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A Preliminary Report on the Social Behavior of the Northern Largemouth Bass Micropterus salmoides (Lacepede) Under Experimental Conditions

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of habitats. During World War II Norway and roof rats and *Mus* were abundant in and about buildings and military camps and in adjacent vegetation. *R. rattus* was feral in woodlands; *Mus* was feral in grasslands of three densities. Norway rats were not feral except as wandering individuals; they rapidly invaded preferred habitat. *R. exulans* was feral only, occurring in taller grass, brush, savannah, lowland woods, bracken fern-heath scrub and gardens. Numbers of *exulans* near dwellings seemed to be determined by population densities of the larger rats. In woodlands few *exulans* were found where *rattus* was common and none where it was abundant. *R. exulans* and *Mus* occurred together in taller grassland and savannah. Only the mouse occurred in short grass. Breeding in *norvegicus* is reduced during early winter (June); in *rattus* for the same period breeding is reduced or absent. *R. exulans* has a major breeding period about April and a second period in December. *Mus* has a major breeding period in September; breeding is reduced in December. The fact that the major breeding periods of *R. exulans* and *Mus* occur at different times of the year is considered of prime importance in permitting both species to maintain high populations where they inhabit the same grasslands. Average number of embryos per pregnant female of the Norway rat was 9.3; of *R. rattus,* 5.0; and of *R. exulans,* 3.0. Sex ratios of feral and non-feral populations are also presented. Three types of *R. rattus,* the subspecies *frugivorus, alexandrinus,* and *rattus,* are considered color phases on New Caledonia, and occurred in the ratio of 12:2:1, respectively. The three types exhibit no ecological differences; they interbreed in the wild and in captivity, and produce various combinations of color types in a single litter, as well as different combinations in different litters.

A PRELIMINARY REPORT ON THE SOCIALBEHAVIOR OF THE NORTHERN LARGEMOUTH BASS MICROPTERUS SALMOIDES (LACEPEDE) UNDER EXPERMINTAL CONDITIONS

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In recent years problems concerning animal social behavior and social organization have been attracting considerable attention. However, this attention has been directed mainly toward birds and higher animals which are more colorful and perhaps easier to work with.

In brief review of the literature concerning animal behavior attention should be drawn to the work of Schjelderup-Ebbe, (1922) who first described the social hierarchy which occurs in chickens. He found that a flock of domestic hens is organized in what he calls "peck-order" or "peck-right." This means that the rank of an individual within a

group is determined by its reactions when another member pecks or threatens to peck it. With hens this organization is definite and is not changed except by combat. This means that the dominant individual has the right to peck all of the others in the group without in turn being pecked; the next in rank can attack all except the first; and so on down the line.

Masure and Allee (1934) found that in certain other species of birds a more flexible social order exists. They called this "peck-dominance." In this situation the dominant individual delivers more blows than it receives, but the subordinate frequently retaliates and the outcome of any single contact is not strictly predictable. Masure and Allee also noted that the various members of a group are more aggressive in one place than in another. They suggest that this territorial behavior might be one factor in the peck-dominance type of society.

Other types of relations between territory and hierarchy have been proposed for pigeons, for *Anolis* the American chameleon, for several tropical aquarium fishes, and for the common green sunfish.

Diebschlag (1941) discovered that residence points of limited area, for example around a nesting box, and larger "influence spheres," which might consist of an entire laboratory cage, are defended by pigeons. Greenburg and Noble (1944) recorded somewhat similar situations for the lizard *Anolis,* however, the relations among territory holding males were of the peck-right type. Greenburgs' work (1947) with the green sunfish showed fairly rigid organization of the peck-right type. After the initial settling of the dominance relations, which in the sunfish takes place within a few hours, there is ordinarily no fighting in the sense that the full fight pattern is shown. Instead, the dominant individuals drive their subordinates by making quick dashes at them, usually without nipping them.

In the studies already mentioned sexually mature animals were used; however, we know that aggressiveness in any species is dependant to some extent on sex hormones, since the degree of aggressiveness can be altered greatly through injections of the several known gonadotropins. Therefore, immature individuals have been used in their present study. This was done in the hopes of determining how important sexual maturity is in hierarchy organization.

The fish which have been used in the study are bass fingerlings which were about six months old when obtained. They range in length from six to seven inches. They were secured for the experiment from Dr. John Moyle of the Minnesota Department of Conservation and held until used in large tanks in the aquarium room of the Zoology building on the university campus.

