INTERNATIONAL PACIFIC HALIBUT COMMISSION

2027-31 FISS design evaluation

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PURPOSE

To present the Scientific Review Board with potential FISS designs for 2027-31, including a preliminary cost evaluation of the 2027 Base Block design.

BACKGROUND

The IPHC's Fishery-Independent Setline Survey (FISS) provides data used to compute indices of Pacific halibut density for use in monitoring stock trends, estimating stock distribution, and as an important input in the stock assessment. Stock distribution estimates are based on the annual mean weight per unit effort (WPUE) for each IPHC Regulatory Area, computed as the average of WPUE of all Pacific halibut and for O32 (greater than or equal to 32" or 81.3cm in length) Pacific halibut estimated at each station in an area. Mean numbers per unit effort (NPUE) is used to index the trend in Pacific halibut density for use in the stock assessment models. Annual FISS designs are developed by selecting a subset of stations for sampling from the full 1890-station FISS footprint (Figure 1).

In recent years, financial constraints due to reduced catch rates and the combined impact of factors affecting revenue and costs (FISS accounting changes, Pacific halibut sales prices, charter vessel and bait costs) have resulted in the implementation of FISS designs with reduced spatial footprints (Figure 2). Effort has been concentrated in IPHC Regulatory Areas 2B, 2C, 3A and 3B (the core of the stock), with limited sampling in other areas in most years (Figure 3).

The **Base Block design** was presented to the Commission at the September 2024 Work Meeting and the 14th Special Session of the IPHC (SS014, IPHC-2024-SS014-03) as a more efficient approach to annual sampling in the core of the stock compared to previous designs based on random selection of FISS stations. The Commission has noted that "the use of the Base Block Design will be the focus of future planning and annual FISS proposals from the Secretariat" (e.g., IPHC-2026-AM102-R, para. 72). The Base Block design ensures that all charter regions in the core areas are sampled over a three-year period, while prioritizing coverage in other areas based on minimizing the potential for bias and maintaining CVs below 25% for each IPHC Regulatory Area. The Base Block design also includes some sampling in all IPHC Biological Regions in each year, ensuring that trend and biological data from across the spatial range of Pacific halibut are available to the stock assessment and for stock distribution estimation.

Since 2016, spatio-temporal (geostatistical) modelling has been used to estimate time series of WPUE and NPUE, and to estimate the stock distribution of Pacific halibut among IPHC Regulatory Areas and Biological Regions (Webster et al. 2020). The IPHC space-time models are fitted through the R-INLA package using R (R Core Team, 2024).

FISS history 1993-2019

The IPHC has undertaken FISS activity since the 1960s. However, methods were not standardized to a degree (e.g., the bait and gear used) that allows for simple combined analyses until 1993. From 1993 to 1997, the annual design featured fishing triangular clusters of stations, with clusters located on a grid (IPHC 2012). Coverage was limited in most years and was generally restricted to IPHC Regulatory Areas 2B through 3B. The modern FISS design, based on a grid with 10 nmi (18.5 km) spacing, was introduced in 1998, and over the subsequent two years was expanded to include annual coverage in parts of all IPHC Regulatory Areas within the depth ranges of 20-275 fathoms (37-503 m) in the Gulf of Alaska and Aleutian Islands, and 75-275 fathoms (137-503 m) in the Bering Sea (IPHC 2012). Annually-fished stations were added around islands in the Bering Sea in 2006, and in the same year, a less dense grid of paired stations was fished in shallower waters of the southeastern Bering Sea, providing data for a calibration with data from the annual National Marine Fishery Service (NMFS) bottom trawl survey (Webster et al. 2020).

Through examination of commercial logbook data and information from other sources, it became clear by 2010 that the historical FISS design had gaps in coverage of Pacific halibut habitat that had the potential to lead to bias in estimates derived from its data. These gaps included deep and shallow waters outside the FISS depth range (0-20 fathoms and 275-400 fathoms), and unsurveyed stations on the 10 nmi grid within the 20-275 fathom depth range within each IPHC Regulatory Area. This led the IPHC Secretariat to propose expanding the FISS to provide coverage of the unsurveyed habitat in United States and Canadian waters. In 2011 a pilot expansion was undertaken in IPHC Regulatory Area 2A, with stations on the 10 nmi grid added to deep (275-400 fathoms) and shallow (10-20 fathoms) waters, the Salish Sea, and other, smaller gaps in coverage. The 10-fathom limit in shallow waters was due to logistical difficulties in standardized fishing of longline gear in shallower waters. The 400-fathom maximum depth is understood to cover almost all Pacific halibut summer habitat. A second expansion in IPHC Regulatory Area 2A was completed in 2013, with a pilot survey in California waters between the latitudes of 40 and 42°N.

The full expansion program began in 2014 and continued through 2019, sampling the entire FISS design of 1890 stations in the shortest time logistically possible, as well as replicating the 2006 calibration with the Bering Sea trawl survey. The FISS expansion program allowed us to build a consistent and complete picture of Pacific halibut density throughout its range in Convention waters. Sampling the full FISS design has reduced bias, and, in conjunction with space-time modelling of survey data (see below), has improved precision and fully quantified the uncertainty associated with estimates based on partial annual sampling of the species range. It has also provided us with a complete set of observations over the full FISS design (Figure 1) from which an optimal subset of stations can be selected when devising annual FISS designs. This station selection process began in 2019 for the 2020 FISS and continues with the current review of design proposals for 2027-29. Note that in the Bering Sea, the full FISS design does not provide complete spatial coverage, and FISS data are augmented with calibrated data from National Marine Fisheries Service (NMFS) and Alaska Department of Fish and Game (ADFG) trawl surveys (stations can vary by year – 2019 designs are shown in Figure 1). Both supplementary surveys have been conducted approximately annually in recent years.

Rationalized FISS, 2020-26

Following the 2011-2019 program of FISS expansions, rationalized FISS designs were approved for 2020 based on random selection of over 50% of stations in the core of the stock (IPHC Regulatory Areas 2B, 2C, 3A and 3B) and sampling of all stations in selected subareas of the remaining IPHC Regulatory Areas. For the latter areas, sampling priorities were determined based on maintaining precise estimates of area-specific indices of density and ensuring low bias in index estimators. That year, the COVID19 pandemic led to a reduced FISS with sampling only in the core areas. The 2021-22 FISS sampling proceeded largely as designed, although planned stations in western IPHC Regulatory 4B in 2022 were unsampled due to a lack of viable charter bids. In some charter regions in the core areas, 100% of stations were sampled in order to achieve revenue goals.

