WEIGHING AND MEASURING RAPTORS

by
Richard R. Olendorff*
Department of Zoology
Colorado State University
Fort Collins, Colorado 80521

Weights of most birds of prey can be taken using an Ohaus triple-beam balance accurate to 0.1 g with a capacity of 2,610 g. This degree of accuracy is unnecessary, particularly with larger nestlings and most adults due to interfering movements of the birds when they are on the balance. If possible, weights are taken in the morning before the first feeding. All castings (usually regurgitated in the early morning) should be weighed and these weights subtracted from the food consumption of the previous day if food consumption is being measured. The weight of pellets cast after the morning weighing should be subtracted from the morning weight.

Linear measurements are taken with a vernier caliper accurate to 0.1 mm. The blunt ends of the measuring surfaces can be filed to sharp points to facilitate approximation of the reference points used as definitions of measurements. If the limit of the vernier caliper is exceeded, the measurement is first taken using an ordinary caliper with curved arms. The length is transferred to a flat surface using the points of the vernier caliper to mark the surface. A two-step measurement is then taken with the vernier caliper. All measurements are taken on the right side of the body and recorded on a measurement data sheet.

Although definitions for standard measurements of birds do exist (Baldwin, Oberholser and Worley, 1931), the practicality of their use is questionable at times when live specimens are being measured. Not every portion of the external morphology of a live bird is linearly quantifiable because of the intervention of varying amounts of skin, plumage and muscle, which hide pertinent anatomical landmarks. Other difficulties arise due to the versatility of movement of even a restrained bird, particularly when it is necessary to place the bird on its back.

I have therefore developed a system of measurements based on practical experience gained with living specimens. All measurements were made with the bird dorsal side up to avoid unnecessary struggling and alarm. There was no purposeful disregard of established measurement definitions; rather, most are exactly the same, or nearly so, as those of Baldwin *et al.* Major exceptions include tarsal length and manus length. In the following list differences between the parameters herein defined and those normally found in the literature will be indicated as will the similarities.

(1) Thigh length (FL)—the distance from the proximal end of the femur, as defined by the groove where the head of the femur fits into the acetabulum, to

*Current address: 3317 Olympus Dr., Bremerton, Washington 98310.

the distal end of the femur which is indicated by the notch at the bend of the knee in which the patella lies. The groove at the proximal end of the femur is circular, so this anatomical landmark was further clarified as being that portion of the groove directly opposite the end of the femur where the groove is roughly perpendicular to the shaft of the femur. The knee is covered by skin and feathers. An effort was made to get the caliper under the feathers, but the skin and underlying tissues not actually part of the femur were necessarily included in the measurement. The measurement was made with the knee flexed and the femur lying as parallel to the trunk axis as possible, because the notch referred to above virtually disappears when the knee is extended, thereby making it difficult to standardize from measurement to measurement. Also, the underlying tissues are rearranged into a different configuration when the knee is extended, thereby introducing error. This measurement is essentially the same as that of Baldwin *et al.*

(2) Crural length (CL)—the distance from the notch at the knee to the back of the heel, i.e. to the distal end of the tibio-tarsus. Again, the measurement was made with the leg flexed as if the bird was lying down with its feet underneath its body. This method is identical with that of Baldwin *et al.*

(3) Tarsal length (TL)—the distance from the heel to the joint between the distal end of the tarso-metatarsus and the third toe. This measurement was taken to include a portion of the tibio-fibula which overlaps the tarso-metatarsus in the plane roughly perpendicular to the shaft of the tarso-metatarsus. Measuring this overlap was necessary in order to obtain a reproducible measurement. The notch between the tibio-fibula and the tarso-metatarsus was not easy to find due to the callused nature of the skin which lies over the back of the heel, particularly in young hawks which spend a great deal of time with their weight on their heels. Baldwin *et al.* do not include the overlapping portion of the tibio-fibula.

(4) Third toe length (L3)—the distance from the joint between the distal end of the tarso-metatarsus and the first phalanx of the third toe, to the point where the talon or claw emerges from the skin at the end of the toe. The toe was extended, but not stretched. The joint mentioned above was not easily found on very young hawks, but its position was estimated by bending the toe, marking the bend with a pen and then using that mark to measure the extended toe. This measurement is exactly the same as that of Baldwin *et al.*

(5) Tarsus and third toe length (LT)—the distance from the heel to the tip of the third toe obtained simply by adding the tarsal length and third toe length. This measurement is pertinent because it corresponds in an anatomical sense to the length of the manus in comparisons between fore- and hindlimbs.

(6) Leg length (LL)—the combined length of the thigh (FL), crus (CL), tarsus (TL) and third toe (L3) obtained by adding all of these measurements.

