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CONTENTS

DAN MUNTEANU PhD
(June 2, 1937 – February 25, 2017)

A life dedicated to the protection of nature and environment

Dan MUNTEANU's great flight towards the unknown high world of birds and stars

Dan Munteanu PhD passed away on the 25th of February 2017, a very special personality, corresponding member of the Romanian Academy, chairman of the *Commission for the Protection of Natural Monuments* (CMN), member of the editorial staff (assistant of the editor-in-chief) of the scientific journal *Romanian Journal of Biology – Zoology* and of other periodicals, researcher – exceptional biologist and ornithologist, well-known in the Romanian scientific world of the lovers of nature for more than half a century.

In 2017, his colleagues, friends, acquaintances, all those who knew and appreciated Dan Munteanu, organised his 80th anniversary, paying homage to his life and scientific work, to his efforts for protecting nature in Romania. There were three months till the anniversary session, but "time had not been patient" and the session became posthumous.

We received with much regret and deep sadness the news of the disappearance of our colleague and a lifetime friend, Dan Munteanu, after unbearable sufferings. It is a great loss for the Romanian biology in the important fields covered by his restless activity.

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Dan Munteanu was born in Cluj, where his father, Dr. Didi Munteanu was a paediatrician, Professor at the Faculty of Medicine and director of "Casa Copilului" ["The Child's House"] institution, and his mother Maria Cupcea was a well-known artistic personality, songwriter, actress of the National Theatre of Cluj within the period 1949–1955, also director of this institution. He had deep Transylvanian roots, being, after his mother, descendent of a famous family of Greek-Catholic priests and professors of Maramureş, nephew of the vicar Petru Cupcea, of Şimleul Silvaniei, and after his father, grandson of the orthodox martyr priest in Huedin, Aurel Muntean.

Primary and gymnasium studies were attended at "Ioan Bob" School in Cluj, the oldest school in the Romanian language teaching of the city. After graduating from "Emil Racoviță" High School of Cluj, Dan Munteanu attended the Faculty of Natural Sciences, Department of Biology of "Victor Babeş" University of Cluj (1959).

Since his childhood he loved the birds of the sky... he loved them with his mind and soul and had moments of unique satisfaction while watching their serene flight towards heights or their intimacy in nests and hiding places, feeding places... He also was a passionate hunter, but his passion for hunting was triggered by his desire to be in the midst of nature, to observe the behaviour of the living world, not to kill.

He ascended the stages of affirmation by himself and confidently, based on an in-depth knowledge of nature and especially of the world of birds, whom he loved deeply since his childhood, and he was attached to it for ever, becoming one of the outstanding Romanian scientific personalities in ornithology and protection of nature.

At the beginning of his career he worked as a Scientific Researcher, for a period of time being also director of the "Stejarul" Biological, Geological and Geographical Station at Pângărați (Neamț County), an institution under the patronage of "Al. I. Cuza" University of Iaşi. Being a rich and varied floral and fauna region the Pângărați settlement area gives the young researcher the idea of reflecting on the choice of the theme of the PhD thesis – "Avifauna of the mountain basin of the Moldavian Bistrița". Dan Munteanu presented his PhD thesis in Bucharest in 1969, being highly appreciated for his contribution to biology and bird migration, for ornithogeographical, systematic and ecological novelties.

His scientific debut was marked by the publication, in 1963, in collaboration with I. Boisteanu, of the paper *Observații asupra componenței avifaunei bazinului mijlociu al Bistriței* ["Observations on the composition of the Bistrița midwater basin"] in Comunicări de Zoologie journal, followed by the publishing, in 1965, in Travaux du Museum d'Histoire Naturelle "Grigore Antipa" of the paper *Trois années d'observations ornithologiques sur le lac de barrage Bicaz*. He published a series of articles in Lucrările Stațiunii de Cercetări Biologice, Geologice şi Geografice "Stejarul" ["Stejarul" Biological, Geological and Geographical Research Papers], in Sesiunile ştiinţifice ale Muzeului de Ştiinţele Naturii din Bacău ["Scientific Sessions of the Museum of Natural Sciences in Bacău"], in Nymphaea Journal – Folia Naturae Bihariae, Acta Musei Porolissensis – Museum of History and Art in Zalău and in the Information Bulletins of the Romanian Ornithological Society.

In 1973, he came back to Cluj, as a Senior Scientific Researcher in Biological Research Center in Cluj-Napoca.

After 1989, Dan Munteanu PhD initiated a new orientation in Romanian ornithology and became the founding President of the Romanian Ornithological Society (S.O.R.), a solid non-governmental scientific organization with multiple achievements at national and international level, at the same time becoming a member of the Executive Board of *International Waterfoul and Wetland Research Bureau* (headquarters in the United Kingdom). S.O.R. was included in the European network of the societies of bird protection coordinated by *Bird Life International*. Therefore, the president-founder of S.O.R. was implied in the elaboration of several Europeans projects on the bird knowledge and protection in South-Eastern Europe.

