УДК 595,9

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THE TAXONOMY, DIFFERENT ASPECTS OF THE BIODIVERSITY AND NEW METHODS OF STUDY OF EARTHWORMS ON THE 4 TH INTERNATIONAL OLIGOCHAETE TAXONOMY MEETING

Мақалада олигохеттер бойынша өткен 4-ші Халықаралық отырыста баяндалған ғылыми жұмыстардың тақырыбы қамтылған. Жауын құрттарының әр түрлі түрлеріне таксономикалық және генетикалық талдау, жинау және есепке алу әдістері келтірілген.

В статье представлена тематика научных работ 4-го Международного совещания по олигохетам. Приведены современные методы сбора и учета, таксономического и генетического анализа разных видов дождевых червей.

All the world is marking the 200 th birthday of Charles Robert Darwin on February 12 th, 2009 and the 150 th anniversary of the publication of his most important work, 'On the Origin of Species'. Undoubtedly, Darwin's most important contribution was to evolutionary theory, but among his 25 books, one was devoted to earthworms. This not very voluminous book entitled «The Formation of Vegetable Mould, through the Actions of Worms, with Observations on Their Habits» and published in 1881 shows his deep understanding of earthworm biology, behaviour and their role for pedogenesis, health of terrestrial and aquatic ecosystems, and for the multiple services they provide to humans. Even, after so many years most of Darwin's observations and explanations are regarded as correct. For example, in the article by Mitra et al. (2009) «Grunting for worms: seismic vibrations cause Diplocardia earthworms to emerge from the soil» published in Biological Letters, the authors confirmed Darwin's explanation of the escaping behaviour of earthworms: «It has often been said that if the ground is beaten or otherwise made to tremble, worm believe that they are pursued by a mole and leave their burrow. From one account that I have received, I have no doubt that this is often the case». Certainly, this book is still a good starting point for naturalists and biologists to acquire a basic knowledge of the biology and ecology of earthworms [1].

However, the amount of information available about earthworms is growing day after day and new scientific fields are opened (e.g. earthworm phylogeography and pharmacology). A way to speed up the progress in scientific work and to exchange ideas is to encourage cooperation by bringing together scientists working on similar subjects. This is the basic idea behind the organization of the International Oligochaete Taxonomy Meetings (IOTM). So far, three successful meetings took place. The 1st IOTM was organized by Ana G.Moreno in Madrid, Spain, the 2nd IOTM by Victor V.Pop in Cluj-Napoca, Romania and the 3rd IOTM by Tomáš Pavlíček and Patricia Cardet in Platres, Cyprus. As a tradition, the meetings concentrate mainly, but not exclusively, on earthworms and discuss, apart of taxonomy, also different aspects of the oligochaete biodiversity and new methods of their study. The 4th International Oligochaete Taxonomy Meeting, taking place in Diyarbakir, Turkey, from April 20 to April, 2009, will continue in the best tradition of the previous three meetings.

Methods of research of the biodiversity. The most of the messages has been devoted to problems of the biodiversity. The biological diversity of region depends primarily on its geographic position, climate and on the habitat heterogeneity. Many other environmental factors affect the species local distributions, their abundance and the species richness. The knowledge of local species distribution provides basic data for the regional conservation planning and management of protected areas. For example, the taxonomic structure of earthworms of coffee plantations systems at three different areas in Puerto Rico (Las Marias, Lares and Jayuya) were stadied by M.Alfaro and C.Ramos. Organisms were hand sorted from two consecutive, 15 cm deep soil layers in a 0,25 m^2, and various soil analyses were carried out. Only four earthworm's species were found: Pontoscolex corethrurus, Pontoscolex spiralis, Pontoscolex melissae, and Pheretima sp. Earthworm density and biomass, soil moisture, organic matter content, total nitrogen and texture varied significantly between coffee plantation system (sun, shade, and forest) and between areas. A greater density and biomass at all areas and coffee plantation systems were found in the first top soil layer and a higher density and biomass of exotic species was found in the most perturbed areas as expected. P. corethrurus was found at all coffee plantations. Jayuya, the area with the highest elevation had the higher density and biomass. On the other hand, P. melissae is a rare species and only have been found twice since its description.

