

Han River and of the Nagdong River and the mudflat of Incheon on the western seashore. These three places (307 km²) occupy only 0.03% of the total area (98 000 km²) of South Korea. These three places must be preserved for wildlife by all means.

There are a number of ponds, reservoirs and mudflats where a considerable number of waterfowl regularly visit or winter, such as Paldang Reservoir in Gyeonggi Province, two reservoirs in Changweon-gun, Gyeongnam Province, Dunjeon Reservoir in Chindo-gun, Jeonnam Province, and the mudflat of Suyu-ri in Gunnaemyeon, Jindo-gun, Jeonnam Province, and Seongsanpo and Kosan Reservoirs in Jeju Island, Jeju Province. Proper conservation of these areas should be established soon.

Of all 372 species of birds hitherto recorded in Korea, half, 186 species, rely on water or wetlands for life. Among these, 34 species have nearly lost their habitats and at least 20 are now faced with extinction. Positive measures to save these species by securing their habitats should be undertaken immediately.

Summary

Swan wintering habitat has been greatly reduced in Korea and the principal remaining site is the Nagdong Delta. Details are given of recent sightings of *Cygnus olor*. Three wetlands have been designated Natural Monuments and conservation measures are needed at other sites.

Pyong-oh WON
Institute of Ornithology
Kyung Hee University
Seoul 131
Korea

NUMBERS OF SWANS WINTERING IN THE UNITED STATES

J C BARTONEK, W W BLANDIN, K E GAMBLE and H W MILLER

Introduction

Four swans winter within the United States, ie the native *Cygnus columbianus columbianus*, *C. cygnus buccinator* and *C. cygnus cygnus* and the feral *C. olor*. In this paper we present summary data on their numbers as measured by Midwinter Waterfowl Surveys and discuss trends of various populations.

Numbers of swans and other waterfowl are estimated generally in January during

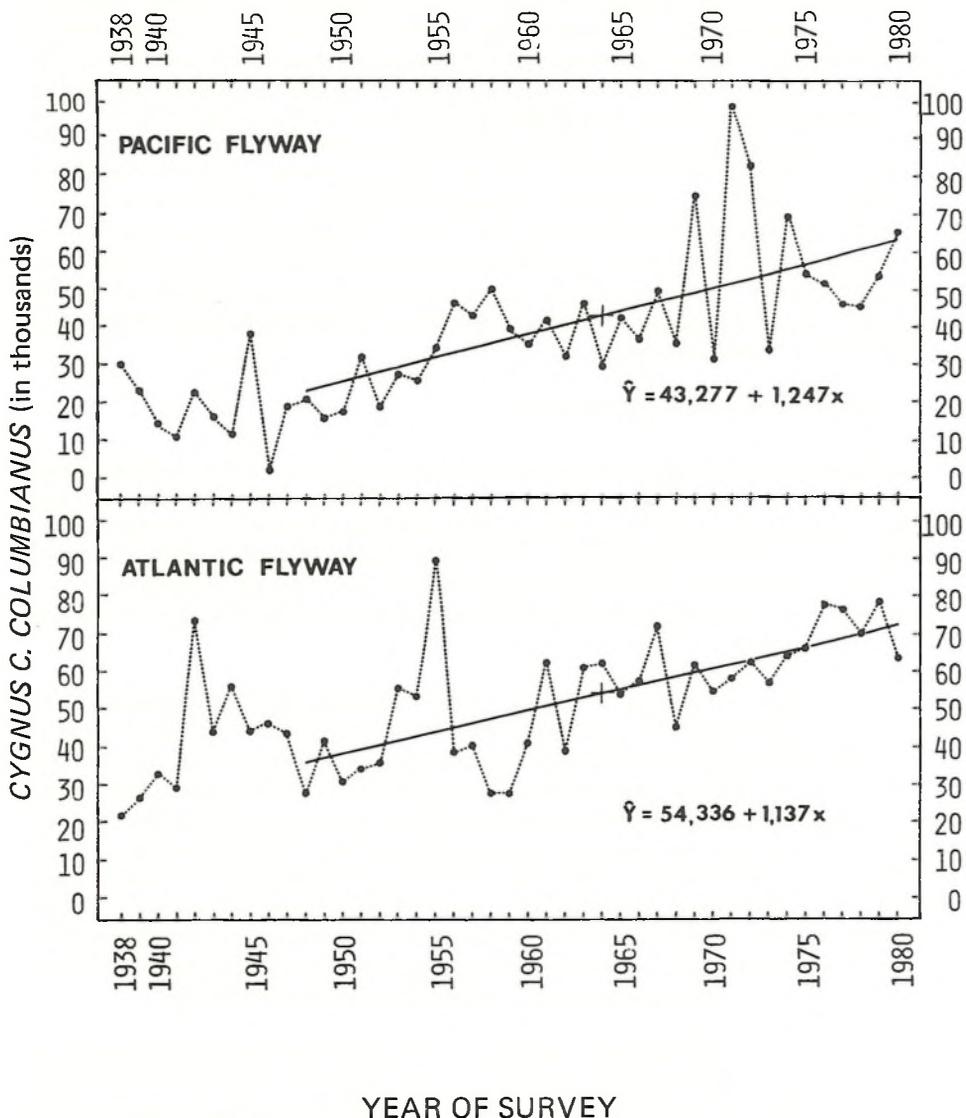


Figure 2. Numbers of *Cygnus c. columbianus* counted in the Pacific and Atlantic Flyways during Midwinter Waterfowl Surveys (usually conducted in January), 1938–80.

