



Introduction

Problem: Restoration of *Coregonus* species in the Great Lakes is a management objective. Stocking of these species is used as a restoration tool; however, post-release survival of hatchery-reared coregonines can be limiting (e.g., < 50% two days after release¹).

Hypothesis: Stress associated with handling and transport may be a cause of low post-release survival.

Approach: The stress response can be measured from cortisol concentrations in the blood plasma of fish². Sedatives such as clove oil (active ingredient eugenol) have been used in other species to reduce the stress response caused by handling³. We tested the effect of sedation from eugenol on the stress response of *Coregonus hoyi*, during a 4-hour simulated transport event.

Question: Does chemical sedation decrease the stress response of *C. hoyi* during handling and 4-hours of transport?

Methods

- C. hoyi* were exposed to concentrations of eugenol (1-20 mg/L) to determine greatest anesthetic stage achieved after 4-hours of exposure. Recovery time from anesthesia was also calculated for each individual after the 4-hour exposure period.
- A concentration of 10 mg/L of eugenol was chosen as a sedative for transported *C. hoyi* based on results from our first experiment (i.e., 10 mg/L induced stage-3 anesthesia).
- One control group (no sedative) and one treatment group (10mg/L eugenol) were used during the 4-hour simulated transport.
- Ten *C. hoyi* were randomly selected for blood draws from each group at each time step of the transport event (before transport-0, 4, 24, and 48 hours after transport)
- Blood samples were centrifuged, blood plasma collected, and plasma analyzed by Stress Bio-analytics for cortisol concentration using a competitive ELIZA method.
- Factorial ANOVA was used to determine if hours of transport or treatment type influenced cortisol concentrations. A Tukey's HSD post-hoc test was used to identify significant differences among factor levels.

Results

Table 1: Stages of sedation and their associated Behavior (modified from Cooke et al., 2003³).

Stage	Behavior
1	Increased swimming speed
2	Slight reactivity loss
3	Partial equilibrium, reaction to touch
4	Loss of equilibrium, no reaction to touch
5	Mortality