C.E.Boothby and S.Borges investigated the distribution of Pontodrilus litoralis in Puerto Rico and its population dynamics in Cabo Rojo. Pontodrilus litoralis has only been reported from Cabo Rojo, near a lighthouse located on the southwestern coast of Puerto Rico. The beaches on the island were surveyed to determine the distribution of this species. The structure and dynamics of the populations of Pontodrilus litoralis in Cabo Rojo were studied as well. Distances from the tide mark and depth stratification in sand were taken into account. Environmental factors such as temperature, pH, humidity, organic matter, and surface accumulation of plant debris were registered. Spatial distribution of Pontodrilus litoralis was determined to be aggregated in clusters. These clusters were predominant right at the high tide mark where sand was always humid but never completely submerged under seawater. Temperature was determined to be the primary factor in the distribution dynamics of this oligochaete species: sites with the lowest temperatures seemed to have the highest number of individuals.

Our knowledge of the Lumbricidae fauna is still very limited in some parts of Iran, therefore many messages have been devoted to this theme. Taxonomic study of earthworms from the western parts of Iran has been executed by R.Latif, S.Ezzatpanah and others. During the course of this study, approximately 60 specimens were collected from 10 stations in different parts of Chahar Mahal Va Bakhteyari province. All collected species belong to five genera of family Lumbricidae. They represent new records for the studied area but not for Iran. These are namely: Aporrectodea caliginosa, A. jassyensis, A. rosea, Dendrobaena byblica complex, D. hortensis, D. veneta, Eisenia fetida, Eiseniella tetraedra, and Helodrilus patriarchalis.

S.Ezzatpanah, R.Latif and M.Malek studied earthworm fauna of the western Mazandaran province of Iran. Samples were collected in wet soil, in leaf litter under forest canopy, under logs and stones, under dead tree barks as well as in rotting logs and decaying plants. The following ten species belonging to six genera and two families were identified: Aporrectodea caliginosa, A. jassyensis, Dendrobaena byblica complex, D. hortensis, D. octaedra, D. veneta, Eisenia fetida, Eiseniella tetraedra, Perelia kaznakovi (family Lumbricidae) and Amynthas corticiscortices (family Megascolecidae). Among these species E. tetraedra represents a new record for the studied region.

The same authors have studied the earthworms of the Central Alborz Mountains of Iran. Species richness of earthworms in the Central Alborz Mountains was studied for the first time. Specimens were collected by hand sorting method (this method involves digging up soil samples and sorting of these by hands) and by a chemical method (applied was 15 liters of 2 % formalin solution per 1 m^2 of soil). In this study earthworm samples were collected from 37 different localities distributed along the Haraz and Chaloos Rivers in the Central Alborz Mountains. Species identification was confirmed at the Hungarian Natural History Museum, Budapest. Twelve earthworm species were identified representing seven genera from family Lumbricidae. The species richness is not equally distributed in the genera. From the most speciose genus, Dendrobaena, four species were recorded. All collected species were deposited in the Zoological Museum, University of Tehran. The recorded species were: Aporrectodea caliginosa, A. rosea, A. jassyensis, Dendrobaena byblica complex, D. octaedra, D. hortensis, D. veneta, Dendrodrilus rubidus, Eisenia fetida, Eiseniella tetraedra, Octolasion lacteum, Perelia kaznakovi. All the recorded species were common and Eiseniella tetraedra was the dominant species in both studied areas.

