Analele Ştiinţifice ale Universităţii "Al.I. Cuza" Iaşi, s. Biologie animală, Tom LI, 2005

THE INFLUENCE OF THE SOIL PARAMETERS UPON THE SOIL'S MESOFAUNA IN FUNCTION OF THE ENVIRONMENT CONDITIONS WITHIN MURIGHIOL-DUNAVAT DAMMED AND DRANAGE AREA AS PART OF THE DANUBE DELTA BIOSPHERE RESERVE

BY

VALENTIN PANAIT[1]

Key word: environment conditions, soil parameters, soil mesofauna, Murighiol-Dunavăţ dammed area

At present, within the Murighiol-Dunavăţ dammed area, the study of the soil's mesofauna is influenced the evolution of young soils of this area.
The changes from the initial submerged conditions to emerged conditions using the dammed and drainage works, as well as the improvement works, in order to obtain land for agriculture, these determined the phenomena, as follows: the of the soil thickness reduction, acidification processes, the salinization process, the pollution with pesticide etc. These phenomena have a negative impact upon the soil mesofauna.

Introduction

Having a surface of 2830 ha, the Murighiol-Dunavăţ area (Fig. 1) is located at the south-western part of the Danube Delta (in frame of the fluviatile delta). The boundaries of this area are represented by: the Sf. Gheorghe Arm at the north, the Dobrudja Hills at the west, the Dunavăţ channel at the east, the Fundea and Dunavăţul de Jos channels at the south. [1] [7]

In the past, 75 % of the surface of the Murighiol-Dunavăţ area was in a permanent and semipermanent submerged regime, while the rest of it was in a periodical submerged regime, 2-3 months per year.

At present, the transitions from submerged to emerged regime have produced in the soils the substitution of reduction with oxidation reaction. This process activated the phenomena of subsidence for the entirely surface of the dammed area and also created conditions for the increasing degree of salinization and acidification, as well as the decreasing of the organic matter concentration, in soils. For this reason, in the Murighiol-Danavăţ dammed area the soil's mesofauna has a high importance in the pedogenesis processes and it is also an important factor in the soil's ripening process.

[1] **Eco-Museal Research Institute - Tulcea**

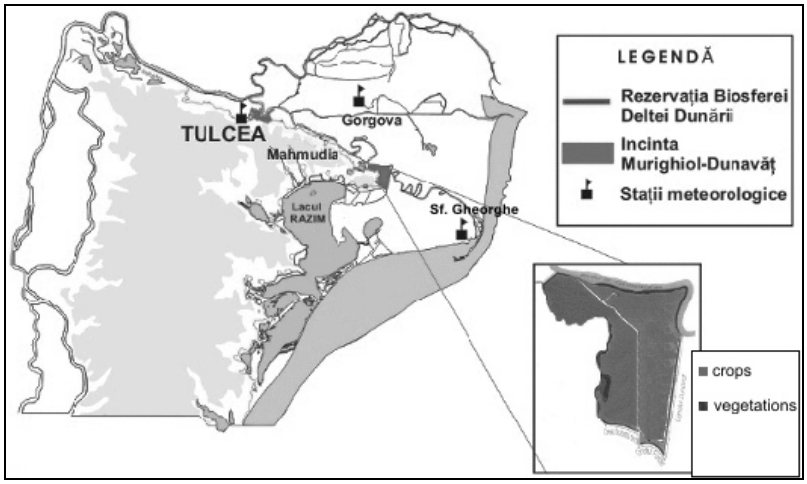


Fig. 1 The Murighiol-Dunavăț dammed area position within the Danube Delta

Material and method

The necessary stages for the achievement of this research are:

