IPHC fishery-independent setline survey expansion and densification

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PURPOSE

To provide the Research Advisory Board (RAB) with a summary of the results of 2017's IPHC fishery-independent setline survey expansions in Regulatory Areas 4B and 2A.

INTRODUCTION

The IPHC fishery-independent setline survey (FISS or setline survey) provides data used to compute indices of Pacific halibut density for use in monitoring stock trends and estimating stock distribution, and as an important input in the stock assessment. Stock distribution estimates are based on the annual mean weight-per-unit effort (WPUE) for each Regulatory Area, computed as the average of WPUE of O32 (greater than or equal to 32" or 81.3cm in length) Pacific halibut estimated at each survey station. Mean numbers-per-unit-effort (NPUE) is used to index the trend in Pacific halibut density in the stock assessment models. In 2016, the IPHC Secretariat moved to a space-time modelling approach for estimating these indices and calculating estimates of stock distribution (Webster 2017), an approach that was continued in 2017.

In most IPHC Regulatory Areas, the standard, annual setline survey's 18.5 km (10 nmi) grid is fished in waters within the 37-503 m (20-275 fm) depth range. Information from commercial fishery data and other fishery-independent sources showed the presence of Pacific halibut down to depths of 732 m (400 fm) and in waters shallower than 37m in some Regulatory Areas. Further, most Regulatory Areas had significant gaps in coverage within the standard 37-503 m depth range. The incomplete coverage of Pacific halibut habitat by the setline survey likely led to biased estimates of WPUE and NPUE density indices in some Regulatory Areas that were then used in the stock assessment modelling and for stock distribution estimation. For this reason, the IPHC has been undertaking a sequence of setline survey expansions since 2014 (following a 2011 pilot), with stations added to the standard grid to cover habitat not previously sampled in our setline survey. The expansions involve adding stations to one or two Regulatory Areas each year, and reverting to the annual grid for those areas in subsequent years. In 2017, setline survey expansions took place in Areas 4B and 2A.

Regulatory Area 2A's 2017 expansion had three components: a repeat of the 2014 expansion, including deep (503-732 m) and shallow (18-37 m) stations, stations within the Salish Sea, and stations in California from 39°N to 42°N; new stations in California from 37.75°N to 39°N; and additional stations off the north Washington coast (north of 46°53.3' N, within 37-503 m) resulting in a doubling of station density in that region. The new stations in California allowed the IPHC to get direct information on density in a region that Pacific halibut are known to inhabit (albeit at low densities), as shown by catches of Pacific halibut on the National Marine Fisheries Service (NMFS) West Coast trawl survey (Webster 2016). The increased station density off the north Washington Coast was motivated by stakeholder concerns that the standard 18.5 km station spacing may be missing localised patches of relatively high Pacific halibut density in that region, and that a denser grid would be more likely to detect such patches if they exist.

RESULTS OF THE 2017 SETLINE SURVEY EXPANSIONS

Figure 1 shows a map of observed setline survey O32 WPUE at each fished station in Area 4B. The station catch rates varied greatly among the regions covered by expansion stations. Eastern

stations had the highest WPUE, with several stations having values close to or above 180 kg/skate (400 lb/skate). Elsewhere, new stations had relatively low catch rates on average, with the majority catching no Pacific halibut. Average WPUE at the new expansion stations was 26.4 kg/skate (58.2 lb/skate), while at annually fished stations, it was 20.5 kg/skate (45.2 lb/skate). These results imply that at current Pacific halibut densities, the annual Area 4B setline survey was undersampling high-density habitat relative to low-density habitat. Prior to the use of the space-time model, this would have led to a negative bias in estimates of mean WPUE in Area 4B. Instead, the time series of estimated mean O32 WPUE from the 2017 modelling was very similar to the one estimated in 2016 prior to the expansion (Figure 2). This implies that, at least on average, the model predictions of WPUE in previously unsurveyed parts of Area 4B had little bias. This was not the case for total NPUE, which was underestimated in last year's modelling (Figure 3), and therefore the setline survey expansion led to a correction in the bias of previous estimates of NPUE in Regulatory Area 4B.

The observed setline survey O32 WPUE at each station in Area 2A in 2017 is shown in Figures 4-5. The California expansion south of 39°N captured a single Pacific halibut on a station outside of San Francisco Bay (Figure 4). This confirms that while Pacific halibut are present in this region, densities are very low.

