Comparison of Feeding Pattern of Pacific Salmon between the Western Subarctic Gyre and the Gulf of Alaska in Summer 2005

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Keywords: Pacific salmon, feeding pattern, Western Subarctic Gyre, Gulf of Alaska, summer 2005

Pacific salmon (*Oncorhynchus* spp.) is one of the keystone species in the North Pacific Ocean ecosystem. Their feeding ecology is influenced by the oceanic environment such as ENSO event (Kaeriyama et al. 2000, 2004), inter- and intra-specific interaction such as density-dependent effect (Tadokoro et al. 1996; Kaeriyama et al. 2000, 2004; Ruggerone et al. 2003), and also population dynamics of prey animal community (Shiomoto et al. 1997), because salmon are opportunistic feeders (Kaeriyama et al. 2000). The evalutation of feeding ecology of Pacific salmon is useful for understanding on prey-animal community structure in the North Pacific Ocean. In this study, we examined the feeding pattern of Pacific salmon in the Western Subarctic Gyre (WSG) and the western Gulf of Alaska (GA) in summer 2005 to understand their feeding ecology.

Sockeye (*O. nerka*), chum (*O. keta*), pink (*O. gorbuscha*), and coho salmon (*O. kisutch*) were collected by non-selective research gillnets and angling aboard T/V *Oshoro Maru* (1,396 MT), Hokkaido University, at seven stations in the North Pacific Ocean during early July (three stations in the WSG, 45–50˚N, 165˚E) and late July (four stations in the GA, 45–47.5˚N, 165˚W) in 2005 (Fig. 1). Their fork length (FL, mm), whole body weight (BW, g), and stomach content weight (SCW, g) were measured aboard. Stomachs were collected and preserved in a 10% formalin-seawater solution. Condition factor (CF; BW / FL^3 × 100) was calculated as relative growth between fork length and body weight. Stomach contents were classified to 12 taxa to the lowest identifiable taxon using a dissecting microscope, counted, and weighed by species. Stomach contents were evaluated in terms of stomach content index (SCI; SCW / BW × 100), as well as a modified index of relative importance (IRI) method (Pinkas et al. 1971; Kaeriyama et al. 2000). The Shannon-Wiener index (H') was used to estimate diversity of stomach contents

Fig. 1. Locations collecting Pacific salmon in the North Pacific Ocean in summer 2005. WSG, Western Subarctic Gyre; GA, Western Gulf of Alaska.

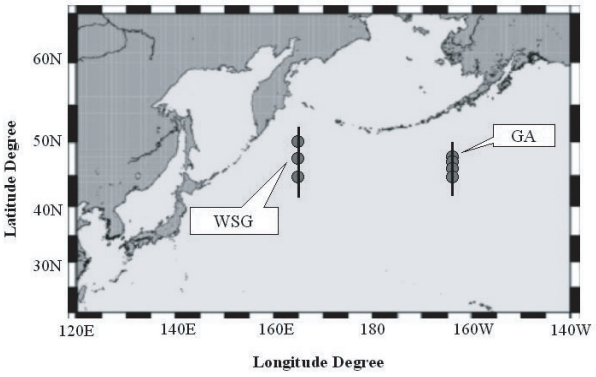

Fig. 2. Stomach contents of Pacific salmon in the WSG and the GA in the summer of 2005. The IRI indicates a modified index of relative importance (Pinkas et al. 1971; Kaeriyama et al. 2000). Open circles show the stomach content diversity. Parenthetic numerals show the number of samples.

