

### Evidence of Long-term Pair Bonds in Barrow's Goldeneye (*Bucephala islandica*)

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Geese, swans, and ducks that cooperate in raising young maintain long-term pair bonds (Kear 1970, Bolen 1971, Weller 1976, Patterson 1982). In most holarctic ducks the female raises the young alone, new pairs are formed every year on wintering and/or migration areas, and males follow their philopatric female to breeding areas (Hochbaum 1944, Rowley 1983, and others).

Female Barrow's Goldeneye (*Bucephala islandica*) return to the same breeding area every year and often use the same nesting sites (Palmer 1976). Males accompany their mates from wintering areas, defend territories on the breeding ground, and then leave for unknown molting areas when the female is incubating (Savard 1982). They are not seen again on the breeding ponds until the following spring. I present evidence here indicating that some Barrow's Goldeneye pairs remain intact from year to year in spite of a long separation and that pair reunion occurs on the wintering areas.

During a study of the breeding ecology of Barrow's Goldeneye in central British Columbia, I captured 15 adult drakes and 81 adult females and marked them with nasal disks. The return rate of females to the study area was 77% ( $n = 36$ ) in 1982 and 75% ( $n = 81$ ) in 1983, indicating a high degree of site fidelity. Similar rates of return for females have been found in other cavity-nesting ducks (Erskine 1961, Dow 1983). The return rate of drakes was 71% ( $n = 7$ ) in 1982 and 63% ( $n = 15$ ) in 1983. Two of three pairs marked in 1982 returned intact in 1983; the other did not return. The females of the two returning pairs had raised a brood in 1982 and therefore were separated from their mates for at least 4 months. The existence of long-term pair bonds was confirmed in 1984, when 3 of 7 marked pairs returned intact. Of the remaining pairs, 1 split and only 1 member returned in the other 3.

The 2 females that had lost their mates had repaired when resighted, but the 4 males had not. These 4 males returned to the same pond where they had been captured the previous year, and 1 even defended a territory for 2 days. Usually, unpaired males do not defend territories (Savard 1982). One Barrow's Goldeneye drake marked on his territory in 1982 defended the same territory in 1983 and 1984. Similarly, 3 other paired males were resighted on the same territory the following year. Although the females of these males were not marked, it is likely that they retained their previous mates because females apparently select the territory in most territorial waterfowl (Hochbaum 1944, Young 1970, Donaghey 1975).

The preceding observations indicate that pairs in

Barrow's Goldeneye can remain intact from year to year in spite of a long separation and that unpaired males home to their previous breeding area. Homing of unpaired drakes to breeding areas has been reported in several dabbling ducks (Poston 1974, Blohm 1978) and diving ducks (Bengtson 1972, Alison 1975, Donaghey 1975). Breeding philopatry in unpaired males would increase their chances of finding a mate, or of reuniting with a previous mate. It could also enhance their survival because of their familiarity with the resources of the area.

I now consider where and how pairs reunite. Within a week of the arrival of Barrow's Goldeneye on their wintering areas in southern coastal British Columbia in early November, some pairs are already defending territories (Savard unpubl. data). Of 34 territories defended along a 5-km stretch of shoreline in Burrard Inlet near Vancouver, B.C. in February and March 1983, 59% were occupied by mid-December and 85% by late December. This rapid formation of pairs soon after the arrival on the wintering areas, when there is little courtship, suggests that pairs reunite then. In 1983, 55% of the 400 males present in Burrard Inlet on 17 November had arrived by 1 November, compared to only 11% of the 200 females. This earlier arrival of the males supports the contention that most pairs reunite on the wintering ground rather than on fall staging areas. Spurr and Milne (1976) found similar pair formation in the Common Eider (*Somateria mollissima*) that also involved little courtship. Butterfield (1970) also observed that pairs of Zebra Finch (*Poephila guttata*) that reunited after separation displayed little courtship.

I was fortunate to document the reunion of one pair of Barrow's Goldeneye on the wintering area. A drake marked on his breeding territory in 1982 was resighted near Vancouver, B.C. defending a winter territory at the tip of a small jetty. He was paired with an unmarked female, and they remained in their territory all winter. In April 1983 the male defended the same breeding territory as in 1982. He was paired, presumably with the female with whom he had wintered. We marked her that summer, and she raised a brood while the male departed for the molting grounds. On 29 October we sighted the male in a small group of goldeneye (37 males, 3 females, 10 immatures) 2 km east of his winter territory. Daily checks indicated that he remained there until 12 November. On 8 November we sighted his mate in a large group of goldeneye (84 males, 39 females, 1 immature) 4 km from the location of the male. This coincided with the first big influx of adult females

on the wintering areas. The next day (9 November) the female had joined her mate and the pair was in a small goldeneye group (5 males, 2 females, 1 immature) 1.5 km from their 1982 winter territory.

