

الكثافة العددية لعشائر الهائمات الحيوانية الأولية واستجابتها لعوامل معينة في  
نهر النيل بمحافظة المنوفية بمصر

منصور جلال ، نجاه جابر

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أجريت هذه الدراسة في الجزء الغربي من نهر النيل " فرع رشيد " لمسافة قدرها ٢٥ كيلومتر تمتد بين قريتي طملاي وعمرس بمحافظة المنوفية ، وذلك لفحص الكثافة العددية للهائمات الأولية وتأثرها ببعض العوامل البيئية سواء فيزيائية أو كيميائية . ويتميز هذا الجزء من النيل بنشاط زراعي كثيف مما يجعله يحتوى على كميات كبيرة نسبيا من الملوثات العضوية وغير العضوية .

ولقد وجد أن الهائمات الحيوانية الأولية هي الأكثر شيوعا بين الهائمات الحيوانية الأخرى ، ويؤثر على تواجدها بعض العوامل البيئية منفردة ( خاصة درجة حرارة الماء ) تأثيرا له دلالة ملحوظة ، ولقد اتضح أن بعض هذه العوامل مجتمعة تؤثر بدرجة ملموسة على وفرة وتواجد هذه الكائنات وبالتالي على معدلات نموها . إلا أنه لوحظ ضعف معدلات النمو لهذه الأوليات في الحقل عن مثيلاتها في المعمل ، ويمكن إرجاع ذلك إلى ندرة المواد المغذية في الطبيعة والتنافس الشديد بين هذه الكائنات وبين آكلات الكائنات الدقيقة الأخرى ، كما يمكن إرجاع ذلك أيضا إلى افتراس بعض الهائمات الحيوانية الأكبر لتلك الأوليات بجانب تواجد كميات ملموسة من الملوثات العضوية وغير العضوية .

FURTHER STUDIES ON FRESHWATER  
TURBELLARIANS OF EGYPT; *MACROSTOMUM*  
*DELTANENSIS* N.SP.\* Samir Beltagi, \*\* Fawzia, A. El-Said  
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Faculty of Science, Zagazig University.Key Words : Turbellaria, Freshwater, *Macrostomum*, Egypt.

## ABSTRACT

This worm was collected from a stagnant freshwater pond near a village called " El Halaby " 10 Kilometers far away from the west side of Zagazig University at Sharkia Province in Nile Delta".

It lives upon the aquatic vegetation including *Eichhornia crassipes* and *Elodea canadensis*. The salinity of water was 2.5‰ and 29°C.

The worm is oval in shape with a blunt anterior end and a broad posterior end. It has a length of 1-2 mm. Its coloration is pale white. It has a pair of kidney-shaped brownish black eyes, situated a little distance in front of the mouth aperture.

This worm is characterized from the other known species of the genus *Macrostomum* by a chitinised penis-stylet which is curved in two planes. Its distal end is enlarged and slightly thickened and has a terminal aperture.

## MATERIAL AND METHODS

These Microturbellarians were collected by means of a standard F.B.A. Zooplankton net of 60 meshes/in. (23.6 meshes/cm.) which was used to scoop up substratum and can move through vegetation such as *Eichhornia crassipes* and *Elodea canadensis*. Samples were placed in water in 3-litre glass jars and left to stagnate. Turbellarians were removed from the jars at intervals. They were at first narcotised by using crystals of magnesium sulphate and then killed in Steinmann's fluid, fixed in Bouin,

70% ethyl alcohol or 10% neutral buffered formalin, and blocked in paraffin wax (MP 56-58°C) Transverse, median, sagittal and frontal sections of the specimens were prepared at thickness of 6-8µm. They were stained by Ehrlich's haematoxylin eosin and Mallory trichrome method.

## Systematics:

Phylum: Platyhelminthes

Class: Turbellaria, Ehrenberg, 1831.

Order: Macrostomida, Meixner, 1926.

