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Short communication

First results of the tagging of shortspine thornyhead, *Sebastolobus alascanus*, in Alaska

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ABSTRACT

Shortspine thornyhead (*Sebastolobus alascanus*) is a commercially valuable deep dwelling rockfish species that has been tagged in Alaska waters since 1992. These tagging results are the primary analyses available for evaluating the movement of this species, which will allow managers to determine the appropriate geographic scale of management. A total of 13,897 tagged fish have been released, with 228 recoveries reported during 1992–2016. Of the returned tags, 19% traveled < 2 M (nm) between tagging and recovery location, 36% traveled 2–5 nm, 18% traveled 6–10 nm, 12% traveled 11–50 nm, 4% traveled 51–100 nm, and 11% traveled > 100 nm. While a small percentage of tagged shortspine thornyhead traveled large distances, at times crossing management and international boundaries, the low movement rate indicates that the current scale of management for shortspine thornyhead rockfish in Alaska appears to be appropriate.

1. Introduction

Shortspine thornyhead (*Sebastolobus alascanus*, SST) is a long-lived, commercially valuable, deep dwelling species that inhabits the northeastern Pacific Ocean from Baja Mexico to the Gulf of Alaska (GOA), westward to the Aleutian Islands (AI), Eastern Bering Sea (BS), and into the Seas of Okhotsk and Japan (Love et al., 2002). Adult SST are generally found along the continental slope at depths of 150–450 m. Thornyheads belong to the family Scorpanenidae, which contains the rockfishes. While SST are considered rockfish, they are differentiated from *Sebastes* in that they lack a swim bladder, making them ideal tagging specimens. The Alaska Fisheries Science Center (AFSC) of the National Marine Fisheries Service (NMFS) has been tagging SST in Alaska waters since 1992. To our knowledge this is the first tagging study on this species. We present here the first summary of the release and recapture data from SST tagging.

Spatially explicit management, that is managing allowable catch by areas, is used for management of several economically important fisheries in Alaska, including the thornyhead stock complex fishery. The thornyhead complex contains three *Sebastolobus* species, including SST (Echave et al., 2015). To help managers determine the appropriate scale of spatial management, an understanding of the distribution and movement of fishes is necessary. Tagging of SST occurs during stock assessment surveys. Analysis of tag data is used to examine SST movement patterns and can assist with questions regarding stock structure and growth. The objectives of this study are to provide a summary of the information on SST growth and movement based on these tagging data, and to examine how these growth and movement results contribute to the definition of SST stock structure.

2. Material and methods

Tagging of SST first occurred in 1992, but was inconsistently done until 1997. Since then SST have been tagged in offshore waters as part of the NMFS annual Alaska Fisheries Science Center Longline Survey (Rutecki et al., 2016). The AFSC longline survey is primarily used for the assessment of sablefish (*Anoplopoma fimbria*), but catches other species of interest as well, such as the shortspine thornyhead. Fig. 1 shows the major release and recovery areas, as well as the location of the annual longline survey stations. Approximately 5% of the longline survey catch of SST was tagged and released each year, which generally equals about 500–1000 fish per year (Table 1). Most of the tagged and released fish carried conventional anchor tags, whereas a small portion also carried internally implanted electronic archival tags. Conventional anchor tags (www.floytag.com) are 1.5 inches long, and inserted externally into the musculature of the fish below the dorsal fin using a needle-like applicator (Fig. 2). Upon recapture of conventionally tagged fish, geo-location and biological data may be collected. Electronic archival tags (www.Lotek.com) are electronic data collecting tags that are surgically implanted into the abdomen of the fish (Fig. 3). These archival tags collect temperature and depth data at a predefined sampling rate. Fish tagged with electronic archival tags were also tagged with a fluorescent pink and green external tag stating that an “Electronic depth sensor” was inside the fish. Upon recapture of the archival tagged fish,