To make quick identification possible a method of marking was devised whereby a glance would distinguish among the fishes. These marks consisted of a series of notches cut into the caudal fin. The freshly cut edges were painted with a one percent solution of zephiran chloride to prevent infection.

The study was designed to investigate (1) the type of organization established among small groups of immature bass, (2) the effects of

variation in the physical environment and, (3) some of the factors that determine position in a hierarchy.

Groups of five fish each were used in all of the experiments. Fish which had been used in one experiment were not reused in others. The bass were fed minnows twice a week. Five, fifteen, and thirty five gallon tanks were used in the experiment. The water used was artificial pond water with well water as a base.

Thermostatic controlled heaters were used to maintain temperatures ranging from 55° to 85° F. All aquaria were kept under constant flourescent lighting. The fish were observed during daily ten minute periods for thirty days. Activity remained the same throughout the daylight period, but tended to decrease when under artificial light alone.

There is in the bass an aggressive behavior different from that described for any other species. It is a nip-dominance type, but differs in that about 85 percent of the nipping is done by the alpha, or despot fish, and beta, its immediate subordinate, with only slightly more than half of the nips being delivered by the despot.

The hierarchy is not stable and the alpha-beta relationship often changes for a day or two or for several weeks. However, the top two fish continue to make the average 85 percent of the nips. When the alpha and beta fish are closely matched, reversals are common. In one such reversal the top two fish did 95 percent of the nipping, but received only 33 percent of the nips. The order of dominance was reversed twice. The first occurred nine days after the experiment began, the second thirteen days later.

The nips are not merely bluffing charges, but are real bites on the mouth, on the pectoral and pelvic fins and especially on the lower portion of the tail.

That nipping will occur for long periods of time is indicated by one tank which has been observed for seven months. In this tank the nips per hour correspond very closely to the average for all of the tanks which is shown in the following table.

Average Number of Nips Delivered by each Fish per Hour.

Alpha	Beta	Gamma	Delta	Omega
50.2	44.2	10.3	6.5	0.7

Flourishes of nips frequently totaling more than 45 nips per ten minute period for the dominant fish are common, although, just as spectacular are the records of the omega fish. They may receive an average of 50 nips per hour but in return give only 0.7 nips.

As might be expected, activity increases with an increase in temperature. At 60° F. and below all aggressive activity ceases. The fish stop eating, rest quietly on the floor of the tank, or occassionally swim about the aquarium. At 65° F. activity has picked up slightly, but it is not until a temperature of 70° F. is reached that the fish are what might be called active. From 70° to 85° F., which is the highest temperature worked with, the activity increases steadily.

At 60° F. and below the fish remain inactive no matter how much space is available. At 70° F. the activity in five gallon tanks is so intense that accurate observation is impossible. Mortality from fungus infections is very high owing to the stripping off of the mucous covering

of the fins and body during combat. In the larger tanks contacts are not so frequent and escape from attack is easier. Infection rarely develops and usually clears without treatment.

These observations definitely show that activity increases with an increase in temperature while at the same time activity decreases as the volume of water available per fish increases.

It is quite apparent that defense of territory is one of the big factors in dominance. The alpha fish usually claims the entire tank for himself and in so doing pushes the other fish into one corner near the surface where they hang in a rather limp, lifeless cluster. It is when they try to move from this position that they are attacked. The beta fish strongly objects to this treatment and consequently in trying to escape from it is bitten more often than the others. However, he may eventually gain control of and defend a small portion of the available tank space. Periodically the gamma fish is able to get control of an even smaller area but he is never able to hold it for more than a few hours.

At this time further conclusions are impossible, however, experiments with both young and adult bass will continue, as will experiments already under progress with other fresh water species.

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DUCK LAKE SURVEYS IN MINNESOTA

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During the 7 year period 1946 through 1952, 862 shallow lakes, marshes and potholes have been surveyed throughout 80 counties in Minnesota. These investigations have been commonly known as Duck Lake Surveys, and have been carried out by the Game Research Unit of the Minnesota Department of Conservation. Two primary objectives of this work are: to provide a basis for evaluating, maintaining and improving waterfowl and muskrat habitats in Minnesota; and to provide information about waterfowl lakes and marshes for groups and individuals in accordance with their requests to the Division of Game and Fish.

Eight wildlife management students are hired each summer to assist the two full time biologists in carrying out the field work.