**Family:** Macrostromidae, Beneden, 1870.

**Genus:** *Macrostomum* O. Schmidt, 1848.

## RESULTS

### Location: (Map)

Twelve Specimens of this worm were collected from a freshwater pond near El-Halaby Village about 10 kilometers West of Zagazig University and far from Cairo by 95 kilometers in the Nile Delta. These Turbellarians are living around the aquatic vegetation such as *Elodea canadensis* and *Eichhornia crassipes*.

Salinity of water was about 2.5‰ and the mean temperature 29°C.

### External Features:

The worm's body is oval in shape with a blunt anterior end and a broad posterior end, reaching its maximum width at the end of the first fourth part of the body. Its length ranges from 1-2 mm and its coloration is pale white.

Two kidney shaped eyes are situated dorsally a little distance in front of the mouth aperture. They have a brownish black coloration.

The intestinal margin is distinctly indented. The posterior end of the intestine partly overlaps to some extent the female genital atrium. Two "Rhammiten strassen" or Rhammite tracks are present (Fig. 1, rht).

Sensory hairs and spines are totally absent. Adhesive papillae are found especially at the ventral surface of the last fourth part of the body. The

body is surrounded externally by cilia (Fig. 1,2,c) which are equal in length, where each cilium has a length of about 6µm. Adenal rhabdites (Fig. 2, r-Plate, 3, r) are found in large numbers especially at the anterior end, on the dorsal and lateral surface of the body.

### Epithelium:

The dorsal epithelial layer is thinner than the ventral epithelial layer. The first one measures about 6.2µm while the latter measures about 7.3µm (Fig. 2, de, ve-plate, 5, epl).

The epidermis is pierced between its cells by bundles of rhabdites which are much more numerous dorsally than ventrally. The epithelial cells are cylindrical with oval nuclei (Fig. 2, ec).

The basal granules of the cilia form together along the whole outer surface of the body a thick line as in *Macrostomum niloticum* (Beltagi, 1972) (Fig. 2).

Fluid-filled spaces (Fig. 2, ffs) are located at the ventral epithelial layer in large numbers, than at the dorsal one. They are considered to be mucous gland cells, while the narrower spaces are the outlet of the subepidermal mucous gland cells.

Sausage-like rhabdites (Fig. 2, r-Plate, 4,r) are abundant at the dorsal epithelial layer, each has a length between 6-8µm.

### Musculature:

The body musculature is formed of two parts:

#### 1. The subepithelial muscle layer:

This consists of outer circular and inner longitudinal muscle fibres (Fig. 2, cm, lm). The ventral subepidermal muscle layer is thick and well developed, as it acts like a creeping sole.

#### 2. Parenchymatous muscle fibres:

The worm exhibits a striking feature, in possessing a strong and well developed muscular formation. Dorso-ventral muscle fibres (Fig. 2, dvf) are seen scattered in the parenchymatous tissue, especially at the anterior and posterior part of the body. Diagonal muscle fibres (Fig. 2, dmf) are extending through the whole parenchymatous tissue.

### Mesenchyma:

As in all species of the genus *Macrostomum*, mesenchyma is formed of a syncytial plasmodial parenchyma, in which the main internal organs are embedded (Fig. 2, pt-Plate, 5, pt). Adenal Rhabdite gland cells are scattered in the parenchymatous tissue (Fig. 2, rgc-Plate, 3, rgc). They secrete sausage-shaped rhabdites which are 2,3,4,6,8 in each packet and are abundant at the posterior part of the body.

Parenchymatous cells are scattered without order in the mesenchyma. Its nucleus is oval in shape having a length of 6.2µm. Subepidermal mucous gland cells (Fig. 2, smc) occur in large numbers especially at the ventral part of the body. They open to the exterior by necks which are situated inbetween

the ventral epithelial cells. They secrete mucous substance in the form of a ventral cushion upon which the animal moves easily.

