Detection: Brandt's Cormorants can readily be seen on breeding colonies from Apr to Aug. The easiest sites for viewing are Yaquina Head, Lincoln Co., Heceta Head, and Sea Lion Caves, Lane Co., and offshore rocks at Bandon, Coos Co. During the rest of the year they can be seen in estuaries and close to shore in the open ocean.

Population Status and Conservation: World population size unknown. Boekelheide et al. (1990c) listed 75,639 breeding pairs in N. America for 1965-79 but this includes only 79 pairs from Oregon. In 1979, 16,188 breeding birds were counted in Oregon (Pitman et al. 1985), and in 1988, 22,816 were recorded nesting (USFWS unpubl. data). In 1979 the largest colony was on the mainland at Sea Lion Caves, where 4,502 birds were counted. The second-largest colony was Bird Rocks, Clatsop Co., with 1,450 birds; a further 21 sites had more than 100 pairs (Pitman et al. 1985). In 1988 the largest breeding colonies were Bird Rocks with 3,100 breeders and the mainland colony at Heceta Head, Lane Co., with 1,840 birds (USFWS unpubl. data). Care must be taken in interpreting changes in numbers at specific sites as Brandt's Cormorant colonies vary from year to year in size and location (Boekelheide et al. 1990c). For example, in 1979 no birds bred at the mainland Heceta Head colony (Pitman et al. 1985), whereas in 1988 the mainland Sea Lion Caves colony had only 628 breeding birds (USFWS unpubl. data).

It appears the population is increasing in Oregon. Anecdotal evidence suggests that prior to the 1960s birds were shot in Oregon to reduce perceived competition with humans. This likely served to lower population numbers.

Disturbance on nesting colonies is the most serious threat to Brandt's Cormorants, which readily desert nests during incubation. Since 1994, Bald Eagles have caused abandonment of nests along the n. Oregon coast (R. Lowe p.c.). Seven eggs collected in Oregon in 1979 had low PCB and DDE concentrations (Henny et al. 1982). In Sept 1991 large numbers of Brandt's Cormorants in Monterey Bay, California, exhibited symptoms of domoic acid poisoning, and some birds died from the toxin produced by the diatom *Pseudonitzschia australis* (Fritz et al. 1992).—*Jan Hodder*

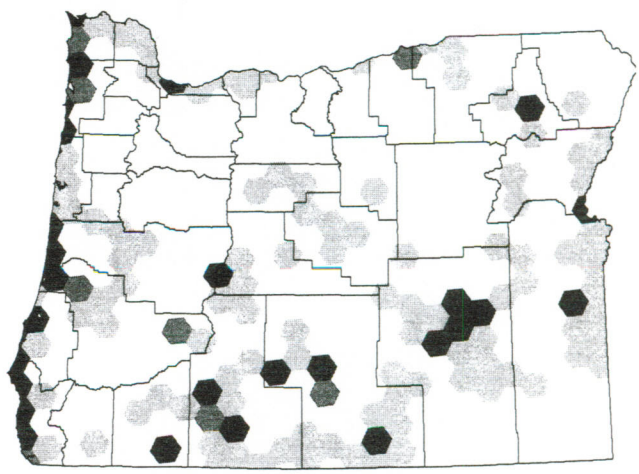
Double-crested Cormorant

Phalacrocorax auritus

Adaptable and opportunistic, this species is the most abundant and widespread of the three cormorant species found in Oregon, occurring inland and on the coast (Brand 1982, Harrison 1983). Adults have deep, coppery feathers, bordered in black, that glisten with a green iridescence and offset a rich orange throat atop a long curved neck. The bird earns its name from plumes, ranging from white to black, that crown either side of the head during the breeding season (Gabrielson and Jewett 1940, Brand 1982, Harrison 1983, Hatch and Weseloh 1999).

