Area 2A survey expansion

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Abstract

The IPHC setline survey was expanded in Area 2A in 2011 in terms of both range within the 20-275 fathom survey depths, and in terms of depth, up to 10 fathoms and down to 400 fathoms. Inclusion of the additional stations in the 20-275 range led to a slight increase in WPUE for the area compared with WPUE computed from existing stations, along with a modest improvement in precision. Mean WPUE at shallow and deep stations was much lower than at stations within 20-275 fathoms, demonstrating the likely bias caused by assuming WPUE values from the standard survey are representative of the full 0-400 fathom depth range.

Introduction

Regulatory Area 2A has been previously identified as a region for which estimates of weight per unit effort (WPUE) are the least precise in relative terms. This became important when commission staff began using WPUE as an index of relative biomass distribution for the purposes of apportioning coastwide exploitable biomass among regulatory areas. In general, the poorer an estimate's precision is, the greater the probability that the estimate differs by a relatively large degree from the true value. Here the concern is that with coefficients of variation of mean WPUE averaging close to 30% in recent years, compared with less than 15% in other areas (Webster and Hare, 2010), Area 2A's estimated share of the coastwide exploitable biomass is likely to differ by a relatively large amount from what its share should have been were WPUE known without error. To address this, we previously considered adding stations to statistical area 50 in Area 2A to increase sample size in the part of the area with the most variability (Webster and Hare 2010).

More recently, IPHC staff made the observation that in some areas there was commercial catch being taken in significant quantities in waters deeper than the current 275 fathom limit of the setline survey (Hare et al. 2010). This led to the proposal to expand the setline survey to both deeper (down to 400 fathoms) and shallower waters (up to 10 fathoms) (Hare et al. 2011). Along with the depth expansion, we also examined a potential range expansion of the current 20-275 fathom survey depths to include areas that are currently unsurveyed. In Area 2A, the potential range expansion included all inside waters of Washington, collectively part of the Salish Sea, which includes the Strait of Juan de Fuca, Puget Sound and the waters around the San Juan Islands. Further, a number of potential new stations were identified in 20-275 fathom waters off the Pacific coast of Washington and Oregon (Webster and Hare 2011).

Rather than implement the denser grid in Area 50 to improve precision of the WPUE estimate, the IPHC decided to undertake a depth and range expansion in Area 2A in 2011. The rationale was that the addition of stations within the 20-275 fathom range would likely also improve the precision of WPUE, while simultaneously reducing bias due to the previous assumption that the unsurveyed waters have the same WPUE as those covered by the setline survey. The depth expansion would allow the logistics of survey fishing in shallow and deep waters to be examined, and provide some preliminary data on halibut density in those waters. It is important to note that there was no

intention of using the deep and shallow stations for stock assessment or apportionment in 2011, because no other regulatory area had a similar expansion.

Methods

Prior to conducting the 2011 survey expansion in Area 2A, each potential new station was examined to determine if it was fishable. A small number of stations were excluded because they fell in unfishable habitat (e.g., estuaries). During the survey, one additional station was not fished because it was in waters shallower than the 10 fathom depth limit. A total of 136 stations were ultimately fished. This total included 24 new stations within the 20-275 fathom depth range, 11 shallow stations (10-20 fathoms) and 17 deep stations (275-400 fathoms), a total of 52 new survey stations. Of the 24 stations in 20-275 fm, half were in the newly created Puget Sound survey region, encompassing the inside waters east of the entrance of the Strait of Juan de Fuca, seven were in the Washington survey region, and five in the Oregon survey region. (One new station within the Strait of Juan de Fuca but near the entrance was included in the Washington region for operational reasons, and therefore 13 stations were actually fished in the 20-275 fathom range within the Salish Sea.) Table 1 contains a more detailed breakdown of station numbers by depth and survey region.