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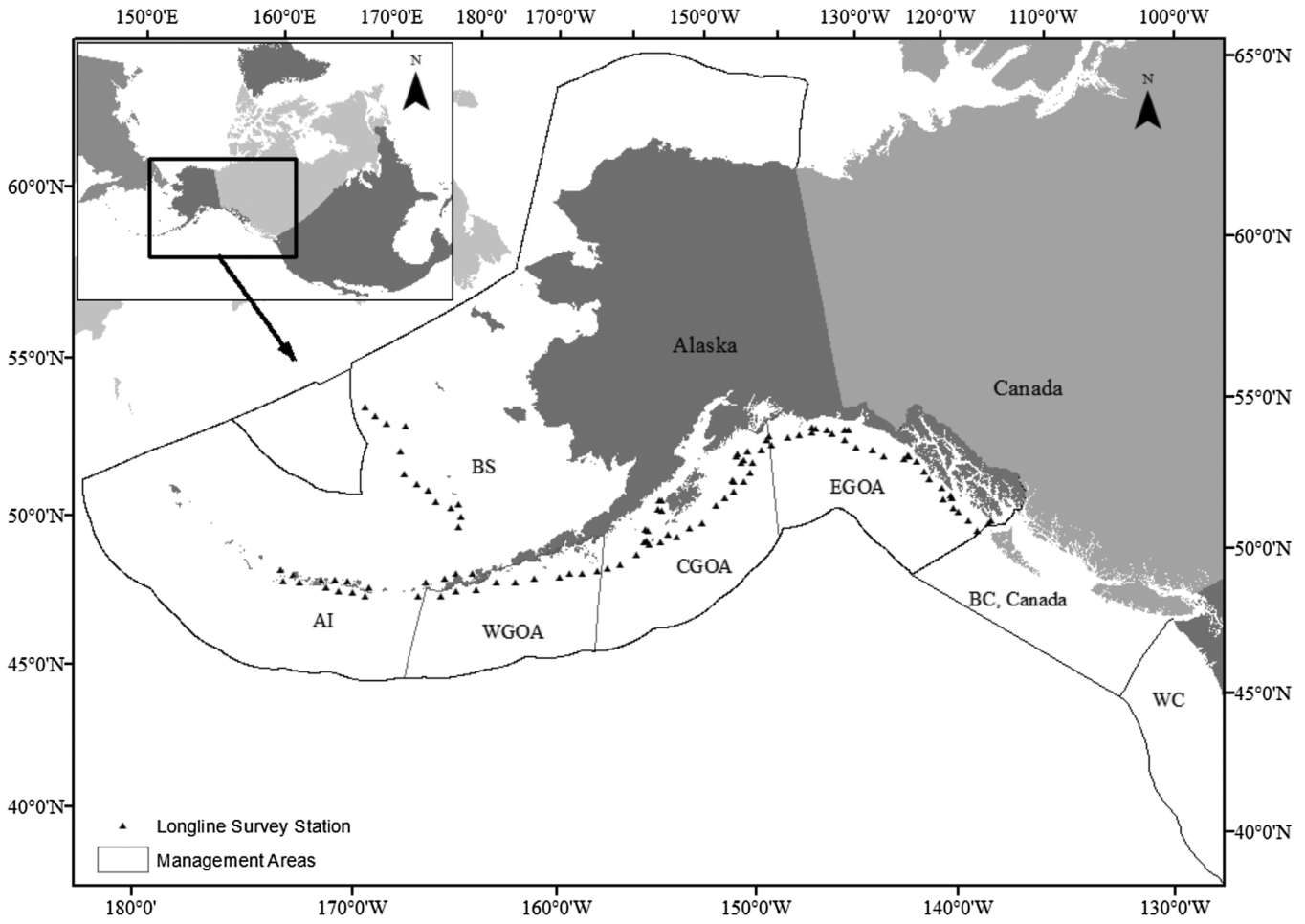

Fig. 1. Map depicting the NMFS annual longline survey stations (triangles) and management areas: the Bering Sea (BS), Aleutian Islands (AI), Western Gulf of Alaska (WGOA), Central Gulf of Alaska (CGOA), and Eastern Gulf of Alaska (EGOA). Tags are deployed at all stations in the GOA each year, and in alternating years in the BS and AI. Additionally, British Columbia (BC), Canada and West Coast of the United States (WC) are noted.

data that are collected include the release and recovery location, archived depth and temperature data, and biological data (e.g., otoliths, length/weight at release and recapture). Because archival tagged fish include similar data (release location, recovery location, and growth), their release and recovery data are pooled with conventional tag release and recovery data and presented together throughout the paper. All SST tag recoveries have occurred during commercial fishery activities and fishery-independent surveys. Analysis of data from recovered archival tags is still underway and will be presented in a separate paper.

All tag recoveries are given a position accuracy score of 1–5: 1 means position is precise to at least the nearest minute of latitude and longitude (0.5–1 nautical mile, nm), 2 means position is precise to the nearest 10 min of latitude and longitude (5–10 nm), 3 means position is precise to the nearest degree of latitude and longitude and includes most Alaska Department of Fish and Game statistical areas (30–60 nm), 4 means position is precise to the nearest 3 ° (90–180 nm) and also includes recoveries where only general area is known such as Eastern Gulf of Alaska, and 5 means position is completely unknown. The release location recorded in the tag database for all tag releases from the longline survey are the start coordinates for the station haul. However, each haul is approximately 4 nm in length and fish that are tagged from the longline survey aren't released at their exact catch location, but generally further along the set of gear.

3. Results

Since 1992, 13,897 SST have been tagged and a total of 228 tagged SST have been recovered (Table 1). The majority of recovered tags have been caught using commercial longline gear (160 tags). Fifty of the 228 total recovered tags have been caught on the NMFS annual AFSC Longline Survey. The majority of tag recoveries have been from the Central (75 tags) and Eastern (83 tags) GOA (Table 2). The shortest duration a tag was at liberty was for 2 days, and the longest was 15.5 years. The fish at liberty for 15.5 years grew 10 mm in that time and was recovered only 4.3 nm from the release location. The fish at liberty for 2 days "traveled" 7.8 nm. The average time at liberty for all recovered SST tags was just under 4 years.

Using only recoveries with a position accuracy code of 1, the great circle distance traveled by a tagged SST ranges from < 1 nm to 990 nm. Of these, 19% traveled < 2 nm, 36% traveled 2–5 nm, 18% traveled 6 − 10 nm, 12% traveled 11–50 nm, 4% traveled 51–100 nm, and 11% traveled > 100 nm. The average distance traveled was 46 nm, with no apparent difference in travel distance by sex (male = 49 nm and female = 44 nm; two sample *t*-test (96) = 0.03, p = 0.49; Table 3). It is important to note that movement of less than 5 nm could be influenced by the survey haul coordinates that are used as the tag release location, as mentioned in the Methods section. The elapsed time between capture and release varies and this could affect the distance between release and recapture estimates.

Apparent movement patterns appear to be unrelated to fish size at release based on a one-way ANOVA ($F(2, 168) = 0.48$, $p = 0.6$). The average distance traveled was greatest (95 nm) for the largest size group (> 40 cm), but a fish from the smallest size group (< 33 cm) traveled the farthest maximum distance (990 nm; Table 3). Note that