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RE: Bering Sea bairdi info – NMFS and BSFRF survey comparisons

To: Bering Sea Fisheries Research Foundation Board and other industry members

Executive Summary

The 2016 mature female bairdi biomass in the Bering Sea was reported to be 8.067 million lbs or 17.9% below the minimum regulatory threshold necessary for a fishery opening. Two independent summaries of 2016 summer survey data (NMFS and BSFRF) were evaluated to further understand the current status of Bering Sea bairdi stock and specifically, the mature female bairdi stock. The 2016 NMFS survey results for bairdi were reviewed closely and compared with prior NMFS-only results back to 2013 for consistency. The BSFRF surveys for the same period were also used to comparatively review NMFS bairdi catch consistency, and for 2016 offered a more complete trawl selectivity comparison, as more stations were covered. Both survey summaries showed a declining trend for mature female bairdi but the relationship of the compared surveys appeared to be different in 2016.

A review of spatial changes since 2013 in the NMFS mature female bairdi catches was completed by ranking the highest 10 observed mature female bairdi catch stations per survey year and plotting those in comparison to management boundaries. The spatial changes were also plotted for the highest 10 stations with a redefined mature female bairdi class – using the cut lines (>84 mm east of 166W, and >79 mm west of 166W) as defined in the ADF&G harvest strategy for bairdi. This comparison showed some differences where the top stations were in relation to east/west classification and some areas in 2016 that could be gaps in mature female bairdi distribution, depending on how female maturity was classified. The spatial comparisons most notably reflected that very high catches of mature female bairdi in recent years were beyond the 173W boundary and were excluded from mature female biomass counting.

A review of NMFS trawl selectivity for female bairdi in 2016 compared with 2013-2015 reflected a more significant difference in 2016 NMFS survey results of mature female bairdi. In 2013-2015 surveys where BSFRF conducted side-by-side towing with NMFS vessels about 26% of mature female bairdi (observed mature) were captured in the NMFS trawl on average. This estimate of capture probability across the 60 stations covered each year appears to be very consistent on average for observed mature female

bairdi. In contrast, the 2016 side-by-side station coverage was more than double the spatial coverage (140 stations), and the average proportion of mature female bairdi captured by the NMFS trawl dropped to 0.20, which is about 26% lower than the prior three years average, and is reflected in comparative plots per year. The relative difference in 2016 trawl selectivity for mature female bairdi (-23%) is similar to but exceeding the scale for which mature female bairdi biomass fell below the required minimum threshold (-18%). Given the significance of current status of mature female bairdi biomass index, the results of this review suggest that some further consideration of mature female biomass is due.

This summary is intended for review and dissemination by the BSFRF Board. The information is from review of 2013-2016 NMFS-BSFRF cooperative crab surveys and from other prior NMFS years before 2013. All information relied on is publicly available from the web or by request. The data used for these summaries has been provided to Westward Regional staff of ADF&G as part of BSFRF data sharing earlier this fall. The summaries presented here have been discussed recently with ADF&G but have not been fully reviewed. As mentioned above, there are two areas of focus in this summary; 1) a review of anomalies in recent NMFS survey data for bairdi, and 2) a review of trawl selectivity estimates for the NMFS survey trawl from side-by-side sampling.

Background

NMFS summer survey crab CPUE data is the primary information relied on for annual stock assessment and management. Results from the surveys are the most comprehensive and systematic information available for crab but are consistently uncertain, and management strategies are at times forced to be precautionary. BSFRF has worked over the last decade to help with further scientific information to improve management. Most of the Foundation's work has focused on helping to calibrate survey results through estimation of trawl selectivity for each crab species separately within each stock assessment model. The recent history of working with NMFS survey teams and crab managers has improved 1) understanding about NMFS survey crab results, 2) transparency for how results are used and 3) how uncertainties are dealt with.

