Studii şi Cercetări	Biologie	10	87 - 94	Universitatea din Bacău	Noiembrie 2005

PRELIMINARY DATA REGARDING REPRODUCTIVE BEHAVIOUR OF PUMPKINSEED SUNFISH - *LEPOMIS GIBBOSUS* (LINNAEUS, 1758) (PISCES, CENTRARCHIDAE)

Ionel-Claudiu Gavriloaie, Lotus Meşter

***Key words**: Lepomis gibbosus, pumpkinseed sunfish, reproductive behaviour*

INTRODUCTION

Parental care may be defined as an association between one or both parents and the young, association increasing the survival chances of the latter (Sargent & Gross, 1986). Among the vertebrates, mammals show a parental care exclusively maternal in 90 % of the families and a biparental care in 10% of the families. There are no mammal species in which only the male takes care of the young. Among the birds, in 90 % of the cases both parents care for the brood and the chicks, in 8% only the female cares for them and in only 2 % the males are taking care alone for the young.

Among the fish, the majority of the species show any parental care for the fry, however among the species that do (approximately 20% of the families) the majority present exclusively paternal care (50% of the cases) followed by an exclusively maternal care (30% of the cases) and biparental care (20% of the cases) (Gross, 2005).

Unlike other vertebrates, fishes continue to grow in size and, implicitly, in weight after they reach sexual maturity. At fish, both female fecundity and the number of eggs fecundated by the male tend to increase with the body size. The energy spent with the reproduction directly affects the growth; this is why the reproductive future of a fish depends on how much it invests in its growth and how big it gets in body size and weight (Sargent & Gross, op. cit.).

At fish species with an exclusive male caring of the brood and fry, it is known the fact that the males loose weight especially during the period they occupy and defend a territory. As a rule, after the breeding period, there is a high mortality as was noticed at the species *Lepomis gibbosus* (Gross, 1980).

The Pumpkinseed Sunfish – *Lepomis gibbosus* (family Centrarchidae, order Perciformes) (photo 1) has its areal in North America, in the upper basin of the Mississipi, Great Lakes and the basin of the Atlantic Ocean from Saint Laurent to South Carolina (Bănărescu, 1964). It was firstly imported in Europe in France (in 1887) and in Germany (in 1890) as an ornamental fish. From Germany extended through the Rhine, Oder and Danube towards the East of Europe. It was recorded in 1921 in the Bulgarian waters, in the Svisciova pool linked with the Danube (Cărăuşu, 1952). In our country, it was recorded for the first time by Buşniţă (1929). From then on, it spread in all the pools of the flooded region and the lower basin of the tributaries of the Danube and even in some littoral lakes (Popovici, 1942). Today, the Pumpkinseed Sunfish is present in almost all limnic ecosystems from our country (barely in the montane ones) and in the lower basin of the rivers, especially in former river channels.

Photo 1. Mature individual of *Lepomis gibbosus* (photo by I. C. Gavriloaie)

At this species, in our country, the breeding takes place from the end of May until the beginning of August. At the edge of the water, males arrange nuptial circular nests in which several females lay the eggs. The males guard the eggs and the fry. The eggs are covered in a thick layer of mucus and are sticky (Bănărescu, op. cit.).

MATERIAL AND METHOD

We chose to study the reproductive behavior of the Pumpkinseed Sunfish as this takes place close to the shore, in shallow water (up to 65 cm) and the observations can be easily made from the water shore as the fishes are not

disturbed by the human presence. Moreover, the Pumpkinseed Sunfish is an invasive species for our ichthyofauna and there are still many unknown aspects of its biology. Our study took place between May – August 2005 on approximately 30 nuptial nests in lake from Carol Park (photo 2) and in the lake from Titan Park (photo 3), both from Bucharest. In order to measure the water temperature we used a digital thermometer "Multi Purpose Digital Thermometer" AA3005 type.