Earthworms of the Azarbaijan and Ardabil Provinces in Iran has been stadied also. Samples were collected by digging of soil and by pouring of 4% formalin solution on the soil surface. The earthworm specimens were firstly transferred to 75% ethanol, after 24 hours they were preserved in 4% formalin for a few days, and then permanently fixed in 75% ethanol. Identification was carried out by using external and internal diagnostic characters as described in the book «Earthworms of Hungary». The nine identified species represent six genera of family Lumbricidea. The dominant species in both areas are Aporrectodea rosea and Ap. caliginosa. Other recorded species are: Aporrectodea longa, Ap. jassyensis, Ap. rosea, Ap. caliginosa, Dendrobanea veneta, Dendrodrilus rubidus, Eisiena fetida, Eisienella tetradera, and Octolasion lacteum. Discussed is the geographical distribution of species according to latitude and according to habitat types.

Identification of Oligochaeta species in the Sari Township in Northern Irann has been analysed by M.Ramezani and others in 2008–2009. The following five species were identified: Eisenia fetida, Dendrobaena byblica, Allolobophora caliginosa, Allolobophora kaznakovi and Allolobophora jassyensis. Interspecific statistical significance ($p<0.05$) was reached in body weight, body length and number of segments. Allolobophora caliginosa was heaviest, longest and possessed the highest number of segments. This study also showed that the most dominant species in the Sari township with 34.8 % amplitude (120 specimens) was Eisenia fetida.

The earthworms of Crete have been investigated by J.C.Kunle. The long lasting land use of more than 6000 years from the Pre-Minoan civilizations until now led to an extreme degradation of origin soils and

vegetation so that it is now hardly possible to demonstrate the origin conditions. This situation is even more reflected by the earthworm fauna. The earthworm fauna is poor and dominated by ubiquitious species. This is in contrast to other animal groups (resp. insects) and also to plants. A point of main effort is led to the biotops of the higher altitudes, sites of extreme conditions in winter as in summer time, where the stature of plants is dominated by cushions and thorny cushions, a vegetation which has comparative conditions in the higher altitudes of the Anatolian mountains or even in Iran and Afghanistan. The aspect of land use and earthworms in the different vegetation types of Crete will be discussed and on selected examples of cultivated land it will be demonstrated that the existance of earthworms and even a higher abundance/production of them is more a question of soil management than of a deficiency of suitable environmental factors.

The summary of past and present faunistic studies on the Turkish earthworm fauna provides interesting results. So far, 75 earthworm species were acknowledged for Turkey. Distribution of Anatolian endemic species in Turkey has been presented by M.Misirlioglu. There were five species (7 %) belong to the introduced families Criodrilidae, Megascolecidae and Acanthodrilidae, and 70 species (93 %) are from the autochthonous family Lumbricidae there. Twenty-seven lumbricid earthworms (39 %) are regarded as Anatolian endemics, i.e., their occurences are limited to the Anatolian region in Turkey. As expected, the endemism is not distributed equally all over Anatolia. The level of species endemism is decreasing from northern Anatolia (16 species, 23 %), through the Anatolian part of the Marmara region (eight species, 11 %), Inner Anatolia (five species, 7 %), the Mediterranean region (four species, 6 %), the Aegean and the eastern Anatolia regions (two species each, 3 % each) up to south-west Anatolia and the Thracian part of the Marmara region (no endemic species recorded). However, some of the mentioned endemic species might have wider distributions. A more detailed investigation is needed. Plate tectonics may certainly play an important role in the observed differences in species distribution. In overall, the ecological factors might be more important for explaining the present-day earthworm distribution patterns than tectonics because almost all regions of Anatolia had different climatic conditions and different types of vegetation.

