

MANAGEMENT PRACTICES FOR CAPTIVE KESTRELS USED AS SEMEN DONORS FOR ARTIFICIAL INSEMINATION

by

David M. Bird

and

Paul C. Laguë

Macdonald Raptor Research Centre

Macdonald College of McGill University

Province of Quebec, Canada, HOA 1C0

Abstract

Detailed information pertaining to artificial insemination (AI) of American Kestrels (*Falco sparverius*) has already been presented elsewhere (Bird et al. 1976, Bird and Buckland 1976). In continuation of the study, further data have been collected on Kestrels in an attempt to determine both effective management procedures for male birds of prey used as semen donors and short-term storage conditions for semen.

Materials and Methods

All birds were maintained on a diet consisting mostly of day-old cockerels, and semen was collected as described by Bird et al. (1976).

Three groups of randomly selected males were involved in the study. The first group was composed of males isolated from visual contact with females. In 1974 eight birds were tethered in falconer's fashion; in 1975, 17 birds were housed in box cages as previously reported by Bird et al. (1976). In both years, we attempted to ejaculate these males three times a week beginning the first week of March. After mid-April, they were massaged only once a week. The number of massages resulting in measurable semen volume was compared between the two years. Only trials attempted on each male after the first successful massage are included here. In 1975 only, the outcome of each attempted massage was recorded as resulting in semen, urates, a combination of the two, or nil.

The second group in 1975 consisted of 12 males paired with females and held in breeding pens as described by Bird et al. (1976). To minimize disturbance, these males were massaged once a week only after egg-laying had completely ceased.

Finally, the third group was comprised of seven males held colonially with three females in a large, sanded pen with three nestboxes. The males were massaged once a week during the same time period the paired males were massaged.

These three groups of males were compared in terms of their production of semen, urates, or nil, as well as their semen characteristics which have been defined and explained elsewhere by Bird and Laguë (in press).

Observations on both frequency of collection and duration of sperm motility (motility ranged from a high of 5 to a low of 0) under storage conditions were also recorded.

Results

There was no appreciable difference in the number of successful massages between 1974 and 1975 (77.4 and 71.4 percent, respectively). Of a total of 500 trials over both years, 74.2 percent resulted in measurable volumes of semen.

Table 1 summarizes the percentages of collections yielding semen, urates, and nil in 1975. The percentages of collections yielding semen alone was greatest in the months of April and

May, dropping considerably in June. The percentages of collections yielding urates, however, was greatest in March, declining to less than half in the remaining months. The percent collections yielding nil in June was almost four times the overall mean of the other three months.

The semen characteristics of the males isolated from females, the colonial males, and the paired males during the period May 27 to July 10 are presented in table 2. The colonial males were by far the lowest in all traits with the exception of a high motility found in the two samples collected. The isolated and paired males were closely comparable in all traits except for sperm count per ejaculate, where that of the isolated males almost doubled the sperm count of the paired group. In each group of males, the percentage of collections resulting in urates almost equaled that resulting in nil (table 3). The colonial males were again by far the highest in both percentages with the paired males ranking second in production of urates.

With respect to frequency of collection, semen collections performed on two consecutive days resulted on the second day in a decrease in semen volume 6 out of 7 times and in decreases in sperm concentration and sperm count per ejaculate volume 4 out of 4 times. A second collection on the same day resulted in reductions of semen volume and sperm concentration 6 out of 9 times and a decrease in sperm count per ejaculate volume 7 out of 9 times.

The mean motility of three samples of pure semen held under refrigeration (i.e., 4.4 to 10.0°C) dropped from 5 to 3.5 after 12 hours and then to 2.3 after 24 hours. Barely motile sperm were still observed at 96 hours. At room temperature the mean motility of three similar samples dropped from 5 to 2.7 after 12 hours, and slight motility was visible up to 72 hours. The mean motility of sperm in three semen samples mixed equally with Wilcox phosphate buffer (16.34 gm Na_2HPO_4 , 5.16 gm $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$ per liter, pH 7.2) (Wilcox 1958) declined after 12 hours from 5 to 3.7 under room and refrigerated temperatures. After 24 hours it decreased to 3.5 in two samples held at room temperature and to 3 in three samples stored in the refrigerated temperature. In samples mixed with Wilcox phosphate buffer, barely visible motility was seen up to 72 hours in one held at room temperature and up to 84 hours in another kept under refrigerated temperatures.

Discussion

The little difference in percentage of successful massages from year to year suggests that experience with the technique of semen collection does not play a large part in the successful procurement of semen. In 1974 many different individuals, some with no experience, collected semen. In 1975 this role was undertaken by one person. The importance of experience is mainly in the collection of good quality semen free of urates, as already demonstrated in chickens (Burrows and Quinn 1938).

The high percentage of collections resulting in urates in the month of March was likely due to the feeding of males prior to collections on collection days. This percentage was decreased by more than half by simply not feeding the males until all collections were performed that day.