In 1999, he was appointed Corresponding Member of the Romanian Academy.

In recognition of his scientific merits and contributions, Dan Munteanu PhD received "Emil Racoviţă" Award of the Romanian Academy (in 2007, for his scientific papers of 2005), and in 2013 he received Diploma "Meritul Academic", for his scientific activities of 2011.

Aware of the environmental problems in our country, Dan Munteanu was recommended by the late Acad. Nicolae Botnariuc to follow him in the position of a great responsibility – the chairman of the Commission for Natural Monuments Protection (CMN). Within the period 2000–2017 he honored this function with great honour and competence, having a complex activity and contributing to solutions for several problems, materialized in important contributions to the good functioning of the system he was leading:

- the organization and functioning of CMN, including the development of regulations and legislation acts;
- coordinating the activity of the Scientific Councils of the natural and national parks;
- substantiating the declaration of new protected areas;
- developing realistic solutions for biodiversity conservation and protection of the natural heritage;
- analyses and opinions concerning numerous requests for works of national interest with a potential impact on the environment, exploitation of natural biological resources, works or constructions in protected areas, ecological restoration works and afforestation, collaborating in this respect with different biodiversity conservation bodies from the Ministry of Environment and the National Forestry Authority (RNP). He also contributed to structuring in Romania the network of NATURA 2000 protected areas, following the European model of this type of network.

Dan Munteanu was a member of the Editorial Staff of several scientific journals such as: *Romanian Journal of Biology-Zoology* (Deputy Editor-in-Chief), Academic Collection *Fauna României* ["Romanian Fauna"] (Deputy Editor-in-Chief), *Travaux du Museum National d'Histoire Naturelle "Grigore Antipa*", *Oltenia Journal for Studies in Natural Sciences.*

Besides his ornithological research, Dan Munteanu was the scientific adviser of several young doctoral students whom they closely followed and gave him all the confidence in the elaboration of doctoral theses at the Doctoral School of Biology at "Babeş-Bolyai" University in Cluj.

Dan Munteanu PhD left us, as an inheritance, the memory of a model of man, researcher, close colleague, a good Transylvanian Romanian by conscience and faith, a man of hope, a modest, quiet one, who also knew what good jokes were. Also, Dan Munteanu left us, as an inheritance, the Ornithology Society of Romania which he founded, being its President, including it in international structures and around which he mobilized all bird lovers in the country. And he left us his work of reference, such as:

- *Aves*, in *Fauna României*, Vol. XV, Fascicle 2 (Galiformes and Ciconiiformes), Romanian Academy Publishing House, Bucharest (2015);
- *Conspectul sistematic al avifaunei clocitoare din România* [Systematic summary of the hatching avifauna of Romania], Alma Mater Publishing House, Cluj (2012);
- *O istorie a nomenclaturii zoologice* [A history of the zoological nomenclature], 2nd edition, Alma Mater Publishing House, Cluj-Napoca: 157;
- *Păsări rare, vulnerabile şi periclitate în România* [Rare, vulnerable, endangered birds in Romania], Alma Mater Publishing House, Cluj (2009);
- *Păsările din România şi Europa* [Birds of Romania and Europe] (Hamlyn Guide – Romanian edition) (Romanian Ornithological Society, 1999);
- *Păsări* [Birds], chapter in *Red Book of the Vertebrates of Romania,* Academia Română Publishing House, Bucharest (2005);
- *Arii de importanţă avifaunistică din România – Documentaţii* [Areas of avifaunal importance of Romania – Documentations], Alma Mater Publishing House, Cluj (2004);
- *Atlasul păsărilor clocitoare din România* [Romanian hatching bird atlas], in Publicaţiile Societăţii Ornitologice Române/2002 [Publications of Romanian Ornithological Society], Cluj-Napoca: 16.

In the series of publications of the *Romanian Ornithological Society* he published two editions (1997 and 2000) on *Etimologia numelor ştiinţifice ale păsărilor din fauna României* [Etymology of Scientific Names of Romanian Birds], as well as three editions (1992, 1998 and 2001) of a *Dicţionar poliglot al speciilor de păsări din România* [Poliglot Dictionary of Bird Species in Romania]. After his own confessions, the idea of printing this dictionary came to him at the ornithological camps organized by S.O.R. in Istria, where youngsters from Romania, Hungary and Germany could hardly communicate, because of the lack of a common language of scientific names. That is why, besides scientific names, the author also mentioned vernacular names in English, French, Romanian, German and Hungarian.

Also, Dan Munteanu PhD was the author of the book *O istorie a nomenclaturii zoologice* [A History of the Zoological Nomenclature] (1999) – a history of the development of the animal nomenclature from antiquity, the Middle Ages, to the *International Code of Zoological Nomenclature of the International Commission on Zoological Nomenclature*.