Central Oregon stations had the highest O32 WPUE in Area 2A during 2017 (Figure 5), but catch rates north of there, particularly off Washington (Figure 6), appear to have been greatly affected by a large, intense area of low dissolved oxygen centered off the Washington coast (Figure 7). WPUE was zero at almost all stations within the area that had dissolved oxygen less than 0.9 ml/l, and lower than in recent years on average elsewhere off the Washington coast. The area of low dissolved oxygen encompassed the region covered by the dense grid expansion, and so likely affected catches on the new expansion stations, along with neighbouring stations on the annual grid. In 2016, mean O32 WPUE at stations off the north Washington coast was 15.0 kg/skate (33.0 lb/skate). The same annually fished stations in 2017 had mean WPUE of 4.5 kg/skate (9.9 lb/skate), and the new dense grid expansion stations had mean of 7.4 kg/skate (16.3 lb/skate). We made no adjustment for the effect of the hypoxic zone on catches in the modelling, which assumes that Pacific halibut were able to avoid areas of extremely low oxygen and therefore became available to the setline survey elsewhere.

The effect the inclusion of data from the dense grid expansion stations on estimated mean O32 WPUE was small (Figure 8). Estimated mean WPUE for Regulatory 2A in 2017 was 2.8% higher with the dense grid data included in the modelling than it was without, a difference that is well within the uncertainly in the estimates shown by the 95% intervals in Figure 8. Note that the model output used for stock assessment and stock distribution estimation comes from fitting models that include the dense grid data, along with all other setline survey expansion data.

RECOMMENDATION/S

That the RAB:

1) **NOTE** paper IPHC-2018-RAB019-06 which provided a summary of the results of the IPHC fishery-independent setline survey expansions in Regulatory Areas 4B and 2A in 2017.

References

Webster, R. A. 2016a. Indexing density in southern Area 2A using West Coast trawl survey data. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2015: 544-551.

Webster, R. A. 2017. Results of space-time modelling of survey WPUE and NPUE data. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016: 241-257.

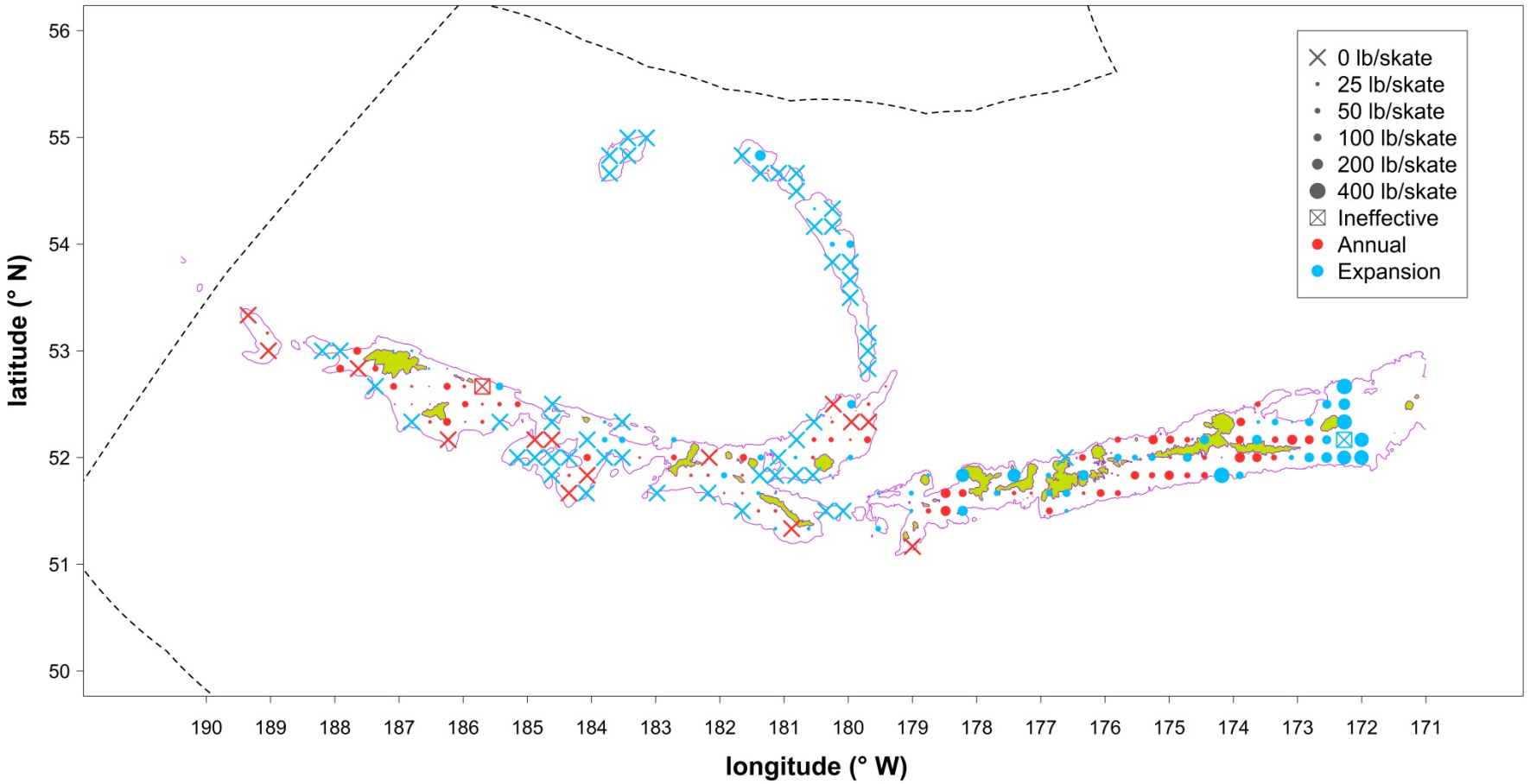

Figure 1. Map of O32 Pacific halibut WPUE by station in Regulatory Area 4B in 2017.

