TSC Agency Reports – IPHC 2018

Contents

I. Agency Overview

Management of the Pacific halibut resource and fishery has been the responsibility of the International Pacific Halibut Commission (IPHC) since its creation in 1923. Assessing, forecasting, and managing the resource and fishery requires accurate assessments, continuous monitoring, and research responsive to the needs of managers and stakeholders. The fishery for Pacific halibut (*Hippoglossus stenolepis*) is one of the most valuable and geographically largest in the northeast Pacific Ocean. Industry participants from Canada and the United States have prosecuted the modern fishery and have depended upon the resource since the 1880s. Annual removals have been as high as 100 million pounds, and the long-term average of removals is 64 million pounds.

Staffing Updates: In addition to some standard turnover seen in both the port and sea sampling seasonal positions, the following transitions occurred in 2017 and early 2018:

Name	Position	Start Date	End Date
Kelly McElligott	Data Transcriber	January 2017	December 2017
Melissa Knapp	1 Administrative Coordinator *		January 2017
Tamara Briggie	2 Administrative Coordinator	January 2017	
Stephanie Hart	3 Administrative Assistant	January 2017	
Kelly Chapman	4 Front Office Administrative Assistant	January 2017	
Collin Winkowski	Survey Coordinator Human Resources	January 2018	
Anna Simeon	Biological Science Laboratory Technician	March 2018	

* Note that the numbering in the subsequent lines reflects the sequence of position changes starting with this opening. Only the last person is new to IPHC.

II. Surveys

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 1993-2017; and IPHC Technical Reports 18 and 58. The majority of the current FISS station design and sampling protocols have been standardized 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 IPHC Regulatory Areas 2C, 4A, 4C, and 4D, with decreases in IPHC Regulatory 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 IPHC 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 IPHC Regulatory 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 are fished on a different layout than the FISS and are not included in the IPHC stock assessment dataset.

Six skates were set in IPHC Regulatory Area 2A and seven skates in IPHC Regulatory Area 4CDE. IPHC 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, 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).

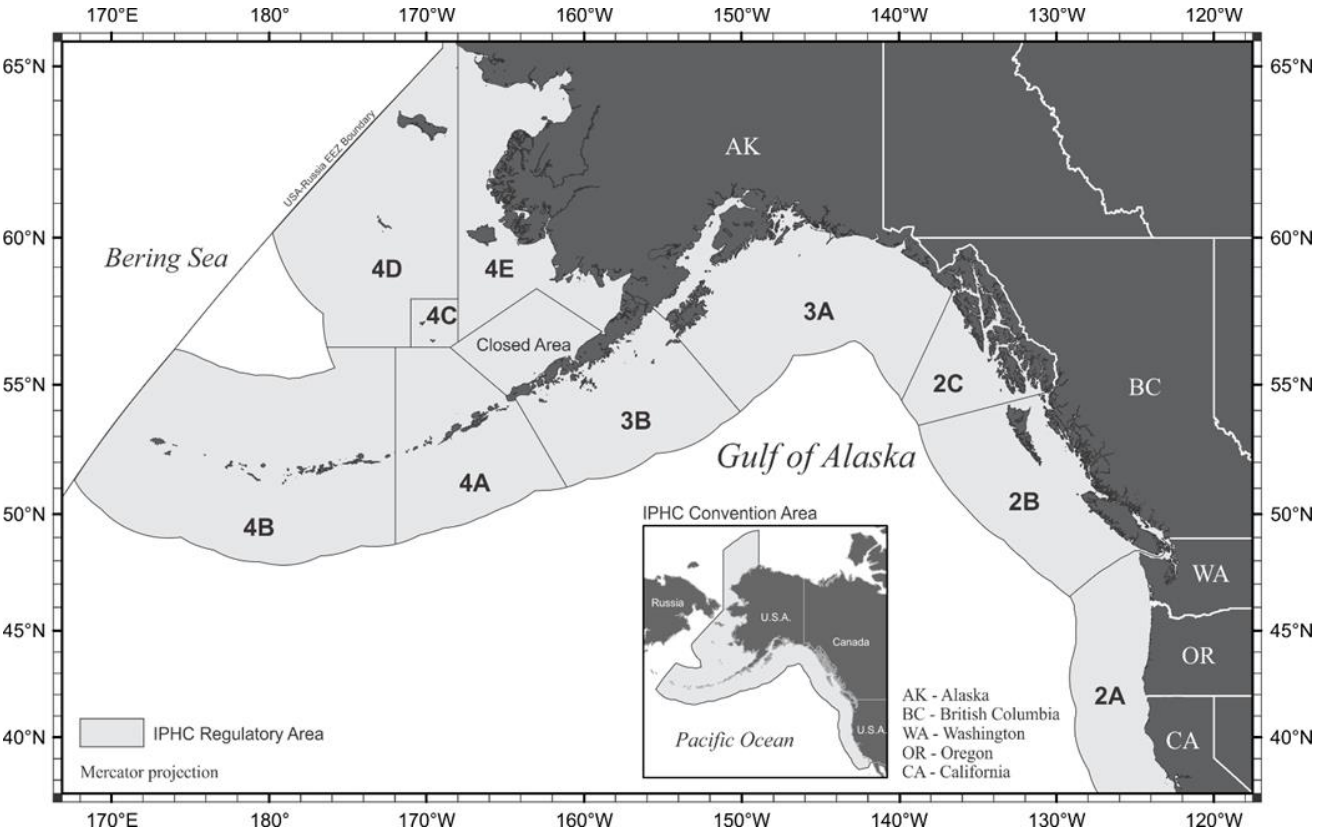

Figure 1a. Map of the IPHC Convention Area and IPHC Regulatory Areas.

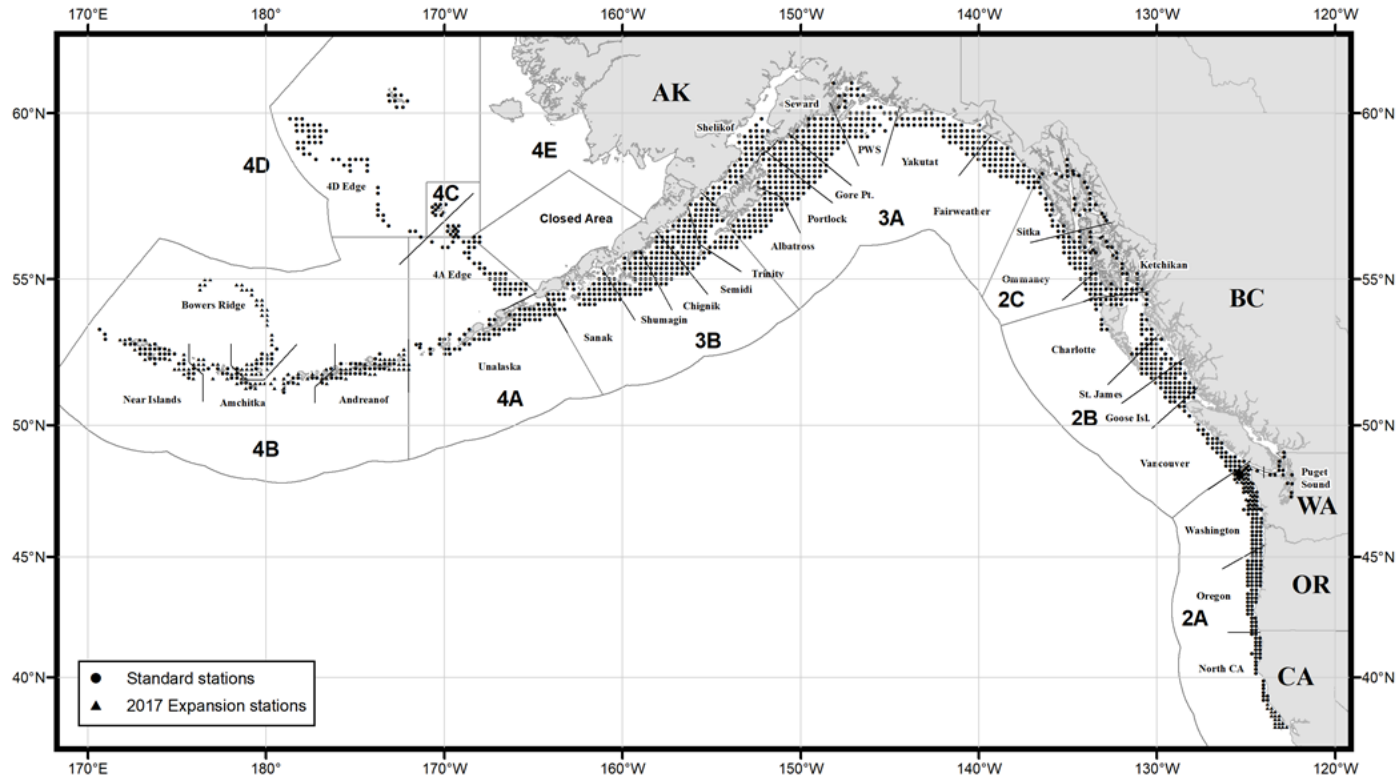

Figure 1b. 2017 IPHC fishery-independent setline survey station positions, charter region divisions, and IPHC Regulatory Areas.

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 IPHC Regulatory Area 4B, which included depths as shallow as 50 fathoms (91 m) and as deep as 400 fathoms (732 m). IPHC 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.

