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A continental study of Whistling Swans using neck collars

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Four species of swan occur in North America. The Trumpeter Swan *Cygnus buccinator* (from Alaska to Wyoming) and the Whistling Swan *C. columbianus columbianus* are native species. The Whooper Swan *C. cygnus* is a regular migrant from Siberia to western Alaska and probably breeds in Alaska (Peter Shepard, personal communication). The Mute Swan *C. olor*, a native of central and western Europe, is introduced and increasing rapidly in central and eastern North America.

There are approximately 100,000 Whistling Swans in North America. More than half migrate across the Continent from their nesting grounds in the tundra regions of Alaska and northern Canada to winter in Maryland, Virginia and North Carolina. This represents an annual round trip of 14,000 to 16,000 km. Other portions of the population winter in western States, mostly California.

A Viscount airliner was lost with all seventeen passengers after striking a flock of migrating *columbianus* at 1,800 m over Maryland in November 1962. This accident coupled with other near swan collisions generated much interest in swan movements among aviation people. In 1968, ecologists at Johns Hopkins University, collaborating with private individuals, Foundations and with biologists from Federal, State and Provincial Agencies in the United States and Canada, initiated a study of the Whistling Swan. The objectives are: how to minimize swan-aircraft hazards; what impact human environmental change has on swan behaviour; what effect the oil industry will have on their breeding grounds and why swans are increasingly feeding in fields instead of in shallow water. Sound management is another objective and whether it be for enjoyment of their aesthetic beauty or related to the controversy of hunting, all must be based on long-term research. The over-all aim is to help sustain the continued well-being of North American swans and learn how we can better live in harmony with these magnificent waterfowl.

To aid these endeavours a number of different methods of study have been used. Methods of capture, dyeing (orange with picric acid and black with nyanzol), radar tracking, and telemetry are described in Sladen & Cochran (1969) and Sladen, Gunn & Cochran (1970). They also describe the early phase of the Continental protocol for colours and coding tarsus bands. This protocol is now completed (Figure 1) and has been used also for neck collars with codes that match the tarsus bands for *columbianus*, *buccinator* and *olor*. These neck-collars were first used for *columbianus* in January 1970, for *olor* in July 1971 and for *buccinator* in August 1972. Data presented in this paper are to support neck collars as a method of study and to compare them with other conventional methods of banding.

Methods

(a) *Metal band protocol*
Following a pattern used in Antarctica (Sladen & LeResche, 1970) the standard metal bands with U.S. Fish & Wildlife addresses are placed on the *LEFT tarsus of known-aged birds* (i.e. cygnets in the arctic or juvenile grey plumage in winter) and on the *RIGHT tarsus for those of unknown age* (i.e. captured for the first time when with all-white plumage). This scheme is especially useful for alerting observers to known-aged swans—important for studying population dynamics—when in social groups or in the far north where close observations are difficult. In other studies the position of the metal band is used as an indication of sex. However, this could generate confusion as swans are often difficult to sex, especially juveniles. Some would be recorded incorrectly or as of unknown sex. With our method, if there is any doubt about the age the metal band is placed on the right tarsus, indicating "age unknown".

(b) *Colour plastic bands (tarsus & collars)*
(i) *The colour protocol* for North America (Figure 1) is very simple, using only five easily recognized colours: blue, red, green, yellow and black. White goes with black and could in the future be interchangeable. This protocol is designed to match with a similar

