |
| Observed Alive | 72 | 48 | 8 |
| **Observed survival rate** | **0.88** | **0.56** | **0.082** |

Table 2. Alive and dead prawns may have been lost at different rates. This table shows how a scenario where 20% of alive prawns were lost impacts estimates of survival. Number at start is the number of prawns in the treatment group at the start. True number alive is the number of prawns after the release stage that remain alive, including lost prawns. Observed total is all the prawns remaining in the trap after the experiment.

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment | 0 | 60 | 120 |
| Number at start | 100 | 100 | 100 |
| True Alive | 90 | 60 | 10 |
| **True survival rate** | **0.9** | **0.6** | **0.1** |
| Observed Total | 80 | 80 | 80 |
| Observed Alive | 72 | 48 | 8 |
| **Observed survival rate** | **0.9** | **0.6** | **0.1** |

Table 3. Alive and dead prawns may have been lost at different rates. This table shows how a scenario where dead and alive were lost at the same rate (20%) impacts estimates of survival. Number at start is the number of prawns in the treatment group at the start. True number alive is the number of prawns after the release stage that remain alive, including lost prawns. Observed total is all the prawns remaining in the trap after the experiment.

**Unbanded prawns**

Some prawns lost their bands (Figure 5). We can’t know what treatment they were from.

**Question:** How will this impact survival estimates? Should we perform a formal analysis on Unbanded vs Treatment?

**Proposed answer:** Our current answer is to make the assumption that the probability a prawn lost its band is random with regard to treatment, alive or dead, etc. We plan to ignore unbanded prawns.

A picture containing diagram, design

Description automatically generated

Figure 5. Each treatment group was denoted with a different coloured band. The plot above shows the number of prawns that lost their band per trial.

**Scavenged**

The length and stage of some prawns could not be assessed because they were scavenged.

We think there is likely a bias in which prawns were scavenged. Longer treatments-> more dead prawns-> more scavenged prawns -> fewer with length/stage data.

**Question:** Could we impute stage data where length data are present?

**Answer:** Our current stage distinctions are as follows: 0=juvenile, 1=male, 2=transitional and 3=female. We could simplify this. For example, 0=male or juvenile and 1=transitional or female. This would retain important biological distinctions and allow us to impute stage data. We would choose a length above which prawns with no stage data would be considered transitional/female and below which would be juveniles and males.