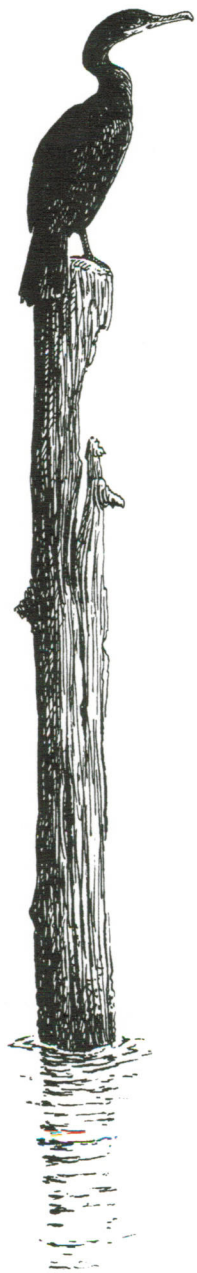
General Distribution: Common breeder along the coasts of N. America, from the Aleutian Is. and Newfoundland, south to nw. Mexico and the Gulf coast. Inland, from Great Lakes west through the prairies of Canada and nc. U.S., with smaller numbers in mid-Atlantic and se. U.S. states. Some Pacific coast populations are resident, but considerable migration is evident among others, with dispersal south to se. California, Sinaloa and Nayarit, Mexico, and a portion northward in British Columbia. Four N. American subspecies, *albociliatus* occurs on the W. Coast south of s. British Columbia (AOU 1957), but the subspecies east of the Cascades needs to be determined (*MRB*).

Oregon Distribution: Common breeder in spring and summer at bays and estuaries, and on islands and cliffs along the coast and lower Columbia R. (Carter, Sowls, et al. 1995, R. Lowe p.c.). Smaller breeding populations are present along the upper Columbia and Snake rivers, and other large rivers, shallow lakes, marshes, and reservoirs in the s. Cascades and se. Oregon. Breeding sites for multiple years include Siuslaw and Umpqua river estuaries, Crane Prairie Res., Deschutes Co., Upper Klamath NWR, Malheur NWR, Pelican L. (Warner Valley), and Summer L. W.A. Migrant and wintering birds are uncommon to sometimes abundant along the coast, on larger rivers, lakes, and reservoirs in w. Oregon, particularly in the Portland area, the lower Columbia R., and c. and s. Cascades. A few winter east of the Cascades on unfrozen water bodies (Gabrielson and Jewett 1940, Thompson et al. 1979, Ryser 1985, Gilligan et al. 1994, Contreras 1997b, Hatch and Weseloh 1999), but generally considered absent in winter from se. Oregon (Brand 1982, Stern 1988, Littlefield 1990a, Gilligan et al. 1994, Contreras and Kindschy 1996,



Marheine et al. unpubl. data, OBBA, ONHP 1999). However, M. Denny (p.c.) reports small numbers winter along the Snake R. from Farewell Bend southward, Malheur Co. Occasional spring and summer transient in ne. Oregon (Evanich 1992a).

Habitat and Diet: The Double-crested Cormorant breeds in colonies. Prefers isolated sites on or adjacent to water, but rarely seen far from land (Hatch and Weseloh 1999, ONHP 1999). On the coast, nests are perched on pilings, channel markers, rocks, and cliff ledges; in conifers at river mouths; and on bare ground, sand, and mats of emergent vegetation on islets, dredged material, and offshore rocks (*SEM*). Freshwater rookeries are found on floating bog marshes (J. Hainline p.c.), nestled among scattered greasewood shrubs and desert saltgrass on lake islands, and in hardstem bulrush stands (Thompson et al. 1979, Ryser 1985, Stern 1988, Malheur NWR files, *DBM*). Before the 1983 floods at Malheur L., nesting took place in hardstem bulrush stands. By 1983 all nesting cormorants had moved to tree sites (G. Ivey p.c.). As tree-nesting options diminished, they later moved to island colonies, nesting with pelicans, gulls, and terns. Nests are assembled from sticks, twigs, grasses, weeds, and tules, topped by a profuse layer of guano (Gabrielson and Jewett 1940, Siegel-Causey and Hunt 1986). New nest may be built, or a used one refurbished by adding a tier of fresh material (Ryser 1985).



Double-crested Cormorant

Throughout the year, roost on rocks, pilings, and other protruding structures. D. Lusthoff (p.c.) has observed 150-200 roosting in winter on power line towers at The Dalles Dam, Wasco Co.