Generalization of results of research of biodiversity of earthworms in the Middle East has been made by T.Pavliček and others. There were eighty-one species and 85 species and subspecies of earthworms are known from Turkey, Iran and the Levant including Cyprus there. They belong to the autochthonous Palearctic families Lumbricidae and Criodrilidae, and furthermore to the introduced families Acanthodrilidae, Megascolecidae and Ocnerodrilidae. In the Middle East (ME), the archaic genus Spermophorodrilus of the presumed Maastrichtian origin and the ancient genera Cernosvitovia and Eophila are limited to the Pondites. However, evolutionary advanced genera, such as Dendrobaena and Perelia, are widely spread. In the ME 16–17 species (20–21 %) have been introduced and the rest (64–65 species) are autochthonous ones, from which 37 species (57–58 %) are endemic. The high level of endemism is confined to the following originally separated tectonic plates: the Levant, the Pondites, the Sakarya continent, Kırşehir and the East Taurus Blocks. The unexpectedly rich earthworm fauna in Cyprus is probably the result of the unique colonization event during the Messinian Salinity Crisis Period. Adaptive radiation resulting in endemism has been observed mainly in the originally arboreal genera Dendrobaena, Eophila and Healyella whose developed ability to dig into compact soils and colonize deeper soils layers was presumably a reaction to the progressively increasing aridization.

In several works the biodiversity of earthworms of the African continent has been presented. The ecological demography study of the earthworms population at «Oued Righ» a place located in the Sahara in the area of Touggourt — Wilaya of Ouargla — and their ecology enabled us to reveal the presence of earthworms which was unknown until nowadays. Two palm groves were selected for the study by G.Ouahrani and others. They took out 45 samples from each place. There were determined the physical and chemical parameters of the soil, the earthworms density and biomass, the percentage of plant cover as well as the biomass of the herbaceous stratum there. The obtained results show: a silty texture, a low moisture, a mean porosity, neutral pH, a weak salinity, a weak limestone level, a mean CEC and a well decayed organic matter. Furthermore, the taxonomic study has revealed the presence of two earthworms species Aporrectodea caliginosa and Ap. rosea. The average earthworm density is of 600 ind/m^2 and their biomass is of 92 g/m^2. The more or less homogeneous plant cover is predominated by date palms. The mean plant cover is of 35 % and the plant biomass of the herbaceous stratum is of 517 g/m^2. The analysis of variance (ANOVA) revealed important variabilities between the two palm groves since the measured parameters and their soils are very heterogeneous.

A review of the South African endemic Proandricus lesothoensis species-group (Oligochaeta: Microchaetidae) has been made by J.D.Plisko. Nine species of fifty-four endemic South African proandric microchaetids accredited to the Proandricus lesothoensis species-group were studied. The group was characterized

by the location of their spermathecal pores in the testis furrow (10/11) with additional pores anterior to testis segment (9, or 9/10, or 9 and 9/10). These species reveal also some differences in the arrangement of setae. Although noted distribution of studied species point to limited part of Drakensberg mountain range, the list of the known species is almost certainly incomplete.

Hot-spot regions of earthworms in western Uttar-Pradesh of India have been investigated by S.M.Singh, O.Prakash and others. The study was conducted in agricultural lands of western Uttar Pradesh state of India from 2006 to 2008 in three different seasons to identify hot-spot regions of the earthworms. Seven species of earthworms' viz., Metaphire posthuma (Vaill.), Megascolex mauritii (Kinb.), Perionyx excavatus (Perr.), Eutyphoeus waltoni (Mich.), E. gigas (Steph.), E. paivai (Mich.) and E. pharpingianus (Mich.), belonging to four genera of Megascolecidae family were identified. During rainy season, the maximum density of earthworms was recorded in Bareilly region and the minimum in Meerut; while their diversity was observed more in Agra region and less in Saharanpur. Density and species diversity of worms was counted the maximum in Bareilly region and the minimum density in Saharanpur during peak winter months. However, least diversity of worms was found in three regions (Agra, Meerut and Saharanpur) of the state during the season. In summers, both density and diversity of earthworms were higher in Bareilly region but their density was less in Saharanpur. Interestingly, least diversity of earthworms was noticed in Moradabad and Meerut — two regions of western state with three different species. Results of the taxonomic work indicated that Bareilly region of the western Uttar Pradesh state was a hot-spot for the maximum density of earthworms in all the seasons of the year; while Agra region was a hot-spot to have worm's maximum diversity during rainy season. Variations in density and diversity of worms in different regions were also discussed.