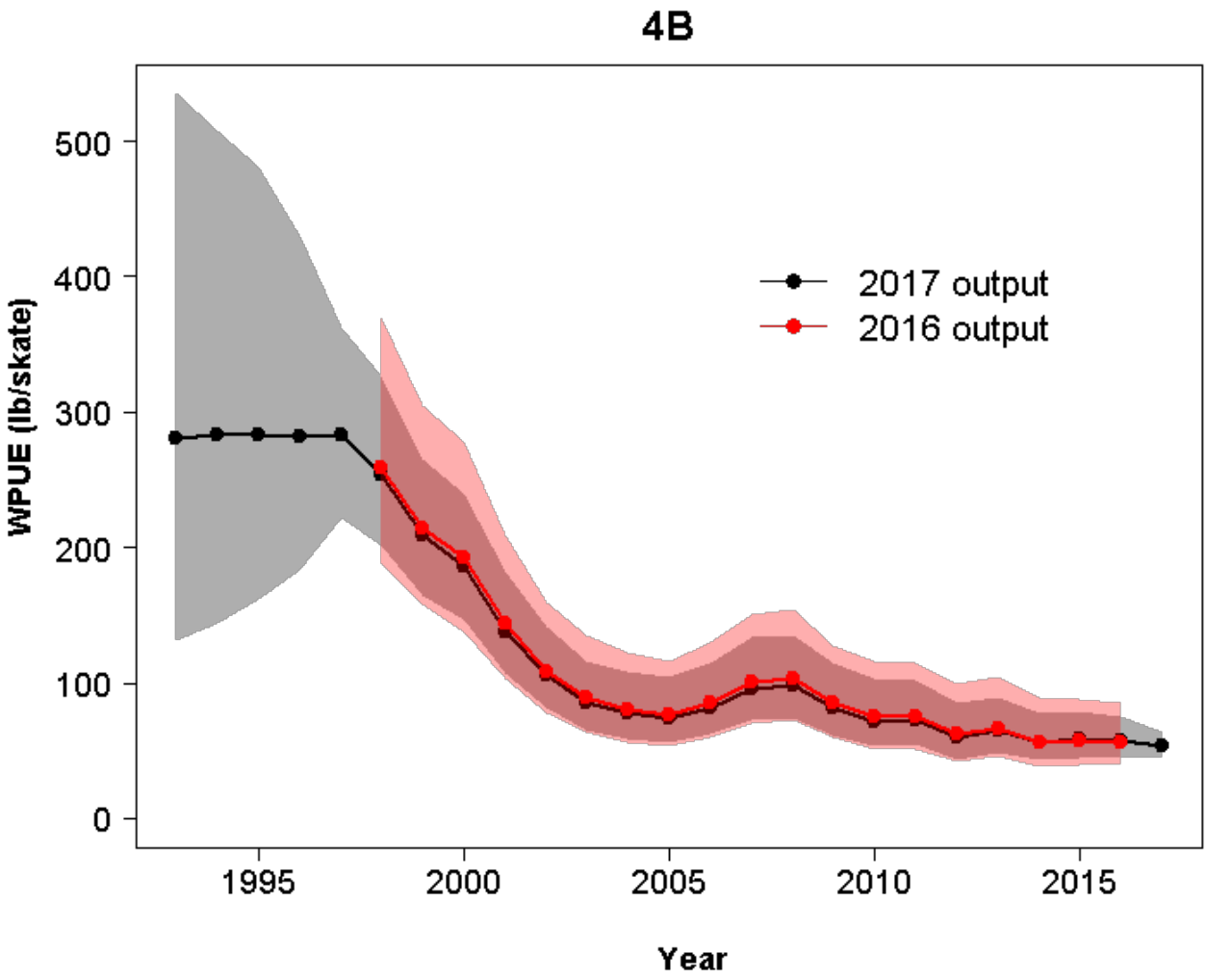

Figure 2. Comparison of the time series of estimated mean O32 Pacific halibut WPUE in Regulatory Area 4B from the 2017 modelling with the output from the 2016 modelling.