- ⇨ We studied the documents concerning the initial status of the Murighiol-Dunavăț area, shown in the data offered by specialists from: I.S.I.P.I.F. Bucharest, I.C.P.A. Bucharest, D.D.N.I. and O.J.S.P.A. Tulcea, in the scientific literature, as well as in reports and/or the technical projects elaborated on the occasion of the damming and draining works.
- ⇨ We studied the cartographical and cadastral materials, in order to establish the way to draw the sampling itineraries, as well as the legislation and the scientific bibliography, concerning the legal situation and the present day status of different land areas from the precincts.
- ⇨ Set up the site for soil study is made within the homogeneous ecological area, where we can establish the sites for the study of some soil's parameters (at unit level), as well as microlandscape, parental mater, microclimate etc.
- ⇨ The opening of a control soil profile in the sites for soil study, in order to obtain information according to the placement of soil horizons and samples drawing at the soil horizon level.
- ⇨ The opening of a soil profile for insertions of the mesofauna traps. It was made on the basis of the control profile and the material collected from each soil horizons with was carefully stored in different places.
- ⇨ Installing the mesofauna traps (Fig. 2) composed by: 1. cylindrical box (diameter - 7.9 cm, height - 12 cm); 2. lid with orifices with a diameter of 0.5 cm (diameter - 8.1 cm, height - 5 cm); 3. isolation band (it has the scope to maintain the lid with orifices in proper position); 4. funnel for gathering organisms (the large opening with at diameter of 7.8 cm, and the small opening with a diameter of 2.6 cm, and

with a height of 4.5 cm); 5. formalin. The traps will be installed, with orifices of lied, on the middle of each horizon of soil and will be covered with the proper maters of this layer (Fig. 3). In that way the aspect of the soil will be returned. In the end will be marked the point.

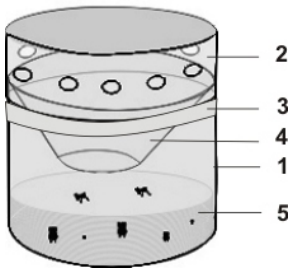


Fig. 2 Mesofauna traps

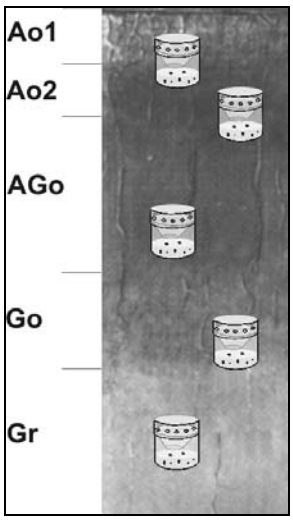


Fig. 3 The traps installing

- ⇨ The traps were collected from the soil profiles of the marked point, after one week (this time is necessary for soil's recovering.
- ⇨ The soil fauna will be studied in laboratory condition using proper methods for each type of organism.
- ⇨ The obtained data can be centralized, analyzed and compared with those found in the scientific literature and in other previous published papers.

Results and discussions

The evolution of the parameters of the soil depending of the environment condition

In the past, the biggest part of the unit, about 75% was in permanent and semipermanent submerged regime, the rest of it being in a periodical submerged regime of 2-3 months per year. The most important percentage concerning the unit surface was detained by peat bog soils and marshy gley soils (about 66.4% from the unit surface), the rest of 33.6% of the surface being distributed between the following types of soils: typical gley soils, puddles, alluvial soils and alluvia.

The human intervention in the Murighiol-Dunavăț area started after 1976 year. The land improvement works led to the emergence conditions for soils (from the submerged initial conditions) in order to obtain land for agriculture. These works have produced within this area a high soils evolution. The monitoring works used to establish these changes were based upon the environment factors and on some soil parameters evolution.

Several of the environment factors analyzed in the soil's mesofauna survey are presented below:

