DEMONSTRATION OF AN ODOROUS INTRAMALE PRIMER EFFECT IN SHORT-TAILED VOLE, *Microtus agrestis* L.

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Abstract—Anal (proctodeal) glands of male *Microtus agrestis* housed in social isolation undergo severe atrophy. Their weight and volume is significantly lower than those of the stock control males. The atrophied glands can be revived by subjecting deprived voles to various social odors. Atrophied glands of isolated males do not respond to the odors of male and female urine, voided feces of females, and unvoided feces of males. Atrophied anal glands of males exposed to voided male feces (which have passed the orifice of the anal gland) and soiled bedding from adult males show strong recrudescence. The mean weight and volume of the glands and plasma testosterone level are significantly higher than of males maintained in complete social isolation, although they are significantly less than those of stock control males. Atrophied glands of socially deprived males strongly respond to the odor of ethereal extract of gland secretion. In males exposed daily to anal gland secretion extract, the weight and volume of the gland and plasma testosterone level increase and are not significantly different from those of stock controls. They enjoy higher plasma testosterone levels and consequently larger and more active anal glands than complete isolates.

Key Words—Vole, *Microtus agrestis*, anal gland, odor, urine, feces, testosterone, social deprivation.

INTRODUCTION

Although they appear to be widespread among mammals, little attention has been paid to anal (proctodeal) glands. In small rodents of the genus *Microtus*
they occur at the distal end of the rectum, enveloped by the rectal sphincter muscles (Vrtis, 1929; Khan, 1984), but this envelopment is not universal among small mammals (Stoddart, unpublished). In his thorough study of the anal gland complex in the European vole *M. arvalis*, Vrtis (1929) observed that the gland of males was much larger than in females and that it underwent a cycle of development linked with the testicular cycle. Although he presented no behavioral data in substantiation, he suggested that its oily secretion was used as a sexual attractant or stimulant during the voles' breeding season.

More recently, and working with the yellow vole *Lagurus luteus*, Fan (1982) observed that fecal pellets coated in anal gland secretion were deposited densely around the breeding nest and along the colony's territorial boundaries, in such a way that it suggests the function of the glandular secretion is not directly for sexual purposes but for a more broadly based social effect.

This study was undertaken as part of a comprehensive examination of the structure and development of the anal glands of the short-tailed vole, *M. agrestis*, which investigated, in particular, the physiological and anatomical response of the gland to sex hormones (Khan, 1984). Since we knew the anal gland of *M. agrestis* to be highly sensitive to circulating levels of blood testosterone (Khan and Stoddart, in preparation), we designed a series of experiments to examine whether anal gland secretion, which is normally deposited passively on feces, is able to influence anal gland development in other males via a testosterone effect. At the same time we investigated whether urine odor was also able to influence plasma testosterone, and hence anal gland size, as has been shown to occur in rats.

**METHODS AND MATERIALS**

All experimental and control voles (other than controls taken from stock), were housed individually in shoe-box cages and fed with standard laboratory food and water ad libitum. Stock voles were housed in mixed sex groups of six to eight in rat cages in an animal house where the lighting regime was 16 hr light and 8 hr dark. Sociosexually isolated voles were removed from their mothers at weaning (24 days) and kept individually in shoe-box cages. Each cage was kept under the same light conditions in a separate room of the Zoology Department of King's College for eight weeks. At this time the isolated voles were subjected either to an experimental odor treatment for three weeks or to a further three-week isolation. Voles in the latter category are referred to as "complete isolates."

Urine and feces were separately collected in a glass metabolic chamber, removed daily, and stored in a deep freeze until needed. To prepare anal gland extracts, glands of mature stock males were cleared of any surrounding tissue or fat and macerated in ether until the ether became cloudy and little was left