Photo 2. General view of the lake from Carol Park – Bucharest (photo by I. C. Gavriloaie)

Carol Park was designed in the first years of the last century on Filaret Hill covered by grape vine in the XVIIIth century. The park has a surface of 36 ha. Inside it, there is a series of turistic objectives of great significance, among them the Technical Museum "Ing. D. Leonida" and "Arenele Libertății" (also known as "Arenele Romane") where, once boxing and wrestling matches were organized and today, theater plays and concertos take place. The park also contains a small lake with a surface of 2 ha, with small entertainment boats (Posea & Ștefănescu, 1984). Beside the Pumpkinseed Sunfish, we have found in the same lake the following fish species: Silver Crucian Carp (*Carassius gibelio*), Bleak (*Alburnus alburnus*), Gambusia (*Gambusia holbrooki*), Perch (*Perca fluviatilis*) and, probably, others. Among the amphibians, frogs of the species *Rana ridibunda* are abundant, while the reptiles are represented by some individuals of *Emys orbicularis*; regarding the birds, on the lake live some pairs of Mallards (*Anas platyrhynchos*) that nest here each year. An interesting record is that of the species *Alcedo atthis*, that feeds here especially on young Gambusia.

In the district Titan contains the extensive park with the same name. Inside it was arranged a lake with a surface of 26 ha (Posea & Ștefănescu, op. cit.); the lake is used for fishing and boat rides. There is a rich ichthyofauna. We find here big-sized Carps (*Cyprinus carpio*), Silver Crucian Carp (*Carassius auratus gibelio*), Bleak (*Alburnus alburnus*), Roach (*Rutilus rutilus*), Rudd (*Scardinius erythrophthalmus*), Bighead Carp (*Aristichthys nobilis*), probably also Bitterling (*Rhodeus sericeus amarus*) and Grass Carp (*Ctenopharyngodon idella*) among the cyprinids, then there are Pike (*Esox lucius*), Pumpkinseed Sunfish (*Lepomis gibbosus*) and probably Catfish (*Silurus glanis*). In the same lake was found an individual from an African catfish species (*Clarias ngamensis*), in November 2004

(Gavriloaie & Chişamera, 2005). Regarding the herpetofauna, we noticed numerous individuals of *Rana ridibunda*; we met individuals of *Natrix tessellata* and *Emys orbicularis*. A peculiar presence is the Red-eared Turtle (*Trachemys scripta elegans*), a North-American species kept as a pet in the entire world. We observed numerous individuals from this species but we do not know yet if they survive the winter in the lake. Concerning the birds, we found numerous Mallards (*Anas platyrhynchos*) and Coots (*Fulica atra*) which nest here; very numerous in autumn and winter are the Black-headed Gull (*Larus ridibundus*).

Photo 3. General view of the lake from Titan Park – Bucharest (photo by G. Chişamera)

RESULTS AND DISCUSSIONS

Regarding the breeding period of the Pumpkinseed Sunfish in our country, the informations from the Romanian literature are not unitary. Thus, after Dumitriu (1931), the Pumpkinseed Sunfish breeds in June; after Băcescu (1942 and 1943) the breeding takes place in May – June; after Borcea (1934), the breeding takes place from June to August, while after Antonescu (1938 and 1957), Cărăuşu (1952), Papadopol & Ignat (1967), the Pumpkinseed Sunfish breeds in May – June, sometimes in July – August. We have found, similar with Bănărescu (1964), the breeding period of this species in the Romanian waters extends from the end of May until at most the first half of August.

After Papadopol & Ignat (op. cit.), the males and the females of this species mature sexually at a standard length of 50 - 60 mm and, correspondingly, at a weight of 6 – 8 grams at the age of two years in the third summer (II +). All individuals (males and females) under 50 mm standard length, with an age of two summers (I +) were sexually immature. At *Lepomis gibbosus* the clutch is asynchronous (in stages).

At a species related with the American Sunfish, namely *Lepomis macrochirus* (Bluegill Sunfish), males build nests at the waters edge, in shallows, in colonies of 15 – 100 individuals, the females coming in shoals in order to lay the eggs (Gross & MacMillan, 1981). At *Lepomis gibbosus*, at the beginning of the breeding period, males come close to the shore in shallows (we noticed a maximum depth of 65 cm) and start to build nuptial nests, but solitary not colonially; females, also, approach solitary the territory (nest) of a male to lay the eggs (Gross, 1979). Another difference between the two species is that at the Pumpkinseed Sunfish not all males that build nests will breed (Gross, op. cit.). Although the males of Pumpkinseed Sunfish are not colonial, they tend to gather in certain zones in the breeding period. Thus, in the

two lakes investigated by us, the majority of males built their nuptial nests in the Eastern and South-Eastern part; in the lake from Carol Park, we noticed a sole male establishing its territory in the Western part of the lake but, some days after this, he did not mate with any female and, finally, left the spot. In the Titan Park, we noticed a pair of Pumpkinseed Sunfishes mating in a nest situated in the Northern part of the lake.