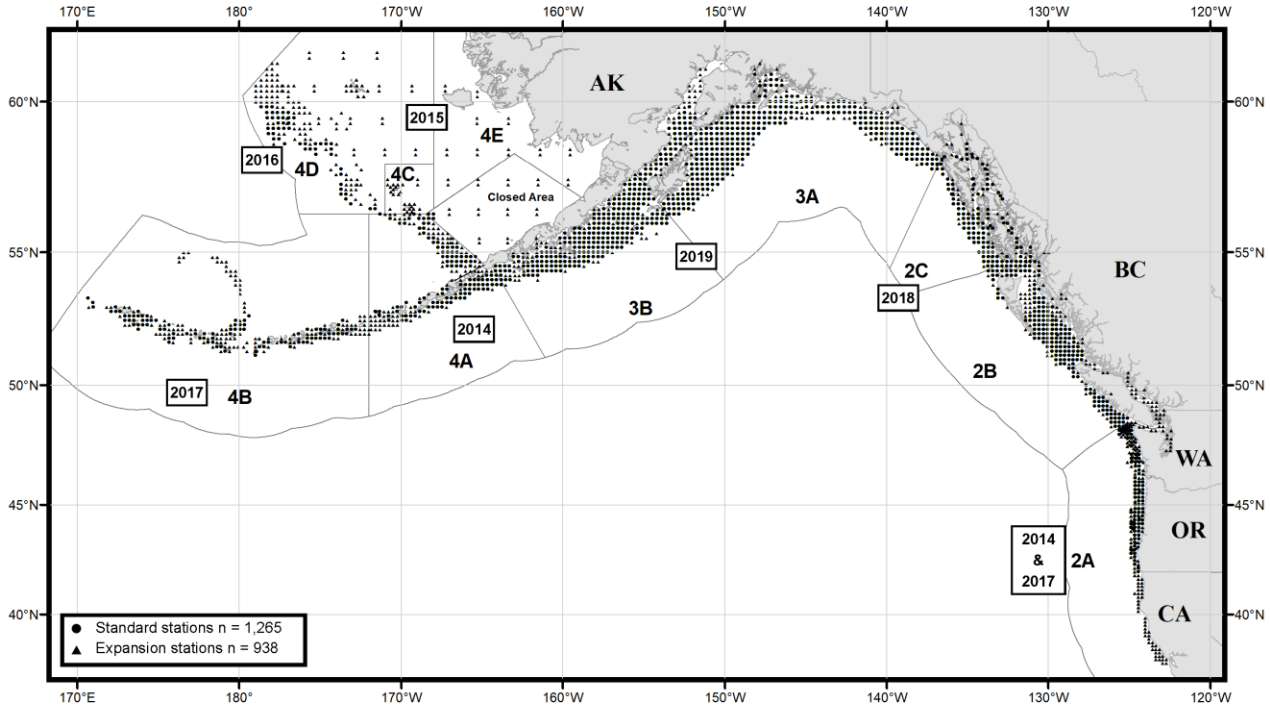

Figure 2. IPHC fishery-independent setline survey (FISS) and expansion stations planned (2014-19).

2017 FISS Expansion in IPHC 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 IPHC 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.

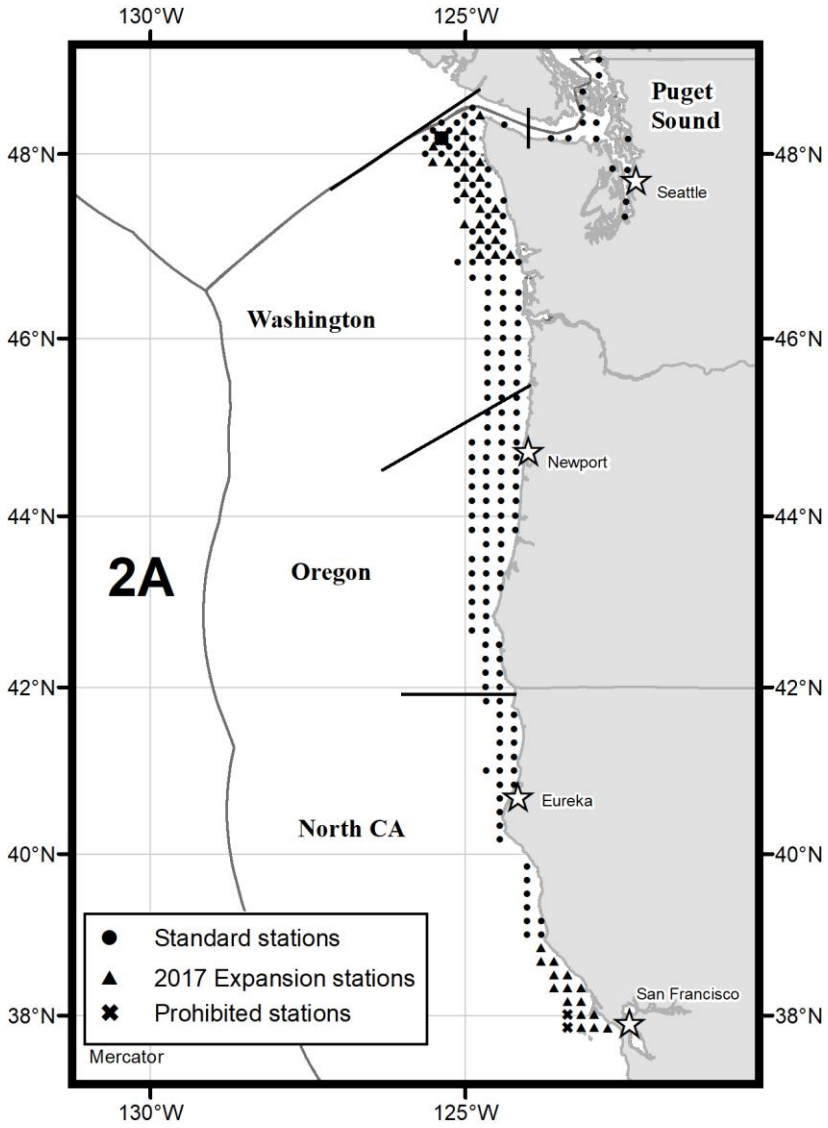

Figure 3. 2017 IPHC fishery-independent setline survey stations in IPHC Regulatory Area 2A with charter regions.

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 IPHC 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 IPHC 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).

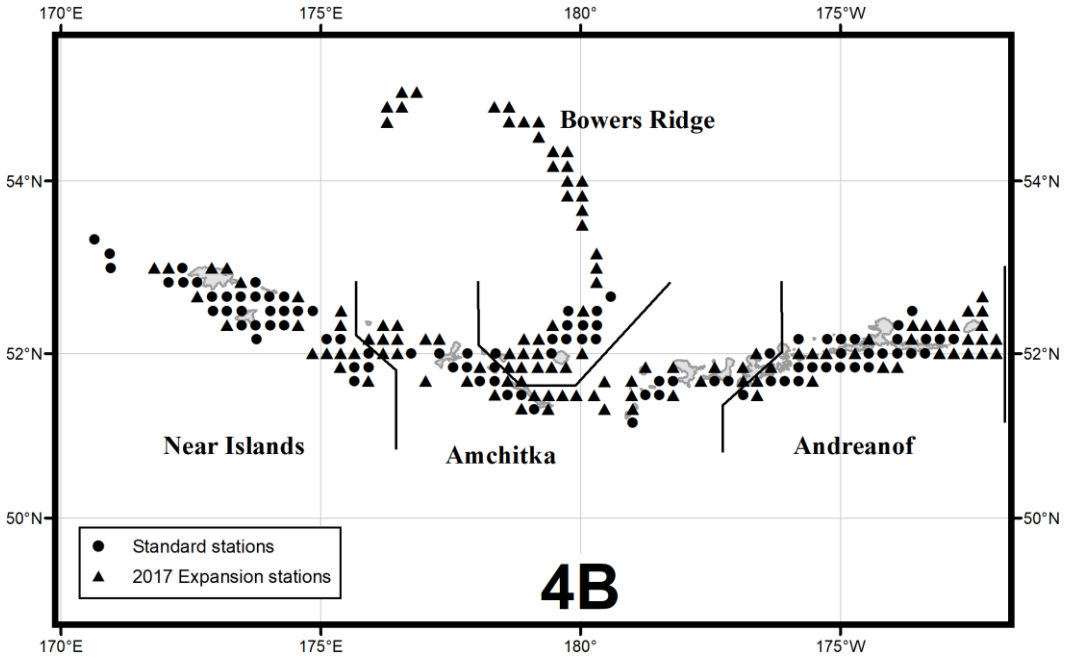

Figure 4. 2017 IPHC fishery-independent setline survey stations in IPHC Regulatory Area 4B with charter regions.

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

Weight Per Unit Effort

The FISS covers commercial as well as non-commercial fishing grounds, so the average WPUE for all IPHC Regulatory Areas surveyed was below that of the commercial fleet.

Compared to 2017 results, setline survey WPUE increased in IPHC Regulatory Areas 2C (+23%), 4A (+2%), 4C (+28%), and 4D (+95%). WPUE decreased in IPHC Regulatory Areas 2A (-53%), 2B (-10%), 3A (-10%), 3B (-20%) and 4B (-7%) (Figure 5). Since 2011, IPHC Regulatory Area 2C's WPUE has exceeded IPHC Regulatory Area 3A's, and has been the highest WPUE of all the regions.