Four years of spatially-reduced designs followed the 2022 FISS:

2023 (IPHC-2023-AM099-R)

- Little sampling outside of the core areas due to large projected revenue losses from designs that included extensive sampling in IPHC Regulatory Areas 2A, 4A, 4B and 4CDE
- Limited sampling in northern IPHC Regulatory 2A
- Planned stations around the IPHC Regulatory Area 4A/4B boundary not sampled due to a lack of charter bids

2024 (IPHC-2024-AM100-R)

- High sampling rates in IPHC Regulatory Areas 2B and 2C
- A small number of charter regions in IPHC Regulatory Areas 3A and 3B
- Sampling of the southern shelf edge and Bering Sea islands in IPHC Regulatory Area 4CDE

2025 (Figure 2, IPHC-2025-AM101-R)

- Charter regions in IPHC Regulatory Areas 3A and 3B selected to complement coverage in recent years
- Sampled stations in IPHC Regulatory Areas 2A, 4A and 4B that had not been sampled for three or more years

2026 (Figure 4)

- Increases spatial coverage relative to 2023-25
- Complements the 2025 design by including ten charter regions not sampled last year

FISS DESIGN OBJECTIVES (Table 1)

Primary objective: *To sample Pacific halibut for stock assessment and stock distribution estimation.*

The primary purpose of the annual FISS is to sample Pacific halibut to provide data for the stock assessment (abundance indices, biological data) and estimates of stock distribution for use in management. The priority of the current rationalized FISS is therefore to maintain or enhance data quality (precision and bias) by establishing baseline sampling requirements in terms of station count, station distribution and skates per station.

Secondary objective: *Cost effectiveness.*

The FISS is intended to be cost-effective without compromising the scientific integrity of the design. Any implemented design must consider logistics and cost together with scientific integrity.

Tertiary objective: *Minimise removals and assist others where feasible on a cost-recovery basis.*

Consideration is also given to the total expected FISS removals (impact on the stock), data collection assistance for other agencies, and emerging IPHC informational needs.

Table 1. Prioritized FISS objectives and corresponding design layers.

Priority	Objective	Design Layer
Primary	Sample Pacific halibut for stock assessment and stock distribution estimation	Minimum sampling requirements in terms of: • Station distribution • Station count • Skates per station
Secondary	Cost effectiveness without compromising the scientific integrity of the FISS design.	Balance operational feasibility/logistics, cost/revenue, and scientific needs. Includes an aspirational target reserve of US$2,000,000
Tertiary	Minimise removals, assist others where feasible on a cost-recovery basis, address specific Commission informational needs.	Removals: minimise impact on the stock while meeting primary priority Assist: assist others to collect data on a cost-recovery basis IPHC policies: ad-hoc decisions of the Commission regarding the FISS design

Annual design review, endorsement, and finalisation process

Since the completion of the FISS expansions in 2019, a review process has evolved for annual FISS designs created according to the above objectives:

- Step 1: The Secretariat presents preliminary design options based on the primary objective (Table 1) to the SRB for three subsequent years at the June meeting, based on analysis of prior years' data. Commencing in 2024, this has included preliminary cost projections based on prior year fiscal details (revenue) and current year vessel contract cost updates;

- Step 2: Updated design options for the following year that account for both primary and secondary objectives (Table 1) are reviewed by the Commission at the September work meeting, recognising that revenue and cost data from the current year's FISS are still preliminary at this time;
- Step 3: At their September meeting, the SRB reviews design options accounting for both primary and secondary objectives (Table 1) for comment and advice to the Commission (recommendation). FISS revenue and cost information from the current year is near-final at this time;
- Step 4: Designs are further modified to account for updates based on secondary and tertiary objectives before being finalized during the Interim and Annual meetings and the period prior to implementation:
    - Presentation of FISS designs for 'endorsement' by the Commission occurs at the annual Interim Meeting;
    - Ad-hoc modifications to the design for the current year (due to unforeseen issues arising) are possible at the IPHC Annual Meeting;
    - The endorsed design for the current year is then modified (if necessary) to account for any additional tertiary objectives or revisions to inputs into the evaluation of secondary objectives prior (i.e., updated cost estimates) and logistical considerations raised by the operators of contracted vessels prior to summer implementation (February-April).

Consultation with industry and stakeholders occurs throughout the FISS planning process, at the Research Advisory Board meeting (late November), and particularly in finalizing design details as part of the FISS charter bid process, when stations can be added and other adjustments made to provide for improved logistical efficiency. We also note the opportunities for direct stakeholder input during public meetings (Interim and Annual Meetings).

Although the review process examines designs for the next three years, revisions to designs for the second and third years are expected during subsequent review periods as additional data are collected. Having design proposals available for three years assists the Secretariat with medium-term planning of the FISS, and allows reviewers (SRB, Commission) and stakeholders to see more clearly the planning process for sampling the entire FISS footprint over multiple years.

POTENTIAL DESIGNS FOR 2027-31

BASE BLOCK DESIGN

At AM102, Secretariat staff presented the Base Block design for 2026 and subsequent years based a rotational block design (IPHC-2025-AM102-13). This design implements sampling of complete FISS charter regions (subsets of stations generally sampled by a single vessel via multiple trips) in each area rather than randomly selected stations as was previously done in the core of the stock. Sampled charter regions are rotated over two or three years depending on area. Block designs are potentially more efficient from an operational perspective than a randomized design as they involve less running time between stations, leading to cost reductions on a per station basis. The proposed Base Block designs for 2027-31 are shown in Figures 5 to 9.

Using posterior samples generated from the fitted 2025 space-time models as simulated data for 2026-29, we projected the coefficient of variation (CV, a relative measure of precision) for mean O32 WPUE for each year of the design by area. As CVs are generally greater in the terminal year of the time series and that year is usually the most relevant for informing management, the CV values in Table 2 are for the final year of the modelled time series. For example, the CVs for 2027 were projected by fitting the model to the data for 1993-2027, with simulated data used for 2026-27.

Table 2. Projected coefficients of variation (CVs, %) of mean O32 WPUE for the 2026 design and the potential 2027-29 Base Block designs by terminal year of time series and IPHC Regulatory Area and Biological Region.

Regulatory Area	2026	2027	2028	2029
2A	27	26	16	22
2B	6	5	10	7
2C	5	6	6	6
3A	11	8	7	7
3B	17	14	12	9
4A	19	24	12	19
4B	17	16	17	14
4CDE	9	9	9	8
Biological Region				
Region 2	4	5	5	4
Region 3	9	7	6	6
Region 4	9	11	7	9
Region 4B	17	16	17	14
Coastwide	5	4	4	4

Projected terminal year CVs for the Base Block design (2027-29) are 25% or less for all IPHC Regulatory Areas except 2A, which has a 26% projected CV in 2027. In the core areas (2B, 2C, 3A and 3B), CVs are projected to be 15% or less (Table 2) following this year's FISS. All Biological Region CVs, except that of Region 4B, are at most 11%, while the coastwide CV is projected to be 4% for the 2027-29 Base Block designs. Thus, the Base Block design is expected to maintain precise estimates of indices of Pacific halibut density and abundance across the range of the stock. At the same time, the rotating nature of the sampled blocks means that almost all FISS stations will be sampled within a 5-year period (2-3 years within the core areas) resulting in low risk of missing important stock changes and therefore a low risk of large bias in estimates of trend and stock distribution. By 2030, we expect to no longer have any significant biases that resulted from unmonitored stock changes in regions that were unsampled for several years.

