Biped Gait in Birds: Some Observations

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Birds are one of the earliest bipeds to survive to modern day. Many species among them have the capability of flying in air, walking on land and swimming in water. The talent to exploit all three mediums - air, land and water for mobility gives them a special niche in the evolutionary tree.

The biped gait in birds has variants. Why do some birds walk while others hop? This rather simple question throws up quite interesting and debatable answers. It is proposed here that 'extra' mobility of neck produced by a wider cervical inter-vertebral articular range, in turn causes a bird to augment its visual range - in turn allowing it to progress slowly step by step. In birds with limited neck movement (reduced cervical inter-vertebral articular capacity) the biped gait is modified into hopping instead of striding. Hopping allows such birds to pivot round or turn abruptly. In essence, the choice of gait, hopping or walking, is determined by visual field – which in turn is controlled by mobility range of neck.

Observations & Discussion

Observations on biped mobility on birds and their locomotion reveal that, generally small birds hop while large ones stride, strut or walk.

a) Raptors (kites, eagles, hawks, owls) hop and strut far less than their arboreal and more terrestrial cousins, the passerines.

b) Arboreal, terrestrial or low flying birds ground hop and walk more than the hi-fliers or nocturnal cousins.

c) Birds with a higher degree of cervical (neck) vertebral rotation, hop less. That is, birds that have limited swivel of neck (up to 180^0 or less) hop more and more frequently than the birds that can rotate their heads through a much wider arc. Some birds have a complete or nearly complete 360^0 field of view. Birds such as owls are gifted with nearly 270^0 plus range of side to side swivel of neck vertebrae. The ability to rotate the head and increase field of vision to almost full circle range makes the birds alert to approaching danger – the talent to spot peril early, gives them the confidence to progress one step at a time. Owls possess twice the number of cervical vertebrae, fourteen, the extra articulations in the cervix allows for more fluidity in neck mobility.

Birds also have more cervical vertebrae than many other animals; most have a highly flexible neck consisting of 13 -25 vertebrae**.** In anatomical terms, the inter-vertebral cervical joints have wider articular surfaces of the plane / condlylar type in birds that soar, hover, or are nocturnal. These birds, hypothetically at least, being gifted with a wider eye view and range of vision, require less need to hop, twist and turn their whole bodies to visualize a wider field. In less mobile necked birds, hopping, *in lieu* striding, allows shift of range and focus in field of vision in continuity.

d) The natural processes of adaptation has perhaps given birds that strut and hop less with better cervical articular vertebral inputs; *vice versa* birds that can better hop, jump, strut and perch, need a less efficient head rotation and mobility - the range and axis of movement of the cervical inter-vertebral joints accentuating or diminishing with range of field of vision. Preyed species, like pigeons, usually have a very wide field of view because they need to see danger coming from any direction. To achieve this most of their vision is monocular, like our peripheral vision, with only a narrow angle of binocular vision with good depth perception. A pigeon can see nearly 360^0 around its head, an advantage when avoiding a peregrine.

Research into visual range and peripheral vision in some waders conclude that neck positioning plays a major role in success in foraging. Predator species usually have a narrower field of view because they need to have good depth perception in order to capture prey. The owl's field of view is more like ours with a wide area of binocular vision and narrow bands of peripheral, monocular vision on either side. Peregrines have fields of view similar to owls. The chicken and the pigeon are two good examples of this. Such birds must judge distance by rotating their heads.

The possibility of that neck mobility and visual ranges could be inter-dependent and complement type of gait used has not been thought of yet. Birds do not possess well developed muscles for eyeball movement they rely on their ability to maneuver their head and neck for good visualization of objects.

As the observations and conclusions derived here are conjectural, speculative and hypothetical, the entire question of biomechanics and of neck as having bearing on bipedal kinetics may require a much deeper probe. Perimetrical visual analysis and collation of data on orbital fields in passerines, raptors and predators could aid in clarifying issues to some extent.

References

Kumar, J.C. and A. Kumar (2005). Biped locomotion: an evolutionary conundrum: Proceedings of the National Seminar on Bird Ecology & Conservation, Eds. Varghese

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A, Sridhar S, Chakravarthy AK, Bhat HR & Kumar P, Bangalore, 2005.

Katzir, G and G.R. Martin (1994). Visual fields in herons (Ardeidae) - panoramic vision beneath the bill; *Naturwissenschaften*, Vol. 81, Issue 4, pp 182-184
Kate St. John, http://www.wqed.org/birdblog/category/birdanatomy/

Sakas, P.S. Basic Avian Anatomy, http://www.4parrots.com/ Basic_Avian_Anatomy.htm
5. http://www.vetmed.vt.edu/education/curriculum/vm8054/eye/ binocs.htm

Kumar, A. (2013). Hopping in Birds: Is choice of gait influenced by cervical mobility and field of vision? Nitte University. *Journal of Health Science*, 3 (1): 56-58.

Kumar, A. (2013). *Biped stance & stride: Origins of orthograde posture and gait*, ISBN 978-3-659-44121-9; 1st. ed. Lambert Academic Publishing, Germany, 2013.

Kumar, A. (2013). Unipedal stance in birds: some observations, *Zoos Print,* 28(11): 35.

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