- ⇨ Landforms and microlandforms are typical for the delta's plane (with a relative altitude framed between 0.5 and 1 m above Black Sea level). Within this, there were identified levee, plane landform, the lake depressions area (completely drained today) etc. [3] [5] [7]
- ⇨ The meteorological aspects were established using information from three meteorological stations, respectively: Tulcea, Gorgova and Sf. Gheorghe. Within the last years, between 1999 and 2004, there was recorded a growing of the multiannual temperature mean at all stations with 1 ^{o}C, thus being registered ~12.9 ^{o}C in Tulcea, ~12.2 ^{o}C in Gorgova and ~12.15 ^{o}C in Sf. Gheorghe. In the case of the rainfall, there were measured less than 440 mm in Tulcea (~435 mm) and in Gorgova and Sf. Gheorghe with ~100 mm less than Tulcea.
- ⇨ The aquatic network is composed of some canals, such as Dunavăț channel (at the east), Fundea and Dunavățul de Jos channels (at the south), Lipovenilor canal (in the middle of the dammed area), and Sf. Gheorghe Arm at the north. [5]
- ⇨ The ground water is situated between 0.5 (in the areas of the plane fluvial levee) and 1.5 or 5 m in the other surfaces of the Murighiol-Dunavăț dammed area. The high concentration of calcium sulphate and magnesium sulphate confered an alkaline value of the pH with a mean value of 7.5.
- ⇨ The most common types of soils, studied between 2000-2004 years, are these: Gley soil calcareous, ripen, emerged; Alluvial soil gleyed, unripen, emerged and Histosoil gleyed hemic, unripen, emerged. The high importance in the soil's mezofauna study has the soil characteristics, as follows:
  - physical properties (texture – loamy-sands, loamy and clay; course sand concentration, as follows: Gley soil calcareous, ripen, emerged - 0,046%, Alluvial soil gleyed, unripen, emerge - 0,050% and Histosoil gleyed hemic, unripen, emerged - 0,015%; fine sand concentration, as follows: Gley soil

calcareous, ripen, emerged - 36,246%, Alluvial soil gleyed, unripen, emerged - 30,800% and Histosoil gleyed hemic, unripen, emerged - 46,927%; silt concentration, as follows: Gley soil calcareous, ripen, emerged - 27,249%, Alluvial soil gleyed, unripen, emerged - 34,550% and Histosoil gleyed hemic, unripen, emerged - 25,006%; clay concentration, as follows: Gley soil calcareous, ripen, emerged - 36,463%, Alluvial soil gleyed, unripen, emerged - 34,600% and Histosoil gleyed hemic, unripen, emerged - 28,050%) (Graf. 1);

- mechanical properties (subsidence – between 0,5 m in 1977-1986 years and 0,2 m in 1993-2000 years) [3] [7];
- chemical properties (humus, organic maters content, nitrogen concentration, $CaCO_3$ concentration, pH, total soluble salt content) (Graf. 2, 3, 4);

⇨ Vegetation is composed, on the largest surface of the Murighiol-Dunavăț dammed area, of hydrophytes (*Salix fragilis, Salix cinerea, Populus alba, Typha angustifolia, Phragmites australis* etc.), mesophytes (*Cynodon dactylon, Artemisia austriaca, Agrostis stolonifera* etc.) and xerophytes (*Elymus giganteus, Carex colchica, Puccinellia distans, Juncus maritimus* etc.) species and also cultivated species with high economic value (wheat, sun-flower, maize etc.).

⇨ Human intervention in the Murighiol-Dunavăț area was concentrated in order to obtain the agricultural production and maintenance of the crops. These works have been produced within that area a high evolution of the subsidence and also there were created conditions for salinization of the soils, acidification, as well as the soil contamination with pesticides. These happened because there were used to heavy machines on the young soils and also, the reed flora was destroyed through the fire and/or with herbicides, as well as the crop's pests were eliminated with pesticides (Table 1). The subsidence is a normal process for the dammed and drainages areas. That process is produced by the drainage of the exceeding water, the organic mineralization and the ripening process of the young soils. These changes lead to the modification of the soils and vegetation structure.