The water minimum temperature we recorded during our study in the two lakes was 19.5^0 C, while the maximum temperature was 24.7^0 C.

In both lakes, the nests were placed at the waters edge; as a rule they had a diameter of 50 cm, being smaller in the case of small-sized males. The distance between the nests was from a few meters down to 50 cm (in most cases). In the Titan lake, we noticed two special cases. One of them concerns the distance between the nests and the shore. In a certain zone there were near the shore 4 close-by nests and, at a distance of approximately 50 cm and 1.5 m from the shore, at the same depth, there was one more nest (fig. 1). It is the sole record of a nest which was not placed near the shore.

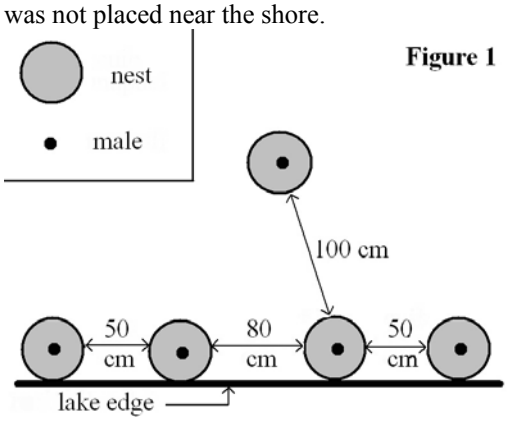


Figure 1

In the second case, we recorded two males practically sharing the same nest. This time, the nest had an oval shape and nearly 1 m in length and the two American Sunfishes were at each end of the nest. One of them had a paler coloration than the other (fig. 2). It is quite probable, that just one male kept the nest in the end. We noticed a certain variability concerning the nests and the substratum on which they were built. In all cases, the nest chosen for the nest is cleaned by the male of the detritus; these places are obvious from the shore as they are lighter than their surroundings.

In the lake from Titan Park, the nests were built on a sandy or stony substratum. The first ones looked like craters dug in sand. Those built on stony substratum were also circular but they also could look like small mounds. The nests were filled up with gasteropod shells eaten, probably, by the males. In the lake from Carol Park, most of the nests were more or less circular areas, arranged on the concrete bottom (almost entirely covered by filamentous algae) of the lakes shores. In some cases, the nest extends on the vertical wall of the shore (we noticed numerous broods on these walls). A male had its nest in a cave in the shore. We did not notice any gasteropod shells in any of the nests from the lake of Carol Park.

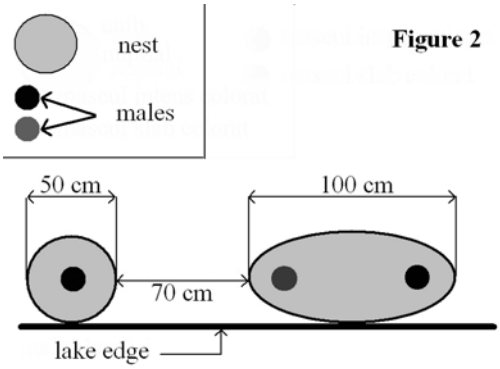


Figure 2

The reproductive behavior of the species *Lepomis gibbosus* presents, as we could notice, 4 distinct stages as Colgan & Gross (1977) pointed out.

1. The first stage, before the egg-laying, implies two distinct phases: a). **establishing a territory** and b). **nest building**. At the onset of the breeding period, the males live the deep waters and set up territories in the shallows near the shore. As a rule, the territory is a circular area on the waters bottom, but, as we saw earlier, it can be chosen on the vertical wall or even in holes dug in the shore. In fact, the territory is represented exclusively by the nuptial nest. After establishing the territory, the males begins to arrange it. For this, with the caudal fin, he makes a strong "sweeping" motion (recorded only in this phase) of the substratum, generating a current that removes the detritus. Thus, a surface roughly circular, cleaner than the surroundings (and as such easier to spot from the shore) is formed: this is the nuptial nest. In general, the nests have a roughly 50 cm diameter, being smaller in the case of smaller sized males.

