

A Comparison of Secondary Sexual Characters and Age Composition of Wild and Hatchery Chum Salmon (*Oncorhynchus keta*) in the Yurappu River, Southern Hokkaido in Japan

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Hatchery salmon may develop their secondary sexual characters less significantly than wild fish because of no opportunity of breeding competition (Fleming and Gross 1989). In the Yurappu River, southern Hokkaido, chum salmon (*Oncorhynchus keta*) originated from hatchery spawn at the upper reaches (designated as hatchery salmon), whereas possible wild chum salmon spawn at the lower reaches. We compared their secondary sexual characters and age composition among both populations during the fall and winter of 2005.

Adult chum salmon were collected at the upper and lower reaches of the Yurappu River (Fig. 1), measured for fork (FL), head (HL) and upper jaw lengths (UJL), and recorded by a digital camera. The digital images were analyzed by a simple digitizer software, and measured for mid-eye to hypural flexure length (MEH), head length (HL), upper jaw length (UJL), kype length (KYPE), body depth (BD), dorsal fin base length (DB), anal fin base length (AB), adipose fin length (AFL), and caudal peduncle depth (CPD). In addition, scales were collected from each fish for the age determination.

Wild and hatchery chum salmon did not show significant difference in their temporal and spatial age composition, although wild salmon was slightly older than hatchery fish (χ^2 -test, NS; Fig. 2). Wild salmon had significantly larger body size than hatchery salmon (t -test, $P < 0.01$; Fig. 3a), although age-6 male and age-4 and

Fig. 1. Locations for collecting adult chum salmon in the Yurappu River system.

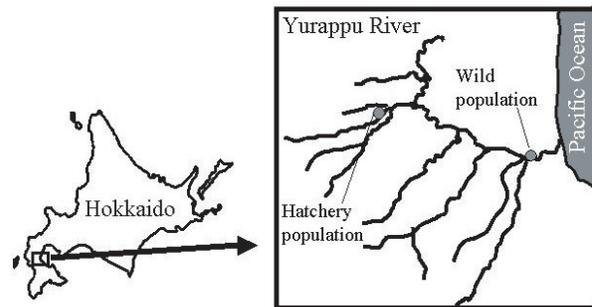


Fig. 2. Temporal-spatial variation of age composition of hatchery (a) and wild (b) chum salmon in the Yurappu River.

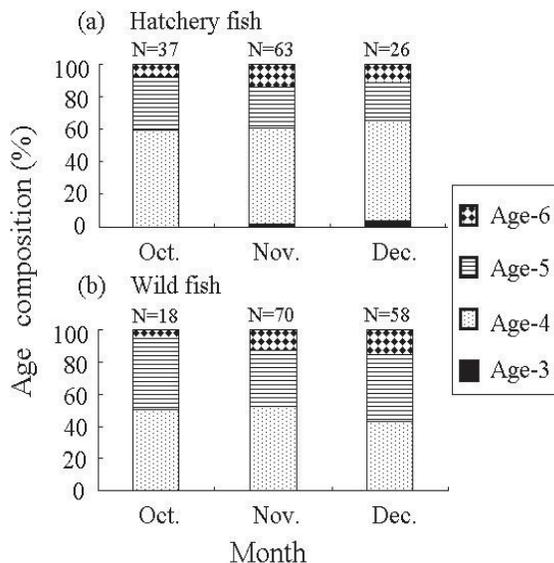


Fig. 3. Frequency distribution in fork length of male (a) and female (b) chum salmon in the Yurappu River. Open bar, wild fish; shaded bar, hatchery fish (t -test: * $P < 0.05$, ** $P < 0.01$).

