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Acute post-harvest survival of <25 cm snapper — a summary of research carried out in the Precision Seafood Harvesting programme

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Precision Seafood Harvesting Limited

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EXECUTIVE SUMMARY

Acute post-harvest survival of <25 cm snapper - A summary of research carried out in the Precision Seafood Harvesting programme

Plant & Food Research Nelson

May 2019

This document summarises:

- The work carried out on acute (48 h) post-harvest survival of <25 cm snapper (SNX) caught with the Modular Harvesting System (MHS). The rationale for undertaking this research has been to:
  1. Gather baseline data on post-harvest survival of SNX caught in conventional mesh codends under commercial fishing conditions
  2. Evaluate the survival of SNX from the MHS
  3. Use the above research to support an application to have the Precision Seafood Harvesting (PSH) technology authorized for general use under the Fisheries Act 1996.
- Preliminary investigations carried out to assess the proportion of <25 cm snapper landed with the MHS to swim down after release back into the sea.

1 ACUTE POST-HARVEST SURVIVAL

1.1 Method

- Methods and equipment were developed that allowed for measurement of acute (48 h) post-harvest survival and condition of <25 cm snapper (coded SNX) aboard commercial trawlers. Briefly:
  - Upon landing fish were collected off the deck within 6 min so that the main variable being evaluated was the codend gear type and not on-board handling
  - Fish were then transferred to 250-L live holding bags located on deck plumbed with flow-through seawater, and survival was assessed over 48 h.

1.2 Post-harvest survival comparison (2015)

- In January 2015 a controlled trawl comparison study was undertaken to compare the survival of SNX caught at three depth ranges (<30 m, 30-60 m, >60 m) in the MHS versus conventional mesh codends. The Modular Harvesting System (MHS was found to facilitate much higher survival rates than conventional codends (Figure 1), and also, the effect of increasing capture depth was much more severe for conventional codends. In addition, the MHS was also observed to land more SNX than mesh codends.
  - A generalised linear mixed model (GLMM) was fitted to the data (a binomial logit link function) to predict the survival of fish. Because of aliasing issues, model selection was performed using standard generalised linear models without any random effects. Gear type, depth, voyage and all two-way interaction effects were included in the full model. After model selection, only gear type and depth were retained in the final model. The effect of inter-tow variability (which is interpreted as a combination of vessel effect, tow length, catch volume etc.) in the model was accounted for by including tow as a random effect, while gear type and depth were treated as fixed effects. Rather than rely on significance testing, we chose to analyse the data using 95% confidence intervals derived from the GLMM (shown in Figure 2).

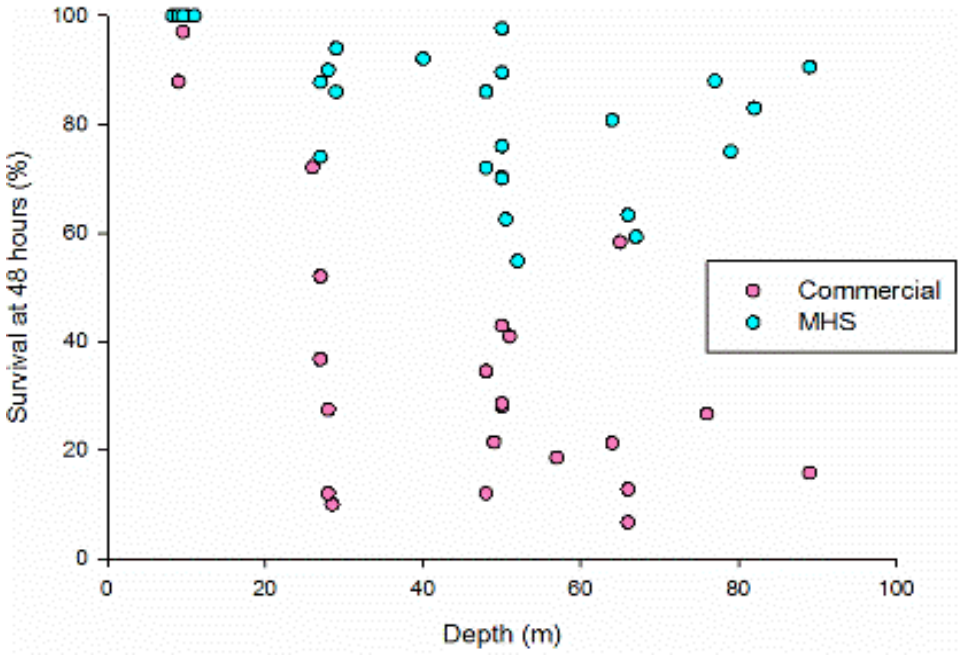

Figure 1. Comparison of capture depth versus postharvest 48-h survival in <25-cm snapper. Each point represents an acute 48-h post-harvest assessment for a tow. For Modular Harvesting System (MHS) n=28 tows; for commercial n=25 tows. Total number of fish assessed = 2098.

