VIABILITY OF BAT SPERMATOZOA AFTER PROLONGED STORAGE IN THE EPIDIDYMIS

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The viability of spermatozoa after prolonged storage in the female reproductive tract has been established in several species of hibernating bats (Wimsatt, 1944; Hiraiwa & Uchida, 1956; Racey & Kleiman, 1970). Spermatozoa are, however, also stored in the cauda epididymidis of male bats during winter (Courrier, 1927). Although mating is initiated soon after the completion of spermatogenesis in late summer, its occurrence has frequently been reported during winter (Wimsatt, 1945) and spring (Moffat, 1922), and Strelkov (1962) showed that an increasing proportion of four vespertilionid species were inseminated as hibernation progressed.

Investigation of the viability of spermatozoa stored in the cauda epididymidis of hibernating bats has only recently become possible now that one species, the noctule (*Nyctalus noctula*), is maintained and bred in the laboratory (Racey, 1970). The annual reproductive cycle of captive noctules has been followed by observations of behaviour and external morphology, and details have been confirmed by histological examination. These studies have shown that spermatozoa are released from the testis during August and pass into the cauda epididymidis which becomes visibly distended. The seminiferous tubules shrink and spermatogenesis is not initiated again until the following spring. Copulation usually takes place in captive noctules in September and October (Kleiman & Racey, 1969) and, as a result, the uterus becomes engorged with semen. The vagina is then occluded with connective tissue (Grosser, 1903). Ovulation takes place in spring and the young are born in midsummer (Wimsatt, 1969).

In the present series of experiments, twenty male noctules, caged individually, were not allowed to mate at the usual time and twenty-nine females were introduced to them at intervals during the winters of 1969–70 and 1970–71. Females were separated from males during April and inspected daily for evidence of conception. Young were born during June. Since the time of insemination was not known, the period between distension of the cauda epididymidis of males, and the time when females were introduced to them, was regarded as the minimum demonstrated duration of sperm storage in the epididymis (Table 1).

Fetuses and neonates were morphologically normal and the results show that noctule spermatozoa are viable after storage for at least 5 months in the cauda epididymidis. In other mammalian orders, the maximal period for which

spermatozoa can be retained in the cauda epididymidis before fertility is impaired is 3 weeks (Tesh & Glover, 1969). The low conception rate (5/29 = 17%) in the present experiments must be interpreted with caution, as it may reflect the difficulties of breeding noctules in captivity. Alternatively, it may suggest that prolonged storage of epididymal spermatozoa plays a relatively unimportant part in the breeding cycle of this species, and that young are usually born as a result of autumn matings.

In three females which died during winter, connective tissue hyperplasia had rendered the cervix and upper vagina imperforate, and this may have prevented insemination, since the reproductive tracts were devoid of spermatozoa. It is possible, therefore, that the spermatozoa responsible for the conceptions listed in Table 1 were retained in the epididymis until vaginal changes at the time of ovulation facilitated successful insemination.

TABLE 1
RESULTS OF DELAYED MATING EXPERIMENTS

<i>Female</i>	<i>Date of introduction to male</i>	<i>Result of subsequent conception</i>	<i>Minimum duration of sperm storage by male (months)</i>
1	30th Nov. '70	Male born	3
2	30th Nov. '70	Male twins born	3
3	3rd Dec. '70	12-mm c to r male fetus (mother died*)	3
4	2nd Feb. '70	9-mm c to r male fetus (aborted)	5
5	27th Jan. '71	Male born†	5

c to r = crown to rump.

* Uterine haemorrhage.

† Malpresentation, delivered by Caesarean section.

Captive noctules frequently arouse from hibernation and spend a considerable proportion of the winter in full metabolic activity. This causes depletion of their fat reserves to such an extent that it has been necessary to feed them twice a week during winter. It is unlikely, therefore, that the explanation of prolonged viability of epididymal spermatozoa lies solely in low body temperature and metabolic rate.

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