### Digestive System:

The mouth aperture (Fig. 1, 2, m-Plate, 1, m) is situated medioventrally at the end of the first fifth part of the body. It is oval in shape, having a moderate length of 175µm. It can be opened or closed by the action of a sphincter of circular muscle fibres (Fig. 2, scm). Several eosinophilous gland cells (Fig. 2, egc) pour their fine coarse granulated contents into the mouth aperture. They are pyriform, with a moderate length of about 100µm each. Its nucleus is nearly circular of about 2.5µm in diameter.

The mouth leads to a flask-shaped simple pharynx which extends dorso-ventrally ((Fig. 1,2, ph-Plate, 2,3,4, ph). It is heavily ciliated and the length of the cilium reaches about 8µm (Fig. 1,2,c). Pharyngeal epithelium is considered to be extension of the ventral epithelial layer. It has a thickness of about 11µm. Cyanophilous pharyngeal gland cells (Fig. 1,2, phc) are surrounding the pharynx in radial streamers. They are flask-shaped with long narrow neck opening into the pharyngeal cavity, also mucous gland cells are found inbetween the columnar epithelial cells of the pharynx. A very short oesophagus (Fig. 2,oe) is located between the distal part of the pharynx and the sac-shaped intestine.

The latter is elongated and tapering posteriorly just in front of the male organ. It has slightly wavy walls composed of ciliated tall bulbous epithelium (Fig. 1,2,ic-Plate,2,ic) which is represented by 2 types of gland cells, the phagocytic gland cells (Fig. 1,2phg-Plate, 2,3,4,ic) and the triangular enzymatic gland cells (Fig. 1,2,egc).

The phagocytic gland cell is a tall columnar epithelial cell which has a length of 107  $\mu\text{m}$ . Its nucleus is oval in shape and situated near the basal part of the cell. It reaches about 19  $\mu\text{m}$  in length. It is heavily granulated, as the diameter of the coarse granule is about 4.2  $\mu\text{m}$ . This type of gland cell is responsible for the intracellular digestion and the food storage.

The triangular enzymatic gland cell reaches about 42  $\mu\text{m}$  in length, with an oval nucleus of 8  $\mu\text{m}$ , which is also strongly granulated. It is responsible for the extra-cellular digestion. The intestinal sac (Fig. 1,2, in) is surrounded by a strong muscular layer which is formed of outer longitudinal muscle fibres and inner circular muscle fibres (Fig. 2, lm, cm). Food materials as minute crustaceans like copepods and Cypris as well as rotifers are often found in the intestinal cavity. The length of the intestine is about 400  $\mu\text{m}$ .

#### Excretory system:

Protonephridia were not detectable neither in the squeezed animal nor in prepared stained sections.

#### Nervous System:

It is fairly typical for that described for other species of *Macrostomum* such as *Macrostomum niloticum* (Beltagi, 1972).

The brain (Fig. 1,2b-Plate, 2,3,5b) is formed of bilobed ganglionic nerve mass, the right and left nerve ganglia are connected by a medio-dorsal nerve commissure (Fig. 1,mdc-Plate, 3,b). A thin membrane, surrounding the brain mass, is totally absent. The brain is surrounded by muscular capsule which is formed of outer longitudinal muscle fibres (Fig. 2, lm) and inner circular muscle fibres (Fig. 2, cm). Each nerve ganglion (Fig. 1, ng) has a diameter of about 80  $\mu\text{m}$ .

The brain mass (Fig. 1,2b-Plate, 2,3,5b) gives rise to 4 pairs of nerve stems as follows:

##### 1. Anterior nerve stems: (Fig. 1, ans)

These are short and extend anteriorly, supplying the anterior part of the body with several anterior nerves.

##### 2. Antero-lateral nerve stems: (Fig. 1, alns)

These are extending antero-laterally, giving rise to several nerves, supplying the most anterior part of the body.

##### 3. Lateral nerve stems: (Fig. 1, lns)

These extend laterally in the parenchymatous tissue, then ventrally towards the posterior part of the body in the form of right and left latero-longitudinal nerves (Fig. 1, rlln, llln)

which are connected together to form a medio-ventral bilobed tail nerve ganglion (Figs. 1,2, tng) located a little distance before the posterior end supplying the male and female genital organs.