2. In the second stage takes place the **egg-laying and the caring of the brood.** A day or two after the males established and arranged their territories, the females begin to arrive in the littoral zone. When a female approaches a nest, the males starts to court her by slow movements around her; the pair swims in tandem, also in a slow rhytm. The males colors are intense and very beautiful. This nuptial dance continues, most of the times, with the egg-laying by the female and their fecundation by the male. The eggs, translucent and sticky, are layed in small portions. After laying, the female lives the territory; in the following hours the male can

mate with other females. As we noticed, if the female is scared by something during the egg-laying, it leaves immediately the nest. After each mating, the male begins to ventilate the brood with the pectoral fins and will do this until the hatching, so for three days. We couldn't record in the same nest different stages of egg-development or eggs along with fry, which means that one or more females lay their eggs in the same nest during the same day.

3. **Fry development**: this stage begins with the hatching and ends four days later when the fry leaves the nest.

4. **Nest abandon**: after the fry leaves, the males stays for one more day, then leaves the nest. This stage marks the end of the breeding cycle.

The same male will repeat several times this cycle during the breeding period. For now, we do not know the period of time between one breeding cycle and the next one. Also, we do not know if the male will choose the same territory in the next breeding cycle as a new male can settle there after the owner departs; during our study, we did not notice males choosing territories already occupied by other males.

On average, at the Pumpkinseed Sunfish, a breeding cycle lasts for 10 days: 2 days, establishing and arranging the territory (the nest), 3 days egg-laying and caring the brood, 4 days fry development and after one more day, abandon of the nest. This cycle may be shorter or longer, between 8 and 15 days. For instance, a male without aggressive interactions with neighboring males, can arrange the nest in just one day (Colgan and Gross, 1977).

In the following we will present a case of "parasitism" of reproductive behaviour at the Pumpkinseed Sunfish. Gross (1979) noticed, during the observations on the breeding behavior at the species *Lepomis macrochirus* – Bluegill Sunfish (closely related with the Pumpkinseed Sunfish), numerous intrusions of the smaller conspecifics in the nests where a pair of adult Bluegill Sunfishes were laying. The quoted author collected tens of small exemplaries of *Lepomis macrochirus* found around the nuptial nests and realized **all** this individuals were sexually mature males. By an analysis of the gastro-intestinal content, he noticed that only in 12.5% of individuals had a few fresh eggs of Bluegill Sunfish. As theses males had completely developed gonads and only a few individuals (an eighth from the total number of collected individuals) had eggs in their stomach, he advanced the hypothesis these males fecundate the eggs without the consent of the territorial male, which we will name "parental males" (as only them show after the egg fecundation a caring behavior for the eggs and, subsequently, the fry). The size of the intruding males is roughly 42% from the size of the adult territorial males. The intruding males position themselves along the females, while the parental male is on the other side, the female releasing the eggs **only** then. The sperm is released in this moment by both males.

This "parasitism" of the parental behavior was also recorded at the species *Lepomis megalotis* (Longear Sunfish) (Keenleyside, 1972, quoted by Gross, 1979).