Table 1 The list of several pesticides used in the Murighiol-Dunavăț dammed area

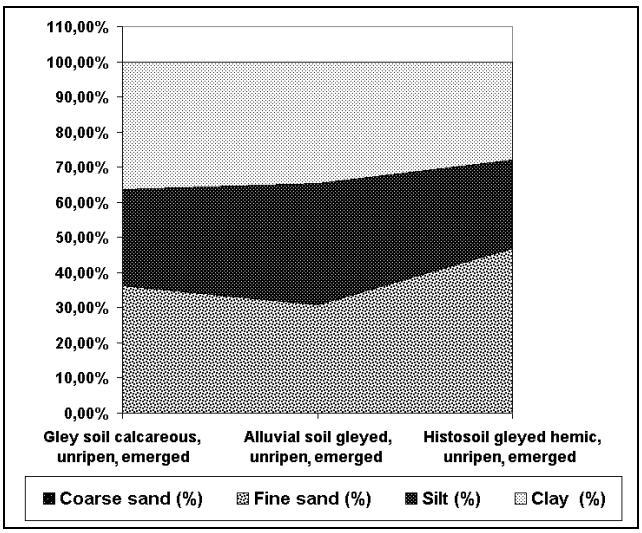
Product (active substance)	Company	Target organism	Concentration	Toxicity group
GAUCHO 70 WS	BAYER	Soil pests	12 kg/t seed	IV
COSMOS 50 FS	RHONE POULENC	Soil pests	12 kg/t seed	IV
DECIS 2.5 CE	OLTCHIM S.A. Râmnicu Vâlcea + AGREVO	varied pests	-	IV

Product (active substance)	Company	Target organism	Concentration	Toxicity group
TILT 20 EC	OLTCHIM S.A. Râmnicu Vâlcea + CIBA GEIGY	leafy pathogenic agent	0.330 kg/ha	IV
SEEDOX 80 WP	AGREVO	soil pests	10 kg/t seed	IV

The emergent soil evolution started after the improvement works that represented a cause of the very active process like secondary salinzation, acidification, subsidence etc.

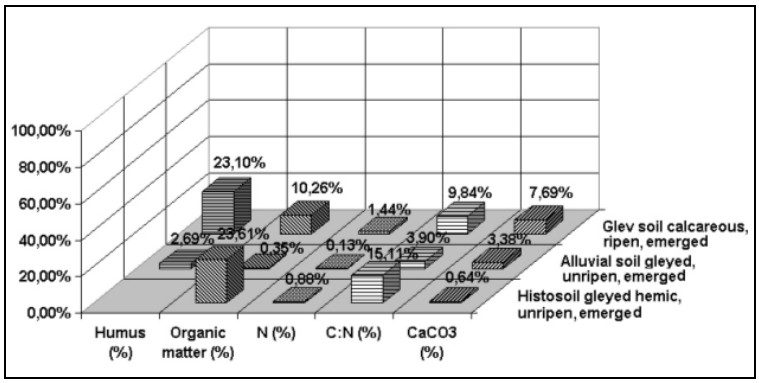
These changes of the soil parameters occurred in the following context:

- ⇨ the evolution of the air temperature from 10.7 °C (the mean value from 1901 to 1980 years) to 12.4 °C (the mean value from 1991 to 1999 years), can cause an amplification of the mineralization processes;
- ⇨ the influence of rainfall and wind, these can cause soil erosion and the decreasing of humus quantity;
- ⇨ the ground water level evolved from 1.7 m (in the 1976-1982 years) to between 0.5-4.2 m (in 1998-2004 years) (the deeper level was 5.2 m) and it can cause the amplification of the mineralization processes.

