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ARTICLE III.

A REVIEW OF THE SUNFISHES OF THE CURRENT GENERA APOMOTIS, LEPOMIS, AND EUPOMOTIS, WITH PARTICULAR REFERENCE TO THE SPECIES FOUND IN ILLINOIS.

BY

R. E. RICHARDSON, A.M.

ERRATA AND ADDENDA.

- Page 55, line 15, for 1854 read 1855.
Page 55, line 16, for *Horticultural* read *State Agricultural*.
Page 60, in second table, Illinois, for 240 read 241.
Page 65, first line above foot-note, for *ventricosa* read *ligamentina*.
Page 72, line 9, for *imbecilis* read *imbecillis*.
Page 79, line 19, for *asperimus* read *asperrimus*.
Page 80, above *Quadrula rubiginosa* insert Section *Fusconaia* Simpson.
Page 76. The record of Calkins for *Margaritana margaritifera* is without doubt erroneous and should be eliminated. This species is not found in Illinois.
Page 95. *Pomatiopsis sheldonii* Pilsbry should read *Ammicola sheldonii* and should be transferred to the genus *Ammicola* on page 93.
Page 100. *Physa gyrina oleacea* Tryon is the immature stage of *Physa gyrina*.
Page 103. *Lymnæa tazewelliana* is a synonym of *Lymnæa parva*.
Page 105. *Lymnæa palustris michiganensis* is the immature form of *Lymnæa reflexa*.
Page 106. *Lymnæa reflexa iowensis* and *Lymnæa reflexa crystalensis* are synonyms of *Lymnæa reflexa*.
Page 112, line 6 from bottom, for *gouldi* read *gouldii*.
Page 114, line 5 from bottom, for *juxtigens* read *juxticens*.
Page 115, line 21, for *Witter* read *Walker*; line 23, *Polygyra sayii* Binney should be changed to *Polygyra sayana* Pilsbry.
Page 116, line 1. *Polygyra exoleta* Binney (1885) should be changed to *Polygyra zaleta* Binney (1837).
Page 117, line 11 from bottom, for *leai* read *leaii*; line 3 from bottom, *Polygyra monodon fraterna* is a good species and should read *Polygyra fraterna*.
Page 119, foot-note. A specimen of *alliaris* in the collection of Mr. Aldrich, received from Calkins, proves to be *draparnaldi*.
Page 121, line 3 from bottom, for *Champaign* read *Piatt*.
Page 122, line 12 from bottom, for *Pyramidula striatella* Anthony read *Pyramidula cronkkitei anthonyi* Pilsbry; line 4, for *Held* read *Hald*.
Page 123, for *Helicodiscus lineatus* Say read *Helicodiscus parallelus* Say.
Page 162, line 7, for *glandulosa* read *linearis*.
Page 171, line 17, for *riparia* read *vulpina*.
Page 176, line 8 from bottom, for *canadense* read *majus*.
Page 180, line 9, for *virginica* read *virginiana*.
Page 221, line 6 from bottom, for *rectangulus* read *rectangularis*.
Page 226, line 3, for *fasciatus* read *fasciata*.
Page 239, line 11, strike out Lake Co. entry.
Page 246, lines 6 and 7, and page 248, lines 1, 14, 20, and 23, for *Ænothera* read *Onagra*.
Page 248, line 4, for *candida* Horn substitute n. sp.

Page 249, line 8 from bottom, for *Olethreutes dimidiana* Sodoff? read *Olethreutes separatana* Kearfott, and strike out parenthetical matter.

Page 251, line 7, for *grossa* read *thoracica*; line 21, for words preceding H. 6, read *Asilus rufipennis* Hine; line 18 from bottom, for words preceding H. 2, substitute *Asilus cacopilogus* Hine.

Page 253, line 8, for *Linn.* read *Emory*.

Page 257, line 15, for *pennsylvanicus* DeG. read *auricomus* Rob.

Page 261, Note 6. *Melanoplus macneilli* is very probably *M. fluviatilis* Brun.

Page 262, Note 9. Dr. Bergroth writes that *Nabis elongatus* is preoccupied. The original is *elogantus* in the check list. Comparison with long-winged *vicarius* is desirable before re-naming it.

Page 309, in table, for 59 read 57, and for 743 read 741.

Page 310, in table, for 59 read 57.

Page 314, line 5, for 1587 read 481; line 16, after *stubble* insert *meadows*; line 17, after *pastures* strike out *and meadows*, and after 1500 strike out *each*.

