Evaluating the Condition and Discard Mortality of Monkfish, *Lophius americanus*, Following Capture and Handling in the Sea Scallop Dredge Fishery

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1.0 EXECUTIVE SUMMARY

Project Title: Evaluating the Condition and Discard Mortality of Monkfish, *Lophius americanus*, Following Capture and Handling in the Sea Scallop Dredge Fishery

Year Awarded: 2016

RSA Priorities Addressed By This Research: Bycatch/Post Release Mortality

Industry Partners: Nordic Fisheries, O'Hara Corporation

Post-release mortality (PRM) studies are considered a primary research priority where discard rates are high, or the fishery is comprised of stocks that are either overfished or interacts with species of concern. Monkfish, *Lophius americanus,* supports the most lucrative finfish fishery in New England, but also represents the second highest bycatch species for the sea scallop dredge fishery. Despite its commercial importance, no data exists on monkfish mortality rates for this (or any) gear type. Given this data gap, the goals of the current study were to evaluate PRM for monkfish captured in scallop dredge gear during standard fishing practices.

The evaluation of monkfish post-release survival builds off of two prior collaborative studies conducted by the Virginia Institute of Marine Science (VIMS), the University of New England and the New England Aquarium that utilized a temperature controlled, on-board deck tank system to evaluate the short term survival of both sea scallops and members of the skate complex (little, winter and barndoor skate). The overall experimental approach was similar to the prior studies in that a species-specific vitality index was created and evaluated for its ability to predict survival. In contrast to the experimental approaches for the skate and scallop studies, the deck tank holding approach was not utilized over concerns related to a negative tank related effect. Instead, Lotek pop-up satellite tags (PSATs) were affixed to a subset of captured monkfish to track survival over 14-28 days post-capture.

Over the course of the experiment, a total of 481 tows with randomly selected durations of 5-90 minutes were conducted between June and October 2017. Upon capture, sampled monkfish (n=5,444) were assigned a semi-quantitative injury condition (1 = uninjured, 2 = minor injuries, 3 = major injuries, 4 = dead) as well as being evaluated via four reflex responses (mouth closure, back arch, pupil fixation, and thrash). Of the sampled monkfish, 60 individuals were fitted with PSAT tags and the resulting survival was modelled as a function of a suite of environmental, biological, and physical factors associated with the capture and handling process. Preliminary results suggest a strong seasonal aspect to monkfish survival (possibly related to spawning). While future efforts to partition temporal bycatch rates are underway, assuming constant monthly bycatch rates, survival was estimated at of approximately 73%.

2.0 PRELIMINARY RESULTS AND DISCUSSION

- 5,444 fish sampled over 481 tows. 70.6% were assessed at injury Code 1, 15.2% at injury Code 2, 3.9% at injury Code 3; and 10.3% at injury Code 4 (figure 1).