There were many more projects to be carried out, including the coordination of a new fascicle on the Aves Class (in the Romanian Fauna Series), a project that will be continued by the younger ornithologists.

Considering both the important scientific and social achievements and the valuable projects remaining on his desk, the biological scientific community in the country and abroad has remained poorer, without the MAN Dan Munteanu, a model of fairness, morality, generosity and modesty – a lovable mentor respected by many young ornithologists, whom he encouraged and supported unconditionally.

We all thank our beloved colleague and friend for everything he left us. Those who have known and appreciated you, those you collaborated with, those who have been your colleagues in the passage of time will proudly keep you in the pantheon of their mind and heart as one of the remarkable personalities with whom they were contemporaries. Your flight to the heavens was a great sorrow to us, but this is the way of life!

Our sincere sympathy to his beautiful family that he was so attached to.

Farewell, Dan Munteanu!

Prof. Dr. Marian – Traian GOMOIU, Member of the Romanian Academy
Dr. Dumitru MURARIU, Corresponding Member of the Romanian Academy
Dr. Sanda MAICAN, Institute of Biology Bucharest of Romanian Academy

P.S. Biographical data and photos after: **CORNEANU Mihaela, CORNEANU C. Gabriel, 2017 –** Dan Munteanu, PhD. Correspondent member of the Romanian Academy – a life dedicated to ornithology. Muzeul Olteniei Craiova. Oltenia. Studii şi comunicări. Ştiinţele Naturii. Tom. 33, No. 2: 207–211.

FLORICA PORUMB PhD
(November 27, 1928 – June 7, 2018)

A life dedicated to the Black Sea zooplankton

In the latter half of the 20th century and at the beginning of our century, an important direction of the Romanian biological oceanography research was dominated by the personality of a lady born and raised in Oltenia, with higher education in Transylvania – in Cluj and with all her activity carried out from youth up to the end of her life at the seaside in Dobrogea. This is Florica Porumb, a passionate explorer of the Black Sea zooplankton, of the myriad of microscopic organisms floating in the mass of water – necessary food for a great many fishes.

Florica Porumb PhD has made her authority felt by the people around her by playing an important role in the scientific community of marine biologist researchers, who do their duty discreetly, competently and devotedly, favourably influencing not only the work, but also the lives of the others. For years on end she served the Marine Institute "Prof. Ioan Borcea" at Agigea (known as Agigea Station), then the Romanian Marine Research Institute, which became the Marine Research Institute "Grigore Antipa" later. From time to time, even after she retired (March 1986), Florica Porumb and her husband, Ioan Porumb, an ichthyologist, former researcher at the same institution, went to visit the laboratories where they worked for a lifetime to see the library again and the former colleagues. As I saw them, from the window of my second-floor lab at GeoEcoMar Institute, a neighboring building, where I was working, they appeared as a classical photo of a stately, self-confident pair with an impeccable, upright posture, walking quietly along the alley which leads to the institute... After visiting the "Grigore Antipa" Marine Research Institute, they used to come to GeoEcoMar Institute. We would have a cup of coffee together, chat about weather, health, about our future plans, news about our former colleagues and, every time, we parted promising to meet again. After Ioan Porumb left for eternity (July 17, 2011), I communicated with Florica Porumb only on the phone. Until one day, when her son answered my call... Mrs. Porumb had left us forever, just the day before, on June 7th, after the sufferings she had boldly and optimistically faced for months, and still at the work table. She would have been 90 years old quite soon...

Florica Porumb (born Bucaleț) came to the world on 27th November 1928 in the town of Caracal, the capital of the former Romanați county, parents being Alexandrina (housewife) and Florea (non-commissioned officer). Her father fought in the World War I at Mărăşeşti and was a prisoner of the Germans, and, between World War I and World War II, he worked as a career officer at the Sibiu military station – then he retired to Caracal; her father being subject to the rigors of the army changed the station, moving with his family from one place to another. Thus Florica Porumb attended the Primary School at Piatra Olt and the high school in Craiova.

After graduating from "*Elena Cuza*" High School in 1947, Florica Porumb became a student at the Faculty of Natural Sciences of the "*Victor Babeş*" University in Cluj, Department of Biology-Zoology, which she graduated with a diploma of merit in 1952. The Professors of the University in Cluj – Vasile Radu, Eugen A. Pora, Emil Pop, Eugen Ghisa, Victor Pop, Marcu Oreste, Ion Ciobanu, Victor Preda and others were renowned scientific personalities, true scholars and patriots; they had thorough training and life experience in downtrodden times – the war and the tearing of the country, and especially, afterwards, the establishment of the communist regime; these Professors formed a team of excellence honoring the institution that had returned from exile and they urged the students to learn thoroughly and acquire knowledge profoundly. In addition to the study and the strong impression that these personalities had on her, she also remembered the harsh winters with shortage of fuel, food shortage and little money, specific to the post-war times.