Prior to conducting research fishing in new areas, particularly in the Salish Sea, several agencies were consulted with, and permits were obtained. The United States Coast Guard (USCG) provided valuable input on shipping lanes, hazards, and pilot transfer areas, and six station locations where slightly modified as a result of USCG input. USCG was also instrumental in providing daily Notice to Mariner updates to vessels operating near our research vessel when conducting work in the Strait of Juan de Fuca and Puget Sound. Due to endangered and threatened species listings of both mammals (southern resident killer whales, *Orcinus orca*, Steller sea lions, *Eumetopias jubatus*) and fish (Bocaccio, *Sebastes paucispinus*, yelloweye rockfish, *Sebastes ruberrimus*, and canary rockfish, *Sebastes pinniger*) the IPHC worked closely with the Protected Resources Division of the National Marine Fisheries Service to agree on avoidance techniques and catch limits/triggers for the expanded survey work.

Results

Mean survey WPUE is given in Table 2 by survey region and depth range, while values for individual stations are presented in Figures 1-2 (20-275 fathoms) and 3-4 (deep and shallow stations). Two stations in the Puget Sound region were deemed to be ineffective, one because of six gill sharks shredding through the gear, and another due to gear loss issues presented by rocky and giant barnacle (*Balanus nubilus*) reefs. This resulted in 22 additional effective stations in the 20-275 depth range of the current survey, making 106 stations in total for those depths. On average, the new stations had slightly higher WPUE than the 84 existing stations (28.5 and 26.6 lbs/skate respectively), leading to a mean of 27.0 lbs/skate for stations in the current survey range. The mean of the five new OR stations was about double that of the existing 42 stations, largely due to one new station with high WPUE off the Oregon coast (Fig. 2). New stations in the WA survey region had almost the same mean as existing stations, while Puget Sound stations had lower WPUE on average. Mean WPUE of the 10-20 fathom stations, at 12.7 lbs/skate, was less than half that of the other stations. Almost nothing was caught on the 275-400 fathom stations.

We compare four different estimates of survey WPUE for Area 2A in Table 3, along with the standard errors (SE) and coefficients of variations (CV). The first is calculated from existing survey stations, and is almost the same as that computed using the full 106 effective stations in the 20-275 standard survey depth range. The third row in Table 3 excludes the 10 effective Puget Sound stations. The purpose of presenting this is to allow computation of an adjustment factor if Puget Sound is excluded from future Area 2A surveys for reasons such as cost. Finally, the estimate from 10-400 fathoms also includes all deep and shallow stations, and is lower than other values because of the low catch rates observed in deep and shallow waters. The coefficient of variation improves with increasing sample size, as expected (Table 3).

Discussion

One of the goals of the expanded survey in Area 2A was to produce a more precise estimate of WPUE, which is very important now that this index is used to estimate the proportion of the exploitable biomass present in each regulatory area. Also of great importance, the expansion into previously unsurveyed parts of Area 2A would lead to a reduction in any bias due to those areas having greater or lower WPUE than those previously surveyed. Because Area 2A was the only regulatory to have the depth expansion, there was never an intention this year to include deep and shallow stations in the WPUE index that is used for stock assessment and apportionment purposes, as such an index would be measuring something different in this area than others. The new stations within the 20-275 depth range should be included in the WPUE index, however. These stations improve the estimate by reducing bias (however small) and improving precision (see below): excluding useful data such as these could not be defended scientifically. We also note that it has been the IPHC's approach to include new survey data to improve the WPUE index as that data became available: following the creation of the current survey grid in 1998, stations have been added to Areas 2B in 1999, 4B in 1999 and 2000, and 4CDE in 2006. New data from federal and state trawl surveys in Area 4CDE have also been included in WPUE calculation in recent years. Thus inclusion of all 20-275 stations in Area 2A when computing WPUE is not only the scientifically sound thing to do, it also follows IPHC precedent.

