Reproductive energy expenditure and changes in body morphology for a population of Chinook salmon *Oncorhynchus tshawytscha* with a long distance migration

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(Received 15 May 2016, Accepted 19 January 2017)

Energetic demands of a long freshwater migration, extended holding period, gamete development and spawning were evaluated for a population of stream-type Chinook salmon *Oncorhynchus tshawytscha*. Female and male somatic mass decreased by 24 and 21%, respectively, during migration and by an additional 18 and 12% during holding. Between freshwater entry and death after spawning, females allocated 14% of initial somatic energy towards gonad development and 78% for metabolism (46, 25 and 7% during migration, holding and spawning, respectively). Males used only 2% of initial somatic energy for gonad development and 80% on metabolic costs, as well as an increase in snout length (41, 28 and 11% during migration, holding and spawning, respectively). Individually marked *O. tshawytscha* took between 27 and 53 days to migrate 920 km. Those with slower travel times through the dammed section of the migration corridor arrived at spawning grounds with less muscle energy than faster migrants. Although energy depletion did not appear to be the proximate cause of death in most pre-spawn mortalities, average final post-spawning somatic energy densities were low at 3·6 kJ g⁻¹ in females and 4·1 kJ g⁻¹ in males, consistent with the concept of a minimum energy threshold required to sustain life in semelparous salmonids.

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Key words: energy threshold; holding; migration; pre-spawning mortality; proximate analysis; spawning.

INTRODUCTION

For semelparous Pacific salmon *Oncorhynchus* spp., individual lifetime fitness depends on maximizing reproductive output during a single event (Stearns, 1976; Bonnet *et al.*, 1998). Therefore, acquisition of sufficient energy reserves and the allocation of resources during reproduction can be critical to reproductive success (Crossin *et al.*, 2009). Upon return to fresh water as mature adults, *Oncorhynchus* spp. cease feeding and rely on endogenous energy stores acquired during ocean rearing to supply the energetic demands of upstream migration, gonadal maturation, development of secondary sexual characteristics, competition, spawning and maternal care in the form of redd guarding (Brett, 1995; Healey *et al.*, 2003; Quinn, 2005). The

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