The future biologist specialist in zoology – Florica Porumb was formed under these conditions.

Steps of affirmation

Immediately after graduating with a diploma of excellence, Florica Porumb was assigned in Bucharest, at "Casa Scânteii", but under the strong influence of her Professors – especially Acad. Eugen Pora, she wanted to embrace a biological research career at the Black Sea. In order to do this, she requested and obtained the modification of the governmental assignment for the Fisheries and Pisciculture Institute set up in Constanța by the new regime. She came to Constanța and was appointed at the young faculty as a principal university lecturer at the Department of Biology, Chair of Hydrobiology, for the period 1952–1953. She lived in the building of the Institute (in a former cell on the first floor – now the Episcopal Palace) in Constanța until 1953. It so happened that, at the Fisheries and Pisciculture Institute, she made the acquaintance of Ioan Porumb – researcher at the Marine Zoological Institute of Agigea and Professor's assistant (1950–1953), collaborator of Prof. Sergiu I. Cărăuşu for the ichthyology courses at the Fisheries and Pisciculture Faculty; the two young people married in Constanța on 2nd March 1953, then Florica Porumb moved to Agigea Zoological Institute, where her husband lived. The Institute was to become for the young scientist, for a long while, a working place and a welcoming home for many scholars from the country and abroad, who came for the summer holidays to the seashore not only for the benefits of thalassotherapy, but also for meeting and discussing present day problems, or experimenting and testing working hypotheses they had previously thought over (Gr. Antipa, C. Antonescu, Al. Borza, C. Brătescu, M. Băcescu, S. Cărăuşu, N. Cosmovici, M. Celan, R. Codreanu, M. Guşuleac, N. Gavrilescu, Constantin Motaş, E. Macovschi, Eugen A. Pora, V. Radu, I. Simionescu, I. Tuculescu and many others). In 1953 she was promoted laboratory chief at the same faculty.

Certified as a junior assistant, Florica Porumb was appointed at the Marine Zoological Institute "Prof. I. Borcea" at Agigea in September 1953, through the decision of the "Al.I. Cuza" University of Iaşi, and she was also a scientific researcher of the Committee of Hydrobiology at the Romanian Socialist Republic Academy for the period 1955–1956. Since 1956 she worked as a scientific researcher at the "Prof. I. Borcea" Marine Research Institute – Agigea, occupying the position of principal scientist (1961–1962) and Head of the Plankton Section (1962–1970). During all these years, Florica Porumb studied the organisms living in the water mass, focusing on the zooplankton qualitative, quantitative and dynamic structure as well as on its role as food for planktonophagous fish; she also carried out a didactic work.

Starting with March 1st, 1970, following the integration of Agigea Station with all its infrastructure and the entire staff within the structure of the newly established Romanian Marine Research Institute (IRCM) in Constanța, Florica Porumb occupied the position of a scientific researcher until 1975, when she became a senior scientific researcher (1975–1987).

On the 1st March 1956, their only child – Dan, was born in the Porumb family, and the work of the two researchers was completed. At the Agigea Institute, where, in those years, in the summertime, remarkable personalities of the Romanian biology came, the child's witnesses to his growing up were: Mrs. and Prof. Pora, Mrs. and Dr. Băcescu, Mr. Mrs. and Prof. Motaş, Mrs. Prof. Necrasov, Mrs. and Prof. Cărăuşu and many others who cultivated special relationships with the Porumb family. Living at the Institute, the Porumbs raised their child as if he were an emblem of the institution and also had the necessary time for their research. After Dan graduated from primary school, the urgent need for more favorable school conditions than those offered by the Agigea General School emerged for the family. In December 1966, the family moved house to Constanța. This environmental change provided Dan with much better conditions for intellectual and social development. The two Porumb researchers kept their enthusiasm for ocean research, although they also they had to commute to and from Agigea Institute... Looking back, it seems odd that their son did not take into his parents' footsteps; maybe he witnessed too much of the vicissitudes of the environment and the hardships of the job. It is difficult to say.

Florica Porumb's scientific authority, long-standing experience in research and her firm character, decisive in taking decisions, and also her impartiality were strong merits in her being appointed Head of the Ecology, Aquacultures and Acclimatization Laboratory of the Romanian Marine Research Institute in Constanța for the period 1977–1979. Throughout this period, she was responsible for research topics and objectives on the knowledge of the zooplanktonic populations in the Black Sea and partly the Mediterranean Sea and the Indian Ocean, the role of these populations as food for planktonophagous fish, and the conservation and protection of the marine environment.

After retirement, she continued her research activity at the Institute for several years, benefiting from access to the resources necessary for scientific projects.