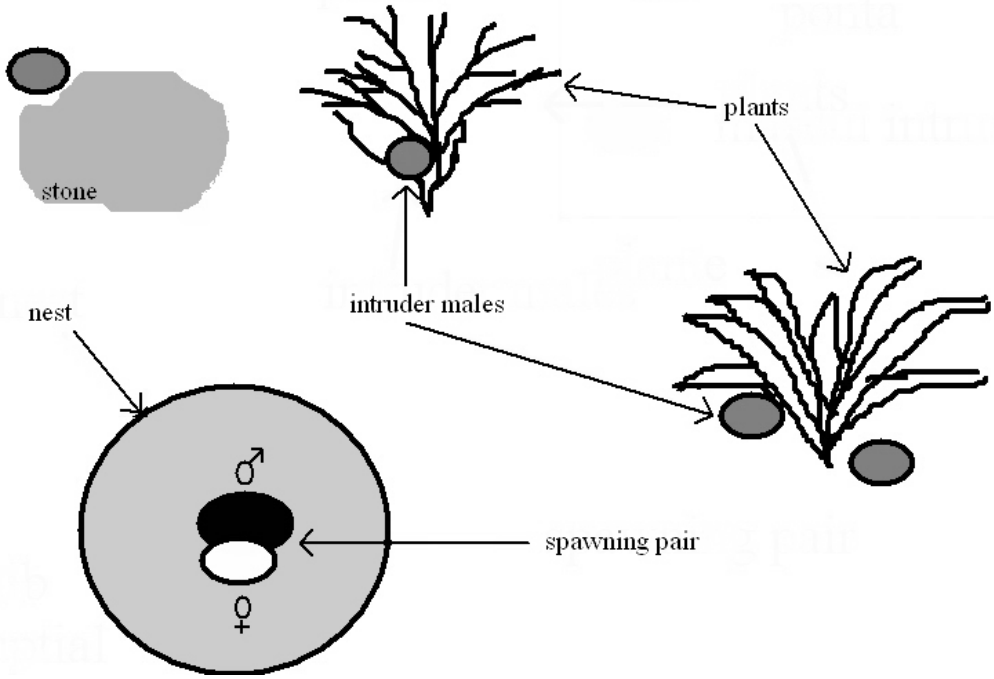
This special behavior is also present at the species *Lepomis gibbosus* (Gross, 1982). We also recorded it during our study. The intruding males are lighter than the parental males. Generally, they stay closer to the substratum, beside the nest, but outside it and position themselves, when they have the opportunity, behind plants or stones (fig. 3). From these hidings, they dart in the nest trying to avoid the parental male.

These small males do not remain in the nest but quickly return in their hidings and always position themselves toward it. The entire process, from the rapid entrance in the nest until its leaving takes at most 10 seconds, the sperm being released during the short pause in the nest center. For instance, in the case of a pair of Pumpkinseed Sunfishes, we recorded no less than 25 intrusions in the nest in 15 minutes. The intruding males position themselves beside the female but opposite to the parental male and always somewhat lower than the legitimate pair. Often, more such smaller males enter together or one at a time, but at short time periods in the nest, confusing the defensive behavior of the parental male. Sometimes, in the nest remain for a short time the female with one or more intruding males (which have very quick motions) while the parental male is busy chasing other intruders which are already in or around the nest. The intruding males show only rarely an aggressive behavior toward the parental male and just sometimes toward other intruding males. The constant delays in the egg-laying due to these intruding males finally force the female to leave the nest.

The intruding males can be frequently injured, more or less seriously, by the parental male. Their wounds can fester in time and the mortality is probably high among them.

During the four stages of the breeding cycle, the males show various degrees of aggression. During the egg-laying and caring of the brood, the aggression reaches the highest level. Males attack promptly, nipping any intruder, including the researchers hand. About these aspects, there will be another study.

Figure 3



The ducks from the two lakes frequently eat the broods and, quite probably, even adult fishes.

After several days of torrential rains, the lakes waters was very troubled, and near the shores there was no nest while the Pumpkinseed Sunfishes retreated to deeper waters. But, a day or two after the rains, everything started al over again.

Concerning the "parasitism" of the parental behavior of the nest-building males, we do not know if the intruding males will eventually became parental males or will present this special behavior during their entire life.

CONCLUSIONS

The species *Lepomis gibbosus* breeds in our country from the end of May until August, at a minimal water temperature of roughly 20^0 C. At the onset of the breeding period, males approach the shores in shallows and choose territories which they arrange as nuptial nests; a day or two after, the females approach the nests for the egg-laying. During the breeding period, the Pumpkinseed Sunfishes mate several times in cycles lasting, in general, 10 days. One such cycle presents 4 distinct stages: a) establishing of a territory and the building of the nest, b) egg-laying and brood caring, c) fry development, and d) nest leaving.

In the breeding cycle, are participating male Pumpkinseed Sunfishes which did not arrange nests. They are smaller than the parental males (which have nests and care for their brood and fry) and fecundate a part of the eggs. During the egg-laying stage, the intruding males dart into the nest for a few seconds and fecundate a part of the eggs. If they are noticed by the parental males, the intruders may be seriously wounded, a fact leading, probably, to a subsequent high mortality among them. We may say, the parental behavior of the male Pumpkinseed Sunfish is "parasited" by small-sized conspecifics.