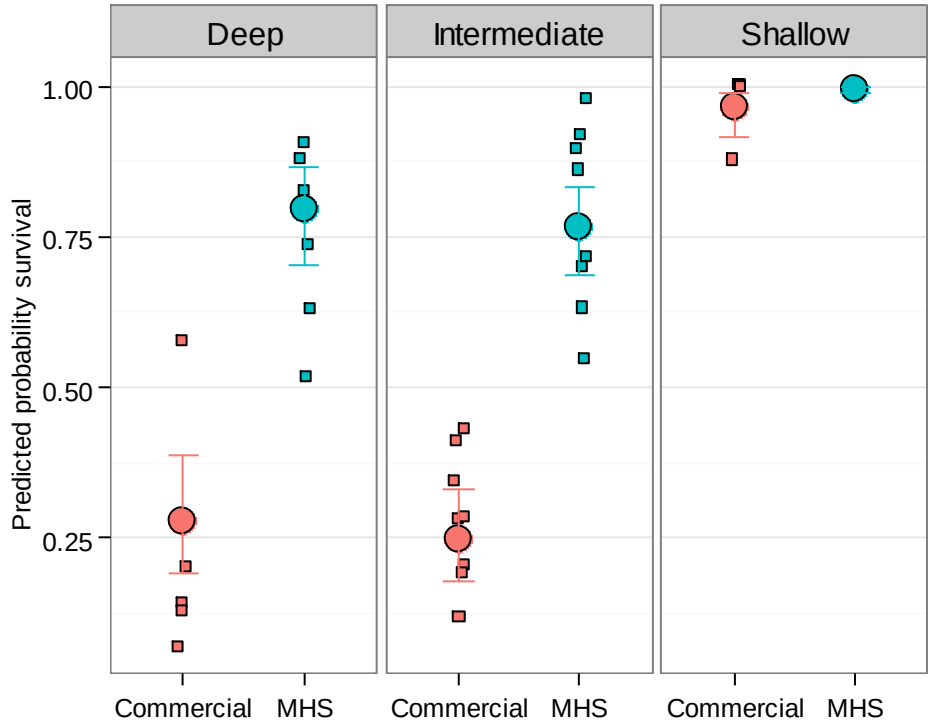

Figure 2. Output from the GLMM analysis for predicted survival of <25-cm snapper landed with either the Modular Harvesting System (MHS) or conventional commercial codend at shallow (<30 m), intermediate (30-60 m) and deep (>60 m) depths. Observed data are plotted as squares, the model predicted mean is plotted as a circle ± 95% CI.

- In winter 2015 a further trawl comparison study was undertaken to compare the acute post-harvest survival of SNX from the MHS versus conventional mesh codends measured over five voyages. Again, the MHS was found to facilitate much higher survival rates than conventional codends: 70.6 ± 4.9%, tow depth 57.8 ± 4.4 m (± SEM, n=14 tows), versus 6.5 ± 1.8%, tow depth 55.3 ± 2.5 m (± SEM, n=16 tows).
    - The observation that more SNX tended to be landed in the MHS led to a change in focus for regulatory change towards altering the selectivity of the MHS so that it was no different from that of conventional mesh codends. In altering the selectivity characteristics of the MHS, it was observed that the survivability of SNX decreased: 48.9 ± 6.5% survival, 52.1 ± 2.6 m, (± SEM, n=16 tows), probably because of increased fatigue and physical damage.

1.3 Effect of catch volume on survivability (2017)

- A further study was carried out in 2017 to determine the effect of catch volume on survivability. Acute post-harvest survival of SNX was measured over five voyages. There was no attempt to control or stratify variables such as trawl depth or tow time. The main variable of interest was catch volume, as this was thought to be the main driver of survival. Acute post-harvest survival assessment was conducted over a range of fishing conditions that reflected normal fishing operations of the vessel. The ranges of key variables were as follows: catch volume 84–1125 kg; capture depth 44–93 m; tow duration 37–163 min. Eighteen tows using the MHS were assessed
    - Catch volume had a major effect on the acute post-harvest survival of SNX. When the ratio of fish to water (volume ratio, kg fish/L Lift Bag volume) was low, survival was highest (Figure 1). A volume ratio of 0.1 kg/L resulted in a 48-h survival rate of ~50-80%, whereas a volume ratio near 1.0 resulted in a survival rate of ~10-20% (Figure 3). At a volume ratio of 0.5 and below (i.e. 1 part fish : 1 part water) the survival rate of the MHS averaged 50 ± 5% (± SEM; n=15). Above this ratio, survival decreased to 16 ± 5% (± SEM; n= 3) (Figure 3).
    - Given the relatively small size of the data set obtained and the uneven distribution of data across the range of variables recorded (catch volume, depth and tow duration), no statistical analysis to quantify the sources of variability was attempted.

