# Fishery-independent setline survey (FISS) design and implementation in 2017, including current and future expansions

**PREPARED BY: IPHC SECRETARIAT**
**(J.GOEN, T. GEERNAERT, E. HENRY, E. SODERLUND, A.M. RANTA, T.M. KONG, AND J. FORSBERG; 20 DECEMBER 2017)**

## PURPOSE

To provide an overview of the IPHC's fishery-independent setline survey (FISS) design and implementation in 2017, including current and future expansions.

## BACKGROUND

The International Pacific Halibut Commission's (IPHC's) fishery-independent setline survey (FISS or setline survey) provides catch information and biological data on Pacific halibut (*Hippoglossus stenolepis)* that are collected independently of the commercial fishery. These data, which are collected using standardized methods, bait, and gear during the summer of each calendar year, provide an important comparison with data collected from the commercial fishery. The commercial fishery is variable in its gear composition and distribution of fishing effort over time, and presents a broad spatial and temporal sampling of the stock. Pacific halibut biological data collected on the setline survey (e.g. the size, age, and sex composition) are used to monitor changes in biomass, growth, and mortality in adult and sub-adult components of the Pacific halibut population. In addition, records of non-target species caught during setline survey operations provide insight into bait competition, rate of bait attacks, and serve as an index of abundance over time, making them valuable to the assessment, management, and avoidance of non-target species.

The IPHC has conducted fishery-independent setline surveys in selected areas during most years since 1963 (with a break from 1987 to 1992). Historical information regarding previous setline survey operations has been presented in IPHC Annual Reports and Survey Manuals; IPHC Report of Assessment and Research Activities documents 1993-2016; and IPHC Technical Reports 18 and 58. The majority of the current FISS station design and sampling protocols have been standardised since 1998.

## FISHERY-INDEPENDENT SETLINE SURVEY (FISS) DESIGN AND PROCEDURES

In summary, the 2017 FISS chartered twelve commercial longline vessels (five Canadian and six U.S.) during a combined 74 trips and 780 charter days. All 1,499 setline survey stations planned for the 2017 setline survey season were either scouted or completed. Of these stations, 1,493 (99.6%) were considered successful for stock assessment analysis. A total of 13 special projects were facilitated and completed, and 12,922 otoliths were collected coastwide. Approximately 569,576 pounds (258 t) of Pacific halibut, 51,338 pounds (23 t) of Pacific cod, and 31,674 pounds (14 t) of rockfish were landed from the setline survey stations. Compared to the 2016 setline survey, weight-per-unit-effort increased in Regulatory Areas 2C, 4A, 4C, and 4D, with decreases in Areas 2A, 2B, 3A, 3B, and 4B. Descriptions of the FISS design and procedures follow.

### *Design*

The IPHC's FISS design encompasses nearshore and offshore waters of the IPHC Convention Area (Figure 1a). The current setline survey station layout has been in place since 1998 (with some additions in 2006 (Bering Sea), and in 2011 (IPHC Regulatory Area 2A)).

The Regulatory Areas are divided into 32 regions, each requiring between 10 and 46 charter days to survey (Table 1). Setline survey stations were located at the intersections of a 10 nmi by 10 nmi square grid within the depth range occupied by Pacific halibut during summer months (20-275 fm [37-503 m] in most areas). Figure 1b depicts the FISS station positions, charter region divisions, and IPHC Regulatory Areas surveyed.

The current standard grid (SG) station layout has been in place since 1998, with the addition of stations around the Pribilof Islands and St. Matthew Island beginning in 2006 and twelve stations in the Washington/Oregon charter regions beginning in 2011. Thirteen extra stations (ES) in southeast Alaska and eight rockfish (*Sebastes spp*.) index (RI) stations in the Washington charter region (described in the Special Projects section of this document) are fished on a different layout than the FISS and are not included in the IPHC stock assessment dataset.

Six skates were set in Regulatory Area 2A and seven skates in Regulatory Area 4CDE. Regulatory Areas 2B, 2C, 4A and 4B had five skates of baited gear set at each setline survey station in all charter regions. Setline survey specifications for gear, setting schedule, and soak time have been consistent since 1998. Setline survey gear consists of fixed-hook, 1,800-foot (549 m) skates with 100 16/0 circle hooks baited with 0.25 to 0.33 pounds (0.11 to 0.15 kg) of chum salmon (*Oncorhynchus keta*) and spaced 18 feet (5.5 m) apart. Gangion length ranges from 24 to 48 inches (61 cm to 122 cm). Each vessel sets one to four stations daily beginning at or after 0500 AM, and soaks the gear at least five hours before hauling. Vessels avoided soaking the gear at night, when possible. Data from gear soaked longer than 24 hours were not used for stock assessment purposes.

Sets were considered ineffective for stock assessment if predetermined limits for lost gear, snarls, depredation, or displacement from station coordinates were exceeded. The fork lengths of all Pacific halibut captured at FISS stations were recorded to the nearest centimeter and all lengths stated hereafter will be fork lengths. Each length was converted to an estimated weight using a standard formula (Clark 1992), and these weights were then used to generate the weight per unit effort (WPUE) data. Average WPUE, expressed as net pounds per skate, was calculated by dividing the estimated catch in pounds (net weight) of Pacific halibut equal to or over 32 inches (81.3 cm; O32 Pacific halibut) in length by the number of skates hauled for each station, and averaging these values by area (statistical, charter, or regulatory).

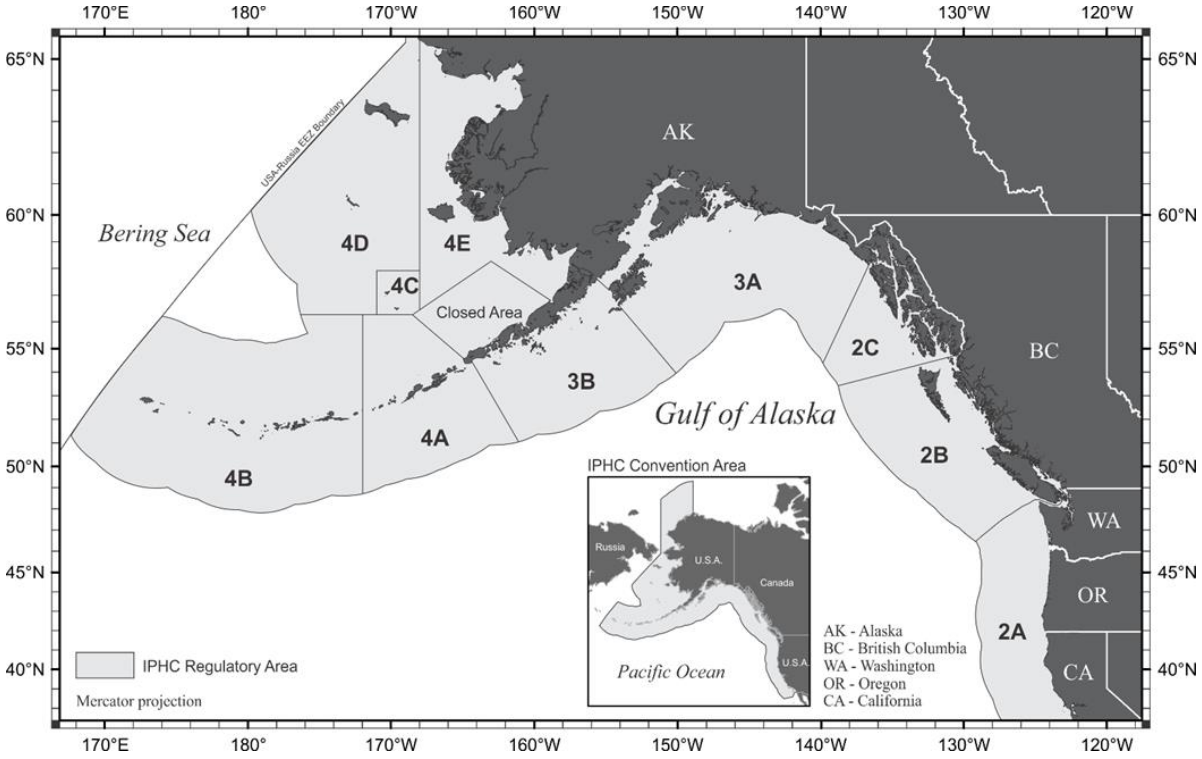


**Figure 1a.** Map of the IPHC Convention Area and IPHC Regulatory Areas.

**Table 1.** Effort and catch summary by FISS charter region and vessel for all 2017 setline survey stations.

| Regulatory Area | Charter Region | Vessel | ADFG or VRN[1] | Charter Days[2] | Planned Stations | Effective Stations | Pacific halibut Sold[3] (lbs) | Avg. Price[4] USD | Chum (lbs) |
|---|---|---|---|---|---|---|---|---|---|
| 2A | N. California | *Pacific Surveyor* | - | 29 | 42 | 41 | 1,728 | $8.01 | 4,767 |
| 2A | Oregon | *Pacific Surveyor* | - | 34 | 60 | 60 | 9,915 | $7.96 | 12,393 |
| 2A | Washington | *Pacific Surveyor* | - | 40 | 96 | 96 | 3,452 | $5.74 | 16,870 |
| 2A | Puget Sound | *Pacific Surveyor* | - | 10 | 14 | 14 | 727 | $4.75 | 2,700 |
| 2B | Charlotte | *Pender Isle* | 27282 | 19 | 43 | 43 | 27,607 | $8.54 | 6,896 |
| 2B | Goose Is. | *Vanisle* | 21912 | 25 | 43 | 43 | 11,015 | $8.02 | 8,600 |
| 2B | St. James | *Vanisle* | 21912 | 20 | 39 | 39 | 19,513 | $8.43 | 7,800 |
| 2B | Vancouver | *Vanisle* | 21912 | 20 | 41 | 41 | 6,594 | $7.77 | 8,200 |
| 2C | Ketchikan | *Star Wars II* | 20492 | 22 | 41 | 41 | 42,502 | $7.55 | 6,200 |
| 2C | Ommaney | *Pender Isle* | 27282 | 18 | 40 | 40 | 47,493 | $6.62 | 5,850 |
| 2C | Sitka | *Pender Isle* | 27282 | 19 | 42 | 41 | 33,712 | $6.44 | 7,150 |
| 3A | Albatross | *Clyde* | 55803 | 23 | 45 | 45 | 27,290 | $6.45 | 9,006 |
| 3A | Fairweather | *Star Wars II* | 20492 | 20 | 49 | 49 | 22,319 | $6.30 | 8,659 |
| 3A | Gore Pt. | *Bold Pursuit* | 20875 | 16 | 45 | 45 | 14,931 | $6.46 | 7,100 |
| 3A | Portlock | *Saint Nicholas* | 45399 | 28 | 46 | 46 | 30,735 | $6.48 | 7,100 |
| 3A | PWS | *Bold Pursuit* | 20875 | 19 | 45 | 45 | 28,695 | $6.07 | 6,008 |
| 3A | Seward | *Bold Pursuit* | 20875 | 24 | 48 | 48 | 22,534 | $6.41 | 7,470 |
| 3A | Shelikof | *Saint Nicholas* | 45399 | 46 | 45 | 44 | 14,537 | $6.39 | 6,900 |
| 3A | Yakutat | *Star Wars II* | 20492 | 23 | 51 | 51 | 36,860 | $6.36 | 9,441 |
| 3B | Chignik | *Allstar* | 55922 | 25 | 45 | 44 | 16,413 | $6.14 | 6,958 |
| 3B | Sanak | *Free to Wander* | 29155 | 26 | 48 | 48 | 12,187 | $5.90 | 4,600 |
| 3B | Semidi | *Predator* | 33133 | 28 | 47 | 47 | 14,730 | $6.19 | 8,700 |
| 3B | Shumagin | *Allstar* | 55922 | 20 | 44 | 44 | 17,444 | $6.11 | 4,067 |
| 3B | Trinity | *Clyde* | 55803 | 19 | 47 | 47 | 10,988 | $6.18 | 8,194 |
| 4A, Closed | 4A Edge | *Free to Wander* | 29155 | 24 | 57 | 57 | 11,074 | $5.65 | 8,272 |
| 4A. 4C | Unalaska | *Free to Wander* | 29155 | 26 | 66 | 66 | 20,395 | $5.56 | 11,012 |
| 4D, 4C | 4D Edge | *Kema Sue* | 41033 | 34 | 68 | 68 | 19,952 | $5.09 | 13,900 |
| 4B | Andreanof | *Norcoaster* | 38173 | 32 | 54 | 53 | 28,251 | $5.51 | 10,295 |
| 4B | Amchitka | *Norcoaster* | 38173 | 38 | 49 | 49 | 10,725 | $5.06 | 9,358 |
| 4B | S. Bower's Ridge | *Norcoaster* | 38173 | 12 | 25 | 25 | 2,557 | $4.96 | 4,757 |
| 4B | N. Bower's Ridge | *Kema Sue* | 41033 | 13 | 25 | 25 | 553 | $5.30 | 3,652 |
| 4B | Near Islands | *Kema Sue* | 41033 | 28 | 49 | 48 | 2,148 | $5.06 | 3,800 |
| **Total** | | **12 Vessels** | | **780** | **1499** | **1493** | **569,576** | **$6.36** | **246,675** |

[1] ADFG or VRN stands for Alaska Department of Fish and Game or Vessel Registration Number.
[2] Days are estimated because some vessels fished two charter regions in one day.
[3] Net weight (head-off, dressed, washed). Poundage may not sum to correct total because of rounding errors introduced by splitting the catch out to region.
[4] Gross prices

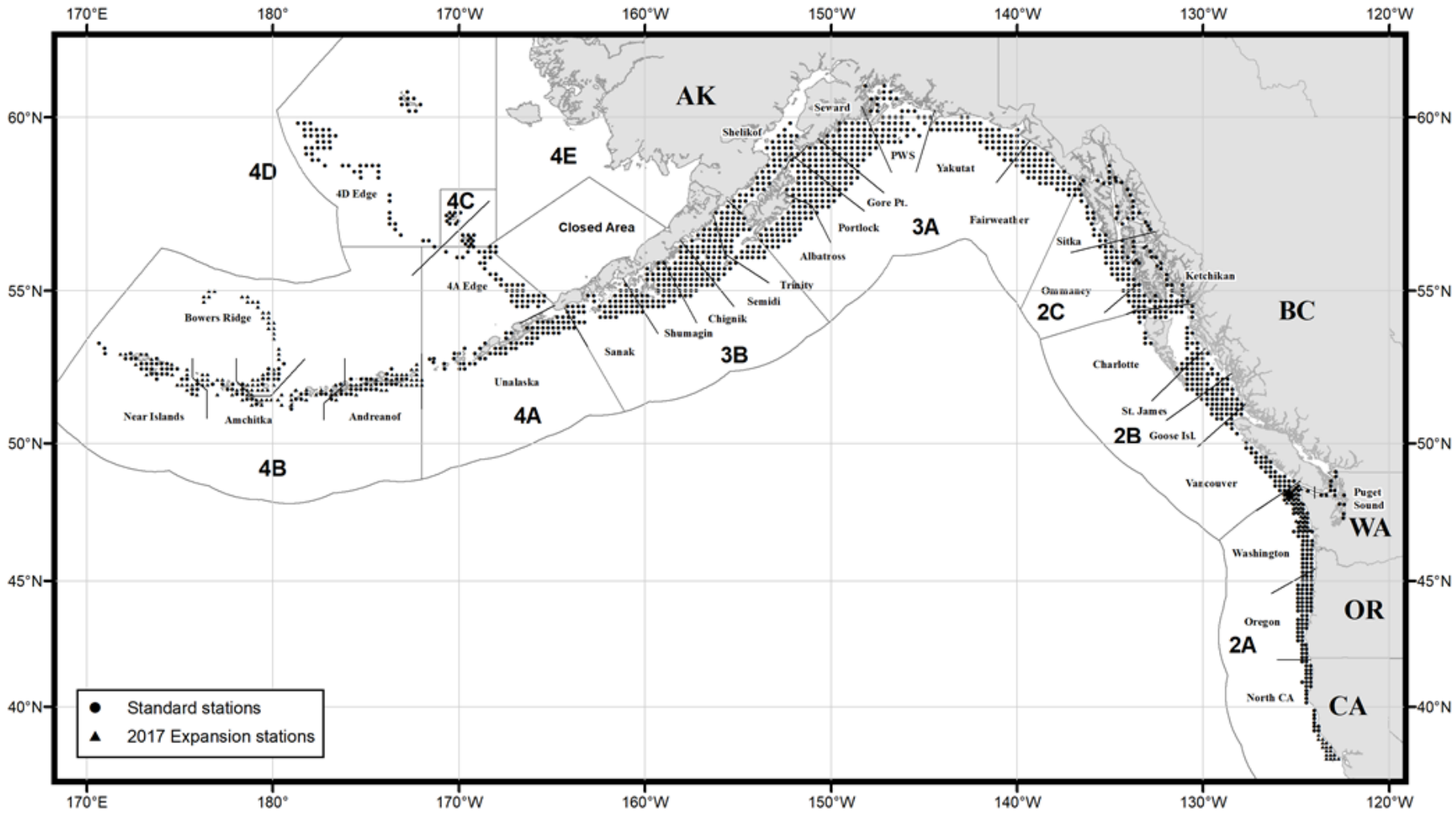


**Figure 1b.** 2017 IPHC fishery-independent setline survey station positions, charter region divisions, and IPHC Regulatory Areas.

### *Vessel Operations*

Fishing vessels are chosen through a competitive bid process each year where up to 3 regions per vessel are awarded and 10-15 vessels are chosen. In 2017, twelve commercial longline vessels (five Canadian and six U.S.), were chartered by the IPHC for our fishery-independent setline survey operations. During a combined 74 trips and 780 charter days, these vessels fished 32 charter regions, covering habitat from northern California on to the island of Attu in the Aleutian Islands, and north along and including the Bering Sea continental shelf (Table 1).

## FISHERY-INDEPENDENT SETLINE SURVEY (FISS) EXPANSION STATIONS

Since 2014, the IPHC has been sampling expansion setline survey stations in one or two IPHC Regulatory Areas each year (Figure 2). Commercial fishery data and other sources have shown the presence of Pacific halibut down to depths of 732 m (400 fm) and in waters shallower than 37 m (20 fm). Further, most IPHC Regulatory Areas have substantial gaps in station coverage within the standard 37-503 m depth range. The incomplete coverage of Pacific halibut habitat by the setline survey could potentially lead to biased estimates of the weight per unit effort (WPUE) and numbers per unit effort (NPUE) when used in the density indices for stock assessment modelling and for stock distribution estimation. For this reason, the IPHC has been undertaking a sequence of expansions since 2014 (following a 2011 pilot), with setline survey stations added to the standard grid to cover habitat not previously sampled.

In 2017, 145 stations were added to Regulatory Area 4B, which included depths as shallow as 50 fathoms (91 m) and as deep as 400 fathoms (732 m). Regulatory Area 2A was fished with the same expansion as in 2014 including an additional 17 stations in the Northern California charter region, an additional densified grid of 26 stations in the Washington charter region, and repeating the 14 stations into Puget Sound (National Marine Sanctuaries Permits OCNMS-2017-006 and MULTI-2017-011). All 1,499 setline survey stations planned for the 2017 setline survey season were either scouted or completed. Of these stations, 1,493 (99.6%) were considered successful for stock assessment analysis.

