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ALLOMETRICAL APPROACH IN BEHAVIORAL SCIENCES

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ABSTRACT - The sparse information on size effects on animal behavior is compiled and the applicability of allometrical approach in behavioral sciences discussed.

KEY WORDS: Allometry, Behavioral Sciences, Learning, Motoric Activity, Avian Song, Avian Flight.

Few of the inspired polyhistors of the 17th and 18th century, particularly Galileo Galilei (1546-1642) and Albrecht von Haller (1708-1778), recognized that differently sized but otherwise similar organisms usually differ in their body proportions (see Gould 1966). Later, comparative physiologists observed that also certain physiological processes, such as metabolism, are size dependent (Rameaux, Sarus 1839, Bergmann 1847), and the number of investigations studying the function P = f(S), where P is a property of biological system S, started slowly to increase. The early respective efforts were summarized by Huxley (1932), who also termed the phenomenon under discussion *allometry*. Rapid development in allometrically oriented research caused later allometry to develop into a more or less separate scientific discipline called *"science of size and its consequences"* (Gould 1966); now a commonly accepted view, although the use of the term allometry for both the phenomenon and the science which studies it may be somewhat confusing in certain respect. For current evaluation of the allometrical approach see especially Smith (1980) and Shea (1985).

At present, the significance of body size for organism's properties is recognized not only in physiology and morphology, where this problem was studied originally (see Röhrs 1959, 1961, Bonner 1965, Gould 1966), but also in various other biological disciplines (see Calder 1983,

McMahon, Bonner 1983, Peters 1983, and Schmidt-Nielsen 1984 for current reviews). Despite of this, allometrical approach was only rarely apllied in behavioral sciences so far. For this reason, I attempted to survey the few indications of the influence of body size on behavioral characters in animals and to comment on this basis upon the applicability of the allometrical approach in behavioral sciences. All the respective evidence I was able to find regards only four problems which will be discussed below.

(1) *Learning abilities.* Bernhard Rensch, German zoologist and evolutionist, was interested since late 1940s in comparison of learning abilities between closely related, but differently sized animals, particularly birds and mammals. He and his pupils performed a long series of appropriate experiments with horses, laboratory murid rodents, domestic chickens and other animals (Altevogt 1951, 1955, von Boxberger 1953, Reetz 1958, Giebel 1958, Neumann 1961, Stichmann 1962, Schulze-Scholz 1963), which Rensch (1954, 1956, 1962, 1967, 1973) evaluated theoretically. These experiments showed invariantly that among closely related animals the larger ones (1) learn more slowly, (2) are able to learn more information, and (3) retain the once learned information for longer period than the smaller ones (cf. also Van Valen 1974). Similar experiments carried out independently of the Rensch's school by Wiener and Prater (1966) and Riesen (1970) yielded the same results.

(2) *Motoric activity.* As a byproduct of their above mentioned studies, Rensch and his pupils observed also that among closely related animals the larger ones were motorically more active than the smaller ones.

(3) *Song properties.* Wallschager (1980) and Ryan and Brenowitz (1985) observed that in song birds (Passeriformes) the mean song frequency is positively correlated with body size of the birds.

(4) *Flight performance.* It has been observed in various studies on birds, that owing to allometrical changes of wing area relative to body size, wing load is lower and, consequently, that maneuvrability and agility are higher in smaller birds than in larger ones (cf., e.g., Greenwalt 1975, Andersson, Norberg 1981, Mueller et al. 1981, Safina 1984, Widén 1984).

CONCLUDING REMARKS

Despite of many efforts of ethologists and zoopsychologists devoted to the study of animal (and human) behavior, comparative ethology is still

in its beginnings (cf. Dewsbury 1978) and many of factors which may cause individual, interspecific, or other differences in behavior between animals are still insufficiently known. Absolute size of investigated objects (e.g., body size, brain size, etc.) may prove to be one of those factors. The present paper was written in the hope on attracting the attention of comparative ethologists to the problems of allometry and in order to help thus to promote the allometrically oriented research in behavioral sciences.

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