PRELIMINARY COST PROJECTIONS FOR 2027

The 2027 Base Block design is projected to result in an operating loss close to US$1 million (Table 3). Preliminary cost and revenue projections for the Base Block design are based on the following assumptions:

1. Designs are optimised for numbers of skates, with sets of 4, 6 or 8 100-hook skates used, depending on projected catch rates and bait costs.
2. Pacific halibut sales price is unchanged from 2025 values, ranging from approximately $6 to $10/lb (coastwide average US$8.18/lb), depending on FISS charter region.
3. Pacific halibut landings remain unchanged from 2025 values.
4. The price of chum salmon bait remains at the 2026 price of US$2.40/lb.

Table 3. Preliminary projected costs and revenue for the 2027 Base Block ($US). (Totals may not equal the sum of individual rows due to rounding.)

Design		**2027 Base Block design**
Income	**Pacific halibut sales**	2,976,000
	Byproduct sales	96,000
	Total	**3,072,000**
Expenses	**Base HQ (staff salary and wages, and benefits x 4)**	(534,000)
	Vessel contracts	(1,496,000)
	Field staff (salary and wages, and benefits)	(615,000)
	Bait	(483,000)
	Non-IPHC fish sales	(346,000)
	Other expenses*	(614,000)
	Total	**(4,089,000)**
Net revenue		**($1,017,000)**

*Other costs include staff training, personnel expenses, mailing and shipping, travel, technology, gear replacement, customs fees, bait storage fees, field supplies and equipment, equipment maintenance fees, facility rental fees, and communication fees.

Note: Cost estimates are largely based on information from the 2025 FISS and outcomes of the 2026 charter bidding process, and it is important to note there is uncertainty in the catch and cost projections for 2027 and that this uncertainty increases over time. Projected income and expenses for the 2027 design will be updated once FY2026 has been reconciled (expected late October 2026) and will be used to refine the projections provided in this Briefing Note at that time.

DISCUSSION

The **Base Block** design has a projected net loss of around $1,017,000 for 2027 and therefore will rely on supplementary funding for implementation. Projected deficits for the Base Block design for 2025 and 2026 led to the adoption of reduced designs, although with reductions in spatial coverage mitigated by supplementary funding from the USA and Canada. For 2027, the Secretariat staff is working with Commissioners to secure the necessary funding to implement the full Base Block design.

RECOMMENDATION

That the Scientific Review Board **NOTE** paper IPHC-2026-SRB028-09, which presents potential Base Block designs for 2027-31, including a preliminary projection of revenue and expenses for the 2027 design.

References

IPHC (2023). Report of the 99th Session of the IPHC Annual Meeting (AM099) IPHC-2023-AM099-R. 62 p.

IPHC (2024). Report of the 100th Session of the IPHC Annual Meeting (AM100) IPHC-2024-AM100-R. 55 p.

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IPHC (2026). Report of the 102nd Session of the IPHC Annual Meeting (AM102) IPHC-2026-AM102-R. 54 p.

R Core Team (2024) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Webster, R. A., Soderlund, E, Dykstra, C. L., and Stewart, I. J. (2020). Monitoring change in a dynamic environment: spatio-temporal modelling of calibrated data from different types of fisheries surveys of Pacific halibut. Can. J. Fish. Aquat. Sci. 77(8): 1421-1432.

Webster, R., Stewart, I., Ualesi, K., Jack, T. and Wilson, D. (2024). 2025 and 2026-29 FISS designs. IPHC-2024-SS014-03. 21 p.

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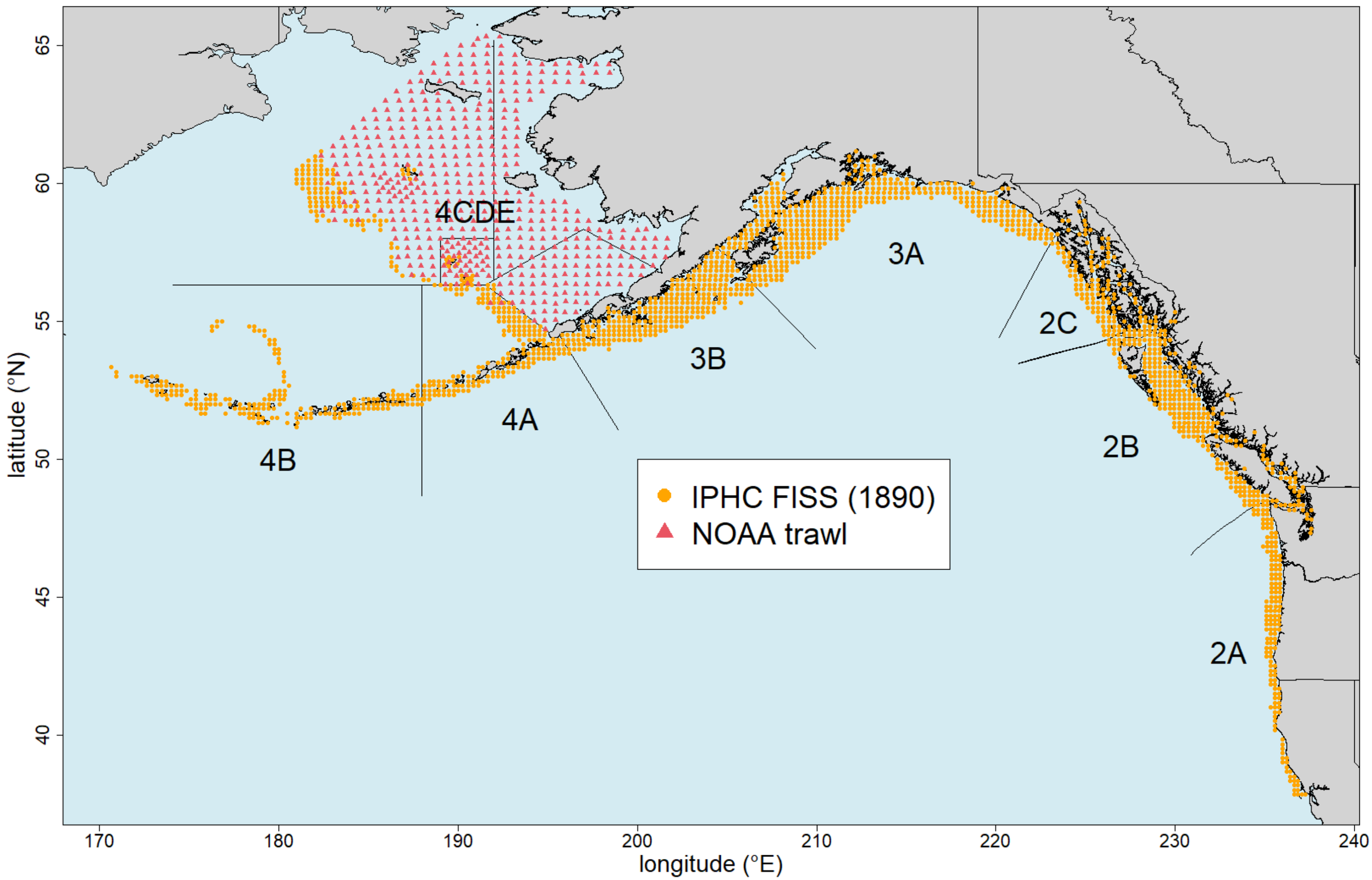