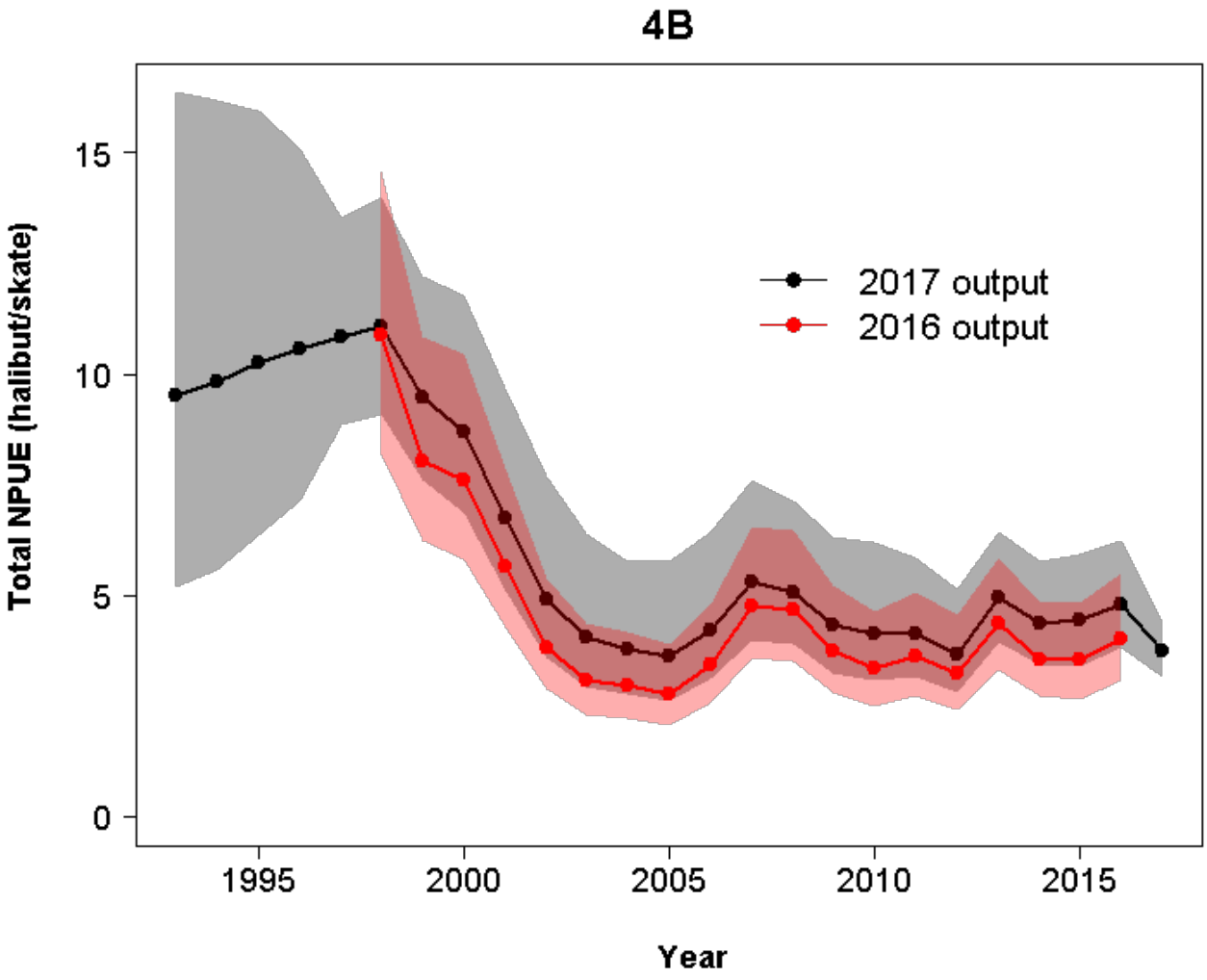

Figure 3. Comparison of the time series of estimated mean total Pacific halibut NPUE in Regulatory Area 4B from the 2017 modelling with the output from the 2016 modelling.

