Opportunities for Animal Behavior Research in Oklahoma, with Selected References on Animal Behavior

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An animal, dead, has certain morphological characteristics. The same animal, alive, has these morphological characteristics plus an elaborate array of functions, from respiration to reproduction, which from conception to death contribute to its maintenance within its environment. The means by which an animal maintains its relation with the environment can be termed its behavior and would include all of the acts performed by the animal.

The recent and continuing dynamic growth in interest and research in animal behavior in Europe and the United States is evidenced by the increasing rate of appearance of outstanding publications concerned with animal behavior, the increase in number of academic courses in animal behavior, and the establishment of new laboratories exclusively for the study of animal behavior.

Oklahoma is in a position for many unique opportunities in the study of animal behavior. Our state is one of diverse biological areas, extending from oak and pine forests through tall- and short-grass prairies to the high plains. Low mountains are scattered over the state, as are areas characterized by granite and gypsum caves. Natural and man-made water bodies are abundant in ever increasing numbers. The diversity of animal forms occupying these numerous habitats offer a vast and relatively untapped source of material for animal-behavior research. The scarcity of information on the behavior of our state animals, other than casual observations, is obvious if one searches the literature.

Some of the methods, techniques and approaches now developed make one realize the possibilities and potential waiting for the inquisitive (34, 49, 122, 125).

The technique of marking an individual animal for easy recognition is essential to many approaches of behavior study (8, 40, 41, 115, 134). Numerous techniques have been developed for marking the various structures presented by the varying animal types. These methods include the use of various colored spots or dyes (91, 147), removal of fingers and toes (61), notching of shells (153), removal of feathers (49), tattooing (153), recording unusual characteristics of an animal, banding, ringing and the use of radioisotopes (110).

Aside from direct observation in the field, often with the aid of blinds, and laboratory studies, the use of experimental habitats and enclosures, either outside or within a building, is proving a fruitful approach. Some

of our most exciting contributions are now coming from research being developed in zoological gardens (73).

The field of animal behavior is little touched and challenging to the "gadgeteer" and photographer.

Let us examine behavior relative to five different, but interdigitating, approaches. These approaches are discrimination, orientation, communication, social behavior, and organization in time and space.

An animal's ability to discriminate is dependent upon the degree of development or refinement of its senses (74, 96, 105, 111, 147). These senses are familiar to all of us.

Excellent experiments have been devised to indicate color vision in honey bees (10, 147), but what do we know of the visual discrimination of most animals? Visual acuity is highly developed in birds of prey (44, 116, 149), but its accurate measurement needs to be studied. Feeding experiments on frogs and toads have shown that certain food sizes and shapes may elicit a feeding response at one age and a fright response at another. We are learning that many animals are sensitive to high frequency sounds, and that some can reproduce these sounds (45, 54).

Experiments demonstrating the ability of certain fish to discriminate the waters of particular streams (72) is helping to solve some of the problems of fish migration. A very exciting series of recent experiments on lizards in California (132) has indicated the function of the parietal or third eye spot as sensitive to light and playing a role in controlling sunning behavior, activity and thermoregulation.

Important considerations in discriminatory behavior relate to an animal's ability to recognize other individuals of its own species (48, 69), sexual recognition (6, 107, 135) and individual recognition. We know that in many species, individual recognition is possible (1, 65, 92), but we usually do not know how this is accomplished. Sex recognition may depend upon elaborate dimorphic characteristics (50, 61), minute structural differences, movements and postures (6, 9, 48) or reaction to contact (107).

Most animals are probably able to select the ecological niche in which they live, but to determine what it is that the animal selects or what it requires is a challenging problem (16, 68, 101, 137). Certain animals discriminate in their choice of food. By what means to they select this food?

Relative to discrimination, but also related to other phases of behavior, is the sign stimulus or "releaser," defined as a specific structure or type of behavior to which an animal responds in a specific way (55, 104, 141). The English robin will attack a tuft of red feathers (89), the male stickleback will challenge a model of particular contrasting colors (142), and a chick will ignore or flee from a silhouette drawn above it (142), the response depending upon the direction of movement. Specific colors, shapes, sounds, and movements may all act as releasers.

Let us now consider orientation, or the means by which an animal locates and moves through its environment (53, 62, 152). The simplest type of orientation is called a taxis (12, 19), examples being the responses of certain protozoa to variation in light and temperature, or the responses of daphnia to polarized light (13, 148). The use of polarized light by bees and ants in directing their movements is now well established (147).

Beyond the simple tropism in orientation is the problem of navigation (35, 71, 97). There is considerable research being carried on at the present time relative to the phenomenon called the "sun compass," a term ap-

plied to the mechanism which permits insects and birds, and perhaps others, to direct their movements relative to the position of the sun (80, 87, 88). What is the relationship of this "sun compass" to migration? Certain animals (fish and birds) when released or during periods of migration, exhibit "intention movements," that is, their movements seem to point in a particular direction (51, 64). The significance of such movements is being studied.