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 IPHC Regulatory 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 IPHC Regulatory Area 2C increased in the Sitka (+18%), Ommaney (+12%), and Ketchikan (+44%) charter regions.

In IPHC Regulatory 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%). IPHC Regulatory Area 3B WPUE decreased in Chignik (-19%), Sanak (-36%), Semidi (-23), Shumagin (-2%), and Trinity (-16%) regions when compared to last year. 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 IPHC Regulatory Area 4A Edge and 4D Edge region's WPUE increased by 8% and 98%, respectfully.

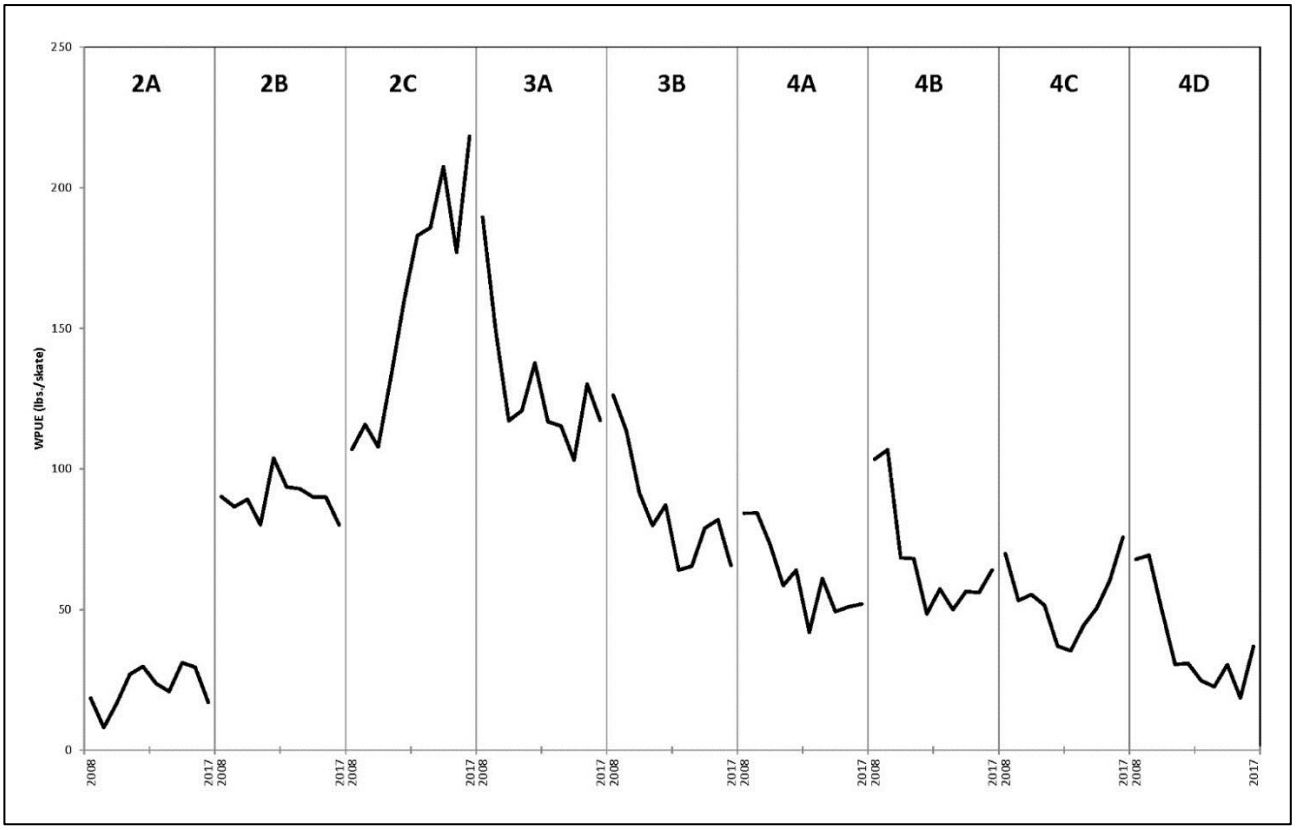

Figure 5. Average O32 WPUE (lbs/skate) of Pacific halibut by IPHC Regulatory Area from all effective standard grid and expansion stations occupied on 2008-2017 setline surveys.

Numbers per unit effort

Trends in the coastwide numbers per unit effort (NPUE) since 2008 are shown in Figure 6 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. 6). 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 IPHC Regulatory Area (Figure 7). A larger NPUE of O32 as compared to U32 Pacific halibut was seen in all IPHC Regulatory Areas except for 3B and 4A. In 2017, IPHC Regulatory Area 2C showed an increase in O32 Pacific halibut with a decrease in U32 Pacific halibut average NPUE. IPHC Regulatory Area 2B had slight decreases in both O32 and U32 average NPUE. IPHC Regulatory Area 4A had a slight increase in both O32 and U32 Pacific halibut rate of capture. IPHC Regulatory Area 3B continues to have the largest gap between O32 and U32 Pacific halibut, with a difference of 51% between the two groups.

Figure 6. Setline survey NPUE (Pacific halibut/skate) coastwide from 2008-2017. Includes data from SG and ES effective stations.

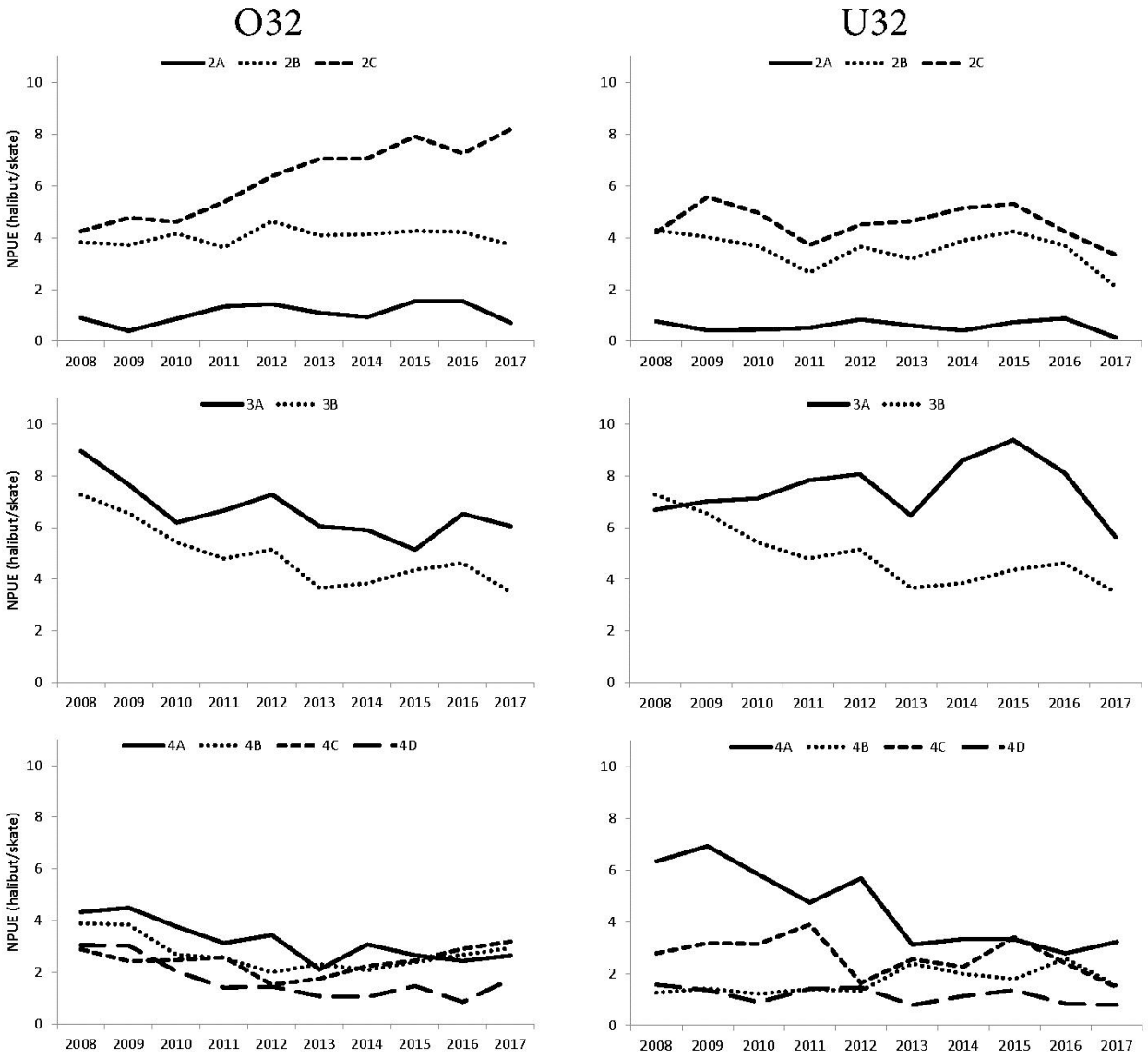

Figure 7. Setline survey NPUE (Pacific halibut/skate) by IPHC Regulatory Area from 2008 to 2017. Individual charter regions are plotted within each IPHC Regulatory Area panel, as indicated. O32 Pacific halibut is on the left, U32 on the right. Includes data from effective standard grid and expansion 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 (Figure 8). In 2017, the median lengths of Pacific halibut captured increased in all IPHC Regulatory Areas except 4A (Figure 8). IPHC Regulatory Areas 3A, 3B, and 4A had median lengths below the legal-size limit. In 2017, the largest median length was in IPHC Regulatory Area 2A (97 cm). The length frequency distribution of Pacific halibut from catches in the 2017 FISS, by IPHC Regulatory Area (Figure 9).