For the first time in recent years, the coefficient of variation of WPUE from the existing 84 survey stations dropped below 20% (Webster and Hare 2011). The value of 16.3% is a consequence of a less patchy distribution of station catches, with somewhat lower catches in the high-density area at the north of Area 2A, and higher catches off the central Oregon coast. This is also the first year on record that the Oregon WPUE is higher than that for Washington (see White et al. 2011, page 397, for a comparison up to 2011). When new stations in the 20-275 fathom range are added, the CV decreases further, to 14.7%. This is much closer to the values for areas such as Areas 4A and 4B (Webster and Hare 2010) than anything obtained previously. At present there is, therefore, no need to further investigate the use of a denser survey grid in parts of Area 2A with higher variability (statistical Area 50 was targeted previously, but the halibut distribution has changed somewhat since that analysis). Given the historically patchy distribution of halibut in Area 2A, we will continue to examine the precision of the WPUE estimate each year to determine whether further action becomes necessary.

At present, for each regulatory area the WPUE from the 20-275 fathom survey grid is multiplied by the bottom area within 0-400 fathoms, and divided by the coastwide bottom area in 0-400 fathoms, to get an estimate of each area's share of Ebio. The range 0-400 is used because of

evidence from the commercial fishery that halibut are present in 0-20 and 275-400 fathoms, at least in some areas. If the halibut density, and therefore WPUE, differs in the 0-20 and 275-400 parts of the range from that in 20-275 fathoms, the WPUE index will be a biased index. The lower WPUEs from the deep and shallow stations in Area 2A show this to be the case for this area. The size of the bias in the estimator of Ebio depends also on how biased the index values are in other areas, which depends on local density and the proportion of each area in those depth ranges. The commercial data, at least, suggest that some areas benefit from having an expansion to 0-400 fathoms at the expense of others (Area 4A in particular). Without additional survey data as we have obtained in Area 2A, there is no ideal way to correct for this.

Aside from the estimates of WPUE, the expanded survey in Area 2A yielded other interesting results from both a scientific and an operational perspective. Deep water fishing incurred significantly more time to complete, and saw higher gear wear. More gear was needed to get it to the bottom (and it took longer to get there, increasing the chance of the gear drifting from the intended target location), and it took longer to haul, mainly due to significantly higher strain on the gear and hauling equipment. The water column profilers were also not set at the deeper stations as the buoy balls used to restrain its descent imploded at one of the first deep sets. As a result we do not have oceanographic data for those sets. Shallower stations were more difficult to drive in, and stay immediately above the gear (less scope of line) and there was more gear loss, likely due to more 'sideways pulling' as opposed to more straight up pulling when the gear is at depth. The vessel had to stay right above it, which was a challenge during the hauling phase, and pulling sideways on the gear resulted in more bottom snagging and gear parting. Shallow water also had many more entanglements with derelict crab gear.

In Puget Sound we had significant encounters with sixgill sharks (*Hexanchus griseus*). We had anticipated this, but the extent to which we encountered them was somewhat surprising and more surprising was the amount of damage they were able to inflict on the gear. Four out of six skates were effectively lost on one entire set near West Seattle due to large sharks shredding through brand new groundline, once hooked. Several other sets lost partial gear due to sixgill sharks. The gear would come up with a large sixgill shark and immediately next to it would be frayed and cut line. One station produced a batch of very small sixgill sharks, believed to have been recently pupped (personal communication with NMFS researchers). One final observation was that the majority of large sixgill sharks were captured secondarily to a spiny dogfish shark. This observation has been seen by other researchers who do tagging work.

Rockfish encounters were a big concern prior to conducting the expanded work, particularly on inside waters of Puget Sound where Bocaccio are considered endangered and yelloweye and canary rockfish are considered threatened. While we had restrictive rockfish piece count caps in place via our permits, and a special sampling protocol to glean maximum data from any encounters. However, it was somewhat disappointing to encounter zero rockfish on all the inside work (both Strait of Juan de Fuca and Puget Sound). For a gear type that is fairly effective at capturing rockfish when they are present, this came as a sobering reminder of the status of rockfishes in this region.

