

## Lipid Composition in Muscle and Liver Tissues of Chum and Pink Salmon Captured in the Gulf of Alaska during May, 1999

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The quantity of lipid has been used as a biochemical index of trophic condition in a variety of contexts for both freshwater and marine fish. In a previous paper, lipid content and fatty acids were studied to investigate trophic condition of chum and pink salmon in the North Pacific Ocean in winter (Nomura et al. 2000). There are no reports of trophic condition of salmonids in spring. A limitation of lipid research on salmonids in spring is the difficulty of collecting samples for analysis. A systematic trawl survey was conducted aboard the F/V *Great Pacific* in the Gulf of Alaska in May of 1999, and we report on the lipid content in white muscle and liver of salmonids in spring.

A total of 210 salmon (116 chum, 51 pink, 9 chinook, 10 coho, and 24 sockeye salmon), captured by trawl on the F/V *Great Pacific* in the Gulf of Alaska in May 1999, was used as spring samples. A total of 268 salmon (122 chum, 92 pink, 5 chinook, 16 coho, and 20 sockeye salmon, and 13 steelhead), captured by gillnet on the T/S *Oshoro maru* at 10 stations in the Gulf of Alaska in July 1999, was used as summer samples. The fork length (cm) and weight (g) of salmonids were measured, and used to calculate the condition factor ( $((\text{Fork length (cm)}^3)/(\text{Body weight (g)})) \times 1,000$ ). Tissue samples were frozen at  $-20^\circ\text{C}$  until analyzed. Total lipids in the white muscle were extracted with chloroform/methanol (Folch et al. 1957) and measured gravimetrically, separated into polar lipid and neutral lipid fractions with Sep-Pak (Waters Co., MS, U.S.A.), and measured gravimetrically.

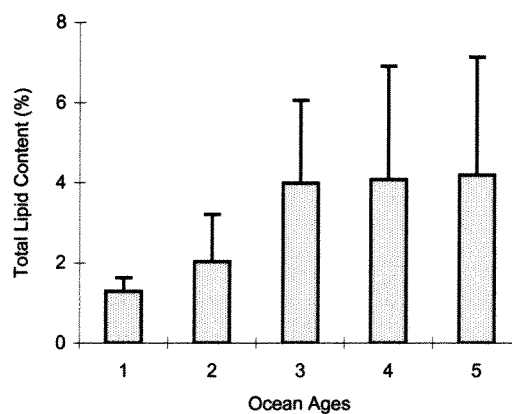
We compared the total lipid content of immature and maturing chum salmon captured in the Gulf of Alaska in spring. The means of total lipid in immature ( $n = 45$ ) and maturing ( $n = 70$ ) fish were 1.8% and 4.2%, respectively. There was a significant difference ( $P = 0.05$ ) between the total lipids in white muscle in immature and maturing fish. In Fig. 1, total lipid content in white muscle of chum salmon is shown by ocean age. Total lipid content in age-1 fish was low ( $< 2.3\%$ , mean = 1.3%), and it was also low in age-2 fish ( $< 5.5\%$ , mean = 2.0%). In age-3 fish, total lipid content was higher than in age-1 and age-2 fish ( $< 10.9\%$ , mean = 3.9%). The total lipid contents in age-3–5 fish were significantly higher than those of age-1–2 fish.

Figure 2 shows the correlation between total lipid content in white muscle and body weight by age of salmon caught in the Gulf of Alaska in spring. Salmon smaller than 1,000g in body weight had low lipid content in white muscle, and total lipid content increased with body weight for salmon weighing over 1,500 g.

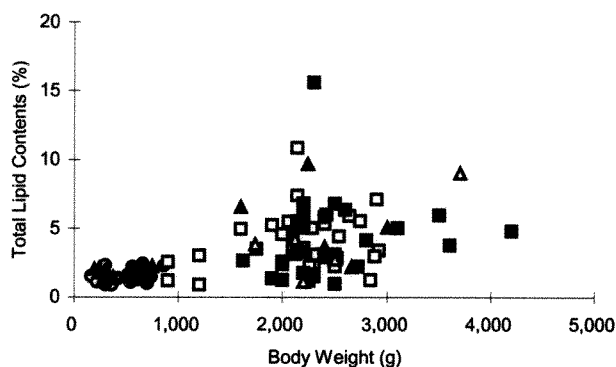
In spring, lipid content in the white muscle in pink salmon was low ( $< 6.5\%$ , mean = 2.7%). In summer, lipid content in white muscle ( $< 20.2\%$ , mean = 7.2%) increased with body weight.

Total lipid contents in sockeye, chinook, and coho salmon, and steelhead captured in spring and summer are studied. In spring, all species had low lipid contents in white muscle, but lipid contents increased with body weight in summer, except for steelhead ( $< 11.0\%$ , mean = 2.4%). There is no correlation between total lipid in liver and body weight in chum and pink salmon (Fig. 3).

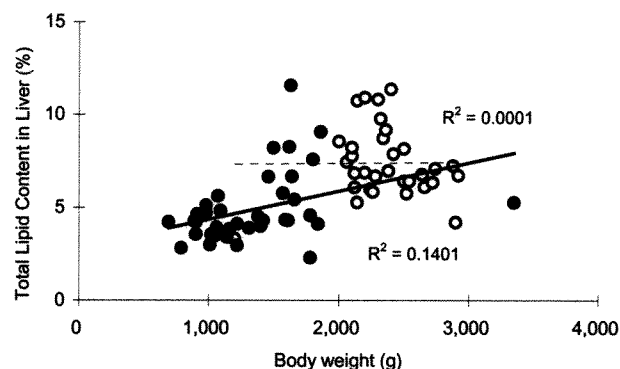
**Fig. 1.** Total lipid content in white muscle in chum salmon caught in the Gulf of Alaska in spring by ocean age. Bars are means, and lines are SD



**Fig. 2.** Correlation between total lipid content in white muscle and body weight in chum salmon caught in the Gulf of Alaska in spring by ocean age. Open circles are the age-1 fish, closed circles are the age-2 fish, open squares are the age-3 fish, closed squares are the age-4 fish, open triangles are the age-5 fish and closed triangles are the age unknown fish of unknown age.



**Fig. 3.** Correlation between total lipid content in liver and body weight in chum salmon caught in the Gulf of Alaska in spring and summer. Open circles and dots are spring fish, and closed circles and line are summer fish.



In previous papers, we reported that lipid content of chum and pink salmon white muscle in winter is low (Nomura et al. 1999; Nomura et al. 2000). Young salmonids in spring showed very low lipid contents, the same as the low lipid contents observed in winter. The low lipid contents in white muscle in spring suggest that a starved condition, which was observed in winter, is prolonged into the spring in young fish in the Gulf of Alaska. We also showed that there is a significant difference in total lipid content in white muscle depending on maturity stage and age. It should be apparent that maturity stage is more significant than age in determining lipid levels. Sample sizes need to be much larger to adequately separate out the effects of age and maturity on total lipid content. We suspect, however, that investigation of lipid content in spring is important for estimation of survival and growth of high-seas salmonids.

## REFERENCES

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