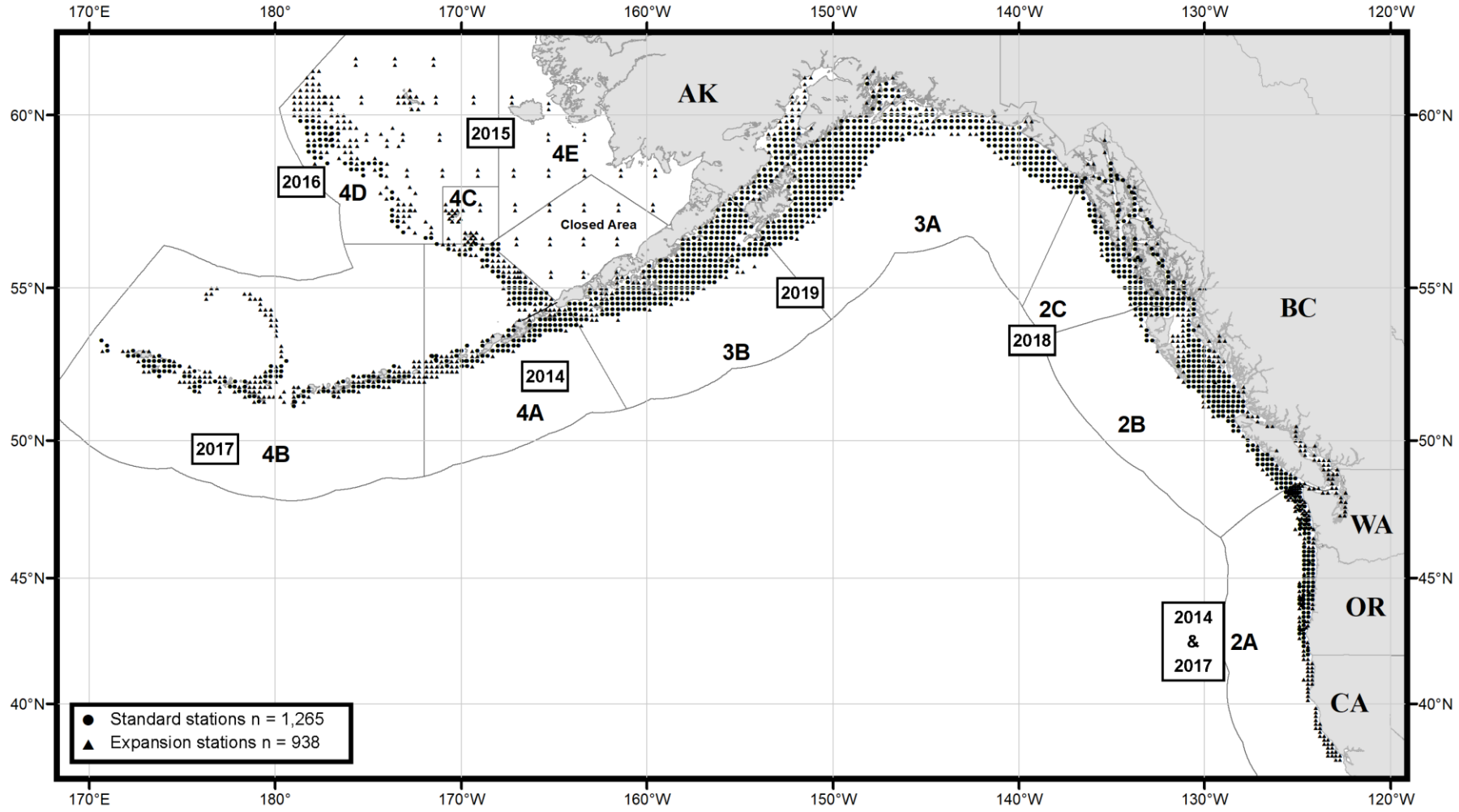


**Figure 2**. IPHC fishery-independent setline survey (FISS) and expansion stations planned (2014-19).

### *2017 FISS Expansion in Regulatory Area 2A*

This was the third year of expansion in IPHC Regulatory Area 2A which already had an expansion of the grid in Oregon down to 42° N latitude in 2011 and 2014, including Puget Sound in Washington. Northern California stations were first surveyed in 2013 down to 40° N latitude to investigate anecdotal reports of increasing Pacific halibut catches in the southern range. Northern California stations were again surveyed in the expansion in 2014, fishing as far south as 39° N latitude. In 2017, the expansion went further south to 37°45' N latitude (near San Francisco) and included Puget Sound. In addition, an ad-hoc densified expansion grid off the north Washington coast was surveyed for the first time in 2017 (per the ad-hoc Annual Meeting recommendation, AM093–Rec.03, and detailed in papers IPHC-2017-AM093-06_ADD_1 and 2). A total of 212 stations were surveyed in Regulatory Area 2A in 2017, of which 108 were expansion stations, including 26 ad-hoc densified grid stations off the north Washington coast (Figure 3 & Table 2). The FISS was conducted under applicable permits, including but not limited to National Marine Sanctuaries Permits OCNMS-2017-006 and MULTI-2017-011.

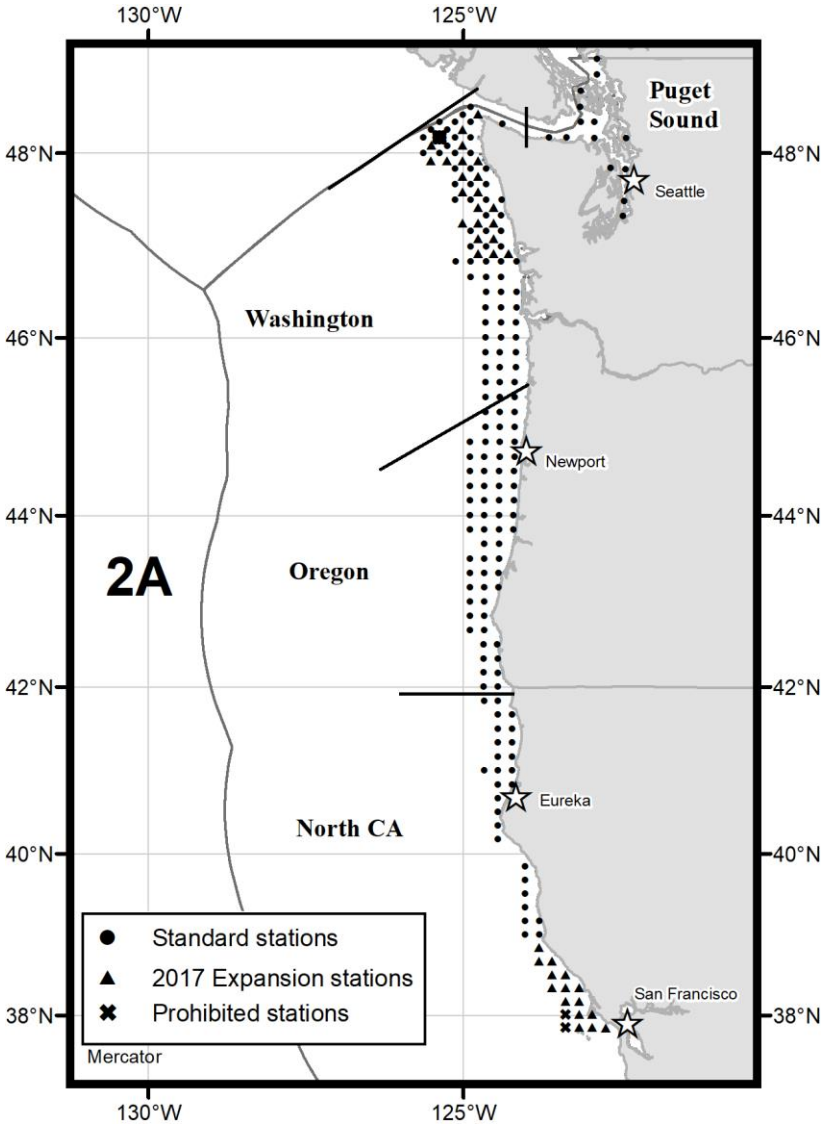


**Figure 3.** 2017 IPHC fishery-independent setline survey stations in Regulatory Area 2A with charter regions.

**Table 2**. IPHC Regulatory Area 2A setline survey charter regions and count by station type.

| California | Station count |
|---|---|
| Expansion -Previously fished | 27 |
| New expansion | 15* |
| Oregon | |
| Expansion | 13 |
| Standard grid | 47 |
| Washington | |
| Expansion | 13 |
| Densified grid | 26 |
| Standard grid | 49 |
| Rockfish Index | 8 |

*2 stations were not permitted because of habitat closures

### *2017 FISS Expansion in Regulatory Area 4B*

As a continued part of a multi-year coastwide effort to expand our setline survey coverage and depth profile, an additional 145 stations were added to Regulatory Area 4B including stations as shallow as 50 fathoms (91 m) and as deep as 400 fathoms (732 m) (Figure 1, Figure 4). To help manage this expansion, the historical Adak and Attu charter regions were divided into four new regions named Amchitka, Andreanof, north and south Bowers Ridge, and Near Islands (Figure 4 & Table 3).

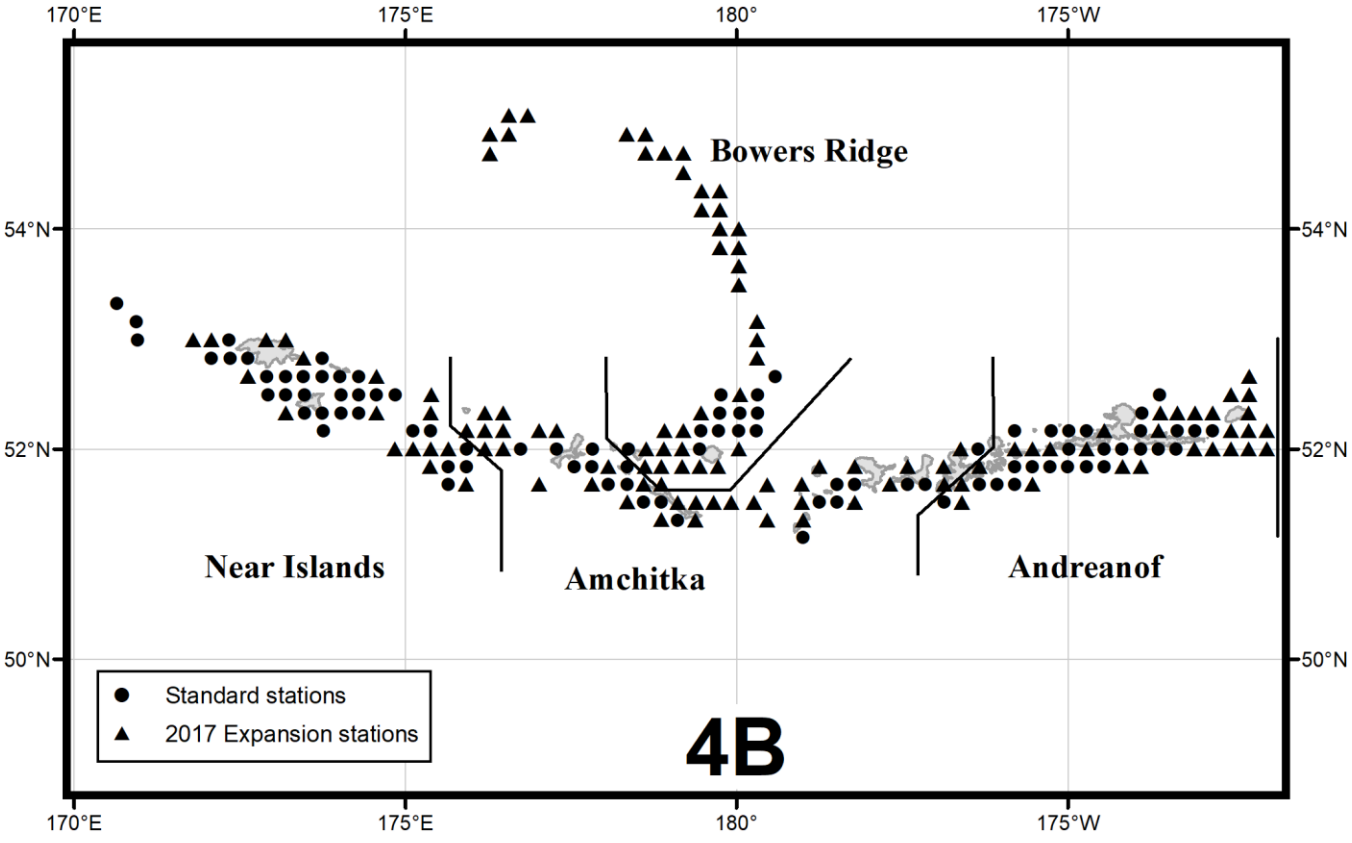

**Figure 4.** 2017 IPHC fishery-independent setline survey stations in Regulatory Area 4B with charter regions.

**Table 3.** IPHC Regulatory Area 4B setline survey charter regions and count by station type.

| Andreanof | Station count |
|---|---|
| Expansion | 28 |
| Standard grid | 26 |
| Amchitka | |
| Expansion | 31 |
| Standard grid | 18 |
| Bowers South | |
| Expansion | 13 |
| Standard grid | 12 |
| Bowers North | |
| Expansion | 24 |
| Standard grid | 1 |
| Near Islands | |
| Expansion | 17 |
| Standard grid | 32 |

### *Sampling protocols*

Sea samplers collected data according to protocols established in the 2017 Fishery-Independent Setline Survey Manual (IPHC 2017a). As the gear was set, IPHC samplers evaluated the performance of the bird avoidance devices that were deployed along with the longline gear and recorded the exact number of hooks set and baits lost per skate of gear fished. During gear retrieval, samplers generally recorded hook status (e.g., empty, returned bait, species captured, bait type) of the first 20 consecutive hooks of each skate. However, processing needs for fish from previous skates, particularly in areas with high catch rates, occasionally affected where in the 100-hook sequence of the skate the sample was taken. In specific northern stations of Regulatory Area 2A, and all of Area 2B, samplers recorded the status of all hooks in the order in which they were hauled, in lieu of 20-hook subsample counts.

Samplers recorded lengths of all Pacific halibut caught along with the corresponding skate number. Vessel crew eviscerated all O32 Pacific halibut and then passed them to an IPHC sampler, who determined sex and maturity, prior hooking injury severity, and evidence of depredation, and collected otoliths from a randomized subsample for later age determination. Male Pacific halibut were assessed as either mature or immature, and females as immature, mature, spawning, or spent/resting. When the maturity stage of either sex could not be determined, the sampler coded the maturity stage as unidentified. The sex and maturity of Pacific halibut less than 32 inches (81.3 cm; U32 Pacific halibut) in length were recorded only if the fish was randomly selected for otolith collection or was already dead upon capture. Samplers used a random sampling table to select Pacific halibut for otolith removal from a subsample of all Pacific halibut caught. All U32 Pacific halibut not selected for otolith collection were measured and released alive.

At the end of each haul, samplers recorded the presence and abundance of seabird species within a 50-m radius from the vessel's stern. Seabird data are used to determine the spatial and temporal variation in the abundance of seabirds. A discussion of seabird data can be found in Geernaert (2017).

### *Bait purchases*

The minimum quality requirement for setline survey bait is No. 2 semi-bright (Alaska Seafood Marketing Institute grades A through E), headed and gutted, and individually quick-frozen chum salmon. The IPHC secures most of the bait needed to supply setline survey operations prior to the start of the setline survey. In August 2016, staff began arranging bait purchases for the 2017 setline survey. Approximately 247,000 pounds (112.0 t) of chum salmon were utilized from three suppliers in the United States. The amount of bait used varied by vessel and charter region (Table 1). Bait quality was monitored and documented throughout the season and found to meet the standard as described above.

### *Fish sales and revenue sharing*

As in previous years, O32 Pacific halibut that were caught on setline survey stations and sacrificed in order to obtain biological data were retained and sold. This helps to offset costs of the setline survey program. Setline survey vessels also retained for sale incidentally captured rockfish (*Sebastes spp*.) and Pacific cod (*Gadus macrocephalus*). These species were retained because they rarely survive the barotrauma resulting from capture. Most vessel contracts provided the vessel a lump sum payment, along with a 10% share of the Pacific halibut proceeds and a 50% share of the incidental catch proceeds. The *R/V Pacific Surveyor* received no share of Pacific halibut or bycatch proceeds. The IPHC does not retain proceeds from the sale of incidentally captured rockfish and Pacific cod. Instead, for retained bycatch captured in U.S. waters, proceeds are divided equally between the vessel (for handling expenses) and the state management agency. In Canada, Fisheries and Oceans Canada (DFO) receives all proceeds from sales of retained bycatch captured in Canadian waters, subsequent to deduction of the predetermined vessel bycatch processing fees.

IPHC's chartered vessels delivered fish to 22 different ports during the 2017 setline survey (Table 4). Fish sales were awarded based on the objectives of obtaining a fair market price and distributing sales among buyers and ports. When awarding sales, the Commission considered the price offered, the number of years that a buyer had been buying and marketing Pacific halibut, how fish were graded at the dock (including the determination of No. 2 and chalky Pacific halibut), and the promptness of settlements following deliveries. Obtaining fair market value was the main consideration in awarding fish sales. However, when factors other than fish price were considered, sales were sometimes awarded to buyers not offering the highest prices, thereby meeting the goal of distributing sales among qualified buyers. Individual sales were evaluated after each event to ensure that the buyer was meeting IPHC's standards.

A summary of landings and prices from the setline survey is provided by species and regulatory area in Table 5. Average prices over the entire setline survey range and season decreased from $6.85 in 2016 to $6.53 in 2017.