Problems of narrowly local endemic fauna have been considered in several works. For example, I.Kaygorodova has presented the material about taxonomical diversity of Oligochaeta in the Baikal region (East Siberia, Russia). There has been discussed by Oligochaeta predominate in all depths and ground types. It was currently known that Baikal hosts 209 oligochaete species, more than 80 % of them are endemic.

The significance of the Apuseni Mountains (the Carpathians) in the origin and distribution of the Central European Earthworm fauna have been examined in Cs.Csuzdi's and V.V.Pop's work. The earthworm fauna of these mountains is very rich in species, most of them being narrow endemics. Till now 38 Lumbricidae taxa are known from the Apuseni Mts., of which 20 are found exclusively there. This high number of local endemism is in accordance with the tectonic history of the region. In the southern part, with patchily distributed limestone areas, an accelerated insular-like speciation resulted in many endemic large-bodied Octodrilus species. In the northern volcanic part, other endemics such as Dendrobaena sp. n. and Allolobophora prosellodacica were found. These species showed an allopatric distribution with their Carpathian vicariant sister species D. attemsi and A. sturanyi dacidoides respectively. The origin of such Apuseni–Carpathian species pairs is possibly due to the Parathetys transgressions which isolated the Carpathians from the Apuseni Mts. for a long time. After final retreat of the Parathetys from the Carpathian Basin some species with larger dispersion capabilities such as Dendrobaena clujensis, Allolobophora sturanyi dacica, Allolobophora mehadiensis etc. migrated to hilly and plain habitats at lower altitudes and form what was presently described as the Dacian faunal element. The high number of endemic species, as well as their area patterns place the Apuseni Mts. as a hot-spot of lumbricid diversification and distribution in Central Europe.

There are about 220 species of lumbricids in the world, of which 19 are common in Europe and 13 in Estonia. Species of the family Lumbricidae, particularly the genera Lumbricus, Aporrectodea, Allolobophora, Eisenia, Eiseniella, Dendrobaena, Dendrodrilus, Bimastos, Octalasion have been spread by man in northern and western Europe and they became dominant earthworms in agricultural lands. The European fauna has been presented in A.Kuu's and M.Ivask's work about the distribution of Octolasion cyaneum (Savigny 1826) in Estonia. Mustard solution as a vermifuge and the hand sorting method were used for collecting the earthworms. The collected earthworms were counted and identified; the mean number of individuals in 1 m^2 of the soil surface and the standard error were calculated for each studied area. The endogeic species O. cyaneum was found in Tallinn Botanic Garden (north Estonia) in Estonia for the first time in 1993. From that time, there have been many changes in the distribution of this species over the past 10 years. A few individuals of O. cyaneum were found in two areas in north-Estonia (Padina, Kuusiku) in 2003. The increase in the number of O. cyaneum in the earthworm community in Kuusiku Experimental Centre was evident in 2004–2008. The fourth place where O. cyaneum was recorded in 2008 was in the soil of natural grassland in west-Estonia (Vigala). It cood been concluded that the species O. cyaneum is slowly expanding in the Estonian territory, mostly in north- and west-Estonian clay soils.

The species of the European fauna were investigated by A.Rozen and R.Myslajek in Poland also. The study was conducted in Siemianice, central Poland. In 1970–71. 53 study plots were established (20 x 20 m)

by clear-cutting of an 81-year-old pine forest, and planted as monocultures of 14 tree species: Abies alba, Acer pseudoplatanus, Acer platanoides, Betula pendula, Carpinus betulus, Fagus silvatica, Larix decidua, Picea abies, Pinus sylvestris, Quercus robur, Tilia cordata, Pinus nigra, Quercus rubra, Pseudotsuga menziesii, 3 or 6 repetitions for each. During 34 years of monoculture growth, the soil chemical conditions, ground flora composition and litter decomposition rates differentiated strongly between some trees species.In October 2008 earthworm communities were checked in selected tree monocultures: Quercus robur, Larix decidua (every monoculture in 6 repetitions), Picea abies, Pinus sylvestris, Tilia cordata (every monoculture in 23 repetitions). On every sampling occasion and on every study plot earthworms were sampled by using mustard method from area of 0,5 m^2. Species composition in studied monocultures was poor. There were found only three earthworm species: Lumbricus terrestris, Dendrobaena octaedra and Dendrodrilus rubidus. Species composition, density and biomass in monocultures in relation with tree species, plant cover and soil conditions were discussed.

