Pacific Fisheries Management Council

2020-2021 PIER Research Update

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PIER Research Progress Report: In addition to managing two groups of cooperative fishers operating under exempted status during the 2020 fishing season, PIER was also engaged in several relevant research studies on fish movements, electronic monitoring and post-release survivorship. This update reports on preliminary findings and relevant research performed during the 2020 field season.

1. **Improving stock structure estimates for west coast swordfish using fishery independent methods. (NOAA Saltonstall-Kennedy award # FNA16NMF4270257 and Ocean Protection Council Project # R/OPCSFAQ-07)**

In 2020 the PIER team deployed an additional 20 electronic tags on swordfish, bringing the total deployed to date to 196 (total includes both satellite based and archival, data logging tags). Geolocation data from recent deployments are now being used to better understanding seasonal swordfish migration patterns in relation to management unit designations in the eastern north Pacific. The first scientific manuscript detailing swordfish migration routes was published in 2019 (Sepulveda et al., 2019) and a second manuscript was published in 2020 (Grifiths et al., 2020). The 2020 publication provides insight into the movements of all swordfish electronically tagged off the US West Coast to date (Figure 1.) and also presents recent data from the deployment of dorsal fin-mounted satellite transmitters which show horizontal movements over extended periods (>900 days). For swordfish, dorsal fin-mounted tags now offer multi-season migration data that is of longer duration and finer scale than those previously collected. Given that migration patterns can be impacted by seasonal and climactic trends, our goal is to continue to deploy 15-20 tags each season to fully address questions pertaining to stock affiliation and structure in the eastern north Pacific. In December of 2020 findings from

the tagging research were shared with the IATTC at the Technical Workshop on Swordfish in the South EPO[1].
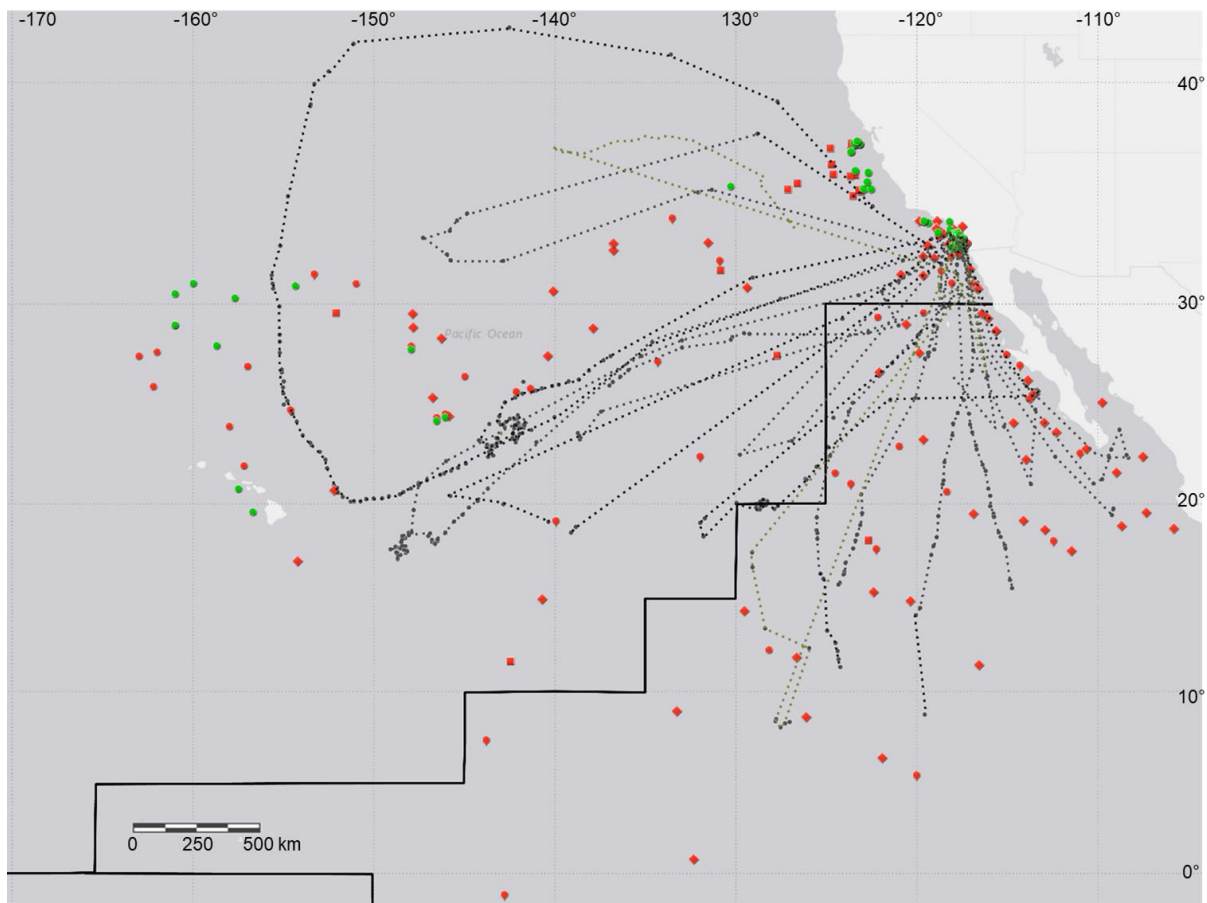

