Factors behind the recent rise in bigeye CPUE in the Hawaii longline fishery – Jeff Polovina

Since 2013 catch-per-unit-effort (CPUE) of bigeye tuna in the Hawaii longline fishery has been increasing both in number of fish and biomass (Fig. 1). Johanna Wren, Phoebe Woodworth-Jefcoats, and Jeff Polovina have used logbook data, dealer weight data, and vertical temperature data to investigate the possible reasons for this recent CPUE increase.

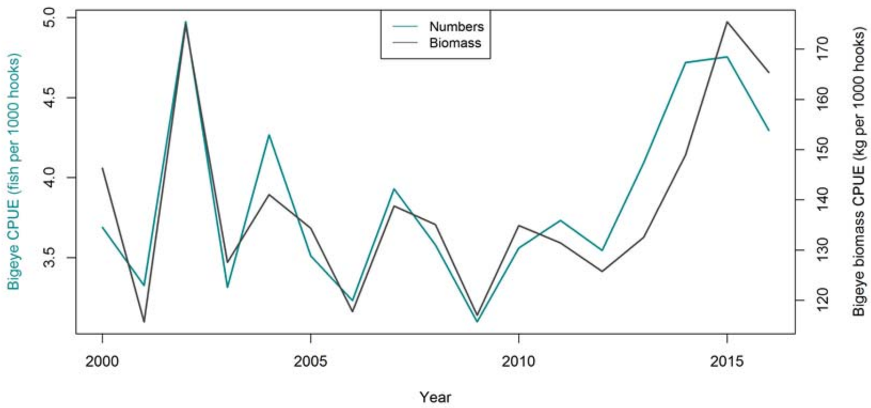

Figure 1. Bigeye tuna annual catch-per-unit-effort (CPUE) by number and weight in the Hawaii longline fishery 2000-2015 with Jan-June 2016 included as the last point.

Quarterly CPUE by weight class of landed bigeye with gilled and gutted fish weight converted to whole fish weight shows a strong recruitment of 2-3-year-old (10-20kg) fish in the 3rd quarter of 2013 (Fig 2). This strong recruitment is seen progressing through the fishery size/age structure over the subsequent quarters, reaching 40-55 kg in quarter 1 of 2016 (Fig.2). This very strong recruitment in late 2013 is a major reason for the rise in CPUE beginning in 2013 with CPUE in numbers leading the rise followed by CPUE in weight as the fish grow (Fig. 1).

