Examining stress profiles and mortality rates of discarded Pacific halibut (*Hippoglossus stenolepis*) from a charter recreational fishery

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INTRODUCTION

The Pacific halibut (*Hippoglossus stenolepis*) recreational fishery (combined guided and unguided) is an important contributor to the total fishery-induced mortality, with 3,460 metric tons (7.6 million pounds) of removals in 2021 (20% of total removals). The Gulf of Alaska (IPHC Regulatory Areas 2C and 3A), accounts for more than 78% of recreational mortalities coastwide. Under current regulations, the number of fish captured, handled and discarded by the Pacific halibut recreational fisheries is significant. Capture-related events impose stress and injury to the fish and, consequently, decrease survival of discarded fish. In contrast to the trawl and longline fisheries, discard mortality rates (DMRs) for Pacific halibut have not been determined experimentally in the recreational fisheries and are currently based on DMR information generated from commercial gear and coarsely applied to recreational hook type and creel census data. Recent reductions in Pacific halibut catch limits place added importance to the recreational fleet for improved DMR estimates applied to their fishery. To collect industry relevant data, we conducted a field study on chartered recreational vessels in the Gulf of Alaska using common recreational fishing gear and capture practices to investigate (1) relationships among hook release injuries, physiological condition, and stress levels of captured Pacific halibut, and (2) post-release survival estimates.

MATERIALS AND METHODS

Charter vessels were contracted out of Sitka and Homer, Alaska to conduct fishing using typical charter recreational gear and techniques to compare impacts of fishing either size 12/0 or 16/0 circle hooks. Environmental parameters collected included depth of capture, time on hook, sea condition, bottom temperature, surface temperature, and time on deck. All fish were measured, weighed, assessed for hooking injury, sampled for blood, tagged (either wire, or archival) and released. Physiological parameters measured included condition status at capture (condition factor, somatic fat levels) and post-handling stress indicators (plasma cortisol, glucose, and lactate). Short-term (i.e. 96 days) assessment of post-release mortality was investigated with the use of electronic survivorship Pop-up Archival Transmitting (sPAT) tags (not dependent on recaptures), while long-term survival is examined with the use of wire tags (dependent on recaptures).

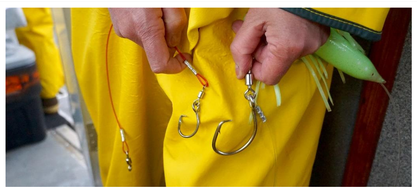

Figure 1. Size 12/0 (l) , 16/0 (r) circle hooks

Figure 2. Drawing a blood sample

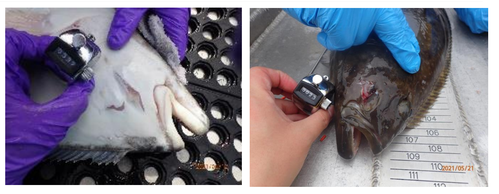

Figure 3. Injury Assessment

Figure 4. Tags: Wire (left) , satellite Pop-of Archival Tag (right)

RESULTS

- **Catch and injury profiles of size 12/0 vs 16/0 circle hooks**

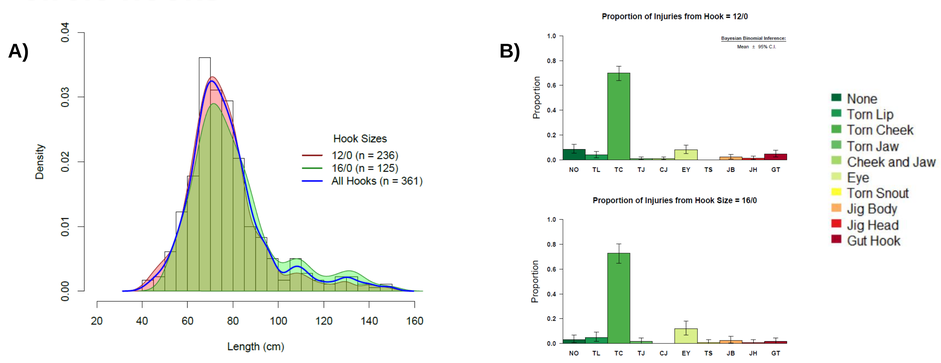

Figure 5. A) Length distributions by hook size. B) Injury type proportions resulting from catch and release from size 12/0 (upper) and 16/0 (lower) circle hooks.