##### 4. Postero-ventral nerve stems: (Fig. 1, pvns)

These arise from the posterior part of the brain mass and extend postero-ventrally around the pharynx, to form a circumpharyngeal nerve commissure (Figs. 1, 2, cpr) which is slightly enlarged in the form of a nerve ganglion (Figs. 1, 2, ng).

#### Sensory Organs:

The 2 eyes are situated dorso-posteriorly behind the main brain mass, and appear to be embedded in the tissue of the brain. They are kidney-shaped blackish brown in coloration. Each eye (Figs. 1,2,e-Plate, 1,2,3,e) contains a large number of granules ranging from 40 to 50, and a clear lens which is situated in the eye chamber (Fig. 2,eb) and is considered as a part of the retinal cell.

Sensory hairs and spines are totally missing.

#### Reproductive System: (Figs. 1, 2, 3-Plate, 4,5,7,8,9,10)

##### 1. Female genital Organs:

These include the right and left ovaries (Figs. 1,2,rov, lov) which are slightly lobulate and situated ventrally in the parenchymatous tissue. The length of the right ovary is about 271  $\mu\text{m}$ , while the left ovary reaches about 254  $\mu\text{m}$ . Oogenesis is clearly

observed inside each ovary. A large mature egg (Figs. 1,2,mg-Plate, 4,mg) is usually located at the posterior part of the ovary. Its moderate diameter reaches about 100  $\mu\text{m}$ . Its nucleus is oval in shape, having a length of about 25  $\mu\text{m}$ .

Each ovary is surrounded by a very thin epithelial wall which extends posteriorly to form a narrow oviduct. The right and left oviducts (Figs. 1,2,rod, lod) are connected medio-ventrally to form a short common oviduct (Figs. 1,2,cod). The latter leads to the passage cells (Verschluss apparat) (Figs. 1,2,pc-Plate, 7,pc) which are pyramidal in shape and situated at the anterior part of the antrum femininum.

The Antrum femininum (Figs. 1,2, af-Plates, 4,5, af) is nearly spherical in shape having a diameter of about 180  $\mu\text{m}$ . A strong sphincter of circular muscle fibres (Figs. 1,2, scm) is located in between the passage cells and the Antrum femininum. Foreign sperms are observed near the posterior edge of the passage cells (Fig. 2,sp) inside the antrum femininum, which has a ciliated wall formed of cuboidal epithelial cells (Figs. 1,2 cec). It leads ventrally to a short ciliated vagina (Fig. 2, va), surrounded radially by outer rod-shaped eosinophilous cement granules and inner coarse cyanophilous cement granules (Figs. 1,2, cg). The vagina opens medioventrally into the female genital aperture (Figs. 1,2, fga)

Inside the antrum femininum, a large fertilized egg or embryo (Fig. 1,2, fg-Plate, 6 em) is observed. It has

a peripheral layer of spherical granules (Figs. 1,2,gr-Plate, 7,em), forming a distinct surface layer of the fertilized egg in the antrum femininum.

#### Male genital organs:

The right and left testes (Figs. 1,2,rt,lt) are elongated, slightly lobed cylindrical bodies that extend alongside the anterior part of the intestine. From the middle part of each testis, a vas deferens (Fig. 1,rvd, lvd) proceeds backwards alongside the intestine behind the rear end of which the two ducts enter an expansible thin walled sac called false vesicula seminalis (Figs. 1,2,fs). This leads posteriorly to an oval thick-walled vesicula seminalis (Figs. 1,2,vs) by means of a short ductus spermaticus (Figs. 1,2,ds).

The wall of the vesicula seminalis is supplied by outer longitudinal muscle fibres and inner circular muscle fibres (Figs. 1,2,lm, cm). It leads to a pear-shaped vesicula granulorum (Figs. 1,2, Plate, 8, vg) through a short ductus intervesicularis (Figs. 1,2,di) which is surrounded by a strong sphincter of circular muscle fibres (Figs. 1,2,scm).

