**R/V Hokko-Maru CRUISE REPORT**

**U2022-001**

**July 13-August 4, 2022**

**(Kushiro-Kushiro)**

Report of the Summer 2022 Japanese Salmon Research Cruise of the R/V *Hokko maru*

**1. Cruise dates:**

13 July 2022-4 August 2022 (Kushiro-Kushiro)

**2. Chief Scientist in charge of the project:**

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**4. Research vessel:**

Name: Hokko Maru

Flag state: Japan

Owner: Japan Fisheries Research and Education Agency

Operator: Japan Fisheries Research and Education Agency

Overall length (meters): 64.73 m

Maximum draught (meters): 4.5 m

Gross tonnage: 1,246 tons

**5. Area of Operations:**

All monitoring stations and actual cruise track of U2022-001 are shown in Fig. 1.



**Fig. 1.** Research area. Monitoring started at St.H22 and ended at St.H12.

**6. Research results:**

6-1. Nature and Objectives of the Project

Japanese research vessels have monitored the condition of Pacific salmon (*Oncorhynchus* spp.) stocks since 1952 (Ishida and Ogura, 1992). The current R/V *Hokko maru* (1,246 gross tons) was launched in 2004 and the 2022 expedition was her fifteenth salmon research cruise in the North Pacific (see Honda *et al*., 2023). The main objective for this cruise was to conduct the annual monitoring survey for Japanese chum salmon (*O. keta*) stocks in the Bering Sea. The annual monitoring survey includes the collection of data on physical oceanography, trophic interactions among zooplankton, salmonids, and organisms at higher trophic levels, and genetic analysis of stock composition of chum salmon.

6-2. Survey Period and Survey Area

The R/V *Hokko maru* departed from Kushiro, northern Japan on 13 July 2022 and returned to Kushiro on 4 August 2022. A total of 19 surface trawls were conducted at 17 stations during the cruise (Fig. 1 and Table 1). All monitoring stations were in the central Bering Sea.

6-3. Temperature and Salinity Sampling

A conductivity, temperature, and depth sensor (memory CTD, ASTD151, manufactured by JFE Advantech Co. Ltd., Nishinomiya, Japan) was used at each monitoring station before the trawl. The CTD recorded data at 1-m intervals from the surface to a maximum of approximately 500 m. Surface seawater was sampled using a bucket to measure sea surface temperature and sea surface salinity at each monitoring station.

6-4. Zooplankton and Micronekton Sampling

Macro-zooplankton were sampled with a remodeled NORPAC net (2 rings, 0.45 m ring diameter, 1.93 m net length, and 0.33 mm mesh size) at each monitoring station. The NORPAC net was towed vertically from a maximum of 150 m to the surface. Large macro-zooplankton were collected at eight stations (Fig. 1) using a BONGO net (2 rings, 0.7 m diameter, 4.1 m overall length, 0.335 mm mesh size). An hour after sunset, the net was towed obliquely along the stern of the vessel from 100 m to the surface at a speed of approximately 1.5 knots.

6-5. Fish Collection

A surface trawl was used for fishing operations to collect salmonids and other pelagic fishes at each monitoring station (Fig. 1 and Table 1). The trawl net was towed at a speed of approximately 5 knots in the surface layer for one hour in daytime, spanning 0 m to approximately 35 m depth. The length of trawl net was 152 m. The cod end of the trawl net was lined with a knotless net of 60.0 mm mesh size.

Additionally, hook-and-line fishing was conducted mainly in the twilight during the survey period for conventional and archival tagging to salmon species.

6-6. Preliminary Results

A total of 3,608 salmonid fish (2,426 kg) were caught by surface trawls and hook-and-lines at all stations including two additional ones (H12-2 and H12-3): 3,505 fish by trawls and 103 fish by hook-and-lines during the R/V *Hokko maru* cruise in 2022 summer (Table 1). Among salmon species caught by trawls at the 17 monitoring stations (i.e., without H12-2 and H12-3), chum salmon was the most abundant species (n = 2,798, 81.9%), followed by sockeye salmon (n = 564, 16.5%), Chinook salmon (n = 42, 1.23%), pink salmon (n = 8, 0.23%), and coho salmon (n = 3, 0.09%). A total of 33 chum and two Chinook salmon equipped with both archival and disk tags and 19 chum and eight sockeye salmon equipped with disk tags only were released in the central Bering Sea.

Surface seawater temperatures (SSTs) at the 17 monitoring stations in 2022 ranged between 9.1 and 11.1°C (Table 1). Mean (± SD) SST in 2022 (10.2 ± 0.5°C) was slightly warmer than that of average in the past survey years (9.8°C). While, according to vertical distributions of seawater temperatures and those anomalies along 175°E, 180°, and 175°W in the Bering Sea during 2022, thermoclines were formed at depth of 20–40 m along each line (Fig. 2).

