Seasonal Changes in the Reproductive System of the Female White-crowned Sparrow, *Zonotrichia leucophrys gambelii*, in Captivity and in the Field

1. The Ovary*

MICHAEL D. KERN

Department of Biological Sciences, Fordham University, Bronx, New York 10458

Received October 5, 1971

Summary. The ovaries of free-living and captive White-crowned Sparrows, *Zonotrichia leucophrys gambelii*, were examined for seasonal changes. The ovary develops each year between March and June. It contains small primary oocytes; developing, preovulatory (yolky), and postovulatory follicles; scars; gland cells; and atresias. Most of its eggs are oocytes. Less than 30% are developing follicles. There is a hierarchy of sizes only in laying sparrows. Follicles apparently begin to secrete estrogen when they are 1 mm in diameter. The depletion of cholesterol from the ovary suggests that synthesis of estrogen begins about 1 month before the oviduct matures. There are five kinds of atresia. Most do not rupture. The ovaries of captive sparrows differ in the following ways from those of free-living birds: (a) they lack pre- and postovulatory follicles; (b) they contain more atresias; (c) the stroma is dense and poorly vascularized year-round; (d) the membrana granulosa of developing follicles becomes proliferative earlier in the spring and is always less active mitotically; (e) thecae do not develop beyond formative stages; (f) thecal gland cells become abundant earlier in spring; and (g) stromal gland cells are less numerous. Many of these differences (a, b, d, f, g) suggest that White-crowned Sparrows do not breed in captivity because of an abnormal synthesis and/or secretion of hypophysial gonadotropin.

Key words: Ovary-seasonal changes — *Zonotrichia* — Captivity — Field.

Introduction

The White-crowned Sparrow (*Zonotrichia leucophrys gambelii*) has been studied intensively for more than two decades. Seasonal changes have been described in the thyroid gland, pancreas, adrenal cortex, testis, and many parts of the hypothalamo-hypophysial system (Farner, 1959, 1964a, b; Farner and Follett, 1966). However, the female reproductive system has been largely overlooked (King et al., 1966; DeWolfe, 1967), in part because female White-crowned Sparrows, like many other female passerines, do not reproduce in captivity (Farner et al., 1966),...
and because they breed in remote areas. As part of a continuing study of this species, I have examined seasonal changes in the female reproductive system and present the ovarian material in this paper.

**Material and Methods**

The female White-crowned Sparrows (Z. l. gambelii) were (1) winter residents collected in the Snake River Canyon near Wawai, Washington; (2) vernal and autumnal migrants passing through the Palouse prairie near Pullman, Washington; and (3) breeding individuals from College, Alaska, and Harts Pass, Washington. They were captured with mist nets or shot during 1962 and 1967–1969. Birds caught near Pullman were retained in outdoor aviaries at Washington State University and used as the captive population in this study.

Free-living and captive females were caught and sacrificed at monthly intervals. They were killed between 10:00 and 14:00 PST. The ovary was removed and cut into halves that were weighed immediately. One half was then fixed in an ethanol-formalin-acetic acid mixture (AFA = formalin : glacial acetic acid : 95% aqueous ethanol : distilled water, 1:1:3:5, v/v). The other was homogenized in ice-cold acetone : ethanol (1:1, v/v) for cholesterol determination (Searcy and Bergquist, 1960).

The diameters of the largest three ovarian follicles were measured to the nearest 0.1 mm after the ovaries had been fixed for 2 days in AFA and then stored at least 5 more days in 70% aqueous ethanol (several changes). Data on ovarian weight and follicular size were evaluated by Duncan’s multiple range test (Kramer, 1956).

For histological study, fixed tissues were dehydrated in ethanol, cleared in xylene, and embedded in Paraplast (Curtin Scientific, Monroeville, Penn.; mp = 56–57°C). They were serially sectioned at 8 μ, stained by Pollak’s trichrome method (Humason, 1962: 155–157), and mounted in synthetic resin. Sections were mordanted overnight in saturated aqueous HgCl before being deparaffinized and stained. A representative cross-section from the center of each ovary was used for the quantitative histological measurements.

**Results**

**Morphological Data**

Seasonal changes in the morphology of the ovary of wild and captive White-crowned Sparrows appear in Fig. 1 and 2, respectively. These figures illustrate several important differences.

1. In autumn and winter, the ovaries and follicles of first-year birds from the field were smaller than those of adults. This is not surprising because the adults have just finished breeding, whereas the younger birds will not breed until the following summer. This age difference does not occur in caged birds (Fig. 2) whose ovaries fail to mature in captivity.

2. In spring, the ovary began to recrudesce more rapidly in captive birds than in free-living ones. However, its growth ceased prematurely in caged individuals at ca. 30 mg in weight (Fig. 2). Even the ovaries of brooding wild birds were considerably heavier than the largest captive ovaries. (*Brooding* females are birds caring for nestlings, *not* incubating birds. This definition applies throughout the paper.)

3. During the spring migration (May), the ovaries of wild females could be clearly separated into two groups by weight (Fig. 1). The sample may include more than one population of White-crowned Sparrows (with slightly different photoperiodic thresholds for gonadal growth—see Mewaldt, Kibby, and Morton, 1968) at this time since many groups of these birds are believed to migrate through the