**Table 4.** Fishery-independent setline survey Pacific halibut landings by port, 2017[1].

| Offload Port | Trips Landed | Pacific halibut Sold (lbs) | Total (USD) | Average Price (USD/lb)[2] |
|---|---|---|---|---|
| Adak | 6 | 28,735 | $ 145,683 | $ 5.07 |
| Akutan | 1 | 1,748 | $ 9,931 | $ 5.68 |
| Alitak | 3 | 12,209 | $ 73,355 | $ 6.01 |
| Bellingham | 1 | 727 | $ 3,453 | $ 4.75 |
| Brookings | 2 | 3,091 | $ 24,809 | $ 8.03 |
| Cordova | 3 | 33,132 | $ 203,177 | $ 6.13 |
| Dutch Harbor | 4 | 42,002 | $ 238,637 | $ 5.68 |
| Homer | 7 | 49,690 | $ 321,802 | $ 6.48 |
| Juneau/Auke Bay | 1 | 10,612 | $ 66,320 | $ 6.25 |
| Kodiak | 7 | 53,683 | $ 341,150 | $ 6.35 |
| Neah Bay | 2 | 1,589 | $ 8,741 | $ 5.50 |
| Newport | 3 | 8,444 | $ 67,554 | $ 8.00 |
| Petersburg | 2 | 41,100 | $ 255,763 | $ 6.22 |
| Port Hardy | 4 | 20,545 | $ 168,372 | $ 8.20 |
| Prince Rupert | 6 | 81,967 | $ 675,954 | $ 8.25 |
| Sand Point | 3 | 26,214 | $ 156,062 | $ 5.95 |
| Seward | 4 | 33,028 | $ 211,889 | $ 6.42 |
| Sitka | 3 | 43,466 | $ 283,423 | $ 6.52 |
| St Paul | 4 | 25,698 | $ 134,071 | $ 5.22 |
| Tofino | 1 | 2,965 | $ 22,518 | $ 7.59 |
| Westport | 2 | 1,971 | $ 11,727 | $ 5.95 |
| Yakutat | 3 | 46,960 | $ 295,534 | $ 6.29 |
| | | 569,576 | $ 3,719,923 | $ 6.53 |

[1] Net weight (head-off, dressed, washed)
[2] Prices based on net weight

**Table 5.** Setline survey landings by species and Regulatory Area in 2017[1].

| Species | | 2A | 2B | 2C | 3A | 3B | 4A | 4B | 4C | 4D |
|---|---|---|---|---|---|---|---|---|---|---|
| Pacific halibut | lbs | 15,822 | 64,729 | 123,709 | 197,901 | 71,762 | 31,470 | 44,233 | 0 | 19,952 |
| Pacific halibut | USD/lb | $7.35 | $8.12 | $6.84 | $6.97 | $6.27 | $5.93 | $5.19 | - | $5.83 |
| Pacific Cod | lbs | 8 | 93 | 472 | 4,096 | 26,365 | 20,304 | 0 | 0 | 0 |
| Pacific Cod | USD/lb | $0.25 | $0.39 | $0.37 | $0.29 | $0.33 | $0.20 | - | - | - |
| Rockfish | lbs | 1,666 | 8,333 | 10,826 | 10,595 | 254 | 0 | 0 | 0 | 0 |
| Rockfish | USD/lb | $0.64 | $1.72 | $1.29 | $0.95 | $0.29 | - | - | - | - |

[1]Weights are net pounds offloaded.

### *Timing of the setline survey*

Each year, the months of May, June, July, and August are targeted for setline survey fishing. In 2017, 90 stations, amounting to approximately 2% of all stations, were fished outside of this

window. On a coastwide basis, setline survey vessel activity was highest in intensity at the beginning of the setline survey season and declined early in August as boats finished their charter regions (Figure 5). All setline survey activity was completed by mid-September.

| Week Beginning | | 22-May | 29-May | 5-Jun | 12-Jun | 19-Jun | 26-Jun | 3-Jul | 10-Jul | 17-Jul | 24-Jul | 31-Jul | 7-Aug | 14-Aug | 21-Aug | 28-Aug | 4-Sep | 11-Sep | 18-Sep |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | 2013 | | 11% | 22% | 34% | 45% | **61%** | 69% | 83% | 89% | 100% | | | | | | | | |
| | 2014 | 6% | 11% | 18% | 26% | 36% | 47% | **52%** | 60% | 67% | 76% | 85% | 94% | 100% | | | | | |
| | 2015 | 13% | 20% | 33% | **52%** | 65% | 72% | 83% | 94% | 100% | | | | | | | | | |
| | 2016 | | 14% | 23% | 42% | **54%** | 73% | 82% | 93% | 100% | | | | | | | | | |
| | 2017 | 2% | 11% | 19% | 28% | 34% | 41% | 47% | **51%** | 56% | 62% | 68% | 74% | 80% | 84% | 86% | 92% | 97% | 99% |
| 2B | 2013 | | 9% | 18% | 28% | 36% | 46% | **54%** | 64% | 79% | 84% | 92% | 100% | | | | | | |
| | 2014 | 8% | 14% | 26% | 38% | 45% | 49% | **55%** | 63% | 76% | 84% | 94% | 100% | | | | | | |
| | 2015 | 9% | 18% | 26% | 34% | 44% | **51%** | | 63% | 71% | 81% | 89% | 100% | | | | | | |
| | 2016 | | | | 5% | 14% | 21% | 29% | 44% | **64%** | 79% | 89% | 100% | | | | | | |
| | 2017 | | 12% | 21% | 28% | 36% | 40% | **59%** | 77% | 90% | 100% | | | | | | | | |
| 2C | 2013 | 7% | 20% | 33% | 46% | **60%** | 73% | 86% | 100% | | | | | | | | | | |
| | 2014 | 10% | 15% | | 19% | 26% | 43% | **66%** | 95% | 100% | | | | | | | | | |
| | 2015 | 12% | 17% | 20% | | 30% | 46% | **58%** | 71% | 100% | | | | | | | | | |
| | 2016 | | 15% | 29% | 38% | **51%** | 66% | 76% | 87% | 88% | 95% | 100% | | | | | | | |
| | 2017 | 2% | 14% | 28% | 38% | **53%** | 66% | | | | | 76% | 82% | 99% | | | | | |
| 3A | 2013 | 3% | 9% | 16% | 26% | 37% | 48% | **59%** | 71% | 81% | 90% | 95% | 98% | 100% | | | | | |
| | 2014 | 2% | 10% | 23% | 30% | 41% | 46% | **55%** | 63% | 70% | 77% | 84% | 90% | 94% | 97% | 100% | | | |
| | 2015 | 7% | 23% | 40% | **61%** | 71% | 79% | 86% | | 91% | 96% | 99% | 100% | | | | | | |
| | 2016 | | 11% | 22% | 33% | 44% | 49% | **55%** | 63% | 78% | 87% | 95% | 99% | 100% | | | | | |
| | 2017 | | 14% | 26% | 36% | 47% | **55%** | 67% | 76% | 82% | 88% | 89% | 91% | 95% | 98% | 100% | | | |
| 3B | 2013 | | | 10% | 13% | 29% | 46% | **66%** | 82% | 96% | 100% | | | | | | | | |
| | 2014 | | 9% | 21% | 33% | 42% | **50%** | 58% | 72% | 83% | 100% | | | | | | | | |
| | 2015 | | 1% | 12% | 19% | 34% | **50%** | 58% | 66% | 73% | 84% | 91% | 97% | 100% | | | | | |
| | 2016 | | 1% | 27% | 47% | **65%** | 83% | 91% | 98% | 100% | | | | | | | | | |
| | 2017 | | 6% | 28% | 49% | **70%** | 84% | 94% | 100% | | | | | | | | | | |
| 4A | 2013 | | 19% | 32% | 45% | **55%** | 67% | 68% | | | | 72% | 79% | 87% | 93% | 95% | 100% | | |
| | 2014 | | 7% | 30% | 34% | 45% | **52%** | 68% | | 72% | 79% | 85% | 91% | 99% | | | | | |
| | 2015 | | 11% | 24% | 41% | 44% | **53%** | | 72% | 82% | 92% | | | 99% | 100% | | | | |
| | 2016 | | 5% | 19% | 33% | 35% | **51%** | 63% | 76% | 91% | 95% | 100% | | | | | | | |
| | 2017 | | | | | 6% | 12% | 27% | 40% | **64%** | 75% | 85% | 100% | | | | | | |
| 4B | 2013 | | | | 19% | 26% | 33% | | 40% | **55%** | 58% | 82% | 97% | 100% | | | | | |
| | 2014 | | 17% | 20% | 24% | 28% | | 31% | | 40% | **54%** | 64% | | 84% | 100% | | | | |
| | 2015 | | | 17% | 29% | 38% | 42% | **52%** | | | 57% | 75% | 97% | 100% | | | | | |
| | 2016 | | | | 13% | 26% | 38% | **51%** | 69% | 71% | 80% | 100% | | | | | | | |
| | 2017 | | | | 1% | 19% | 31% | 41% | **53%** | 64% | 70% | 72% | 81% | 85% | 93% | 97% | | | |
| 4C | 2013 | | | | | | | 40% | | | | **60%** | | 100% | | | | | |
| | 2014 | | | | | | 10% | 25% | 40% | **100%** | | | | | | | | | |
| | 2015 | | | | | | | 18% | **93%** | | 100% | | | | | | | | |
| | 2016 | | | | | | | | 5% | **50%** | 100% | | | | | | | | |
| | 2017 | | | | | | 15% | **50%** | | | | 60% | | 100% | | | | | |
| 4D | 2013 | | | | | | | 5% | 47% | **57%** | 90% | 100% | | | | | | | |
| | 2014 | | | | 14% | **50%** | 69% | 84% | 100% | | | | | | | | | | |
| | 2015 | | | | | | | 4% | 21% | 49% | **61%** | 79% | 90% | 100% | | | | | |
| | 2016 | | | 1% | 15% | 20% | 35% | **55%** | 75% | 87% | 100% | | | | | | | | |
| | 2017 | | | | | | | | | 31% | **52%** | 71% | 100% | | | | | | |

**Figure 5.** The cumulative percentage of each Regulatory Area's planned stations completed and considered effective for stock assessment by the end of the week beginning on the date show for 2017. Highlighted cells are the week in which 50% of setline survey work in that area, cumulatively, was completed.

### *Weight Per Unit Effort*

The FISS covers commercial as well as non-commercial fishing grounds, so the average WPUE for all regulatory areas surveyed was below that of the commercial fleet (Table 6). Not all of the WPUE data included in this report are used in the stock assessment analysis. Three setline survey stations located in the Closed Area (stations 7041, 7047, and 7048; see IPHC [2017a]) fall in the 4A Edge charter region and are listed in Area 4A, but are included in Areas 4CDE for stock assessment purposes. Thirteen stations in southeast Alaska's inside waters occur at a spatial density that is not acceptable for the stock assessment, and are not used in assessment or stock distribution calculations. Detailed information regarding pounds of O32 Pacific halibut and average WPUE by regulatory and statistical area are provided in Table 7 for effectively surveyed stations. Table 8 provides detailed average WPUE for the statistical areas of the Eastern Bering Sea island cluster stations.

Compared to 2017 results, setline survey WPUE increased in Regulatory Areas 2C (+23%), 4A (+2%), 4C (+28%), and 4D (+95%). WPUE decreased in Regulatory Areas 2A (-53%), 2B (-10%), 3A (-10%), 3B (-20%) and 4B (-7%) (Table 6, Figure 6). Since 2011, Area 2C's WPUE has exceeded Area 3A's, and has been the highest WPUE of all the regions (Figure 6).

As seen in Figures 7 and 8, setline survey WPUE increased by 17% in the Oregon charter region, but decreased by 70% in the Washington region. WPUE increased in two out of the four regions of Area 2B, with Charlotte and St. James increasing by 4% and 7%, respectively. In the Vancouver (-39%) and Goose Island (-34%) charter regions, WPUE decreased. WPUE in Area 2C increased in the Sitka (+18%), Ommaney (+12%), and Ketchikan (+44%) charter regions.

In Area 3A, WPUE increased in the PWS (+2%), Shelikof (+74%), and Portlock (+21%) charter regions, while decreases were observed in Fairweather (-27%), Yakutat (-16%), Seward (-14%), Gore Point (-43%), and Albatross (-16%). Area 3B WPUE decreased in Chignik (-19%), Sanak (-36%), Semidi (-23), Shumagin (-2%), and Trinity (-16%) regions when compared to last year. (Figure 7). All four charter regions along the Aleutian chain increased in 2017 as compared to last year, with Attu region's WPUE increasing by 13%, and Adak and Unalaska up 3%. On the Bering Sea continental shelf, WPUE for St. Paul Island decreased by 2% and stations around St. George increased by 30%. The 4A Edge and 4D Edge region's WPUE increased by 8% and 98%, respectfully.

**Table 6.** Average setline survey and commercial WPUE (lb/skate) of Pacific halibut from 2013 to 2017[1,2].

| Reg. Area | Year | Effective Stations | Setline survey WPUE | Commercial WPUE | % of Commercial | Areas Surveyed |
|---|---|---|---|---|---|---|
| 2A | 2013 | 111 | 24 | 132 | 18.2% | Northern California to Cape Flattery |
| | 2014 | 162 | 18 | 116 | 15.5% | Northern California to Cape Flattery, Puget Sound |
| | 2015 | 96 | 31 | 110 | 28.2% | OR-CA Border to Cape Flattery |
| | 2016 | 95 | 30 | 59 | 50.8% | OR-CA Border to Cape Flattery |
| | 2017 | 203 | 14 | 95 | 14.7% | Northern California to Cape Flattery, Puget Sound |
| 2B | 2013 | 170 | 94 | 269 | 34.8% | All 2B |
| | 2014 | 170 | 92 | 315 | 29.2% | All 2B |
| | 2015 | 170 | 89 | 307 | 29.0% | All 2B |
| | 2016 | 169 | 89 | 317 | 28.1% | All 2B |
| | 2017 | 166 | 80 | 301 | 26.6% | All 2B |
| 2C | 2013 | 122 | 183 | 227 | 80.6% | All 2C |
| | 2014 | 123 | 185 | 228 | 81.1% | All 2C |
| | 2015 | 122 | 207 | 240 | 86.3% | All 2C |
| | 2016 | 123 | 177 | 227 | 78.0% | All 2C |
| | 2017 | 122 | 218 | 231 | 94.4% | All 2C |
| 3A | 2013 | 372 | 117 | 240 | 48.7% | All 3A |
| | 2014 | 374 | 115 | 232 | 49.6% | All 3A |
| | 2015 | 372 | 103 | 260 | 39.6% | All 3A |
| | 2016 | 373 | 130 | 277 | 46.9% | All 3A |
| | 2017 | 373 | 117 | 273 | 42.9% | All 3A |
| 3B | 2013 | 229 | 64 | 113 | 56.7% | All 3B |
| | 2014 | 229 | 65 | 99 | 65.7% | All 3B |
| | 2015 | 231 | 79 | 146 | 54.1% | All 3B |
| | 2016 | 231 | 82 | 155 | 52.9% | All 3B |
| | 2017 | 230 | 66 | 142 | 46.5% | All 3B |
| 4A | 2013 | 105 | 42 | 164 | 25.6% | 4A Aleutians and 4A Edge |
| | 2014 | 185 | 61 | 134 | 45.5% | 4A Aleutians and 4A Edge |
| | 2015 | 111 | 49 | 149 | 32.9% | 4A Aleutians and 4A Edge |
| | 2016 | 111 | 51 | 169 | 30.2% | 4A Aleutians and 4A Edge |
| | 2017 | 113 | 52 | 123 | 42.3% | 4A Aleutians and 4A Edge |
| 4B | 2013 | 89 | 57 | 122 | 47.0% | 4B Aleutians |
| | 2014 | 89 | 50 | 167 | 29.9% | 4B Aleutians |
| | 2015 | 89 | 56 | 155 | 36.1% | 4B Aleutians |
| | 2016 | 88 | 56 | 113 | 49.6% | 4B Aleutians |
| | 2017 | 200 | 52 | 118 | 44.1% | 4B Aleutians |
| 4C | 2013 | 20 | 35 | 55 | 64.3% | St. George and St. Paul Islands |
| | 2014 | 20 | 44 | 60 | 73.3% | St. George and St. Paul Islands |
| | 2015 | 20 | 44 | 98 | 44.9% | St. George and St. Paul Islands |
| | 2016 | 20 | 60 | 72 | 83.3% | St. George and St. Paul Islands |
| | 2017 | 20 | 77 | 87 | 88.5% | St. George and St. Paul Islands |
| 4D | 2013 | 58 | 25 | 151 | 16.4% | 4D Edge and St. Matthew Island |
| | 2014 | 58 | 23 | 167 | 13.8% | 4D Edge and St. Matthew Island |
| | 2015 | 58 | 30 | 157 | 19.1% | 4D Edge and St. Matthew Island |
| | 2016 | 141 | 19 | 177 | 10.7% | 4D Edge and St. Matthew Island |
| | 2017 | 58 | 37 | 301 | 12.3% | 4D Edge and St. Matthew Island |

[1] Commercial WPUE data for the current year are preliminary.
[2] Does not include ineffective, RI, or EBS expansion stations surveyed in 2015. This may differ from that used in the stock assessment.

**Table 7.** Number of stations effectively surveyed, total O32 Pacific halibut catch, and average setline survey WPUE (lb/skate), by statistical area in 2017[1,2].

| Reg. Area | Stat. Area | Effective Stations | O32 Pacific halibut Lbs. | Avg. WPUE |
|---|---|---|---|---|
| 2A | 6 | 25 | 131 | 1 |
| | 7 | 12 | 788 | 11 |
| | 8 | 11 | 1,056 | 16 |
| | 9 | 16 | 1,536 | 16 |
| | 10 | 20 | 6,050 | 52 |
| | 20 | 20 | 1,792 | 15 |
| | 30 | 18 | 933 | 9 |
| | 40 | 27 | 470 | 3 |
| | 50 | 54 | 4,296 | 13 |
| **2A Total** | | **203** | **17,052** | **14** |
| 2B | 60 | 16 | 2,792 | 36 |
| | 70 | 13 | 938 | 14 |
| | 80 | 5 | 915 | 37 |
| | 90 | 7 | 2,542 | 72 |
| | 91 | 23 | 4,979 | 43 |
| | 100 | 1 | 137 | 28 |
| | 102 | 36 | 12,063 | 71 |
| | 112 | 31 | 16,068 | 104 |
| | 121 | 7 | 4,951 | 140 |
| | 130 | 6 | 8,007 | 265 |
| | 131 | 3 | 4,561 | 303 |
| | 132 | 9 | 4,181 | 92 |
| | 133 | 5 | 2,476 | 98 |
| | 134 | 3 | 521 | 34 |
| | 135 | 1 | 690 | 138 |
| **2B Total** | | **166** | **65,822** | **80** |
| 2C | 140 | 9 | 16,737 | 375 |
| | 141 | 8 | 9,878 | 248 |
| | 142 | 13 | 12,789 | 199 |
| | 143 | 8 | 4,134 | 104 |
| | 144 | 1 | 644 | 131 |
| | 150 | 14 | 22,389 | 319 |
| | 151 | 10 | 10,390 | 206 |
| | 152 | 3 | 1,767 | 116 |
| | 153 | 5 | 4,085 | 164 |
| | 160 | 13 | 18,200 | 278 |
| | 161 | 4 | 3,495 | 175 |
| | 162 | 6 | 6,326 | 211 |
| | 163 | 2 | 2,498 | 249 |
| | 170 | 7 | 7,964 | 226 |
| | 171 | 4 | 1,429 | 73 |
| | 173 | 6 | 2,308 | 77 |
| | 181 | 4 | 4,278 | 212 |
| | 182 | 3 | 3,305 | 219 |
| | 183 | 2 | 535 | 53 |
| **2C Total** | | **122** | **133,149** | **218** |
| 3A | 185 | 17 | 9,523 | 113 |
| | 190 | 27 | 10,849 | 81 |
| | 200 | 27 | 23,324 | 174 |
| | 210 | 17 | 11,056 | 131 |
| | 220 | 13 | 11,674 | 180 |
| | 230 | 21 | 14,888 | 143 |
| | 232 | 3 | 2,959 | 198 |
| | 240 | 31 | 18,597 | 121 |
| | 242 | 9 | 5,699 | 127 |
| | 250 | 48 | 21,375 | 89 |
| | 260 | 54 | 28,972 | 107 |
| | 261 | 19 | 9,512 | 101 |
| | 270 | 34 | 23,940 | 142 |
| | 271 | 14 | 5,566 | 79 |
| | 280 | 29 | 17,575 | 123 |
| | 281 | 10 | 1,867 | 37 |
| **3A Total** | | **373** | **217,375** | **117** |
| 3B | 290 | 54 | 15,280 | 57 |
| | 300 | 57 | 19,095 | 67 |
| | 310 | 44 | 17,457 | 80 |
| | 320 | 32 | 11,969 | 75 |
| | 330 | 25 | 8,290 | 67 |
| | 340 | 18 | 3,051 | 34 |
| **3B Total** | | **230** | **75,141** | **66** |
| 4A | 350 | 22 | 5,541 | 51 |
| | 360 | 12 | 965 | 16 |
| | 370 | 10 | 1,338 | 27 |
| | 380 | 7 | 4,726 | 135 |
| | 390 | 2 | 1,035 | 103 |
| | 523170 | 1 | 990 | 199 |