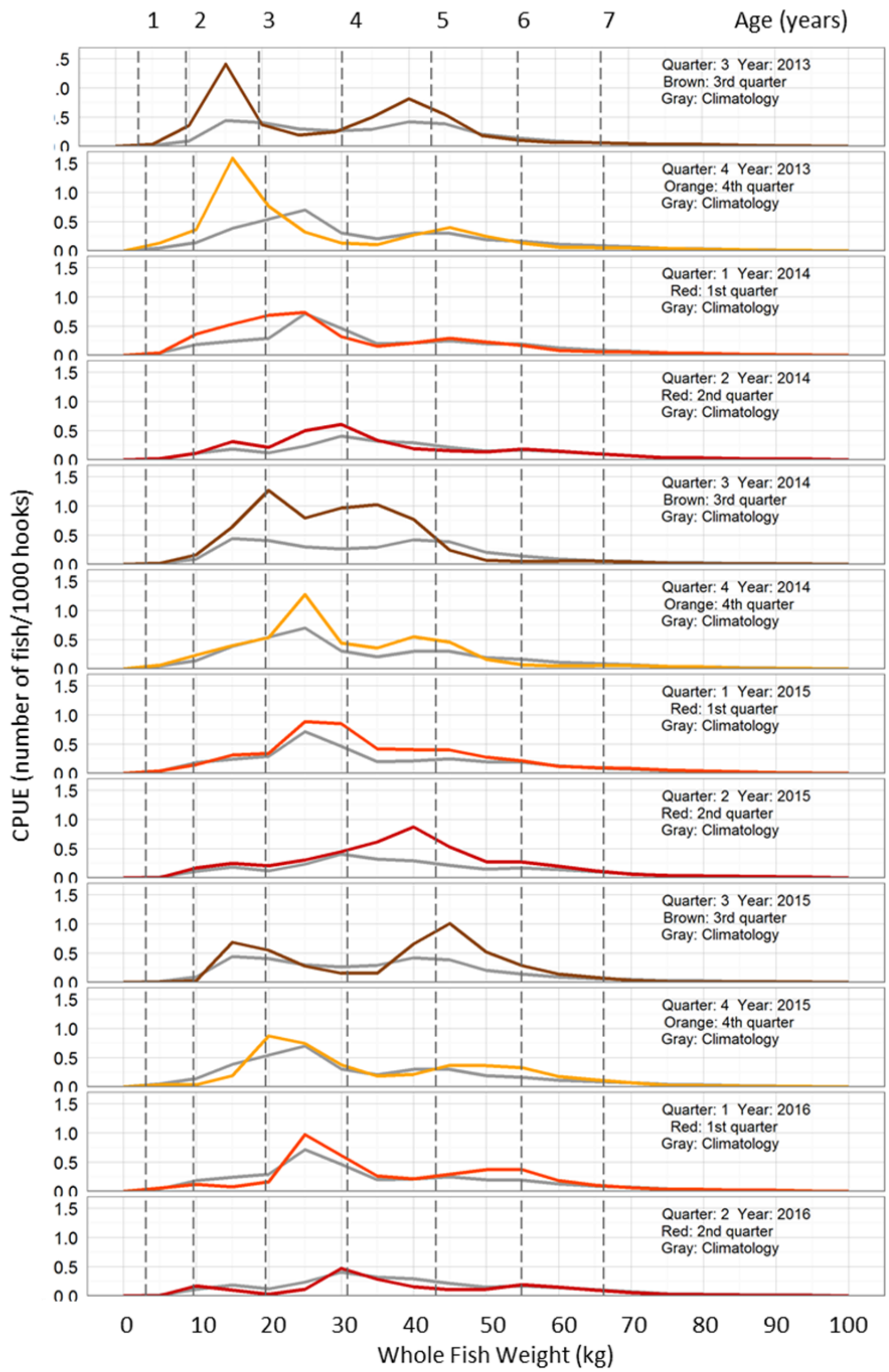

Figure 2. Quarterly CPUE by weight together with longterm mean quarterly CPUE (gray line).

Argos vertical profiling float data provides data on vertical temperature. Bigeye tagging data has documented the preferred foraging habitat of bigeye tuna in 8-14 °C water. The depth of this water shoaled by about 50m in the core region of the fishing grounds in 2015 relative to the long term mean depth (Fig.3). This shoaling of bigeye forage habitat may have improved catchability and hence CPUE in 2015 by compressing bigeye vertical distribution in the water column and also possibly allowing more hooks to reach the foraging depth. This shoaling is a response from weak trade winds in 2015 (Bo Qui, pers. comm.). However, in 2016 with the return of strong trades the depth of the forage habitat has been pushed deeper than the long term average. Thus the vertical temperature data show that foraging depth can change interannually and this could be a source of interannual variation in CPUE and may have resulted in increased 2015 CPUE but was not responsible for the multi-year CPUE increase over 2013-2016.