Scientific activity

Imposing on herself a lifestyle based on professional training and self-improvement, Mrs. Florica Porumb obtained, in 1975, the scientific title of Doctor of Biological Sciences at the Institute of Biological Sciences of the Romanian Socialist Republic Academy in Bucharest with the dissertation "***Researches on seasonal dynamics and nictemeral variations of the main species of Copepoda from the Romanian Black Sea waters***" under Acad. Mihai C. Băcescu's scientific coordination. Further on, we will briefly illustrate the scientific activity carried out by Florica Porumb over the years, through the themes she approached and her writings (within brackets – reference to the bibliographic list):

- Structure of zooplanktonic populations – trophology, production of the main components (**37**), (**39**), (**42**). In particular, she studied the composition of the zooplankton in the western Black Sea region by species and by component groups: the dynamics of population development over time (years, seasons, days), nictemeral migration, distribution of zooplankton in the mass of water from the shore to the depth of 200 m;
- Pelagic Copepoda biology – dynamics, fertility, production, productivity (**21**), (**22**). (**23**). (**25**), (**26**), (**27**);
- Zooplankton dynamics in the waters of the Romanian Black Sea continental shelf (**31)**, (**49**), (**50**);

- Zooplankton nictemeral migrations of Copepoda (*Pseudocalanus elongatus*, *Centropages ponticus* and *Acartia clausi*) (**12**), (**13**), (**15**), (**17**);
- Reproduction, development and distribution of pelagic copepoda (**16**);
- Zooplankton – phytoplankton relationships (**28**);
- Long-term dynamics of zooplankton productivity (**36**), (**41**), (44), (**51**);
- Development of zooplankton under conditions of eutrophication (**29**), (**48**);
- Zooplankton living above rock crevices (**18**), (**24**);
- Dynamics of meroplankton (**20**);
- Southern Mediterranean Zooplankton (Libyan coast); between 1975 and 1976, she participated in a Mediterranean Zooplancton Research Program on board the B22 "Delta Dunării" during 3 expeditions in the waters of the Libyan coast (**33**), (**34**), (**35**) (**53**);
- Research in the Western Indian Ocean – R.P. Mozambique (**32**);
- Biochemistry of Cystoflagellat *Noctiluca scintillans* (**46**), (**47**);
- Efficiency of energy transformations in the pelagic ecosystem (**43**);
- New species in the Romanian Black Sea waters (**4**), (**5**), (**9**), (**10**), (**30**);
  - Identification and signaling of two species of parasitic Copepoda – *Modiolicola insignis* and *Septosaccus cuenoti*, in the *Mytilus galloprovincialis* cavity;
  - Adult identification of *Saculina carcini* (Cirripedia, Sacculinidae) – Ecto-parasite Rhizocephala Castratator of Crabs (Decapoda);
  - Identification and description of 4 species of Copepoda from Fam. Monstrillidae, previously unknown at the Romanian seaside;
  - Identification of the *Verruca* (Cirripedae, Pedunculatae) larva, previously unknown;
  - Identification of two species of jellyfish (*Rathkea octopunctata* and *Sarsia tubulosa*).
- The importance of zooplankton for pelagic fish distribution (**40**);
- Zooplankton as sprat food (**38**), (**45**);
- Fish biology – *Trachurus mediterraneus ponticus*;
- History of Romanian marine research (**52**).

Florica Porumb's activity has resulted in more than 70 scientific papers published in specialized journals in the country and abroad. In addition, she participated in a large number of scientific research contracts under the aegis of the institutions for which she worked. Due to the contractual provisions, some of the scientific works elaborated under the contracts were not published, being capitalized and belonging exclusively to the financing units. Starting from the annual and seasonal quantitative data of planktonic biomass, Florica Porumb evaluated the amount of food consumed by fish populations (mostly sprat). This has made it possible to produce fishing forecasts and establish the exploitable quantities of fish without endangering stocks. Based on the zooplankton data, she determined the daily, seasonal and annual feed rations, then the weight gain of consumers, their production and consumption for metabolic needs. The results obtained through these researches also supported further research on fish migration and their trophology, aspects also dealt with by Ioan Porumb, with whom Florica Porumb, colleague and wife, collaborated a lifetime, forming an exemplary family, a model in society.

Among Florica Porumb's most important papers we can count 70 publications: in periodical scientific journals – 54, general culture magazines – 11 and books – 5; 63% of her scientific work as the only author, 19% as the first author, 14% as the second author and 4% co-author, collaborating with a number of researchers, including Ioan Porumb, Teodora Onciu, Adriana Petran, Elena Ialina and others.

She published the first scientific paper in 1956 in collaboration with physiologists, Professors of the "Victor Babeş" University of Cluj – Acad. Eugen A. Pora and Prof. Roşca, together with the ichthyologist Ioan Porumb; the paper encompasses the results of research on the biology of horse mackerel in the Black Sea, the co-author – the young researcher Florica Porumb dealing with the pelagic fish food during a fishing season (**1**).