Figure 1. Map of the full 1890 station FISS design, with orange circles representing stations available for inclusion in annual sampling designs. Red triangles represent standard locations of NOAA trawl stations used to provide complementary data for Bering Sea modelling (actual NOAA trawl design can vary year-to-year).

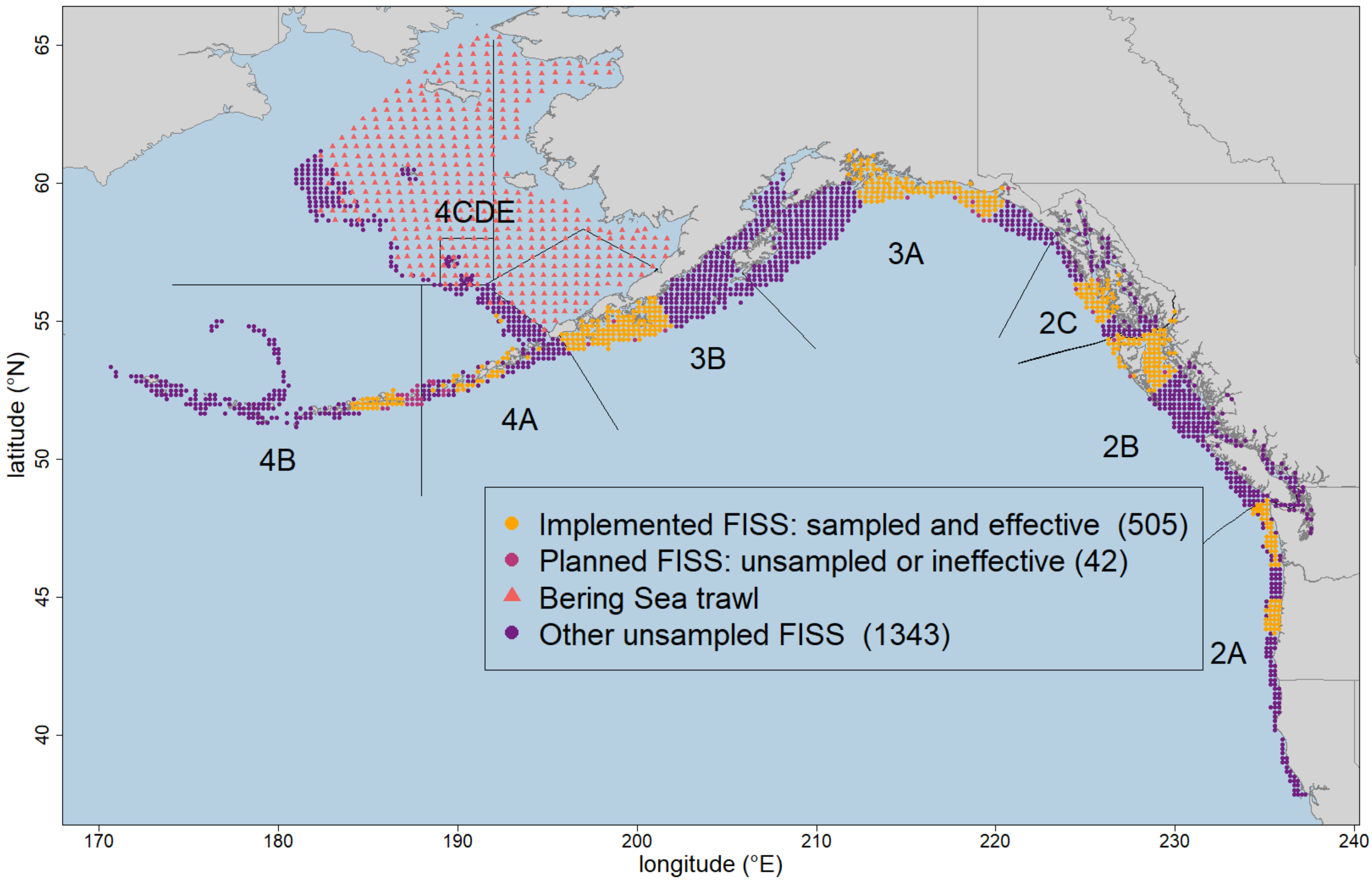

Figure 2. Map of implemented 2025 sampled FISS design showing sampled stations with data used in modelling (orange circles for FISS, red triangles for trawl), along with planned but ineffective FISS stations, FISS grid stations fished off grid as vessel captain stations and other unsampled FISS stations.

