THE INCUBATION PATCH IN TINAMOUS

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There are still many groups of birds for which there is no recorded information concerning the occurrence and structure of the incubation patch. Many of these groups, such as the tinamous, are distributed in relatively remote areas or at least are not readily accessible to ornithologists in this country. During recent expeditions to the Peruvian Andes, Oliver P. Pearson, Anita K. Pearson, Carl B. Koford, and the late Mary R. Koford, of the Museum of Vertebrate Zoology, Berkeley, made extensive studies of the natural history and breeding behavior of the three species of tinamous inhabiting that region. A record of their observations of one of the three, *Nothoprocta ornata,* has recently been published (Pearson and Pearson, Auk, 72, 1955:113-127). The following description of the incubation patch of *Nothoprocta* was made possible by the kind assistance of the Pearsons and Kofords, who collected the material in connection with their field work and made it available to this author for study.

Material from 27 individuals (16 males and 11 females) was included in the collection. It consisted of small pieces of the abdominal skin fixed in Bouin's fluid, sketches of the abdominal region showing the arrangement of the feather tracts and the extent to which feathers had been lost, photographs, dried skins of the abdominal region, and the field notes of the collectors. The fixed material was embedded in paraffin, sectioned at 8 microns, and stained with iron hematoxylin-aniline blue. The large pieces of abdominal skin were relaxed by soaking them in water in order to permit a study of the arrangement and distribution of the feathers.

The collection included specimens of both sexes for nearly every month of the year. Incubation patches were present on all males during the nesting season (middle of February to middle of April). They were absent on females and on males at other times of the year. The presence of a patch only on the males is in agreement with the generally accepted belief that in the family Tinamidae only the males incubate, an observation confirmed in the case of *Nothoprocta* by Pearson and Pearson (*op. cit.*).

The size, number, and location of the the incubation patches is closely related to the arrangement of the ventral feather tracts and apteria (Bailey, Condor, 54, 1952: 121-136). In the tinamous contour feathers on the ventral surface are concentrated in paired ventral tracts which run from the neck region to the anal circlet. The ventral tracts of *Nothoprocta,* like those of other tinamous, are broad on the anterior fourth of the breast and narrow over the remainder of the breast and on the abdomen. At the junction between the narrow and broad parts, each ventral tract is continuous with a tract that runs posteriorly and laterally across the breast and onto the lateral aspect of the thigh.

Down feathers are present but are confined to the feather tracts; the apteria, therefore, are naked. The ventral apterium is quite narrow on the breast (about 20 mm. wide), but it is somewhat enlarged and circular in shape on the abdomen due to the fact that the ventral feather tracts in this region are concave medially. Paired lateral apteria lie lateral to the ventral tracts. These are less sharply defined than the ventral tracts and possess occasional contour feathers.

One of the primary characteristics of an incubation patch is, of course, the absence of feathers due to a special molt. Usually only down feathers are molted and consequently the patches are confined to the apteria. In some groups, however, the patches are enlarged or united into a single large patch by a loss of contour feathers. In *Notho-*

procta the incubation patch develops primarily in the ventral apterium but spreads over the area covered by the ventral tracts by a loss of the contour and down feathers. This loss of feathers from the tracts is not precipitous, as is true of the loss of the down feathers in most birds, but is gradual, with the bare area being continuously enlarged during the period of incubation. In this latter respect, the incubation patch of the tinamous is