The NMFS surveys cover 375 standard stations each summer between about June 1 and August 5. The Bering Sea bairdi stock area is managed around 166 W longitude and NMFS survey data is also split east and west of this line with 255 stations in the west and 120 stations in the east. A further boundary at 173 W longitude excludes NMFS survey results from consideration in State of Alaska (SOA) harvest strategies. In certain years, high survey CPUE of bairdi are observed in NMFS stations near 175 W longitude (near Zhemchug Canyon) and are excluded from SOA crab biomass estimates. BSFRF charters have worked alongside or in the area with NMFS charter vessels for portions of the Bering Sea summer survey for the last four years covering about 60 stations in the eastern section of the bairdi district from 2013-15 and 140 stations were covered in 2016, 20 in the west and 120 in the east.

Bairdi Survey Results

Current results from the 2016 NMFS survey are particularly challenging for the Bering Sea bairdi stock as some stock components are up, others are down, and the status of

the current mature female biomass estimate from the 2016 survey is of critical importance this year as the fishery is closed. The results below attempt to reveal if any apparent anomalies exist in the 2016 bairdi survey data by looking back at the last several year's information, especially to increasing trends apparent about 4-5 years ago in contrast to current declines.

A measure of bairdi "survey footprint" on the Bering Sea shelf can be gauged by the number of NMFS stations with positive bairdi catches. The lowest number of stations with bairdi present during the last decade is from the 2009 survey where bairdi were present at only 183 stations (49% of stations). East and west positive station counts also reveal trends in bairdi footprint. In recent years, presence of bairdi sampled in NMFS east survey stations has been high and has increased from 2011 (72 stations) to 2016 (107 stations). However, biomass in the east, of most bairdi size-sex categories peaked a couple of years ago and is now reflecting a decline. In the west, presence of bairdi at stations has been more variable over the same period ranging from 148 (2013) to a high of 172 (2012) and is currently at 161 (2016). The biomass in the west of important size-sex groups in 2016 results is variable – some up and some down. While mature female biomass declined in 2016 by about 7% over 2015, mature male biomass in the west increased by about 13%. Importantly, the current mature male biomass in the west is 77.4 million lbs (2016 NMFS survey) and is the second highest in the last 10 years.

An evaluation of annual "high station" catches was completed to look at any anomalies in current NMFS survey mature female bairdi catches over the last 4 years – to match any observable trend with BSFRF surveys. The high catch stations were chosen as the top 10 highest stations with mature female CPUE as identified from NMFS survey data. This review also included reclassifying maturity for females to match the cut line approach defined in the SOA bairdi harvest strategy to determine if any further trends or significant changes in NMFS survey results may be revealed. Plots of the top 10 stations for mature female bairdi stations by year allowed a quick spatial review of any changes reflected in the different maturity index (observed v. cut line) and where those changes may lie near or outside boundary areas. The charts in Figure 1 show these plots for 2013-2016.

The 2013 comparison shows that the observed v. cut line mature female spatial top 10 stations are different but don't show any implication for management. There are 5 of the top 10 stations in the eastern section and only one high station near the 166 W line. The 2014 comparison shows some differences between observed v. cut line top 10 stations and only 3 are in the eastern section. Two stations to the northwest are beyond the 173 W line and are excluded from mature female biomass considerations. In 2015 the same comparison shows more differences (obs. v. cut line) between high stations, more aggregation near the 166 W line and also a single high station to the northwest beyond 173 W. For the 2016 comparison, there are none of the top 10 stations for mature female bairdi in the eastern section and the furthest east of the high stations are adjacent to (west of) the 166 W line. There is one single high station to the northwest. It is notable from NMFS survey data that the single high station (ranked 1 in both years) of observed mature female bairdi in 2015 and 2016 surveys was from station L-29 near a high spot immediately northwest of Zhemchug Canyon, outside of the area used for biomass threshold determination. A further review of NMFS observed mature female

bairdi back to 2009 suggests that high CPUEs of mature female bairdi at this station may be associated with warm survey years and show some connectivity with portions of the bairdi stock east of 173 W longitude (Figure 2).

