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OBSERVATIONS ON THE MATING AND SPAWNING OF *Pimephales promelas* (Raf.)

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CONSIDERABLE interest has been aroused in connexion with the raising of the Black-headed Minnow (*Pimephales promelas* Raf.) as forage fish for use in fish culture. Although several papers dealing with the breeding habits of this species, and of the closely related Blunt-nosed Minnow (*Hybomphichthys notatus* Raf.), have been published, so far as I have been able to ascertain no account of the actual mating has been given, the papers dealing rather with descriptions of the physical conditions suitable for breeding, of the nest, and of the strongly developed parental instincts of the male.

During the course of an examination of several lakes in the region of Big Lake Nominigou, Labelle County, for the Fishcultural Branch of the Quebec Government, about the middle of June 1933 many nests of *P. promelas* were observed in several lakes. In one, Lac Smith, a small lake located high in the hills to the south of Lac Saugay, the processes of mating and of egg-laying for this species were observed on June 19th.

Immediately on approaching the edge of this lake, it was obvious that there was much unusual activity amongst the many groups of minnows, principally *S. atromaculatus* (Mitchill) and *C. erythrogaster* (Raf.). These schools, instead of making their way slowly along the edge of the lake as they are generally found to do, were, in this case, in a very nervous state and were continually breaking up and re-forming again.

The cause of this disturbance was soon traced to the presence of many smaller groups of male *Pimephales*. Generally these occurred in groups of four to six. These bands were passing rapidly along the shore and were frequently observed to force their way through the much larger groups, scattering the latter as described.

Shortly afterwards, having made my way out along a log which extended some twenty feet

out over the silt bottom of a small shallow bay, it was found that occasionally one of the males would break away from the group with which he had been travelling and would dart into position below a log, or small branch, at a point where this was raised clear of the bottom by several inches. Here the male would remain, slowly turning round in an attitude of extreme watchfulness, until with a swift movement he would dart out at a passing group of minnows of various species and from them cut out a female of his own species driving her back to the location he had selected.

Usually the female would respond willingly to this treatment without attempting to escape; but in three cases where the male was observed to have considerable difficulty in persuading the female to approach the nest, the male was seen to resort to a brutal chivvy, pushing her and frequently snapping at her whenever she attempted to turn aside.

As the couple approached near to the nest, the male was seen to close up the gap between them and to draw into a position so that his snout came almost to the level of her pectoral fin. It was most commonly found that the male took up his position on the left-hand side of the female. In contrast to this behaviour, it was noted that in the case of those females which the male had some difficulty in leading to the nest, the male took up his position on the right side and with his snout ahead of hers.

On arriving below the log or branch, previously selected by the male, he would, whether in front or behind, by pushing firmly against the side of the female, cause her to swing into an anti-clockwise circle. It is rather noteworthy that in the nine cases where this was observed the circle was in each case of the same type and the male managed his approach to this end by pushing the posterior end of the female in the one case, or by heading her off in the other.

Gradually, with an increasing pressure on the part of the male, the circle was decreased in diameter until eventually it was performed entirely below the log. As the speed of the pair did not appear to have decreased to any extent, the number of revolutions increased as the circle diminished.

At this point, the male, if on the inner side of the female, would slowly commence to sink below her level, so that instead of pressing on her side he would come to press more on her belly and, owing to the circular motion, his tendency was to form a larger circle and to slip out from below her. By pushing himself upwards, the force so created was utilised in pressing on the lower part of the body of the female and resulted in her being slowly rolled over onto her side. Finally she was brought to a position where she was riding almost entirely on her side and on the back of the male who by pressing her upwards brought her into close relationship with the lower surface of the log.

For the completion of this complicated manoeuvre, it would be necessary for the female to reciprocate to some extent the pressure of the male. Such an action could not be observed. However, it is suggested that the ridge of thickened epidermal tissue situated on the back of the male, and described by Wynne-Edwards as being utilised in manipulating the eggs in the nest, may also have a second function in preventing the female from slipping too easily from the back of the male.

As the last part of this circling action was completed the activity of the pair rose to such a height, and the motion churned the water to such an extent, that finally for several seconds the pair were not visible. However, with a sudden cessation of activity, the water calmed down; but there was still no trace of either fish. It was not until nearly half-a-minute later that the pair came into view, when both appeared from beneath the branch and the male, turning viciously on the female, drove her away from the nest, immediately returning to take up his position again below the branch.