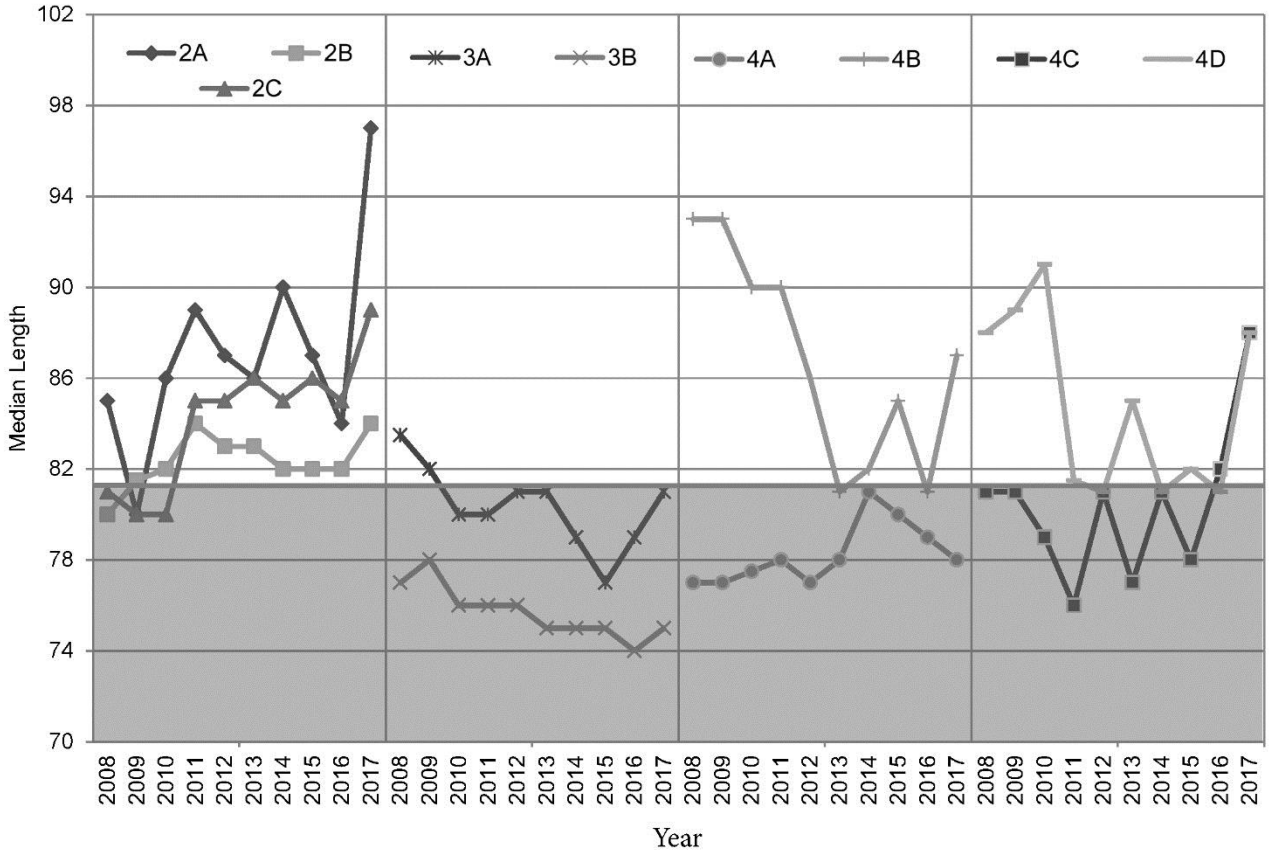

Figure 8. Median length of Pacific halibut caught on setline survey, by IPHC Regulatory Area, from 2008 to 2017.The shaded area shows length below the current commercially-legal size limit. Includes data from effective standard grid and expansion stations.

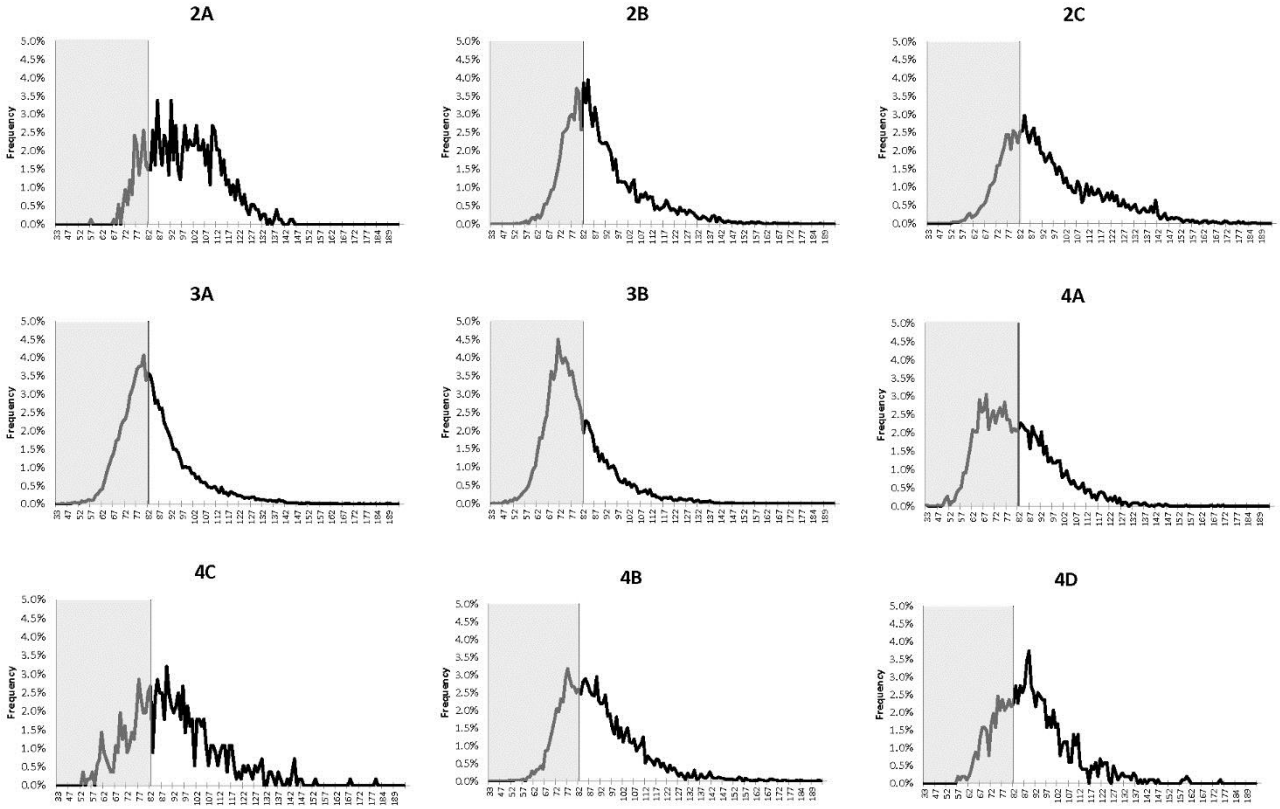

Figure 9. The length (cm) frequency distribution of Pacific halibut, by Regulatory Area, from catches in the 2017 setline survey. Shaded areas denote smaller thtn current legal commercial size limit. Catch from rockfish index staions not included.

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 10). IPHC Regulatory Area 4B had the lowest percentage of females in the catch, and has been consistently below 50% since 1998. IPHC Regulatory 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.