On 12 November the pair had joined a large group of goldeneye (175 males, 79 females, 30 immatures) and was at the location where we first saw the female. They stayed for 11 days in this large group, mainly feeding and resting. On 22 November they left the group and attempted to establish a territory 2 km east of their old territory, but apparently they were unsuccessful because on 12 December they were back on their old 1982-1983 territory. They defended the territory all winter and were last sighted there on 12 April 1984 at 0715. The next day (13 April) they were seen on their breeding territory at 1120. They had covered the 320-km distance in one night and apparently had migrated alone, as they were not seen in any groups prior to their departure from the wintering area.

This observation indicates that fidelity to wintering areas in Barrow's Goldeneye may be as strong as fidelity to breeding areas. Homing by members of a pair would facilitate pair reunion. Homing to wintering areas has been documented in Bufflehead (*Bucephala albeola*, Erskine 1961, Limpert 1980), Oldsquaw (*Clangula hyemalis*, Alison 1975), and Common Eider (Spurr and Milne 1976), indicating that pair reunion may also occur in these species.

Pair bonds in Barrow's Goldeneye are strong. Forced copulation is common among waterfowl but has never been reported in the genus *Bucephala* (McKinney et al. 1983), and I did not witness any attempts in 4 years of intensive studies of Barrow's Goldeneye and Bufflehead. Goldeneye drakes take several minutes before mounting a prone female (Afton and Sayler 1982, Savard unpubl. data), a delay that would make forced copulation difficult. Pairs copulate throughout winter as well as during incubation, and this may reinforce the pair bond.

A few studies on seabirds have shown that pairs that reunite are more successful than pairs that split (Coulson and Thomas 1983). Scott (1980) and Hepp and Hair (1984) found that pairing in waterfowl enhanced the dominance status of both partners and improved their foraging opportunities. Rowley (1983) lists several possible advantages of pair reunion over the formation of new pair bonds. In Barrow's Goldeneye these may include: 1) obtaining an experienced mate of known abilities; 2) familiarity of the male with the breeding and wintering territories, which strengthens his motivation to defend them and in turn enhances the chances of the female to retain her previous territory; and 3) reduction of the time and energy spent in courtship.

There is also evidence that other migrating diving ducks may have long-lasting pair bonds [e.g. Harlequin Ducks (*Histrionicus histrionicus*, Bengtson 1972,

Kuchel 1977, Dzinbal 1982), Oldsquaw (Alison 1975), Common Eider (Spurr and Milne 1976)]. I suggest that stability and renewal of pair bonds is more common in ducks than has been previously thought. It is likely that this will be confirmed as more adult males are individually marked in future studies.

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### The Calls of Male and Female Madeiran Storm-Petrels (*Oceanodroma castro*)

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Attention has been forced recently on the phenomenon of sex-specific calls in the nocturnal Procellariiformes (Brooke 1978, Ristow and Wink 1980, Simons 1981, James 1984a, James and Robertson 1985). It has been suggested that such sexual dimorphism in voice constitutes an adaptation for sexual advertisement in low light levels (Brooke 1978). However, for most of these species, little is known regarding such potential differences. With this in mind, we conducted research on the calls of male and female Madeiran Storm-Petrels (*Oceanodroma castro*) on Great Salvage Island (30°09'N, 15°52'W) in the northeastern subtropical Atlantic from 30 June to 11 July 1983.

At the time of our visit, egg-laying was in progress, so it was possible to sex birds by cloacal inspection (Serventy 1956). Nesting birds were located at night from their vocal activity and removed from their burrows for sexing and banding. The nests were visited later, again at night, and the same incubating birds (15 males and 7 females) stimulated to call using the playback of this species' Burrow Call (Cramp and Simmons 1977) on a Sony M9 microcassette recorder.

Their vocal responses were recorded using a Uher 4000 Report IC tape recorder, and spectrograms were produced on a Kay 6061-B Sound Sona-Graph using the wide-band filter.

Both males and females produced three call types in response to playback (Fig. 1). Two of these, the Flight Call and Burrow Call (Cramp and Simmons 1977), were sexually dimorphic, and the third, here called the High Call, was not. The Flight Call consists of an irregular repetition of short notes. The general form, timing, and emphasis of notes is similar in the calls of both sexes, but in all males investigated these notes were markedly clearer, producing a more melodious call. In females, by comparison, the notes were more harsh. This difference was such that we could easily assign all Flight Calls heard at the colony, whether given in flight or in burrows, to one sex or the other. As this was possible, we decided to investigate the sex ratio of these calls heard in flight. For three nights, 9-11 July, male and female Flight Calls were counted for a 5-min period at the same time and site. The results were 81, 83, and 86 male calls and 71, 73, and 78 female calls heard. The totals (250 male and 222 female calls) were not significantly different from parity ( $\chi^2 = 1.66$ ,  $df = 1$ ). This contrasts strongly with similar flight call counts conducted on Manx Shearwaters (*Puffinus puffinus*; Brooke 1978, James 1985), where female calls significantly outnumbered male calls, and Cory's Shearwaters (*Calonectris diomedea*, James 1984b), where the opposite was

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