Page 315, last line, for 553 read 481.

Page 362, line 7 from bottom, for *longa* read *parvilamellata*.

Page 373. As a second entry in synonymy insert as follows:

1854. *Nothrus bistriatus*, Nicolet, *Acariens des Environs de Paris*, p. 397, Pl. VII., Fig. 7.

Page 376, line 13 from bottom, for *Oribata* read *Oribates*.

Page 378, line 1, for XXV. read XXXV.

Page 384, after line 5 insert as follows:

N. bipilis Hermann. Mem. Apt., p. 95.

In moss, Arcola and Parker, Ill.

Page 384, line 5 from bottom, for *pyrostigma* read *pyrostigmata*.

Page 386, after line 11 from bottom insert as follows:

H. bistrinata Nicolet. *Acariens des Environs de Paris*, p. 397, Pl. VII., Fig. 7.

Under logs and in moss, Urbana and Arcola, Ill.

Page 388, line 12, for *sphærum* read *sphærule*.

ARTICLE III.—*A Review of the Sunfishes of the current Genera Apomotis, Lepomis, and Eupomotis, with particular Reference to the Species found in Illinois.* BY R. E. RICHARDSON.

During the progress of studies on material from the large collection of Illinois sunfishes belonging to the Illinois State Laboratory of Natural History, a striking and, as it appeared later, fundamental difference in form was observed between the lower pharyngeals of specimens of *Lepomis pallidus* (Mitch-

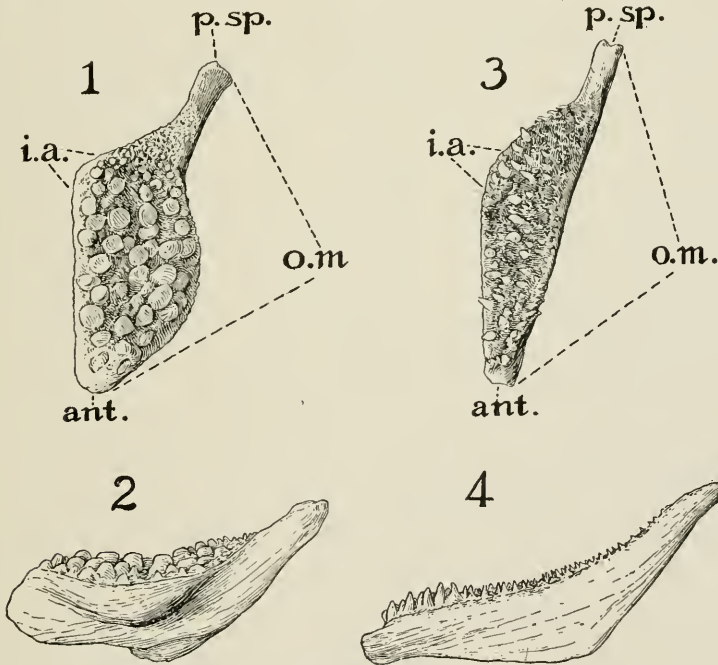


Fig. 1, *Eupomotis gibbosus*, lower left pharyngeal, from above; 2, side view; 3, same of *Lepomis pallidus*, from above; 4, side view.

Ant., anterior apex; *p. sp.*, posterior spur; *o. m.*, outer margin; *i. a.*, inner angle.

ill) and *Eupomotis gibbosus* (Linnæus). These bones in the first species were found to be comparatively light, flattened dorso-ventrally, and always narrow, the width in the length of

the toothed portion of the bone ranging from 2.9 to 3.4 and averaging more than 3 in twenty measured specimens whose length ranged from $2\frac{3}{4}$ to 6 inches. The inner angle (*i. a.*) is quite obtuse, 120° to 140° , and the outer margin (*o. m.*) is straight or slightly inbent from the tip of the posterior spur (*p. sp.*) to the anterior extremity (*ant.*) of the bone. The lower pharyngeals of *Eupomotis gibbosus* are deep and broad, with inferior and lateral prominences, never being flattened or hollowed out underneath as in *L. pallidus*. Measurements made on twenty specimens, from $2\frac{1}{2}$ to 6 inches in length, show a variation of only 1.9 to 2.5 (average 2.17) in the ratio of width to length of the toothed portion, and a range of 95° to 111° in the inner angle. The outer margin of the pharyngeal in this species presents a double curve, with a moderate sinus situated posteriorly, immediately in front of the spur, and a more or less decided anterior arcuation, margining a lateral ledge-like prominence. The spur is directed more or less definitely outward, rather than backward as in *L. pallidus*. The differences between the teeth of these two species were found to be as hitherto described, those of *E. gibbosus* being short and heavy and either very blunt or entirely paved, while those of *L. pallidus* are long and comparatively slender, with more or less acuminate tips.