The proximal part of the vesicula granulorum is broad and internally ciliated, while its distal part narrows to a curved tube which encloses the proximal end of the stylet (Fig. 3-Pos). The vesicula granulorum is surrounded by numerous cyanophilous accessory gland cells (Figs. 1,2,ac-Plate, 8,ac) which pour

their coarse granular contents into its distal half.

Each accessory gland cell is flask-shaped and filled with small coarse granules, and has diameter of about 30µm. The stylet (Figs. 1,2,3,st-Plates, 8,9,10,st) is a long double-curved chitinous tube which is directed backwards ventrally and tapers slightly. Its distal tip lies at the male genital aperture (Figs. 1,2, mga) which is situated medio-ventrally.

The stylet is situated in a penial canal lined by an epithelial layer (Figs. 1,2,epl). Its length reaches about 321µm. The proximal end of the stylet (Figs. 1,2,3,pos-Plate 9, pos) has a diameter of about 26 µm, while its distal end (Figs. 1,2,3, dos-Plate, 10, dos) is oval in shape and slightly thickened and has a diameter of about 18µm.

#### DISCUSSION

Undoubtedly *Macrostomum deltanensis* n.sp. belongs to *Macrostomum tuba* species group.

The shape of the penis stylet of this worm can be alone regarded as sufficient basis for its separation from all other *Macrostomum* spp.

It differs from *Macrostomum tuba* (Graff, 1882) as the stylet is curved in two planes and its distal part ends by an oval enlarged bulb which is slightly thickened. In this respect, it differs from *Macrostomum curvītuba* (Luther, 1947), *Macrostomum bulbostylum* (Ferguson, 1939) *Macrostomum minutum* (Luther, 1947)

as the latter has a straight stylet with thickened enlarged distal end.

Moreover the stylet of the present species differs from that related to *Macrostomum quritium* (Beklemischev, 1951), *Macrostomum caireonse* (Beltagi, S., 1972), *Macrostomum amaniense* (Young, 1976), *Macrostomum goharii* (Beltagi, S., et al. 2000), and *Macrostomum Ismailiensis* (Beltagi, S., et al. 2001).

#### Species Diagnosis:

The present worm a length up to 2 mm. Sensory hairs and adhesive disc are absent. Eyes are present and epithelial rhabdoids are distributed all over the body.

Adhesive papillae occur at the posterior ventral part of the worm. Ovaries are indented, "Verschluss apparat" passage cells are well developed. Vagina present.

Penis stylet is curved in two planes. Its distal end is enlarged and slightly thickened and has a terminal aperture.

Thus a new species name has been proposed to the present material, Namely *Macrostomum deltanensis* where it was collected from a site in the Nile Delta. Type specimens were deposited at the Department of Zoology, Faculty of Education, Ain Shams University, Cairo, Egypt.

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## LIST OF ABBREVIATIONS

- ac accessory granular gland cell  
af antrum femininum  
agc adhesive gland cell  
alns antero-lateral nerve stem  
ans anterior nerve stem  
b brain  
c cilia  
cec cuboidal epithelial cell  
cg cement granules  
cgl cement gland cell  
cm circular muscle fibre  
cod common oviduct  
cpr circum-pharyngeal nerve ring

- di ductus inter-vesicularis  
dmf dilatator muscle fibre  
dos distal end of the stylet  
ds ductus spermaticus  
dvf dorso-ventral muscle fibre  
e eye  
eb eye-chamber  
egc eosinophilous gland cell  
em embryo  
eng enzymatic gland cell  
ep epithelium  
epl epithelial layer  
fg fertilized egg  
fga female genital aperture  
fs false vesicula seminalis  
gr granule  
ic intestinal cell  
in intestine  
ine intestinal epithelium  
lln left latero-longitudinal nerve  
lm longitudinal muscle fibre  
lns lateral nerve stems  
lod left oviduct  
lov left ovary  
lt left testis  
lvd left vas deferens  
m mouth  
mdc medio-dorsal nerve commissure  
mg mature egg  
mga male genital aperture  
n Nucleus  
ng nerve ganglion  
o ovocyte  
oe eosophagus  
oo oogonium  
pc passage cells " Verschluss apparat "  
ph pharynx  
phc pharyngeal gland cell  
Plc Penial canal  
pmf protractor muscle fibre  
pos proximal end of the stylet