| Reg. Area | Stat. Area | Effective Stations | O32 Pacific halibut Lbs. | Avg. WPUE |
|---|---|---|---|---|
| 4A | 523171 | 3 | 674 | 45 |
| | 530168 | 2 | 1,068 | 106 |
| | 530169 | 3 | 1,816 | 121 |
| | 530170 | 1 | 2,300 | 463 |
| | 533167 | 3 | 1,023 | 68 |
| | 543165 | 5 | 19 | 1 |
| | 543166 | 11 | 858 | 16 |
| | 543167 | 2 | 100 | 10 |
| | 550166 | 4 | 925 | 46 |
| | 550167 | 6 | 3,209 | 107 |
| | 550168 | 1 | 160 | 32 |
| | 553168 | 5 | 411 | 17 |
| | 560168 | 8 | 1,217 | 35 |
| | 560169 | 3 | 445 | 30 |
| | 560170 | 2 | 303 | 31 |
| **4A Total** | | **113** | **29,123** | **52** |
| 4B | 400 | 10 | 10,683 | 214 |
| | 410 | 10 | 5,579 | 111 |
| | 420 | 10 | 3,335 | 67 |
| | 430 | 8 | 2,647 | 66 |
| | 440 | 7 | 2,390 | 68 |
| | 450 | 7 | 297 | 9 |
| | 460 | 7 | 219 | 6 |
| | 470 | 11 | 537 | 10 |
| | 480 | 10 | 493 | 10 |
| | 490 | 13 | 1,729 | 27 |
| | 500 | 6 | 555 | 18 |
| | 510 | 1 | 0 | 0 |
| | 513176 | 3 | 1,139 | 76 |
| | 513177 | 1 | 1,491 | 303 |
| | 513178 | 2 | 1,662 | 164 |
| | 513179 | 1 | 76 | 15 |
| | 513277 | 1 | 70 | 14 |
| | 513278 | 8 | 818 | 20 |
| | 513279 | 4 | 143 | 7 |
| | 520172 | 3 | 2,392 | 159 |
| | 520173 | 8 | 3,593 | 89 |
| | 520174 | 3 | 1,461 | 101 |

| Reg. Area | Stat. Area | Effective Stations | O32 Pacific halibut Lbs. | Avg. WPUE |
|---|---|---|---|---|
| 4B | 520175 | 4 | 1,733 | 85 |
| | 520176 | 1 | 361 | 73 |
| | 520179 | 6 | 1,244 | 42 |
| | 520275 | 2 | 0 | 0 |
| | 520276 | 4 | 653 | 33 |
| | 520277 | 4 | 508 | 26 |
| | 520278 | 1 | 425 | 85 |
| | 520279 | 6 | 515 | 17 |
| | 523172 | 1 | 2,030 | 413 |
| | 523173 | 1 | 233 | 49 |
| | 523179 | 4 | 125 | 6 |
| | 523272 | 1 | 46 | 9 |
| | 523273 | 3 | 112 | 7 |
| | 523274 | 4 | 950 | 48 |
| | 523279 | 1 | 0 | 0 |
| | 530179 | 2 | 0 | 0 |
| | 530272 | 1 | 483 | 97 |
| | 533179 | 3 | 467 | 31 |
| | 533279 | 2 | 194 | 20 |
| | 540279 | 5 | 58 | 2 |
| | 543276 | 5 | 0 | 0 |
| | 543278 | 4 | 941 | 48 |
| | 543279 | 1 | 0 | 0 |
| **4B Total** | | **200** | **52,386** | **52** |
| 4C | 563169 | 10 | 3,891 | 78 |
| | 570169 | 1 | 300 | 43 |
| | 570170 | 9 | 4,824 | 77 |
| **4C Total** | | **20** | **9,015** | **76** |
| 4D | 563171 | 3 | 14 | 1 |
| | 563173 | 2 | 13 | 1 |
| | 570173 | 4 | 65 | 2 |
| | 573173 | 2 | 145 | 10 |
| | 580174 | 1 | 566 | 81 |
| | 580175 | 1 | 981 | 141 |
| | 583174 | 5 | 233 | 7 |
| | 583175 | 3 | 169 | 8 |
| | 583176 | 1 | 18 | 3 |
| | 583177 | 3 | 407 | 19 |

| Reg. Area | Stat. Area | Effective Stations | O32 Pacific halibut Lbs. | Avg. WPUE |
|---|---|---|---|---|
| 4D | 590176 | 2 | 518 | 37 |
| | 590177 | 6 | 939 | 22 |
| | 590178 | 2 | 644 | 46 |
| | 593176 | 3 | 142 | 7 |
| | 593177 | 7 | 1,253 | 26 |
| | 593178 | 4 | 1,726 | 62 |
| | 600172 | 4 | 3,822 | 137 |
| | 600173 | 1 | 111 | 16 |
| | 603172 | 3 | 1,009 | 48 |
| | 603173 | 1 | 2,152 | 309 |
| **4D Total** | | **58** | **14,926** | **37** |
| **Grand Total** | | **1485** | **613,990** | **85** |

[1]O32 Pacific halibut pounds and WPUE (lb/skate) are calculated from the length distribution of the catch converted to weight using a standard length-weight relationship (Clark 1992), not from recorded weights of Pacific halibut sold.
[2]Does not include rockfish index stations.

**Table 8.** Average setline survey WPUE for Eastern Bering Sea island cluster stations, 2017[1,2].

| Reg. Area | Stat. Area | Location | Effective Stations | O32 Pacific halibut Lbs. | Avg. WPUE |
|---|---|---|---|---|---|
| 4C | 563169 | St. George | 10 | 3,891 | 78 |
| **St. George Total** | | | **10** | **3,891** | **78** |
| 4C | 570169 | St. Paul | 1 | 300 | 43 |
| 4C | 570170 | St. Paul | 9 | 4,824 | 77 |
| **St. Paul Total** | | | **10** | **5,124** | **60** |
| 4D | 600172 | St. Matthew | 4 | 3,822 | 137 |
| 4D | 600173 | St. Matthew | 1 | 111 | 16 |
| 4D | 603172 | St. Matthew | 3 | 1,009 | 48 |
| 4D | 603173 | St. Matthew | 1 | 2,152 | 309 |
| **St. Matthew Total** | | | **9** | **7,093** | **128** |
| **Grand Total** | | | **29** | **16,108** | **101** |

[1]O32 Pacific halibut pounds and WPUE (lb/skate) are calculated from the length distribution of the catch converted to weight using a standard length-weight relationship (Clark 1992), not from recorded weights of Pacific halibut sold.
[2]Values from individual statistical areas are rounded, which may lead to slight discrepancies in total values.

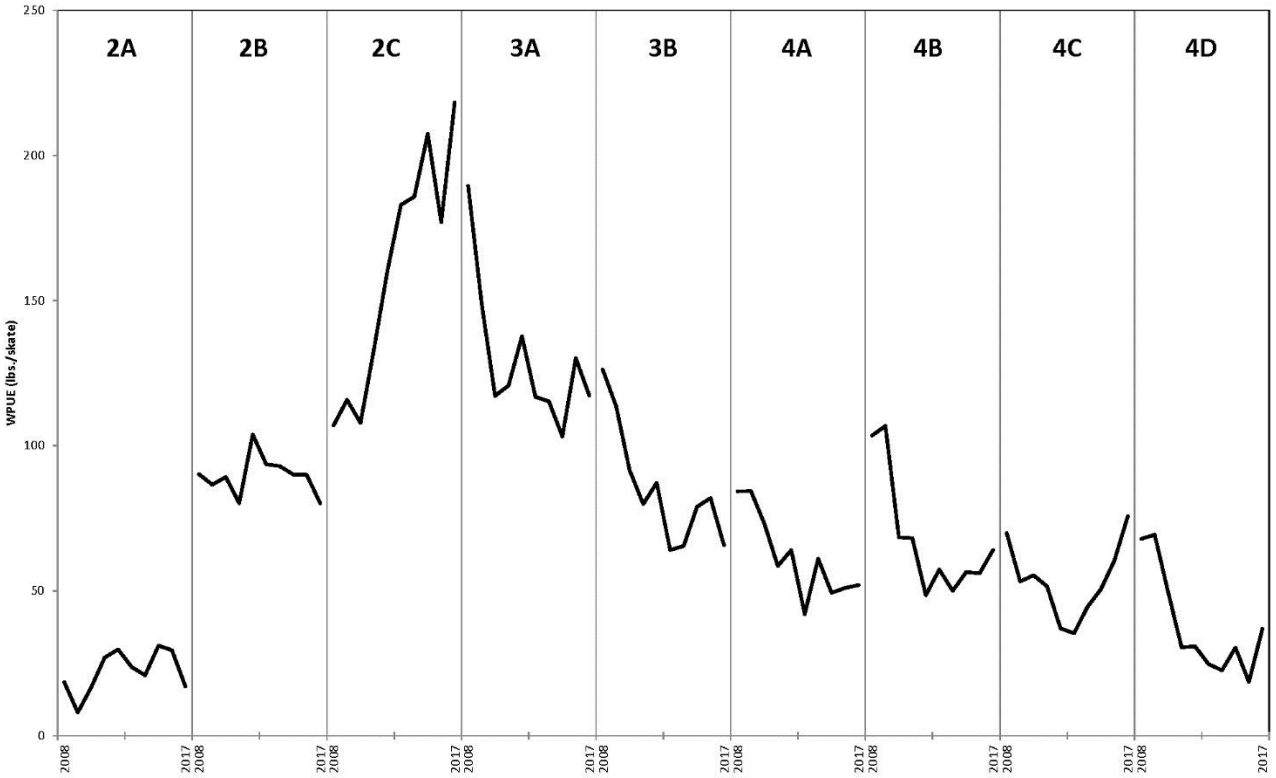


**Figure 6.** Average O32 WPUE (lbs/skate) of Pacific halibut by IPHC Regulatory Area from all effective standard grid and expansion stations occupied on 2008-2017 setline surveys.

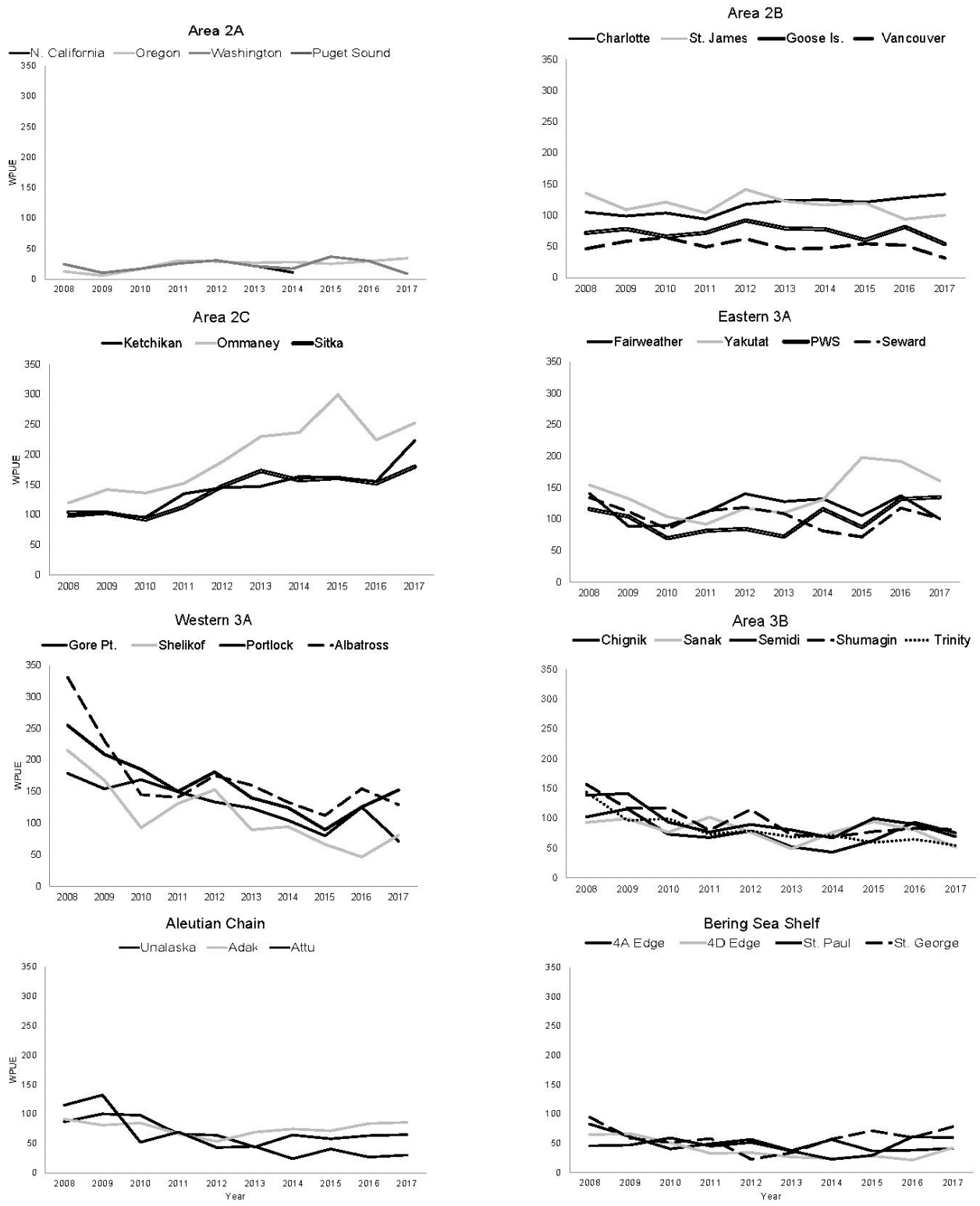


**Figure 7.** Setline survey WPUE (lbs/skate) by IPHC Regulatory Area 2008-2017. Individual charter regions are plotted within each Regulatory Area panel, as indicated. Includes data from effective standard grid and expansion staions.

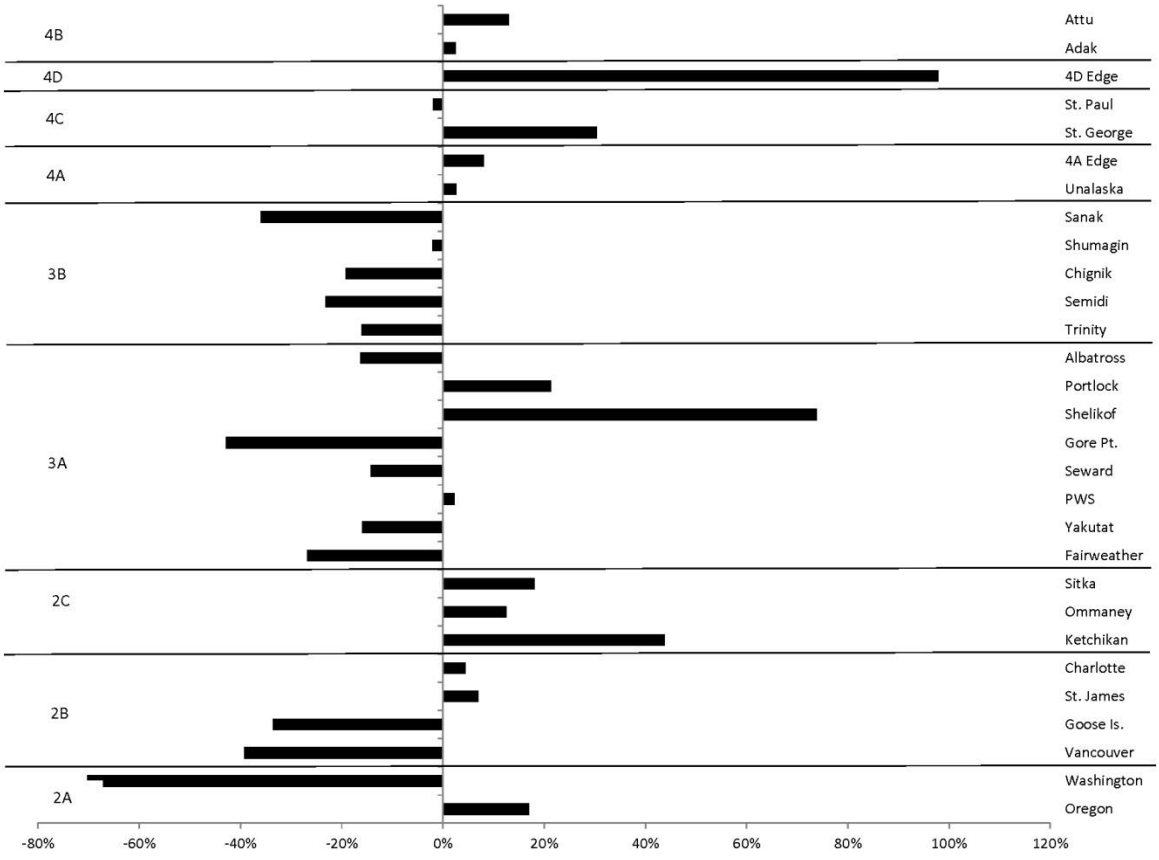


**Figure 8**. The percent difference between setline survey WPUE (lbs/skate) documented in 2016 as compared to 2017 by charter region.

***Numbers per unit effort***

Trends in the coastwide numbers per unit effort (NPUE) since 2008 are shown in Figure 9 for both O32 and U32 Pacific halibut. There was a 31% decrease in the relative numbers of U32 caught and a 6% decrease in catch rates of O32 length Pacific halibut when compared to 2016 (Figure. 9). In 2017, there were 16% more U32 Pacific halibut captured than O32 Pacific halibut, which is a 9% decrease in difference from 2016.

Some interesting trends can be noted when NPUE is observed by Regulatory Area (Figure 10). A larger NPUE of O32 as compared to U32 Pacific halibut was seen in all Regulatory Areas except for 3B and 4A. In 2017, Area 2C showed an increase in O32 Pacific halibut with a decrease in U32 Pacific halibut average NPUE. Area 2B had slight decreases in both O32 and U32 average NPUE. Area 4A had a slight increase in both O32 and U32 Pacific halibut rate of capture. Area 3B continues to have the largest gap between O32 and U32 Pacific halibut, with a difference of 51% between the two groups.

