AN ABNORMAL STERNAL APPARATUS IN A RUFFED GROUSE, *BONASA UMBELLUS*

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Anatomical abnormalities were noted in an immature female ruffed grouse shot by the junior author on October 16, 1955, in Clark County, Wisconsin. After being pointed by a dog and flushed, it flew approximately 15 yards at a height of 5 or 6 feet before being killed. Nothing in the bird's behavior or flight indicated any physical abnormality. However, when the bird was prepared for the table, it was found to exhibit an unusual development of the pectoral region (Fig. 1, left).

Although the pectoral muscles were symmetrical, the entire muscle mass was displaced anteriorly along the coracoids; the mass also extended somewhat farther dorsally on either side. The breast muscles did not extend the usual distance posteriorly and a midline gap separated the muscles of the two sides.

Study of the skeleton revealed a number of atypical conditions. The two halves of the sternum are asym-

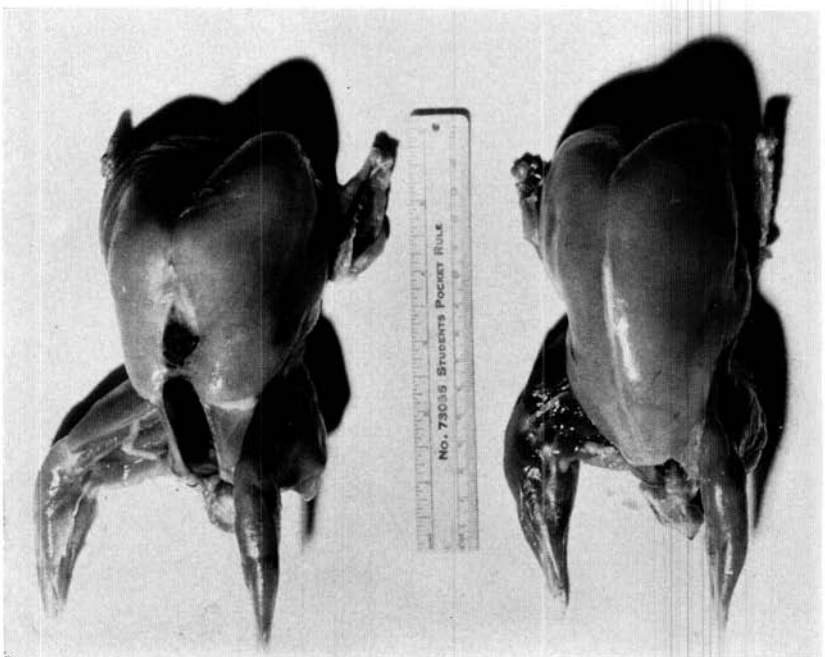

FIG. 1.—Ventral views of pectoral musculature of *Bonasa umbellus*. Normal bird is on right.