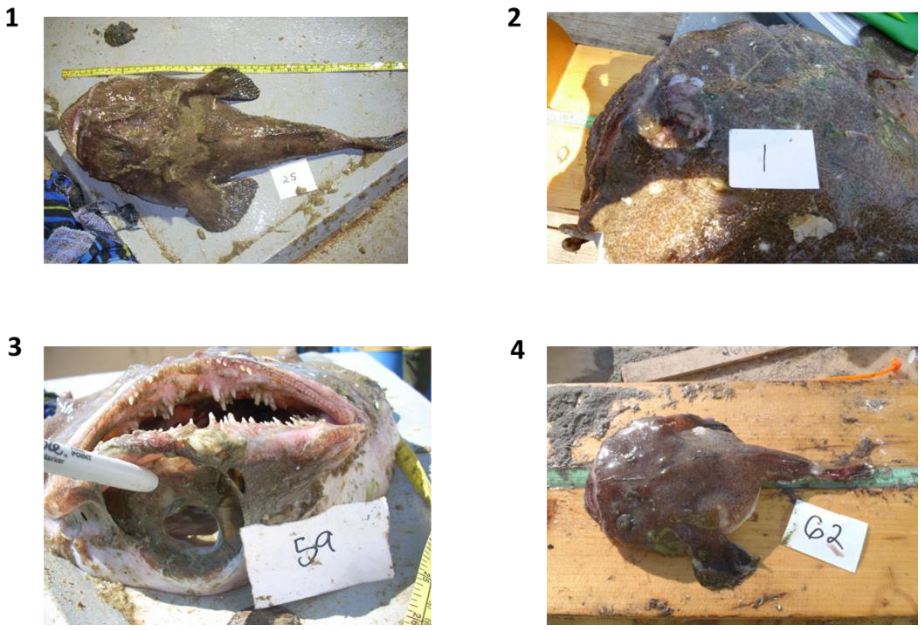

Figure 1. Semi-quantitative scale of monkfish injury codes used for the creation of vitality index.

- A total of 60 monkfish (ranging in total length from 45.0 – 92.0 cm) were assessed for injury condition and reflex impairment, and tagged with Lotek PSATLIFE tags in June, July, and August of 2017.

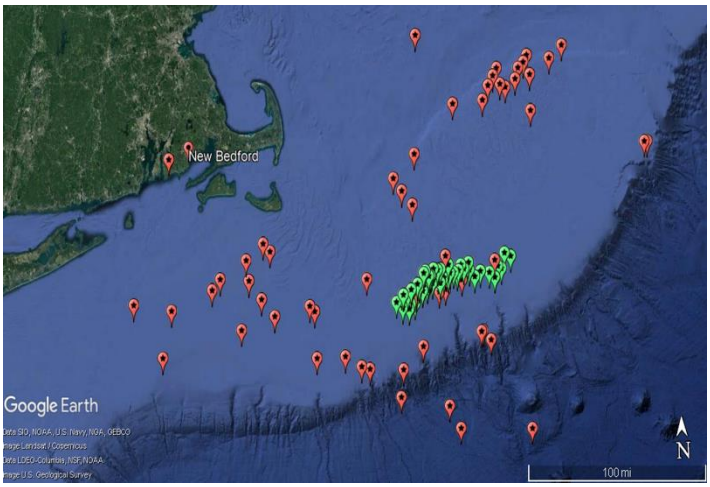

Figure 2. Location of monkfish tag deployment (green symbols) and initial tag recovery locations (red symbols).

- Fifty 28-day tags and ten 14-day satellite tags were deployed on representative injury codes: Injury 1 = 34; Injury 2= 15; Injury 3 = 8; Injury 4 = 3 (figure 2).
- 60/54 tags reported data.

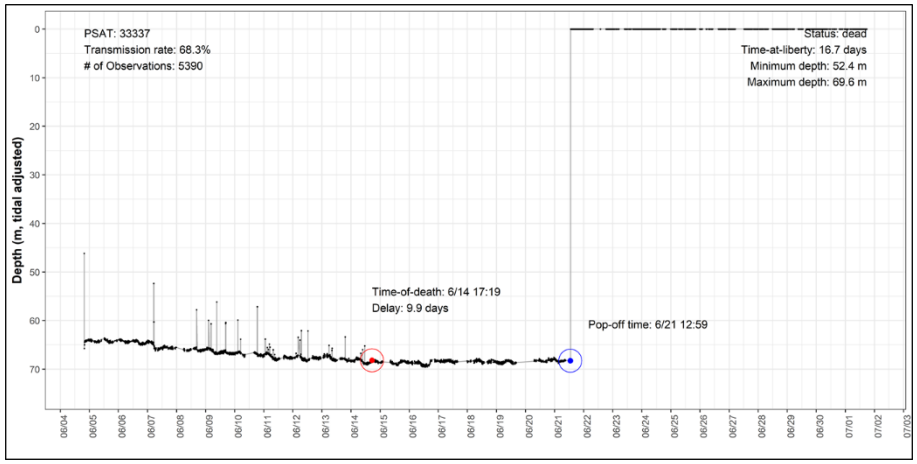

Figure 3. Example of depth data used to infer survival for monkfish tagged with PSAT.