Seldom forage in the ocean (D. Fix p.c.). These cormorants feed opportunistically on aggregated or readily caught fish (Brand 1982, Roby et al. 1998, Hatch and Weseloh 1999). Foraging flocks may form lines and circles to herd and condense prey aggregations (Nelson 1979). During daylight, dive from surface in pursuit of prey, using totipalmate feet to propel underwater for a peak recorded duration of 70 sec (Lewis 1929, Mendall 1936, Palmer 1962, Ryser 1985, Johnsgard 1993, King et al. 1995). Known to dive as deep as 72 ft (22 m), but most forage in water <33 ft (10 m) deep (Palmer 1962, Knopf and Kennedy 1981).

Seasonal Activity and Behavior: Birds arrive as early as Feb at Malheur (Malheur NWR files) and Upper Klamath breeding grounds (Gilligan et al. 1994); nesting generally commences in Apr (Gabrielson and Jewett 1940, OBBA, Roby et al. 1998). First breed at 2-3 yr, laying 2-8, usually 3-5 pale-blue eggs (Palmer 1962, Brand 1982, Siegel-Causey and Hunt 1986, Roby et al. 1998). Frequently nest alongside White Pelicans and Great Blue Herons in s. Oregon (*SEM*). Both sexes participate in nest building, incubation, and feeding of young (Ryser 1985); egg dates are Apr-Jul (Palmer 1962, Harrison 1983, Roby et al. 1998). Renesting is common following loss of clutch or brood to disturbance (ONHP 1999).

Young are altricial, fledge at 6-8 wk, and are fully independent at 9-10 wk (Reilly 1968, Johnsgard 1993, Hatch and Weseloh 1999). There is some migration, beginning in Aug (Bent 1922, Reilly 1968, Bayer and Lowe 1995), to the Columbia R. (east to Tri-cities area), n. Willamette R., freshwater sites west of the Cascades, and marine locations extending from British Columbia to the Gulf of California. Departures peak mid-Sep to mid-Nov; birds concentrated in winter areas by Dec (Bent 1922, Reilly 1968, Bayer and Lowe 1995).

Detection: Easily observed at many breeding colonies, though some require a boat or plane to census. Birds nesting in trees can be identified by dead or decaying limbs and underbrush caused by accumulations of guano. On the water, this species often resembles a periscope with only its long neck and up-tilted head visible above the surface (*SEM*). Migrant flocks often seen along coast Sep-Nov (Bayer and Lowe 1995).

Population Status and Conservation: The Double-crested Cormorant has flourished over the past two decades after being almost decimated throughout its N. American range (Hatch 1995, Krohn et al. 1995). Recent population expansion can be attributed, in part, to its efficiency in adapting to anthropogenic environments, such as dams, dredged material, hatcheries, and aquaculture facilities (Nettleship and Duffy 1995). In addition, reductions in pollutants, persecution, and disturbance have resulted in dramatic increases in Double-crested Cormorants since the mid-1970s (Carter, Sowls, et al. 1995, Roby et al. 1998). About 6,249 pairs nested in coastal Oregon in 1991-92 compared to 989 in 1979 (Carter, Sowls, et al. 1995). East Sand I. in the Columbia R. estuary supports the largest colony on the Pacific coast of N. America peaking at 7,242 breeding pairs in 1999

(Collis et al. 1999). A complete census of marine populations has not been conducted since 1992, but current observations indicate that total coastal numbers have risen slightly (*KC*). Interior populations fluctuate with water levels, inclement weather, and disturbance. Malheur NWR averaged 60 breeding pairs/yr in the 1970s, 629 in the 1980s, and 307 during 1990-98 (Thompson et al. 1979, Malheur NWR files, G. Ivey p.c.). Upper Klamath NWR averaged 675 pairs in the late 1980s, decreasing slightly to 535 in the 1990s (no estimates available for 1995, 1996, or 1998) (Klamath Basin NWR unpubl. data, J. Hainline p.c.). Summer L. supported 35-60 pairs/yr in the early 1990s, and 16-36 1998-2000 (Summer L. W.A. files). Crane Prairie had 53 pairs in 1998 and 61 in 1999 (C. Heath p.c.).

