

*Interior.* Nearly 70 percent of the DCCO breeding population is found in the Interior region (Tyson *et al.* 1999), which reaches across the prairie provinces of Canada, includes the Canadian and U.S. Great Lakes, and extends west of Minnesota to southwestern Idaho (Wires *et al.* 2001). Interior DCCOs are strongly migratory and, in the breeding months, are concentrated in the northern prairies, with the Canadian province of Manitoba hosting the largest number of breeding DCCOs in North America (Wires *et al.* 2001). Additionally, large numbers of Interior DCCOs nest on or around the Great Lakes (Hatch 1995, Wires *et al.* 2001). Since 1970, when 89 nests were counted during a severe pesticide induced population decline (Weseloh *et al.* 1995), DCCO numbers have increased rapidly in the Great Lakes, with breeding surveys in 2000 estimating 115,000 nests there (Weseloh *et al.* 2002). From 1990 to 1997, the overall growth rate in the Interior region was estimated at 6 percent with the most dramatic increases occurring in Ontario, Michigan, and Wisconsin. The Interior population (including Canada) numbers  $\geq 256,212$  breeding pairs (Tyson *et al.* 1999).

*Southern.* The Southern region includes Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas (Wires *et al.* 2001). Most DCCOs in this region are winter migrants from the Interior and Atlantic regions; the number of these wintering birds has increased dramatically in recent years (Dolbeer 1991, Glahn and Stickley 1995, Jackson and Jackson 1995, Glahn *et al.* 2000). Surveys conducted by APHIS/WS biologists suggest that winter numbers in the delta region of Mississippi have increased by nearly 225 percent since the early 1990s (over 73,000 DCCOs were counted in the 2001–2002 winter surveys; G. Ellis, unpubl. data). Breeding DCCOs in this region are also on the rise, with some nesting occurrences representing first records and others recolonizations (Wires *et al.* 2001). Today, approximately 4 percent of the DCCO breeding population occurs in this region, numbering  $>13,604$  breeding pairs with an estimated annual growth rate of 2.6 percent (Tyson *et al.* 1999).

#### *Pacific Coast and Alaska.*

Approximately 5 percent of the DCCO breeding population is found along the Pacific coast (Tyson *et al.* 1999), which extends from Alaska down the coastline to Mexico and includes some inland colonies (Wires *et al.* 2001). Numbers were most recently estimated at  $\geq 17,084$

breeding pairs with approximately 12 percent in Alaska (Tyson *et al.* 1999). Along the coast from British Columbia to Mexico, past estimates numbered nearly 22,000 nesting pairs (Hatch 1995). However, significant changes occurred in the 1990s, with large increases documented at the Columbia River estuary (Oregon) and inland at the Salton Sea (California) and sharp declines observed in coastal British Columbia and Washington (Wires *et al.* 2001). Tyson *et al.* (1999) estimated the annual rate of change of the Pacific Coast DCCO population (including Alaska) at  $-7.9$  percent.

#### **Impacts of Double-Crested Cormorants on Public Resources**

*Fish.* Effects of DCCO predation on a given fish population are dependent on variables including the number of birds present, the time of year at which predation is occurring, prey species composition, and physical characteristics such as depth or proximity to shore (which affect prey accessibility). Environmental and human-induced factors that affect fish populations can be classified as biological (*e.g.*, overexploitation, exotic species, etc.), chemical (*e.g.*, water quality, nutrient and contaminant loading, etc.), or physical (*e.g.*, dredging, dam construction, hydropower operation, siltation, etc.). Such activities may lead to changes in species density, diversity, or composition due to direct effects on year-class strength, recruitment, spawning success, spawning or nursery habitat, or competition (USFWS 1995). Based on a review of the DCCO diet literature, commercially and recreationally valuable fish do not generally make up a large proportion of DCCO diet but there are localized exceptions (Trapp *et al.* 1999, Wires *et al.* 2001). While increasing DCCO populations do not appear to be causing widespread negative impacts to fish populations, there is evidence that DCCO predation has had a detrimental effect in some areas. For example, research efforts in New York's Oneida Lake and eastern Lake Ontario have examined data on DCCO diets and fish populations and concluded that cormorant predation is likely a significant source of fish mortality negatively impacting recreational catch (Adams 1999, Rudstam 2000, Lantry *et al.* 1999).

Literature on DCCO feeding habits and fisheries impacts has shown that: (1) DCCOs are a generalist fish predator with prey selection varying opportunistically throughout the seasons and among locations; (2) present composition of cormorant diet

has been strongly influenced by human-induced changes in the natural balance of fish stocks; (3) an impact can occur at different scales, such that ecological effects on fish populations are not necessarily the same as effects on recreational or commercial catches, or vice versa; (4) cormorant impact is generally most significant in artificial, highly managed situations; (5) cormorant diet typically consists of low percentages of sport fish, but conclusions about fisheries impacts cannot be based on diet studies alone; and (6) conflicts with cormorants will vary locally since ecological conditions vary locally.

*Other Birds.* Weseloh *et al.* (2002) observed that nesting DCCOs could impact other colonial waterbirds in at least three ways: by DCCO presence limiting nest site availability, by DCCOs directly taking over nest sites, or by falling guano and nesting material from DCCO nests leading to the abandonment of nests below. Habitat destruction is another concern reported by biologists (USFWS 2001). The significance of DCCO-related effects on other birds varies with scale. While large-scale impacts on regional or continental bird populations have not been documented (Cuthbert *et al.* 2002), there is evidence that species such as black-crowned night herons, common terns, and great egrets can be negatively impacted by DCCOs at a site-specific level (Jarvie *et al.* 1999, Shieldcastle and Martin 1999, USFWS 2001, Weseloh *et al.* 2002). Biologists from several States and provinces have reported or expressed concern about impacts to other bird species associated with increased cormorant abundance (Wires *et al.* 2001, USFWS 2001).

*Vegetation and Habitat.* Cormorants destroy their nest trees by both chemical and physical means. Cormorant guano, or excrement, is highly acidic and kills ground vegetation and eventually the nest trees. In addition, cormorants damage vegetation by stripping leaves for nesting material and by breaking branches due to the combined weight of the birds and their nests. Vegetation and habitat destruction problems tend to be localized in nature. For example, resource professionals from the Great Lakes region are concerned about loss of plant diversity associated with increasing cormorant numbers at some breeding sites (Weseloh and Ewins 1994, Moore *et al.* 1995, Lemmon *et al.* 1994, Bédard *et al.* 1995, Shieldcastle and Martin 1999).

*Aquaculture.* Cormorant depredation at commercial aquaculture facilities, particularly those in the southern catfish-producing region, remains