There are no IPHC setline survey stations south of the Oregon/California border. However, IPHC staff has been informed that this year, and possibly in other recent years, a potentially significant catch of Pacific halibut has been taken from California waters. This coincides with a much larger than usual sport catch of halibut in the region of Oregon south of Humbug Mountain, just north of California. This area had a catch share of 5625 lbs, but lacking in-season management, close to 10000 lbs was estimated to have been harvested. Recent years' harvests had been on

the order of hundreds of pounds. We do have survey stations in that part of OR (Fig. 2), but with catches increasing that far south, and with the reports from California itself noted above, the further expansion of the Area 2A setline survey into the waters of northern California will need to be evaluated.

References

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Table 1. Number of survey stations fished in 2011, by survey region and depth. Two stations were deemed ineffective, and these are indicated by the numbers in parentheses.

Survey Region	20-275 fathoms			10-20 fathoms	275-400 fathoms
	Existing	New	All		
Oregon	42	5	47	3	10
Washington	42	7	49	6	7
Puget Sound	0	12 (2)	12 (2)	2	0
Total	84	24 (2)	108 (2)	11	17

Table 2. Mean WPUE (lb/skate, net weight) of survey stations fished in 2011, by survey region and depth. Ineffective stations are excluded from calculations.

Survey Region	20-275 fathoms			10-20 fathoms	275-400 fathoms
	Existing	New	All		
Oregon	27.5	55.4	30.5	9.3	0.0
Washington	25.6	26.2	25.7	18.7	0.4
Puget Sound	-	16.7	16.7	0.0	-
Total	26.6	28.5	27.0	12.7	0.1

Table 3. Comparison of mean WPUE (lb/skate, net weight) and corresponding measures of variability for different subsets of the expanded Area 2A stations in 2011.

Region	Effective stations	WPUE (lbs/skt)	SE (lbs/skt)	CV (%)
Existing survey	84	26.6	4.3	16.3
Expanded 20-275	**106**	**27.0**	**4.0**	**14.7**
Expanded 20-275 excluding Puget Sound	96	28.0	4.3	15.4
Expanded 10-400	134	22.4	3.3	14.6