As its numbers increased, so did concern for its impact on commercial and recreational fisheries. Studies conducted in Oregon concluded that avian predation can have an effect on survival of juvenile salmonids and, potentially, the recovery of listed salmonid stocks, but ocean conditions, habitat modifications, harvest, and hatchery stock release practices are also contributing factors (Brand 1982, Bayer 1989b, Schaeffer 1992, Independent Multidisciplinary Science Team 1998, Roby et al. 1998).

Killing cormorants has been illegal under federal law since 1972 (Oregon State Game Commission 1971). In 1988, ODFW granted commercial boats permits to harass cormorants at Nehalem and Tillamook bays to reduce predation on hatchery-released salmon and steelhead smolts (Bayer 1989b). In 1995, the Oregon Legislature legalized the harassment of cormorants in Tillamook Co. estuaries (ORS 498.247, Carter, Sowls, et al. 1995).—*Shelley Espeland Matthews, David P. Craig, Ken Collis, and Daniel D. Roby*

Pelagic Cormorant *Phalacrocorax pelagicus*

Seemingly misnamed, Pelagic Cormorants are rarely seen far from land. During the breeding season the distinct white flank patches contrast markedly with their black plumage. In bright light the slender neck has a purple iridescent sheen, and the back shines green accenting white filoplumes. They nest on cliff ledges.

General Distribution: Breeds from the s. Chukchi Sea south through the Bering Sea to the Aleutian Is., and along the Pacific coast to n. Baja California, and from Wrangel I. east along the Arctic coast of Siberia to the Bering Strait and south to n. Japan. Winters from the Aleutian Is. south to c. Baja California and from Kamchatka south to China. Two subspecies; *P. p. resplendens* occurs in Oregon (AOU 1957).

Oregon Distribution: Common year round along the entire coast; not found away from salt water. Breeds where rocky cliffs with ledges are present; does not breed along the sandy coast from Coos Bay to Florence. The colony at Cape Foulweather, Lincoln Co., is one of the largest on the Pacific coast with up to 925 breeding birds (R. Lowe p.c.), but most breeding colonies tend to be much smaller. This species is seen in estuaries during all months; no distinct migrations. Not found inland away from salt water.

Habitat and Diet: Nearshore marine and estuarine. They nest in loose colonies on ledges on vertical cliffs on rocky islands and headlands. In British Columbia and Washington they have habituated to nesting on human-made structures such as lighthouses, docks, pilings, and bridges (Hobson and Wilson 1985), but such nesting is rare in Oregon and occurs only on the Yaquina and Alsea Bay bridges. Nest is constructed of terrestrial vegetation and algae cemented to the cliff ledge with excrement; both sexes contribute (Hobson 1997). Some are built inside caves. In British Columbia some colony sites not used each year (Carter et al. 1984). Roost on islands, cliffs, logs, pilings, and sandbars (Hobson 1997). Occasionally range several miles up large estuaries.

Foot-propelled divers, they have been caught in fishing nets set at 100 ft (35 m) (Johnsgard 1993). Average dive time at Barkley Sound, British Columbia, was 35 sec (Hobson and Sealy 1985). Diet is particularly difficult to determine as birds capture and often swallow prey underwater. Likewise it is difficult to determine chick diet as chicks feed by placing their heads into the adult's mouth and throat to eat regurgitated food. Little information is available for Oregon populations. Stomach contents of 12 adults from Newport were empty or contained cottids (Scott 1973). Contents of six stomachs from Washington contained flounder, sculpin, herring, and smelt (Jewett et al. 1953). In California, nesting birds feed on non-schooling fish and decapod crustaceans in rocky reef or sand/mud areas within a few miles of nest site (Ainley et al. 1981). No data on nonbreeding season diet for any area, and no information on chick diet in Oregon. In British Columbia, gunnels, sandlance, clingfish, sculpins, pricklebacks, and shrimp were fed to chicks (Robertson 1974). When food is abundant, participate in multispecies feeding flocks initiated by gull activity (Scott 1973, Chilton and Sealy 1987). Adults and fledging-age chicks regurgitate a pellet of indigestible materials almost daily, usually just before dawn. The presence of nematodes in the pellet suggests regurgitation may function as a parasite control (Ainley et al. 1981).

Seasonal Activity and Behavior: Detailed studies of breeding biology throughout its range are rare as only