the federal-state co-operative Midwinter Waterfowl Survey which has been undertaken throughout the conterminous United States since 1935. Counts of wintering waterfowl in Alaska were attempted for only a few years in the 1950s. Observers count from aeroplanes, automobiles, boats and on foot. While originally intended to enumerate all waterfowl wintering in the nation, this survey proved practical to estimate numbers of waterfowl mainly in areas where they habitually wintered in large numbers. Among its several uses, the survey provides indices to populations of many species, and for *C. c. columbianus* it is believed to provide a reasonable assessment of their total numbers. Coverage of areas, manner of survey, and effort expended have been more or less consistent since 1948; since then data were more reliable for comparisons than those from earlier surveys. Because an unmeasured amount of the year-to-year differences between estimates can be attributed to weather's effect on habitat which in turn affects distribution of birds, these data reflect flyway- and nation-wide long-term trends in populations better than either state-wide or annual changes.

Cygnus columbianus columbianus

Most numerous of the North American swans, *C. c. columbianus* has averaged about 124 000 birds during 10 winter surveys from 1970 to 1979. The Atlantic and Pacific Populations constitute 58% and 42% respectively of the nation's population, with only fractional percentages wintering in Alaska (Fig 1). Canada, primarily British Columbia and secondarily those provinces bordering the Great Lakes, may winter 1% or 2% of the species' population. Swans are irregularly observed during surveys in Mexico.

Atlantic swans winter mostly in and about Chesapeake Bay in Maryland, North Carolina and Virginia. The primary terminuses of the Pacific Population are in California's Sacramento Valley, the delta of the Sacramento and San Joaquin Rivers and San Francisco Bay, with the lower Columbia River in Oregon and Washington and the Great Salt Lake marshes in Utah being secondary. A small but distinct and most likely unique population, perhaps fewer than 200 birds, winters on the Alaska Peninsula (John E Sarvis pers. comm.), with 700 miles separating them from the nearest flock. Areas in other states and flyways are indispensable during migration, and some will host above-average numbers of swans throughout mild winters. Wintering areas, migration routes, stopovers and breeding grounds of these swans have been adequately described (eg Bellrose 1978, Palmer 1976).

Numbers of *C. c. columbianus* counted in Midwinter Waterfowl Surveys since the winter of 1937/38 are shown in Fig 2. From 1948 to 1980 (33 winters) the Atlantic Population averaged about 54 000 swans with an average annual increase of about 1100 birds, and the Pacific Population averaged about 43 000 swans with an average annual increase of about 1200 birds. Erratic counts in the Pacific Flyway, particularly in the early 1970s and in the Atlantic Flyway during much of the 1950s, cannot be attributed solely to changes in survival and recruitment rates

but in part reflect imperfections of the surveys.

Cygnus cygnus buccinator

C. c. buccinator is segregated into Pacific and Midcontinent Populations. The Pacific Population breeds entirely in Alaska and winters in coastal areas from southeastern Alaska through British Columbia and Washington to Oregon. The Midcontinent Population breeds in that area where Montana, Idaho and Wyoming join boundaries, in southern Saskatchewan, western Alberta and more recently in eastern British Columbia. The Midcontinent Population winters in its entirety in that same tri-State area, primarily Red Rock Lakes, Henry's Fork of the Snake River and Yellowstone National Park. Additionally, there are small but locally important 'refuge flocks' of *C. c. buccinator* breeding in and wintering near National Wildlife Refuges in Washington, Oregon, Nevada, Wyoming and South Dakota. In an effort to prevent the demise of the species, these flocks were established beginning in the 1930s from swans taken from their then only known stronghold, the Red Rock Lakes National Wildlife Refuge.

The Midwinter Waterfowl Surveys tallied an average of 1041 *C. c. buccinator* wintering in the conterminous United States during the period 1971–80 (Fig 1). Average counts in Idaho, Montana and Wyoming were 412, 217 and 54 respectively. Coverage of the Midcontinent Population's wintering area was incomplete because the densities of other waterfowl did not warrant the additional costs and efforts to achieve the needed coverage. Washington and Oregon averaged 178 and 34 respectively during the 10 years; but intermingling of the Pacific Population with those of refuge flocks confounded differentiation between the groups. Increases in Washington's *C. c. buccinator* from about 100 to nearly 400 during this period more likely reflects an increasing awareness and recognition of Pacific Population *C. c. buccinator* amongst the *C. c. columbianus* than an actual increase in population. Nevada's Ruby Lake National Wildlife Refuge flock averaged 25 *C. c. buccinator*, with a high of 38 recorded in 1971. The flock at LaCreek National Wildlife Refuge in South Dakota has averaged 121 swans, with a high of 201 swans in 1979.