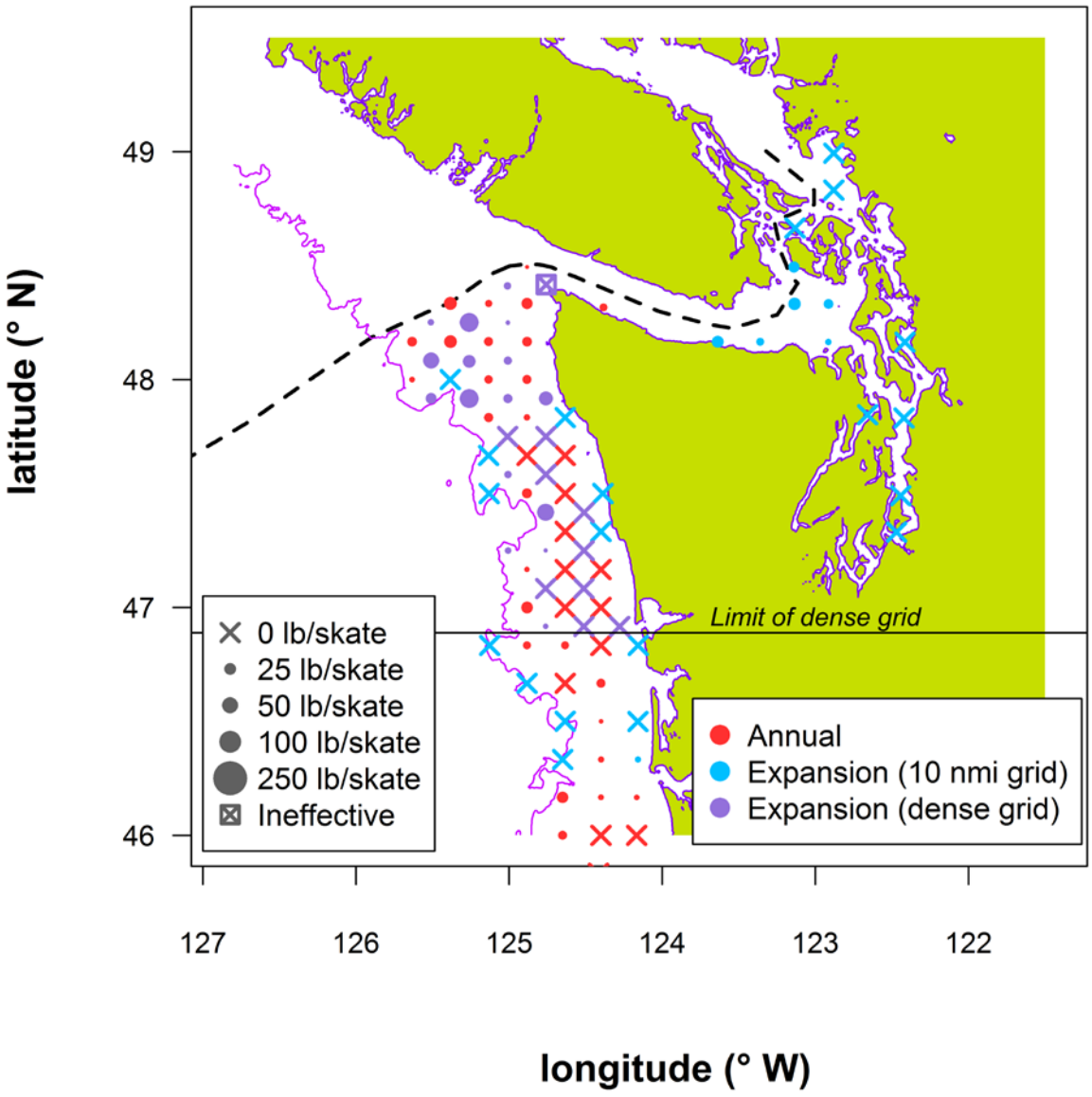

Figure 4. Map of O32 Pacific halibut WPUE by station in northern Regulatory Area 2A in 2017.