- pt parenchymatous tissue  
prc parenchymatous cell  
pvns postero-ventral nerve stem  
r rhabdite  
rgc rhabdite gland cell  
rh rhammite  
rlln right latero-longitudinal nerve  
rmf retractor muscle fibre  
rod right oviduct  
rov right ovary  
rt right testis
- rvd right vas deferens  
scm sphincter of circular muscle fibres  
sp sperm  
st stylet  
tng tail nerve ganglion  
va veagina  
ve ventral epithelial layer  
vg vesicula granulorm  
vs vesicula seminalis  
yg yolk granule

Location Map

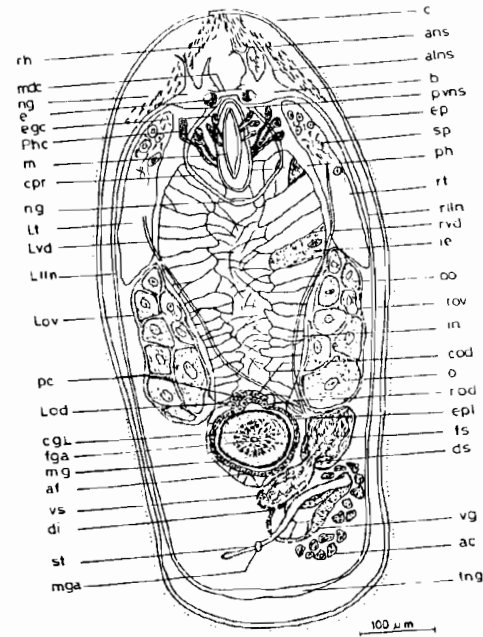
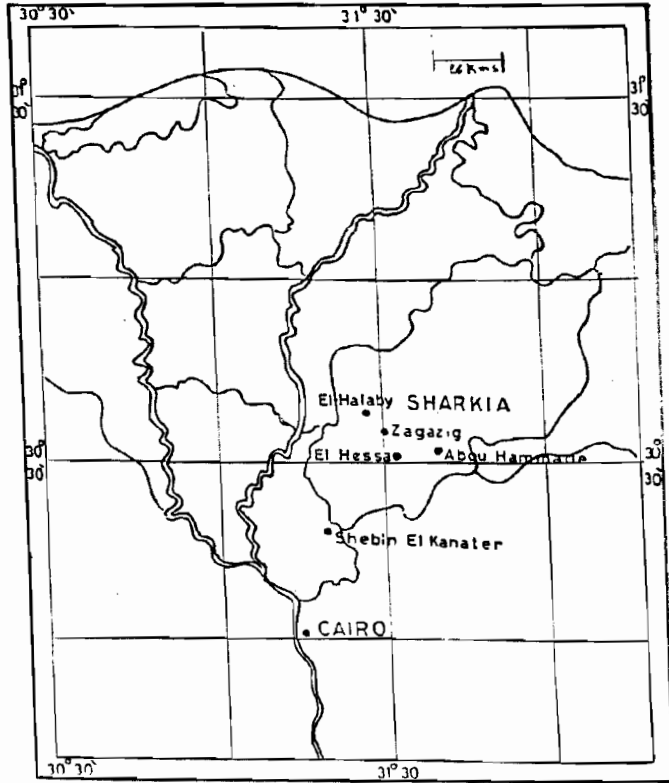


Fig. (1) *Macrostomum deltanensis* sp. nov.  
Diagrammatic dorsal view (gross Anatomy).

