

## UNIPEDAL POSTURES IN BIRDS

By GEORGE A. CLARK, JR.

Many avian species characteristically stand continuously on one foot for many minutes. Although primarily bipedal, birds exhibit unipedal postures perhaps more frequently than any other tetrapod vertebrates. However, this attribute varies taxonomically among birds. The present study reviews examples of unipedal postures and hypotheses concerning their functional and systematic significance. The information is based on an extensive literature search and personal observations made over several years in a number of geographic areas including Arizona, Connecticut, Florida, and England.

I have limited my survey to taxa that stand on one foot for extended periods of time (minutes). Probably all birds stand at least momentarily on one foot while stretching or scratching with the opposite foot, but I have not attempted to review such transient positions. As one example, Berger (1958) reports that sleeping juvenile Kirtland's Warblers (*Dendroica kirtlandii*) perched on one foot for 20 to 30 seconds, but this does not constitute a unipedal posture in the sense here recognized. I have excluded most still photographs and sketches of birds on one leg, as captions commonly do not report the duration of the behavior.

### TAXONOMIC DISTRIBUTION AND INDIVIDUAL VARIATIONS

Records were compiled for 56 species representing 23 families (Table 1). All of these stand on one leg for prolonged periods under suitable conditions, and undoubtedly many additional species do likewise. This behavior is best known for Ciconiidae, Phoenicopteridae (Heinroth and Heinroth, 1958), Anatidae, and waders of the order Charadriiformes (Witherby et al., 1940: 154). At the other extreme, extended standing on one foot is apparently difficult or impossible for many birds of specialized locomotion such as loons (Gaviidae), grebes (Podicipedidae), storm petrels (Hydrobatidae; Palmer, 1962: 233), and tropicbirds (*Phaethon*; Stonehouse, 1962). Furthermore, unipedal postures apparently do not occur among the ratites (see, for example, Raikow, 1968). It is, of course, hazardous to equate lack of a positive record with absence of the behavior, but probably extended standing on one foot is rare or absent in many avian species. Goodwin (1967) indicates that many species of pigeons (Columbidae) lack unipedal postures, and Chaplin (1964) draws a similar conclusion for hummingbirds (Trochilidae). Many passerines appear capable of perching for extended periods on one leg, but I have few records of such behavior (Table 1) in the many observations of birds in this order. Chaplin (1964) indicates that unipedal postures are common in passerines, but presents no documentation.

TABLE 1. Species with unipedal postures.

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Phalacrocoracidae: *Phalacrocorax carbo* (Witherby et al., 1940: 3); Ardeidae: *Ardea cinerea* (Witherby et al., 1939: 126), *A. herodias* (McAllister and Maxwell, 1971), *Butorides virescens* (Meyerriecks, 1960: 12), *Nycticorax nycticorax* (this study), *Nyctanassa violacea* (this study); Ciconiidae: *Mycteria americana* (Bent, 1926: 57), *Ciconia ciconia* (Witherby et al., 1939: 113; this study), *C. nigra* (Baur and Glutz von Blotzheim, 1966: 425), *Xenorhynchus asiaticus* (this study), *Ephippiorhynchus senegalensis* (this study), *Leptoptilos crumeniferus* (Kahl, 1966; this study); Threskiornithidae: *Geronticus eremita* (Baur and Glutz von Blotzheim, 1966: 452), *Guara alba* (Bent, 1926: 31), *G. rubra* (Bent, 1926: 41, this study), *Plegadis chihi* (this study), *Platalea leucorodia* (Witherby et al., 1939: 119); Phoenicopteridae: *Phoenicopterus ruber* (Witherby et al., 1939: 164); Anhimidae: *Chauna torquata* (this study); Anatidae: *Branta canadensis* (this study), *Anas acuta* (this study); Accipitridae (all species from this study): *Accipiter gentilis*, *Buteo jamaicensis*, *B. albonotatus*, *B. nitidus*, *Parabuteo unicinctus*, *Circus cyaneus*; Falconidae (all species from this study): *Falco mexicanus*, *F. femoralis*, *F. sparverius*; Rallidae: *Porphyrio poliocephala* (this study), *Fulica americana* (this study); Eurypygidae: *Eurypyga helias* (this study); Charadriidae: *Hoplopterus armatus* (Hall, 1964), *Squatarola squatarola* (this study), *Pluvialis apricaria* (this study), *P. dominica* (this study), *Charadrius melodus* (this study), *C. vociferus* (Bent, 1929: 211); Scolopacidae: *Tringa nebularia* (Witherby et al., 1940: 336), *Crocethia alba* (Bent, 1927: 273), *Ereunetes pusillus* (Bent, 1927: 250), *Erolia alpina* (this study); Recurvirostridae: *Himantopus himantopus* (Witherby et al., 1940: 404), *Recurvirostra avosetta* (Simmons, 1955; this study); Burhinidae: *Burhinus capensis* (Maclean, 1964); Laridae: *Larus delawarensis* (this study); Columbidae: *Columba livia* (Goodwin, 1967; this study); Psittacidae: *Pionites melanocephala* (Smith, 1971, 1972), *Melopsittacus undulatus* (Brockway, 1964); Tytonidae: *Tyto alba* (this study); Strigidae: *Micrathene whitneyi* (this study), *Speotyto cucularia* (this study); Musophagidae: *Musophaga violacea* (this study); Eurylaimidae: *Calyptomena viridis* (this study); Corvidae: *Pica pica* (this study)