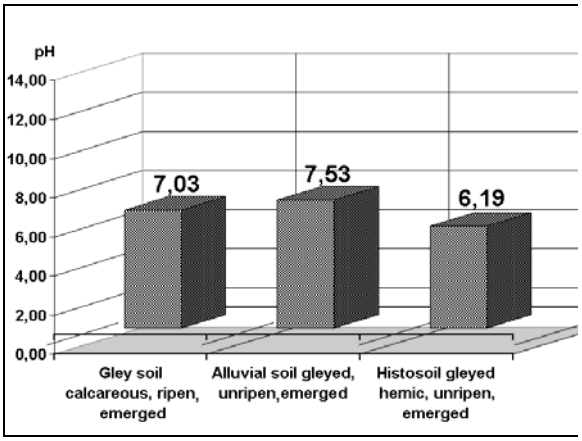


Graf. 1 The evolution of the average value of physical soil parameters

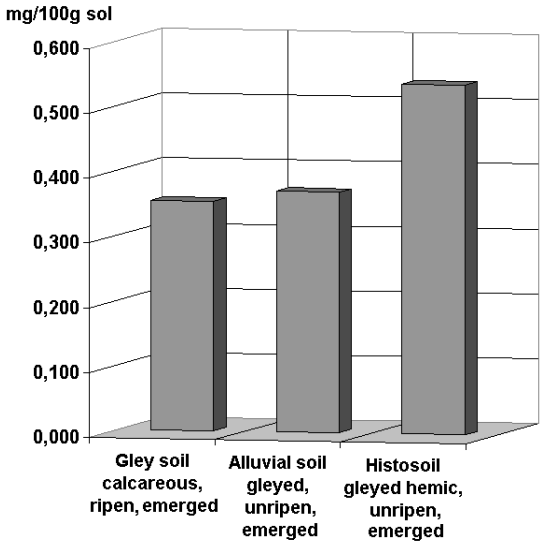
Within the dammed area the ripening process occurs after the soil's drainage, but, in the case of the improper soil works and in the actual environment conditions, these lead to an over passing of the boundary of the soil's grain stress and the disturbing of the soil characteristics. These created conditions for soil subsidence, secondary salinization and acidification, as well as an amplification of soil degradation process and a great variation of the vegetation and crops biomass production.



Graf. 2 The evolution of the average value of chemical soil parameters



Graf 3. The evolution of the average value of pH soil parameters



Graf 4. The evolution of the average value of soluble salts soil parameters

The soil's mesofauna

Soil faunas generally are small and have simplified appendages. The mesofauna identified in the area is composed of mites, springtails, spiders, pot-worms etc.

On the Murighiol-Dunavăț dammed area was determined a number of taxa included in the following: *Oligochaeta*, *Chilopoda*, *Arachnida* and *Hexapoda*.

Class *OLIGOCHAETA*
Order *Haplotaxida*
Family *Lumbricidae*
Lumbricus terrestris (Linnaeus 1758)
The common earthworm with a length of 9-30 cm and 110-180 segments it is found in the loamy soil. [1]

Allolobophora rosea (Savigny 1826)
The meaty colour earthworm with a length of 3-8 cm and 120-150 segments it is found in the high moisture soil. [1]

Octolasium lacteum (Örley 1881)
The brownish-yellow earthworm with a length of 3-16 cm it is found in the fertile clay soil. [1]

Class *CHILOPODA*
Order *Lithobiomorpha*
Family *Lithobiidae*
Lithobius forficatus (Linnaeus 1758)
The nocturnal venomous myriapod with a length of 2.5-3 cm, middle waist, brownish colour, a large head with long antennae and the first pair of legs transformed into chelipeds it is found in a wide range of soils types (loamy, sandy, loamy-sands, loamy-silts etc.). [1][8]

Order *Geophilomorpha*
Family *Geophilidae*
Geophilus flavus (De Geer 1778)
It is a cosmopolitan species of the *Geophilidae* family, with a very long and slender body, 49-57 pairs of legs and reddish colour. [1][8]

Pachymerium ferruginium (C.L. Koch 1835)
That is a robust species of the centipede's family, which include small and extremely elongate earth-living myriapods with brown-red colour it is found in a wide range of soils types (loamy, sandy, loamy-sands, loamy-silt etc.).

Class *ARACHNIDA*
Order *Araneae*
Family *Lycosidae*
Arctosa cinerea (Fabricius 1777)
A northern wolf spider found among stones besides lakes and rivers where it builds a silken tube beneath a stone. The spider appears to stay in this tube throughout the winter, even when it is covered by water. [1][8]

Trochosa terricola (Thorell 1856)
It is considered a Holarctic species, occurring in North America and northern Europe, as well as in some parts of south-eastern Europe. We distinguished that species by using the absence or presence of a claw on the palpal tarsus (in both sexes and all instars in each case). The ridge on the fang is lacking and the apical portion of the embolus forms a circular loop. [1][6][8]

Class *INSECTA (HEXAPODA)*
Order *Hymenoptera*
Family *Ponerinae*
Ponera coarctata (Latreille 1802)
It is a slow, timid ant with small colonies, it is found within and/or without of the agricultural land's soils. [1][8]

Subfamily *Formicinae*
Formica fusca (Linnaeus 1758)

Body dull, black, it is found excavating nests in drier places, in the sandy soils as well as in the soils with sandy-loamy to loamy or loamy-clay texture and low concentration of organic matters. [1][8]

Conclusions

The impacts of the environment factors on the soil evolution occurred on a large scale in the entire dammed area. The evolution of the environment factors is independent from soil processes and determines the soil's characteristics. The exception is made by the human factor that has a high influence and dependence by the soil evolution.