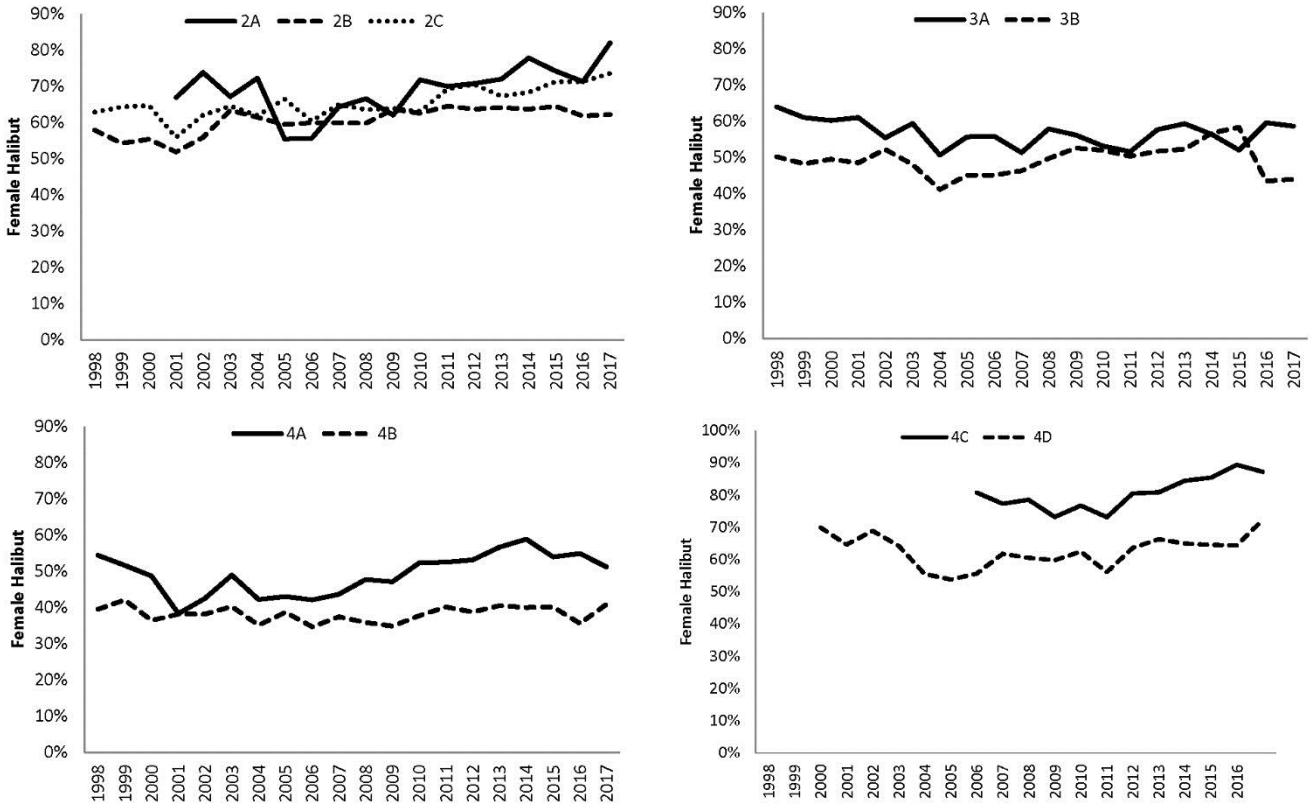

Figure 13. Percentage of Pacific halibut captured and sampled for otolith collection that was composed of females, by IPHC Regulatory Area, from 1998 to 2017.

Otolith collection and Pacific halibut age results

The otolith collection goal for the 2017 setline survey was 2,000 otoliths per IPHC Regulatory Area, with a minimum target of 1,500 per IPHC Regulatory Area. Fewer than 1,500 otoliths were collected in IPHC Regulatory Areas 2A, 4C, and 4D as the catch rates were low and there are fewer stations in these IPHC Regulatory Areas.

The age distribution of Pacific halibut sampled from the 2017 IPHC setline survey is summarized in Tables 4-6. The 2005 year class (12-year-olds) accounted for the largest proportion (in numbers) of sampled Pacific halibut for all IPHC Regulatory Areas and sexes combined. The next most abundant year classes were 2004 and 2006 (13- and 11-year-olds, respectively).

Twelve-year-olds were the most abundant age class for female Pacific halibut sampled from all IPHC Regulatory Areas combined, as well as for females in all IPHC Regulatory Areas except for IPHC Regulatory Area 4A (Table 5).
The second and third most abundant age classes for sampled females across all IPHC Regulatory Areas were 13- and 11-year-olds, respectively.

The 2005 year class (12-year-olds) was the largest for male Pacific halibut from all IPHC Regulatory Areas combined, as well as from IPHC Regulatory Areas 2, 3B, 4A, and 4B (Table 6). The second and third most abundant age classes for sampled males across all IPHC Regulatory Areas were 13- and 11-year-olds, respectively.
Mean age and fork length (FL) by IPHC Regulatory Area of sampled setline survey Pacific halibut for the years 2008-2017 are presented in Table 7. Average length was calculated only from fish that were aged. Average age was higher and average fork length was lower for males than females in all IPHC Regulatory Areas for all years with the exception of IPHC Regulatory Area 4C in 2008, where the average age was slightly lower for males than females.

The youngest and oldest Pacific halibut in the 2017 setline survey samples were determined to be four and 46 years old (Table 8). There were four fish determined to be four years old: a female from IPHC Regulatory Area 3A measuring 53 cm FL; two females from IPHC Regulatory Area 3B measuring 53 and 55 cm FL); and one male from IPHC Regulatory Area 3B measuring 71 cm FL. The 46-year-old was a male captured in IPHC Regulatory Area 4B with a fork length of 119 cm. The maximum fork length recorded for setline survey-caught Pacific halibut in 2017 was 190 cm: a female from IPHC Regulatory Area 3A aged at 22 years. The smallest Pacific halibut sampled in the 2017 setline survey measured 33 cm FL: a male from IPHC Regulatory Area 4A aged at five years.

Table 4. Age distribution (number of individuals sampled) of all Pacific halibut (male, female, and unknown sex combined) collected in the 2017 fishery-independent setline survey. "Sample rate" indicates the percentage of those Pacific halibut captured in each IPHC Regulatory Area whose otoliths were removed for subsequent aging.

	IPHC Regulatory Area									
	2A	**2B**	**2C**	**3A**	**3B**	**4A**	**4B**	**4C**	**4D**	
	Sample rate (%)									
	100	35	33	9	13	78	45	100	100	
Age (years)										**Total**
4				1	3					**4**
5	1	7	9	5	10	9	4	7	2	**54**
6	4	18	26	13	25	34	14	12	7	**153**
7	12	23	21	13	38	40	43	9	10	**209**
8	18	31	43	18	37	86	26	23	29	**311**
9	86	129	117	82	110	222	76	71	92	**985**
10	104	123	145	107	115	172	72	57	130	**1,025**
11	125	204	240	174	183	220	109	69	131	**1,455**
12	193	345	371	287	289	335	228	87	133	**2,268**
13	141	240	349	233	208	331	191	77	106	**1,877**
14	64	105	184	145	144	249	175	50	96	**1,212**
15	47	88	186	140	113	163	113	38	55	**943**
16	20	45	113	94	41	82	62	8	30	**495**
17	14	43	82	97	34	65	55	7	16	**413**
18	10	32	81	95	29	56	41	4	11	**359**
19	11	11	49	47	21	28	38		9	**214**
20	4	13	35	29	6	25	31		11	**154**
21	4	4	13	20	2	12	19		6	**80**
22	1	3	12	17	2	10	11		6	**62**
23	3	3	10	7	1	9	18		6	**57**
24	1		4	2	2	4	13		6	**32**
25	1	2	5	5	2	4	9	1	2	**31**
≥26	1	2	9	3	6	31	60	2	59	**173**
Total	**865**	**1,471**	**2,104**	**1,634**	**1,421**	**2,187**	**1,408**	**522**	**953**	**12,565**

Table 5. Age distribution (number of individuals sampled) of female Pacific halibut collected in the 2017 fishery-independent setline survey. Note that Pacific halibut are not sampled at the same rate in all IPHC Regulatory Areas (see rates in Table 1), and that there are not separate sampling rates by sex within an IPHC Regulatory Area.

	IPHC Regulatory Area									
Age	**2A**	**2B**	**2C**	**3A**	**3B**	**4A**	**4B**	**4C**	**4D**	**Total**
4				1	2					**3**
5	1	6	7	4	8	5	3	7	2	**43**
6	3	9	16	7	22	28	7	10	4	**106**
7	11	15	14	10	26	28	30	6	9	**149**
8	15	19	29	11	18	54	15	19	17	**197**
9	65	83	80	51	60	101	37	66	66	**609**
10	84	91	97	72	47	95	37	46	97	**666**
11	101	125	179	122	77	93	57	64	97	**915**
12	158	230	285	202	126	164	116	79	106	**1,466**
13	118	159	279	152	100	172	103	65	84	**1,232**
14	52	65	131	89	59	139	71	47	73	**726**
15	38	44	142	77	36	83	44	31	40	**535**
16	11	22	87	43	9	42	14	7	23	**258**
17	12	19	57	39	9	26	20	4	10	**196**
18	6	9	53	31	11	28	14	3	6	**161**
19	10	3	29	12	4	11	3		5	**77**
20	1	2	23	7		14	6		7	**60**
21	3	1	8	5		3	4		1	**25**
22	1	2	8	2		5	3		4	**25**
23	3		6	2		4	2		3	**20**
24	1		2			2	3		4	**12**
25		1	5			1	2	1	1	**11**
≥26		2	4	2		9	9		23	**49**
Total	**694**	**907**	**1,541**	**941**	**614**	**1,107**	**600**	**455**	**682**	**7,541**

Table 6. Age distribution (number of individuals sampled) of male Pacific halibut collected in the 2017 fishery-independent setline survey. Note that Pacific halibut are not sampled at the same rate in all IPHC Regulatory Areas (see rates in Table 4), and that there are not separate sampling rates by sex within an IPHC Regulatory Area.

