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SOCIAL INFLUENCES ON REPRODUCTION IN PINE VOLES

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The presence of large populations of pine voles in apple orchards suggests that in the field reproduction of these pests has few constraints. Yet, evidence collected from our colony at Union College indicates that in the laboratory reproduction is not at random but instead is socially restrained and predictable. Unless these findings are artifacts of laboratory life, they may help explain some of the data collected in the field.

Horsfall (1963) trapped voles every month of the year from an orchard near Cloverdale,VA. Since he found pregnant females in all collections, he concluded that reproduction occurred throughout the year with a peak in the summer months. On the other hand, Valentine and Kirkpatrick(1970) found pregnant females in only seven months of the year in orchards near Danville, VA. The conflict in data has not been resolved and may be a result of social factors that could not be determined in the field.

In the laboratory, we found that reproduction in pine voles is influenced by a variety of social conditions.

Crowding of young animals suppresses maturation of gonads in both males and females (Schadler, 1980). If more than ten animals are reared together after weaning in cages 30cm x 62cm x 41cm in size maturation of gametes is suppressed.

Females reared with their mothers and other family members in a freely reproducing colony seldom become reproductive (Schadler, 1981 and unpublished data). A study of 11 colonies,established by a single pair of voles and ranging in size from 8 - 28 animals, that were reared in enclosures one meter square in size showed the following. With rare exceptions, only the founding female bore litters although all daughters were chronologically mature at the termination of the experiment. In 3 of the 11 colonies, one first generation daughter delivered an occasional litter but these females were never more than marginally successful in rearing their young to weaning. Ovaries and testes from all animals in three of these colonies containing 11, 18 and 26 animals respectively were examined histologically. Most animals showed normal gametogenesis. That the daughters were capable of breeding was shown when three other colonies were dismantled and the females paired with normal males from the breeding colony. In most cases the females became pregnant within 3-5 days after pairing. The males too showed normal ability to sire litters when they were paired with normal females. Studies of reproduction in large freely reproducing colonies is continuing in our laboratory.

Sisters almost never mate with their brothers. (Schadler, 1983). Ordinarily females are induced to become reproductively active by strange males (Schadler & Butterstein, 1979) but a brother even if sequestered behind a barrier in the breeding cage containing the sister and a strange male, will signicantly reduce mating. The strength of this incest taboo is further demonstrated where proven females fail to produce a second litter if they are placed with their brothers.

This paper will report on recent work in our laboratory to extend

our understanding of social factors on puberty. Two will be cited: 1) the effect of adult males on puberty in males and 2) the effect of adult females on puberty in females.

ADULT MALES DO NOT SUPPRESS PUBERTY IN YOUNG MALES

The following experimental cages were established: 1) 3-4 weanling males with no adult and 2) 2-3 weanlings plus a) their father; b) a fertile adult strange male and c) a castrated adult male. Assessment of maturity was based on gonadal maturation which was measured by size of testes and degree of spermatogenesis. The latter was determined by histological examination.

All cages were assembled when the young males were weaned. All animals were killed when the weanlings were 8 weeks of age at which time they are normally reproductively mature (Schadler and Butterstein, 1979). Testes were removed, preserved in Bouin's solution, weighed, and prepared for histological examination.

Regardless of housing conditions the testes of young males were no different in size or in degree of spermatogenesis from those of their adult, intact male cagemates. Testes also compared favorably with mature testes described previously (Schadler, 1980).

These results suggest that maturation of male gonads is not affected by the presence of adults and that males are physiologically prepared to mate if the opportunity occurs.

The ability of young males to sire a litter in the presence of fertile male adults was not determined. A hierarchy of dominance exists among voles (Schadler, 1977) with older males dominating younger ones. It may be that the presence of adults suppresses active mating in the young animals. Since pine voles are promiscuous, however, and only one male is needed to impregnate many females, it is unlikely that control of reproduction rests with the male.

ADULT FEMALES SUPPRESS BREEDING IN YOUNG FEMALES

Reproduction in young females in dramatically reduced by the presence of adult females. This is suggested by the suppression of reproduction in the freely reproducing colonies described above and by the following experiment. Cages in this experiment were as follows: 1) 3-4 female weanlings were caged alone (n=6) and 2) 2-3 female weanlings were caged with a) their mothers or b) with a strange fertile female (n=12). A male was placed in each cage when the young reached chronological maturity at 12 weeks of age. The criterion for ability to reproduce was delivery of a litter. Any females bearing litters were removed along with their young from the experimental cages within 2 days post partum. The remaining animals were observed for an additional 45 days for birth of a litter.

Of the six groups of weanlings reared alone, four of the six delivered litters. One cage had one breeding animal and 3 cages had 2 breeding animals. All litters were born 25-32 days after the male was placed in the cage. No additional litters were born to females remaining with the male after the mothers and young were removed.

In all of the twelve groups containing mature females, litters were born to the mature animals twenty-five to thirty days after the male was introduced. In two of these cages one young female in each cage also delivered during that time period. Young animals in the remaining ten cages did not reproduce until after the breeding females were removed. When the breeders were taken away, young females in seven of the ten cages did deliver litters within five to forty-four

days. This suggests that females too may be mature physiologically but are under behavioral restraints that prevent successful parturition.

SUMMARY

Both male and female pine voles that are reared in uncrowded conditions in the laboratory appear to mature physiologically in a normal fashion. Yet not all animals reproduce.

Data does not suggest that males are inhibited from breeding by social factors. Because of the lack of genetic markers it is unlikely that it can be determined which males are actively breeding. Females, on the other hand are clearly influenced by social factors. Newly mature females rarely breed when they are: 1) paired with sibling males, 2) reared in family groups in freely reproducing colonies, or 3) housed with mature females in small groups of one sex.

If any of these constraints also exists in the wild, it might help explain the conflict in data on pregnant females collected during field studies. I hope that integrated pest control plans may be able to capitalize on the social and behavioral factors that appear to influence breeding in pine voles.

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