Diel Feeding and Gastric Evacuation of Juvenile Pink and Chum Salmon in Icy Strait, Southeastern Alaska, May–September 2001

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We studied seasonal diel feeding and gastric evacuation rates of juvenile pink (*Oncorhynchus gorbuscha;* n = 458) salmon and chum (*O. keta*; n = 464) salmon in the marine waters of the northern region of southeastern Alaska, from May through September of 2001. These process studies were conducted as part of the Southeast Coastal Monitoring (SECM) Project of the Auke Bay Laboratory, National Marine Fisheries Service. For each of the past seven years (1997–2003), SECM scientists have monitored the abundance, distribution, stock composition, and energy content of juvenile salmon as the fish transit through the principal migration corridor in the region, and also have monitored habitat biophysical parameters and carrying capacity (Orsi et al. 2002). For this project, we sampled monthly in Icy Strait by beach seining two sites near shore in May and by surface trawling at a station located 6.4 km offshore in June through September (Sturdevant et al. 2002). Surface (2-m) temperature was taken, and samples of fish (size and stomach analysis) and zooplankton (surface to 20-m oblique hauls, 333 µm mesh, 60 cm diameter bongo net) were examined from seven intervals within a 24-hr day. The objectives of the diel study were to monitor juvenile salmon feeding rhythms (stomach % fullness, numbers of prey, and prey percent body weight (%BW)) and prey composition (% number and % weight by taxon), as well as zooplankton displacement volumes (DV, $ml \cdot m^{-3}$), densities ($number \cdot m^{-3}$), and composition (% $number \cdot m^{-3}$). The objectives of the gastric evacuation study were to monitor the passage of food out of the stomachs (decline in prey number and biomass) of juvenile salmon that were caught in single hauls at different times of day in May and July, and to compute exponential evacuation rate, ER. Results of these studies were used to compute daily ration (DR) for each month, where DR = 24·mean diel prey %BW·ER (Williams et al. 2001).

Biophysical habitat parameters exhibited strong seasonal and diel patterns. Seasonal surface temperatures rose from approximately 7°C in May to a peak greater than 13°C in June, declining to approximately 9°C in September; we observed little diel change except in June. Zooplankton DV and densities were also highest in June, and peaked late in the day each month. Prey composition changed seasonally with zooplankton composition (Fig. 1). In May and June, small calanoids were prominent in the varied diets, the only time this taxon did not dominate zooplankton composition. In June, large calanoids, euphausiid larvae and juveniles, and larvaceans were also prominent prey, while in later months, hyperiid juveniles and larvaceans were prominent; however, no consistent patterns in diel prey composition were observed. Prey selection for hyperiids, euphausiids, and larvaceans was indicated by high percentages of these taxa in the diets compared to their low abundance in the 333 µm mesh zooplankton (Fig. 1); juvenile salmon avoided the prominent, small prey taxa.

Juvenile salmon fed continuously throughout the day, with average stomach fullness indices of 60–95% per diel period in all five months. However, numbers of prey in stomachs were generally highest early and late in the day (Fig. 1), coincident with peak zooplankton density and DV late in the day. Fullness index and DR peaked in June, coincident with the seasonal peak in zooplankton density (Fig. 1). ER approximately doubled from May to July (Fig. 2), when 1) time to completely empty the guts increased from approximately 8 hrs to 12 hrs, 2) temperature increased from 7.1°C to 12.7°C, 3) prey composition changed from principally hard-bodied (crustaceans) to principally soft-bodied (larvaceans) taxa, 4) starting numbers of prey at time of capture for evacuation experiments were at least five times greater, and 5) fish length tripled (approximately 40 mm to 120 mm fork length) and weight increased by two orders of magnitude. The lower DR at summer's end coincided with the decline in zooplankton density.

Further analysis of these preliminary results will be supplemented with data from zooplankton samples collected in different mesh nets and fish diet composition by weight. Our study provides input parameters for bioenergetic modeling of juvenile salmon (Orsi et al. 2003a), a tool useful for assessing the demands of increased hatchery production on the carrying capacity of the marine ecosystem in a region of economically important commercial fisheries. It also provides the background necessary for investigations on trophic ecology and interactions between wild and hatchery chum salmon (Orsi et al. 2002, 2003b; Sturdevant et al. 2002).

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Fig. 1. Monthly diel prey composition (mean % number) and mean total number of prey of juvenile pink and chum salmon, with 20-m zooplankton (double oblique bongo, 333-µm mesh) composition (mean % number) and total density (thousands per m^3); number of fish (n) and daily rations (DR, wet % body weight) shown.