The papers signed by Florica Porumb PhD in the five books concern the following aspects:

- Integrated pelagic Copepoda study at the Romanian Black Sea waters – PhD thesis (**56**);
- Correlation between the distribution of pelagic Copepoda and heterotrophic bacteria (**57**);
- Black Sea Planktonic Associations – overview (**58**);
- Monograph of the Black Sea horse mackerel (*Trachurus mediterraneus ponticus*) (**59**);
- Development of populations of Cystoflagelate *Noctiluca scintillans* under the influence of the Romanian Black Sea waters eutrophication (**60**).

As the contents of most of the papers published by Florica Porumb have been exposed above, we would like to make only one remark on her history of Romanian marine research, which contains a bibliography of over 3000 titles, being a very useful tool for all those researchers interested in the oceanography of the Black Sea.

Educational activities

In addition to research activities, Florica Porumb took part in the students' theoretical and practical workshops for students (**56**) and guided them during their diploma work.

It is worth mentioning the work carried out by Florica Porumb as a member of the Romanian Naval League and her collaboration with the Marine Culture and Information Magazine "***Marea Noastră***" (Our Sea), founded by Eugen Botez (Jean Bart) in 1932, in which she published 11 scientific articles. She was the sole author of eight papers, and in three papers she signed in collaboration with her husband Ioan Porumb. The subjects they developed are varied and cover the following aspects:

- Plankton in Black Sea waters (**68**), (**62**), (**66**);
- Current status of Black Sea ecosystems (**60**);
- Knowledge of the biology of mammals in the Black Sea through Romanian research (**65**);
- The Black Sea and the ancient world (**64**);
- Portraits of Romanian scholars who studied the marine life (Gr. Antipa, I. Borcea, M.C. Băcescu, E.A. Pora), (**63**), (**67**);
- Historical outline of Romanian marine research in the Black Sea (**61**), (**69**) or the Mediterranean Sea (**70**).

Honour

Florica Porumb PhD was a member of the following national and international scientific organizations:

- *International Commission for the Exploration of the Mediterranean – CIESMM*, a well-known European Organization, founded a century ago at the initiative of a special committee chaired by Prince Albert I of Monaco in 1914, which Romania joined as a founding member in 1925, through the authority of the scientists Emil Racoviță and Grigore Antipa;
- *The CIESM Plankton Science Committee*, Monaco;
- *The Romanian Naval League (LNR)* – established in 1928 as a patriotic, cultural and public utility association, a nonprofit, non-governmental organization (NGO), outside the policies of any party, a forum for all those who love both the sea and the Danube River, and are spiritually linked to maritime and river activities, a means of promoting the Romanian maritime values and traditions, a promoter of marine culture, aiming to develop in society a state of mind, attitudes and mentalities favorable to the navy.

Passing into eternity at a venerable age, Florica Porumb left behind an important scientific work and an example of a model scholar, who honored her profession with honesty and passion, publishing numerous scientific papers, novel pages, ideas and projects in progress. She was among the first researchers in the study of the Black Sea zooplankton, an important dynamic system in Black Sea productivity, greatly affected by global climate change, a system representing the trophic basis of planktonophagous fish. She left behind new knowledge about the Black Sea biology. Turning into account Florica Porumb's work and continuing the marine researches in her direction are necessary. And she also left behind the memory of a well-informed researcher of high professional culture, an optimistic and generous soul.

Prof. Dr. Marian-Traian GOMOIU,
Member of the Romanian Academy

Acknowledgments. Warm thanks to engineer Dan PORUMB for all the biographical data provided with all due consideration.

Works published by Florica Porumb PhD

A. Scientific papers published in periodicals

1. PORA A.E., PORUMB I., **PORUMB F.,** ROSCA D., 1956 – Biologia stavridului din Marea Neagră. Hrana stavridului în timpul unui sezon de pescuit (mai–octombrie 1953). *Analele Inst.Cerc.Pisc. Bucureşti*, **1**: 187–205.
2. PORUMB I., **PORUMB F.,** 1958 – Contributions à l'étude de la biologie des poissons pélagiques en face du littoral roumain de la mer Noire. *Ann.St.Univ. "Al.I. Cuza", Iaşi,* ser.n.sect.2, **4**, *1* : 77–101.
3. PORUMB I., **PORUMB F.**, 1958 – Contributions à l'étude de la biologie des poissons pélagiques en face du littoral roumain de la mer Noire. *An.St. Univ. "AI.I. Cuza" Iaşi*, ser.n., sect.2, **4**, 1: 77–101.
4. **PORUMB F.,** 1959 – *Rathkea octopunctata* (M. Sars), o nouă meduză pentru apele româneşti ale Mării Negre. *Comunicările Acad. RPR*, *Bucureşti*, **9**, *10*: 1037–1040.
5. **PORUMB F.,** 1959 – Asupra prezentei larvei Verruca *(Cirripedae Pedunculatae)* în apele româneşti ale Mării Negre. *Lucr. Ses. St. Stat. Cercet. Marine "Prof. I. Borcea" Agigea*, *Univ. "Al.I. Cuza" Iaşi*: 309–313.
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EFFICACY OF ENTOMOPATHOGENS AGAINST MOSQUITOES *ANOPEHELES MACULIPENNIS* AND *CULEX PIPIENS MOLESTUS* (DIPTERA: CULICIDAE)