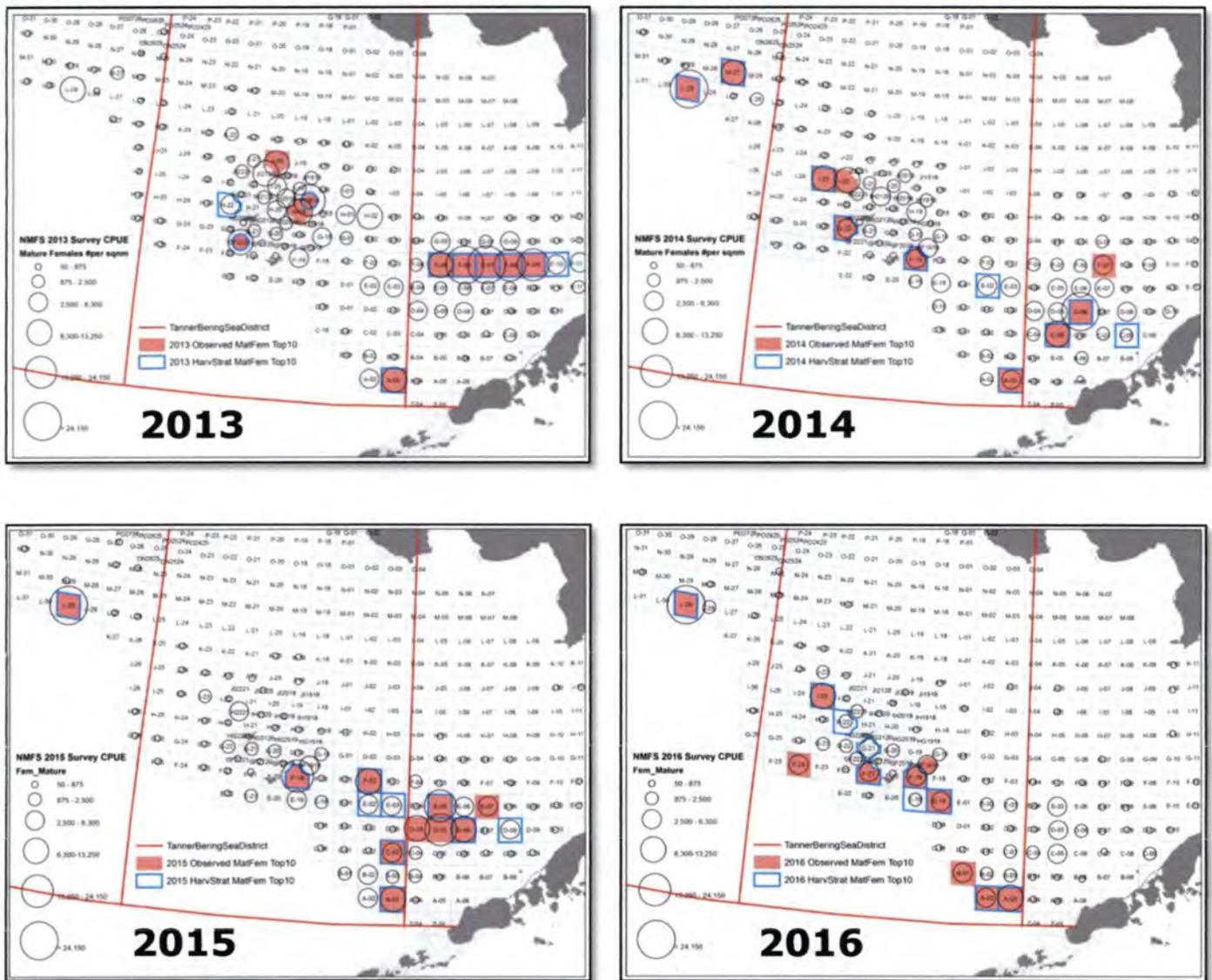


Figure 1. Comparison of top 10 high NMFS survey stations for mature female bairdi CPUE using observed maturity v. size dependent (cut line) maturity, 2013-2016.

