

## Summary of Preliminary Juvenile Salmonid Consumption Estimates by Double-crested Cormorants in Tillamook Bay during April and May, 2012

Don Lyons  
Oregon State University  
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This document summarizes preliminary bioenergetic-based estimates of consumption of juvenile salmonids by double-crested cormorants in Tillamook Bay, Oregon, produced in collaboration with Lindsay Adrean, Oregon Department of Fish and Wildlife. Using Tillamook Bay cormorant foregut samples that Lindsay collected during April and May, 2012, salmonids were estimated to be ~35% of the cormorant diet during this period. Salmonids were identified to species in collaboration with David Kuligowski of NOAA Fisheries, who provided genetic identification of salmonid soft tissue taken from cormorant foregut samples. Lindsay also conducted point count surveys during April and May across Tillamook Bay to quantify how many cormorants were present and potentially consuming salmonids. Energy demands of adult cormorants were scaled from measures of energy expenditure of cormorants rearing chicks in the Columbia River estuary to account for the pre-breeding or incubating status of Tillamook Bay birds. Energy content of cormorant prey in Tillamook Bay were assumed to be equivalent to previously characterized values for the Columbia River estuary, or drawn from the literature when Columbia River values were not available. Monte Carlo calculation techniques were used, with 1000 calculations performed to estimate confidence intervals after Lyons (2010).

The estimates provided here are best described as preliminary for at least two reasons: (1) revisions may occur if more comprehensive data on prey energy content becomes available, and (2) the abundance of cormorants present in Tillamook Bay is challenging to quantify with even the best of surveys. In comparison, estimates of prey consumption by double-crested cormorants in the Columbia River estuary are more robust due to laboratory analysis of prey energy content and more reliable measurements of cormorant abundance made possible by the overwhelming majority of cormorants congregating at a single breeding colony where aerial photographs made accurate counts possible. Regardless of these limitations, the information presented here represents the best available estimates of salmonid consumption by Tillamook Bay cormorants.

We estimate that cormorants consumed between 3 and 13 thousand coho salmon smolts in Tillamook Bay during April and May, 2012 (best estimate is 8,000 coho smolts, 95% CI: 3,000 – 13,000). We estimate consumption of steelhead and cutthroat trout together was between 7 and 30 thousand smolts (best estimate is 19,000, 95% CI: 7,000 – 30,000). Consumption of chum salmon fry was estimated to be between 4 and 40 thousand fry (best estimate is 22,000, 95% CI: 4,000 – 40,000). In total, we estimate that cormorants consumed tens of thousands of juvenile salmonids in Tillamook Bay during April and May, 2012 (best estimate is 50,000 juveniles, 95% CI: 18,000 – 82,000).

To put these estimates in context, comparisons to juvenile salmonid consumption by double-crested cormorants nesting on East Sand Island in the Columbia River estuary are helpful:

	Tillamook Bay	East Sand Island
Estimate Period	April 1 – May 31, 2012	March 27 – May 21, 2012
% Salmonids in Diet	35%	34%
Maximum number of cormorants	215	24,572
Coho Salmon smolts consumed per individual cormorant	37	132
Steelhead/Cutthroat Trout smolts consumed per individual cormorant	85	41
Chum Salmon fry consumed per individual cormorant	97	Below detection levels
Chinook Salmon smolts consumed per individual cormorant	Below detection levels	117

There is considerable uncertainty associated with the point estimates presented in this table so only cautious interpretation should be applied. Nonetheless, in a general sense, per capita consumption of juvenile salmonids by cormorants is relatively similar between the two coastal estuaries. Consumption of individual salmonid species varies more dramatically, presumably reflecting differences in relative availability of the different salmonid types.

Literature Cited:

Lyons, D.E. 2010. Bioenergetics-based predator-prey relationships between piscivorous birds and juvenile salmonids in the Columbia River estuary. Unpubl. Ph.D. dissertation, Oregon State University, Corvallis, Oregon. Available on-line at [www.birdresearchnw.org](http://www.birdresearchnw.org).