An examination of the pharyngeal bones and their teeth from specimens of *E. heros* and *E. holbrookii** disclosed complete conformity in those species to the type of bone and tooth found in *E. gibbosus*. The pharyngeals of *E. euryorus* McKay proved, however, to be of the pattern found in *L. pallidus*. The pharyngeals of *Apomotis cyanellus*, *ischyrus*, and *symmetricus*, and of *L. miniatus*, *auritus*, *megalotis*, *occidentalis*,† *humilis*, and *haplognathus* were also found to differ in no essential respect from these bones as described for *L. pallidus*. The lower pharyngeal teeth of *A. cyanellus*, *ischyrus*, and *symmetricus*, and of *L. miniatus* and *E. euryorus* appear as a rule to be somewhat less

*Through the courtesy of Dr. S. E. Meek, of the Field Columbian Museum, we have been permitted to examine specimens of this and other species not found in the waters of Illinois.

†*L. occidentalis*, Meek, Field Col. Mus., Zool. Ser., Vol. II., No. 6, p. 118.

slender and acutely pointed than the teeth of the remaining species of the genus *Lepomis*, but this distinction is recognizable only with difficulty, and is scarcely to be regarded as of even subgeneric value. In the case of *L. pallidus* and *E. gibbosus*, and in other species when possible, care was taken to examine the pharyngeals of a considerable number of young specimens, and no difficulty was in any case experienced in making out the distinctive form of the pharyngeal in each species, the best idea of which is obtained from the accompanying figures. While the ratio of width to length of the toothed portion of the bone becomes greater in the young of *Eupomotis*, it was in no case found to equal the ratio obtained for the species of *Apomotis* and *Lepomis*.

Species of which I have yet had no opportunity to examine specimens are *A. phenax* and *punctatus*, *L. macrochirus*, and *E. pallidus*. Of the first two there can scarcely be any doubt concerning the generic affinities, the first species being possibly identical with *A. ischyris* (Jordan & Nelson). Of *L. macrochirus* little is known. In view of the palatine teeth, long gill-rakers, and dusky color at back of dorsal and anal in *E. pallidus* (Agassiz), I have, with Boulenger, regarded that species as identical with *L. pallidus* (Mitchill), and have taken no account of it in the present characterization of the genus *Eupomotis*. Consequent on the removal of this species and *E. eurymus* McKay to the genus *Lepomis*, and apparently in no other way, does it become possible to establish the genus *Eupomotis* beyond question on characters that have constant value.

LEPOMIS Rafinesque.

Lower pharyngeals narrow and comparatively weak, flattened or hollowed out underneath; width in length of toothed portion about 3 in adult specimens; inner angle, 120° to 140°; outer margin straight or slightly inbent from tip of posterior spur to anterior extremity of bone; pharyngeal teeth always long and slender and more or less acuminate. Brilliant colors

on posterior margin of opercular flap, if present, always blending with the adjacent paler or darker color, and not forming a definitely localized spot as in *Eupomotis*.

A somewhat heterogeneous group, represented in this state by eight species, the genus as here understood including *Apomotis* and *Lepomis* of recent authors. The form of the body is variously elongate, elliptical, or short and deep. Most of the species are inclined to be rather robust, while others are thin and compressed. Mouth various, usually rather large; supplemental maxillary bone well developed in some species, rudimentary or wanting in others, its development greatest in those species which have the mouth largest; teeth on palatines in most species. Operculum ending behind in a convex bony or osseomembranous process or flap, its development much greater in some species than in others and subject to variation with age; the flap proper well differentiated (or not) from a fleshy or membranous margin partly or wholly of paler color than the opercular spot. Gill-rakers well developed (long, stiff, and rough) to rather slender, or very soft and weak. Pectorals nearly always considerably shorter than head, but about equaling it in some species (*megalotis*, *humilis*, *pallidus*); dorsal spines usually low, but scarcely lower in some species than in *Eupomotis*.

KEY TO THE SPECIES OF THE GENUS LEPOMIS FOUND IN ILLINOIS.