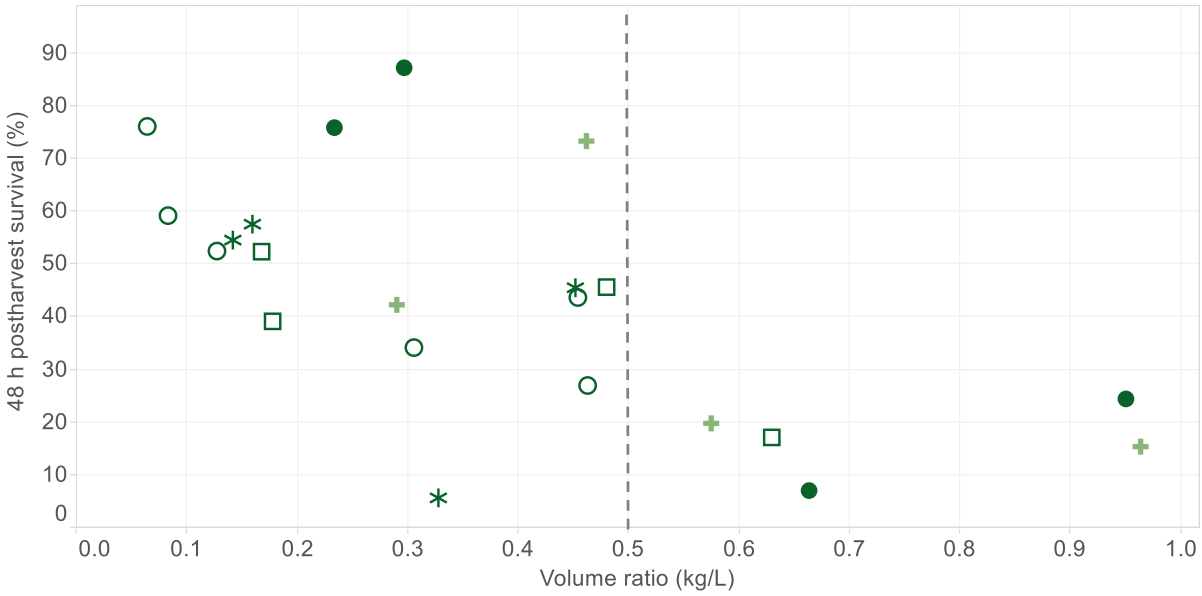

Figure 3. Acute post-harvest survival of snapper (SNX). Volume ratio represents the kg catch/L Lift Bag volume.

2 SWIM DOWN AFTER SORTING

- During trials it was observed that most SNX landed with the MHS had the capability to swim down when returned to sea, provided they were not excessively crushed during transfer to the deck or left emergent for too long (more than a few minutes of aerial exposure). Also, we had observed that the righting behaviour of fish in a tank or bin varied depending on the depth of the bin and the length of time from landing.

2.1 Method

- A method was developed to document the ability of SNX to swim down after sorting. Briefly:
  - SNX were collected into a holding bin containing seawater as the catch was processed.
  - SNX were assessed for cloacal trauma (normal, everted, slightly everted) and buoyancy (floating or swimming).
  - SNX were then returned to the sea at a rate slow enough to monitor whether they swam downwards within the first 10-20 s, or remained at the surface.
    - The time from landing to release depended on the likelihood of observing the release outcome (i.e. observations were not undertaken if sea conditions or vessel speed precluded useful observation), but all observations were made within approximately 2 hours of landing.

- Trawl depths under which the swim down rates were observed ranged from 44 to 118 m.
- Catch was either processed using a 'wet' (fish were kept in water as much as possible) or 'dry' handling technique (where SNX were processed in the normal commercial way where green bins need to be filled and shown to the camera before being tipped overboard). Approximately 2000 individual snapper were assessed (Figure 4).