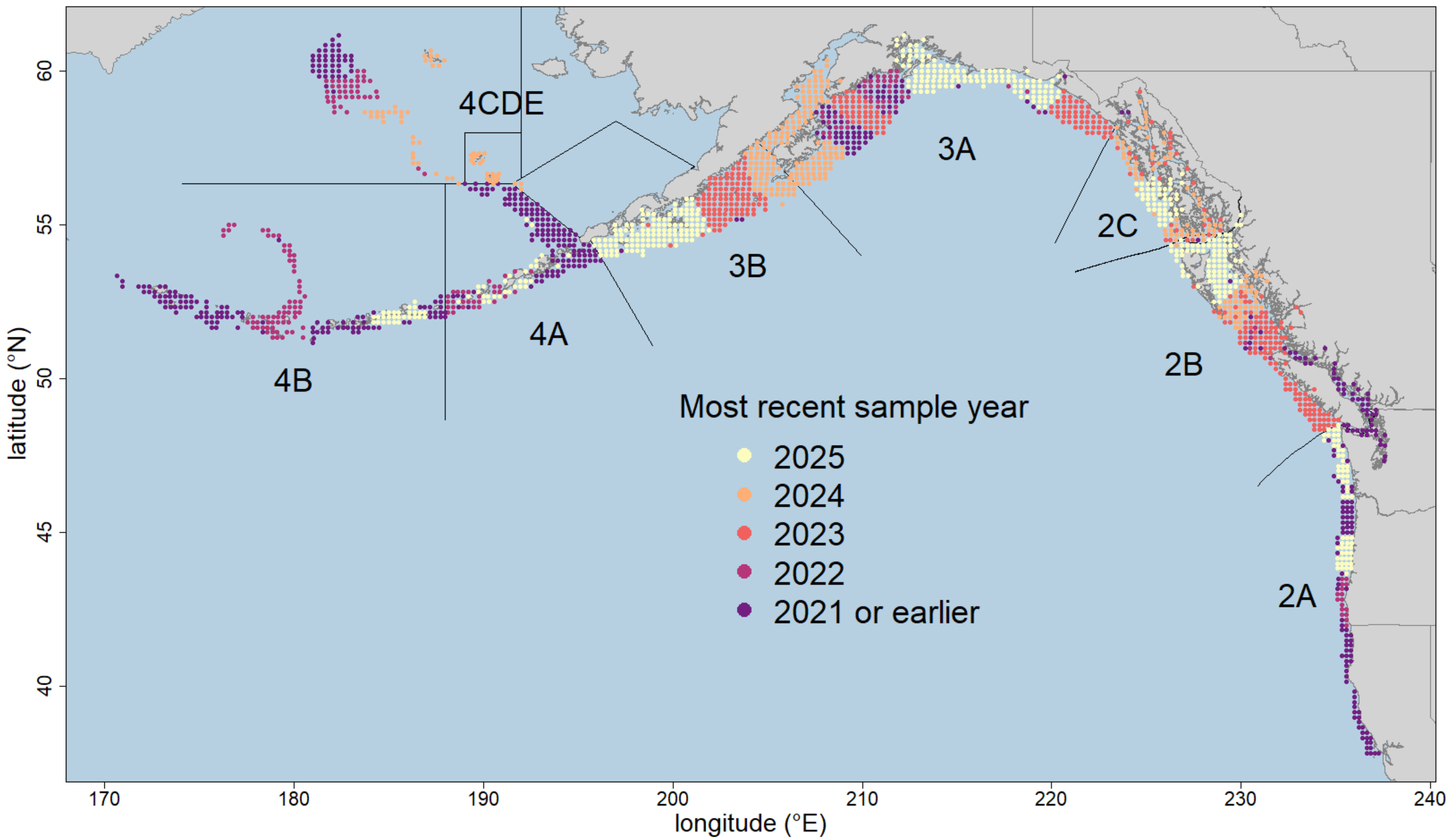

Figure 3. Map showing the most year that each station on the full FISS grid was successfully sampled.

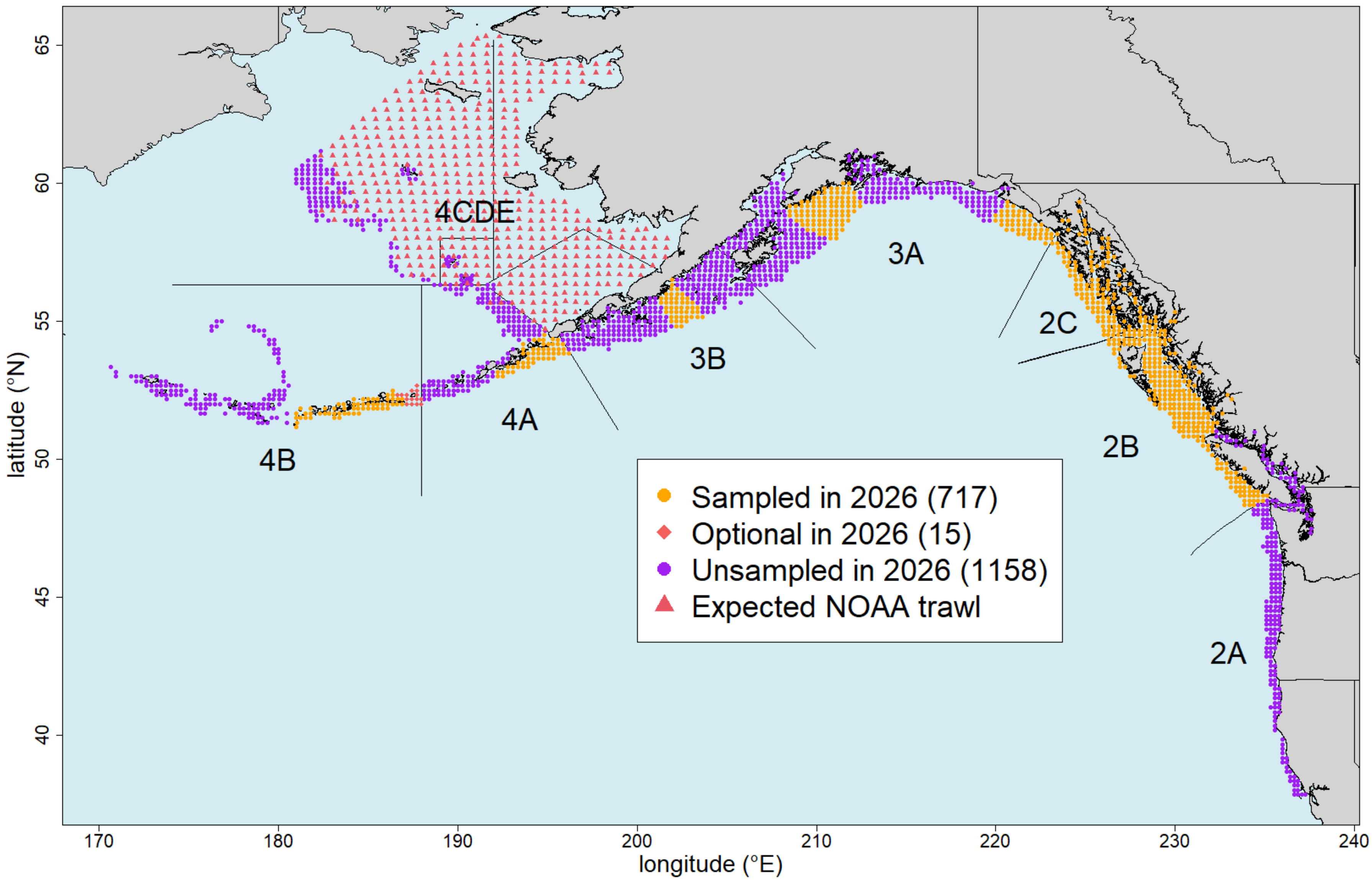

Figure 4. Adopted 2026 FISS design, with planned FISS stations shown as orange circles.