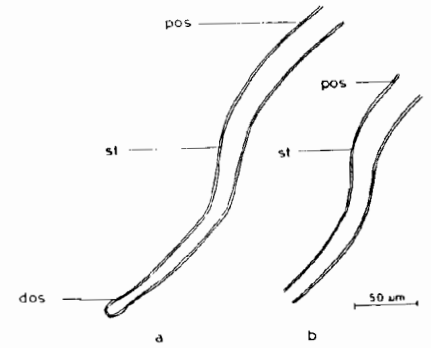


Fig. (3) *Macrostomum deltanensis* n. sp.  
a) Distal part of the stylet  
b) Proximal part of the stylet

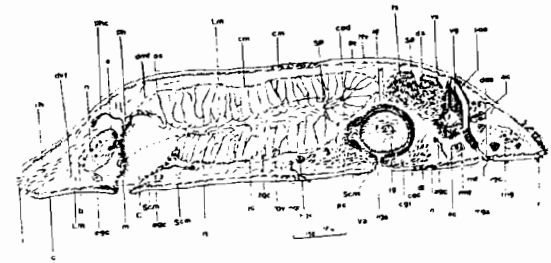


Fig. (2) *Macrostomum deltanensis* sp. A diagrammatic representation from a sagittal section showing internal organization

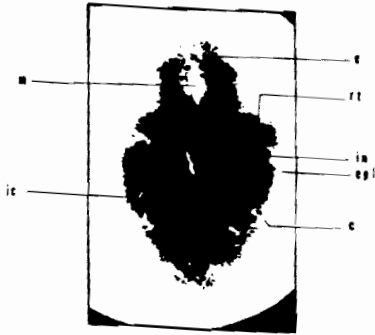


Plate (1) *Macrostomum deltanensis* n sp. External features of the animal (Dorsal view)

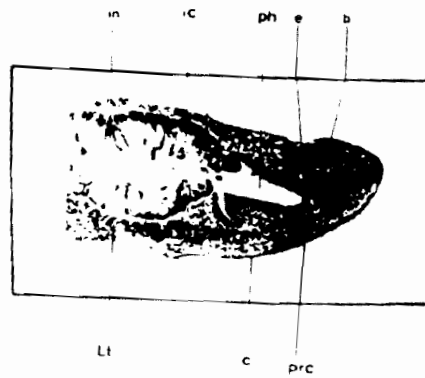


Plate (2) *Macrostomum deltanensis* n sp. Longitudinal section in the anterior half of the body.

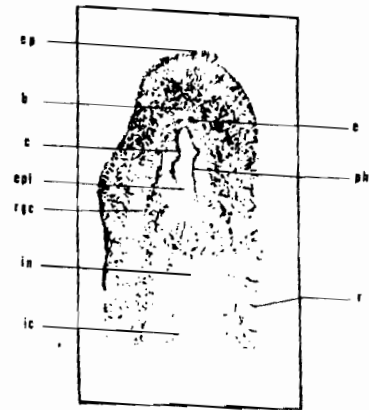


Plate (3) *Macrostomum deltanensis* n sp. Horizontal section in the anterior half of the body.

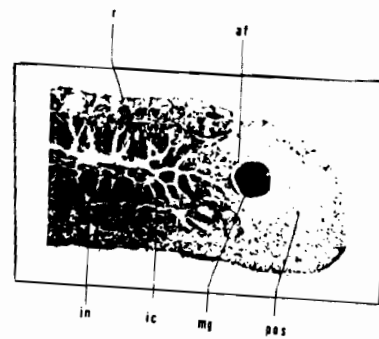


Plate (4) *Macrostomum deltanensis* n sp. Horizontal section in the posterior half of the body.

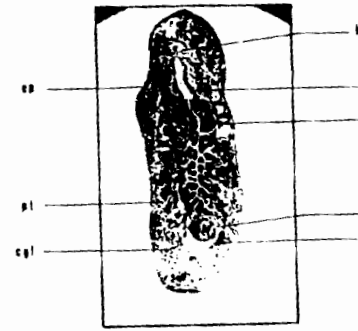


Plate (5) *Macrostomum deltanensis* n sp. Horizontal section through the body of the animal.