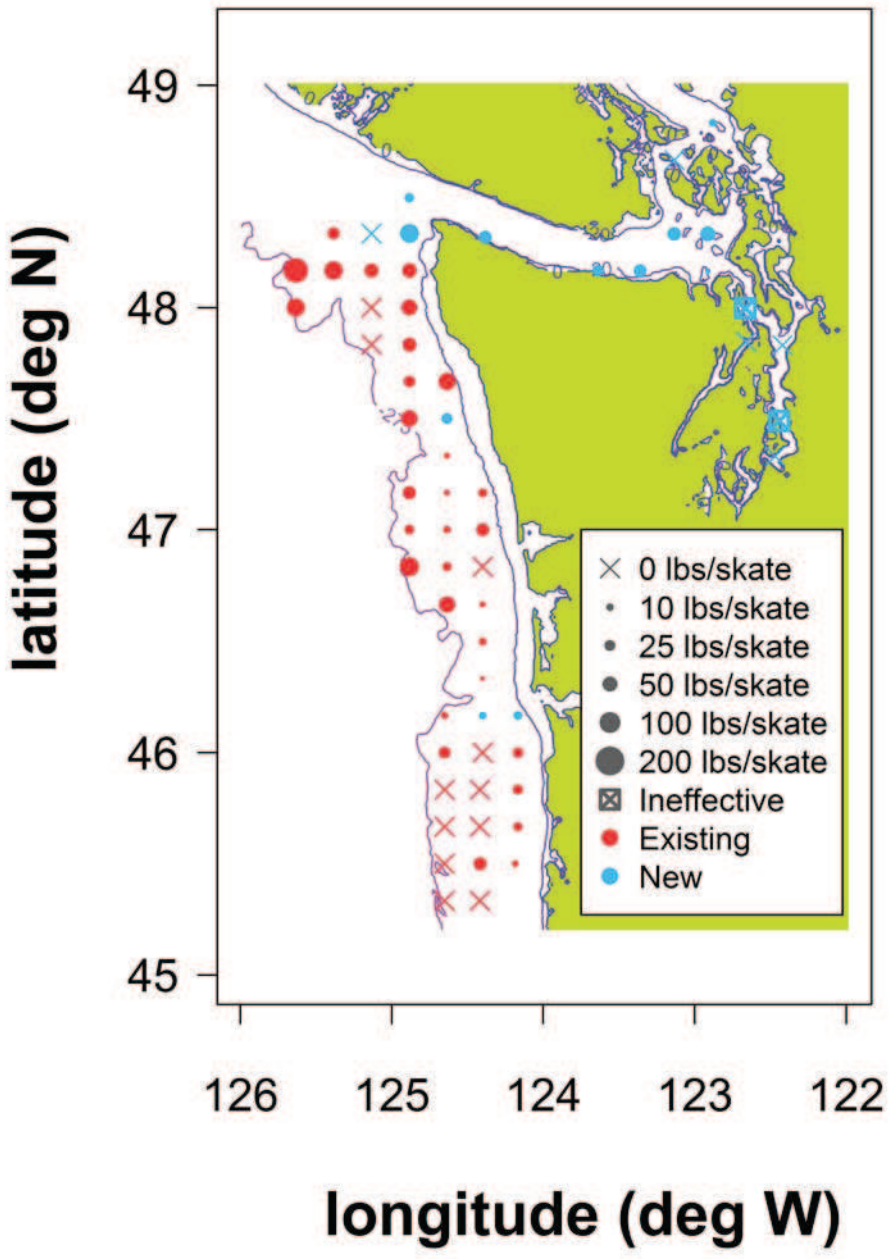

Figure 1. WPUE of stations in the Washington and Puget Sound survey regions within the standard 20-275 fathom survey depth range.