- **Physiological parameters by fight time and injury type**
  - **Glucose**
  - **Lactate**
  - **Cortisol**

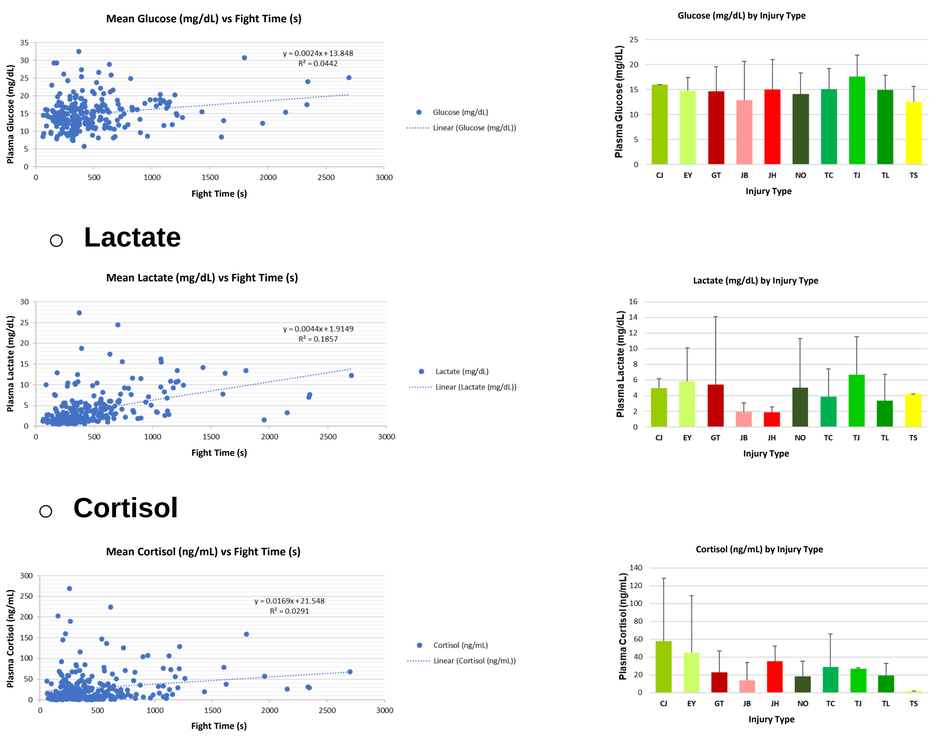

Figure 6. Plasma stress indicators. Left column by fight time (s) and right column by injury type (see legend in Figure 5B). Top row: Glucose (mg/dL). Middle row: Lactate (mg/dL). Bottom row: Cortisol (ng/mL).

- **sPAT Survival Analysis (R package 'survival' – time to event)**

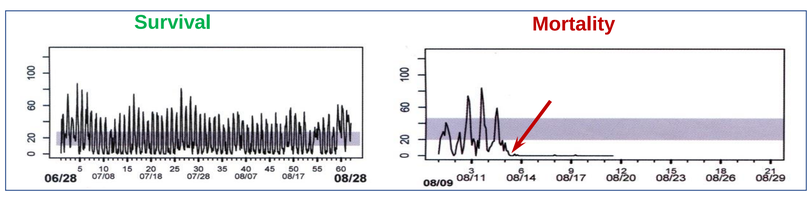

Figure 7. Typical acceleration patterns for fish that survive (left) or die (right).

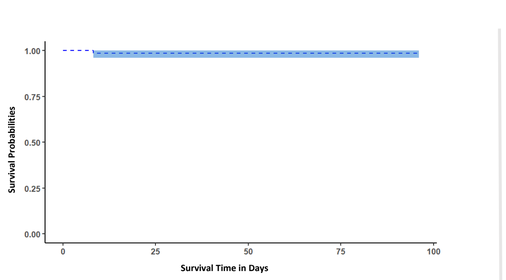

Figure 8. Survival probability for fish in excellent viability caught on circle hooks. Mortality rate of 1.35% (0.00-3.95%).

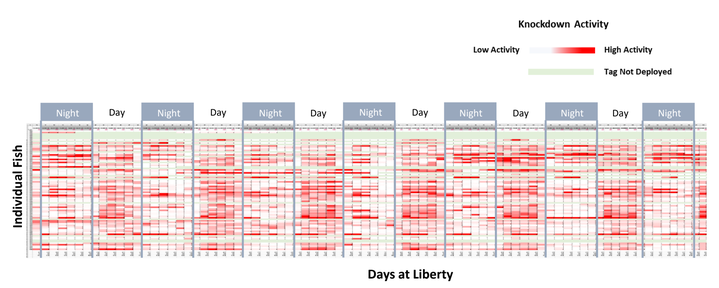

Figure 9. Diurnal activity pattern investigation

CONCLUSIONS

- Hook size does not have a marked difference in size of catch
- Different hook sizes have similar injury profiles (torn cheek being the predominant injury)
- Blood plasma stress indicators increased with fight time
- Blood plasma stress indicators increased with fight time but were not influenced by injury status or predictive of release condition.
- Tagging results show low mortality (DMR 1.35% (0-3.95%) for fish in excellent viability released from circle hooks), consistent with current discard mortality estimates
- This study represents the first thorough characterization of viability and survival of Pacific halibut discarded from the recreational fishery and contributes to our understanding of practices leading to best outcomes

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