Estimating hooking success for large halibut on circle hooks

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Abstract

A GoPro camera was used to observe hook attacks on a single baited hook off Afognak Island near Alaska’s Kodiak Island. We hoped to observe attacks by 50 halibut, each over 40 pounds, and to create a hooking success point estimate for these larger halibut. We did not observe enough large halibut to generate this parameter but did observe numbers of smaller halibut which confirmed our earlier estimates of hooking success for halibut 60 to 100 cm fork length and validated the technique for estimating hooking parameters.

Introduction

The study attempted to observe hook attacks by halibut in the 110 to 150+ cm fork length (FL) range to estimate hooking success. These are 40 to 80+ pound fish. Previous camera studies (Kaimmer 1998) demonstrated an increasing hooking success with increasing size for halibut ranging from about 70 to 110 cm. Our Didson\(^1\) studies in 2006 and 2007 (Kaimmer and Wischniowski 2008 and 2009) used a much larger pool of observations to refine this curve. Although these investigations estimated an increasing relationship between hooking success and fish size, which would be indicative of an asymptotic curve, neither had enough observations of large fish (over 100 cm) to estimate whether this relationship might be dome shaped with a decreasing hooking success for very large fish. It is expected that observing an additional 50 attacks from halibut spread throughout the 110 to 150+ cm range would allow the estimation of the form of the relationship between hooking success and fish length for these larger fish. The form of this curve has very important implications for stock assessment assumptions (Clark and Kaimmer 2006).

Methods

The 63-foot F/V Venturess was chartered to deploy a drop camera to observe hook attacks of large halibut. All hook attacks were monitored and recorded. A light aluminum frame holding a GoPro Hero\(^2\) camera was focused on a single baited hook (Fig. 1). This was the same frame and system which was used in the 2012 Hook Modification Study; full details of the gear design can be found in Kaimmer and Wischniowski (2013). Images were viewed in real time and were also recorded by the GoPro camera for later review. Captured rockfish were repressurized using a SeaQualizer\(^3\) pressure-activated release mechanism set to release the fish at 100 feet depth. Fork lengths of captured halibut were measured to the nearest centimeter. The length of fish not captured was estimated from the video recording. This estimation was aided by the fact that most halibut spent at least some part of their time on or very near the bottom and thus length could be compared with length of known items in the video recording. The gangion was marked at 20 cm intervals, and in most cases this was the best comparable item of known length.

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\(^1\) www.soundmetrics.com/products/didson-sonars
\(^2\) www.GoPro.com
\(^3\) SeaQualizer LLC, Miami, Florida, United States: theseaqualizer.com
Results

Fifty-nine gear deployments were completed, with durations of time on bottom ranging from 9 to 147 minutes with a total of 61 hours and 31 minutes recorded (see Fig. 2 for a chart of fishing locations). The gear was deployed in depths ranging from 20 to 65 fathoms. We observed 152 hook attacks by halibut, 64 resulting in captures, for an overall hooking success rate of 42% (Table 1). Length of halibut captured ranged from 66 to 138 cm, while length of halibut not captured ranged from 58 to 114 cm. We observed hook attacks by eleven halibut 110 cm or longer in length. Ten of these eleven attacks resulted in hooked fish.

Analysis

There were too few hook attacks by large fish to create a point estimate for the hooking success of this size group. However, the hooking success data for the smaller size fish lends itself to comparison with the more extensive hooking success data from the earlier Didson scanning sonar work (Kaimmer, unpublished). Combining the current observations with the original Didson data allows us to test for evidence of a difference in the relationships for 16/0 hooks between data gathered in 2009 and 2014. Fitting a simple logistic model, we find no evidence (Table 1) for differences in rates of hooking success between years (test of “year” effect) or of a year effect on the relationship of hooking success and fork length (test of “fork length:year”). Based on this analysis, the Didson and GoPro data sets could be combined into a single data set for 16/0 hooks. As in the earlier study, there is evidence for a relationship (test of fork length) and for a hook size effect (hook size); and, as before, no evidence that the steepness of the slope depends on hook size (hook size:fork length).

Discussion

While too few large halibut were encountered for determination of the hooking success for larger halibut, the hooking success results for smaller fish, and the close agreement of those results with results gathered earlier using scanning sonar, give a validation of the current technique for determining hooking success.

Acknowledgements

We would like to thank Tor A. Bjorklund, an oceanographic equipment fabricator at the University of Washington, for his innovative design help in constructing our deployment frame, and Captain Travis Larson of the F/V Venturess for sharing his knowledge of fish behavior and distribution during the field portion of our project.
References


Table 1. Hooking success for halibut with standard error during the 2014 experiment.

<table>
<thead>
<tr>
<th>Forklength (cm)</th>
<th>Number of hook attacks</th>
<th>Number caught</th>
<th>Hooking success</th>
</tr>
</thead>
<tbody>
<tr>
<td>55-64</td>
<td>7</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>65-74</td>
<td>32</td>
<td>7</td>
<td>0.22</td>
</tr>
<tr>
<td>75-84</td>
<td>48</td>
<td>11</td>
<td>0.23</td>
</tr>
<tr>
<td>85-94</td>
<td>37</td>
<td>21</td>
<td>0.57</td>
</tr>
<tr>
<td>95-104</td>
<td>15</td>
<td>13</td>
<td>0.87</td>
</tr>
<tr>
<td>105-114</td>
<td>8</td>
<td>7</td>
<td>0.88</td>
</tr>
<tr>
<td>115-124</td>
<td>3</td>
<td>3</td>
<td>1.00</td>
</tr>
<tr>
<td>&gt;124</td>
<td>2</td>
<td>2</td>
<td>1.00</td>
</tr>
<tr>
<td>Total</td>
<td>152</td>
<td>64</td>
<td>0.42</td>
</tr>
</tbody>
</table>

Table 2. Analysis of deviance table comparing current GoPro results with earlier Didson results for 16/0 hooks. Terms are added sequentially first to last. Significant relationships are noted with an asterisk.

<table>
<thead>
<tr>
<th>Term</th>
<th>Df</th>
<th>Deviance residual</th>
<th>DF residual</th>
<th>Dev</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hook size</td>
<td>1</td>
<td>12.826</td>
<td>557</td>
<td>747.23</td>
<td>0.0034*</td>
</tr>
<tr>
<td>Fork length</td>
<td>1</td>
<td>123.485</td>
<td>556</td>
<td>623.75</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Year</td>
<td>1</td>
<td>0.948</td>
<td>555</td>
<td>622.80</td>
<td>0.3302</td>
</tr>
<tr>
<td>Hook size:fork length</td>
<td>1</td>
<td>0.646</td>
<td>554</td>
<td>622.15</td>
<td>0.4215</td>
</tr>
<tr>
<td>Fork length:year</td>
<td>1</td>
<td>2.163</td>
<td>553</td>
<td>649.19</td>
<td>0.1413</td>
</tr>
</tbody>
</table>
Figure 1. GoPro deployment frame used in 2014 Hooking Success experiment.
Figure 2. Fishing locations during the 2014 Hooking Success experiment.
Figure 3. Hooking success from the 2014 experiment compared to the results from the 2007-8 Didson experiment. Didson results are shown by the solid circles with solid line showing the fitted curve and dotted line showing 95% confidence intervals. Crosses indicate data from the current 2014 experiment with vertical bars indicating plus or minus 1 standard error.