The Effect of Ocean Temperature on Herring Spawn Timing

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Introduction

This study regarding water temperature and phytoplankton abundance's effect on herring spawn has wide-reaching cultural impacts on people in Sitka and the broader Northwest Coast. Not only do people rely on herring and herring eggs for consumption, but also for cultural reasons, especially for the Tlingit and Haida people, as the sharing of herring eggs traditionally has been used to promote connection between tribes (Thornton 2015). Additionally, Pacific herring play an important role in maintaining the productivity and overall stability of the entire marine ecosystem. As a forage fish, they transfer energy from lower trophic levels, like plankton, to higher predators, like seabirds. Any disruption to the herring population can have devastating effects throughout the entire food web.

Considering the ecological and cultural significance of Pacific herring, understanding the factors that influence their spawn timing is crucial, as having an abnormal herring spawn season can throw off the equilibrium of the entire ecosystem. This concern is amplified by the effects of climate change, as rising sea temperatures are altering seasonal timing patterns in marine ecosystems. Even small increases in water temperature can potentially disrupt some of the environmental cues that trigger herring spawning. According to Schweigert et al. (2013), herring productivity is closely related to the timing of the spring plankton bloom, as larvae survival depends on adequate food availability. This relationship highlights the importance of looking at how environmental factors like water temperature influence spawn timing in the Sitka Sound.

Hypothesis

I predict that increased water temperature in the Sitka Sound will correspond to earlier Pacific herring spawn in the spring of 2026 because temperature is a seasonal indicator for herring to spawn.

Method

Figure 1: Map of study site for phytoplankton collection and analysis

Figure 2: Phytoplankton tow sample collection

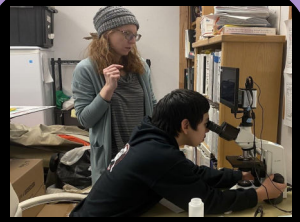

Figure 3: Analyzing phytoplankton abundance under the microscope

The sample collection of both the phytoplankton and the water temperature took place at the Sitka Float Plane Dock. Water temperature was taken once prior to the phytoplankton tow. The net was towed under a meter of water slowly to not break the water tension for three minutes. Around a liters worth was collected. Next, the results from the tow were determined via microscopy immediately after the tow was conducted. Sampling occurred four times, on 03/06/26, 03/23/26, 03/27/26, and 03/30/26 with one tow conducted per collection day.

For the sample processing, two drops were put onto a slide containing a grid. Eight cells were chosen at random and then those "cells" (referring to the microscope fields of view) were the only ones looked at for phytoplankton. "None" was marked for no phytoplankton found in that particular cell, "present" for 1-20 found, and "abundant" marked for more than 20 phytoplankton in that cell.

For water temperature, a bucket of surface water was collected and the temperature was measured immediately using a thermometer to prevent changes due to sun exposure or other factors.

Additionally, historical herring spawn data from the Alaska Department of Fish and Game was documented from 2020 to 2025. For each season the average daily spawn was recorded and the cumulative spawn for the whole season was calculated.

NOAA buoy Itka2 took water surface temperature measurements every six minutes. Data was pulled for the month of March from 2020-2026, and was then calculated into an average surface temperature.

Results

Fig. 4a

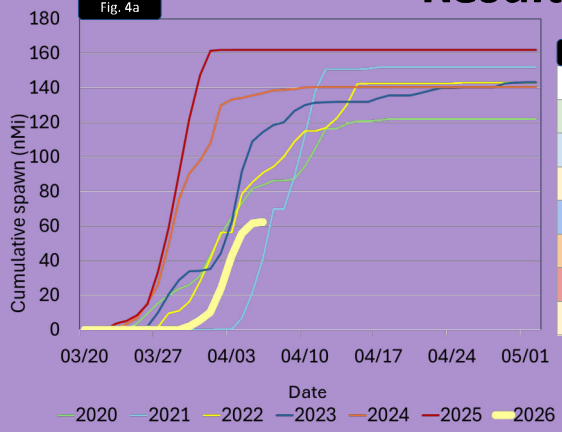

Fig. 4b

	March (°C)	Rank
2020	5.7	4
2021	5.4	5
2022	5.8	3
2023	5.3	6
2024	6.4	2
2025	6.5	1
2026	5.8	3

Fig. 5

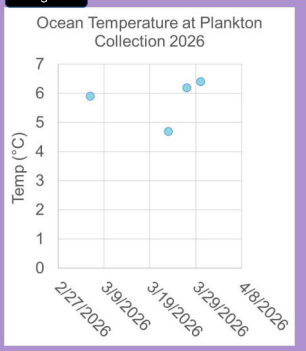

Fig. 6

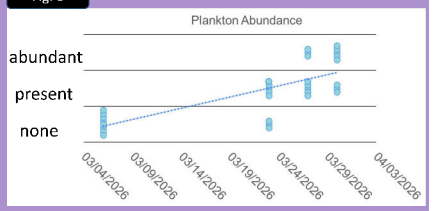

Fig. 4. a) Cumulative spawning over 7 recent years by date. Color for each year indicates the average temperature in March taken at NOAA buoy Itka2. b) Warm colors indicate warmer temperatures ranked warmest to coolest.
Fig. 5. Temperature during March until April. Samples were taken during plankton tows
Fig. 6. Results of our phytoplankton tow samples under microscope

- Temperatures in Sitka were warmer in recent years
- Herring spawn started earlier in warmest years
- 2026 was colder than 2025 and 2024.
- 2026 was similar to 2022
- The first observation of phytoplankton was on March 23, 2026
- The first observation of abundant phytoplankton was on March 27, 2026
- The first day of herring spawn recorded was on March 30, 2026
- Compared to the temperature collected by Itka2, the temperature measured at the Sitka Float Plane Dock was higher than the March average for all but one sample.

Discussion

Our hypothesis was supported for the most part, but temperature proved to not be a perfect model. 2025 was the hottest year and had the earliest spawn time. We were expecting 2026 spawn to occur earlier than in the previous year, due to global warming, however it was slightly colder than typical, ranking near 2021. One possible explanation for these findings are that 2026 was a much colder winter with much more snow than usual, especially in March, contributing to colder air and ocean temperature overall. A consideration for future studies regards the age classes of the herring as another potential factor that influence herring spawn timing. A limitation could be location. For example, we consistently did the plankton tow in one spot, and it could be consistent over the Sitka Sound. Temperature could also affect herring survival in other ways. Uehara & Mitani (2009) found that it could affect when they emerge and what food would be available.

References:

Thornton, T. F. (2015). The Ideology and Practice of Pacific Herring Cultivation Among the Tlingit and Haida. *Human Ecology*, *43*(2), 213–223.

J.F. Schweigert, M. Thompson, C. Fort, D.E. Hay, T.W. Therriault, L.N. Brown. (2013) Factors linking Pacific herring (Clupea pallasi) productivity and the spring plankton bloom in the Strait of Georgia, British Columbia, Canada. Progress in Oceanography, Volume 115,Pages 103-110.

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