It is commonly known in poultry that males will respond to the massage technique exceptionally quickly after a period of practice. On four occasions Kestrel semen was ejaculated with little or no massage required, indicating that some of the males were being conditioned to the technique. In two of these instances the semen examined was contaminated with as much and more debris than samples collected previously from the same

bird by full massage. This is not in agreement with the finding of Kamar (1958) that cock semen obtained by collection without milking is relatively free of contaminants compared to that milked from the bird.

The results of table 2 seem to indicate that males kept in small quarters isolated from females are superior to both paired males and colonial males in almost every semen characteristic including percentage of successful massages. This finding is not congruent with the work of Lorenz et al. (1956) who found no significant differences in semen volume or sperm concentrations between paired and nonmated turkey toms. The results reported here may not be conclusive, however, as the isolated males were handled regularly prior to May 27, whereas the paired and colonial males were not. In support of the results are the observations of Burrows and Quinn (1937) in fowl and Owen (1941) in pigeons that males kept in large pens or males paired with females may be ejaculated regularly but give smaller yields of semen.

There are two advantages to keeping males in small quarters either tethered in falconer's fashion or held in box cages. Firstly, feeding is more easily controlled, and thus one can reduce the percent collections contaminated with urates. In this regard the single males held in box cages had lower percentages than either paired or colonial males. Secondly, the stress and trauma associated with catching males in large pens is considerably reduced by keeping males in quarters where they can be easily caught. Although Rowan (1928) in his early work on juncos suggested that exercise promotes gonadal development in birds, Bissonnette (1931) observed no such effect in his starlings with additional exercise. In this study, restricted space, hence possible lack of exercise of the single males, had no negative influence on their semen production.

Since semen collection in 1974 was rarely examined microscopically, it is virtually impossible to compare semen quality between 1974 and 1975, when the food of the males was supplemented by additions of calcium and phosphorus in the form of bone meal. Although the percentage of successful massages was higher in 1974, the fertility from the AI birds was considerably lower that year (Bird et al. 1976). Ganders, when fed a high calcium diet, gave increased sperm concentration and viability (Molnar et al. 1971, Kovacs 1972) and, when fed a high phosphorus diet, gave increased sperm concentration and ejaculate volume (Kovacs 1972). From these results, it is possible to conclude that the increased dietary calcium and phosphorus of Kestrel males may have been responsible for the greatly increased fertility seen in 1975 (Bird et al. 1976).

The few observations on the effects of frequency of collection did indicate that both daily and twice daily collections reduced the semen volume, concentration of spermatozoa (nos./cu mm), and sperm numbers per ejaculate. This finding is in complete agreement with those reported for fowl (Penquite et al. 1930, Sampson and Warren 1939), for turkeys (Lorenz et al. 1956, McCartney et al. 1958, Nestor and Brown 1971), but only partially for hawks (Temple in Grier et al. 1972) as daily collections in goshawks did not appear detrimental to semen quality (Corten 1973). The decrease in sperm numbers in twice daily collections also lends support to Owen's (1941) feelings that regular collections more than once a day cause male pigeons to become aspermic. To obtain good semen quality in Kestrels, minimum and maximum intervals between collections appear to be two days and roughly one week, respectively. The same recommendations exist for chickens (Smyth 1968) and turkeys (Lorenz et al. 1956).

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Table 1

Percent collections yielding semen, urates, and nil in 1975.

Type of yield	March 12-31	April 1-30	May 1-31	June 1-30	Mean
Semen (S)	25.7 (37)	66.9 (89)	71.4 (105)	54.9 (45)	54.7 (276)
Urates (U)	59.7 (86)	23.3 (31)	15.6 (23)	22.0 (18)	30.2 (158)
SU	5.6 (8)	6.8 (9)	6.8 (10)	1.2 (1)	5.1 (28)
Nil	9.0 (13)	3.0 (4)	6.1 (9)	22.0 (18)	10.0 (44)
Total attempts	(144)	(133)	(147)	(82)	(506)

Table 2

Semen characteristics of sex segregated, colony, and paired male Kestrels during the period May 27-July 10

Male group	Percent successful massages	Mean semen volume (μ l)	Mean sperm conc. $\times 10^3/\text{mm}^3$	Mean sperm count ($\times 10^3$)	Mean motility score	Mean semen colour score	Mean percent contamination
Segregated	55 (57/104)	10.0	31.4	384.9	3.1	2.3	70.0
Paired	44 (30/ 68)	8.3	31.5	196.9	2.8	2.8	78.8
Colony	7 (2/ 30)	3.7	28.0	106.2	5.0	1.0	30.0

Table 3

Percent collections yielding urates and nil in sex segregated, colony, and paired male Kestrels during the period May 27-July 10

Male group	Percent collections resulting in urates	Percent collections resulting in nil
Segregated	23.1 (24/104)	22.1 (23/104)
Paired	32.4 (22/ 68)	23.5 (16/ 68)
Colony	50.0 (15/ 30)	43.3 (13/ 30)