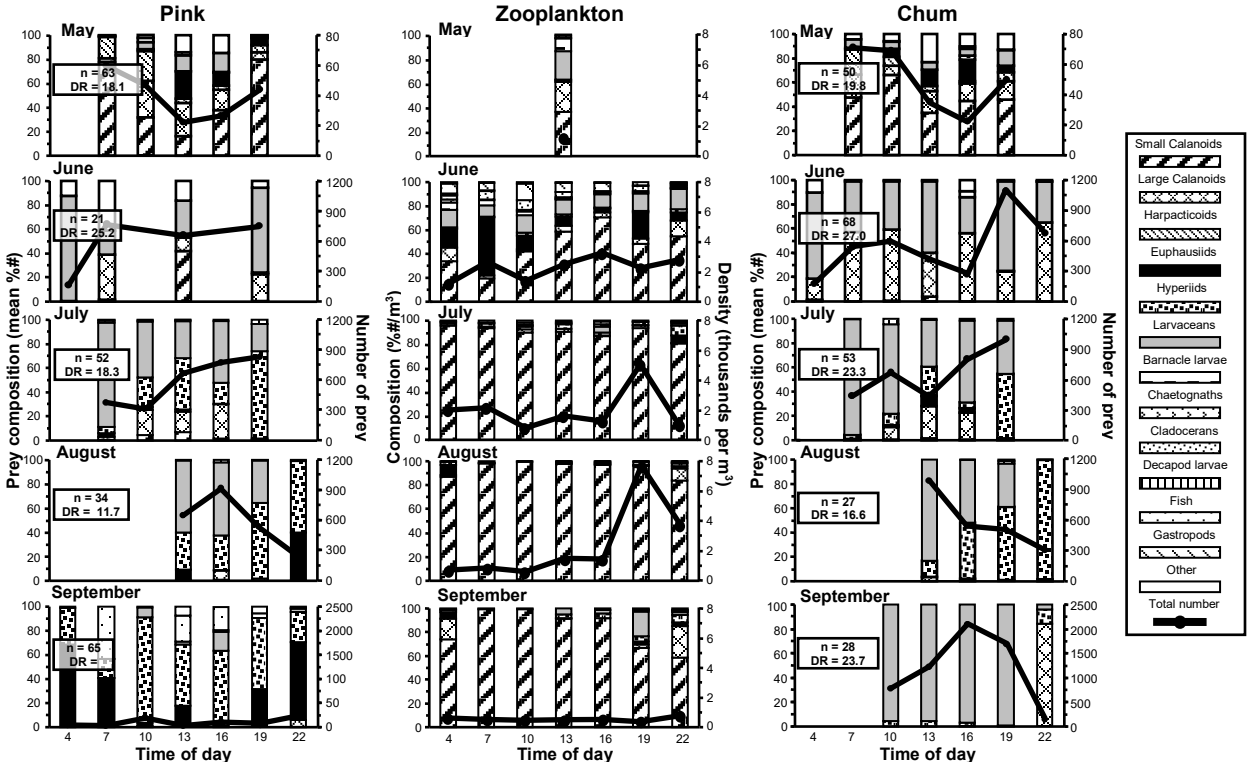
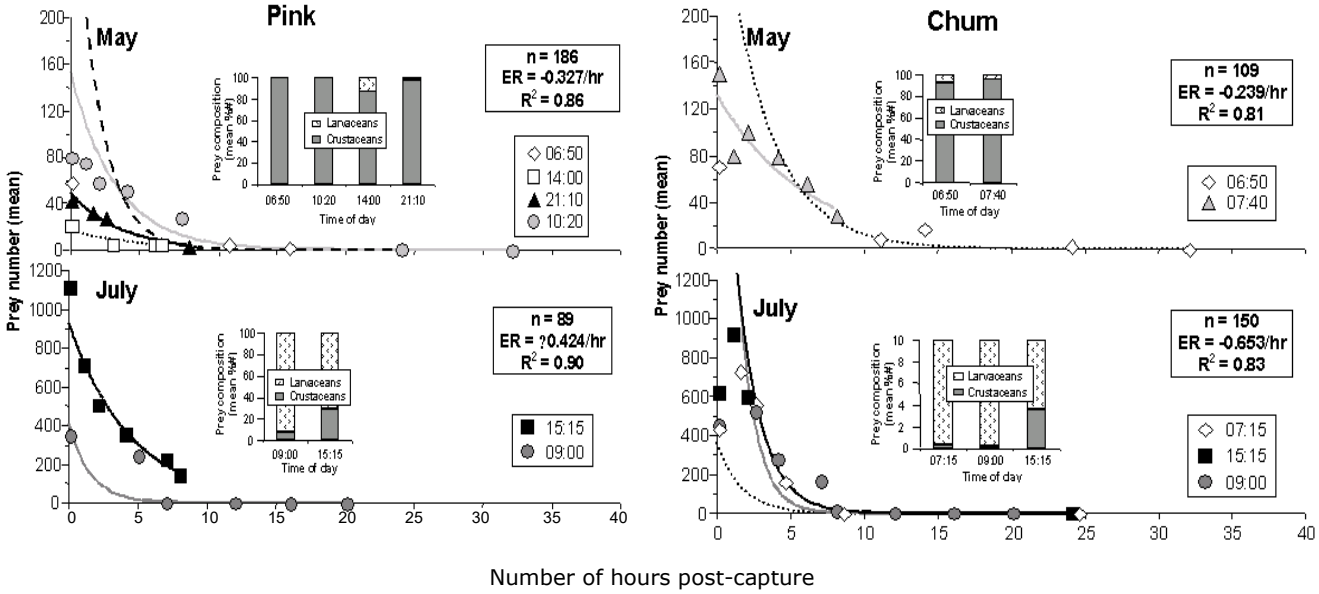


Fig. 2. Exponential Evacuation Rate: decline in number of prey over time, with prey composition (mean % number of hard- or soft-bodied taxa, bar graphs) from time of capture (time 0), in May and July, for juvenile pink and chum salmon; number of fish (n) and R^2 shown.



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