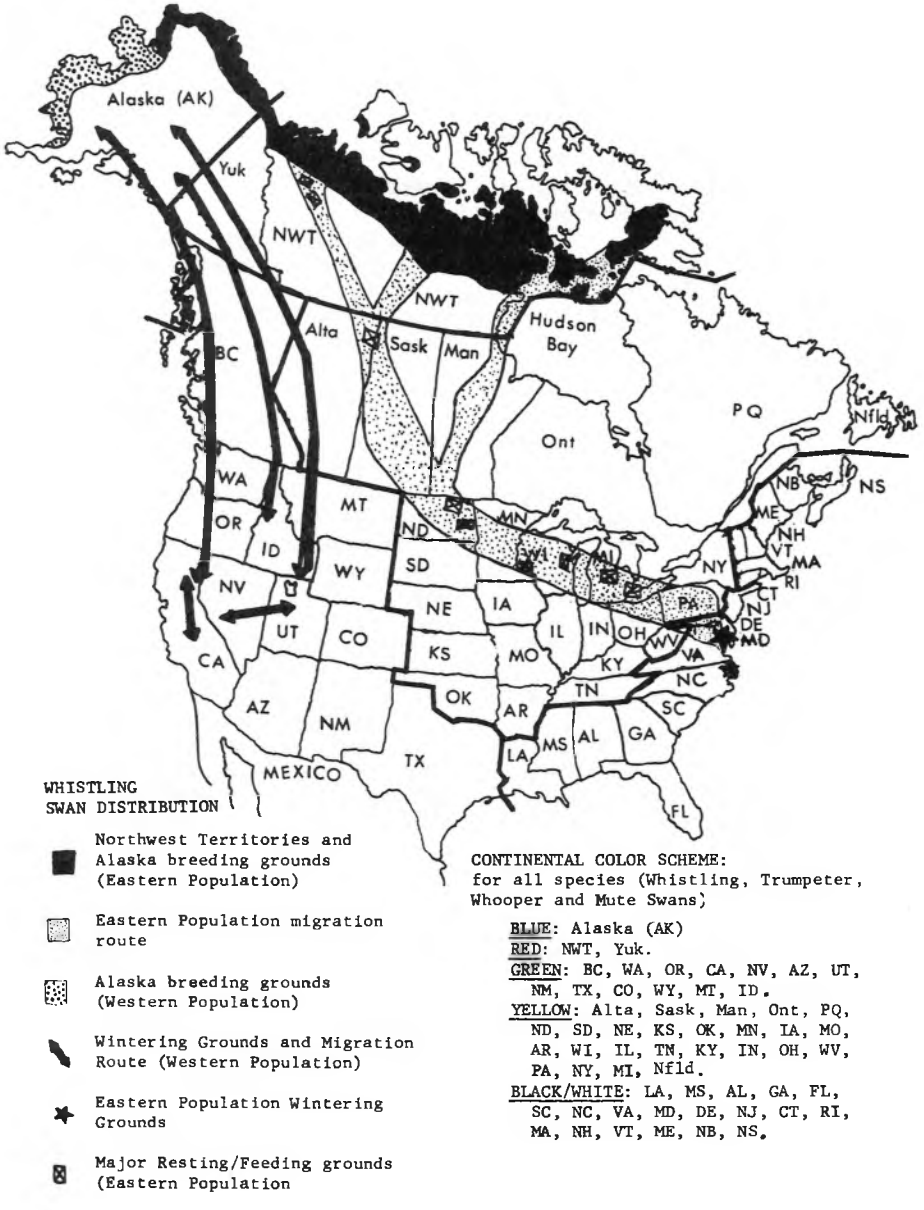

Figure 1. Colour markings (neck collars and/or tarsus bands) for the North American swans.

protocol for Europe and Asia being developed by Sladen for the International Waterfowl Research Bureau's (IWRB) Swan Research Group.

(ii) *Code for colour bands.* The neck collar code matches the band for each swan. We are using four place letter and number combinations, the relative positions of which indicate the species. Thus, for *columbianus* the code is one letter followed by three numbers (e.g. A234); for *buccinator*, two numbers followed by two letters (e.g. 23PA); and for *olor*, two letters followed by two numbers (e.g. CT68). Ogilvie (1973) is using three larger (instead

of our four) digits without letters for Bewick's Swans *Cygnus columbianus bewickii* at Slimbridge in Britain. We believe the advantage of larger numbers is outweighed by the disadvantage of possible confusion in certain numbers when read the wrong way. For example, 169 can be read 691 unless a letter is added (e.g. C169).

We are using only twelve letters (A C E F J K M P R T V Y). The others have been omitted at present because of similarities (B = 8, O = Q, G = C, I = 1, L = 7, W = M, etc.). Others (H N S & X) omitted are the same when read the wrong way (e.g. XH91 *olor* could be read 16HX *buccinator*). The code is engraved four times on a strip of laminated plastic (trade name Lynnply) 216 × 77 mm (i.e. to give 77-mm-tall collar) and shaped, to allow overlap, to diameter 55–60 mm. The letters and numbers are 25·4 mm high. The overlap is fused by quick-drying cement. It is essential that the collar slides freely up and down the neck. Matching tarsus bands are 40 mm tall and diameter 25–30 mm, also with a cemented overlap. Failure to cement will result in band and collar loss or even slipping of the tarsus band over the tarso-metatarsal joint.