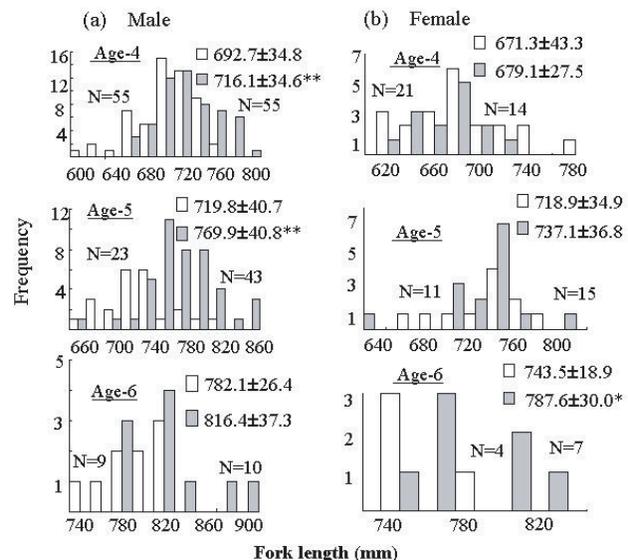
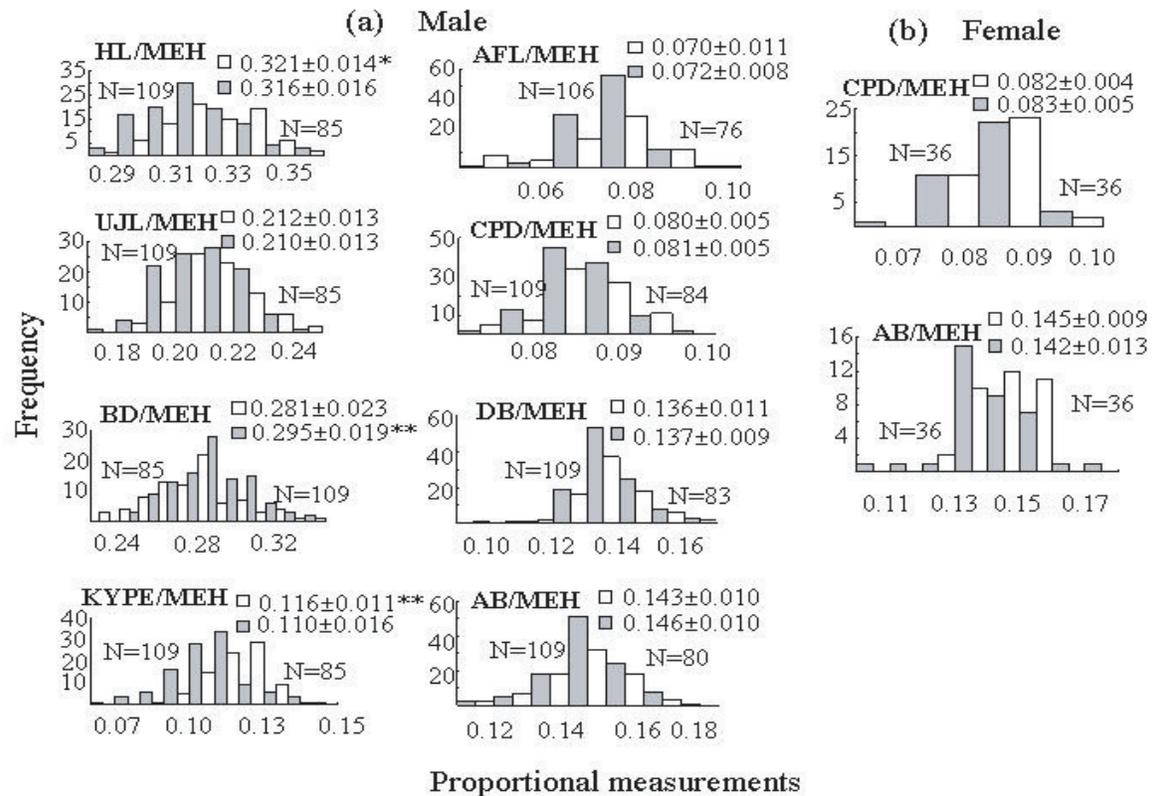


Fig. 4. Frequency distribution in proportional measurements concerning the secondary sexual characters of male (a) and female (b) chum salmon. Open bar, wild fish; shaded bar, hatchery fish (*t*-test: * $P < 0.05$, ** $P < 0.01$).



-5 female salmon did not show significant differences between both populations (U-test, NS; Fig. 3b). In the proportional measurements concerning the secondary sexual characters, wild male had significantly higher BD, smaller HL and KYPE than hatchery salmon (*t*-test, $P < 0.05$; Fig. 4a), and wild salmon had smaller UJL than hatchery male despite no significance (*t*-test, NS; Fig. 4a). Other characters (such as AFL, DB, AB and CPD) of male salmon had no differences between both populations (*t*-test, NS; Fig. 4a). Secondary sexual characters of adult females had no difference between both populations (*t*-test, NS; Fig. 4b).

Sockeye salmon developed the secondary sexual characters as a result of the breeding trade-off between mortality risk and reproductive success (Quinn et al. 2001). Difficulties with the migration to spawning ground and intensity of breeding competition affected the morphology of adult female salmon (Fleming and Gross 1989). Male sockeye salmon which had larger body size and larger dorsal humps obtained higher status for breeding competition in the spawning grounds than other males (Quinn and Foote 1994). In this study, wild male chum salmon spawning at the lower reaches had higher BD, and smaller HL, KYPE and UJL than hatchery salmon spawning at the upper reaches. This morphological difference salmon may response the opportunity of breeding competition and the migration distance to each spawning ground.

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