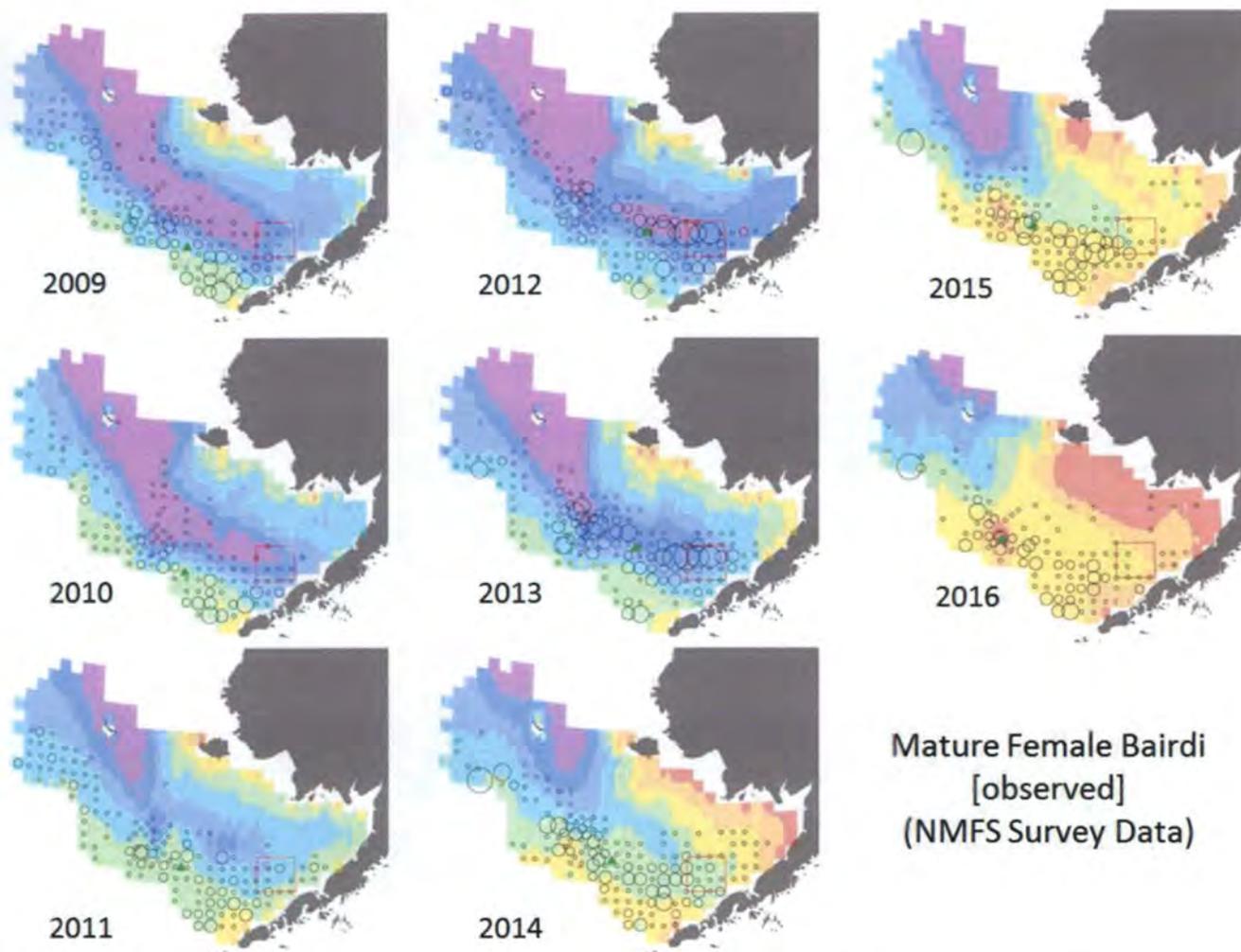


Figure 2. Station CPUEs of observed mature female bairdi and cold pool (bottom temperature) from NMFS summer surveys, 2009-2016.