The information about the evolution from the initial to the actual status indicates a very good fertility of soils cover that will be maintained in the future.

The ripening of the young soils is a normal process for the dammed and drained areas. This process is produced by the drainage of the exceeding water, the organic mater mineralization and the agricultural works. But, a degradation of the soil's characteristics, started after the damming and drainage works, have produced the loss of the organic mater, a high soils mineralization and salinization (> 900 mg salts/100 g soil). The results of these are represented by the loss of fertility, the soil compaction and salinization.

In these conditions, we determined the soil's mezofauna distribution, as follows:

- ⇨ Gley soil calcareous, ripen, emerged (mean influenced by salinization, acidification, subsidence and strong influenced by agriculture works), that are found: *Octolasium lacteum*, *Lithobius forficatus*, *Geophilus flavus*, *Arctosa cinerea*, *Ponera coarctata*;
- ⇨ Gley soil calcareous, ripen, emerged (low influenced by salinization, acidification, subsidence, low influenced by agriculture works and/or situated in natural condition), that are found: *Lumbricus terrestris*, *Octolasium lacteum*, *Lithobius forficatus*, *Geophilus flavus*, *Pachymerium ferruginium*, *Arctosa cinerea*, *Ponera coarctata*, *Formica fusca*;
- ⇨ Alluvial soil gleyed, unripen, emerged (strong influenced by salinization, acidification, subsidence and low influenced by agriculture works), that are found: *Lithobius forficatus*, *Arctosa cinerea*, *Ponera coarctata*;
- ⇨ Alluvial soil gleyed, unripen, emerged (strong influenced by salinization, subsidence and situated in natural condition), that are found: *Octolasium lacteum*, *Lithobius forficatus*, *Geophilus flavus*, *Arctosa cinerea*, *Ponera coarctata*, *Formica fusca* (few colonies);
- ⇨ Histosoil gleyed hemic, unripen, emerged (influenced by acidification, subsidence and strong influenced by agriculture works), that are found: *Allolobophora rosea*, *Lithobius forficatus*, *Ponera coarctata*;

⇨ Histosoil gleyed hemic, unripen, emerged (strong influenced by salinization, subsidence and situated in natural condition), that are found: *Allolobophora rosea*, *Lithobius forficatus*, *Geophilus flavus*, *Ponera coarctata*, *Formica fusca*.

Bibliography

1. Muntenu, I., Grigoraş, C., 1977 - Studiu pedologic al Incintei Murighiol-Dunavăț, arhivele I.C.P.A. Bucureşti
2. Müller, Georg, 1968 - *Biologia solului*, Editura Agro Silvică, Bucureşti
3. Panait, V., 1999 - The Delta's: State-of-the-art protection and management, Tulcea - Romania 1999, pp. 160-168
4. Panait, V., 2003 - Analele Ştiințifice ale Institutului Național de Cercetare-Dezvoltare Delta Dunării Tulcea, pp. 240-248 , Ed. Tehnică, Bucureşti
5. Puiu, Şt., 1980 - Pedologie, Editura Ceres, p. 84, Bucureşti
6. Thomas, R. Prentice, 2001 - The Journal of Arachnology 29, pp 427–430, http://www.americanarachnology.org/JoA_free/JoA_v29_n3/ arac_29_03_427.pdf

*** Amenajarea complexă a unitații Murighiol-Dunavăț județul Tulcea, vol. 1-12, arhivele I.S.P.I.F. Bucureşti, 1983

*** Online Dictionary at Datasegment.com, The Collaborative International Dictionary of English v.0.48 & WordNet (r) 2.0 (August 2003), http://onlinedictionary.datasegment.com/