Age one *C. hoyi*

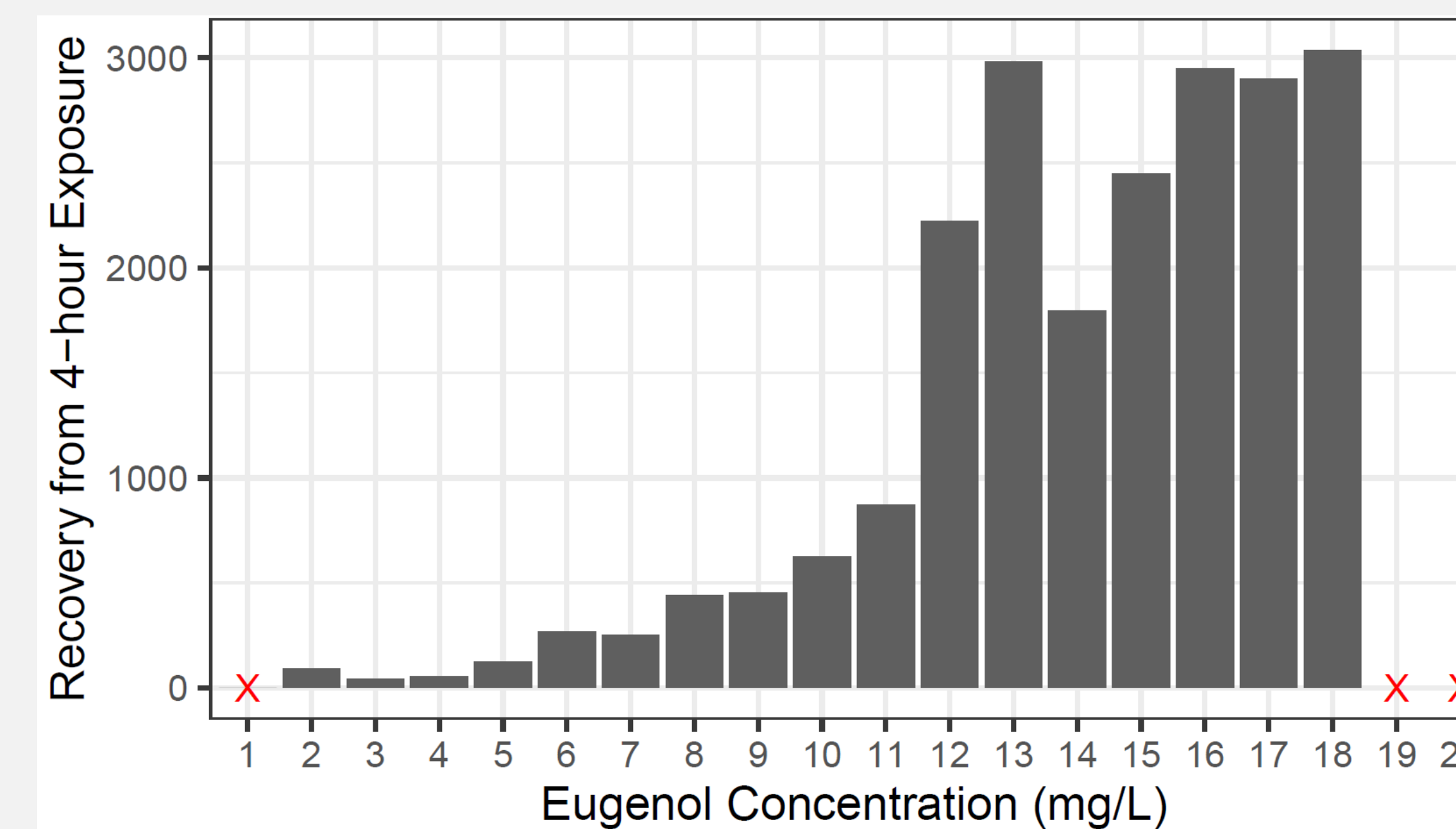


Figure 2: Recovery time (seconds) of *C. hoyi* after 4-hours of exposure to varying concentrations of eugenol. Red "X" indicate no sedation (1 mg/L) or mortality (19-20 mg/L).

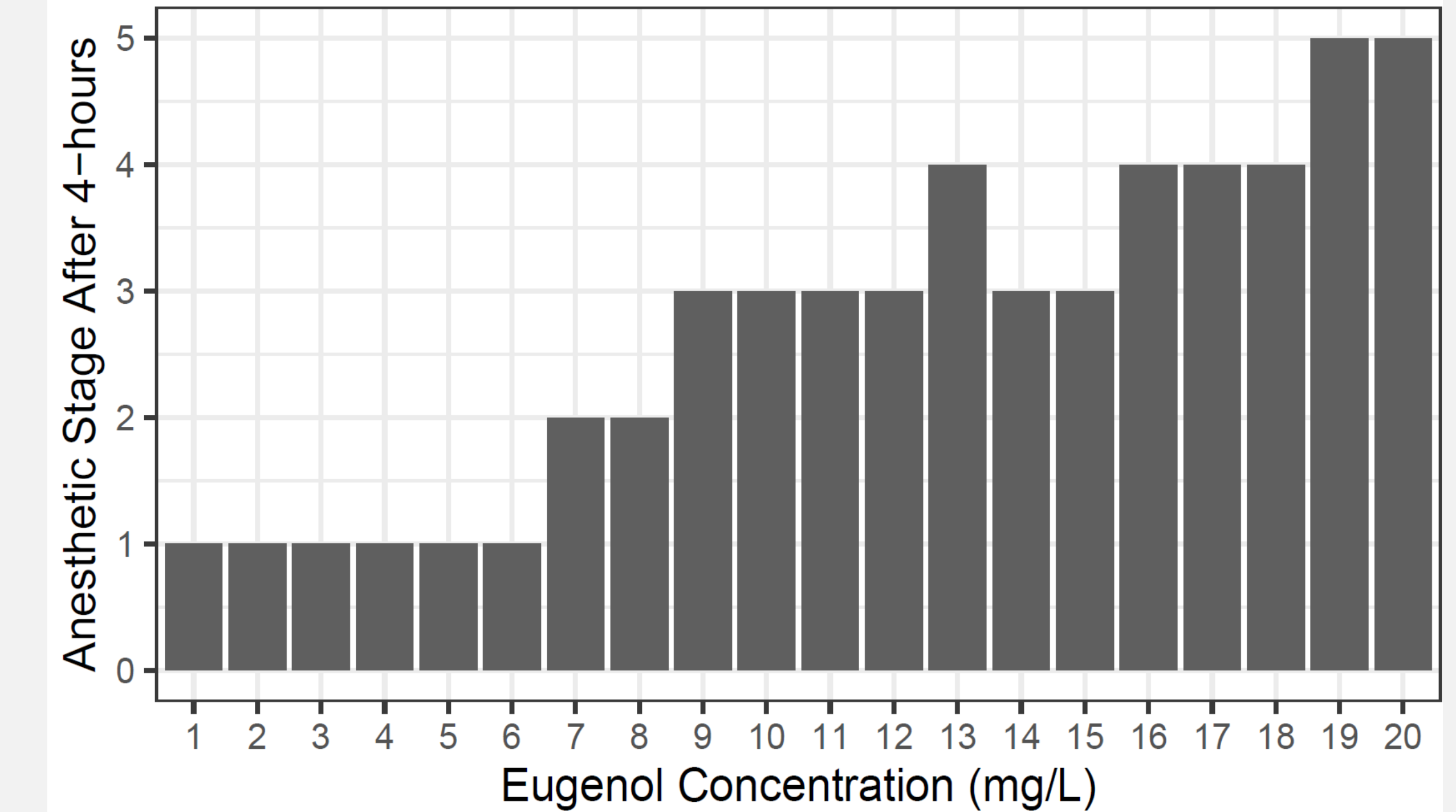


Figure 1: Anesthetic stage achieved by *C. hoyi* for different concentrations of eugenol.