- Survival Mixture Models indicate June had the highest mortality (rates 73%) while July and September collectively had the lowest mortality rates (17%).
- Higher mortality associated with timeframe in June of highest gonadosomatic index (Armstrong *et. al.* 1992) and highest cortisol levels (Wiessman *et. al.*, 2018) (figure 4).

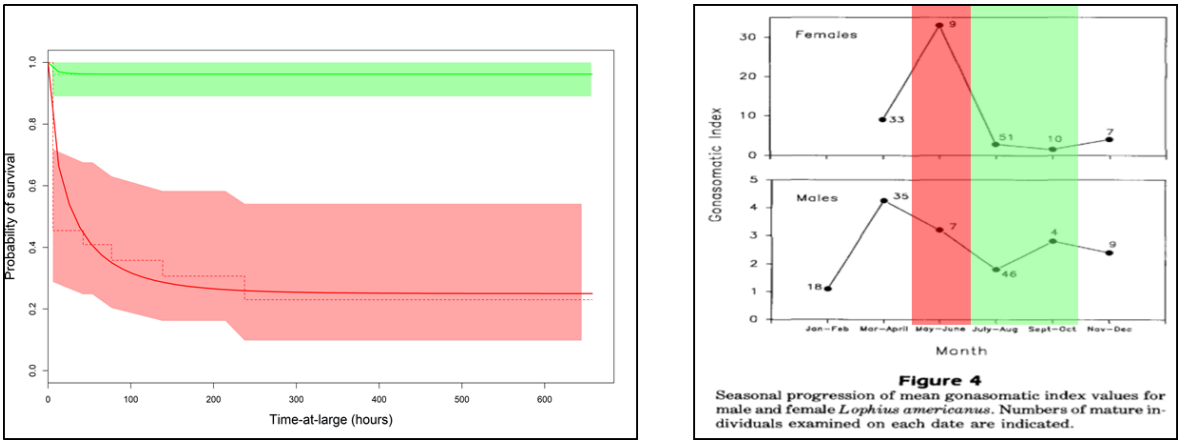

Figure 4. Preferred survival mixture model that included sampling month as a covariate. The red shading represents the timing of spawning activity and corresponds with the highest estimated post- release mortality.

- If we assume catch rates are equal throughout months and apply these survival rates to spawning vs. non-spawning months, then the estimated total discard mortality = 26.98% (Benoit, *et. al.*, 2012).

3.0 SPECIAL COMMENTS

- While monkfish appear to exhibit a high degree of physiological stress associated with capture and handling in scallop dredge gear our study suggests that they can recover from that process (Weissman et al., 2018).
- Our study indicates that mortality in this fishery is significantly lower than current estimates (100%) and could potentially be reduced further (see next two bullets).
- Since our mortality rates suggest that monkfish post release mortality is higher when the species is reproductively active, future studies should investigate this in more detail by tagging and releasing fish across all months/seasons.
- If indeed this is the case, then fishing effort could be modified to reduce overall mortality to under 20%.

Literature Cited

Armstrong M.P., Musick J.A., Colvocoresses J.A. 1992. Age, growth, and reproduction of the goosefish *Lophius americanus* (Pisces: Lophiiformes). Fishery Bulletin 90(2): 217-230.

Benoit H.P., Hurlbut T., Chasse J., Jonsen I.D. 2012. Estimating fishery-scale rates of discard mortality using conditional reasoning. Fisheries Research 125-126: 318-330.

Knotek R.J, Rudders D.B., Mandelman J.W., Benoit H.P., Sulikowski J.A. 2018. The survival of rajids discarded in the New England scallop dredge fisheries. Fisheries Research 198: 50-62.

Knotek R.J., Gill, S. M., Rudders, D. B**.**, Mandelman, J. W., Benoît, H. P., & Sulikowski, J. A. 2015. The development of a low cost refrigerated flow-through seawater system for at-sea estimation of post-release mortality. *Fisheries Research*, *170*, 152-157.

Weissman A, Mandelman J.W., Rudders D.B., Sulikowski J.A. 2018. The effect of handling and capture stress in *Lophius americanus* in the scallop dredge fishery with observations of delayed mortality. Conservation Physiology 6(1): 10.1093/conphys/coy058