The collars can be read through a × 40 power spotting scope in favourable light from a distance of 150 m or more, providing an extremely valuable method of studying large numbers of individually marked swans without disturbance.

Results

Metal bands or metal and colour tarsus bands were used for the first 3 years. Neither could be seen clearly enough to identify swans as had been the case with Bewick's Swan tarsus colour bands at Slimbridge (Ogilvie). The aquatic habits and wide distribution of the Whistling Swan were responsible. Use of neck collars produced dramatic results. Between January and March 1970, the first 300 swans were marked with neck collars in Maryland. In the following winter, 1970–71, over half these collared swans were resighted back in Maryland, Virginia or N. Carolina after a migration of about 11,500 km to and from the arctic.

A more careful analysis (Table 1) of 179 swans neck-collared in three closely watched study areas in Maryland gave us a 60% resighting rate of live birds in the second winter in contrast to only 2% from a sample of 186 swans marked with metal and colour tarsus bands. When all resightings, including dead or retrapped birds, were added in the categories listed in Table 1, it is clear that 84% neck-collared swans were individually identified again during the year since marking. This was in contrast to only 8% of the birds with metal

Table 1. Resightings of Whistling Swans marked by three different methods in wintering grounds in Maryland, 1967–1970*

Method	Total banded	Resightings (alive) after banding (see Key below) I	II	III	IV	Dead or shot	Retrapped after migration to arctic & back	Total resighted (or retrapped or found dead) after banding
Metal (FWS) band only	165	0	0	0	0	3 (2%)	8 (4%)	11 (7%)
Metal + plastic tarsus band	186	0	2 (1%)	0	3 (2%)	1 (0·5%)	8 (4%)	14 (8%)
Metal + plastic color tarsus + NECK COLLAR	179	59 (33%)	63 (35%)	1	108 (60%)	7 (4%)	0	151 (84%)

Resighted and individually recognized: I, in Maryland before spring migration; II, en route on spring migration; III, in arctic breeding grounds; IV, in winter after round trip to and from arctic.
FWS = U.S. Fish & Wildlife metal tarsus band.
*Neck collars were first used Jan. 1970.

plus tarsus colour bands. Moreover, most of these few were not identified at a distance, but retrapped or found dead.

There is a slightly higher incidence of dead or shot swans among those with collars but this is likely to be due to factors other than collars. For example, most of the collared birds were dyed a conspicuous orange, whereas relatively few of the non-collared birds were dyed. Moreover, the collar makes a dead bird more conspicuous and raises more curiosity in the finder than does a metal or colour tarsus band. A further analysis of these factors and band loss will be made after 3 years of data have been gathered.

Some equally spectacular resighting rates have resulted from smaller study samples. Of the first forty-eight swans collared in our closest watched study area in Rhode and West Rivers near Annapolis, Maryland, forty-four (92%) were individually identified during the first year after banding. Two of these (black collars CO22 and CO28) were resighted in summer in their breeding grounds on the Northern Slope of Alaska (Figure 2). Of ten adults collared (blue) in the Arctic National Wildlife Range and near Prudhoe Bay on the Northern Slope, Alaska, in August 1971, eight were resighted in Maryland, Virginia and North Carolina the following winter. Moreover, one of the two not resighted during the first winter after banding was sighted in Maryland in November 1972. This gives 90% resighted since banding in the breeding grounds. All the nine were resighted several times and none have yet been reported dead.

Percentages of resightings are only one aspect of data accumulating from collared swans. A vast amount of data on multiple resightings of individual neck-collared swans throughout the extent of their continental migration is being analysed and cannot yet be presented. However, four case histories of some of our specially interesting swans illustrate the potentials of neck collars.