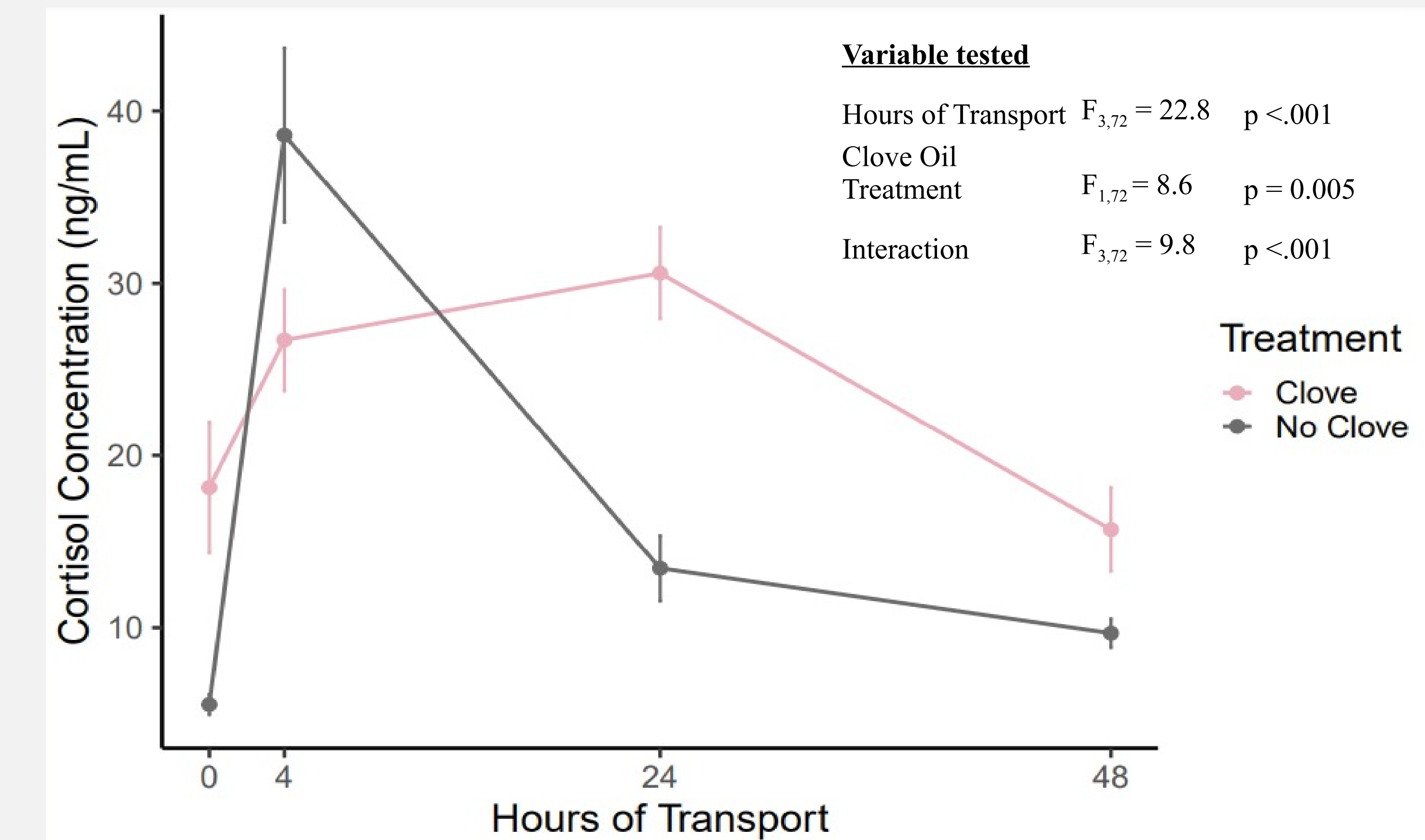


Figure 2: Average blood plasma cortisol concentration (ng/mL) of *C. hoyi* before and after simulated transportation event with and without clove oil (eugenol) sedation.

Conclusion

- The stress response, caused by handling and transport of *C. hoyi*, was not mitigated by eugenol-induced stage-3 anesthesia.
- There were no differences in mortality after simulated transport between sedated and non-sedated *C. hoyi*.
- Stage-3 anesthesia causes partial loss of equilibrium, which may have increased a stress response compared to non-sedated individuals.
- Future studies could evaluate the effectiveness of different concentrations of eugenol during transport to reduce the stress response of *C. hoyi*.