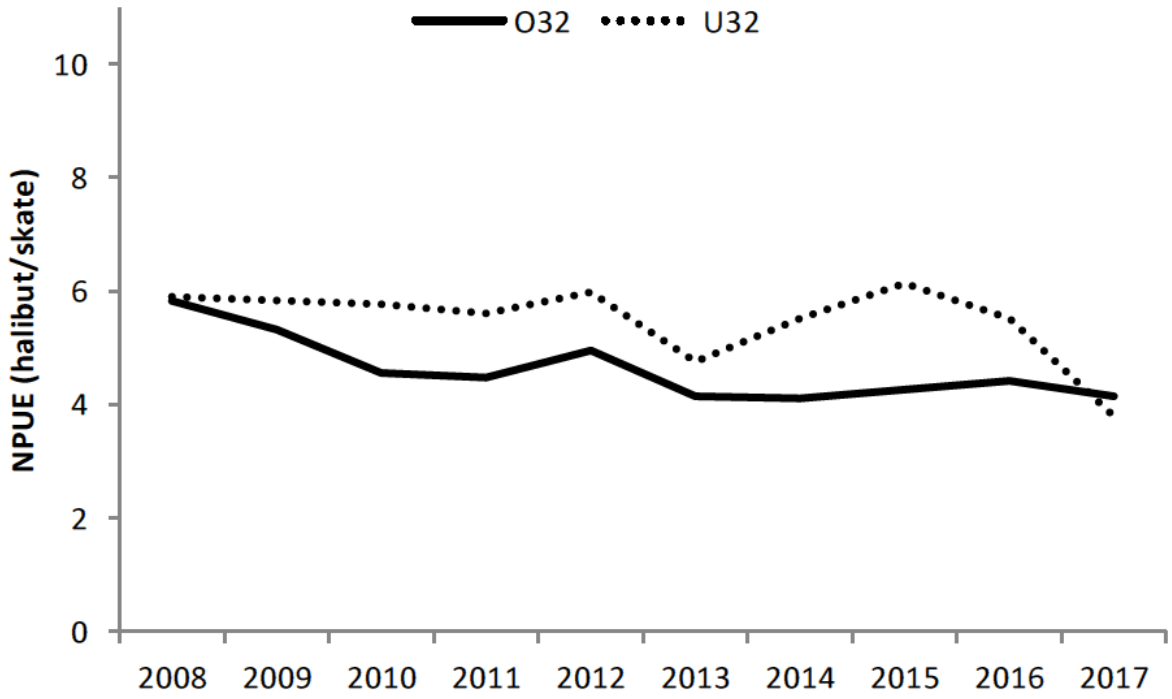


**Figure 9.** Setline survey NPUE (Pacific halibut/skate) coastwide from 2008-2017. Includes data from SG and ES effective stations.

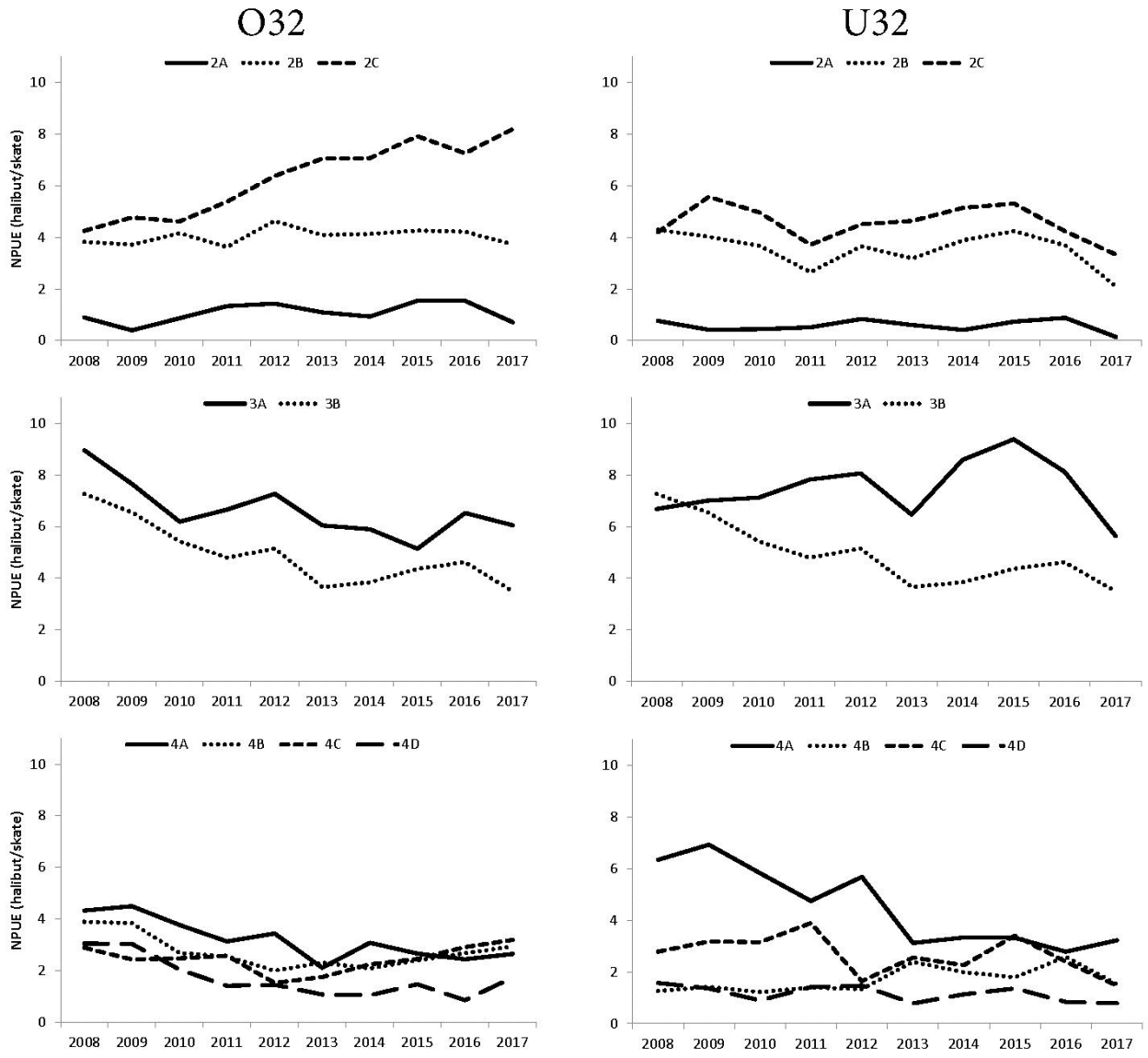


**Figure 10.** Setline survey NPUE (Pacific halibut/skate) by IPHC Regulatory Area from 2008 to 2017. Individual charter regions are plotted within each Regulatory Area panel, as indicated. O32 Pacific halibut is on the left, U32 on the right. Includes data from effective standard grid and expansion stations.

### *Length distribution*

Slightly less than 47% of Pacific halibut caught on the setline survey were smaller than the current commercial legal size limit (U32 Pacific halibut), with a median length of 79 cm coastwide (Table 9). In 2017, the median lengths of Pacific halibut captured increased in all Regulatory Areas except 4A (Figure 11). Regulatory Areas 3A, 3B, and 4A had median lengths below the legal-size limit (Figure. 11). In 2017, the largest median length was in Area 2A (97 cm). The length frequency distribution of Pacific halibut from catches in the 2017 FISS, by Regulatory Area, are illustrated in Figure 12.

**Table 9.** Number of Pacific halibut caught on setline survey by 5-cm length category and regulatory area in 2017. The 80-84 cm category is divided to show the U32/O32 split within that category[1].

| Fork Length (cm) | Regulatory Area | | | | | | | | | Setline survey Total | % of Setline survey Removals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2A | 2B | 2C | 3A | 3B | 4A | 4B | 4C | 4D | | |
| 30-34 | | | | | | 1 | | | | 1 | 0.002 |
| 40-44 | | | | 1 | 2 | | | | | 3 | 0.005 |
| 45-49 | | | 1 | 11 | 18 | 2 | | | | 32 | 0.058 |
| 50-54 | | 1 | 8 | 48 | 73 | 25 | 3 | 2 | | 160 | 0.291 |
| 55-59 | 1 | 14 | 35 | 136 | 258 | 104 | 8 | 7 | 5 | 568 | 1.033 |
| 60-64 | 4 | 49 | 91 | 567 | 852 | 299 | 44 | 24 | 16 | 1,946 | 3.540 |
| 65-69 | 11 | 178 | 241 | 1,577 | 1,784 | 438 | 128 | 26 | 61 | 4,444 | 8.084 |
| 70-74 | 36 | 467 | 519 | 2,650 | 2,445 | 413 | 333 | 35 | 76 | 6,974 | 12.686 |
| 75-79 | 80 | 726 | 815 | 3,844 | 2,101 | 398 | 488 | 58 | 113 | 8,623 | 15.685 |
| 80-81 | 43 | 296 | 330 | 1,615 | 645 | 138 | 182 | 25 | 46 | 3,320 | 6.039 |
| **Total U32 Pacific halibut** | **175** | **1,731** | **2,040** | **10,449** | **8,178** | **1,818** | **1,186** | **177** | **317** | **26,071** | **47.4** |
| 82-84 | 53 | 533 | 566 | 2,230 | 785 | 217 | 278 | 33 | 74 | 4,769 | 8.675 |
| 85-89 | 102 | 671 | 849 | 2,822 | 981 | 326 | 460 | 72 | 155 | 6,438 | 11.711 |
| 90-94 | 112 | 512 | 686 | 1,898 | 692 | 285 | 425 | 63 | 127 | 4,800 | 8.731 |
| 95-99 | 81 | 322 | 574 | 1,226 | 470 | 203 | 297 | 54 | 99 | 3,326 | 6.050 |
| 100-104 | 99 | 258 | 409 | 889 | 336 | 151 | 236 | 42 | 73 | 2,493 | 4.535 |
| 105-109 | 82 | 174 | 315 | 584 | 218 | 94 | 183 | 31 | 50 | 1,731 | 3.149 |
| 110-114 | 90 | 146 | 313 | 453 | 159 | 71 | 146 | 25 | 38 | 1,441 | 2.621 |
| 115-119 | 49 | 119 | 275 | 321 | 94 | 53 | 93 | 18 | 19 | 1,041 | 1.894 |
| 120-124 | 34 | 91 | 264 | 238 | 79 | 35 | 67 | 11 | 26 | 845 | 1.537 |
| 125-129 | 16 | 82 | 183 | 183 | 73 | 18 | 40 | 11 | 10 | 616 | 1.121 |
| 130-134 | 8 | 48 | 141 | 123 | 39 | 11 | 29 | 8 | 11 | 418 | 0.760 |
| 135-139 | 6 | 40 | 135 | 101 | 31 | 7 | 19 | 4 | 7 | 350 | 0.637 |
| 140-144 | 2 | 23 | 107 | 57 | 9 | 5 | 24 | 7 | 3 | 237 | 0.431 |
| 145-149 | 1 | 14 | 58 | 26 | 10 | 3 | 14 | 2 | 2 | 130 | 0.236 |
| 150-154 | | 8 | 39 | 19 | 1 | | 10 | 1 | | 78 | 0.142 |
| 155-159 | | 11 | 25 | 13 | 2 | 1 | 8 | | 2 | 62 | 0.113 |
| 160-164 | | 2 | 16 | 13 | 1 | | 4 | | 3 | 39 | 0.071 |
| 165-169 | | 6 | 13 | 3 | 2 | 2 | 5 | 1 | | 32 | 0.058 |
| 170-174 | | 3 | 11 | 3 | 1 | 1 | 3 | | | 22 | 0.040 |
| 175-179 | | 1 | 8 | 1 | | | 1 | | 1 | 12 | 0.022 |
| 180-184 | | | 4 | 2 | | | 2 | 1 | | 9 | 0.016 |
| 185-189 | | 1 | 6 | 4 | | | | | | 11 | 0.020 |
| 190-194 | | | | 1 | | | | | | 1 | 0.002 |
| 205-209 | | | 1 | | | | | | | 1 | 0.002 |
| 210-215 | | | | 1 | | | 1 | | | 2 | 0.004 |
| **Total O32 Pacific halibut** | **735** | **3,065** | **4,998** | **11,211** | **3,983** | **1,483** | **2,345** | **384** | **700** | **28,904** | **52.6** |
| **Total Pacific halibut** | **910** | **4,796** | **7,038** | **21,660** | **12,161** | **3,301** | **3,531** | **561** | **1,017** | **54,975** | **100.0** |

[1]Excludes Pacific halibut from rockfish index stations and ineffective stations.

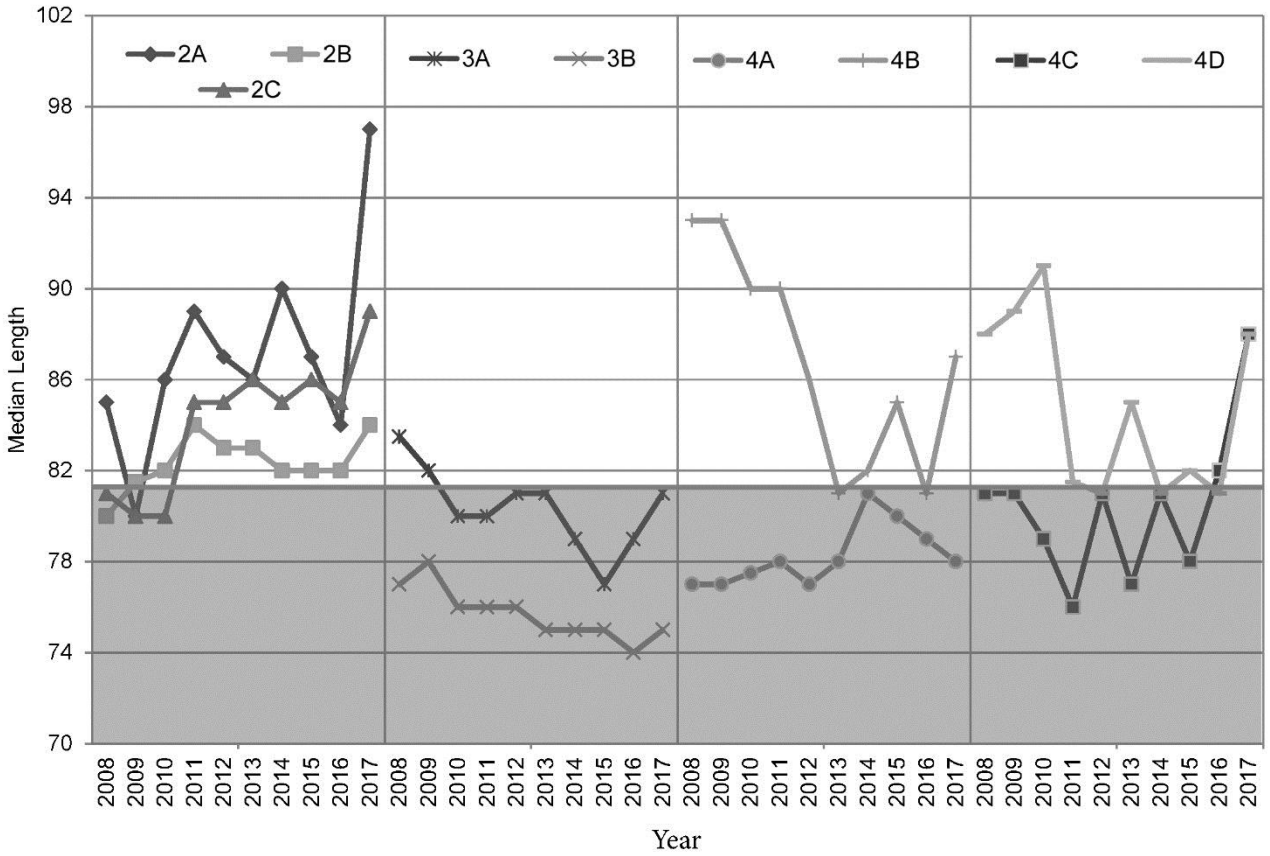


**Figure 11.** Median length of Pacific halibut caught on setline survey, by Regulatory Area, from 2008 to 2017.The shaded area shows length below the current commercially-legal size limit. Includes data from effective standard grid and expansion stations.

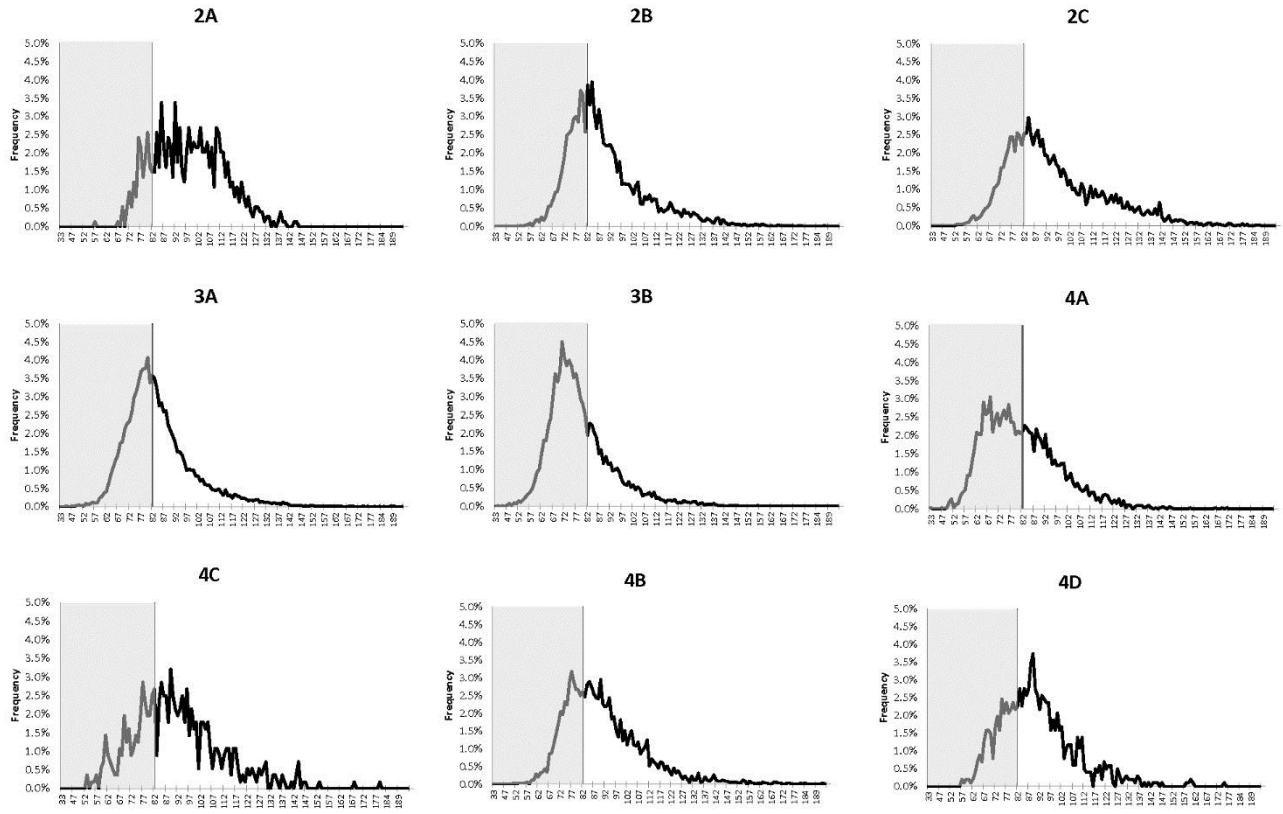


**Figure 12.** The length (cm) frequency distribution of Pacific halibut, by Regulatory Area, from catches in the 2017 setline survey. Shaded areas denote smaller thtn current legal commercial size limit. Catch from rockfish index staions not included.