Figure 1 Electronic tag deployment (green symbols) and recovery/popup locations (red symbols) for 128 swordfish in relation to the ISC swordfish stock boundary lines from tagging studies conducted in the eastern and central north Pacific (Dewar et al., 2011; Abecassis et al., 2012; Sepulveda et al., 2018; Sepulveda et al., 2019 and PIER, unpublished data), in addition to preliminary movement data from 16 dorsal-fin mounted SPOT tags deployed on swordfish off southern California from November, 2017 through November, 2020.

2.   **Post-release survivorship and movements of bigeye thresher sharks following capture on deep-set buoy gear (NA16NMF4720371) and linked buoy gear (NA18NMF4720288)**

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[1] https://www.iattc.org/Meetings/Meetings2020/SWO-01/_English/SWO-01-RPT_1st%20Technical%20workshop%20on%20swordfish%20in%20the%20South%20EPO.pdf

In 2020, the PIER team published NOAA-BREP findings on bigeye thresher shark (BETS) post release survivorship following capture on Linked Buoy Gear (Aalbers et al., 2020). The work identified that BETS are resilient to capture on linked gear with >90% surviving the acute effects of catch and release. Findings align with previously published NOAA-BREP research on DSBG survivorship, which also suggested that this species is relatively hardy and capable of post release survival (Sepulveda et al., 2019). The work also revealed that BETS are highly migratory and capable of extensive movements (>1,000 km in less than 30 days). Interestingly, both the 2019 and 2020 studies showed that the BETS captured off California migrate to the same general area after release, suggesting a migratory corridor between Southern California and an offshore region of the eastern Pacific (Sepulveda et al., 2019). Collectively, these studies provide valuable information that can be used by managers to quantify the impacts the developing deep-set fishery has on the BETS resource.

3. Electronic Monitoring of the Deep-set fishery

In 2020, the PIER team initiated the first phase of an electronic monitoring (EM) study funded through the National Fish and Wildlife Foundation (NFWF ID# 0303.19.066290) and The Nature Conservancy. The work is focused on assessing the feasibility of monitoring deep-set fishing activity with a small-vessel EM system. In 2020, PIER worked with two service providers to develop and test two independent EM systems aboard the research vessel *Malolo*. Despite a reduced field season due to COVID-19 safety concerns, the team was able to collect data from 15 set days. Currently the team is working to refine review protocols using the research dataset and preparing to outfit 2-3 commercial vessels with EM systems in the 2021 season. Project goals are to collect electronic and physical observer data from >75 DSBG and LBG sets to assess whether deep-set catch and activities can be accurately quantified using EM.

4. Opah Tagging

Electronic tagging of Opah (*Lampris guttatus*): In 2021, PIER will work with NOAA researchers at the Southwest Fisheries Science Center to address questions related to the movements, reproductive biology and targeting of opah using both DSBG and LBG. Objectives include increasing biological sampling and the expansion of studies on the reproductive biology of this poorly studied species.

Recent PIER Scientific Publications

Sepulveda CA, Wang M, Aalbers SA, Alvarado-Bremer JR. Insights into the horizontal movements, migration patterns, and stock affiliation of California swordfish. *Fish Oceanogr.* 2019;00:1–17. https ://doi.org/10.1111/fog.12461; https://onlinelibrary.wiley.com/doi/abs/10.1111/fog.12461

Sepulveda, C.A, M. Wang, S.A. Aalbers, (2019) Post-release survivorship and movements of bigeye thresher sharks, Alopias superciliosus, following capture on deep-set buoy gear,

Fisheries Research, Volume 219, 105312, ISSN 0165-7836, https://doi.org/10.1016/j.fishres.2019.105312.

Aalbers, S.A., Michael Wang, Charles Villafana, Chugey A. Sepulveda, (2021). Bigeye thresher shark Alopias superciliosus movements and post-release survivorship following capture on linked buoy gear, *Fisheries Research*, Volume 236, 105857, ISSN 0165-7836, https://doi.org/10.1016/j.fishres.2020.105857

Griffiths S., C. Sepulveda and S. Aalbers. (2020). Movements of swordfish (Xiphias gladius) in the northeastern Pacific Ocean as determined by electronic tags (2002-2019). ISC/20/BILLWG-01/10 file:///C:/Users/Chuge/Downloads/ISC_20_BILLWG-01_10%20(2).pdf