2.2 Key findings

- Approximately 10-15% of fish had significant cloacal trauma and about 80% floated upside down at the surface of a water-filled bin.
- When efforts were made to maintain SNX in water during the entire sorting process, approximately 90% were able to swim down when released overboard.
- When SNX were handled via the dry green bin system, the swim down rate was approximately 50%.
- Provided they are handled well, most SNX have the ability to swim down from the surface, even at capture depths >100 m.
- At the moment it is unclear what the relationship is between a vitality metric such as swim down capability and survival; however, these preliminary studies suggest that most SNX landed with the MHS have the capability to swim down quickly provided the on-board handling is carried out in a manner that maximises fish condition.

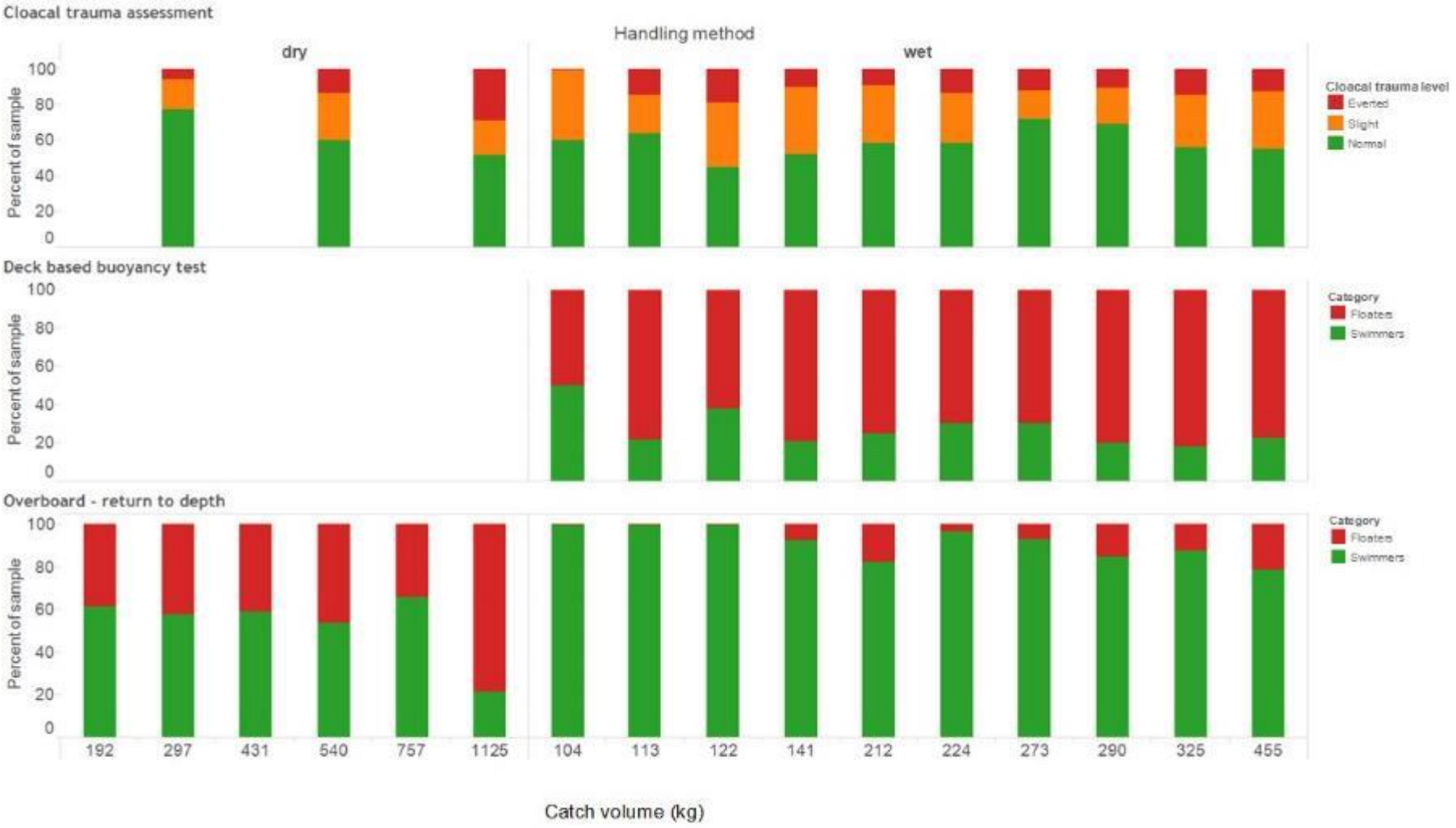

Figure 4. Tow-by-tow data on cloacal trauma assessment, deck-based buoyancy and swim down rates for snapper (SNX) landed with the Modular Harvesting System (MHS).

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