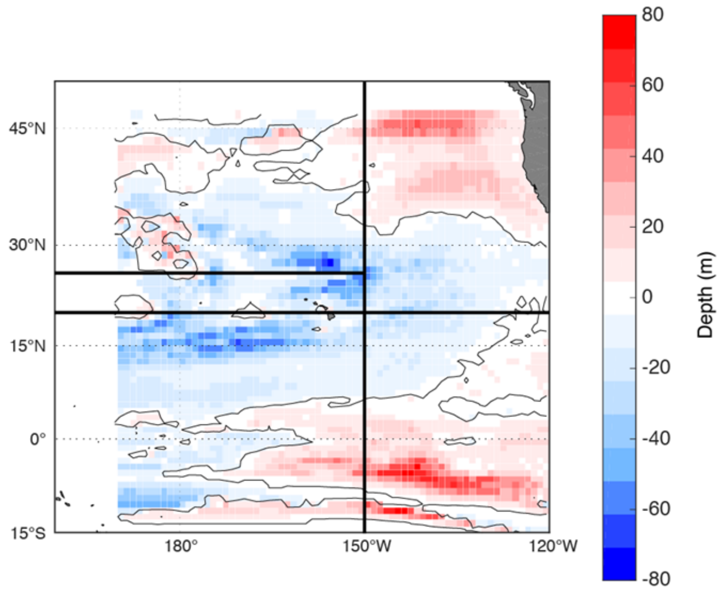

Figure 3. Depth of 8-14°C water (m) in 2015 relative to the longterm mean from Argos profiling floats.

Lastly, in recent years effort in the fishery has continued to increase and expanded to the north and northeast where CPUE has been higher than in the core region around the Hawaiian Archipelago. A comparison between CPUE in the spatially constrained core region verses CPUE for the entire fishing ground shows that CPUE is higher over the entire fishing ground due to the higher CPUE in the north and northeast (Fig. 4). Thus some of the increase in CPUE since 2013 is likely due to an increase in effort in regions with higher CPUE especially in the third quarter.

In Summary a recent increase in bigeye CPUE is due primarily to a strong recruitment pulse entering the fishery in quarter 3, 2013, and propagating through the fishery over the 3 subsequent years. A trend of more fishing effort deployed to the north and northeast where CPUE was higher than the core region also increased CPUE. Lastly interannual variation in the depth of bigeye foraging habitat can be significant and may have increased catchability in 2015. Going forward the CPUE by weight class from the dealer data provides a source for developing a recruitment index to forecast future CPUE. In 2016 the annual bigeye quota of 3500mt was reached earlier than any previous year. An 8% increase in effort during the first 6 months of 2016 compared with 2015 was an important contribution to reaching the quota earlier.

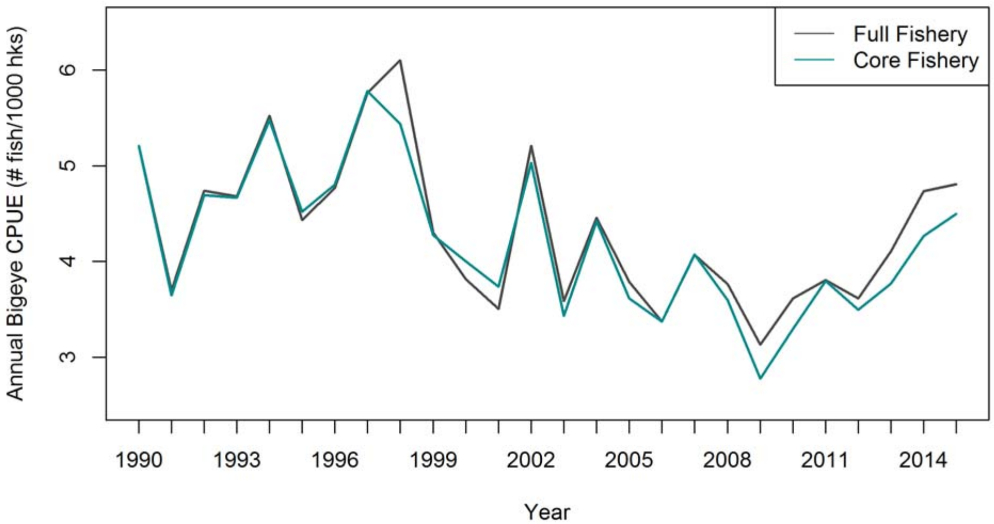

Figure 4. Annual bigeye CPUE over the entire fishing ground (black) and the core area fished continuously since 1990.