

AVIAN PREDATION IN THE COLUMBIA RIVER ESTUARY: MONITORING MANAGEMENT OF CASPIAN TERNS AND EVALUATING IMPACTS OF DOUBLE-CRESTED CORMORANTS

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ABSTRACT

Implementation of the federal plan “Caspian Tern Management to Reduce Predation of Juvenile Salmonids in the Columbia River Estuary” was initiated in 2008 with construction of two alternative colony sites in interior Oregon: at Crump Lake in Warner Valley and at Fern Ridge Reservoir near Eugene. We deployed Caspian tern social attraction (decoys and sound systems) on these two 1-acre islands and monitored for Caspian tern nesting activity. Caspian terns (*Hydroprogne caspia*) quickly colonized the Crump Lake tern island and about 430 pairs nested there, including 5 terns that had been banded in the Columbia River estuary over 500 km to the northwest. The diet of Crump Lake Caspian terns, based on 2,909 identified bill-load fish, consisted primarily of tui chub (*Gala bicolor*) (59%), introduced bullhead catfish (*Ameiurus* spp.) (23%), and introduced crappie (*Pomoxis* spp.) (16%); however, 5 Warner suckers (*Catostomus warnerensis*) (0.17%), a threatened species, were also identified in the diet. No Caspian terns nested at the Fern Ridge tern island in 2008, but at least 9 different Caspian terns were present on the island late in the nesting season.

In addition to alternative Caspian tern colony sites in interior Oregon, island construction or enhancement is planned for the San Francisco Bay area. We researched the nesting ecology of Caspian tern colonies in the Bay area in preparation for potential colony expansion at Brooks Island in central San Francisco Bay near Richmond. The Brooks Island Caspian tern colony, at about 810 breeding pairs, is the largest in the Bay area, but about 10% of tern diets at this colony consist of juvenile salmonids (*Oncorhynchus* spp.). Consequently, fisheries managers are concerned that relocation of Caspian terns from the Columbia River estuary to Brooks Island might reduce survival of ESA-listed salmonids from the Sacramento River basin. A radio telemetry study of Brooks Island terns, combined with recoveries of smolt coded wire tags from the Brooks Island colony, revealed that nearly all salmonid smolts consumed by Caspian terns from this colony in 2008 were hatchery-reared, non-listed fall-run Chinook (*O. tshawytscha*) that were depredated near net pen release sites in San Pablo Bay.

In 2008, we also continued field studies to assess the impact on survival of juvenile salmonids from Caspian tern predation in the Columbia River estuary. The Caspian tern colony on East Sand Island, the largest of its kind in the world, consisted of about 10,700 breeding pairs in 2008, the highest estimate of colony size since this colony formed in 1999, but not significantly higher than the estimate in 2007. The proportion of juvenile salmonids in the diet of East Sand Island Caspian terns was 29% in 2008, similar to

the proportions in 2006 (31%) and 2007 (30%). Northern anchovy (*Engraulis mordax*) and surfperch (Embiotocidae) were the most prevalent non-salmonid prey types in the tern diet. Calculation of juvenile salmonid consumption by East Sand Island Caspian terns in 2008 is still in progress, but is likely similar to 2007, when terns consumed an estimated 5.5 million smolts (95% c.i. = 4.8 – 6.2 million).

East Sand Island is also home to the largest double-crested cormorant (*Phalacrocorax auritus*) colony in western North America. The colony consisted of about 10,950 breeding pairs in 2008, about 20% smaller than 2007 (ca. 13,770 breeding pairs). Despite the sharp and unexpected decline in colony size, nesting success was comparatively high at 2.3 young raised per breeding pair, and an adjacent colony of Brandt's cormorants (*P. penicillatus*) nearly doubled in size to 510 breeding pairs. Juvenile salmonids represented ca. 12% of double-crested cormorant diets in 2008, compared with 9% in 2007. Estimates of total smolt consumption by East Sand Island cormorants in 2008 are pending, but in 2007 East Sand Island cormorants consumed about 9.2 million juvenile salmonids (95% c.i. = 4.4 – 14.1 million), similar to the 2006 estimate (8.9 million). Of the estimated 9.2 million smolts consumed by East Sand Island cormorants in 2007, about 4.8 million were sub-yearling Chinook salmon, 2.7 million were coho salmon (*O. kitsch*), 1.3 million were steelhead (*O. mykiss*), and 1.1 million were yearling Chinook salmon. These species proportions are based on genetic analyses of salmonid tissues recovered from the stomachs of East Sand Island cormorants. During 2006 and 2007, losses of coho, steelhead, and yearling Chinook smolts to cormorant predation in the estuary were considerably higher than average annual losses during 1998-2005. Combined losses of salmonid smolts to double-crested cormorants and Caspian terns in the Columbia River estuary were approximately 14.7 million in 2007, about an order of magnitude greater than losses to avian predators elsewhere in the Columbia Basin.

Analyses of double-crested cormorant genetic structure indicate that the East Sand Island cormorant colony is part of a population that extends along the coast from the Strait of Georgia, BC to Pt. Conception, CA and inland to the Continental Divide. Additional samples collected in 2009 will better clarify the geographic extent of the population. In 2008, satellite tags were deployed on 28 adult double-crested cormorants nesting at East Sand Island in order to track post-breeding movements and identify possible alternative nesting areas. To date, satellite-tagged cormorants have been tracked to roost sites in the greater Puget Sound region (n = 6); the lower Columbia River between Longview, WA and Gresham, OR (n = 5); interior northern California (n = 2); and interior British Columbia along the Fraser River (n = 1). These preliminary results suggest that breeding colonies in NW Washington and SW British Columbia, many of which have declined in the last two decades, have contributed recruits to the East Sand Island cormorant colony. Research on the status of the Pacific Coast population of double-crested cormorants is on-going in preparation for potential cormorant management in the estuary to enhance survival of Columbia Basin salmonids.