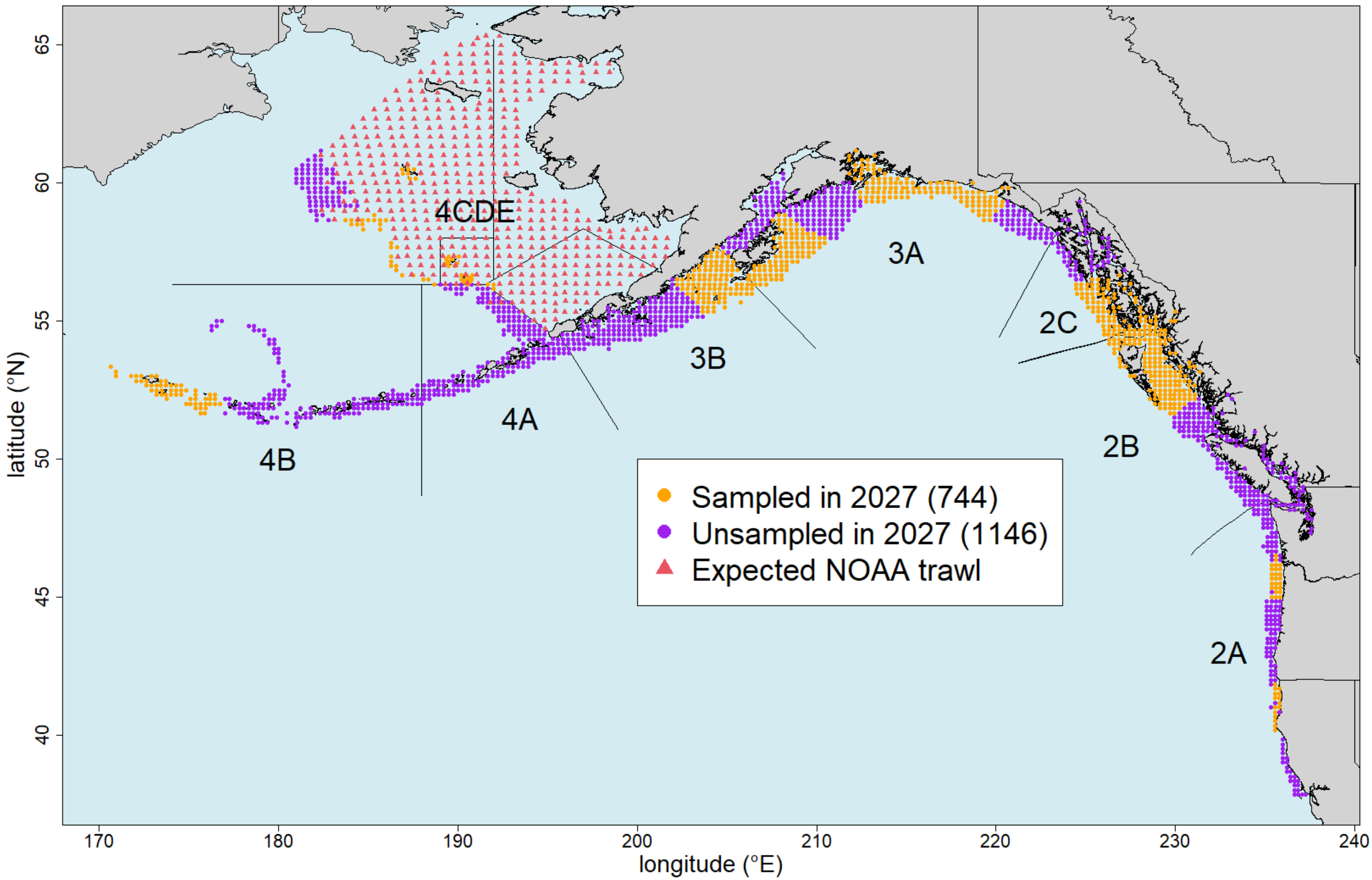

Figure 5. Base Block design for 2027 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

