MARINE ORNITHOLOGY

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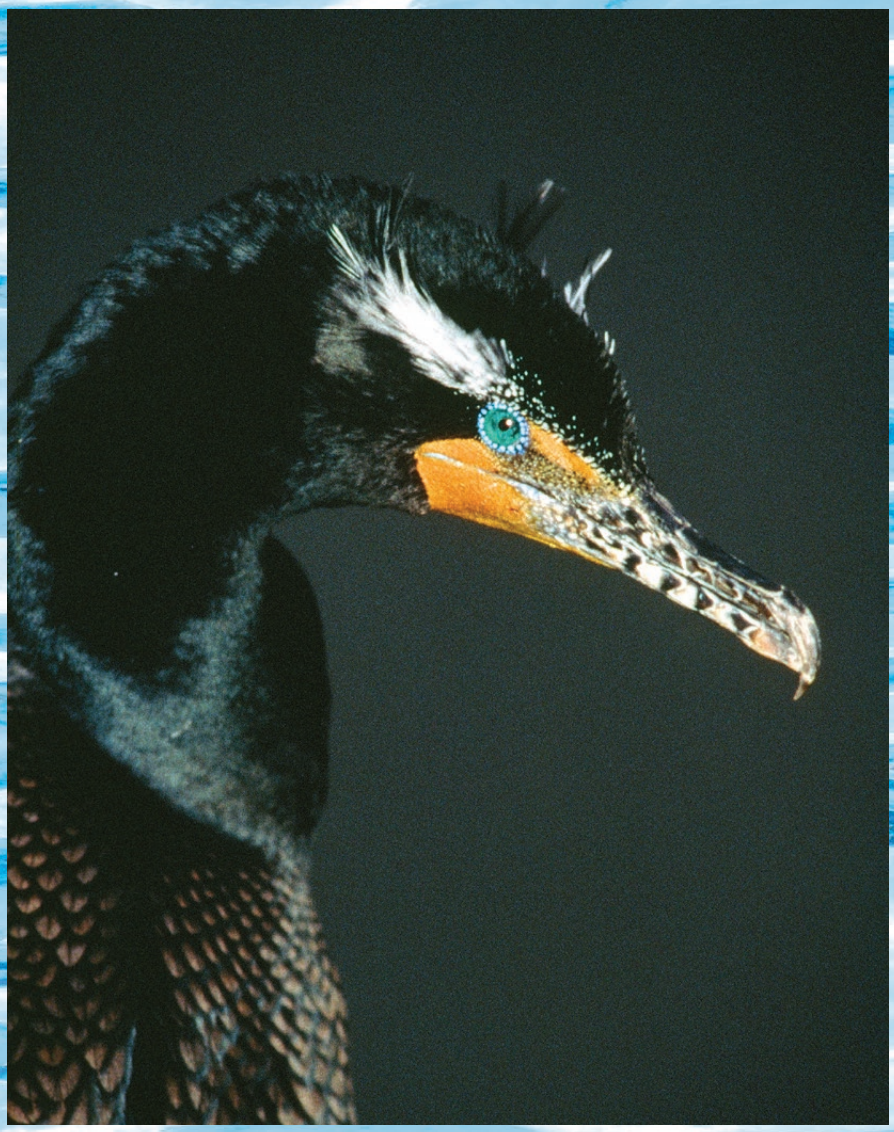

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Front cover picture: The white-plumed subspecies of the Double-crested Cormorant *Phalacrocorax auritus albociliatus*, once called the "Farallon Cormorant", on the Richmond-San Rafael Bridge, California, USA, circa 2000. (Photo: Mark J. Rauzon)

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CHANGES IN ABUNDANCE AND DISTRIBUTION OF NESTING DOUBLE-CRESTED CORMORANTS *PHALACROCORAX AURITUS* IN THE SAN FRANCISCO BAY AREA, 1975–2017

MARK J. RAUZON[1*], MEREDITH L. ELLIOTT[2], PHILLIP J. CAPITOLO[3], L. MAX TARJAN[4], GERARD J. McCHESNEY[5], JOHN P. KELLY[6] & HARRY R. CARTER[7†]

