Prolonged Sperm Storage Duration in Domesticated Canaries

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Relative to most mammals, female birds can retain their fertility for a considerable time after mating and separation from the male (Lake 1975). Maximum sperm storage durations range from about 6 days in Ringed Turtle-Doves (*Streptopelia risoria*), 16 days in ducks, and 35 days in chickens to 72 days in turkeys (see Birkhead 1987 for a review). No published information is available on the duration of sperm storage in passerines. Here I report maximum sperm storage values for female domesticated Common Canaries (*Serinus canaria*).

I collected data from a questionnaire to breeders of canaries and "mules" (i.e. hybrids between a British finch male × canary female). Six independent instances were reported; in each case female canaries laid fertile eggs several days or weeks after separation from the males. Routinely, some breeders separate the male and female after the clutch has been laid, leaving the female to incubate and rear the young alone (Carr 1959, Dodwell 1986). After the first brood had been reared, some females laid fertile eggs without being remated. Other instances involved cases of unexpected paternity when females had been paired with males of two different finch species in succession. In each case described below I give the most conservative estimate of the duration of sperm storage.

(1) A female canary was paired to a male Eurasian Linnet (*Carduelis cannabina*), but the linnet died before any eggs were laid. Approximately 3 weeks later the female canary was paired to a male Common Redpoll (*C. flammea*); they built a nest and a clutch was started after 7 days. Of the clutch of 4 eggs, 2 were fertile. When the chicks fledged they were clearly linnet rather than redpoll mules, i.e. the linnet had fertilized the eggs, not the redpoll. Sperm storage duration was estimated at 28 days.

(2) A male and female canary were separated after egg laying and the female left to incubate (13–14 days) and rear the young alone. After the chicks were removed (aged 21 days), the female laid a second clutch "within days"; one egg was fertile and subsequently hatched. Estimated sperm storage duration was 35 days.

(3) Ten canaries, all thought to be female, were maintained in an aviary over winter. In early February one bird (obviously a male) was heard singing and removed. Four weeks later one of the females was paired to a male Eurasian Siskin (*C. spinus*) in a separate cage; this pair built a nest and started to lay within a week. From the clutch of 5 eggs 3 were fertile and proved to be canaries, not siskin mules. The female could have been fertilized only by the male canary, which had been removed from the aviary 4 weeks previously. The other 8 birds in the aviary were subsequently paired and confirmed to be females. Estimated sperm storage duration was 35 days.

(4) A female canary was paired to a male European Goldfinch (*C. carduelis*), and the male removed once the clutch was complete. A single goldfinch mule was reared: this took 42 days (14 days of incubation and 28 days to rear the chick). The female canary was then paired immediately with a male siskin, and within a week a clutch had been laid. One chick was reared from this clutch, but this was also a goldfinch rather than a siskin mule. Estimated sperm storage duration was 49 days.

(5 and 6) The situation was identical to that in (2) above, except that after the second brood had been reared and the chicks removed, the female laid a third clutch without being remated. The entire third clutch was fertile, but it is not known whether the eggs hatched. Estimated sperm storage duration was 35 days for the second clutch and 68 days for the third clutch.

Although these individual values are conservative, they are likely to lie near the extreme for canaries. Nonetheless, the maximum value, 68 days, is similar to the maximum record for any bird species: 72 days in domesticated turkeys (Lorenz 1950) and 60 days in Grey-faced Petrels (*Pterodroma macroptera*, Imber 1976; see Perrins and Brooke 1976, Hatch 1987 for information for other Procellariiformes).

Information on the duration of sperm storage is essential if one is to calculate accurately the period over which a female bird might be fertilized. In particular, it is important to know the timing and duration of this period to determine whether extrapair copulations occur when they could fertilize eggs. Several workers, including me (Birkhead 1982), have assumed, in the absence of data, that sperm storage duration in passerines is considerably less than the values presented here suggest.

The adaptive significance of the prolonged sperm storage that occurs in some birds is poorly understood, but it may be important in species in which females copulate infrequently but produce large clutches (e.g. some Galliformes; see Birkhead et al. 1987) and in seabirds, where the female may be away from the colony and her partner for extended periods before laying (see Imber 1976, Hatch 1983). There is no compelling reason why canaries should have prolonged sperm storage. Wild canaries produce clutches of 4–5 eggs (Bannerman and Bannerman 1968), and the male and the female are unlikely to be apart for long periods. In all other cardueline finches that have been studied, and in domesticated canaries, mate guarding is well developed; the male remains with

the female continuously until she starts to incubate (Tsuneki 1961; Newton 1972, pers. comm.). One possible explanation for the results on canaries is that selective breeding during the period of domestication (ca. 350 yr; Dodwell 1986) has produced incidentally a well-developed sperm storage ability (Clayton 1972, Lake 1975). This idea is plausible because breeders have undoubtedly selected for individuals that bred successfully in captivity, and prolonged sperm storage contributes to successful breeding. In addition, sperm storage durations differ significantly between different strains of chickens selected for different traits (Taneja and Gowe 1961), indicating that sperm storage duration has a genetic basis. Another explanation for these results is that they represent a few very rare occurrences at the extreme end of the distribution of sperm storage duration in canaries. A systematic study of sperm storage in canaries and other passerines, particularly wild species, might be interesting.

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Energetic Consequences of Sexual Size Dimorphism in White Ibises (*Eudocimus albus*)

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Sexual dimorphism is pronounced in White Ibises (*Eudocimus albus*): males are heavier than females, and they have substantially longer tarsi, bills, and wing chords (Kushlan 1977a). Sexual size dimorphism may result either from natural selection acting to reduce intersexual food competition or to increase clutch size in females (cf. Carothers 1984), or from sexual selection acting to enhance the mating success of appropriately sized individuals. Kushlan (1977a) proposed that the size dimorphism he reported for White Ibises resulted from sexual selection acting to increase body size and bill length in males.

Male ibises use their bills during courtship, when males and females intertwine their bills and necks during pair formation (Palmer 1962, Rudegeair 1975), and during copulation, when males extend their bills over females and engage in twig pulling (Rudegeair 1975). A larger bill and body in males undoubtedly is also important for intrasexual fighting during courtship, mating, and nest building, when males fight over mates and attempt nest-site takeovers (Rudegeair 1975, Frederick 1986). Fighting ability in males has also been linked to increased extrapair copulations in this sometimes promiscuous species (Frederick 1985a). Although female ibises participate in aggressive interactions at the colony site, female aggression is con-