- A. Operculum more or less stiffened posteriorly, its osseous portion always distinctly differentiated from a posterior fleshy or membranous margin, which is about equally broad above, behind, and below, and partly or wholly of paler color than the osseous portion, to which the black of the opercular spot is entirely or for the most part confined. A well-developed supplemental maxillary bone.
 - b. Scales moderate or small, 42 to 50 in lateral line; operculum produced backward and rather sharply rounded behind, triangular.

- c. Soft dorsal dusky, with a more or less distinct blotch of darker color near base of last rays; dark coloration on scales regular, with no appearance of mottling due to darker color on scattered groups of scales.
- d. Body oblong, depth 2.2 to 2.5 in length; profile long and straight; margin of ear-flap coppery to purplish. *cyanellus*.
- dd. Body short and deep, depth 1.8 to 2 in length; profile steep, convex in front of dorsal, and with angle at nape prominent; margin of ear-flap pale blue to pinkish. *ischyrus*.
- cc. Soft dorsal tessellated with darker but without large black blotch at base of last rays; dark coloration more intense on scattered groups of scales, resulting in a mottled appearance much as in *E. gibbosus*; in life, some red or coppery on ear-flap behind.
euryorus.
- bb Scales large, 35 to 41 in lateral line; operculum not prolonged much backward, but more or less broadly rounded behind, not triangular.
- e. Flexible margin of operculum narrow, its width $\frac{1}{4}$ to $\frac{1}{3}$ the length of the black opercular spot, which is mostly confined to the bony portion; body green, barred with darker; small coffee-colored specks on body and fins. *symmetricus*.
- ee. Flexible margin of operculum broad, $\frac{1}{2}$ to as wide as the black or dark green spot on osseous portion, and mostly of the same dark color; body dusky olive, with rows of red or orange spots on sides.
miniatus.
- AA. Operculum thin and flexible behind, its thin membranous margin much produced and broadened posteriorly, with a rather wide edging of pinkish to crimson almost surrounding the black of the opercular spot, which is mostly confined to the membranous extension, barely tipping the osseous portion of the flap. No supplemental max-

illary bone. Color olive, with orange spots; body rather elongate; size small, not exceeding $3\frac{1}{2}$ inches.

humilis.

AAA. Operculum not composed of well differentiated osseous and membranous portions, the bone becoming gradually thinner posteriorly and terminating in a flexible osseo-membranous flap, which is usually considerably produced in adults, sometimes exceedingly so, and is entirely black or with only a very narrow edging of pale. Supplemental maxillary bone very rudimentary or entirely wanting.

f. Dorsal spines low, the longest but slightly more than snout; gill-rakers very short and weak; color olive, with blue or orange spots and wavy vertical streaks of emerald; no black blotch on dorsal or anal behind. *megalotis.*

ff. Dorsal spines higher, the longest usually greater than snout and eye; gill-rakers rather long and slender; color olive, with purplish lustre, usually rather dark; dorsal and anal with black blotch at base of last rays. *pallidus.*

Lepomis cyanellus Rafinesque.

Apomotis cyanellus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 996.

Distributed throughout the state, being the most abundant sunfish in the smaller prairie streams and pools of central Illinois.

Lepomis ischyryus (Jordan & Nelson).

Apomotis ischyryus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 997.

Type, in possession of the Illinois State Laboratory of Natural History, obtained from the Illinois River in 1877. Not again taken until 1899, when two excellent adult specimens were obtained from the Illinois River at Meredosia.

Lepomis euryorus (McKay).

Eupomotis euryorus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1008.

Form strongly suggestive of *Eupomotis gibbosus*, but the

body robust and rather more elongate than in that species; dorsal outline more arched than ventral; depth 2 to 2.3, head 2.6 to 2.9 in length. Mouth large, oblique, maxillary reaching considerably past front of orbit, 2.6 to 2.9 in head; jaws about equal; supplemental maxillary well developed; teeth present on vomers and palatines; lower pharyngeals narrow, the teeth rather bluntly pointed; eye small, 3.8 to 4.3 in head; opercle produced backward and rather sharply rounded behind, triangular; gill-rakers well developed, rather stiff and rough. Dorsal X, 11 or 12, the spines low, but slightly longer than from snout to eye in young specimens, 2.2 to 2.7 in head; anal III, 9 or 10; pectorals short, 1.3 to 1.4 in head; ventrals reaching a little past vent. Scales 6 or 7, 43-45, 14 or 15, those on cheeks small, in 6 to 8 rows. Color in life not very well known; in spirits dusky olive, mottled with darker, the general appearance very much as in *E. gibbosus*; fin-membranes dusky, with darker tessellations behind on soft dorsal and anal and near base of caudal; opercular spot black, the margin paler, with some red or coppery behind in life.