**References**

Honda, K., T. Sato, H. Mizumoto, K. Imai, T.K. Abe, S. Garcia, and S. Sato. 2023. The summer 2022 Japanese salmon research cruise of the R/V *Hokko maru*. NPAFC Doc. 2088. 18 pp.

Ishida, Y., and M. Ogura. 1992. Review of high-seas salmon research by the National Research Institute of Far Seas Fisheries. p. 23–30. *In* Y. Ishida, K. Nagasawa, D. W. Welch, K. W. Myers, & A. P. Shershnev [eds.] *Proceeding of the International Workshop on Future Salmon Research in the North Pacific Ocean*. National Research Institute of Far Seas Fisheries, Shimizu, Japan.

**Table 1.** Catches of sockeye salmon (SO), chum salmon (CH), pink salmon (PK), coho salmon (CO), Chinook salmon (CN), adult Atka mackerel (AM), and adult Walleye Pollock (WP) along with the sea surface temperature (SST, °C) at each station during the R/V *Hokko maru* cruise in summer 2022. For each station, the white line reports number caught whereas gray line reports total weight (kg). a Point at which the net was hauled. Gear codes are J for surface trawl and O for hook-and line. b Catch number was estimated based on body weights of randomly selected 133 fish. c Data collected at stations H12-2 and H12-3 are excluded. d Body weights of fish caught by hook-and-line, tagged, and released, are not included.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | |  |  |  |  |  |  |  |  |  |  |  |
|  | St. | Date (in 2022) | Location a | | | | SST | Gear | Salmonid fishes | | | | | AM | WP |
|  | SO | CH | PK | CO | CN |
|  | H22 | 19 Jul | 56°01´N | 175°06´ | | E | 10.8 | J | 6 | 71 | 1 | 0 | 0 | 0 | 0 |
|  |  |  |  |  | |  |  |  | 3.5 | 39.9 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 |
|  | H23 | 19 Jul | 55°00´N | 175°03´ | | E | 10.7 | J | 18 | 146 | 0 | 0 | 0 | 4 | 0 |
|  |  |  |  |  | |  |  |  | 22.8 | 77.3 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 |
|  | H24 | 20 Jul | 54°02´N | 175°06´ | | E | 11.1 | J | 3 | 87 | 0 | 0 | 1 | 1 | 0 |
|  |  |  |  |  | |  |  |  | 3.3 | 43.4 | 0.0 | 0.0 | 3.0 | 0.3 | 0.0 |
|  | H25 | 20 Jul | 53°01´N | 175°06´ | | E | 10.2 | J | 11 | 136 | 1 | 0 | 0 | 11 | 0 |
|  |  |  |  |  | |  |  |  | 11.3 | 78.0 | 1.2 | 0.0 | 0.0 | 2.4 | 0.0 |
|  | H15 | 21 Jul | 52°28´N | 179°53´ | | W | 9.9 | J | 6 | 59 | 0 | 0 | 1 | 1935 b | 0 |
|  |  |  |  |  | |  |  |  | 4.7 | 38.8 | 0.0 | 0.0 | 3.2 | 393.9 | 0.0 |
|  | H16 | 22 Jul | 53°30´N | 179°53´ | | W | 9.9 | J | 14 | 65 | 0 | 1 | 1 | 1 | 0 |
|  |  |  |  |  | |  |  |  | 17.6 | 32.0 | 0.0 | 2.3 | 2.5 | 0.3 | 0.0 |
|  | H17 | 22 Jul | 54°26´N | 179°58´ | | W | 10.3 | J | 12 | 188 | 0 | 1 | 3 | 1 | 0 |
|  |  |  |  |  | |  |  |  | 12.6 | 78.5 | 0.0 | 1.7 | 7.6 | 0.1 | 0.0 |
|  | H18 | 23 Jul | 55°27´N | 179°56´ | | E | 9.9 | J | 7 | 102 | 0 | 0 | 0 | 5 | 0 |
|  |  |  |  |  | |  |  |  | 8.6 | 43.3 | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 |
|  | H19 | 23 Jul | 56°31´N | 179°53´ | | E | 10.3 | J | 156 | 232 | 1 | 0 | 2 | 3 | 1 |
|  |  |  |  |  | |  |  |  | 227.4 | 127.5 | 0.6 | 0.0 | 3.0 | 0.5 | 1.1 |
|  | H20 | 24 Jul | 57°33´N | 179°57´ | | W | 10.6 | J | 19 | 203 | 1 | 0 | 2 | 0 | 0 |
|  |  |  |  |  | |  |  |  | 20.3 | 113.1 | 1.5 | 0.0 | 2.9 | 0.0 | 0.0 |
|  | H21 | 24 Jul | 58°26´N | 179°59´ | | W | 10.7 | J | 91 | 150 | 0 | 0 | 13 | 0 | 2 |
|  |  |  |  |  | |  |  |  | 122.1 | 81.7 | 0.0 | 0.0 | 10.4 | 0.0 | 1.3 |
|  | H07 | 25 Jul | 57°57´N | 175°00´ | | W | 10.1 | J | 128 | 791 | 1 | 0 | 4 | 0 | 0 |
|  |  |  |  |  | |  |  |  | 104.1 | 440.2 | 1.4 | 0.0 | 5.1 | 0.0 | 0.0 |
|  | H08 | 26 Jul | 56°58´N | 174°53´ | | W | 9.8 | J | 39 | 176 | 1 | 1 | 4 | 0 | 1 |
|  |  |  |  |  | |  |  |  | 37.8 | 114.0 | 1.1 | 2.3 | 3.3 | 0.0 | 1.4 |