Collection of eggs from one nest which had been watched from the time that the male first took up his position down to this point showed that during this performance the eggs had been laid and fertilised. In another nest, the pair were interrupted just as they rose to the branch and it was found that no eggs had been laid. So that it is quite safe to assume that the eggs had been laid in this brief period of apparent

activity, and the male had fertilised them before chasing the female away.

In the case of the refractory female, the male would also cause her to swing into a circle by heading her off as described. The circle would thus be also anti-clockwise in direction. Not until the circle had been performed several times and had commenced to decrease in size would the male slip below the female, and so come up on the inside of her in the normal position.

Only once was the performance seen to have been accomplished successfully without difficulty. Generally it was not completed without the female's slipping off the back of the male at least once. In one case interruptions of this nature occurred three times before the operation ended with the female being turned completely over on to her back. The entire performance then took nearly five minutes, a remarkable length of time considering the extreme activity of the pair. Usually, although there may be one or two unsuccessful attempts, the entire operation lasts only a matter of one or two minutes before the male drives the female away from the nest.

Having chased the female away, the male returns and takes up his position below the eggs. His attitude is now one of ceaseless vigilance, and he is seen to turn with slow jerky movements so that in a short interval of time he is brought to face in all directions.

One male was seen to go through this manoeuvre three times, each time with a different female and without variation of the routine. In another case a male mated with two females, one after the other. In the second case one of the females did not proceed willingly to the nest and the male treated her in the fashion described above.

Any intruder is treated with short shrift, and as noted by Wynne-Edwards (2) and by Lord (1) the male is most courageous in the defence of his nest. On several occasions a passing band of males was observed to be attacked by a nesting male and to be driven off. In one instance, four males attacking a nest were driven off only after prolonged battle in which the male first attacked the band as a whole and then followed up this aggression by attacking each individual separately. The latter was somewhat of a misplaced gesture, for while he was busy with one the remainder quietly proceeded back to the nest and made a meal of the eggs.

The significance of the parental care exhibited by the male may be best appreciated when it is pointed out that after the visit of only one

female to a new nest there were only sixty eggs. In another after three females had visited the nest and during the interval between the visits of the second and third females the nest had been raided by three males, only one hundred and five eggs were found. The discrepancy between this figure and that which would be anticipated on the basis of the number of eggs found in the former may be laid to the attack of the three males, and serves to illustrate the extent of the damage consequent upon a raid of this nature. That any eggs should survive the full period of development, running such risks as these, is one of the highest compliments which can be paid to the vigilance of the male.

Both Wynne-Edwards and Lord have established the fact that *Pimephales* is polygamous in habit, basing their statements on the numbers of eggs found in the nests they examined, and also on the fact that many stages of development are to be found in some nests at one time. The above observations bear out this assumption.

This may be further considered in the light of the risks that a nest runs during the time of development of the eggs and would indicate that the male obtains females possibly to make good any losses that may be sustained. Another not inconsiderable factor which enters here is that the female can only bear a small number of eggs since they are relatively large and she is of such small size.

It is interesting to note also in this connexion that the male after having been so vicious in driving off a female which has spawned for him will shortly afterwards drive another into the nest.

Regarding the use of the term "nest", it is well to point out that although over twenty males were under observation for over an hour, and of these nine took up their position for the first time during this period, it was found that apart from being particular in selecting a location for a nest the male did not exhibit any of the meticulous care in its preparation such as is commonly described for the other Cyprinidae.

At Lac Smith all the nests were of the same type as found at several other locations. Although many plants of the yellow pond-lily were present, a careful search of the pads failed to find any cases where the eggs had been placed on these surfaces as described by Wynne-Edwards. All the nests which were located, a total of over thirty, were found to be situated

below logs or small branches at points where these were raised some two or more inches from the silt. Many other nests were located, but it was not possible to determine their number as they were situated below old planks and were out of sight, the only indication of their presence being an occasional glimpse of the male.

From Lord's account, in which the fish spawned below planks, and from the above observations, it would appear that *Pimephales* exhibits preference for an object more stable than a lily-pad to which to attach its eggs; though, as Wynne-Edwards has shown, it will resort to the latter on occasion.

The apparent uniqueness of this method of laying eggs and the peculiar use of an "inverted" nest in a member of the Cyprinidae is really only a highly developed exhibition of several rather common characteristics of that family. That there is in many of the members of this group a highly developed nesting instinct is a well-vouched-for fact, and is shown in the many accounts of species which go to considerable pains to construct a nest of stones, a habit associated with the presence of a clean bottom.