The review of the top 10 stations for observed mature female bairdi compared to the same rank stations for cut line maturity reveals there may be some discontinuity of mature female bairdi sampled during 2016. The 2016 low biomass could be a retraction of females from the area in response to warmer than usual summer temperatures or an absence due to unknown factors. An undersampling of mature females by the NMFS trawl, BSFRF trawls or both could also explain the observed biomass.

NMFS Trawl Selectivity

The NFMS survey trawl selectivity for crab can be estimated when another sampling gear is present to make a comparison of standard catches of crab by sex and size. Trawl selectivity is a function of size for crab – smaller crab are captured less efficiently than larger sized crab as they are more easily missed by the trawl (passing under the footrope). BSFRF trawl selectivity experiments have collected side-by-side data for bairdi since 2013 but with more focus and coverage in 2016. The focus allowed for more stations covered and for the first stations west of 166 W longitude to be completed for bairdi specific trawl selectivity.

A closer review of female bairdi trawl selectivity is presented here beginning with the bairdi selectivity information presented earlier this fall to the Crab Plan Team in September (Figure 3). Across all side-by-side stations covered in 2016, the NMFS trawl captured a relatively low proportion of female bairdi at size compared to 2013-2015.

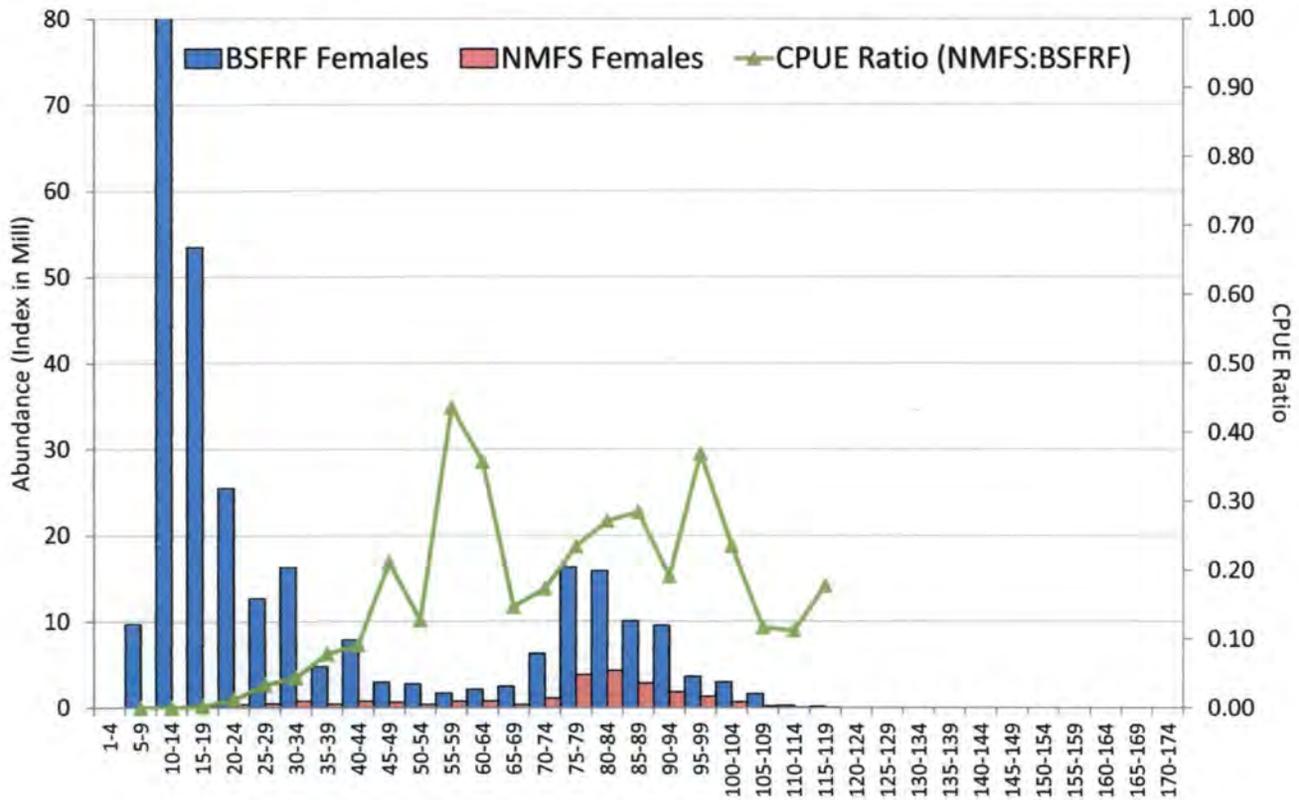


Figure 3. Female bairdi trawl selectivity estimated by side-by-side surveys conducted by BSFRF and NMFS, 2016. CPUE ratio is NMFS:BSFRF.

