CASTOR SACS AND ANAL GLANDS OF THE NORTH AMERICAN BEAVER (*Castor canadensis*): Their Histology, Development, and Relationship to Scent Communication

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Abstract—Both sexes of beavers possess a pair of castor sacs and a pair of anal glands located in paired subcutaneous cavities between the pelvis and the base of the tail. The castor sacs are not glandular in the histological sense, hence references to these structures as preputial glands or castor glands are misnomers. The wall of the castor sacs is plicate and comprised of three distinct zones: an outer layer of vascular connective tissue, a two- to five-cell-thick layer of mitotic epithelial cells, and several densely packed layers of cornified epithelium which grade into more widely separated sheets toward the lumen. Monocultures of a gram-positive facultatively anaerobic bacterium were present in the lumen of all castor sac preparations. Differences in the frequency of castoreum deposition were not attributable to differences in the structure of the castor sacs. The anal glands of beavers are holocrine sebaceous glands. These glands develop more rapidly than the castor sacs. Anal gland tissue from embryos exhibited cellular characteristics associated with the production of sebum. Secretory activity was evident in all preparations. The relationship of castoreum and anal gland secretion to scent communication among beavers is discussed.

Key Words—*Castor canadensis*, castor sacs, anal glands, chemical communications.

INTRODUCTION

Both sexes of beavers (*Castor canadensis*) possess a pair of castor sacs and a pair of anal glands located in subcutaneous cavities between the pelvis and base of the tail (Svendsen, 1978). The contents of the castor sacs mix with urine to form castoreum. Beavers deposit this thin yellow liquid on mud
mounds constructed within the home range of the family (Aleksiuk, 1968; Svendsen, 1980; Müller-Schwarze and Heckman, 1980; Butler and Butler, 1979).

The anal glands are located caudal to castor sacs (Svendsen, 1978). Ducts from the glands open on papillae lateral to the rectum and orifice leading to the vestibule of the castor sacs. Anal gland secretions vary in color from straw to light brown, are viscous and insoluble in water, and have a pungent odor.

The variety of terminology reflects the paucity in data concerning the histology of these structures. "Castor glands" (Brady and Svendsen, 1981; Butler and Butler, 1979; Svendsen, 1978) and "preputial glands" (Müller-Schwarze and Heckman, 1980; Wilsson, 1971) have been used synonymously with "castor sacs" and "oil sacs" (Müller-Schwarze and Heckman, 1980) with "anal glands." The purpose of this research was to describe the histology of the castor sacs and anal glands and test the following hypotheses: Both structures are true glands; both structures develop synchronously in beavers; and castor sacs and anal glands do not differ in structure or activity among beavers of different age or gender, or vary seasonally. These data will provide a baseline for assessing the role of castoreum and anal gland secretion in integrating the social behavior of beavers.

METHODS AND MATERIALS

The castor sacs and anal glands used for microscopic study were from beavers live-trapped in southeastern Ohio. Sexing and handling of these beavers followed the methods of Svendsen (1980). Animals were classified as adults, two-year-olds, yearlings, or kits.

Beavers were anesthetized with Nembutal (pentobarbital sodium, Abbott Laboratories). Both pairs of anal glands and castor sacs were removed surgically from 11 animals of different age and gender. These animals were subsequently sacrificed. Portions of the excised glands were fixed immediately in glutaraldehyde, buffered with phosphate to pH 7.1, and rinsed with buffered sucrose. Pieces of tissues were postfixed in buffered 1% osmium tetroxide, dehydrated in an ethanol series, and embedded in an Epon-Araldite mixture. Tissues were sectioned on a Reichert OmU2 microtome. Thick sections were transferred to clean microscope slides and stained with toluidine blue. Thin sections were contrasted with uranyl acetate and lead citrate and examined on a Siemens Elmiskop I electron microscope.

Paraffin sections of both anal glands and castor sacs from four beavers were prepared by fixing excised tissue in Carnoy's fixative for 20 hr at 4°C. Tissues were dehydrated in an ethanol series, cleared with three changes of benzene, and embedded in paraffin under a vacuum. Sections (10 μm) were cut and stained with either hematoxylin and eosin, azan, or trichrome stains.