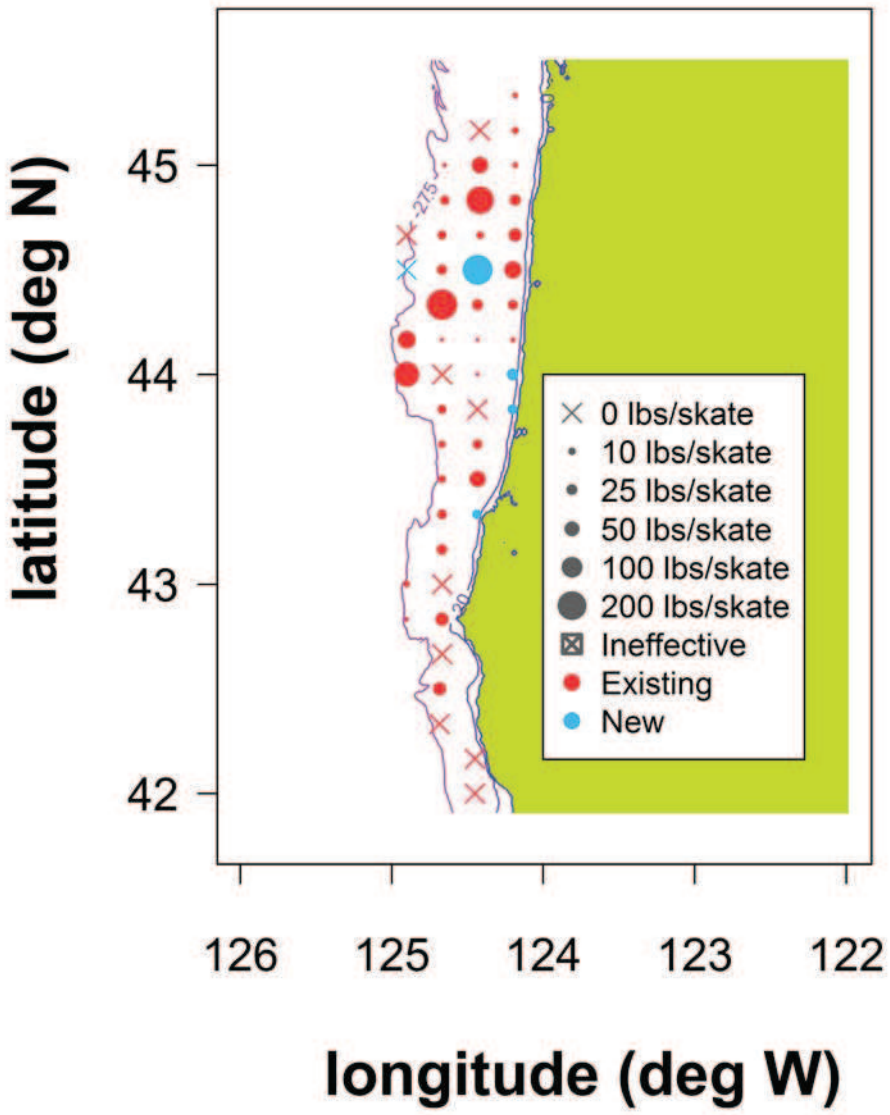

Figure 2. WPUE of stations in the Oregon survey region within the standard 20-275 fathom survey depth range.