Methods of industrial cultivation. The problems of industrial cultivation of earthworms have been considered in work S.Bharty and S.Shweta about the design for criteria for high cost effective simplification of fast-paced vermireactors based on epigeic earthworms. By doing away with the conventionally used elaborate vermibed, which used to take up ~5 % of the vermireactor volume in the conventional systems, they have effectively increased the usable fraction of the reactor volume, thereby enabling a much higher feed throughout per litre of the reactor. One year long operation of the conventional and the modified vermireactors in two concurrently run batches —one operating at low density of Perionyx excavatus and the other in the high-rate mode — revealed that vermicast production per litre of reactor volume in both batches of modified reactors was dramatically higher than the output in the corresponding conventional reactors.

Toxicological methods. Influence of environmental contamination by heavy metals and herbicides on a population of earthworms was discussed in some works. The paper of N.Arslan and others is to investigate the concentration of boron in soil and in earthworms (Eiseniella tetraedra) collected from five sampling sites at different times during the year 2008 from the surrounding Kırka county of Eskişehir. Because the adsorption of borates to soils is controlled by the presence of aluminium and iron, earthworms and soil samples were also analyzed for the presence of aluminium and iron. The results showed that earthworm samples accumulated more boron than soil and that at five sampling sites aluminium and iron were present in soil at relatively high concentrations.

To explore the effect of exposure to commercial herbicide (butachlor) on the life history parameters (biomass, clitellum development and cocoon production) and the histological changes in the earthworm have been considered by M.Gobi and others. The dried cow dung was contaminated with 0.1554 mg kg–1, 0,3108 mg kg–1 and 1,5540 mg kg–1 of butachlor based on the LC 50 value, and a control was maintained. The mean earthworm biomass was found to be decreased with increasing herbicide concentration. Similarly, cocoon production was also reduced by the increasing herbicide concentration. All earthworms in the exposed group were found to have glandular cell enlargement and to be vacuolated. The effect of the herbicide butachlor can be assessed by the histological observation of the intestinal region, as evidenced by glandular cell enlargement at all the exposed concentrations, which may massively affect food intake and which in turn may indirectly inhibit the earthworm reproductive capacity.

Method of the analysis of DNA. In many researches it is necessary to summarize the anatomy morphology and molecular data on both, try to find a place for species among the taxa. The parthenogenetic/clonal spp-complex of earthworms has snowballed to >60 names, and its resolution yet remains the hottest, most pressing and seemingly intractable problem in Oriental (and Cosmopolitan!) earthworm systematics. Reproductive structures, morphometrics, colouration or intestinal caeca characterizations are largely defunct. And molecular/phylogenetic ‘solutions’ are utterly meaningless without DNA analysis of Types (or Neotypes from type-localities) in strict chronological priority required by ICZN.

The Indian subcontinent is rich in earthworm fauna, with about 506 known species belonging to about 65 genera. Nine families — Moniligastridae, Criodilidae, Lumbricidae, Glossoscolicidae, Almidae, Ocnerodrilidae, Acanthodrilidae, Ochtochaetidae and Megascolecidae, are known in the Indian subcontinent. Though majority of the forms have specific habitat preference, a few ubiquitous species also occur. It is therefore, important to critically assess existing diversity in Indian earthworms by using molecular tools like 18S rDNA and amplified rDNA restriction analysis (ARDRA), which has been lead by M.Gobi and P.Gunasekaran. The small subunit of ribosomal DNA (18S rDNA) was amplified and sequenced. One of these consists of amplification of the 18S rDNA-gene followed by separate restriction digestions with different restriction enzymes. This yields restriction patterns which in combination result in ARDRA profiles

which enable differentiation between species. This approach could be applied for the confirmation of all earthworm species and subspecies.