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In the recent years, as a result of the increase of anthropogenic influence on the environment, global ecological changes have taken place – climatic rise in temperature, soil erosion, deforestation, desertification etc. We face a rapid increase of pathogenic microorganisms which cause various infections such as malaria, yellow fever, dengue, rift causing great economical damage to many countries. Biological control with entomopathogens can provide a good control of pests, reduce the population of mosquitoes and decrease damage to human health. The efficacy of entomopathogenic nematodes (EPNs) of the species *Steinernema feltiae* and bacterial pesticides: Bitoxybacillin (BTB), Thuringin-2 and Dipel were evaluated in the control of two species of mosquitoes: *Anopheles maculipennis* and *Culex pipiens molestus* in the laboratory conduction. The mosquitoes mortality grew with increase of concentration of bacterial pesticides. On the 5th day with the high concentration of Thuringin-2 and Dipel, mortality rate of insects increased, although it did not reach 100%. The maximum mortality (100%) of mosquito larvae was observed only when exposed to *BTB*. It can be concluded that suspension of entomopathogenic nematodes of the species *S. feltiae* with dose 100 IJs /per larvae showed slight activity (36%–40%), compared with bacterial pesticides toward the larvae of the indicated mosquito species where the mortality ranged between 45 and 100%.

Keywords: entomopathogenic nematodes, bacterial pesticides, *Anopheles maculipennis*, *Culex pipiens molestus*.

INTRODUCTION

Among blood-feeding arthropods as carriers of causative agents of dangerous infectious diseases, mosquitoes have major importance. Mosquitoes (Diptera: Culicidae) are the most important groups of arthropods in medical and veterinary fields. They act as vectors of several diseases such as malaria, yellow fever, dengue, etc. Ecological changes connected with global warming produce an essential effect on the thermal conditions of the biotopes of blood-feeding arthropods. In recent years much attention has been given to the study of carriers of pathogenic microorganisms which cause various infections in men and animals.

South Caucasus (Georgia and Azerbaijan) – is characterized as a zone of great geographic and climatic diversity as well as diversity of fauna migrant and drift birds, bats that may cause significant variations in the virus circulation chain and in the forming of ecological niches for pathogenic agents. This paper will discuss the advances in understanding in the application of entomopathogenic nematodes (EPNs) species *Steinernema feltiae* and bacterial pesticides Bitoxybacillin (BTB), Thuringin-2 and Dipel against mosquitoes: *Anopheles maculipennis* Meigen, 1918 and *Culex pipiens molestus* Forskal, 1775 in laboratory. Generally, application of both pathogens showed encouraging results. The successful widespread use of biological control agents against mosquitoes requires a precise understanding of the ecology of predator/prey and pathogen/host relationships. The opportunistic characteristics of many species, including their ability to take advantage of temporary habitats, coupled with their short generation time, high natural mortality, great dispersal potential, and other R-strategist characteristics, pose difficult problems for any biological control agent (Garcia & Legner, 1999). Mosquitoes typically exploit many aquatic habitats. Often a good biological control agent will have a much narrower range of environmental activity than the target species. Thus, in many situations a number of different biological control agents and/or appropriate methods are necessary to control even one species of mosquito across its range of exploitable breeding sources.