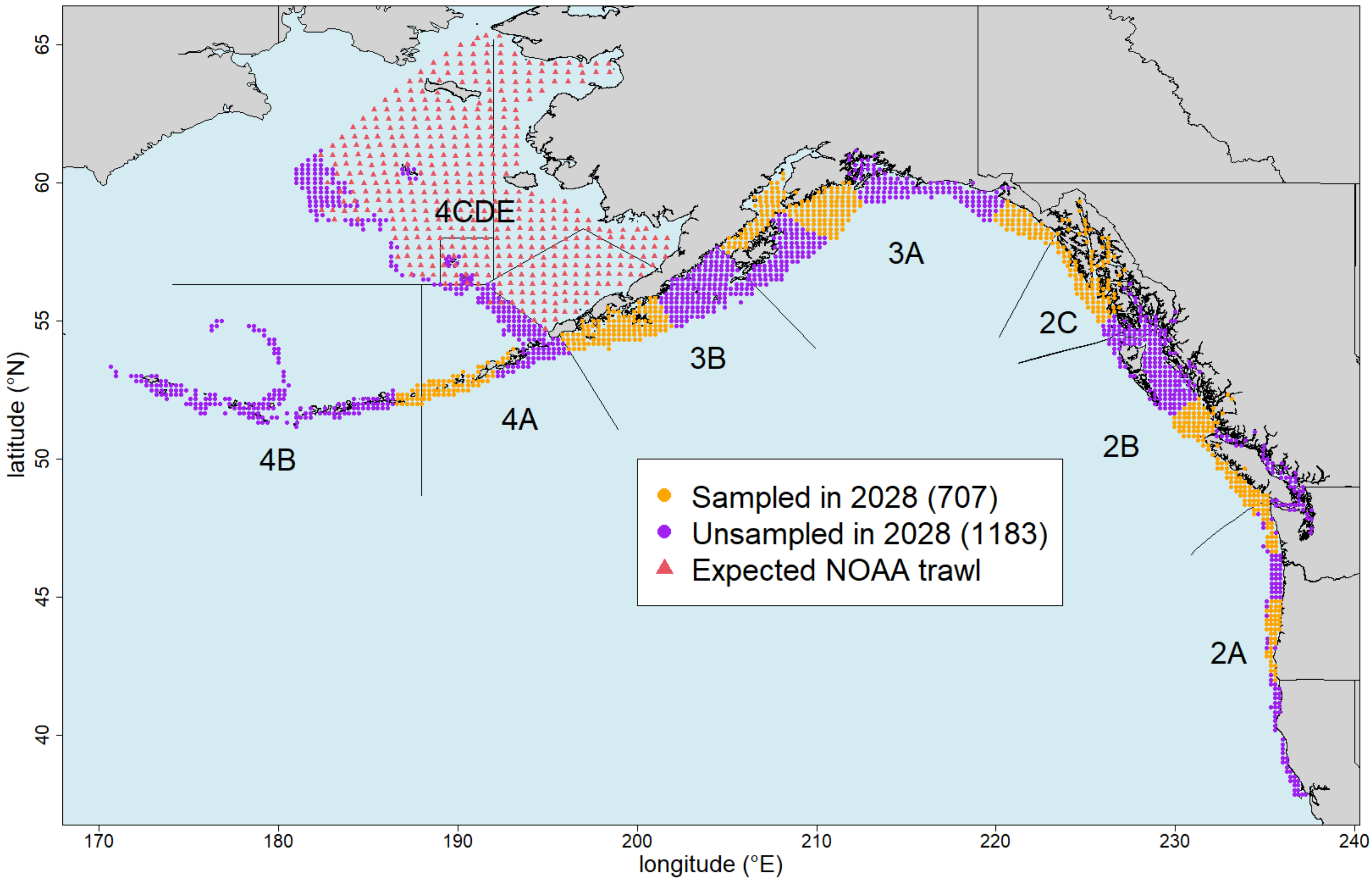

Figure 6. Base Block design for 2028 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

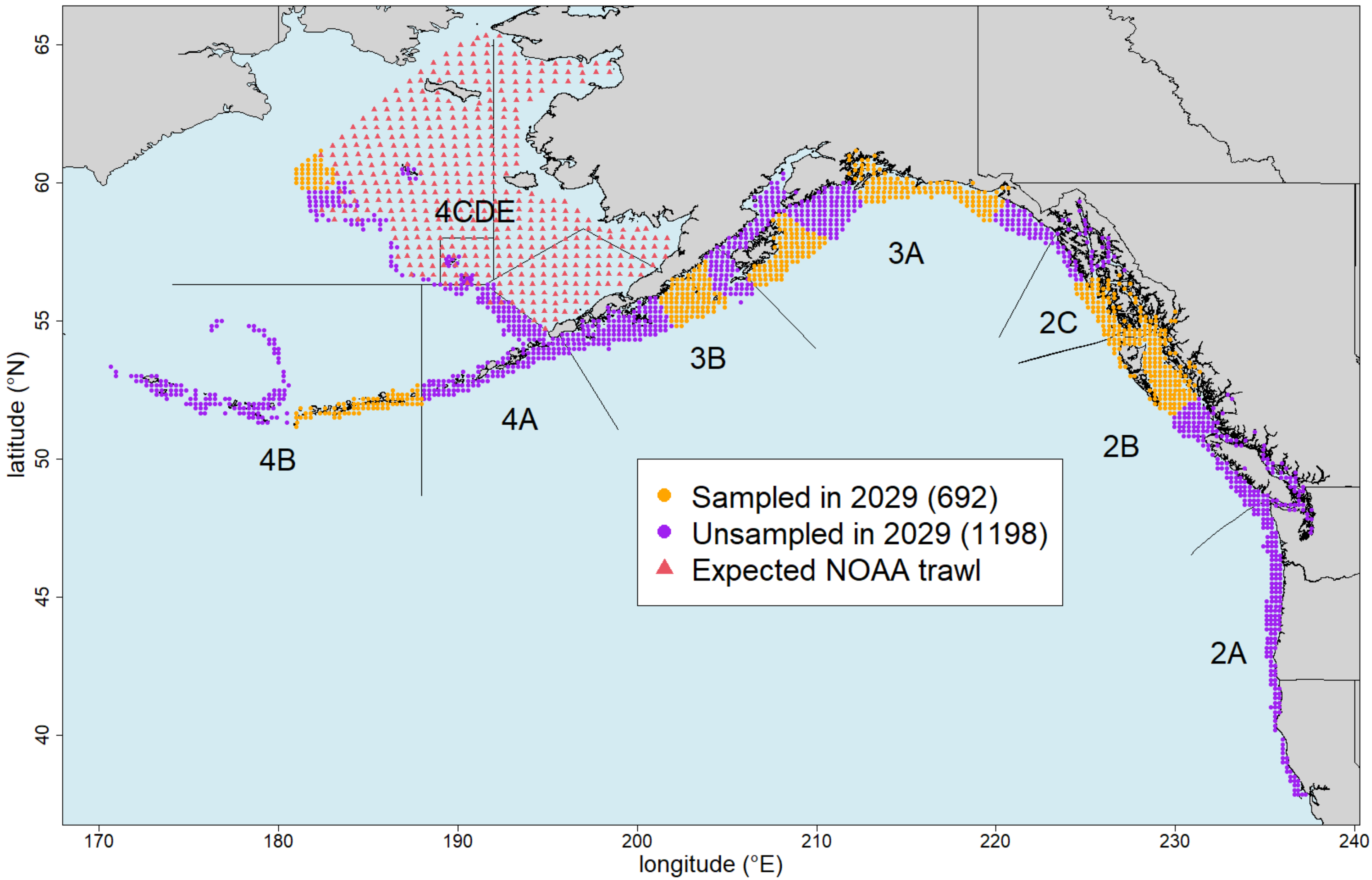

Figure 7. Base Block design for 2029 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

