Pacific Fisheries Management Council

2018-2019 PIER Research Update

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PIER Research Progress and Preliminary Summary: In addition to managing two groups of cooperative fishers operating under exempted status during the 2018-19 fishing season, PIER was also engaged in several relevant research studies on fish movements, gear development and post release survivorship. This update reports on preliminary findings from linked buoy gear research sets and relevant research performed during the 2018-19 field season.

1. Linked buoy gear development and research trials

In 2018, PIER worked under several NOAA awards to further develop, trial and conduct research on deep-set buoy gear (DSBG) and linked buoy gear (LBG). Details for activities performed under each award are provided below, as well as an initial synopsis of catch and preliminary gear performance.

Collectively, the PIER research team performed 21 sets of Linked Buoy Gear from May, 2018 through January, 2019 bringing the total to 95 research sets to date (2015-2019). To date, catch composition between research sets of DSBG and LBG has been similar, with swordfish and bigeye thresher shark (BET) comprising the two primary catch species. Thus far, one slight difference in the catch is that there have been no LBG interactions with northern elephant seals (*Mirounga angustirostris*). This may be attributable to the rarity of these events and the lower number of sets performed to date.

Swordfish comprised 75% of LBG catch and bigeye thresher sharks made up an additional 12% of the total. An additional 9% of LBG catch consisted of blue sharks, most of which were caught either during a single research cruise to the waters off Central California (i.e., Pacific Leatherback Conservation Area, PLCA) or prior to the installation of a hydraulic line-setter for increasing gear sink rates. As with previous DSBG research trials, target catch rates have varied by season and have shown a steady increase in catch per unit effort (CPUE), ranging initially from 1.1 swordfish/set day in 2015 to 2.3 swordfish/set day in the 2018-19 season.

2. Improving stock structure estimates for west coast swordfish using fishery independent methods. (NOAA Saltonstall-Kennedy award # FNA16NMF4270257)

This study reports on the horizontal movements of swordfish tagged and released during deep-set research trials from August, 2015 through December, 2018. Geolocation data from a suite of electronic tag types were collected to better understand swordfish movements and stock affiliation relative to current management hypotheses for the north Pacific. Twenty-seven percent of tagged swordfish reported proximal (<225 km) to their tagging location within the southern California Bight (SCB). Of the 53 swordfish that moved outside of the southern California tagging area, 74% exhibited affiliation to the Eastern Pacific Ocean (EPO) management unit, 22% moved into the Western and Central North Pacific (WCNP) and 4% spent time within both the EPO and WCNP boundaries. Wide-spread seasonal movements ranged from the Equator (0.8ºN.132.0ºW) to out beyond the Hawaiian Islands (17.0ºN/154.0ºW) validating the highly migratory nature of California swordfish. Findings from this work suggest that southern California swordfish may exhibit a higher level of EPO connectivity than previously proposed. Initial findings have been submitted for publication in a peer-reviewed scientific journal and additional tagging studies are underway to further assess inter-annual variability as well as test population structure hypotheses using genetic techniques (OPC 2018 award # 111805971)

3. **Bigeye Thresher Shark (BET) Survivorship Using DSBG methods (NA16NMF4720371)**

This NOAA-BREP funded study outfitted BET with pop-up satellite archival tags (PSATs) to evaluate acute post-release survival following capture in the DSBG fishery. Additionally, this work collected movement information to better understand depth and temperature distribution for this poorly known species while in the SCB. Fourteen BET (43-93 kg) were tagged from 2016 to 2018 with PSATs programmed for a 30-day deployment