### *Sex composition*

The sex composition for Pacific halibut captured and sampled for otolith collection has shown considerable variation among areas, ranging from 41% to 87% females (Figure 13). Regulatory Area 4B had the lowest percentage of females in the catch, and has been consistently below 50% since 1998. Area 4C currently has the highest percentage of females, observing the first decrease in the past couple of years. Most female Pacific halibut caught during the setline survey period (i.e., summer months) were in the ripening stage and expected to spawn in the upcoming season.

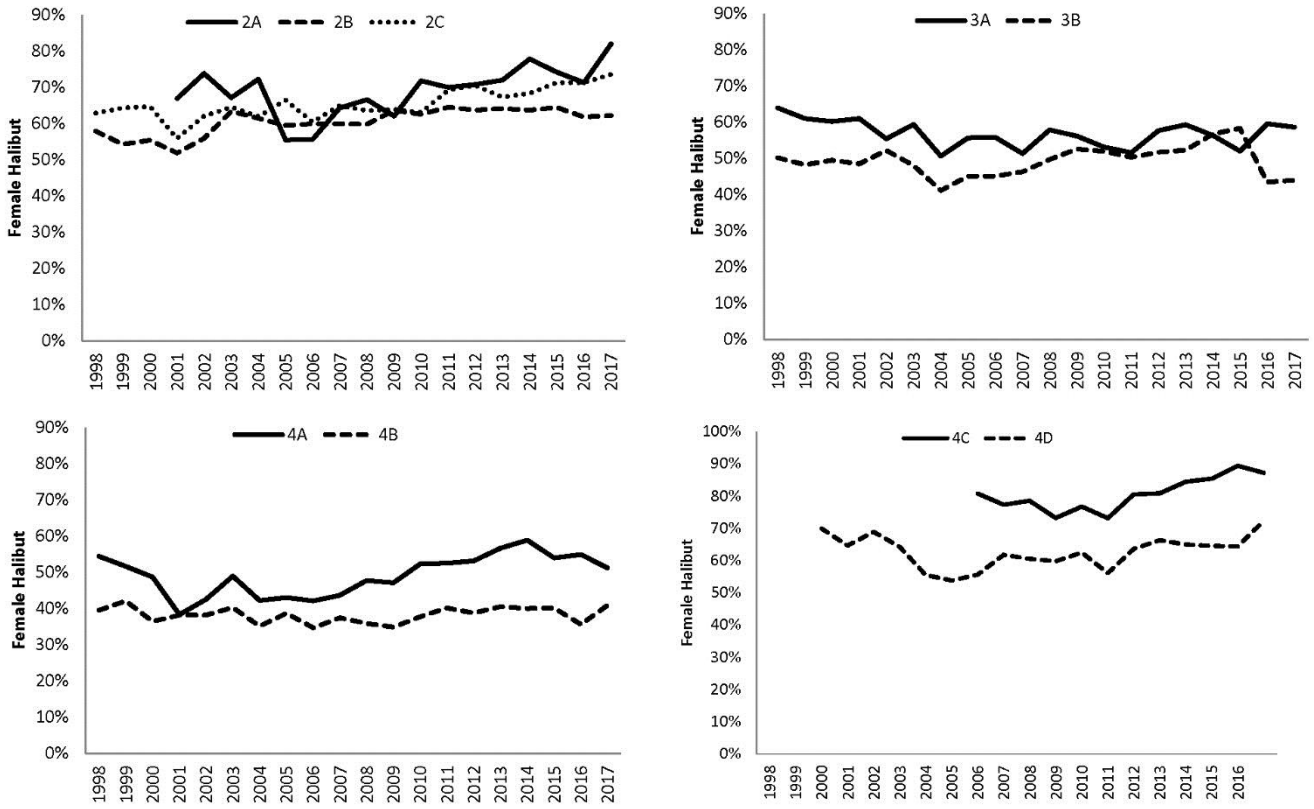


**Figure 13.** Percentage of Pacific halibut captured and sampled for otolith collection that was composed of females, by Regulatory Area, from 1998 to 2017.

### *Otolith collection*

The otolith collection goal for the 2017 setline survey was 2,000 otoliths per Regulatory Area, with a minimum target of 1,500 per area. Fewer than 1,500 otoliths were collected in Areas 2A, 4C, and 4D as the catch rates were low and there are fewer stations in these areas (Table 10). Information regarding age distributions for the 2017 setline survey can be found in Forsberg (2017a). Additional otoliths were collected in most regulatory areas for the clean otolith archive collection and details can be found in Tobin et. al. (2017).

**Table 10.** Otolith sampling rates of Pacific halibut captured and sampled from standard stock assessment skates during the 2017 setline survey,[1,2,3].

| Reg. Area | Pacific halibut Caught | Pacific halibut Sampled | Sampling Rates | | | |
|---|---|---|---|---|---|---|
| | | | Expected | Overall | O32 | U32 |
| 2A | 918 | 889 | 100% | 97% | 81% | 19% |
| 2B | 4,796 | 1,521 | 35% | 32% | 66% | 34% |
| 2C | 7,089 | 2,163 | 33% | 31% | 74% | 26% |
| 3A | 21,668 | 1,671 | 9% | 8% | 56% | 44% |
| 3B | 12,167 | 1,456 | 13% | 12% | 36% | 64% |
| 4A | 3,301 | 2,268 | 78% | 69% | 44% | 56% |
| 4B | 3,629 | 1,456 | 45% | 40% | 64% | 36% |
| 4C | 561 | 532 | 100% | 95% | 68% | 32% |
| 4D | 1,017 | 966 | 100% | 95% | 68% | 32% |
| **Total** | 55,146 | 12,922 | | | | |

[1]Includes Pacific halibut from ineffective stations, which are not used in stock assessment calculations.
[2]Does not include Pacific halibut lost at the roller (i.e., recorded as "0" length).
[3]Sampling rate does not include otoliths collected for the clean otolith archive collection.

### *Prior hooking injury results*

A prior hooking injury (PHI) is defined an injury that appears to have occurred when the fish was being released during a previous capture by hook-and-line gear. A PHI code was recorded for every Pacific halibut captured (no injury, minor injury, moderate injury, severe injury, or unknown) using criteria outlined in Table11. A total of 55,144 Pacific halibut were examined during the 2017 setline survey (Table 12). Overall, the coastwide average PHI rate was 6.4% for Pacific halibut examined during the 2017 setline survey, 0.5% higher than observed in 2016 (5.9%; Table 13).

**Table 11.** Descriptions of prior hooking injury (PHI) categories used on the 1998-2017 fishery-independent setline surveys.

| Injury locations | Categories only apply to <u>prior</u> hooking injuries, if any. Worst injury of jaw, eye, & eye socket prevails. | | | | Did not check or can't tell |
|---|---|---|---|---|---|
| | **None** | **Minor** | **Moderate** | **Severe** | **Unknown** |
| **Jaw** | No injury | Jaw in one piece, not split or separated from head. Skin of lip may be torn, but jaw is intact. | Upper or lower jaw bone may be torn through, hanging from fish, or torn away on either side of the head. Tear may or may not include tearing through the cheek area. Lower or upper jaw may be split laterally, tearing through either snout or lower mouth. | Removal of hook has torn large flap from side of head, usually originating in cheek area. Flap, usually including part of jaw, is either hanging loosely or missing. | Did not examine the fish, or can't tell. |
| **Eyeball & eye socket** | No injury | Eye socket may be torn, but eyeball is undamaged. | Eyeball punctured. | | Did not examine the fish, or can't tell. |

**Table 12.** Prior hooking injury (PHI) data collected on 2017 fishery-independent setline survey. Length group definitions: U32 is ≤ 81 cm(32 in); O32 is ≥ 82 cm (32 in). This table does not include Pacific halibut for which the length was not recorded.

| | | Injuries | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reg. | Length | None | | Minor | | Moderate | | Severe | | Unknown | | |
| Area | Group | No. | % | No. | % | No. | % | No. | % | No. | % | Total |
| | U32 | 165 | 94.29% | 8 | 4.57% | 1 | 0.57% | 0 | 0.00% | 1 | 0.57% | 175 |
| 2A | O32 | 708 | 95.29% | 27 | 3.63% | 7 | 0.94% | 1 | 0.13% | 0 | 0.00% | 743 |
| | Total | 873 | 95.10% | 35 | 3.81% | 8 | 0.87% | 1 | 0.11% | 1 | 0.11% | 918 |
| | U32 | 1,614 | 93.24% | 83 | 4.79% | 10 | 0.58% | 0 | 0.00% | 24 | 1.39% | 1,731 |
| 2B | O32 | 2,725 | 88.91% | 273 | 8.91% | 32 | 1.04% | 2 | 0.07% | 33 | 1.08% | 3,065 |
| | Total | 4,339 | 90.47% | 356 | 7.42% | 42 | 0.88% | 2 | 0.04% | 57 | 1.19% | 4,796 |
| | U32 | 1,898 | 92.50% | 90 | 4.39% | 6 | 0.29% | 0 | 0.00% | 58 | 2.83% | 2,052 |
| 2C | O32 | 4,180 | 83.00% | 637 | 12.65% | 75 | 1.49% | 1 | 0.02% | 143 | 2.84% | 5,036 |
| | Total | 6,078 | 85.75% | 727 | 10.26% | 81 | 1.14% | 1 | 0.01% | 201 | 2.84% | 7,088 |
| | U32 | 9,882 | 88.12% | 271 | 2.42% | 80 | 0.71% | 2 | 0.02% | 219 | 1.95% | 11,214 |
| 3A | O32 | 10,026 | 95.91% | 551 | 5.27% | 139 | 1.33% | 3 | 0.03% | 495 | 4.74% | 10,454 |
| | Total | 19,908 | 91.88% | 822 | 3.79% | 219 | 1.01% | 5 | 0.02% | 714 | 3.30% | 21,668 |
| | U32 | 7,810 | 195.94% | 176 | 4.42% | 48 | 1.20% | 2 | 0.05% | 145 | 3.64% | 3,986 |
| 3B | O32 | 3,467 | 42.38% | 120 | 1.47% | 41 | 0.50% | 3 | 0.04% | 355 | 4.34% | 8,181 |
| | Total | 11,277 | 92.69% | 296 | 2.43% | 89 | 0.73% | 5 | 0.04% | 500 | 4.11% | 12,167 |
| | U32 | 1736 | 95.49% | 45 | 2.48% | 34 | 1.87% | 0 | 0.00% | 3 | 0.17% | 1818 |
| 4A | O32 | 1311 | 88.40% | 121 | 8.16% | 43 | 2.90% | 1 | 0.07% | 7 | 0.47% | 1483 |
| | Total | 3047 | 92.31% | 166 | 5.03% | 77 | 2.33% | 1 | 0.03% | 10 | 0.30% | 3,301 |
| | U32 | 1,122 | 89.90% | 35 | 2.80% | 18 | 1.44% | 1 | 0.08% | 72 | 5.77% | 1,248 |
| 4B | O32 | 1,984 | 83.36% | 175 | 7.35% | 42 | 1.76% | 1 | 0.04% | 178 | 7.48% | 2,380 |
| | Total | 3,106 | 85.61% | 210 | 5.79% | 60 | 1.65% | 2 | 0.06% | 250 | 6.89% | 3,628 |
| | U32 | 153 | 86.44% | 12 | 6.78% | 11 | 6.21% | 0 | 0.00% | 1 | 0.56% | 177 |
| 4C | O32 | 309 | 80.47% | 54 | 14.06% | 11 | 2.86% | 0 | 0.00% | 10 | 2.60% | 384 |
| | Total | 462 | 82.35% | 66 | 11.76% | 22 | 3.92% | 0 | 0.00% | 11 | 1.96% | 561 |
| | U32 | 287 | 90.54% | 28 | 8.83% | 1 | 0.32% | 0 | 0.00% | 1 | 0.32% | 317 |
| 4D | O32 | 586 | 83.71% | 96 | 13.71% | 4 | 0.57% | 0 | 0.00% | 14 | 2.00% | 700 |
| | Total | 873 | 85.84% | 124 | 12.19% | 5 | 0.49% | 0 | 0.00% | 15 | 1.47% | 1,017 |
| **Grand** | **Total** | 49,963 | 90.60% | 2,802 | 5.08% | 603 | 1.09% | 17 | 0.03% | 1,759 | 3.19% | 55,144 |

**Table 13.** Summary of prior hooking injury (PHI) data collected during the 2017 IPHC fishery-independent setline survey. This table does not include Pacific halibut where the PHI was coded as 'unknown'.

| | | | All Pacific halibut | | | | | U32 Pacific halibut (<82cm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reg. Area** | **No. of sets** | **No. std. skates** | No. examined | No. with injury | % with injury 2017 | No. inj. per std. Skate | % with injury 2016 | No. with injury | % with injury 2017 | No. inj. per std. skate | % with injury 2016 |
| 2A | 203 | 1,218 | 917 | 44 | 4.8% | 0.04 | 5.3% | 9 | 0.98% | 0.01 | 6.3% |
| 2B | 166 | 830 | 4,739 | 400 | 8.4% | 0.48 | 6.0% | 93 | 1.96% | 0.11 | 4.6% |
| 2C | 122 | 610 | 6,887 | 809 | 11.7% | 1.33 | 6.0% | 96 | 1.39% | 0.16 | 3.2% |
| 3A | 373 | 1,865 | 20,954 | 1,046 | 5.0% | 0.56 | 6.5% | 353 | 1.68% | 0.19 | 4.6% |
| 3B | 230 | 1,150 | 11,667 | 390 | 3.3% | 0.34 | 3.8% | 226 | 1.94% | 0.20 | 3.0% |
| 4A | 113 | 565 | 3,291 | 244 | 7.4% | 0.43 | 22.0% | 79 | 2.40% | 0.14 | 19.9% |
| 4B | 200 | 1,000 | 3,378 | 272 | 8.1% | 0.27 | 4.8% | 54 | 1.60% | 0.05 | 3.6% |
| 4C | 20 | 140 | 550 | 88 | 16.0% | 0.63 | 12.9% | 23 | 4.18% | 0.16 | 11.8% |
| 4D | 58 | 406 | 1,002 | 129 | 12.9% | 0.32 | 15.6% | 29 | 2.89% | 0.07 | 12.3% |
| Total | 1,485 | 7,784 | 53,385 | 3,422 | 6.4% | 0.44 | 5.9% | 962 | 1.80% | 0.12 | 4.2% |

### *Incidental Species*

A total of 112 species of fish and invertebrates were caught as incidental catch during the setline survey. Hook occupancy of species groups varied by Regulatory Area (Figure 14). The predominant incidental catches in Regulatory Areas 2A, 2B, 2C, and 3A were sharks. The most frequent incidental catch in Areas 3B, 4A, and 4D was Pacific cod. In Areas 4B and 4C, the "other species" category was most common and was comprised of yellow Irish lord sculpins (*Hemilepidotus jordani*), unidentified starfish, grenadiers (*Macrouridae*), and arrowtooth flounder (*Atheresthes stomias*).

Trends in bycatch NPUE are presented in Figures 15 through 18. Bocaccio (*Sebastes paucispinus*), canary rockfish (*S. pinniger*), and yelloweye rockfish (*S. ruberrimus*) populations are of concern in Areas 2A, 2B, and 2C, and their numbers often drive catch regulations. Catch rates of bocaccio and canary rockfish are so low on the IPHC FISS that it is difficult to make any inferences from them (Figure 15). Trends in bycatch NPUE over the last ten years for the other major incidentally-captured species and species groups show that the encounter rate for most remained relatively constant over time (Figures 15 - 18).

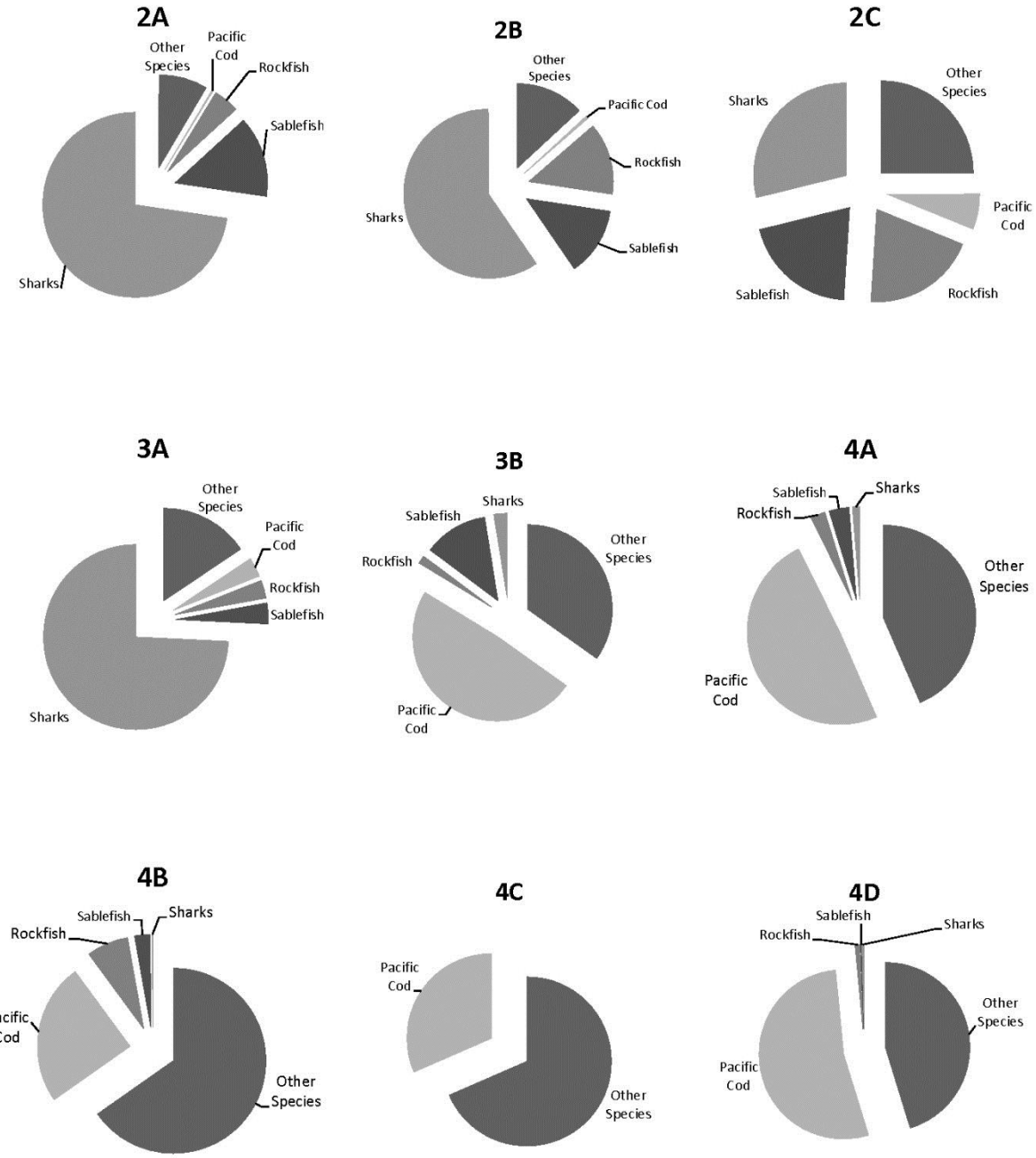


**Figure 14.** Percent hook occupancy of incidental catch by major species categories in the 2017 IPHC FISS by Regulatory Area.