The Midwinter Waterfowl Survey as it has been conducted does not adequately provide the information needed to monitor the status of the small (about 1000 birds) and potentially precarious Midcontinent Population of *C. c. buccinator*. A few will most likely be found outside traditional wintering areas once observers can better distinguish them from *C. c. columbianus*, eg in Utah (Bartonek 1966) and North Dakota (Cowardin and Bartonek 1968). The Pacific Population is best counted during late summer on its breeding grounds in Alaska rather than during winter when foul weather in coastal areas would preclude most surveys. The five-year interval between current surveys in Alaska seems adequate to monitor the status of this more abundant (nearly 5000 birds) and widely dispersed population.

Cygnus cygnus cygnus

This swan winters in the western and central Aleutian Islands of Alaska. Although there has been no comprehensive survey, this population is estimated to number about 300 or 400 birds. The habitat is remote, seldom visited by man, and secure in that it is entirely within the Aleutian Islands National Wildlife Refuge. The specific breeding ground and migration route of this small population are not known. While *C. c. cygnus* are sighted in western Alaska at other times and elsewhere in North America, these other occurrences are of greater interest than significance.

Cygnus olor

C. olor escaping and being released from ornamental and avicultural flocks has become established in the wild in many states and poses threats to wintering and in some cases breeding native swans. Because *C. olor* is not hunted and mostly non-migratory, it has been largely ignored or misidentified during Midwinter Waterfowl Surveys. Although the populations of *C. olor* are poorly defined by these surveys, other evidence suggests that they are increasing in size and range.

In the Atlantic Flyway, during 1975–79 when absolute rather than rounded numbers of waterfowl were reported, midwinter surveys tallied an average of 2424 *C. olor* (Fig 1).

C. olor in the Mississippi Flyway is irregularly reported in Midwinter Waterfowl Surveys but, nonetheless, constitutes possibly the majority of the flyway's wintering swans. Michigan, particularly the northern part of the Lower Peninsula in Traverse Bay, wintered 1080 in January 1979 (Gerald F Martz pers. comm.). Wintering *C. olor* has been identified in Minnesota, Wisconsin and Indiana, with many other states possibly having the species but not distinguishing it from *C. c. columbianus* and possibly *C. c. buccinator*. *C. olor* was introduced and has become established in reclaimed coal fields of Illinois (John W Ellis pers. comm.) but is not inventoried.

C. olor has not been reported in the Central Flyway but is becoming established in the Pacific Flyway. As many as 30 feral swans, possibly originating from birds near Livingston, Montana, are expanding their range into already crowded breeding and wintering habitats of *C. c. buccinator* in the tri-state area (Ruth E Shea pers. comm.). If any of these *C. olor* were identified during Midwinter Waterfowl Surveys they went unreported. Richard C Parker (pers. comm.) reports that *C. olor* escaping from captive flocks is irregularly observed wintering in the Puget Sound area of Washington. He also observed a male *C. olor* with its *C. c. columbianus* mate and their progeny wintering near Skagit Flats. The pair had apparently nested somewhere in Alaska. The hybrid swans but not the parent *C. olor* were observed during the following winter. During the 1978 survey, two and three *C. olor* were counted in Idaho and Oregon respectively.

In states of the Mississippi and Atlantic Flyways numbers of waterfowl estimated during Midwinter Waterfowl Surveys are rounded to the nearest 100 birds or called 'trace' when the number is 50 or less. While this procedure may be both practical for reporting the more abundant species and appropriate when considering the impreciseness of the survey and estimates, it nevertheless obscures changes in status of the less abundant species such as *C. c. buccinator* and *C. olor* at both state and flyway levels. We recommend that absolute values, rather than rounded or trace, be reported for these less common species. Also those waterfowl species that are lumped into a 'miscellaneous' category because they are uncommon should be identified so that potentially important information on zoogeographic changes, as with that on *C. olor*, will not be sacrificed for convenience.

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Summary

Numbers of native *Cygnus columbianus columbianus* and *Cygnus cygnus buccinator* and feral *Cygnus olor* as measured during nation-wide January surveys are reported by state and by flyway for each year from 1948 to 1980. Additional data, beginning in 1936, are available for certain states in the Pacific Flyway. Trends in numbers and distribution of these wintering swans are discussed. The status of wintering *C. c. cygnus* and the irregular occurrence of other species are also discussed.

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J C BARTONEK
US Fish and Wildlife Service
Office of Migratory Bird Management
Washington DC 20240
USA