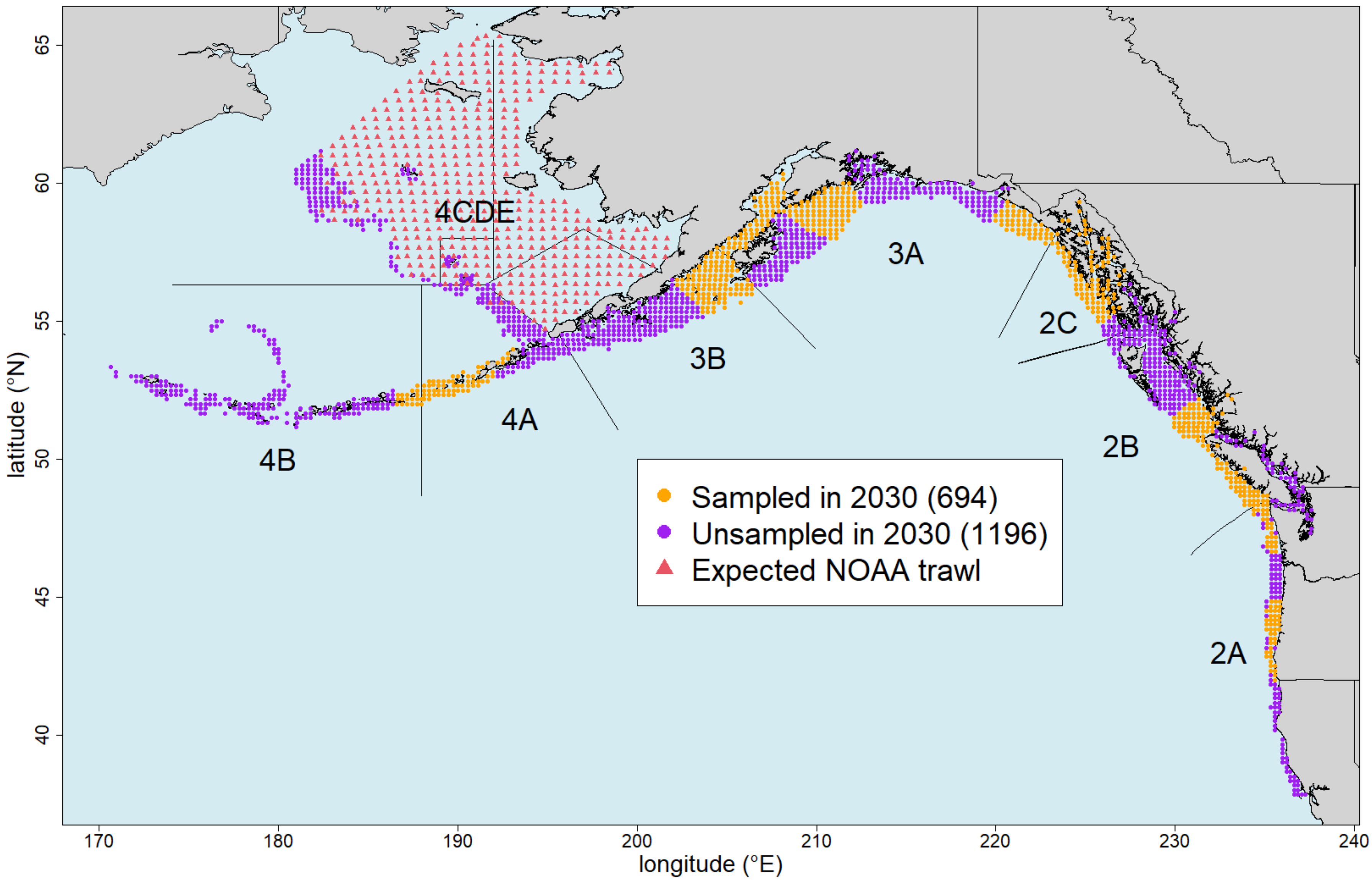

Figure 8. Base Block design for 2030 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.

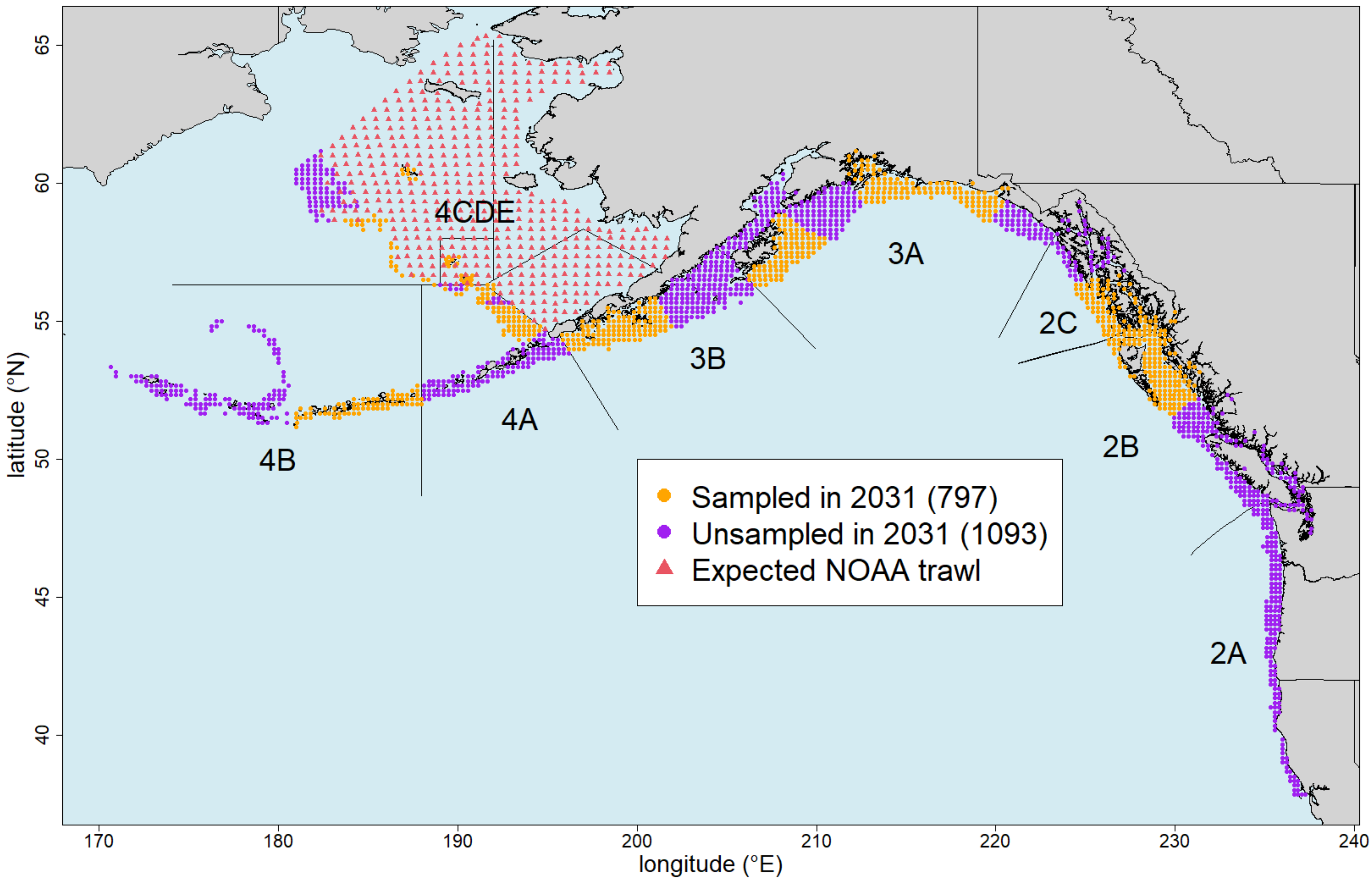

Figure 9. Base Block design for 2031 (orange circles). Design is based on fishing 2-4 complete blocks of stations (charter regions) in the core areas (2B, 2C, 3A and 3B) and previously implemented subareas elsewhere.