Further review of size dependent selectivity by year can be seen using a more robust ratio to compare CPUEs. This ratio is an estimate of the proportion captured by the NMFS trawl out of the total catch rather than out of the BSFRF Nephrops trawl catch. With both CPUEs in the denominator of the ratio, more size classes are retained for analysis. A value of 0.50 for a given size class with the second ratio equates to parity between the survey gears – NMFS catching 50% and BSFRF catching 50% of that size class. The comparison across the four years of available side-by-side work for bairdi sampling to estimate NMFS trawl selectivity with the second ratio are shown in Figure 4. The trends are standardized to total average CPUE for stations sampled. In 2013-2015 the average is across 60 stations and for 2016 it is across 140 stations. The size range for maturity of bairdi as observed in the length frequency plots typically shows a mode centered around 80 millimeters carapace width (Figure 3). The plots using the combined ratio are across all female sizes but reflect a lower average value for the proportion of mature females captured in 2016. The three years prior to 2016 reflect variability in smaller sizes but the average proportion captured of mature females from total standard catch of mature sizes is 0.26 in 2013, 0.27 in 2014 and 0.25 in 2015. For 2016, the

same estimate is 0.20 for the proportion of observed mature female bairdi captured by the NMFS trawl. While there is still substantial bairdi grounds without side-by-side coverage, the 2016 sampling is across more than twice as many stations. This difference in relative terms to the prior 3-year average of 0.26 is 23% lower and could be representative of an undersampling of mature female bairdi at some stations in the NMFS survey in 2016.