Plate (6) *Macrostomum deltanensis* n sp. Mature egg in the Antrum (minimum) (squeezed preparation)

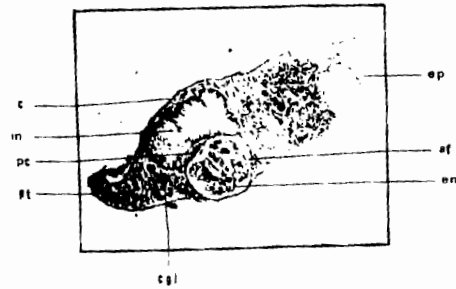


Plate (7) *Macrostomum deltanensis* n sp. L.S. through the antrum (minimum) showing rufous cubes.



Plate (8) *Macrostomum deltanensis* n sp. L.S. through Visceral granulum and stylet.

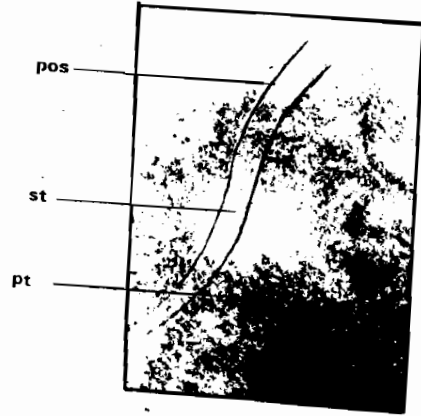


Plate (9): *Macrostomum deltanensis* n.sp. Plate of the Proximal Part of stylet (squeezed Preparation)

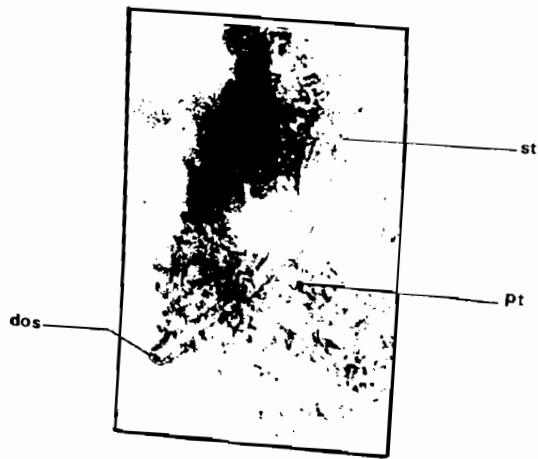


Plate (10): *Macrostomum deltanensis* n.sp. Distal part of the stylet (Squeezed preparation)

مزيد من الدراسات على تيربيلاتريا المياه العذبة في مصر  
 - "ماكروستوم دلتانينسيس (نوع جديد)"

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تم جمع هذه الديدان من بركة ماء عذب بالقرب من قرية الحلبي والتي تبعد قرابة ١٠ كيلومترات غرب جامعة الزقازيق بمنطقة الشرقية بدلتا النيل، وهذه العينات الحيوانية تعيش على النباتات المائية مثل ايكورنيا كراسيبسيس و الوديا كندينسيس وغيرها . حيث درجة ملوحة الماء ٢,٥% ودرجة الحرارة ٢٩م.

جسم الودة بيضاوي الشكل وله طرف أمامي مستدير وطرف خلفي عريض ويتراوح طوله ما بين ١-٢ مم ولونه أبيض باهت وعليه زوج من العيون كلويه الشكل وتقع على مسافة قليلة أمام فتحة الفم في الناحية الظهرية لجسم الحيوان ، وذات لون بني مائل إلى السواد . حيزمتاز هذا النوع الجديد من جنس الماكروستوم بشكل العضو التناسلي الذكرى وهو القضيب الكيتيني الذي يبلغ طوله ٣٢١ ميكرون ويختلف هذا القضيب عن مثيله الموجود في الأنواع الأخرى المعروفة التابعة لنفس الجنس بأنه منحني في مستويين ، كما أن طرفه الخالص متضخم قليلاً وبيضاوي ويلاحظ أن بجداره زيادة طفيفة في السمك وله فتحة في نهايته.