The species *Lepomis gibbosus* presents an interesting and particularly complex reproductive behavior. It probably contributed substantially to the relatively rapid expansion of the Pumpkinseed Sunfish in Europe. Many aspects of this species behavior remain, for now, unknown, but we will try to elucidate them, at least partially, in our future researches.

REZUMAT

Bibanul soare - *Lepomis gibbosus* (familia Centrarchidae, ordinul Perciformes) are arealul în America de Nord, în bazinul superior al fluviului Mississippi, Marile Lacuri şi bazinul Oceanului Atlantic de la Sf. Laurenţiu până în Carolina de Sud. A fost importat în Europa mai întâi în Franţa (în 1887) şi Germania (în 1890), ca peşte ornamental. Din Germania s-a extins prin Rin, Oder şi Dunăre spre răsăritul Europei. La noi a fost semnalat pentru prima dată în 1929. De atunci s-a răspândit în toate bălţile regiunii inundabile şi în cursul inferior al râurilor ce se varsă în Dunăre

şi chiar în unele lacuri litorale. La ora actuală bibanul soare este prezent în aproape toate ecosistemele limnice de la noi din țară (mai rar în cele montane) şi în cursul inferior al râurilor, mai ales pe brațele moarte.

Am realizat un studiu asupra comportamentului de reproducere al acestei specii în perioada mai-august 2005, în lacul din Parcul Carol şi în lacul din Parcul Titan, amândouă din Bucureşti.

Specia *Lepomis gibbosus* se reproduce în țara noastră începând cu sfârşitul lunii mai până în prima jumătate a lunii august, la o temperatură minimă a apei de circa 20° C. La începutul perioadei de reproducere, masculii vin în apropierea malului, la adâncime mică şi îşi aleg teritorii pe care le amenajează apoi sub forma unor cuibare nupțiale; la o zi sau două după aceasta, femelele se apropie de cuiburi pentru a depune icrele. De-a lungul perioadei de reproducere, bibanii soare se împerechează de mai multe ori, în cicluri care durează, în general, 10 zile. Un astfel de ciclu cuprinde 4 etape distincte: a) stabilirea teritoriului şi construirea cuibului, b) depunerea şi îngrijirea pontei, c) dezvoltarea puietului şi d) părăsirea cuibului.

Am constatat că la reproducere participă şi masculi de biban soare care nu au amenajat cuiburi nupțiale. Aceştia sunt de talie mai mică decât masculii parentali (care au cuiburi şi îngrijesc ponta şi progenitura) şi fecundează şi ei o parte din icrele depuse de femele. În faza de depunere a icrelor, aceşti masculi intruşi țâşnesc în cuib pentru câteva secunde şi fecundează o mică parte din icrele depuse atunci de femelă. Dacă sunt reperați de masculii parentali, intruşii pot fi vătămați grav, ceea ce duce, probabil, la o mortalitate ulterioară ridicată în rândurile lor. Putem spune că în acest fel comportamentul parental al masculilor de biban soare este „parazitat" de către unii conspecifici de talie mai mică.

Constatăm, în cele din urmă, faptul că specia *Lepomis gibbosus* manifestă un comportament reproductiv extraordinar de interesant şi deosebit de complex. Probabil şi aceasta a contribuit substanțial la expansiunea relativ rapidă a bibanului soare în apele Europei.

ACKNOWLEDGEMENTS

All our gratitude to drd. Istvan Falka, who put at our disposal some of the papers cited in the text; we are gratefull to Mr. Andrei Giurginca who made the English translation of the paper. We also have to mention the field work was made within the framework of the C.N.C.S.I.S. grant no. 34699/2005, financed by M. Ed. C.