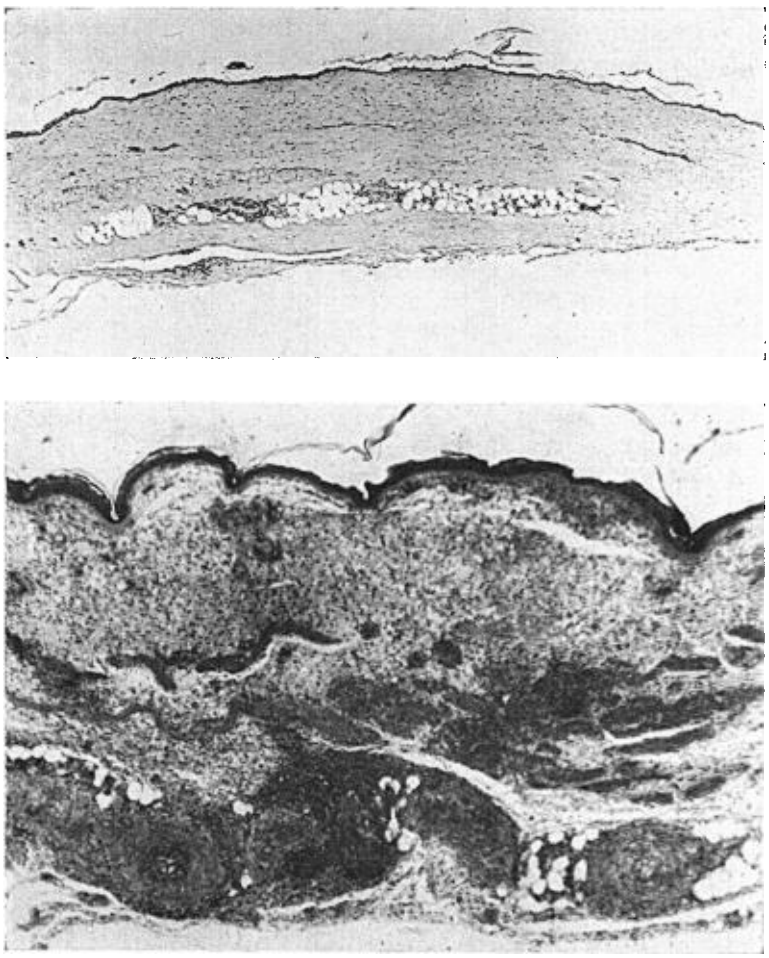

Fig. 1. Skin from the ventral apterium of *Nothoprocta ornata*. Iron hematoxylin —aniline blue; ×62. Above, non-breeding male, August 4. Below, incubating male with incubation patch, April 9.

similar to that of the galliforms, in which there is also a gradual loss of contour feathers which enlarges the median patch and secondarily unites it with the lateral patches.

The fully developed patch of *Nothoprocta* is roughly oval in shape and occupies nearly all the ventral apterium and much of the area of the ventral feather tracts. Because the loss of contour feathers appears to occur in no particular pattern, the edges of the patch are irregular and ill defined. Apparently the patch does not spread to the lateral apteria in *Nothoprocta*. In his field notes, Carl Koford gives the dimensions for

the ventral apterium in a nonbreeding male as 50 by 20 mm. whereas the incubation patch of a breeding male measured 55 by 40 mm.

Feathers are used by the male *Nothoprocta* to cover the eggs while away from the nest (Pearson and Pearson, *op. cit.*). Although it has not been determined which sex builds the nest, it seems probable that the feathers are furnished by the male. There is an increased loss of feathers from the ventral tract as incubation proceeds and at the same time an increase in the number of feathers in the nest.

Figure 1 (above) is a section of the skin of the ventral apterium of a nonbreeding male *Nothoprocta*. It is similar to that of other birds, showing a thin epidermis of a few cell layers and a considerably thicker dermis. The collagenic fibers of the dermis are dense and are arranged parallel to the surface. No large blood vessels are present.

A section of the incubation patch of a breeding male *Nothoprocta* is shown in figure 1 (below). The epidermis and dermis are thicker than in the nonbreeding bird; the dermis is also very edematous. The collagenic fibers are widely separated by tissue fluid and are irregularly arranged. Many large and small blood vessels are present and, as is characteristic of the incubation patch of other birds, there are extensive areas of white-cell infiltration near the vessels.

The present findings constitute the first details available on the incubation patch in the so-called palaeognathous birds (ostriches, rheas, cassowaries, kiwis), with which the tinamous are usually grouped. Davis (Wilson Bull., 57, 1945:189-190) reported the absence of an incubation patch in two female tinamous during the breeding season but apparently no males were collected.

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