[1]*Laney College, Geography Department, 900 Fallon Street, Oakland, CA 94607, USA *(mrauzon@peralta.edu)*
[2]*Point Blue Conservation Science, 3820 Cypress Drive, #11, Petaluma, CA 94954, USA*
[3]*Institute of Marine Sciences, University of California Santa Cruz, 115 McAllister Way, Santa Cruz, CA 95060, USA*
[4]*San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA 95035, USA*
[5]*US Fish and Wildlife Service, San Francisco Bay National Wildlife Refuge Complex, 1 Marshlands Road, Fremont, CA 94555, USA*
[6]*Audubon Canyon Ranch, Cypress Grove Research Center, P.O. Box 808, Marshall, CA 94940, USA*
[7]*Humboldt State University, Department of Wildlife, 1 Harpst Street, Arcata, CA 95521, USA*
[†]*Deceased*

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ABSTRACT

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In the San Francisco Bay area, California, the Double-crested Cormorant *Phalacrocorax auritus* population has recovered from significant declines to reach breeding population sizes comparable to those from the late 19th century, when only one colony offshore at the South Farallon Islands (SFI) was known. The recent replacement of the bridge hosting one of the current largest colonies prompted a comprehensive assessment of Bay Area breeding population trends through 2017. Since the early 1970s, the Bay Area population has expanded from < 50 pairs at one site, SFI, to nearly 3 500 pairs at > 20 colonies, with breeding documented at 31 different locations. However, missing counts at many colonies before 2003 prevented calculation of precise, long-term growth rates. Expansion has been facilitated by cormorant adaptations to the urbanized estuary, including nesting on bridges, electrical towers, non-native trees, and managed pond levees. Breeding colonies that formed by 1984 on the San Francisco-Oakland Bay Bridge (SFOBB) and Richmond-San Rafael Bridge (RSRB) grew quickly, and in several different years totaled more than 1 000 nests. From 2003 to 2017, when construction of a new east span of the SFOBB (and demolition of the old span) was underway and when substantial maintenance of the RSRB occurred, the colonies on the bridges declined by 71 % and the overall Bay Area population declined by 39 %. The decline was likely due to reduced prey availability, although construction disturbance may have driven some birds from the bridges to colonies outside the region. On the Outer Coast, the colony at Hog Island was formed in 2001 and has become the largest in the study area since 2011. Nesting on artificial platforms installed on the new SFOBB east span in 2017 occurred only after demolition of the old span was complete, despite social attractions being in place since 2011.

Key words: San Francisco-Oakland Bay Bridge, Double-crested Cormorant, *Phalacrocorax auritus,* San Francisco Bay, regional expansion, urbanized estuary

INTRODUCTION

The Double-crested Cormorant *Phalacrocorax auritus* (DCCO) is widely distributed across North America (Wires & Cuthbert 2006, Dorr *et al*. 2014). About 21 000 breeding pairs were estimated in 2008–2009 within the Western population (west of the continental divide excluding Alaska and Mexico; USFWS 2017a), along the Pacific coast from British Columbia through California. The largest colony—at East Sand Island (ESI) in the Columbia River Estuary, Oregon—accounted for 57 % of nests. The population in the San Francisco Bay area (Bay Area), including the offshore colony at the South Farallon Islands (SFI), was a distant second, accounting for 10 % of Pacific coast breeders (Adkins *et al*. 2014). The estimated nest total along the Pacific coast in 2008–2009 was about 68 % higher than the total in 1987–1992 (Adkins *et al*. 2014), which itself represented a substantial increase in nests since the 1970s (Carter *et al*. 1995).

Declines in Double-crested Cormorant nests throughout North America in the 19th century, and again in the 1950s–1970s, were due, in part, to anthropogenic activities, including disturbance to nesting colonies, fisheries depletion, and eggshell thinning from DDT pollution (Dorr *et al*. 2014). The elimination of organochlorine pesticides in the early 1970s reduced their deleterious effects on cormorant reproduction. Several additional factors have contributed to substantial population recovery, especially among Interior, Atlantic, and Southeast populations. Human disturbance has been reduced and food availability has increased through aquaculture, stocking of water bodies with hatchery-reared fish, introductions of invasive fish species, and overfishing of large predatory fish that compete with cormorants (Hatch 1995, Wires *et al*. 2001). This recovery has led to conflict with commercial and recreational fishing interests, resulting in the permitted take of DCCO in 37 central and eastern states (USFWS 2017b). In the Western