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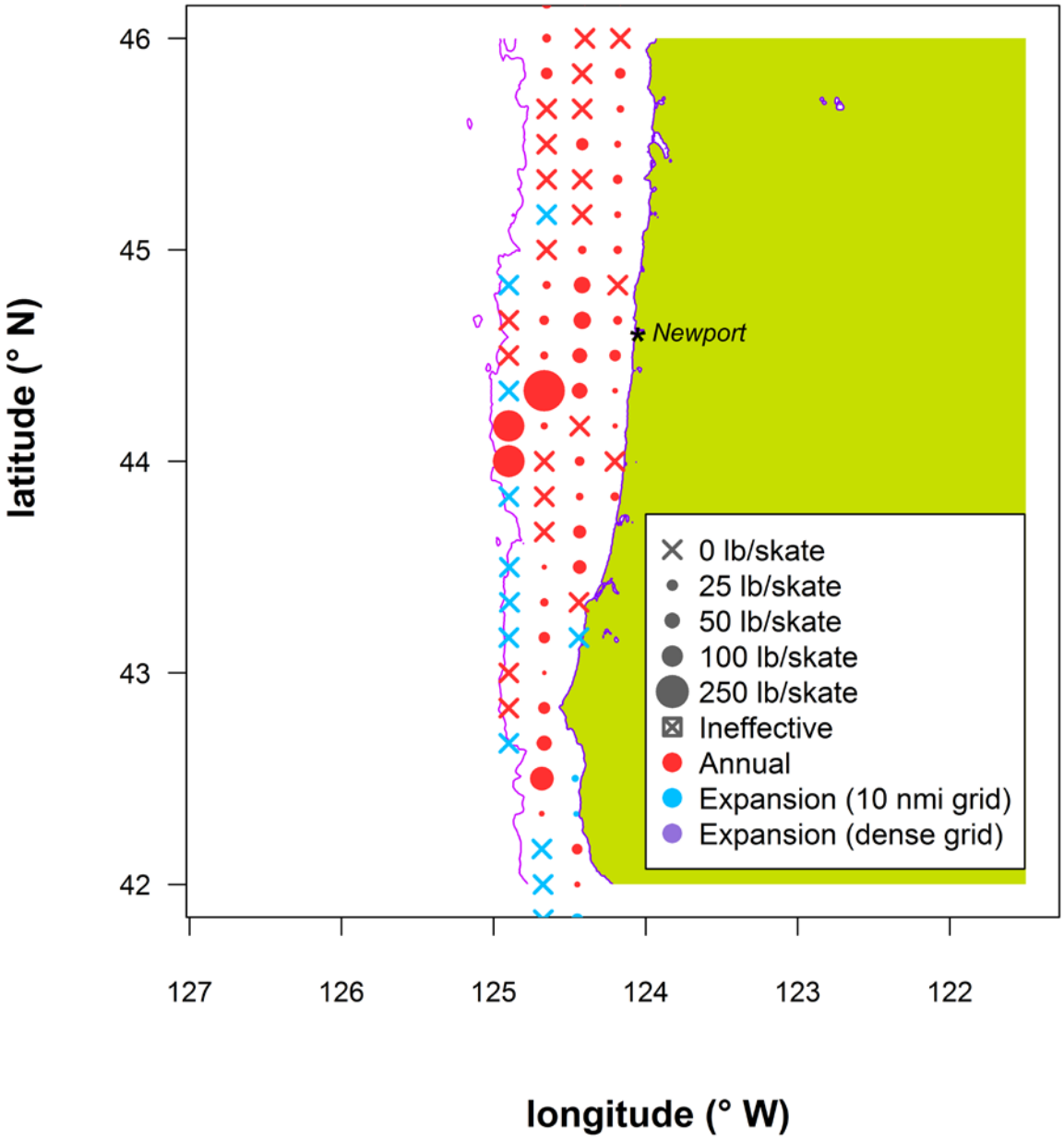

Figure 5. Map of O32 Pacific halibut WPUE by station in central Regulatory Area 2A in 2017.