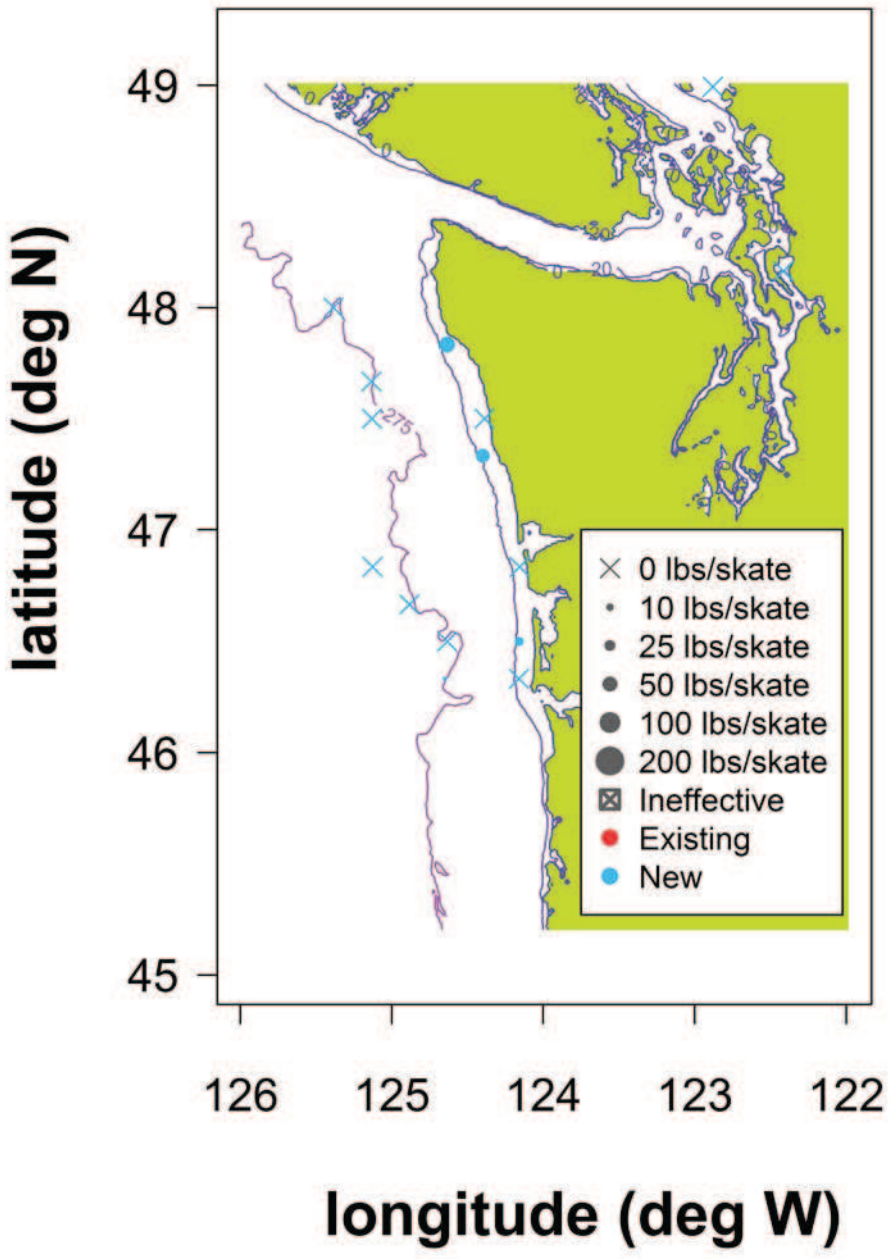

Figure 3. WPUE of deep (275-400 fathoms) and shallow (10-20 fathoms) stations in the Washington and Puget Sound survey regions.

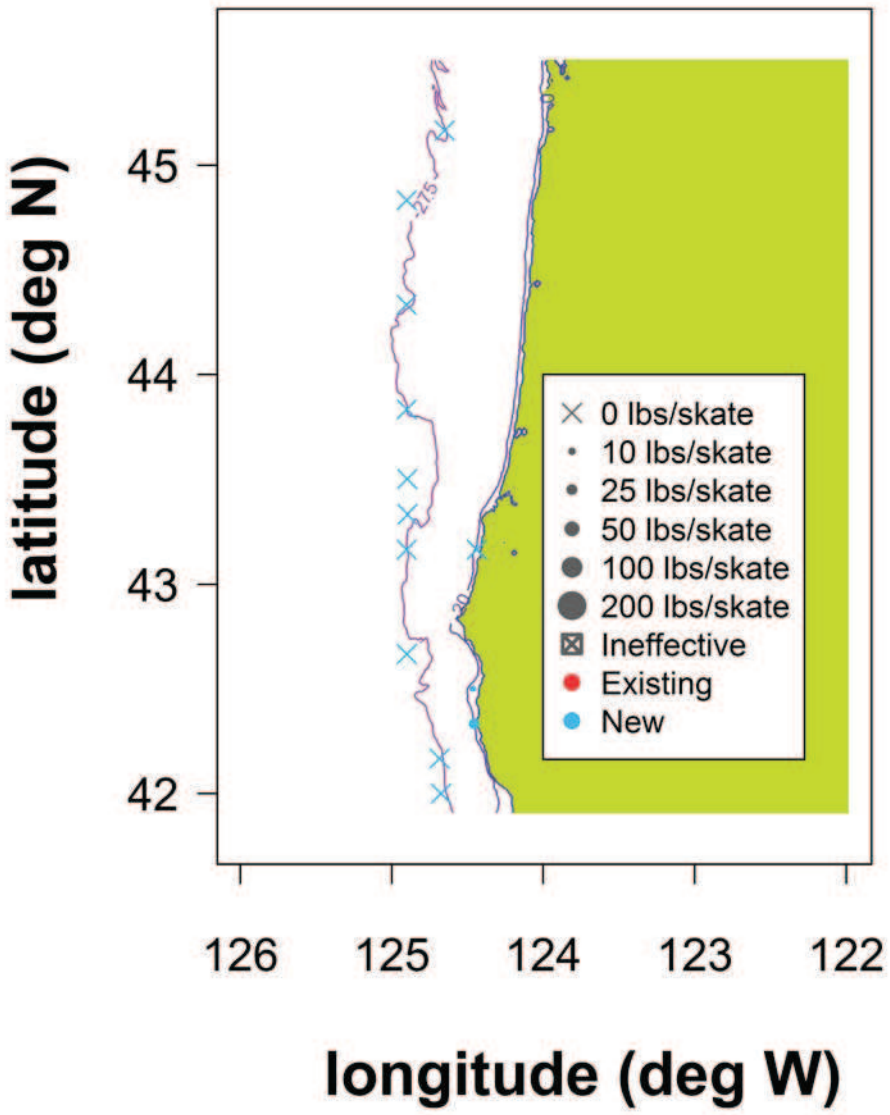

Figure 4. WPUE of deep (275-400 fathoms) and shallow (10-20 fathoms) stations in the Oregon survey region.