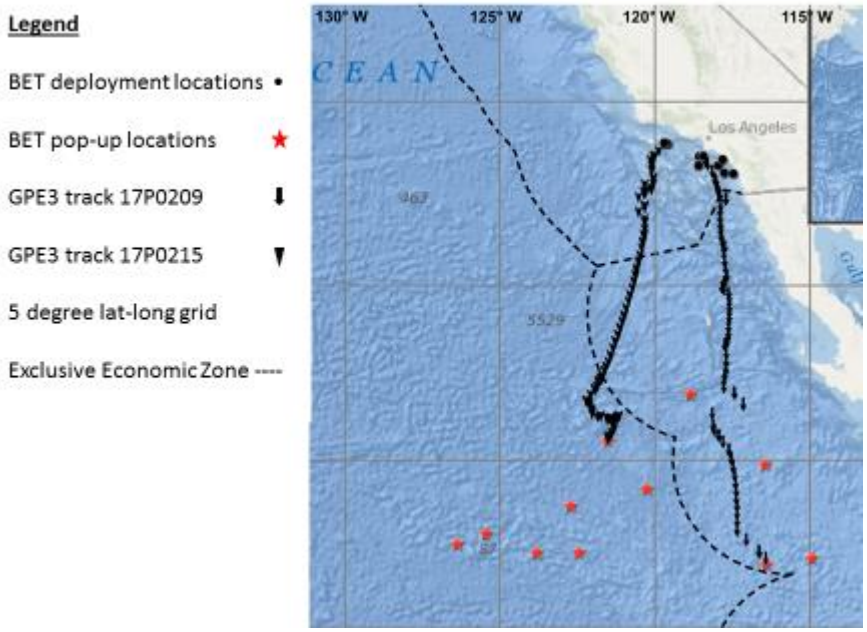

Figure 1. A map of capture and release points for 12 BET tagged and released using DSBG techniques.

period. Cooperative fishers participating in the PIER DSBG EFP assisted with the deployments to ensure that methods and handling were consistent with those currently used in the exempted fishery. BET fight and handling times (period from strike detection to release) ranged from 15 to 171 minutes, aligning with previous capture and handling observations. Out of the 14 deployments, twelve individuals survived the acute effects of capture, one BET died shortly after release and one individual was preyed upon 6h after release. Given the uncertainties associated with predation induced mortality of tagged fish, the dataset was presented both with (86% survivorship) and without (92% survivorship) the predation event. All surviving BET exhibited consistent diurnal dive patterns in which the sharks remained below the thermocline during the day and within the mixed layer at night. Most of the tagged BET in this study moved significant horizontal distances to an offshore area off southern Baja California, Mexico (Figure 1). Depth data is currently being used to assess if fishing operations can be further modified to avoid BET in future deep-set operations. Collectively this study has found that BET can survive the acute effects of DSBG capture when handled properly.

Project findings were submitted to *Fisheries Research* for publication in early 2019.

4. **Bigeye Thresher Shark Survivorship on Linked Buoy Gear (NA18NMF4720288)**

This NOAA-BREP funded study is currently underway, with additional tagging proposed for the 2019 fishing season. Preliminary data obtained from six BET tagged in 2018 suggests high post-release survivorship, as all six sharks survived the acute effects of LBG capture. Similar to the DSBG BET survivorship findings, LBG tagged sharks also moved significant distances (>1,000 km) to an offshore region off southern Baja California.

5. **Bluefin tuna post-release survivorship from recreational gear (FNA15NMF4270314)**

Although recreational fisheries only account for a minor component of Pacific bluefin tuna harvest, a bag limit reduction from 10 to 2 fish person^{-1} day^{-1} was implemented off California in 2014. Considering the potential for an increased number of PBF to be released in the California recreational fishery, this study assessed post-release disposition using a combination of electronic and conventional tags. Additionally, biochemical indices of capture stress were measured in the blood and coupled with tagging data to better understand the physiological response to time on the line. A survivorship estimate was generated based on tagging data from 41 PBF ranging in size from 82-148 cm FL (~11-63 kg) and blood sampling was performed on an additional 49 PBF (80-170 cm FL). Tagging results yielded only one mortality for the fish with the longest fight time (280 min) and one predation event. These data suggest that, when

handled properly, PBF can be relatively resilient to west coast angling techniques. This work also generated a best handling practice guide that has been disseminated among the recreational community.

The findings from this study were submitted to *Fisheries Research* in March of 2019.

6. Future Research Directions

a. In 2019 the PIER team will continue to tag swordfish and assess horizontal movement patterns under both NOAA and state funded awards.

b. PIER will focus more closely on swordfish movements and the potential for fishery development off Central California and the waters of the PLCA.

c. *Fishery development and electronic tagging of Opah* (*Lampris guttatus*): In 2019 PIER will work with NOAA researchers at the Southwest Fisheries Science Center to address questions related to the movements, stock structure and targeting of opah using both DSBG and LBG. The goal will be to increase biological information available for this poorly studied species and also explore the potential for increased targeting with the newly developed deep-set techniques. This work has received initial funding for pilot testing and PIER will continue to look for additional resources to support this line of study.