Using the sequences of the mitochondrial cytochrome c oxidase subunit1 (COI), 16S rRNA and 12S rRNA and the nucleus internal transcribed spacer (ITS) and 28S rRNA, S.James and others attempted to revise the systematics of Pheretima complex speciose group. The results showed some highly supported clades that were not observed in previous phylogenetic analyses. In addition, phylogenetic resolution increased with the increasing gene number analyzed. These results suggest that more taxa should be sampled and longer DNA sequences should be used before a preliminary revision of the Pheretima complex can be made. The is a group of earthworms in the Megascolecidae. Its distribution is in northeast Australia, Pacific islands, and East and Southeast Asia, including Indonesia and the Philippines, with approximately 30 cosmopolitan species and more than 900 nominal species within 13 genera.

To demonstrate the usefulness of DNA barcodes in earthworm taxonomy C. -H Chang and others made an analysis using the mitochondrial cytochrome c oxidase subunit 1 (COI) sequences of the Pheretima complex (Clitellata: Megascolecidae). In this analysis, the monophyly of most species was supported; levels of sequence variation are appropriate for species separation but not suitable for interspecific phylogenetic reconstruction. In addition, several new species were discovered, and some previously proposed synonyms were supported or rejected. Finally, we showed that the integrative approach that combines morphology and DNA data might facilitate the discovery and description of new species.

Other example — use of this method for studying of fauna of New Zealand. In New Zealand, 173 endemic earthworm species were described by K.E.Lee in 1958. Only minor revisions have occurred since this date. A restoration ecology project in the West Coast region of New Zealand is interested in rehabilitating the local fauna of endemic earthworms after mining activities. Species identification is performed by morphological analysis (following Lee's taxonomic key) and DNA analysis (using the mitochondrial 16S gene) by S.Boyer and others. A thousand individuals have been collected, of which only 5 % were adults. Preliminary results revealed the existence of at least 11 undescribed species in a small sampling area (2600 ha). These results emphasize the potentially high diversity of endemic earthworm species that may exist in New Zealand, particularly in undisturbed remote areas and this probably reflects the high rate of specialization of these species. Because most collected individuals were juveniles and keys are based only on adults, part of this diversity would have remained undetected without DNA analyses of juveniles. From an ecological point of view, the use of molecular techniques for invertebrate species identification is becoming indispensable to maximize information obtained from each sample. This approach minimizes sampling effort and population disturbance.

Genetic, morphological, physiological and histologic methods. The investigation of genetic structure of diploid-polyploid earthworm taxa in the fauna of Ukraine was done by A.V Garbar and others with means of biochemical gene marking, karyotyping and accompanied by the analysis of morphological changeability.

Aporrectodea caliginosa — A. trapezoides. A. caliginosa — diploid (2n =36) amphimictic species distributed in the whole territory of Ukraine, except the southern steppe zone, and of the Crimea.

Parthenogenetic A. trapezoides is characterized by a triploid set of chromosomes (3n = 54) and a polyclonal structure. Among 242 individuals 29 clones are registered. The species is distributed in the whole territory, but its abundance dominates in number in the South and in the steppe regions of Ukraine. Papilles location and pigmentation play a key role in the discrimination between two species only after taking into account peculiarities of the different clones.

A. rosea. Among individuals of this species di- (2n = 36), tri- (3n = 54), hexa- (6n = 108) and octo- (8n ≈ 144) forms are registered. The triploid form is dominating. The species is polyclonal with a very high level of clone diversity. Among 224 individuals 96 clones are identified, 67 of which are represented by a single individual.