**Table 1.** (continued)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | St. | Date (in 2022) | Location a | | | | SST | Gear | Salmonid fishes | | | | | AM | WP |
|  | SO | CH | PK | CO | CN |
| 87 1 2 8 0 0 n.a.  36.54 56.9 1.56 3.82 9.65 0 0 110.21  93 24 0 0 4 0 1 n.a.  48.07 14.94 0 0 2.29 0 0 24.54  333 413 2 3 10 0 3 n.a.  180.61 203.2 1.75 8.02 15.45 0 3.21 8.8  38 216 1 1 5 0 0 n.a.  34.1 122.96 2.01 1.93 5.91 0 0 17.48  24 215 3 0 2 0 0 n.a.  24.09 138.36 4.06 0 6.74 0 3.21 49.4  23 136 2 0 4 2 0 n.a.  138.02 31.35 3.7 0 12.8 1.16 0 12.77  1569 2362 15 9 61 3 34 n.a.  891.24 1391.23 21.31 21.13 73.61 2.07 33.1 1756.46 | H09 | 26 Jul | 56°00´N | | 174°53´ | W | 9.5 | J | 27 | 169 | 0 | 0 | 2 | 0 | 0 |
|  |  |  |  | |  |  |  |  | 28.4 | 94.4 | 0.0 | 0.0 | 5.6 | 0.0 | 0.0 |
|  | H10 | 27 Jul | 55°03´N | | 175°03´ | W | 9.9 | J | 11 | 83 | 0 | 0 | 5 | 2 | 0 |
|  |  |  |  | |  |  |  |  | 10.8 | 49.9 | 0.0 | 0.0 | 7.1 | 0.3 | 0.0 |
|  | H11 | 27 Jul | 54°01´N | | 175°05´ | W | 9.9 | J | 11 | 101 | 0 | 0 | 0 | 0 | 0 |
|  |  |  |  | |  |  |  |  | 14.8 | 60.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
|  | H12 | 28 Jul | 53°01´N | | 175°08´ | W | 9.1 | J | 5 | 39 | 2 | 0 | 4 | 0 | 0 |
|  |  |  |  | |  |  |  |  | 6.3 | 38.4 | 2.8 | 0.0 | 8.6 | 0.0 | 0.0 |
|  | H12-2 | 28 Jul | 53°00´N | | 175°06´ | W | 9.1 | J | 5 | 63 | 0 | 0 | 2 | 0 | 0 |
|  |  |  |  | |  |  |  |  | 4.0 | 48.2 | 0.0 | 0.0 | 5.4 | 0.0 | 0.0 |
|  | H12-3 | 28 Jul | 52°58´N | | 175°07´ | W | 9.1 | J | 0 | 17 | 0 | 1 | 2 | 0 | 0 |
|  |  |  |  | |  |  |  |  | 0.0 | 14.1 | 0.0 | 2.4 | 3.7 | 0.0 | 0.0 |
|  | Total (trawl at 17 stations) c | | | |  |  |  | J | 564 | 2798 | 8 | 3 | 42 | 1963 | 4 |
|  |  |  |  | |  |  |  |  | 656.3 | 1551.0 | 10.2 | 6.3 | 62.2 | 399.5 | 3.8 |
|  |  | 19–28 Jul | Bering Sea | | | |  | O | 44 | 54 | 0 | 2 | 3 | 0 | 0 |
|  |  |  |  | | |  |  |  | 53.6 d | 1.5 d | 0.0 | 4.5 | 2.5 d | 0.0 | 0.0 |
|  | Total (trawl + hook-and-line at all stations) | | | | | |  | J+O | 613 | 2932 | 8 | 6 | 49 | 1963 | 4 |
|  |  |  |  |  | |  |  |  | 714.0 d | 1614.8 d | 10.2 | 13.1 | 73.8 d | 399.5 | 3.8 |



**Fig. 2.** Vertical distributions of seawater temperature (°C) along 175°E, 180°, and 175°W lines in the Bering Sea from surface layer to 200 m depth in 2022.

Attachment

Scientists aboard

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