	IPHC Regulatory Area									
Age	**2A**	**2B**	**2C**	**3A**	**3B**	**4A**	**4B**	**4C**	**4D**	**Total**
4					1					**1**
5		1	1	1	2	4	1			**10**
6	1	9	9	6	3	5	7	2	3	**45**
7	1	8	5	2	12	12	12	3	1	**56**
8	3	12	14	6	18	31	11	4	12	**111**
9	21	45	35	30	49	119	38	5	26	**368**
10	19	32	45	34	65	77	33	11	33	**349**
11	22	78	58	46	106	125	50	5	33	**523**
12	34	113	85	82	159	169	109	8	26	**785**
13	21	77	69	80	103	156	84	11	21	**623**
14	11	40	53	52	82	108	104	3	23	**476**
15	9	43	44	63	76	79	67	7	15	**403**
16	9	23	26	50	32	39	47	1	7	**234**
17	2	23	24	58	25	38	33	3	6	**212**
18	4	23	28	63	18	27	27	1	5	**196**
19	1	8	20	35	17	16	34		4	**135**
20	3	11	12	22	6	11	24		4	**93**
21	1	3	5	15	1	9	15		5	**54**
22		1	4	15	2	5	7		2	**36**
23		3	4	5	1	5	16		3	**37**
24			2	1	2	2	10		2	**19**
25	1	1		4	1	3	7		1	**18**
≥26	1		5	1	5	21	51	2	36	**122**
Total	**164**	**554**	**548**	**671**	**786**	**1,061**	**787**	**66**	**268**	**4,905**

Table 7 . Mean age (in years) and mean fork length (in centimeters) of sampled Pacific halibut caught on standard survey skates by sex and IPHC Regulatory Area (CLS = Bering Sea closed area), 2008-2017 (F = female, M = male).

IPHC Regulatory Area		2008		2009		2010		2011		2012[1]		2013		2014		2015		2016		2017	
		F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M
2A	Age	11.3	11.4	10.3	11.0	11.0	11.1	11.4	12.0	11.8	12.0	11.2	11.6	10.59	11.4	10.69	11.1	10.89	11.8	12.0	12.4
	Length	90.3	78.8	89.5	79.4	93.1	79.1	95.6	81.5	95.1	80.1	94.7	80.4	95.8	81.3	93.0	80.5	92.1	78.5	100.7	81.1
2B	Age	10.6	11.1	11.2	11.8	10.9	11.4	11.1	11.6	11.4	12.3	11.4	12.3	11.29	12.6	11.39	12.4	11.59	12.3	12.0	12.8
	Length	91.0	77.2	93.5	77.4	93.8	78.2	94.6	78.5	95.2	79.8	94.4	79.1	92.1	78.8	91.8	78.7	93.4	78.1	95.6	80.0
2C	Age	11.4	11.5	10.9	11.7	11.0	11.5	11.9	12.0	11.2	11.6	11.9	12.4	11.79	12.3	11.99	12.3	12.79	13.2	13.1	13.4
	Length	93.4	78.8	90.6	78.2	91.0	77.0	96.9	79.8	95.8	80.1	96.4	79.4	97.0	80.0	97.7	80.4	96.7	81.0	100.7	82.9
3A	Age	12.9	16.0	11.7	14.6	12.1	15.0	12.2	14.9	12.2	14.6	12.7	14.3	11.888	13.8	11.888	13.7	12.889	14.6	12.8	14.7
	Length	93.7	81.8	89.5	79.6	89.4	78.7	87.6	78.3	90.1	78.6	89.4	76.4	87.7	75.5	88.5	75.3	90.4	76.0	92.0	77.2
3B	Age	11.1	14.4	10.6	13.5	10.7	13.0	10.8	12.9	10.7	12.5	11.3	13.3	10.98	12.7	11.38	12.8	11.58	12.4	11.6	12.8
	Length	83.0	78.1	82.3	77.6	81.8	75.9	81.5	74.2	81.7	74.9	80.3	73.3	80.5	73.4	82.3	72.2	83.9	71.2	87.8	73.2

4A	**Age**	10.7	13.5	10.5	12.6	10.6	12.7	10.8	13.2	11.1	13.2	11.3	13.4	12.38	14.7	11.58	13.9	12.38	13.0	12.5	13.0
	Length	82.4	78.6	84.1	77.6	82.6	76.6	83.4	76.5	82.8	76.6	85.8	78.3	88.2	79.7	84.7	77.0	89.1	74.1	88.0	74.1
4B	**Age**	12.6	15.8	13.1	15.9	12.2	14.9	12.2	15.2	11.8	13.9	11.0	13.6	11.29	13.7	11.09	13.6	11.49	13.6	12.8	15.3
	Length	103.4	92.1	103.8	92.7	100.3	90.3	98.4	89.7	96.6	86.5	89.4	84.1	92.0	84.1	94.6	86.2	91.1	82.1	96.7	85.3
4C	**Age**	10.5	10.4	9.6	10.8	10.2	10.8	10.4	11.2	11.3	13.2	10.6	11.2	11.38	11.4	10.78	11.4	11.78	12.1	11.5	12.3
	Length	88.0	72.7	84.1	75.1	84.3	73.8	82.0	72.8	86.3	78.8	80.7	74.2	84.7	72.9	83.1	72.2	87.0	74.9	93.9	74.3
4D	**Age**	13.4	16.1	13.8	16.6	14.4	17.4	13.2	14.9	12.0	13.7	13.8	15.2	12.38	13.1	12.58	13.3	13.38	14.2	12.8	15.1
	Length	93.8	85.3	94.4	86.7	96.6	87.3	88.4	80.9	86.6	78.5	91.9	81.5	88.2	77.6	88.2	77.6	88.1	77.7	93.7	80.6
4E	**Age**	----	----	----	----	----	----	----	----	----	----	----	----	--	----	10.18	12.5	--	----	----	----
	Length	----	----	----	----	----	----	----	----	----	----	----	----	--	----	89.0	79.9	--	----	----	----
CLS	**Age**	----	----	----	----	----	----	----	----	----	----	----	----	--	----	10.48	11.2	--	----	----	----
	Length	----	----	----	----	----	----	----	----	----	----	----	----	--	----	86.9	73.4	--	----	----	----

[1]**Does not include otoltihs from fish sampled on experimental bait skates that were fished concurrently with standard survey skates during 2012 bait study (Webster et al. 2013).**

Table 8. Maximum and minimum age (in years) and fork length (in centimeters) of Pacific halibut for which sex was determined, collected in the 2017 fishery-independent setline survey, by IPHC Regulatory Area and sex.

IPHC Regulatory Area	Sex	Max. age	Min. age	Max. length	Min. length
2A	Female	24	5	145	60
2A	Male	33	6	113	57
2B	Female	30	5	174	55
2B	Male	25	5	127	56
2C	Female	31	5	186	57
2C	Male	32	5	139	54
3A	Female	28	4	190	48
3A	Male	27	5	147	51
3B	Female	19	4	161	50
3B	Male	31	4	127	48
4A	Female	34	5	155	50
4A	Male	37	5	121	33
4B	Female	36	5	174	53
4B	Male	46	5	134	57
4C	Female	25	5	180	56
4C	Male	36	6	106	53
4D	Female	32	5	175	57
4D	Male	42	6	134	34

III. Reserves – N/A

IV. Review of Agency Groundfish Research, Assessment, and Management

A. Pacific halibut and IPHC activities

1. Research

Abstract

Since its inception, the IPHC has had a long history of research activities devoted to describing and understanding the biology of the Pacific halibut (*Hippoglossus stenolepis*). At the present time, the main objectives of the Research Program put forward by the Biological and Ecosystem Science Branch at IPHC are to:

1) identify and assess critical knowledge gaps in the biology of the Pacific halibut;
2) understand the influence of environmental conditions; and
3) apply the resulting knowledge to reduce uncertainty in current stock assessment models.

Traditionally, IPHC staff propose new projects annually that are designed to address key biological issues as well as the continuation of certain projects initiated in previous years. Proposals are based on their own input as well as input from the Commissioners, stakeholders, and specific subsidiary bodies to the IPHC such as the Research Advisory Board (RAB) and the Scientific Review Board (SRB). Proposed research projects are presented to the Commissioners for feed-back and subsequent approval. Importantly, biological research activities at IPHC are guided by a Five-Year Research Plan that is put forward by the Branch Manager identifying key research areas that follow Commission objectives. According to the Five-Year Research Plan for the period 2018-2023, the primary biological research activities at IPHC can be summarized in five main areas:

1) Reproduction
2) Growth and Physiological Condition
3) Discard Mortality and Survival
4) Distribution and Migration
5) Genetics and Genomics

These research areas have been selected for their important management implications. The studies conducted on Reproduction are aimed at providing information on the sex ratio of the commercial catch and to improve current estimates of maturity. The studies conducted on Growth are aimed at describing the role of some of the factors responsible for the observed changes in size-at-age and to provide tools for measuring growth and physiological condition in Pacific halibut. The proposed work on Discard Mortality and Survival is aimed at providing updated estimates of discard mortality rates in both the longline and the trawl fisheries. The studies conducted on Distribution and Migration are aimed at further understanding larval and juvenile dispersal, distribution of all life stages in relation to the environment, and reproductive and seasonal migration and identification of spawning times and locations. The studies conducted on Genetics and Genomics are aimed at describing the genetic structure of the Pacific halibut population and at providing the means to investigate rapid adaptive changes in response to fishery-dependent and fishery-independent influences. An overarching objective of the Five-Year Research Plan is to promote integration and synergies among the various research activities led by IPHC in order to significantly improve our knowledge of key biological inputs that are introduced into the stock assessment.