In those species which spawn over a silt bottom, both in the members of this family and also in other families, it is found that the nesting instincts are generally poorly developed, and it is far more common to find that the eggs are strewn freely over weeds to which they adhere. This custom is generally to be found only in species of large size capable of laying many eggs.

Recourse to either of these methods is not possible for *Pimephales*, the first since their habits lead them to regions where the bottom is of silt; the second, as pointed out, on account of the small size of the species.

The impossibility of *Pimephales*' clearing away the silt to reach a solid base for spawning is obvious when it is pointed out that this often reaches a depth of three feet and more in the localities where spawning takes place.

In association with the above considerations, the utilisation of the lower surface of some object for the reception of the eggs may be regarded as being the choice of a location best suited for their protection, as well as a means of removing the eggs from any danger of "drowning" in the silt. At the same time, this illustrates a retention and a modification of two of the characteristics commonly found in the family, *viz.*, the nesting instinct and the adhesive nature of the eggs.

It is in the technique employed in attaching the eggs to such a surface that *Pimephales* and, in all probability, *Hyborhynchus* also stand unique among the members of their family.

1. R. F. Lord: Notes on the Use of the Black-head Minnow, *Pimephales promelas*, as a

Forage Fish. Trans. A.F.S., Vol. 57, 1927.

2. V. C. Wynne-Edwards: The Breeding Habits of the Black headed Minnow (*Pimephales promelas*). Trans. A.F.S., Vol. 62, 1932.

PEST Vs. PEST

By L. L. SNYDER



THE BALANCE of nature" is a concept very frequently discussed and one which, thought of as a tendency to balance rather than as a state of balance, is a truism. Yet when one wishes to illustrate the point with actual examples, it seems that recorded cases are rather uncommon in the literature. Generalized and more or less theoretical discussions seem more prevalent. The following observation is, therefore, a very small contribution to the literature on particular instances.

We have in Toronto a lawn weed known as Knotweed, *Polygonum aviculare*, which is at all times common. Reference to Gray's *New Manual of Botany* reveals that this plant is stated to be "common everywhere in yards, waste places etc." and that it is of Eurasian origin. This can only be interpreted as meaning an extremely wide distribution.

During the season of growth of any year, this plant is a strong competitor of lawn grass. During the past summer (1934), Knotweed was in the ascendancy. The winter of 1933-34 was notably severe and turf or lawn grass suffered conspicuous losses in lawn and park. Extensive blotches of earth where the grass had been winter-killed were much more obvious than after a normal winter. These blotches were, however, gradually erased as the summer growth progressed and their greenness deceived the eye, except that of the expert gardener, until autumn came. Then by degrees the outlines of the winter-killed areas were made apparent again, this time by the warm reddish tint of the overgrowth. The colour was due to the tinted wiry stems of the branching Knotweed which had flourished exceedingly.

The tiny seeds produced by this plant in any city park, if obtainable, could have been measured by bushel units. It appalls a struggling lawn-keeper to think of the possible war with this

weed with its bushels of seed ammunition. Personal experience has taught the writer that only a dentist-like extraction of the long and well-set tap-root is feasible for the eradication of the weed, and, at a guess, it seems that every seed is capable of germination. It is then with some pleasure that the second part of this account has been observed.

The writer's daily route has afforded considerable regularity in observing certain areas conspicuously affected by Knotweed. Starting with his own lawn and a small park adjacent, thence across Ramsden Park and to the Museum, about which are the extensive lawns of Queen's Park and the University Campus, sufficient space is covered to demonstrate that conditions are not localized. From early October to November the Knotweed patches were the feeding areas of flocks of English Sparrows (*Passer domesticus*). Several days passed before it was realized that these birds were invariably associated with the dark blotches in the turf. The flocks were merely noted as being unusually large and compact, in fact, it has been suggested that this is a "sparrow year" since they are markedly more conspicuous. The writer is inclined to believe from meagre data that such is the case; that there are more English sparrows during this fall than there have been for a few years past.* However, their concentration in conspicuous open lawn areas no doubt exaggerates their numbers.

At the time of writing, November 14, sparrows are still to be seen regularly visiting the Knotweed patches but this food supply is rapidly disappearing. An examination of several of these areas discloses the fact that the bare skeletons of the whorls of stalks are about all that remain; the seeds are gone and only an occasional tiny leaf is visible. It is quite clear that the bumper crop has already been consumed

*It is unfortunate that the English Sparrow is rather generally ignored in daily bird lists.



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