Bocaccio

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.012 | 0.000 | 0.000 | 0.009 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2B | | 0.038 | 0.020 | 0.011 | 0.023 | 0.014 | 0.005 | 0.011 | 0.008 | 0.008 | 0.002 |
| 2C | | 0.012 | 0.000 | 0.000 | 0.054 | 0.000 | 0.007 | 0.000 | 0.000 | 0.020 | 0.000 |
| 3A | | 0.000 | 0.000 | 0.000 | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Canary Rockfish

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.024 | 0.000 | 0.037 | 0.017 | 0.006 | 0.005 | 0.009 | 0.056 | 0.097 | 0.010 |
| 2B | | 0.044 | 0.058 | 0.026 | 0.034 | 0.017 | 0.059 | 0.029 | 0.027 | 0.020 | 0.031 |
| 2C | | 0.089 | 0.071 | 0.144 | 0.047 | 0.048 | 0.086 | 0.097 | 0.034 | 0.054 | 0.041 |
| 3A | | 0.000 | 0.002 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Yelloweye Rockfish

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.346 | 0.163 | 0.179 | 0.140 | 0.204 | 0.171 | 0.190 | 0.117 | 0.051 | 0.071 |
| 2B | | 1.004 | 1.158 | 1.286 | 0.952 | 0.861 | 0.848 | 0.601 | 0.596 | 0.910 | 0.907 |
| 2C | | 0.997 | 1.325 | 1.614 | 1.173 | 1.381 | 1.287 | 1.389 | 1.198 | 1.273 | 1.141 |
| 3A | | 0.609 | 0.421 | 0.510 | 0.427 | 0.501 | 0.319 | 0.456 | 0.418 | 0.461 | 0.464 |
| 3B | | 0.096 | 0.148 | 0.117 | 0.145 | 0.108 | 0.119 | 0.131 | 0.196 | 0.231 | 0.067 |
| 4A | | 0.119 | 0.121 | 0.091 | 0.072 | 0.038 | 0.040 | 0.042 | 0.053 | 0.046 | 0.137 |
| 4D | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.014 | 0.000 | 0.000 | 0.000 | 0.000 |

**Figure 15.** Ten-years of NPUE (numbers per standardized 100-hook skate) for bocaccio, canary and yelloweye rockfish on IPHC's fishery-independent setline surveys across Regulatory Areas.

Arrowtooth Flounder

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.155 | 0.129 | 0.112 | 0.052 | 0.258 | 0.254 | 0.071 | 0.066 | 0.080 | 0.018 |
| 2B | | 1.313 | 1.586 | 1.465 | 1.180 | 0.939 | 0.716 | 0.755 | 0.745 | 0.813 | 0.364 |
| 2C | | 1.535 | 1.686 | 1.362 | 0.963 | 0.964 | 0.876 | 0.865 | 0.751 | 0.422 | 0.764 |
| 3A | | 1.323 | 1.735 | 1.200 | 1.245 | 1.168 | 0.950 | 1.068 | 0.882 | 0.443 | 0.158 |
| 3B | | 2.318 | 1.231 | 1.446 | 1.341 | 0.502 | 0.764 | 1.244 | 0.965 | 0.916 | 0.777 |
| 4A | | 1.917 | 2.016 | 0.970 | 1.136 | 1.074 | 0.582 | 0.833 | 1.029 | 1.129 | 1.068 |
| 4B | | 1.100 | 0.938 | 1.348 | 1.233 | 0.290 | 0.777 | 0.482 | 0.859 | 0.709 | 0.848 |
| 4C | | 0.202 | 0.564 | 0.165 | 0.209 | 0.083 | 0.375 | 0.179 | 0.150 | 0.374 | 0.125 |
| 4D | | 3.263 | 1.692 | 1.357 | 2.476 | 1.395 | 1.050 | 0.739 | 1.881 | 1.288 | 0.813 |

Sablefish (Blackcod)

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 4.335 | 2.798 | 2.186 | 1.808 | 1.356 | 0.924 | 1.080 | 1.839 | 2.084 | 1.097 |
| 2B | | 2.805 | 2.814 | 2.976 | 2.607 | 1.876 | 2.176 | 1.438 | 2.039 | 2.373 | 1.937 |
| 2C | | 3.840 | 2.917 | 3.310 | 4.359 | 3.262 | 3.955 | 3.205 | 2.338 | 2.525 | 2.660 |
| 3A | | 2.655 | 3.576 | 2.965 | 2.927 | 2.338 | 1.823 | 2.094 | 1.290 | 1.209 | 0.834 |
| 3B | | 2.707 | 2.570 | 2.113 | 3.030 | 1.913 | 1.042 | 1.272 | 0.576 | 0.945 | 1.337 |
| 4A | | 0.981 | 0.538 | 0.816 | 0.699 | 0.798 | 0.773 | 0.444 | 0.422 | 0.423 | 0.785 |
| 4B | | 0.428 | 0.269 | 0.267 | 0.437 | 0.506 | 0.459 | 0.426 | 0.313 | 0.255 | 0.348 |
| 4D | | 0.104 | 0.138 | 0.022 | 0.000 | 0.029 | 0.101 | 0.025 | 0.000 | 0.012 | 0.037 |

**Figure 16.** Ten-years of NPUE (numbers per standardized 100-hook skate) for arrowtooth flounder and sablefish on IPHC's fishery-independent setline surveys across Regulatory Areas**.**

Pacific Cod

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.020 | 0.016 | 0.023 | 0.028 | 0.000 |
| 2B | | 0.067 | 0.080 | 0.109 | 0.266 | 0.114 | 0.093 | 0.206 | 0.213 | 0.110 | 0.074 |
| 2C | | 0.509 | 0.698 | 1.064 | 1.342 | 1.067 | 0.863 | 0.825 | 1.362 | 0.610 | 0.780 |
| 3A | | 2.500 | 5.336 | 4.753 | 6.029 | 3.983 | 4.270 | 5.726 | 2.360 | 1.178 | 0.770 |
| 3B | | 12.552 | 16.124 | 15.264 | 15.590 | 10.610 | 16.090 | 13.245 | 9.425 | 6.834 | 5.402 |
| 4A | | 11.757 | 12.195 | 10.923 | 13.784 | 10.143 | 11.170 | 12.557 | 14.145 | 12.416 | 10.616 |
| 4B | | 8.431 | 7.048 | 2.984 | 5.813 | 2.650 | 4.176 | 3.622 | 7.086 | 6.432 | 6.873 |
| 4C | | 23.384 | 23.271 | 14.987 | 13.303 | 16.160 | 17.062 | 11.977 | 15.250 | 10.104 | 7.750 |
| 4D | | 12.155 | 8.708 | 6.281 | 6.477 | 7.321 | 6.284 | 10.977 | 15.153 | 11.204 | 9.914 |

Spiny Dogfish

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 4.073 | 3.518 | 3.111 | 10.98 | 8.692 | 7.311 | 7.582 | 7.786 | 6.139 | 6.163 |
| 2B | | 10.6 | 16.16 | 12.96 | 12.83 | 7.839 | 10.34 | 7.51 | 5.572 | 5.502 | 8.757 |
| 2C | | 6.915 | 6.195 | 6.485 | 4.284 | 4.54 | 5.203 | 3.022 | 1.622 | 2.74 | 3.678 |
| 3A | | 16.21 | 8.346 | 12.89 | 7.256 | 8.682 | 4.658 | 5.533 | 7.366 | 11.29 | 16.81 |
| 3B | | 0.249 | 0.433 | 0.15 | 0.149 | 0.069 | 0.159 | 0.087 | 0.089 | 0.061 | 0.063 |
| 4A | | 0.119 | 0.047 | 0.051 | 0.032 | 0.046 | 0.112 | 0.038 | 0.053 | 0.008 | 0.027 |
| 4B | | 0.232 | 0.008 | 0.043 | 0.039 | 0.028 | 0.075 | 0.032 | 0 | 0 | 0 |
| 4C | | 0 | 0 | 0 | 0 | 0 | 0 | 0.036 | 0 | 0 | 0 |
| 4D | | 0 | 0 | 0.011 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Figure 17.** Ten-years of NPUE (numbers per standardized 100-hook skate) for pacific cod and spiny dogfish on IPHC's fishery-independent setline surveys across Regulatory Areas.

Rockfish

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.585 | 0.438 | 0.381 | 0.214 | 0.438 | 0.464 | 0.459 | 0.599 | 0.609 | 0.178 |
| 2B | | 3.256 | 3.692 | 3.033 | 2.651 | 2.165 | 2.23 | 1.913 | 1.553 | 2.344 | 2.039 |
| 2C | | 2.904 | 3.39 | 3.541 | 3.227 | 2.886 | 3.464 | 3.529 | 2.929 | 2.84 | 2.578 |
| 3A | | 1.277 | 1.051 | 1.01 | 0.798 | 1.139 | 0.957 | 0.958 | 0.859 | 0.876 | 0.719 |
| 3B | | 0.157 | 0.281 | 0.182 | 0.225 | 0.209 | 0.238 | 0.243 | 0.3 | 0.339 | 0.171 |
| 4A | | 0.431 | 0.8 | 0.399 | 0.429 | 0.284 | 0.303 | 0.313 | 0.554 | 0.415 | 0.575 |
| 4B | | 0.753 | 1.24 | 1.694 | 1.349 | 0.73 | 1.199 | 0.916 | 1.059 | 0.889 | 1.443 |
| 4D | | 0.155 | 0.288 | 0.215 | 0.331 | 0.158 | 0.187 | 0.16 | 0.232 | 0.087 | 0.172 |

Skates

| Regulatory Area | Trend | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2A | | 0.776 | 0.438 | 0.597 | 0.583 | 0.78 | 0.396 | 0.492 | 0.711 | 0.695 | 0.391 |
| 2B | | 1.074 | 1.161 | 1.211 | 1.141 | 1.16 | 1.196 | 1.19 | 1.042 | 0.913 | 0.746 |
| 2C | | 1.549 | 2.023 | 1.788 | 1.491 | 1.997 | 2.628 | 1.656 | 1.938 | 1.36 | 1.618 |
| 3A | | 2.551 | 3.481 | 2.647 | 3.053 | 3.851 | 2.968 | 3.53 | 2.622 | 2.598 | 2.295 |
| 3B | | 2.855 | 2.901 | 3.42 | 2.461 | 2.811 | 2.953 | 2.298 | 1.915 | 2.557 | 1.635 |
| 4A | | 4.65 | 4.166 | 4.377 | 4.06 | 3.667 | 3.944 | 4.947 | 4.42 | 4.003 | 4.719 |
| 4B | | 5.339 | 5.139 | 5.658 | 4.62 | 2.715 | 4.672 | 3.373 | 4.887 | 3.509 | 6.112 |
| 4C | | 8.838 | 3.421 | 1.054 | 1.626 | 2.749 | 3.079 | 1.645 | 1.3 | 0.998 | 3.208 |
| 4D | | 5.508 | 4.31 | 2.65 | 3.138 | 5.048 | 3.451 | 3.696 | 5.901 | 5.96 | 4.717 |

**Figure 18.** Ten-years of NPUE (numbers per standardized 100-hook skate) for rockfish (*Sebastes spp* only) and skates on IPHC's fishery-independent setline surveys across Regulatory Areas**.**

### *Marine Mammal Depredation Tracking*

Since 2009, the IPHC has recorded marine mammal depredation events during FISS hauling operations. Sea samplers record all damaged and missing hooks to establish a baseline rate of gear damage against which to compare stations with suspected interference from marine mammal depredating species. Any toothed whales or pinnipeds within 100 meters of a setline survey vessel are identified to species level and the number recorded. Samplers also note all damaged Pacific halibut and damaged bycatch retrieved during these encounters. In 2017, marine mammals approached IPHC-chartered vessels during FISS gear retrieval on 58 sets (3.9% of total sets); of those, 33 encounters involved either sperm whales or killer whales (Table 14). Though damaged Pacific halibut were observed on 22 of the stations at which whales were present, no sets were deemed ineffective for Pacific halibut stock assessment because of depredation.

We hypothesize that our encounter rates may be lower than experienced by the commercial fleet because each station is occupied for a relatively short period of time and only one set of gear is deployed at each station. Unlike commercial harvesters, who focus effort on high catch areas, FISS operates in both high and low catch areas, thereby making it less efficient for whales to target. Because FISS boats move at least 10 nmi between sets, the whales also have less opportunity to identify and target setline survey gear. Setline survey vessels are instructed to move to other stations when whales are observed, and may opt to buoy-off gear during retrieval and return at a later point in time if whales appear to be targeting a set.

**Table 14.** Whale sightings by IPHC Regulatory Area during hauling in 2017.

| Reg Area | Whale | No. sets with whales during hauling* | Total stations in Reg Area | Percent of total stations |
|---|---|---|---|---|
| **2A** | None | 0 | 213 | 0% |
| **2B** | None | 0 | 166 | 0% |
| **2C** | Sperm whale | 2 | 123 | 2% |
| **3A** | Killer whale | 1 | 374 | 0% |
| | Sperm whale | 5 | | 1% |
| **3B** | Sperm whale | 1 | 231 | 0% |
| **4A** | Killer whale | 13 | 110 | 12% |
| **4B** | Killer whale | 5 | 202 | 2% |
| | Sperm whale | 2 | | 1% |
| **4CDE** | Killer whale | 4 | 80 | 5% |
| | **Total** | 33 | 1,499 | 2% |

*Whales seen within 100m of gear during hauling or suspected of interacting with gear.

### *Field personnel*

In 2017, the Commission employed 26 sea samplers, who worked a total of 1,716 person-days, including travel days, sea days, and debriefing days. The Commission typically employs two sea samplers aboard each setline survey vessel. One works on deck, handling fish and collecting the required data and biological samples. The other sea sampler, in a portable shelter, records data and observations and stores samples collected by the deck sampler. Since catch rates in Regulatory Area 2A are generally low, one sampler was deployed for all but trips 8 through 11 in the northern portion of the Washington charter region, where two samplers were deployed for 37 days. The IPHC also deployed 5 sea samplers on the National Oceanic and Atmospheric Administration Alaska Fisheries Science Center (NOAA-AFSC) trawl survey (Sadorus et al. 2017a; Sadorus et al. 2017b). The *F/V Ocean Explorer was* staffed by three IPHC samplers who split the work 41, 25, and 21 days, respectively, during the Gulf of Alaska trawl survey. The Bering Sea trawl survey also had two IPHC samplers on the *F/V Vesteraalen* or *F/V Alaska Knight*; one sea sampler was aboard for 49 days and the other sea sampler was aboard for 50 days. The trawl contracts are included in the seasonal hire totals.

### *Special projects*

The FISS program often facilitates experiments that are not directly associated with the Pacific halibut stock assessment, yet which are valuable to IPHC and/or external agencies and researchers. The following is a comprehensive list and description of the projects that the Commission facilitated in 2017:

### *Rockfish sampling in Regulatory Area 2A*

The IPHC sea samplers retained all rockfish caught in Regulatory Area 2A, marked them with a tag, and recorded the station and skate of capture. After the rockfish were offloaded, state biologists from Washington Department of Fish and Wildlife (WDFW) and Oregon Department

of Fish and Wildlife collected additional data (such as sex, weight, length, and maturity) and biological material (such as otoliths and fin clips for genetic analysis) from each fish. Tag numbers enabled the biologists to associate the fish at the dock with the skate of capture, and thereby location and depth. In 2017, state biologists sampled 250 rockfish that were captured in Area 2A.

As in 2016, the vessel contracted for the Regulatory Area 2A charter regions fished eight rockfish index (RI) stations in addition to the IPHC FISS stations. WDFW selected the index station locations with the intent of targeting more rocky-bottom habitat than the setline survey stations. RI stations were located at 2.5 nmi intervals within the standard 10-nmi grid around IPHC station 1082 (see IPHC [2017a] for station locations). At each of the RI stations, fishing effort was reduced to three skates to limit impacts on rockfish populations. Pacific halibut captured on RI stations were measured and released alive without removing otoliths or examining gonads for sex and maturity. Data from these stations were not used in the Pacific halibut stock assessment. The IPHC has been approached by WDFW to continue the RI station work on future setline surveys, subject to budgets and ongoing sample design considerations. IPHC intends to continue collaborating with state agencies to collect detailed data regarding rockfish captured on FISS stations in Area 2A.

### *Rockfish sampling in Regulatory Area 2B*

In cooperation and with funding from Canada's DFO and the Pacific Halibut Management Association, IPHC samplers aboard setline survey vessels working in Regulatory Area 2B recorded round weight, round length, sex, and maturity, and collected otoliths from all rockfish caught on the setline survey, according to the sampling criteria in the 2017 Protocols for Rockfish Data Collection in British Columbia (IPHC 2017b). IPHC samplers in Area 2B sampled 1,684 rockfish (representing 14 different species) for length, sex, and maturity, and collected otoliths from 1,346 rockfish. These data and otoliths were shared with DFO. This project began in 2003, and has since been conducted annually, except for 2013. This project is expected to continue in future years.

### *Yelloweye rockfish enumeration in Alaska*

IPHC samplers recorded the capture of all yelloweye rockfish (*Sebastes ruberrimus*) encountered by setline survey vessels working in all of Regulatory Area 2C and in the Fairweather charter region in eastern Area 3A at the request of the Commercial Fisheries Division of the Alaska Department of Fish and Game (ADFG). A total of 1,187 yelloweye rockfish were recorded in 2017.

### *Oceanography*

During FISS operations in 2017, sea samplers deployed water column profilers on every station (unless weather or tide conditions were so risky the units could be lost). Water column profilers measured chlorophyll a and pH in addition to temperature, depth, salinity, and dissolved oxygen concentration (Sadorus and Walker 2017).

### *Environmental contaminant sampling*

IPHC sea samplers collected Pacific halibut muscle and liver samples for the Alaska Department of Environmental Conservation (ADEC) as part of an ongoing study of

environmental contaminants in Pacific halibut. A discussion of these data can be found in Dykstra (2017).

### *Ichthyophonus sampling*

In 2017, the IPHC continued investigating *Ichthyophonus* incidence in Pacific halibut. *Ichthyophonus* is a protozoan parasite from the class Mesomycetozoea, a highly diverse group of organisms with characteristics of both animals and fungi, and has been identified in many marine fish. Refer to Dykstra (2017) for more details on this project.