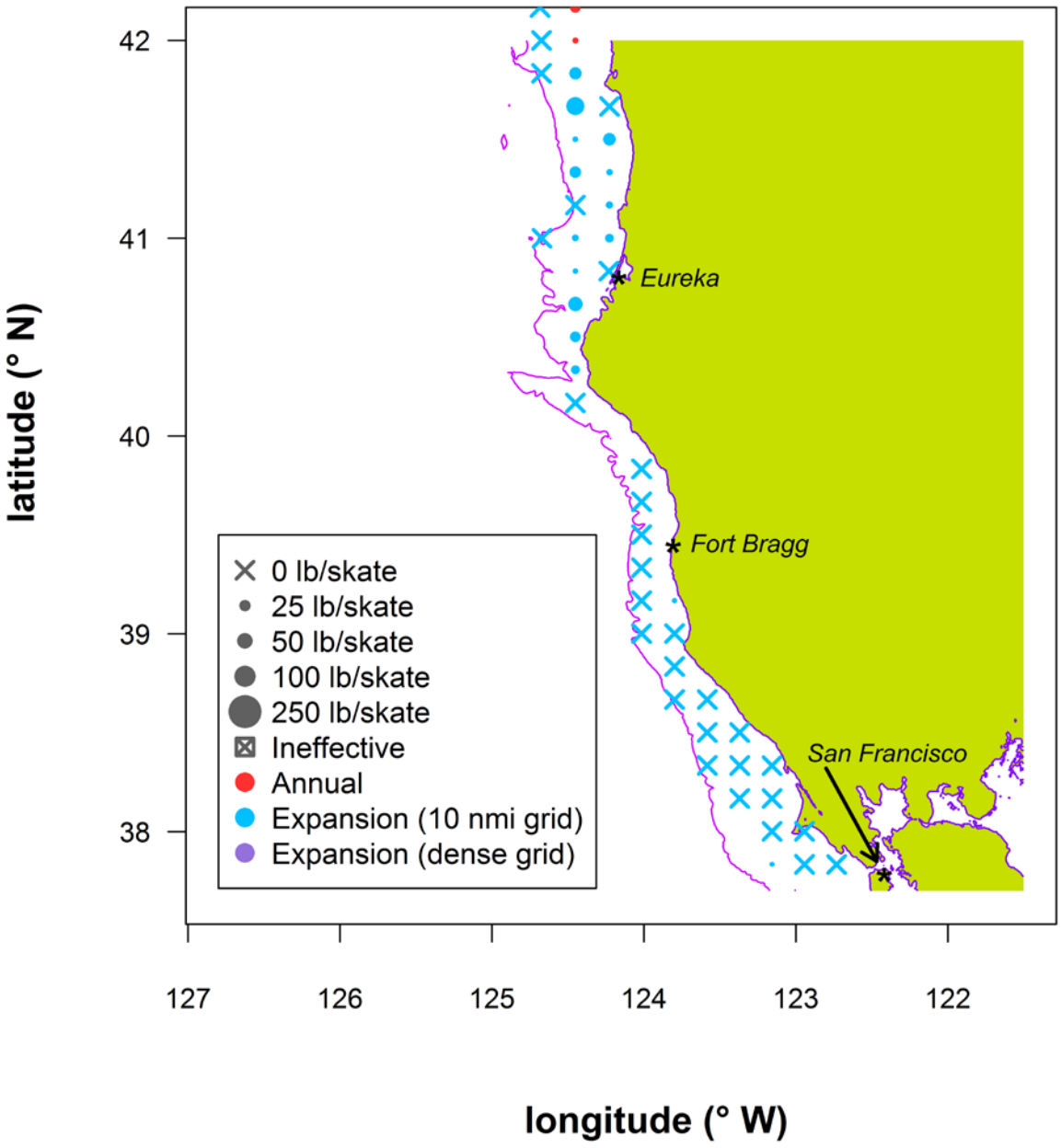

Figure 6. Map of O32 Pacific halibut WPUE by station in southern Regulatory Area 2A (California) in 2017.