(a) C030 and C031 (black) were neck-collared in the Rhode River, south of Annapolis, Maryland, in February 1970. Before they left in March we had evidence that they were a pair. Next winter, C030 was seen in the Rhode and Severn Rivers near Annapolis, between November 1970 and 31 January 1971, feeding in the water. Her mate, C031, was resighted between 26 December 1970 and 16 January 1971 at Boardman Lake, Traverse City, Michigan, being fed corn with a large flock of Mute Swans. This pair of Whistling Swans was therefore separated for part of the 1970–71 winter, the male spending some time in Michigan and supplementing his diet with artificial food. We do not know where this pair is in the arctic, but they were back *together* at Boardman Lake, on 4 December 1971 and remained there together all winter until they departed on spring migration on 6 April 1972. They returned to Boardman Lake again on 9 November 1972 with two cygnets. Several interesting biological facts have come from these two neck-collared Whistling Swans. They were separated for at least a part of the 1970–71 winter. Or was it that they had not yet established a permanent pair bond? They were together in Michigan all 1971–72 winter. C031 spent (at least part of) a third consecutive winter, and C030 a second, in Michigan. Thus we must record Michigan as a regular wintering place for some of our eastern Whistling Swans. Moreover, this pair gives us further evidence that neck collars are not deterring *columbianus* from mating or rearing cygnets.

(b) C116 & C119 (black) were banded in February 1970 at East Neck Island National Wildlife Refuge (NWR), Rock Hall, Maryland. Next winter they returned in November and December, 1970, to exactly the same area, and from then on were seen together regularly feeding in the water at the Refuge throughout the 1970–71 winter. They left on spring migration in late March, 1971. For the third consecutive winter, but for 2 days only on 11 and 12 November 1971, they were back together and in the same place at East Neck Island NWR. They were not seen again together until 27 February 1972. Where had they been during the winter? The female, C119, continued feeding in the water at East Neck Island until 17 November, but on 19 November, until 2 December, changed to feeding in a harvested corn field near Grasonville, Maryland, 24 km to the south. Meanwhile we feared that the male, C116, which had not been seen by any of our small team since 12 November had been killed or had lost his neck collar. However, on 12 February 1972 he was resighted feeding in a harvested corn field with 366 other swans 320 km to the south at Jarvisburg, N. Carolina. But the neck collar observations did not end that Spring with a disunited pair. On 27 February they were again side by side feeding in a field near Hope, Maryland, 24 km east of their original banding and wintering site at East Neck Island NWR. Back in Maryland they remained

together in this area until 16 March, after which they apparently took off on spring migration.

(c) The third case history relates to a brood of five cygnets captured by Ray Schweinsburg in August 1971 in the Old Crow Flats, Yukon, arctic Canada. One cygnet had a broken leg so was not banded. The other four were collared (red for arctic Canada) D366, D367, D368 & D369. The entire brood of four red collars and one unmarked (presumably the injured cygnet) reached the Chesapeake Bay safely and were seen regularly from 1 December 1971 to 16 March 1972 in the Ruthsburg, Maryland, area. Throughout the winter they and their unmarked parents fed in harvested corn fields. On 9 April 1972 this same family unit was again resighted intact in the Upper Mississippi NWR near Winona, Minnesota, on their way north during spring migration. Near Winona the marshes boast an abundance of aquatic vegetation and the swans were feeding in their natural aquatic habitat and not in the fields.

(d) Figure 2 illustrates the potentials of resighting Whistling Swans by collars at both ends of their range. C028 (black) banded in the West River, Maryland in February 1970 was resighted on 7 August 1970 in the mouth of the Colville River, Northern Slope, Alaska where its mate was captured and collared A301 (blue). During the second winter they were in company

