A NON-INVASIVE METHOD TO ASSESS THE IMPACT OF ELECTRONIC TAG ATTACHMENT TECHNIQUES ON STRESS LEVELS IN FISH

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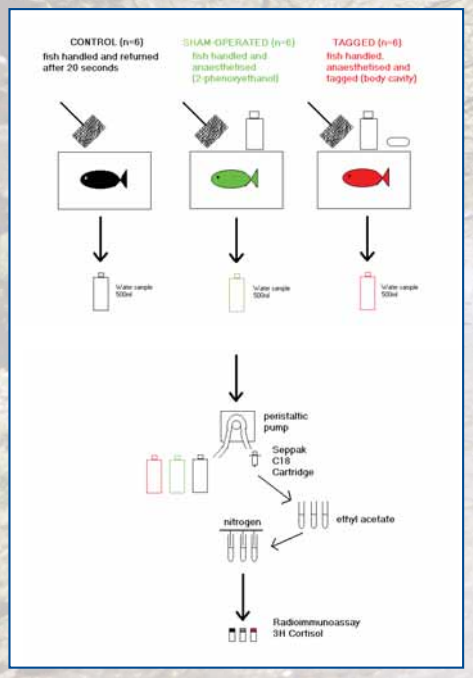
Introduction

Telemetry and electronic tagging techniques are increasingly being utilised to conserve and manage a wide variety of fish species. In such studies it is vital that the capture, sedation and tag attachment techniques do not compromise the behaviour or subsequent survival of the fish. An additional problem with telemetry studies is obtaining a quantitative assessment of when the fish have recovered from the tagging protocols and accurate data can start to be recorded which represents the natural behaviour of wild individuals. Monitoring stress levels by measuring plasma cortisol can be used to assess recovery in tagged fish. However, this normally requires a blood sample and the subsequent handling during sampling can modify cortisol levels. This study utilises a non-invasive technique for monitoring cortisol in tagged fish by measuring levels excreted into the water. This technique was used to assess the recovery of two species of freshwater fish (carp *Cyprinus carpio*, and roach *Rutilus rutilus*) after the surgical implantation of acoustic tags into the body cavity.

Materials and Methods

Two separate experiments were carried out using carp and roach. Fish were placed individually in opaque plastic tanks (22cm depth, 35cm width, 49cm length) and allowed to acclimate for two weeks. Baseline water samples were taken. Tanks were surrounded with screens to ensure minimal disturbance. Fish were divided into 3 groups:



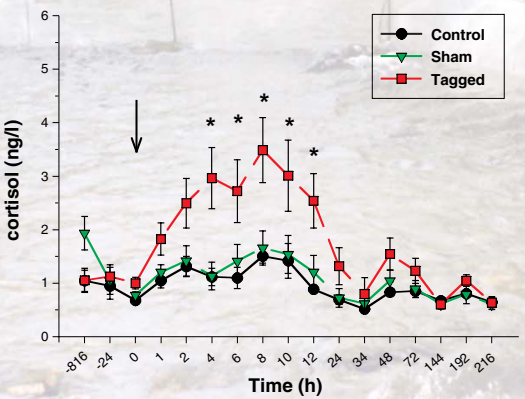
Outline of cortisol sampling protocol

Results and Discussion

Carp

- No significant differences in levels of cortisol released into the water at any of the time points between the Control and Sham-operated groups (P>0.05).
- No significant increase in cortisol levels from baseline time points to any points post-stressor in the Control and Sham-operated groups.
- This indicates that handling alone, and with anaesthetic, does not cause a significant increase in stress levels of carp.
- Levels of cortisol in the Tagged fish peaked at 4 to 8 hours post-tagging. Levels were significantly higher in the Tagged fish at 4, 6, 8, and 12 hours post-tagging compared to both the Control and the Sham-operated groups (P<0.05).
- This indicates that tag insertion causes an acute stress response. However, levels returned to baseline within 24 hours post-tagging and there was no further increase in the stress response up to 9 days post-tagging. This indicates a lack of a chronic stress response and no adverse physiological effects from prolonged tag presence.

Carp *Cyprinus carpio*

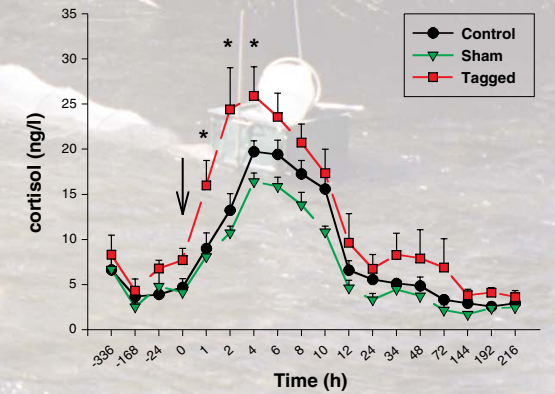


*Effect of handling stress (Control); handling stress and anaesthetic (Sham); and tag insertion (Tagged) on levels of cortisol released into the water by carp. Arrow indicates stressor. * P<0.05 compared to Control group.*

Roach

- No significant differences between the Control and the Sham-operated groups (P>0.05).
- Levels of cortisol in both Control and Sham-operated groups rise significantly from baseline up to 10 hours post-stressor. This suggests that roach are particularly susceptible to handling stress and this is not masked completely by anaesthetic with 2-phenoxyethanol.
- Tagged fish released significantly higher levels of cortisol at 1, 2 and 4 hours post-tagging compared to the Control group (P<0.05). Tag insertion therefore causes an acute stress response, but this physiological stress response returns to baseline after 6 hours post-tagging.
- Tagged fish also released significantly higher levels of cortisol at all time points up to 12 hours post-stressor, compared to the Sham-operated fish (P<0.05). This also indicates an acute stress response from tag insertion.
- Cortisol levels released by the Tagged fish returned to baseline within 24 hours post-tagging, and remained low for 9 days post-tagging. There is therefore no evidence of a chronic stress response due to prolonged tag presence.

Roach *Rutilus rutilus*



*Effect of handling stress (Control); handling stress and anaesthetic (Sham); and tag insertion (Tagged) on levels of cortisol released into the water by roach. Arrow indicates stressor. * P<0.05 compared to Control group*

Conclusions

- Measuring cortisol levels released into the water by individual fish is an effective way of determining physiological stress.
- There was an acute stress response (shown by elevated cortisol levels in the water) in both species after tag insertion.
- In both carp and roach, levels of cortisol returned to baseline within 24hours of tag-insertion.
- There was no chronic stress response due to prolonged tag presence in both species.
- There were differences in the stress response between carp and roach despite both being cyprinid species.
- Levels of cortisol released by the roach were higher than in the carp. In the Tagged group there was a 3-fold increase in cortisol levels in the carp and a 4-fold increase in cortisol in the roach. These higher levels released by the roach may have further adverse physiological and behavioural effects.
- Roach were much more susceptible to handling stress compared to the carp, and sedation by 2-phenoxyethanol did not significantly depress this stress response.
- This study highlights differences between species' stress levels in response to tagging.
- This is a non-invasive technique which can easily by applied to a number of species.
- We recommend that the technique is applied to all fish telemetry studies as a method of quantifying the recovery time from tagging protocols. This will allow accurate data to be collected on the natural behaviour of the individual once recovery is complete.

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