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Many birds are relatively stationary when unipedal, but waders (Charadriiformes) may hop along on one foot. I have seen the Sunbittern *Eurypyga helias* swiveling from side to side while standing on one leg and also while on both feet. Slud (1964: 89) described a similar movement of *Eurypyga* perched in an unspecified manner.

I made most of my observations on aviary birds. One uncertainty is whether captivity increases the time spent in unipedal postures. Perhaps human provision of food for captives results in more time spent resting, including time on one foot.

Individual variations may occur. As examples from my observations, Black-capped Chickadees (*Parus atricapillus*) and Starlings (*Sturnus vulgaris*) ordinarily stand on both feet, but in the field I have seen injured or malformed individuals standing on only one foot. Such abnormal individuals sometimes appear to have difficulty in balancing. The potential for unipedal postures in such species is realized only under abnormal conditions. Goodwin (1967) mentions that sick Rock Doves (*Columba livia*) are always bipedal, unlike healthy birds that frequently rest unipedally. Similarly,

Brockway (1964) reports that sick Budgerigars (*Melopsittacus undulatus*) commonly sleep or rest with both feet on the perch, but healthy birds sleep while perching on one foot with the other drawn up into the breast feathers. Although captive hummingbirds (Trochilidae) typically lack unipedal postures, one individual of *Boissonneaua flavescens* characteristically rested on one leg with the other leg held up in the feathers (Chaplin, 1964).

Little evidence is available to indicate whether individual birds favor either the right or left foot (footedness) in unipedal postures. Smith (1971, 1972) did not find footedness in the unipedal postures of the parrot *Pionites melanocephala*.

Little is known about the ontogeny of unipedal postures. I noted this behavior at less than one week of age in a laboratory-hatched Piping Plover (*Charadrius melodus*).

#### FUNCTIONS OF UNIPEDAL POSTURES

I have noted that individuals of *Passer domesticus*, *Junco hyemalis*, *Spizella arborea*, and *Melospiza melodia* on cold winter days in Connecticut stand briefly on one leg with the other leg held up in the feathers. This behavior presumably aids in retaining heat, because the legs are potentially a major source of heat loss in birds (Brush, 1965; see also Dawson and Hudson, 1970). Such passerines standing for brief periods on one leg during cold days often have apparent difficulties in balancing on the surface of snow and are seemingly more subject to aggression by members of their own species at feeding stations.

For herons, storks, ducks, hawks, plovers, sandpipers, gulls, and owls, there is no direct evidence that unipedal postures serve in heat retention, but presumably this is an important function, as Smith (1972) suggests. Particularly is this likely where the elevated foot and leg rest among the feathers. However, where the elevated foot grasps the heel or tarsus of the supporting leg (e.g., in *Leptoptilos crumeniferus*; Kahl, 1966; *Ciconia ciconia*; this study), a thermoregulatory function seems less clear.

Another possible function in unipedal postures might be to avoid fatiguing muscles, as in the shifting of weight from one leg to another in human standing.

No structural or physiological specializations are known to be associated directly with unipedal postures, but specializations in musculature or circulation are conceivable.

#### SYSTEMATIC SIGNIFICANCE

The scattered taxonomic distribution of specialized birds not ordinarily exhibiting unipedal postures suggests that there have been multiple evolutionary losses of this behavior. The lack of unipedal postures would thus appear in many cases to be an evolutionarily derived, rather than ancestral, state. The loss of unipedal postures is apparently frequently associated with adaptation for specialized aquatic or terrestrial locomotion. In many such cases it apparently becomes inefficient energetically to attempt to sustain a center of gravity over a single foot, as, for example, in loons

(Gaviidae). Too little is known about the taxonomic distribution and evolution of unipedal postures to assert with assurance that they represent the ancestral condition in the Class Aves; indeed, there have possibly been multiple evolutionary origins, as well as multiple evolutionary losses, of this behavior. The simplicity of presence versus absence of the trait might conceal convergences.

However, details of unipedal postures might possibly eventually be systematically significant. In resting Anatidae the head is often placed under the shoulder feathers on the opposite side from that of the supporting leg, whereas flamingos place the head on the same side as the supporting leg (Heinroth and Heinroth, 1958: 18). Much more information is needed on the occurrence and details of unipedal postures for many taxa.

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*Biological Sciences Group, University of Connecticut,  
Storrs, Connecticut 06268.*

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