(7) Claw lengths (1C and 2C)—the distance between the point where the upper surface of the claw emerges from the skin at the tip of the toe to the end of the claw as measured across its arc. This measurement was taken as the chord of the claw as indicated by Baldwin *et al.*

(8) Brachial length (HL)—the distance from the elbow to the trunk. The

notch between the distal end of the humerus and the proximal end of the ulna on the trailing edge of the wing is well defined and was used as the reference point on the elbow. The proximal end of the brachium was probably the most difficult reference point to find consistently. The proximal or dorsal end of the coracoid articulates with the clavicle forward of the point where the humerus articulates with the pectoral girdle. At the clavicle-coracoid articulation the bones are covered with a relatively thick layer of muscle and connective tissue. There is, nevertheless, a ridge of bone near this articulation constituting the proximal end of the clavicle. This ridge was used as the proximal end of the brachium for the purpose of measurement. The humerus was held parallel to the trunk axis and the elbow was flexed when this measurement was made. When the birds were down-covered, it was very helpful to clip the down in the elbow region. Baldwin *et al.* illustrate the measurement as it was taken in this study, but their written description of the technique is sketchy.

(9) Antebrachial length (AL)—the distance from the elbow to the wrist. The notch at the elbow (defined above) was used as a point of reference for the proximal end of the antebrachium. The best reference point on the distal end of the antebrachium is a groove on the leading edge of the wrist between the radius and the carpo-metacarpus. More specifically, this is the position of the radiale bone. Again the elbow and wrist were flexed and the down was clipped in the wrist region. Except for the flexion of the elbow and wrist, this is as Baldwin *et al.* describe it.

(10) Manus length (ML)—the distance between the wrist and the tip of the third phalanx. The point on the wrist is defined above, and, in very young birds at least, the tip of the third phalanx is clearly defined. This measurement was taken *not* to include the length of the feathers as they developed. A different point of reference was adopted as the feathers emerged. The end of the third phalanx was difficult to locate at this time, but the point at which the first primary covert feather emerged from the skin closely approximated it. At the age when this feather was definitely located, the reference point was switched to its base. The objection to the method of Baldwin *et al.* is that they take this measurement on the ventral surface of the wing by placing the bird on its back. This was not found to be practical with larger birds when only one person was doing the measuring.

(11) Wing length (WL)—the combined length of the brachium (HL), antebrachium (AL) and manus (ML) obtained by adding all of these measurements.

(12) Bill depth (BD)—the distance from the culmen to the gonys in the region of the nostril. This measurement was made as a dorso-ventral perpendicular line, not as a circumference around the lateral curvature of the bill. Care was taken to completely close the mouth so that the edges of the tongue or the whole tongue did not prevent total closure. This measurement is called the height of the bill at the nostrils by Baldwin *et al.*

(13) Bill length (BL)—the distance from where the culmen emerges from the cere to the tip of the upper mandible as measured by the arc from the cere to the tip. This is equivalent to the length of the exposed culmen without the cere as described by Baldwin *et al.*

(14) Maximum width of the head (WH)—essentially the distance from one eyelid to the other taken perpendicular to the longitudinal axis of the skull. This was taken as the distance between the outer edges of the supra-orbital processes on each side, but during early development the eyelids were used since the eyes bulged out of the orbits at that time. Care was taken not to damage the eyes when measuring the maximum width of the head.

(15) Feather lengths—(a) *Total Length*—the distance from the point where the shaft exits the skin dorsally to the tip of the feather, as measured across the arc if the feather is curved and/or naturally bent. This is the length of the quill as described by Baldwin *et al.* (b) *Shafted Portion*—the distance from the point where the shaft exits the skin to the point where the protective sheath is flaking off. In the case of a fully-grown feather, the distal end of the shafted portion was defined as the point where the vanes began or, ideally, where the superior umbilicus was located. (c) *Open Portion*—the distance from the distal end of the shafted portion to the tip. The tip of the feather was difficult to define, since the natal down adhered to the tips of the major feathers. The downy tip was cut off after the feather emerged in order to allow reproducible measurements throughout the period of growth. If this was done on the day the feather was first measured, little or no error resulted. It should be emphasized that all feather measurements including covert lengths were made without straightening or flattening the feather as described for primaries and secondaries by Baldwin *et al.* Tail feather measurements were equivalent to measurements of the length of the tail as described by Baldwin *et al.*

Sexing. Sexing birds of prey by sight is unacceptable to most ornithologists who have not handled many raptors. Yet, experienced falconers and biologists who study birds of prey do not hesitate to sex birds of the species they know well. Those who do not appreciate the differences consider such educated guesses useless, but there are many qualitative guidelines which can be used as sex characteristics.

Most female buteos are visibly larger than males of the same species. They have larger, more massive feet, thicker tarsi and larger heads relative to the size of the body. Females usually appear broader through the shoulder region and the beak is larger relative to the size of the head. There undoubtedly is overlap in each of these features, but when the sexes are seen together, or after some experience, even nestlings can be sexed a high percentage of the time.

Reference

Baldwin, S. P., H. C. Oberholser, and L. G. Worley; 1931. Measurements of birds. *Sci. Publ. Cleveland Mus. Natur. Hist.* 2:1-165.

(Received August 21, 1971.)