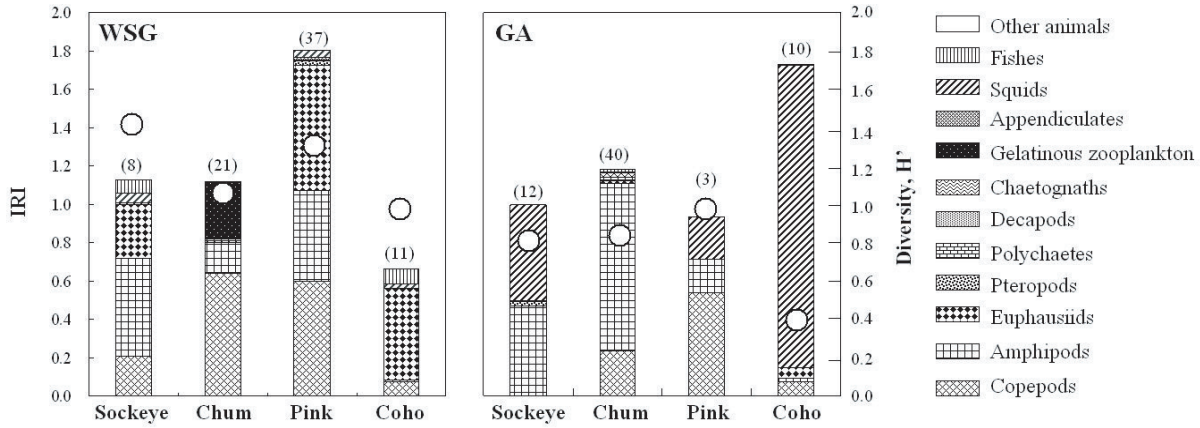

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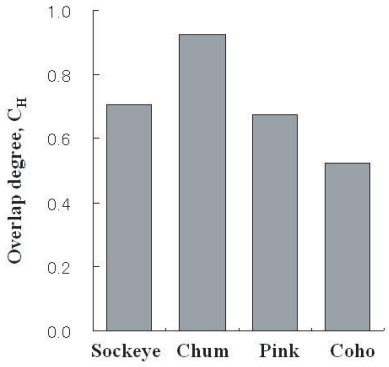
Fig. 3. Overlap degree of stomach content of Pacific salmon between the WSG and the GA during the summer of 2005.



(Colwell and Futuyama 1971). A simplified Morishita's index (C_H) was also used to estimate similarity of their stomach contents between the WSG and the GA (Horn 1966). The Student's *t*-test and the Mann-Whitney U-test were used to compare biological characters of salmon between the WSG and the GA. Significance in all tests was accepted at the P = 0.05 level.

Sockeye and pink salmon mainly fed on amphipods, copepods, and euphausiids in the WSG, while amphipods, copepods, and squid in the GA. Chum salmon mainly consumed copepods, gelatinous zooplankton, and amphipods in the WSG, and copepods and amphipods in the GA. Only chum salmon fed on gelatinous zooplankton (Fig. 2). Food of chum salmon mostly overlapped between both areas (Fig. 3). CF and SCI of coho salmon were higher in the GA than those in the WSG (Figs. 4 and 5). Coho salmon mainly fed on euphausiids in the WSG, and squids (mainly *Berryteuthis anonychus*) in the GA (Fig. 2). Pacific salmon except for chum salmon had more-diverse preys in the WSG than in the GA. They also fed on more squids in the GA than in the WSG (Fig. 2). Thus, the food habit of Pacific salmon may differ between the WSG and the GA in the North Pacific Ocean. Coho salmon was also the most nektonic-feeder, and followed by sockeye, pink, and chum salmon. Coho salmon often feeds on larger micronektonic prey such as fishes and squids, while sockeye, chum, and pink salmon feed on zooplankton (Kaeriyama et al. 2004). Primary production in the WSG are higher than those in the GA (Mackas and Tsuda 1999). Sugimoto and Tadokoro (1997) also indicated zooplankton biomass in the WSG was higher than in the GA. Therefore, these suggest that the difference of oceanic environment including prey animal community in both the WSG and the GA may cause a diverse feeding pattern of Pacific salmon in the North Pacific Ocean.

Fig. 4. Comparison of condition factor (CF) of Pacific salmon between the WSG (open bar) and the GA (closed bar) in the summer of 2005 (*t*-test: NS; p > 0.05, *; p < 0.05, ***; p < 0.001, -; a few samples). Parenthetic numerals show the number of samples.

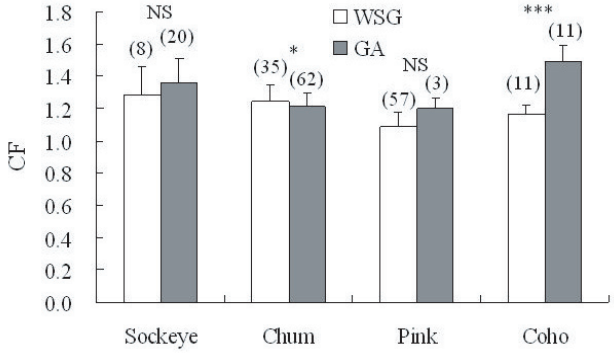
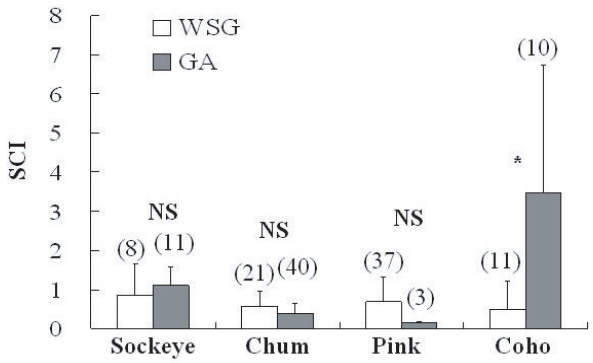


Fig. 5. Comparison of stomach content index (SCI) of Pacific salmon between the WSG (open bar) and the GA (closed bar) in the summer 2005 (*u*-test: NS; p > 0.05, *; p < 0.05, -; a few samples). Parenthetic numerals show the number of samples.



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