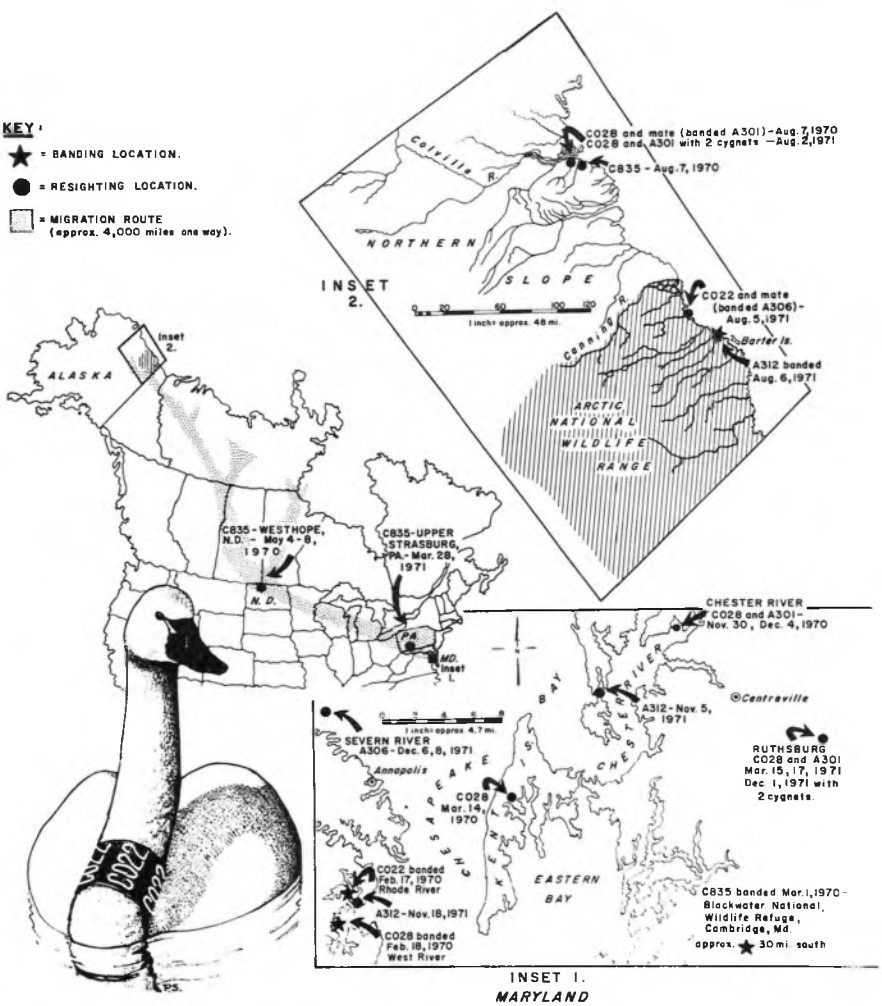

Figure 2. Movements of individually marked Whistling Swans between Maryland wintering grounds and Alaskan breeding grounds.

with two cygnets which had also been seen in Alaska. Like other collared swans, CO28 changed its winter feeding habits from aquatic to harvested corn fields in 1970–71. Swan C022, banded in the Rhode River, Maryland in February 1970 was not seen again until its band was read from a helicopter 18 months later in the Arctic NWR, Alaska. It has not been seen subsequently though its partner, A306, banded in Alaska was seen in Maryland in December 1971.

Swan C835, banded at Blackwater NWR, Maryland in March 1970, was seen at Westhope, N. Dakota 4–8 May on spring migration and on 7 August near Prudhoe Bay, Alaska. It was not resighted the following winter but during spring migration in March 1971 was observed at Upper Strasburg, Pennsylvania.

Discussion

The use of neck collars on swans is not a new technique. Yellow plastic collars were first used on Whistling Swans in U.S.A. by Harvey K. Nelson (personal communication) in 1956 and subsequently by John Frye at Shiawassee National Wildlife Refuge, Saginaw, Michigan from 1960 to 1969, after which they joined the Continental Program. Utah State Fish & Game Department (John Nagel and Clair Jensen) used less than fifty green and red collars between 1964 and 1970 in Utah. A variety of colours were used by Willey (1968) for Mute Swan collars from 1962 in Rhode Island. A few experimental green and red collars were put on Trumpeters at Red Rock Lakes National Wildlife Refuge, Wyoming in 1966. None of these schemes used coded collars, consequently individual swans were not recognized. These early studies, plus 4,500 Black Swans *Cygnus atratus* neck-collared in Australia by Braithwaite (1966), were important in demonstrating, that swans could be neck-collared without adverse publicity and without harm to the birds. Since codes have been engraved on the collars and research workers have agreed to follow a simple continental-wide protocol there has been a widespread increase in public interest. Moreover, the collars have enabled the public to converse on equal terms with the researchers and contribute greatly to the data gathering.

The case histories given above demonstrate that our study method using neck collars is providing us with some remarkable data on pair and family bonds, on winter and breeding site tenacity, and on change of feeding habits (which initially may not be shared by both members of a pair) in relation to environmental deteriorations. Moreover, they are being gathered on a continental scale throughout 16,000 km migration to the arctic and back again. We could not have collected them by any other method.

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Summary

Using coded colour neck collars increased the resighting rate of Whistling Swans *Cygnus c. columbianus* as individuals to as much as 90%, compared with less than 5% by conventional band methods, even after a migration across N. America. Details of the continental marking protocol for four swan species are given. Much public interest and co-operation has resulted from the use of collars.

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