Known in this state from two young specimens, 2 and $3\frac{1}{2}$ inches in length respectively, taken in Crooked Creek, near La Harpe, Illinois, in May, 1900. These specimens form the basis of the present description.

Lepomis symmetricus Forbes.

Apomotis symmetricus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 998.

Not taken in Illinois since 1883, when it was described by Professor Forbes from specimens taken in the Illinois River at Pekin. Found only sparingly, chiefly in the southern portion of the state, especially the Wabash valley.

It has not been observed that the pharyngeals of this fish suggest affinities with the genus *Eupomotis* as hitherto supposed.

Lepomis miniatus Jordan.

Lepomis miniatus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1002.

Lepomis garmani, Forbes, Bull. Ill. State Lab. Nat. Hist., Vol. II., Art. II., p. 135.—
Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1002.

Specimens which I now refer to this species were de-

scribed by Professor Forbes in 1885 from the Wabash and Little Fox rivers in southern Illinois, under the name of *L. garmani*, but no examples have since been taken in that part of the state. The types of *L. garmani* Forbes are thin and rather deeply angled at the nape, with pectorals comparatively long, 1.2 to 1.4 in head, and dorsal spines rather high, 1.9 to 2.2 in head, in these and all other essential respects agreeing with typical more southern representatives of the species from Missouri, Arkansas, and Texas. Specimens of this species taken since 1894 in the Illinois River at Havana and Meredosia have the body more or less robust, dorsal spines short, 2.3 to 2.7 in head, and pectorals reaching but little beyond the back of the cheek in adults, their length 1.4 to 1.6 in head. These differences are seen to be less important after comparison of specimens from different southern localities, some of which are quite intermediate between the two extremes just described. Southern specimens examined, however, agree in most instances more nearly with the types of *L. garmani* than with the form from the Illinois River.

Lepomis megalotis (Rafinesque).

Lepomis megalotis, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1002.

Generally distributed in Illinois, in the clearer portions of the swifter streams and brooks.

Lepomis humilis (Girard).

Lepomis humilis, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1004.

The peculiar structure and coloration of the opercular flap gives to this fish a unique place among the species of the genus *Lepomis*.

Widely distributed over Illinois, except in the northern part.

Lepomis pallidus (Mitchill).

Lepomis pallidus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1005.

In our collections from Lake Michigan and the streams and lakes of the northern part of the state to the waters of Union county. The most abundant sunfish by far in the Illinois River.

EUPOMOTIS Gill & Jordan.

Lower pharyngeals deep and broad, with inferior and lateral prominences, never flattened or hollowed out underneath as in *Lepomis*; width in length of toothed portion about 2 in adults; inner angle 95° to 111° ; outer margin a double curve, moderately indented posteriorly, in front of spur, and more or less decidedly rounded anteriorly, as the margin of a lateral ledge-like prominence; teeth on lower pharyngeals short and heavy, their upper surfaces very bluntly rounded or paved. Red or orange on posterior portion of opercular flap definitely marked off from the paler or blackish portions adjacent, and not blended with them as in the preceding genus. Body more or less compressed and back elevated. Mouth rather small; no supplemental maxillary bone and no teeth on palatines. Gill-rakers always short, sometimes very much reduced. Pectoral fins always longer than head, sometimes extending past middle of anal. Dorsal spines rather higher than in most species of *Lepomis*. Two species found in Illinois.

KEY TO THE SPECIES OF THE GENUS EUPOMOTIS FOUND IN ILLINOIS.

- a.* Pectorals reaching to or beyond middle of anal; wavy lines on cheeks faint. *heros*.
aa. Pectorals scarcely reaching front of anal; evident wavy lines of emerald on cheeks. *gibbosus*.

Eupomotis heros (Baird & Girard).

Eupomotis heros, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1007.

Rare in Illinois, mostly from the southern part. Not taken since 1882.

Eupomotis gibbosus (Linnæus).

Eupomotis gibbosus, Jordan & Evermann, Bull. U. S. Nat. Mus., No. 47, p. 1009.

Widely distributed in Illinois, except in the Wabash basin.

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Parascaphirhynchus albus Forbes & Richardson



Scaphirhynchus platorhynchus Rafinesque.