The fact that bats can navigate in total darkness is due to the phenomenon termed "echolocation" and is related to high frequency sound waves (63, 70). Perhaps there are other animals which use a similar system for navigation and orientation. Homing behavior is not fully understood (46, 82, 83, 86, 98).

Have you ever watched the monarch butterfly migrating? An extensive banding program now exists between many cooperators to study this migration (146). Many other insects migrate, but their routes of travel, how they travel and the distances traversed have yet to be learned. The marvelous migration of penguins over miles of pack-ice to their ancestral breeding grounds (131) as well as the great migrations of most of our birds are recognized, yet for many species we have yet to learn where they specifically winter. How some of these individual migrants are able to return year after year and nest in the same field or few square yards is still a mystery (103). The "Coriolis Force" has been proposed as a method used by birds as a guide in navigation (17).

Man communicates by using sounds, movements and symbols. These methods are also used by other animals. The songs of birds, the calls of amphibians, and the mechanical sounds of insects are the most familiar (18, 20). These sounds are now being subjected to analysis by use of sonograms and other recording devices with results indicating geographical varation, temperature relationships and genetic variability, even hybrid calls (43). Modern recording devices are also being used to study the songs of mice as well as the various sounds produced by fish (45, 52).

One of the most outstanding contributions to biology in recent years has been the demonstrated use of a unique dance by the honey bee to communicate information to others in its hive (147). The movements of other animals, such as the dance of the prairie chicken, the display of the stickleback (142) and cichlid fish (9), and the "push-up" of iguanid lizards (106) are means of communication for these animals.

The use of symbols by animals is an area not well studied, yet when a male rosy-finch presents a piece of nesting material to its mate, or your pet dog comes to you with a ball in its mouth, are these not symbols which transmit information?

We are all familiar with terms such as flock, school, herd, colony and similar terms, used to connote aggregations of individuals of a particular species. These aggregations may be loose assemblages or highly organized societies of animals. The factors that are responsible for keeping schools of fish (81) or aggregations of tadpoles (24, 25) together are not well known.

The study of social behavior is one of the most active fields of animal behavior study (1, 3, 39, 47, 85, 126, 139). Social orders are now known to exist in all classes of vertebrates. The organization of these social strata depends upon a phenomenon known as dominance, called various names such as peck-right, peck-dominance, or nip-right (2, 22, 58, 151). Dominance and social standing may be established by aggressive behavior (26, 38, 61, 77, 128, 129, 130, 136,144) such as fighting, displaying, bluffing or vocal sounds (33, 57, 99, 120, 123, 124, 65).

The relationship between opposite sexes is a type of social behavior which involves courtship and mating (7, 27, 30, 113). There is a great volume of literature on the various types of animal courtship from scorpions (4) to birds of paradise. Certain movements involved in the courtship of various groups such as ducks (94), geese, pigeons (150), cichlid fish (9), gulls (145), and others have been studied and the evolutionary development and elaboration of these movements can be followed.

The relationship between adults and young is a special category of social behavior and involves such things as parental care of young (84, 94, 108), learning (138) and play (14).

From the time of its birth or hatching, an animal occupies or moves through a certain amount of space for a certain length of time. It is generally true, particularly among vertebrates, that the space used by an animal shows some consistent pattern, that is, in a biological community, a type of organization exists for the utilization of the available space (174). The area covered by an individual in its day to day activities is termed its activity range. Activity ranges, within species, generally have some conformity as to size. This may be true for a herd, school, flock or similar group, as well as for the individual. When this activity has some central focus to which the individual or group consistently returns, we then call the area a home range (31, 56, 118).

Many animals, by use of aggressive actions such as display, fighting, chemical signs, or songs assert their claim to a particular area, which may be the same as the home range or smaller. Such action is territoriality (28, 29, 59, 60, 76, 78). Such territorial actions have been demonstrated in all groups of vertebrates as well as in many arthropods, such as dragonflies (78) and bees.

The space occupied has three dimensions and in the organization of a biotic community, different animals occupy the various strata, limiting their vertical movements. The stratum used by a species is often directly related to some particular behavior pattern.

Man has terms to express periods of time, such as diurnal, crepuscular, nocturnal, aestival, hibernal and autumnal. Though these terms are based primarily upon physical phenomena, they have real meaning relative to the behavior patterns of animals (11, 32, 66, 67, 75, 102, 109). The pattern of activity in time for a species is usually consistent. This relates to reproductive cycle, feeding and resting periods, periods of dormancy and others. We accept these temporal relationships, but we have actually only begun to study such phenomena as hibernation, aestivation, diel activity, nocturnalism, and the specializations of behavior that go with these.

A brief sketch of five approaches to the study of animal behavior has been presented, but one could not study one without also learning about another. The opportunity to study and learn about the behavior of animals is before you. No two species would be expected to have identical patterns, yet we are learning that these patterns show homologies, consistent with other taxonomic characters and that for the limited groups studied, these patterns can be demonstrated to exhibit evolutionary trends from the primitive to the specialized. (9, 26, 79).

The door is open and the opportunity to study animal behavior is yours. Won't you come inside and look around for yourself?

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