Octolasion lacteum. At least 18 cryptic genetically different biotypes are registered. In the northern and central parts of Ukraine two polymorphic symbiotopic reproductively isolated forms dominate. These two forms make about 90 % of the investigated individuals that differ in fixation of alternative alleles of non-specific esterases. They are characterized by a subtriploid set of chromosomes (2n+x = 38) and by an anomalous spermatogenesis going on with a chromosome number smaller than a haploid one. At least 10 subtriploid probably clone forms are found mainly as single individuals. In the south of the steppe zone of Ukraine only clone forms having according to the karyological analysis of the earthworms in Crimea triploid genome structure (3n = 54) are registered.

Octodrillus transpadanus. South-eastern populations have clonal structure. Two main forms are identified differing in isoenzyme spectra, having heptaploid set of chromosomes (7n ≈ 105). Western (the

karyotype is not stable, the chromosome number varies from 3n = 45 to 4n = 60) and south-western (2n = 30) populations are characterized with exceptionally high level of genetic polymorphism. In some cases it was impossible to find two individuals with the same spectra. The earthworms in the Crimea (4n = 60) have no clonal structure. They are characterized with specific for the species alleles of enzyme loci and have obvious morphological differences from continental forms. Similar results have been obtained also on other numerous polyploid species of earthworms (Eiseniella tetraedra, Dendrodrilus rubidus and Dendrobaena octaedra).

The variations in size and coloration of the body, as well as the number of seminal vesicles were observed and contrasted with the different species races which are showing significant differences in ecology. The morphometric analysis of 326 specimens of Dtndrobaena schmidti, done by I.Rapoport with means of the statistical program «Statistica-6», give us an opportunity to identify the main morphological features of the three morpho-ecological groups of species. Results showed that anecic, epigeic and endogeic morpho-ecological forms of D. schmidti, resulting from the wide adaptive radiation of species, are different in size and shape of the body, as well as in the presence and patterns of pigmentation. These differences are related with the depth and stratification of the soil profile and with the corresponding food preferences of each of the above mentioned forms. Morphological polymorphism of D. schmidti can be explained by the genetic heterogeneity at the population level. Different ploids may populate various ecological niches within the same biotope especially in mountain localities where they are exposed to a broad range of environmental conditions.

The morphoecological differentiations between species of Lumbricidae have adaptive character. The contractive activity of earthworms visceral muscles was studied by V.Abukenova. The results have shown that parameters of spontaneous contractive activity of smooth muscles of earthworm guts are related to the species life characteristics in biocenosis. These parameters are stable characteristics of species which are adapted to consumption of certain types of food resources in natural habitats.

The earthworm Octodrillus complanatus (Lumbricidae) could be used as a bioindicator in ecotoxicological testing. According to previous studies by E.Vavoulidou the collagen of this earthworm is similar to the vertebrate and mammalian one. The main objective of the project was the histological description of O. complanatus and determination of the collagen distribution in its tissues. The histological study was carried out by means of the hematoxylin-eosin staining in paraffin sections. The distribution of collagen was examined by histochemical techniques: CAB and Trichrom masson. The paraffin sections were examined by a light microscope after staining and the internal organs of the earthworm (alimentary canal, nervous, excretory, circulatory and reproductive systems) were described. According to the above results and according to the histological examination of the cuticle of the earthworm and the connective tissue of its internal organs, most of the collagen was detected in the cuticle, in the muscles under the epidermis and in the nervous system.

It is obvious, that oligochaeta (few-bristled worms) is an extremely important taxonomic group in aquatic and terrestrial ecosystems. In spite of their importance, oligochaeta did not receive during the 19th and 20th centuries the attention they deserve, probably due to their hidden mode of life, their inconspicuousness and unattractiveness as well as the agriculture and aquaculture over-reliability on fertilizers and pesticides.

There are presently some serious deficiencies in the knowledge about their taxonomy, distribution, biology and ecology. One way to bridge this gap is to bring together scientists working on the subject with the aim to speed up information about the progress in their work, exchange ideas and encourage them to cooperate. This was the basic idea in the organization of the 4th International Oligochaeta Taxonomy Meetings.

The list of the literature

1. The 4th International Oligochaete Taxonomy Meeting (20–24 of April): Abstracts / Diyarbakır. — Turkey, 2009. — 47 p.