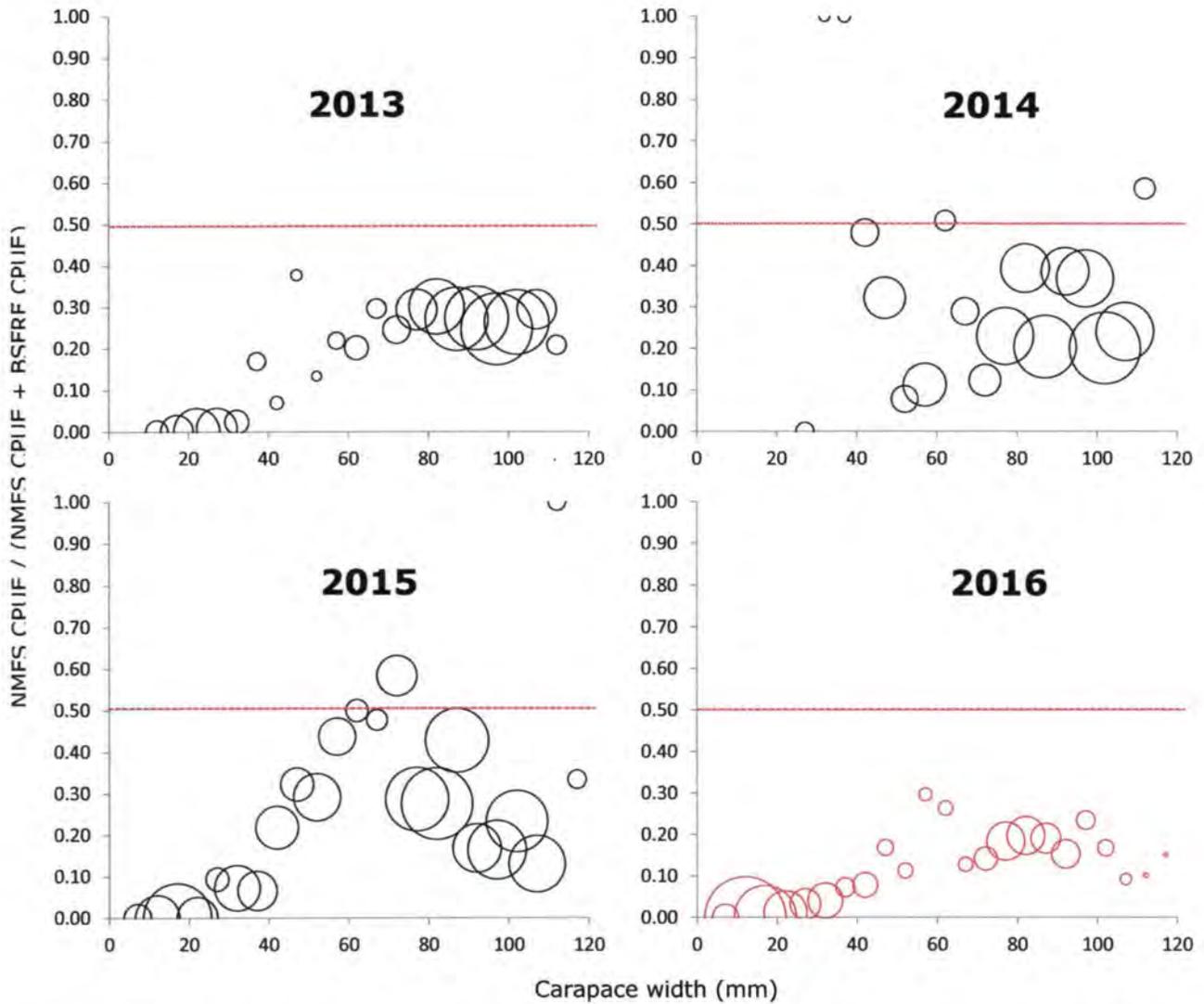


Figure 4. Estimates of NMFS survey trawl selectivity for female bairdi crab by size as sampled during side-by-side cooperative survey tows conducted by NMFS and BSFRF, 2013-2016.

Summary

The 2016 NMFS survey results for mature female bairdi abundance and biomass are low, especially east of 166 W longitude. The 2016 decline in biomass of mature female bairdi is amplified further by the cut line method used to determine maturity. This method shows some minimal distinction spatially when plotted but when paired with other boundary issues may compound the very low current estimate. Historically high bottom water temperatures may be directly influencing the movement of bairdi into different areas. High temperatures may also lead to mature female bairdi to respond in unknown ways. Both of these as effects from temperature would reduce availability to survey trawls.

The BSFRF trawl selectivity information from 2016 offers an incomplete but much broader review of trawl selectivity and capture probability for bairdi by size and sex. These 2016 summaries will be reviewed further as they are incorporated in the stock assessment process but appear to support a difference – a 23% lower capture probability for the same sized mature female animals as in the prior three years. These summaries together may warrant further consideration of current bairdi stock status issues.

For questions or comments about BSFRF data or surveys, or in response to any information in this summary please contact me at NRC.

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