Overview of research projects for 2018

The following projects are being conducted at IPHC in 2018:

Project 621.16 ("*Development of genetic sexing techniques*") is the continuation of a project dealing with genetic sex identification of the commercial catch that will entail the testing and application of the recently developed genetic assays for sex identification.

Projects 642.00 ("*Assessment of mercury and other contaminants*") and **661.11** ("*Ichthyophonus incidence monitoring*") represent the continuation of projects monitoring the prevalence of heavy metal contamination and *Ichthyophonus* infection in the Pacific halibut population, respectively.

A total of four projects are continuing migration-related studies. Three of these projects involve tagging and include: **Project 650.18:** "*Archival tags: tag attachment protocols*", **Project 650.21:** "*Investigation of Pacific halibut dispersal in IPHC Regulatory Area 4B*"; and **Project 670.11:** "*Wire tagging of Pacific halibut on NMFS trawl and setline surveys*". A fourth migration-related project, **Project 675.11** ("Tail pattern recognition"), is investigating the identification of individual tail markings in U32 fish through the collection of tail images from IPHC's fishery-independent setline survey.

Project 669.11 ("*At-sea collection of Pacific halibut weight to reevaluate conversion factors*") is continuing to collect weights at sea to improve estimation of the weight-length relationship in adult Pacific halibut.

Project 672.12 ("*Condition Factors for Tagged U32 Fish*") is continuing to study the relationship between the physiological condition of fish and migratory performance and growth as assessed by tagging in U32 fish in order to better understand the potential use of quantitative physiological indicators in predicting migratory performance and growth.
Project 673.13 ("*Sequencing the Pacific halibut genome*") is continuing the first characterization of the genome of the Pacific halibut that will be instrumental to provide genomic resolution to genetic markers for sex, reproduction, and growth that are currently being investigated.

Project 673.14 (*"Identification and validation of markers for growth in Pacific halibut"*) is continuing to identify and validate molecular and biochemical profiles that are characteristic of specific growth patterns and that will be used to identify different growth trajectories in the Pacific halibut population and evaluate potential effects of environmental influences on growth patterns. This project has also received funding from the North Pacific Research Board under project number 1704.

Project 672.13 ("*Discard mortality rates and injury classification profile by release method*") is continuing to study the relationship between hook release methods in the longline fishery and associated injuries with the physiological condition of fish and with post-release survival in order to update current estimates of discard mortality rates in the directed longline Pacific halibut fishery. This project has also received funding from the Saltonstall-Kennedy NOAA grant program under project number NA17NMF4270240.

Project 674.11 ("*Full characterization of the annual reproductive cycle*") is continuing to characterize the annual reproductive cycle of male and female Pacific halibut in order to improve

our understanding of sexual maturation in this species and to improve maturity assessments and maturity-at-age estimates.

Two new projects at IPHC are starting in 2018. **Project 2018-01** ("*Influence of thermal history on growth*") will study the thermal profile experienced by fish at sea as assessed by archival tagging and otolith microchemistry in order to investigate the relationship between growth patterns (or productivity) and both spatial and temporal variability in environmental conditions for growth. **Project 2018-04** ("*Larval connectivity*") will study the movement and connectivity of Pacific halibut larvae both within and between the Gulf of Alaska and the Bering Sea

In addition to these continuing and new projects at IPHC, we note the participation of IPHC in an externally-funded and coordinated project entitled "*Survival of Pacific halibut released from Bering Sea flatfish trawl catches through expedited sorting*". This project is continuing to study the efficacy of expedited release as a method for reducing Pacific halibut discard mortality following trawl capture and the development of methods for the estimation of discard mortality rates without the need for fish-by-fish vitality estimation. This project is funded by the Saltonstall-Kennedy program under project number 15AKR013 and by the North Pacific Research Board under project number NPRB 1510.

Figure 2 presents a schematic diagram of the IPHC research projects, their interactions, and their relationship to the major research areas identified in the IPHC Five-Year Research Plan.

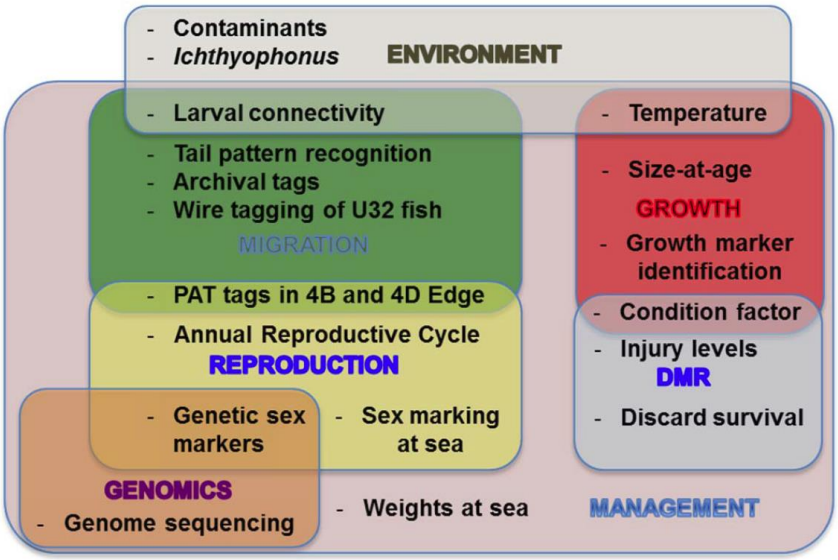

Figure 2. Schematic diagram of IPHC research projects and their interactions

Other ongoing data collection projects

In addition to specific research projects, the IPHC collects data each year through ongoing data collection projects that are funded separately, either as part of the fishery-independent setline survey or as part of the commercial fishery data collection program. Ongoing data collections projects that are continuing in 2018 include the following:

IPHC fishery-independent setline survey

IPHC Survey Team – Tracee Geernaert, survey manager

The IPHC fishery-independent setline survey provides catch information and biological data on Pacific halibut that are independent of the commercial fishery. These data, which are collected using standardized methods, bait, and gear during the summer of each year, provide an important comparison with data collected from the commercial fishery.

Biological data collected on the surveys (e.g., the size, age, and sex composition of Pacific halibut) 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 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 Commission has conducted fishery-independent setline surveys in selected areas during most years since 1963. The majority of the current survey station design and sampling protocols have been consistent since 1998.

Environmental data collection aboard the IPHC setline survey using water column profilers

PIs: Lauri Sadorus, Jay Walker

The IPHC collects oceanographic data using water column profilers during the IPHC fishery-independent setline survey. The profilers collect a suite of oceanographic data, including pressure (depth), conductivity (salinity), temperature, dissolved oxygen, pH, and fluorescence (chlorophyll concentration). The IPHC has operated profilers since 2000 on a limited basis, and coastwide since 2009.

IPHC aboard National Marine Fisheries Service groundfish trawl surveys in the Gulf of Alaska, Bering Sea, and Aleutian Islands

PI: Lauri Sadorus

The National Marine Fisheries Service (NMFS) has conducted annual bottom trawl surveys on the eastern Bering Sea continental shelf since 1979 and the IPHC has participated in the survey on an annual basis since 1998 by directly sampling Pacific halibut from survey catches. The IPHC has participated in the NMFS Aleutian Islands trawl survey, which takes place every two years, since 2012. Alternating year by year with the Aleutian Islands trawl survey is the NMFS Gulf of Alaska trawl survey, which IPHC has participated in since 1996. The IPHC uses the NMFS trawl surveys to collect information on Pacific halibut that are not yet vulnerable to the gear used for the IPHC fishery-independent setline survey or commercial fishery, and as an additional data source and verification tool for stock analysis. In addition, trawl survey information is useful as a forecasting tool for cohorts approaching recruitment into the commercial fishery.

Commercial fishery sampling program

IPHC Port Team – Lara Erikson, commercial fisheries manager

The IPHC positions field staff to sample the commercial catch for Pacific halibut in Alaska, British Columbia, Washington, and Oregon. Commercial catch sampling involves collecting Pacific halibut otoliths, tissue samples, fork lengths, weights, logbook information, and final landing weights.

The collected data are used in the stock assessment and other research and the collected otoliths provide age composition data and the tissue samples provide sex composition. Lengths and weight data, in combination with age data and sex data, provide size-at-age analyses by sex. Mean weights are combined with final landing weights to estimate catch in numbers. Logbook information provides weight per unit effort data, fishing location for the landed weight, and data for research projects. Finally, tags are collected to provide information on migration, exploitation rates, and natural mortality.

In addition to sampling the catch, other objectives include collecting recovered tags, and copying information from fishing logs along with the respective landed weights, for as many Pacific halibut trips as possible throughout the entire season.

2. Assessment

The 2017 Stock Assessment and 2018 Harvest Advice

Sources of mortality: In 2017, total removals were below the 100-year average, and have been stable near 42 million pounds (19,050 t) from 2014 to 2017. In 2017, 83% of the total removals from the stock were retained, compared to 80% in 2016.

Fishing intensity: The 2017 mortality from all sources corresponds to a point estimate of Spawning Potential Ratio (SPR) = 40% (there is a 75% chance that fishing intensity exceeded the IPHC's reference level of 46%). In order to reach the interim reference level, catch limits would need to be reduced for 2018. The Commission does not currently have a coastwide limit fishing intensity reference point.