REFERENCES

1. ANTONESCU C. S., 1938 – Elemente nouă în fauna apelor dulci din România, Volumul jubiliar «Gr. Antipa, hommage à son oeuvre», Bucureşti, 85-91.
2. ANTONESCU C. S., 1957 – Peştii din apele R. P. R., Editura Agro-Silvică de Stat, Bucureşti, 122-123.
3. BĂCESCU M., 1942 – *Lepomis gibbosus* (Lin.) – studiu etnozoologic, zoogeografic şi morfologic, Analele Academiei Române, Memoriile Secțiunii Ştiințifice, Seria III, Tomul XVII, 15, 547-560.
4. BĂCESCU M., 1943 – Interesanta istorie a unei „regine" a peştilor (*Eupomotis*), Natura, 32 (6), 221-227.
5. BĂNĂRESCU P., 1964 – Fauna R. P. R., Pisces-Osteichthyes (peşti ganoizi şi osoşi), vol. XIII, Editura Academiei R. P. R., Bucureşti, 647-651.
6. BORCEA I., 1934 – Sur la présence du poisson soleil américain (common sunfish): *Eupomotis gibbosus* Linnaeus dans le bas Danube, Annales Scientifiques de l'Université de Jassy, 19 (1-4), 232-235.
7. BUŞNIȚĂ T., 1929 – *Micropterus salmoides* Lac. în apele noastre, Pescăria şi Piscicultura, 29, 155.
8. CĂRĂUŞU S., 1952 – Tratat de ichtiologie, Editura Academiei R. P. R., Bucureşti, 659-662.
9. COLGAN P. W., GROSS M. R., 1977 – Dynamics of aggresion in male pumpkinseed sunfish (*Lepomis gibbosus*) over the reproductive phase, Zeitschrift fur Tierpsychologie, 43, 139-151.
10. DUMITRIU M., 1931 – O specie nouă de peşte apărută anul acesta în Lacul Greaca, Buletinul Ministerului Agriculturii, Seria III, 3-4.
11. GAVRILOAIE C., CHIŞAMERA G., 2005 – Note on the presence of the blunt toothed African catfish, *Clarias ngamensis* Castelnau, 1861 (Pisces, Clariidae) in Romania, Travaux du Muséum National d'Histoire Naturelle «Grigore Antipa», 48: 309-315
12. GROSS M. R., 1979 – Cuckoldry in sunfishes (*Lepomis:* Centrarchidae), Canadian Journal of Zoology, 57, 1507-1509.
13. GROSS M. R., 1980 – Sexual selection and the evolution of reproductive strategies in sunfishes (*Lepomis*: Centrarchidae), PhD thesis, University of Utah, 1-319.
14. GROSS M. R., 1982 – Sneakers, satellites and parentals: polymorphic mating strategies

in North American sunfishes, Zeitschrift fur Tierpsychologie, 60, 1-26.
15. GROSS M. R., 2005 – The evolution of parental care, The Quarterly Review of Biology, 80 (1), 35-45.
16. GROSS M. R., MACMILLAN ANNE M., 1981 – Predation and the evolution of colonial nesting in bluegill sunfish (*Lepomis macrochirus*), Behavioral Ecology and Sociobiology, 8, 163-174.
17. KEENLEYSIDE M. H., 1972 – Intraspecific intrusions into nests of spawning longear sunfish (Pisces: Centrarchidae), Copeia, 272-278.
18. PAPADOPOL M., IGNAT GH., 1967 – Contribuţii la studiul biologiei reproducerii şi creşterii bibanului-soare (*Lepomis gibbosus* (L.)) din Dunărea Inferioară (zona inundabilă), Buletinul Institutului de Cercetări şi Proiectări Piscicole, 26(4), 55-68.
19. POPOVICI Z., 1942 - Betrachtungen über das vorkommen des sonnenbarsches (Eupomotis aureus J.) im küstensee «Tăbăcăria» am Schwarzen Meere, Analele Institutului de Cercetări Piscicole al României, 1 (1), 59-65.
20. POSEA GR., ŞTEFĂNESCU IOANA, 1984 – Municipiul Bucureşti cu Sectorul Agricol Ilfov, Editura Academiei R. S. R., Bucureşti, 82-103.
21. SARGENT R. C., GROSS M. R., 1986 – Williams' principle: an explanation of parental care in teleost fishes, The behaviour of teleost fishes, Croom Helm, London, 275-293.

AUTHORS' ADDRESS

IONEL-CLAUDIU GAVRILOAIE – University of Bucharest, Faculty of Biology, Animal Biology Department, Splaiul Independenţei, No 91-95, sector 5, 050095, Bucharest Romania, e-mail: ionelclaudiu@yahoo.com

LOTUS MEŞTER - University of Bucharest, Faculty of Biology, Animal Biology Department, Splaiul Independenţei, No 91-95, sector 5, 050095 Bucharest, Romania