THE ANNUAL CYCLE OF FLEHMEN IN BLACK-TAILED DEER
(Odocoileus hemionus columbianus)

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Abstract—Flehmen is a stereotyped response of ungulates and other mammals to urine. In black-tailed deer, Flehmen occurs typically in males (rarely in females), and its frequency shows an annual cycle. Flehmen in response to female urine was most frequent in November, and to male urine in January. The response minimum to both types of urine occurred in May. Fifty-five to 100% of initial responses to female urine resulted in Flehmen. The deer responded more often to female urine, and the difference between the responses to female and male urine increased from May to November. A male's own urine released Flehmen more often than did urine of other males. The response intensity varied with the spatial orientation of the male to the urinating female, and responses were usually limited to distances of 15 m or less.

Key Words—Artiodactyls, black-tailed deer, Flehmen, Odocoileus hemionus columbianus, reproductive behavior, seasonal variation, ungulates, urine.

INTRODUCTION

During reproductive behavior in mammals, males generally respond to the urine of females. In ungulates, cats, and some other mammalian groups female urine releases a stereotyped response in males: the lips are parted, the upper lip curled up, the nostrils closed, the head held high and/or moved up and down or from side to side; the respiration pattern is slow and deep. This has been called Flehmen by Schneider (1930) and is also known in English as "lipcurl." A variety of odors may release Flehmen, including those of males,
females, and young. Both sexes may perform Flehmen, but there is consensus that “the male's behavioral response to the odor of the female's urine or anogenital region prior to mounting appears to be the most frequent and the most important biological role of Flehmen” (Grau, 1976).

The function of Flehmen has remained a puzzle. There are very few quantitative studies of Flehmen that would allow conclusions as to its function. Knappe (1964) suggested a connection between Flehmen and stimulation of the vomeronasal organ. Estes (1972) saw urinalysis (i.e., the testing of female urine for estrus status) as the major function of Flehmen. Dagg and Taub (1970) found no annual cycle in the frequency of Flehmen in captive giraffes, which came into heat every two weeks, and doubted a connection of Flehmen with the vomeronasal organ in ungulates. Verberne (1970, 1975) and Verberne and deBoer (1976) found the Flehmen response of tomcats to estrous females was longer in duration and was repeated more often than their response to nonestrous cats.

To provide information on seasonal changes and sex specificity of Flehmen, we recorded the annual cycle of Flehmen in black-tailed deer.

METHODS AND MATERIALS

Five male and eleven female adult black-tailed deer (*Odocoileus hemionus columbianus*) were kept in three different groups from May through September. These groups consisted of two males and three females, two males and four females, and one male and four females, respectively. From October through April we worked with eight deer who lived in two groups of two males and two females each, a change necessitated by the rutting behavior of the bucks.

Data were recorded by two observers for an average of 13 hr during each month of the year. At least 50 incidents of urinations by bucks and does were recorded each month (annual total: 649). Observations were recorded at a distance of 2 m from a separating fence after the initial responses to the observers had ceased (about 5 min after observers' arrival). The deer usually urinated when becoming active after a resting period. They were observed during such periods of frequent urinations, and observations ceased when no or few urinations were expected. Therefore, the number of urinations cannot easily be related to the observation time.

For each urination, the bucks' responses, the estimated distance(s) between urinator and the male(s), and the body orientation of the buck to the urinator were recorded. For estimating distances, fence-post intervals were used. The number of "general responses" (i.e., approaching the urinator or the fresh urine on the ground and touching with their muzzle the urine stream while it is being voided or the urine on the ground) was recorded. This "general