### *At-sea weights*

Net weight is a fundamental concept that the IPHC uses for stock assessment, apportionment, and all facets of Pacific halibut management. However, individual net weight is not a strict biological quantity. It is the result of natural variation and variable processing procedures that occur after the fish is caught. The purpose of this study is to collect data on IPHC's FISS for use in estimating the relationship between fork length and net weight. This includes the estimation of adjustments necessary to convert head-on weight to net weight, as well as estimation of shrinkage (potentially occurring in both length and weight) from time of capture to time of offload. This study complements an on-going project, in which portions of commercial deliveries are measured and weighed at the dock. This study provides length-to-weight data that is not available at commercial offloads: from U32 Pacific halibut, round fish, and freshly eviscerated and dressed fish, allowing for measurements of shrinkage from the time of capture to final weighing at the offload.

In 2017, building on experience from the pilot project in 2016, a motion-compensating scale was used to weigh Pacific halibut on nine trips made by the *F/V Free to Wander*, fishing in the Unalaska and 4A Edge charter regions. These regions were selected because they have a high proportion of larger Pacific halibut. The scale has a maximum load of 132 pounds (60 kg) with 0.04 pounds (20 g) accuracy. In total, 612 fish were weighed and measured at sea in the round and immediately after being dressed. At the time of writing, data collected during offloads had not yet been entered and no analysis had been conducted. This project is anticipated to continue into 2018.

### *Spiny dogfish sampling*

The IPHC samplers recorded the length and sex of the first five spiny dogfish (*Squalus suckleyi*) per station in Regulatory Areas 2 and 3, and all spiny dogfish encountered in Area 4. Spiny dogfish inhabit areas that are more effectively covered by the IPHC than other surveys. Data collected are part of a multi-year project requested by the NOAA-AFSC's Auke Bay Laboratories to compare IPHC's FISS catch rates with those from their sablefish (*Anoplopoma fimbria*) longline surveys. Species distribution will be examined and used in conjunction with tagging data to test the hypothesis that there may be two biological stocks of dogfish in Alaska: an inside population in southeast Alaska and a second that comprises those that live in coastal waters elsewhere. These data will be used to develop a length-based population dynamics model for the annual dogfish stock assessment. The IPHC samplers collected 3,096 spiny dogfish length and sex samples in 2017. This project is anticipated to continue into 2018.

### *Sixgill shark genetics*

The Seattle Aquarium and NOAA-AFSC have been examining the population genetics of the broadnose sixgill sharks (*Hexanchus griseus*) in the North Pacific Ocean. Little is known about these sharks outside of Puget Sound. Since 2014, the IPHC has assisted the Seattle Aquarium by collecting samples of six-gill sharks caught on setline survey. Simple morphometrics (greatest length) to determine maturity and tissue samples (1-2 mm fin clips) to determine approximate age (subadult vs adult) were collected on 55 specimens in 2017. This project is anticipated to continue into 2018.

### *Pacific cod length frequencies*

NOAA-AFSC requested and received data collected from Pacific cod captured on IPHC setline surveys to bolster data currently used by NOAA to assess the Bering Sea and Aleutian Islands Pacific cod stock. Length frequency data was collected by recording the total lengths of the first 15 Pacific cod from each skate on the IPHC setline survey vessels working the Bering Sea continental shelf edge in Regulatory Areas 4A and 4D and in Area 4B. Samplers collected 8,779 Pacific cod length samples in 2017. This project is expected to continue and expand into Area 3 in 2018.

### *Pop-up Archival Transmitting (PAT) tagging*

A total of 22 Pacific halibut were tagged with pop-up archival transmitting tags aboard the *F/V Kema Sue* in the north Bowers Ridge charter region. Eight males, 13 females, and one “unknown”. Additional information can be found in Loher (2017).

### *Wire tagging*

A total of 1,944 U32 Pacific halibut were tagged with wire tags during the 2017 setline survey, with a small fin tissue sample collected before the releasing of each fish. Of those tags, 1,700 were fluorescent yellow and 244 were pink. Additional information can be found in Forsberg (2017b).

## FUTURE WORK

The IPHC plans to continue fishing most of the current FISS stations in the near future. However, setline survey operations are dependent upon the ability of the project to remain self-funding. Although the surveys are designed exclusively to fulfill scientific needs, IPHC has adjusted fishing effort so that the ability to conduct the setline surveys on budget would withstand limited variation in Pacific halibut sale price or WPUE over the long term. If average Pacific halibut sale prices or WPUE fall substantially in the future, the Commission may need to find alternate sources of funding to collect these important data, or scale back the FISS program accordingly. The number of regions surveyed, and the extent of any pilot projects, is subject to change and is dependent upon decisions made at the IPHC's 2018 Annual Meeting.

### *Future fishery-independent setline survey (FISS) expansions*

In 2018, it is anticipated that the setline survey will be conducted in all 27 traditional regions and the IPHC will be continuing with the setline survey expansion into Regulatory Areas 2B and 2C, as approved by the Commission in 2014. The IPHC has begun vetting the proposed expansion setline survey stations with the respective State and Federal agencies. In some cases, this also involves special permitting requirements. There are 103 expansion stations planned in 2018 in Regulatory Area 2B and 55 in Area 2C (Figure 19 & 20).

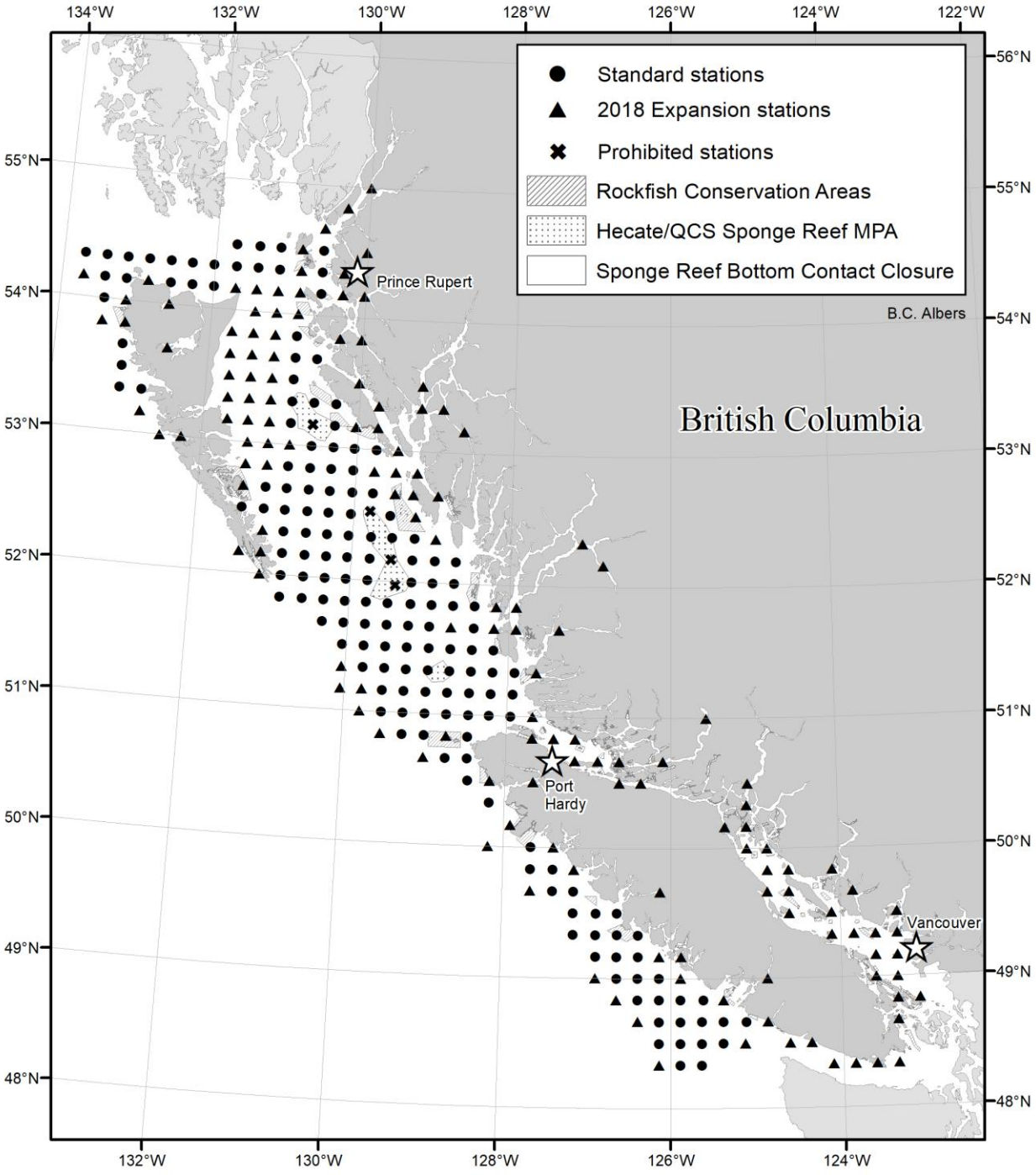


**Figure 19.** Proposed 2018 IPHC Regulatory Area 2B fishery-independent setline survey (FISS) stations.

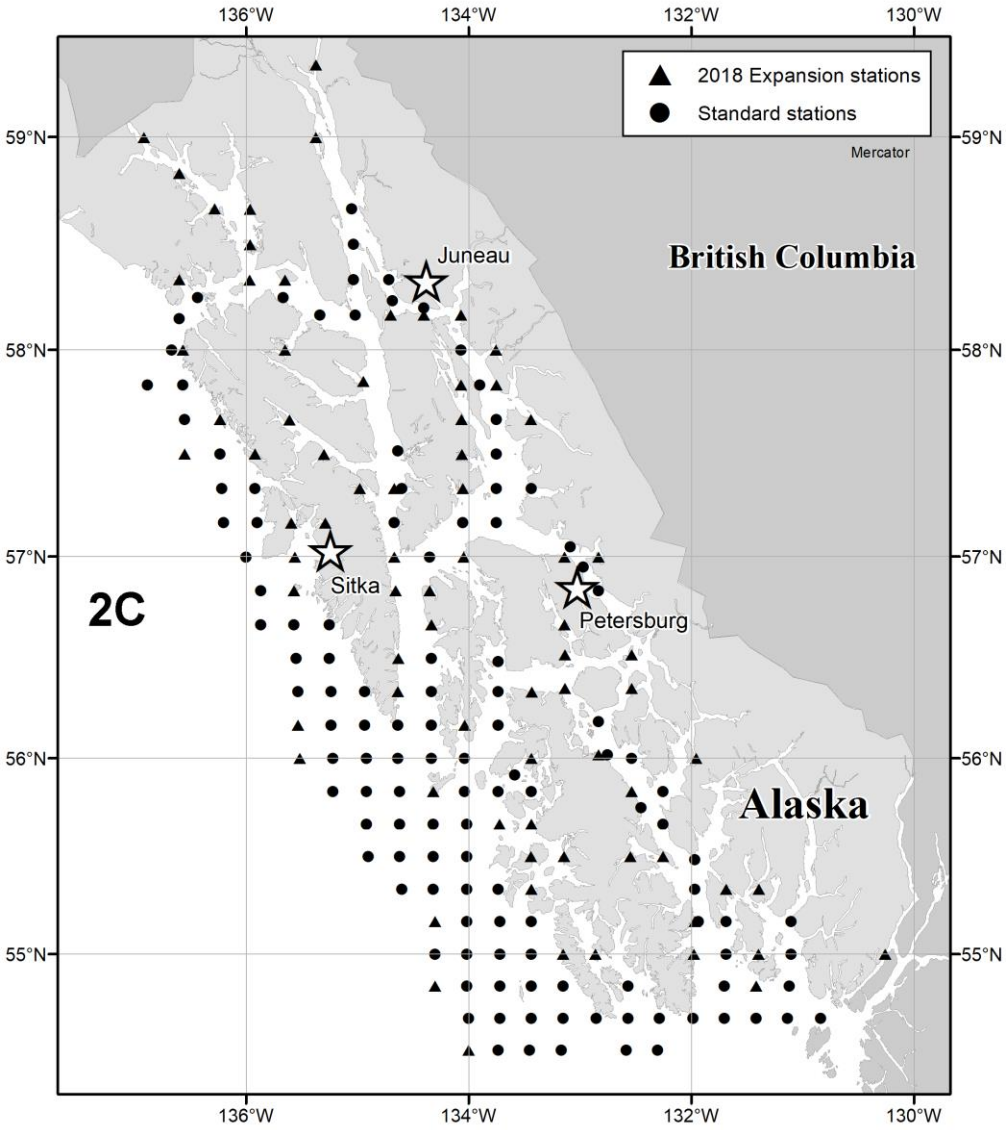


**Figure 20.** Proposed 2018 IPHC Regulatory Area 2C fishery-independent setline survey (FISS) stations.

For the last year of the proposed expansions (2019), the IPHC plans to move into Regulatory Areas 3A and 3B where 95 and 68 stations are being proposed to be fished, respectively (Figure 21).

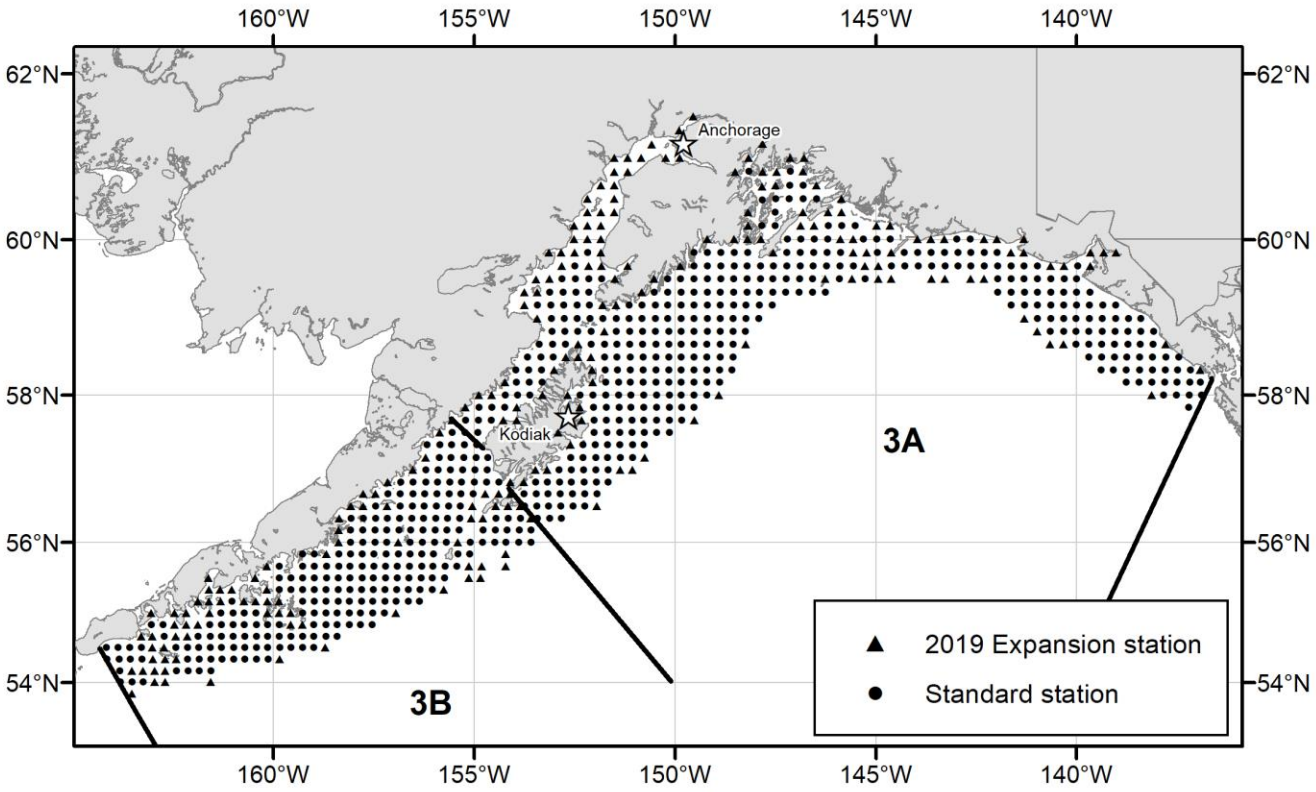


**Figure 21.** Proposed 2019 IPHC Regulatory Areas 3A and 3B fishery-independent setline survey (FISS) stations.

## ACKNOWLEDGEMENTS

The IPHC's fishery-independent setline survey operations occur over a large geographic range, in a wide variety of weather conditions, and often involve long, demanding days. The IPHC gives special thanks to our sea samplers, charter vessel captains and crews, plant personnel, port samplers, and permanent staff, as well as those individuals from outside agencies, whose dedicated contributions and efforts made the 2017 setline survey a success.

## RECOMMENDATION/S

That the Commission:

a) **NOTE** paper IPHC-2018-AM094-06 which provided an overview of the IPHC's fishery-independent setline survey (FISS) design and implementation in 2017, including current and future expansions.

## REFERENCES

Clark, W. G. 1992. Estimation of halibut body size from otolith size. Int. Pac. Hal. Comm. Sci. Rep. 75.

Dykstra, C. 2017. Chapter 2.7.2. Contaminnt and parasite monitoring at IPHC. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017:99-100.

Forsberg, J. E. 2017a. Chapter 2.3.2. Age distribution of Pacific halibut in the 2017 IPHC fishery-independent setline survey. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 34-42.

Forsberg, J. 2017b. Chapter 2.5.4. Wire-tagging on the fishery-independent setline survey:.Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 64-72.

Geernaert, T.O. 2017. Chapter 2.7.3. Trends in seabird counts from the IPHC fishery-independent seltine surveys (2002-2017). Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017:101-110.

Hoag, S. H., Williams, G. H., Myrhe, R. J., and McGregor, I. R. 1980. Halibut assessment data: Setline surveys in the north Pacific Ocean, 1963-1966 and 1976-1979. Int. Pac. Hal. Comm. Tech. Rep. 18.

IPHC. 2017a. 2017 Fishery-Independent Setline Survey Manual. Int. Pac. Hal. Comm., Seattle, WA.

IPHC. 2017b. 2017 protocols for rockfish data collection in British Columbia. Int. Pac. Hal. Comm., Seattle, WA.

Loher, T. 2017. Chapter 2.5.2 Deployment and reporting of pop-up archival transmitting (PAT) tags to study seasonal and interannual dispersal of Pacific halibut on Bowers Ridge (Area 4B). Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 52-59.

Sadorus, L. L., Lauth, R., and Ranta, A. 2017a. Chapter 3.4.1. Results from the Bering Sea NMFS trawl survey 2017. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 114-128.

Sadorus, L. L., Palsson, W. A., and Ranta, A. 2017b. Chapter 3.4.. Results from 2017 NOAA Fisheries Service Gulf of Alaska trawl survey 2017. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 129-140.

Sadorus, L. L. and Walker, J. 2017. Chapter 2.7.1. IPHC oceanographic monitoring program 2017. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2017: 90-98.

Soderlund, E., Randolph, D. L., and Dykstra, C. 2012. IPHC Setline Charters 1963 through 2003. Int. Pac. Hal. Comm. Tech. Rep. 58.

Tobin, R., Forsberg, J.E. and Rudy, D. M. 2017. Chapter 2.5.5. Otolith archive collection for elemental and isotopic studies. Int. Pac.Halibut Comm. Report of Assessment and Research Activities. 2017:73-76.

**APPENDICES:** Nil