Stock status (spawning biomass): Current female spawning biomass is estimated to be just above 200 million pounds (90,700 t), which corresponds to only a 6% chance of being below the IPHC threshold (trigger) reference point of $SB_{30\%}$, and less than a 1% chance of being below the IPHC limit reference point of $SB_{20\%}$. Therefore, no adjustment to the target fishing intensity is required, and the stock is not considered to be 'overfished.' Projections indicate that the target fishing intensity is likely to result in similar but declining biomass levels in the near future.

Stock distribution: Regional stock distribution has been stable within estimated credibility intervals over the last five years. Region 2 (IPHC Regulatory Areas 2A, 2B, and 2C) currently represents a greater proportion, and Region 3 (IPHC Regulatory Areas 3A and 3B) a lesser proportion, of the coastwide stock than observed in previous decades.

The complete reports of the 2017 stock assessment and 2018 harvest advice are available on the IPHC website at https://iphc.int/venues/details/94th-session-of-the-iphc-annual-meeting-am094 (please see papers IPHC-2018-AM094-08 through -11).

3. Management

The International Pacific Halibut Commission (IPHC) completed its 94th Annual Meeting (AM094) in Portland, Oregon, U.S.A., on 26 January 2018, with Dr. James Balsiger of the U.S.A. presiding as Chairperson. More than 200 Pacific halibut industry stakeholders attended the meeting, with over 100 more participating via the web. All of the Commission's public and administrative sessions during the meeting were open to the public and broadcast on the web. Documents and presentations from the Annual Meeting are available on the Annual Meeting page on the IPHC website: https://iphc.int/venues/details/94th-session-of-the-iphc-annual-meeting-am094.

Catch Limits

The IPHC did not agree on new Pacific halibut catch limits for 2018, and therefore the catch limits adopted by the IPHC in 2017 remain in place. Both Contracting Parties, Canada and the United States of America, indicated their intention to pursue more restrictive catch limits for 2018 via domestic regulatory processes, as allowed by the *Convention between Canada and the United States of America for the preservation of the* [Pacific] *halibut fishery of the Northern Pacific ocean and Bering sea*. Since then, both countries have implemented more restrictive catch limits for 2018.

Note that these catch limits are more restrictive than the catch limits published by the IPHC in the *Pacific Halibut Fishery Regulations (2018)* (https://iphc.int/uploads/pdf/regs/iphc-2018-regs.pdf).

On 23 March 2018, the United States of America, via NOAA-Fisheries, announced the adoption and implementation of the following 2018 catch limits for the commercial Pacific halibut fisheries in IPHC Regulatory Area 2A:

	Catch limit (pounds)	**Catch limit (metric tons)**
IPHC Regulatory Area 2A	**1,190,000**	**539.78**
Treaty Indian commercial	389,500	176.68
Non-treaty directed commercial (south of Pt. Chehalis)	201,845	91.56
Non-treaty incidental catch in salmon troll fishery	35,620	16.16
Non-treaty incidental catch in sablefish fishery (north of Pt. Chehalis)	50,000	22.68

More restrictive 2018 catch limits for non-commerical fisheries in IPHC Regulatory Area 2A – the Treaty Indian ceremonial and subsistence and recreational (sport) fisheries in Wasington, Oregon, and California – are specified in the final promulgation of the Pacific Fishery Management Council's Catch Sharing Plan for 2018.

On 13 February 2018, Canada, via Fisheries and Oceans Canada (DFO), announced the adoption and implementation of the following 2018 catch limits for Pacific halibut fisheries in IPHC Regulatory Area 2B:

	Catch limit (pounds)	Catch limit (metric tons)
IPHC Regulatory Area 2B	**6,223,985**	**2,823.18**
Commercial Total Allowable Catch	5,295,995	2402.25
Recreational Total Allowable Catch	927,990	420.93

On 19 March 2018, NOAA-Fisheries announced the adoption and implementation of the following 2018 catch limits for the Pacific halibut fisheries in IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B and 4CDE:

	Catch limit (pounds)	Catch limit (metric tons)
IPHC Regulatory Area 2C	**4,450,000[1]**	**2,018.51[1]**
Commercial (IFQ)	3,570,000	1,619.32
Charter sport	810,000	367.41
IPHC Regulatory Area 3A	**9,450,000[1]**	**4,286.49[1]**
Commercial (IFQ)	7,350,000	3,333.91
Charter sport	1,790,000	811.94
IPHC Regulatory Area 3B	**2,620,000**	**1,188.41**
IPHC Regulatory Area 4A	**1,370,000**	**621.42**
IPHC Regulatory Area 4B	**1,050,000**	**476.27**
IPHC Regulatory Area 4CDE	**1,580,000**	**716.68**
IPHC Regulatory Area 4C	733,500	332.71
IPHC Regulatory Area 4D	733,500	332.71
IPHC Regulatory Area 4E	113,000	51.26

[1] In accordance with the catch sharing plan in place for this IPHC Regulatory Area, this overall total includes estimates for discard mortality.

NOAA-Fisheries also announced the following 2018 management measures for the charter recreational fisheries in IPHC Regulatory Areas 2C and 3A, based on the revised 2018 catch limits:

- In IPHC Regulatory Area 2C: a one-fish daily bag limit, with a reverse slot limit that allows retention of Pacific halibut less than 38 inches or greater than 80 inches, and no annual limit.
- In IPHC Regulatory Area 3A: a two-fish daily bag limit, a maximum size limit of less than or equal to 28 inches on one of those Pacific halibut, and a four-fish

annual limit. In addition, Wednesdays will be closed to charter fishing in IPHC Regulatory Area 3A all season, along with six Tuesday (July 10, July 17, July 24, July 31, August 7, and August 14) closures in the summer. Vessels and charter permit holders will continue to be limited to one trip per day.

Fishing Periods (Season dates)

The Commission approved a season of 24 March to 7 November 2018, for the U.S. and Canadian quota fisheries. Seasons will commence at noon local time on 24 March and terminate at noon local time on 7 November 2018 for the following fisheries and IPHC Regulatory Areas: the Canadian Individual Vessel Quota (IVQ) fishery in IPHC Regulatory Area 2B, and the United States IFQ and CDQ fisheries in IPHC Regulatory Areas 2C, 3A, 3B, 4A, 4B, 4C, 4D, and 4E. All IPHC Regulatory Area 2A commercial fishing, including the treaty Indian commercial fishery, will take place between 24 March and 7 November 2018. The Saturday opening date was chosen to facilitate marketing.

In IPHC Regulatory Area 2A, seven 10-hour fishing periods for the non-treaty directed commercial fishery south of Point Chehalis, Washington, are recommended: 27 June, 11 July, 25 July, 8 August, 22 August, 5 September, and 19 September 2018. All fishing periods will begin at 8 a.m. and end at 6 p.m. local time, and will be further restricted by fishing period limits announced at a later date.

IPHC Regulatory Area 2A fishing dates for incidental commercial Pacific halibut fisheries concurrent with the limited-entry sablefish fishery north of Point Chehalis and the salmon troll fishing seasons will be established under U.S. domestic regulations by the National Marine Fisheries Service (NMFS). The remainder of the IPHC Regulatory Area 2A CSP, including sport fishing seasons and depth restrictions, will be determined under regulations promulgated by NMFS. Further information regarding the depth restrictions in the commercial directed Pacific halibut fishery, and details for the sport fisheries, is available at the NMFS hotline (1-800-662-9825). The IPHC Regulatory Area 2A IPHC licensing procedures did not change.

Regulatory Changes

The IPHC adopted a number of regulatory changes to update and clarify existing regulations, including:

- A change to allow the use of leased IFQ by CDQ organizations in IPHC Regulatory Areas 4B, 4C, 4D and 4E
- A change to allow the use of pot gear for directed Pacific halibut fishing in areas where such gear is allowed by Contracting Party domestic regulations.
- Clarifications to the regulations for landing catch with the head on, reflecting the experience gained since this regulation was first adopted in 2017.

A complete summary of the regulatory actions taken by the IPHC for 2018 can be found in the report of the 94th Annual Meeting, posted on the IPHC website.

Other Actions

Harvest Policy Analysis

The IPHC provided direction to the Management Strategy Advisory Board (MSAB) for further work on harvest strategy policy development, including consideration of both scale – the level of removals from the stock – and distribution – how the catch is distributed across the range of the stock. *Expanded Survey*

The IPHC approved the next in a series of expansions to its annual fishery-independent setline survey. The purpose of the expansion series is to provide more accurate and precise estimates among IPHC Regulatory Areas and to encompass all depths over which the stock is distributed. In 2018, the setline survey in IPHC Regulatory Areas 2A, 2B, and 2C will be expanded beyond the standard grid of setline survey stations fished each year.

Meeting Report

The Report of the 94th Session of the IPHC Annual Meeting (AM094) has been published and posted at the Annual Meeting page of the IPHC website: https://iphc.int/uploads/pdf/am/2018am/iphc-2018-am094-r.pdf . The Report includes details on all the decisions, recommendations, and requests made by the Commission during the Annual Meeting.

V. Ecosystem Studies

[See the description of "Environmental data collection aboard the IPHC setline survey using water column profilers" in the Research section on ongoing IPHC data collection projects above.]

VI. Publications

International Pacific Halibut Commission. 2017. Report of Assessment and Research Activities 2017. https://www.iphc.int/uploads/pdf/am/2018am/iphc-2017-rara27-r.pdf