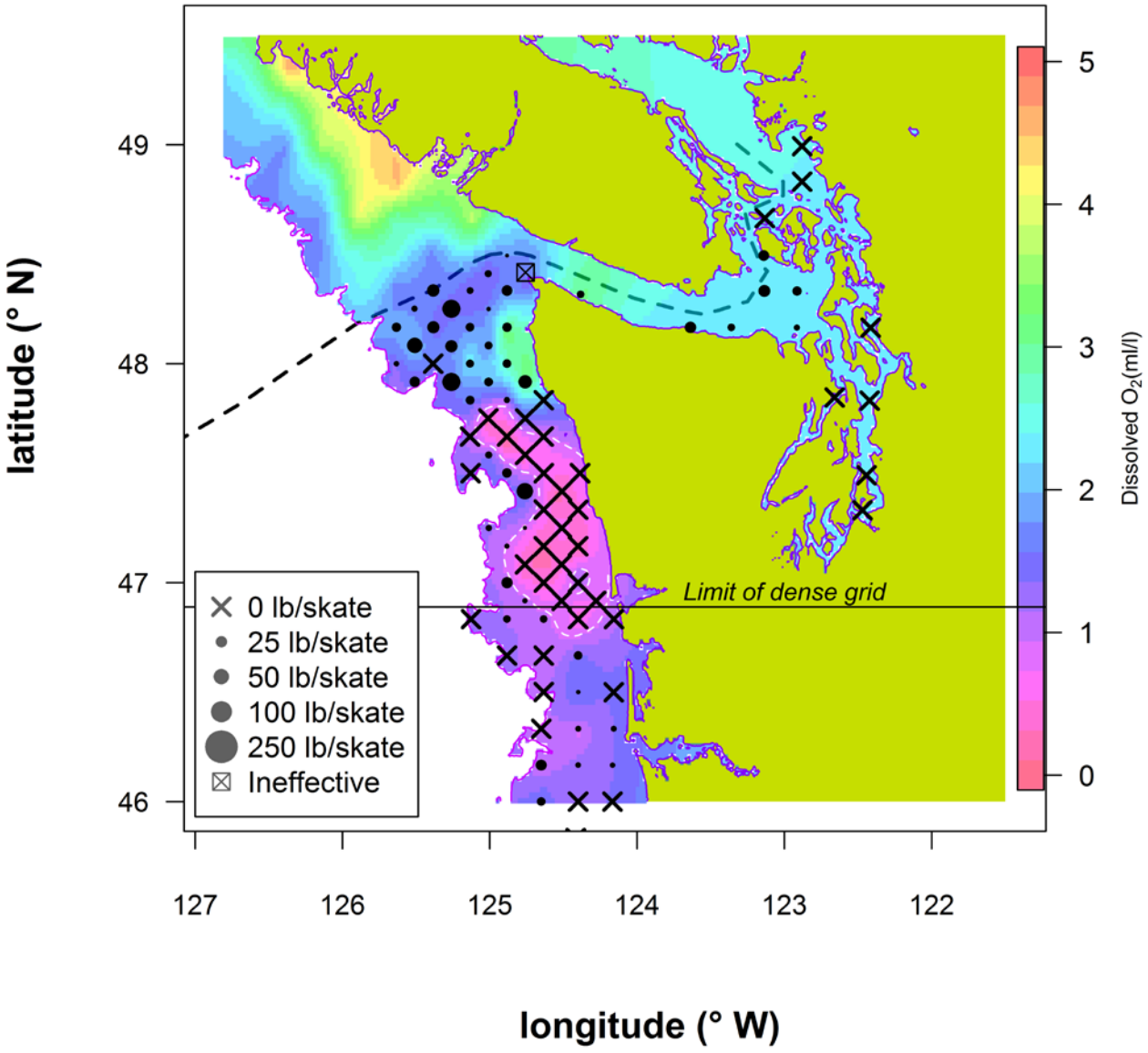

Figure 7. Estimated dissolved oxygen in northern Regulatory Area 2A in 2017. Values are model predictions from a spatial model fitted to the 2017 IPHC water column profiler data. O32 WPUE values from the setline survey are overlaid with black symbols.

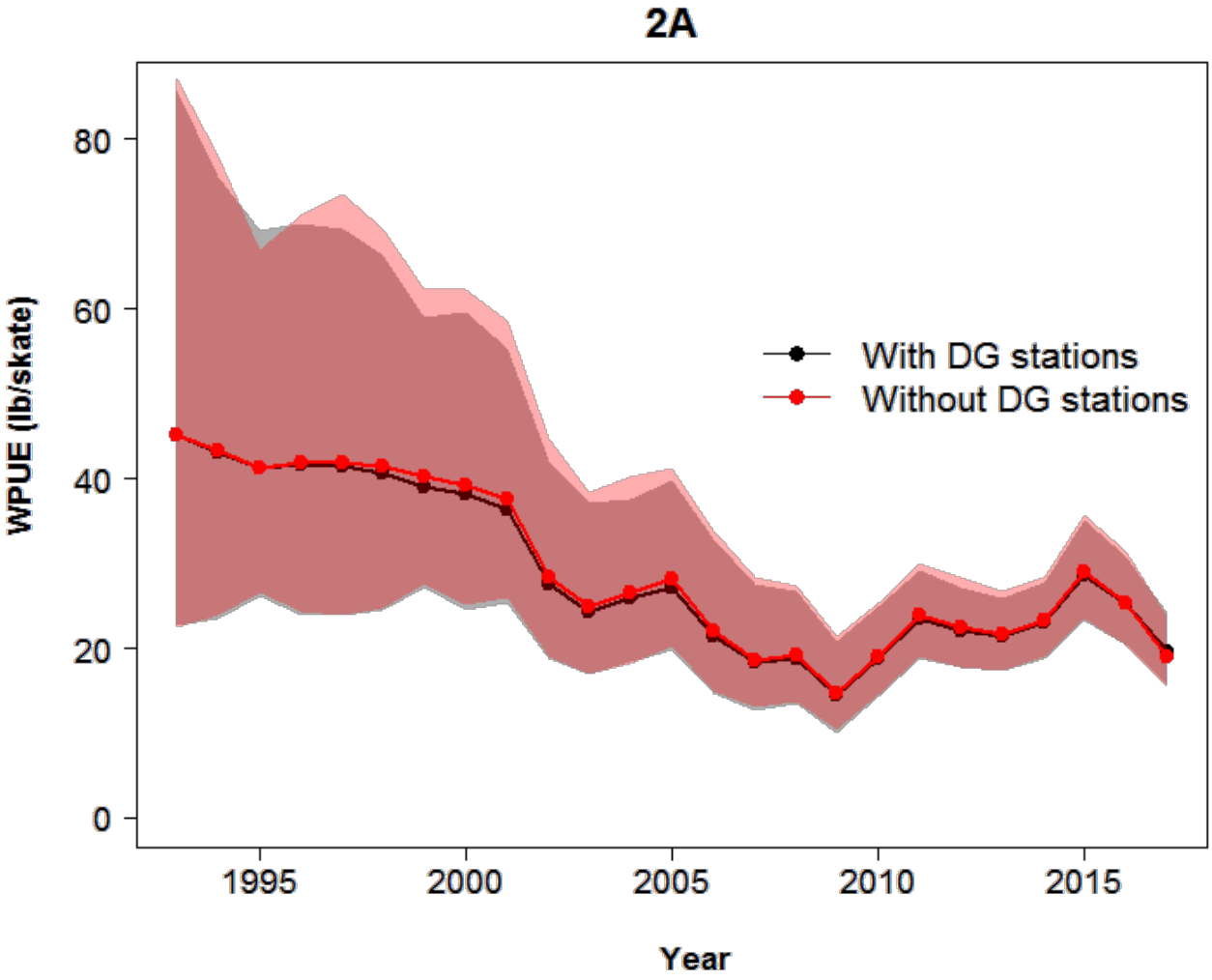

Figure 8. Posterior means (points) and 95% posterior credible intervals (shaded regions) for mean O32 WPUE from the space-time modelling for Regulatory Area 2A from models fitted with data from the dense grid (DG) stations (black) and without those data (red).