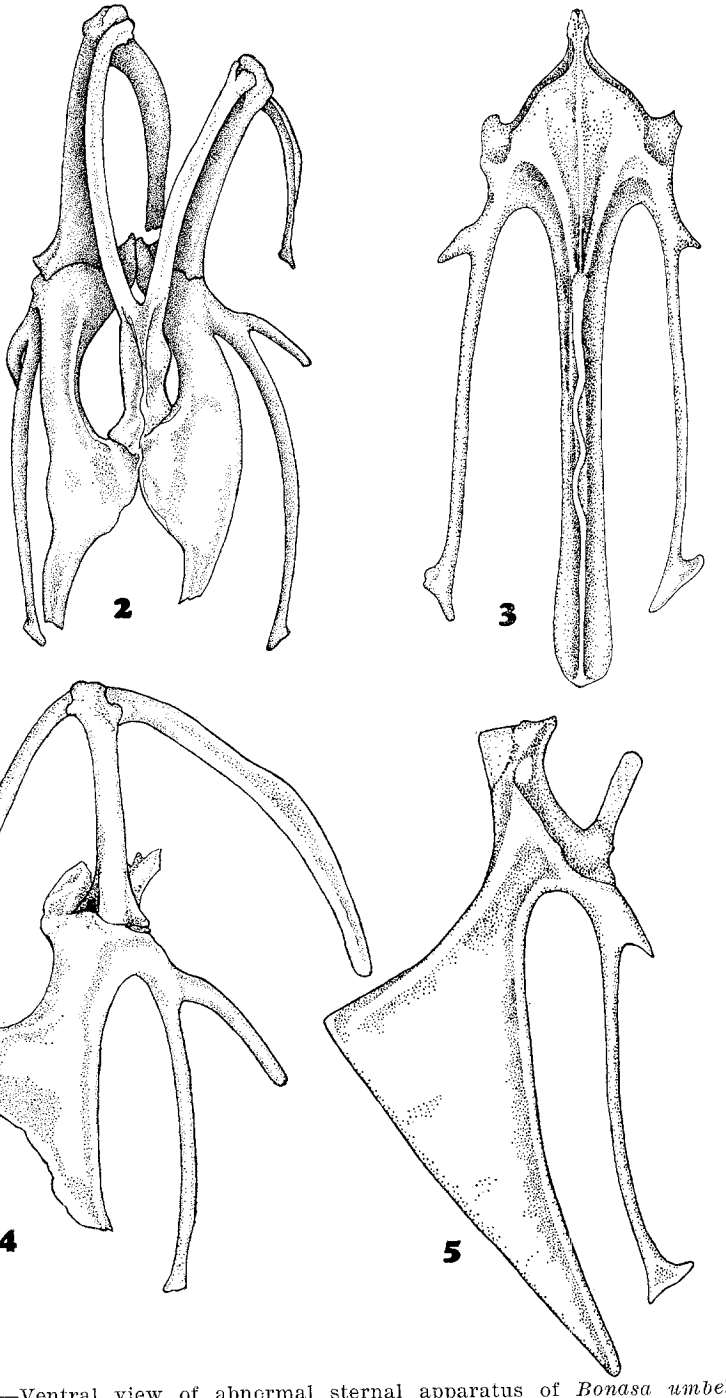

FIG. 2.—Ventral view of abnormal sternal apparatus of *Bonasa umbellus*; FIG. 3.—Ventral view of normal sternum of *Bonasa umbellus;* FIG. 4.—Lateral view of abnormal sternal apparatus of *Bonasa umbellus;* FIG. 5.—Lateral view of normal sternum of *Bonasa umbellus.*

metrical (Fig. 2) and have not fused to form a normal keel; the two halves of the keel touch anteriorly but are widely separated and abbreviated posteriorly. However, a functional keel was formed by the ventrally directed halves of the keel, a posterior extension of the furcular symphysis, and the fusion of this symphysis and the two keel plates. Such fusion is not usual in grouse (Fig. 3).

The sternal plates are generally much reduced in grouse, but in this specimen the median processes or bodies of the left and right plates are unusually small. The left lateral sternal process is normal in position; the right process is placed farther mediad and dorsad than usual. Both processes are normal in configuration except for slightly shorter lengths and considerably heavier bodies. The latter may have developed because of the greater stress on this part of the plate, exerted by the origin there of a greater than usual part of the pectoral mass of muscles.

The dorsal and ventral manubrial processes are reduced and atypical. The costal processes are irregular and indefinite. The large pneumatic foramen usually found on the dorsal surface of the sternal body, just posterior to the dorsal manubrial process or spine, is absent. All parts of the bony sternal apparatus seem to be less pneumatic, although cancellous or spongy bone is visible externally on the dorsal borders of the unfused sternal plates.

The coracoids are normal in size and configuration, but their position is unusual. The left coracoid appears shorter in Figure 2 only because it is directed so far ventrally, but both coracoids deviate from the normal in being more ventrally directed. The more ventral position of the anterior end of the coracoid may be related to the fact that the furculum has been pulled posteriorly to fuse with the ventro-anterior part of the malformed keel. Another deviation is related to the ventral position of the anterior end of the coracoid; the scapula articulates with the coracoid at a less acute angle. This may have been necessary to accommodate shoulder and back muscles attaching to the scapula. The scapulae are of the usual shape but slightly subnormal in length. The clavicles are asymmetrical and twisted to the left; their symphysis is distorted, presumably by fusion to the sternum and by its function as a "substitute keel."

The only additional bones available from this "table-dressed" bird were humeri, ulnae, radii, the proximal two-thirds of the tibiotarsi, the vertebral column posterior to the neck, and the synsacrum. All these, except the latter, appear to be normal. The anterior ends and dorsal borders of the ilia are not completely and normally ossified; cancellous bone is visible on the surface and the transverse processes of the vertebrae do not make contact with the anterior half of the dorsal border of the ilium on either side.

Abnormal bone formation, particularly of the sternum, has been reported frequently. The present instance is significant because: 1) the deviations are apparently not the result of injury; 2) the malformations are restricted to flat bones; and 3) there has been a satisfactory readjustment of muscular attachments and masses to compensate for the severe malformations of bones and to permit normal flight.