Nematodes. Entomopathogenic nematodes (EPNs) are extraordinarily lethal to many important insect pests, yet they are safe for plants and animals. This high degree of safety means that unlike chemicals, nematode applications do not require masks or other safety equipment; and re-entry time, residues, groundwater contamination, chemical trespass, and pollinators are not issues. Most biological pesticides require days or weeks to kill, yet nematodes, working with their symbiotic bacteria, can kill insects within 24–48 hours. Two families – the steinernematids and the heterorhabditids – are obligate parasites of insects used for microbial control. Juvenile nematodes parasitize their hosts by directly penetrating the cuticle or through natural openings. They then introduce symbiotic bacteria, which multiply rapidly and cause death by septicemia. The symbiotic bacteria break down the insect body, which provides food for the nematodes. After the insect has died, the juvenile nematodes develop to adults and reproduce. A new generation of infective juveniles emerges 8–14 days after infection. Dozens of different insect pests are susceptible to infection, yet no adverse effects have been shown against beneficial insects or other nontargets in field studies (Georgis *et al*., 1991; Akhurst & Smith, 2002). The entomopathogenic members of the genera *Photorhabdus* and *Xenorhabdus* are represented by endo-symbionts of insecticidal nematodes. The first which are typically associated with entomopathogenic nematodes in the genus *Heterorhabditis*, while the other is the species of genus *Steinernema*. The pathogenic action usually involves the release of symbiotic bacteria in the insect hemocoel once the nematodes have actively entered the insect body. Here the bacteria proliferate producing various antimicrobial compounds to contrast the growth of other microorganisms. They also release different enzymes that contribute to the degradation processes in the hemocoel, thus creating an ideal environment for the development of the nematode population (Luca, 2015). A variety of bacterial virulence factors are involved in the interaction with the susceptible host. Different *Photorhabdus* and *Xenorhabdus* species producing an insecticidal toxin complex (Tc) have high potential for pest management (Waterfield *et al*., 2001). Generally, the Tcs are high-molecular weight and multisubunit proteins that include three components, A, B and C, orally active against different insects (French-Constant & Waterfield, 2006). All these components are normally needed to achieve full toxicity (French-Constant *et al*., 2007).

Bacterial pesticides. Over 90 species of naturally occurring, insect-specific (entomopathogenic) bacteria have been isolated from insects, plants, and the soil, but only a few have been studied intensively. Much attention has been given to *Bacillus thuringiensis*, a species that has been developed as a microbial insecticide. *B. thuringiensis* (*Bt)* occurs naturally in the soil and on plants. Different varieties of this bacterium produce a crystal protein that is toxic to specific groups of insects. *Bt* have an excellent safety record and can be used on crops until close to the day of harvest. *Bt* can be applied using conventional spray equipment but, because the bacteria must be eaten to be effective, good spray coverage is essential. *B. thuringiensis* the majority of bacterial pathogens of insects, widespread in soil, is a lethal pathogen of a range of orders and the most widely used as biological control agent (Hoffmann & Frodsham, 1993). Bitoxybacillin (BTB) has been widely used for a long period of time in forestry and agriculture all over the world. The active components of the bitoxybacillin (BTB) are beta-exotoxin and crystal endotoxin. Dipel delivers outstanding control of more than 30 species of insects, did not harm any other organism and has long been a favorite of organic gardeners and commercial growers. Dipel is biodegradable and has minimal effect on humans, non-target animals or the environment (Grishechina, 2015).

Mosquitoes. Mosquitoes (Diptera: Culicidae) are the most important groups of arthropods in medical and veterinary fields. They act as vectors of several diseases such as malaria, yellow fever, dengue, filariasis, setariasis and encephalitis, causing serious health problems to humans (Service, 2003, Almeida *et al*., 2008).

The study has shown that in respect of feeding mosquitoes of west Georgia may be divided into three groups: 1) Species characterized by a wide range of feeders, i.e. these preferring to feed on domestic ungulates, humans, and more or less birds (*Anopheles plumbeus, An. elaviger, An. maculipennis, An. hyrcanus, Mansonia richiardii, Aedes vexans, Ae. cinereus, Ae. caspius, Ae. geniculatus*); 2) Species which seldom bite humans, but feed mainly on domestic ungulates and poultry (*Culex hortensis, Cx. mimeticus, Cx. theileri, Culiseta annulata, Cs. setivalva*) as well as on birds and cold-blooded vertebrates (*Culex territans*); 3) Species feeding in the countryside on birds and domestic ungulates (*Culex pipiens pipiens*) and in towns on humans, birds and carnivores (*Culex pipiens molestus, Cx. pipiens pipiens*) (Sichinava, 1978; Gugushvili, 2002).

In the recent time larvae and adults collections were carried out from different habitats using the standard methods in twenty-five localities of seven counties across West Azerbaijan Province (Iran) near Georgia. Overall, 1569 mosquitoes including 1336 larvae and 233 adults were collected from 25 localities. The details of geographical properties were recorded. Five genera with 12 species were collected and identified: *Anopheles claviger, An. maculipennis s.l., An. superpictus, Culex pipiens, Cx. theileri, Cx. modestus, Cx. hortensis, Cx. mimeticus, Culiseta longiareolata, Ochlerotatus caspius s.l., Oc. geniculatus and Uranotaenia unguiculata.*

Due to the geographical location of the West Azerbaijan Province, it comprises different climatic conditions which provide a suitable environment for the establishment of various species of mosquitoes. The solidarity geographical, cultural and territorial exchanges complicate the situation of the province and its vectors as a threat for future and probable epidemics of mosquito-borne diseases (Farahnaz Khoshdel-Nezamiha *et al*., 2014). The objective of this study was to evaluate the susceptibility of entomopathogenic nematodes of the species of *S. feltiae* and action of bacterial pesticides: Bitoxybacillin (BTB), Thuringin-2 and Dipel against Mosquitoes – *Anopheles maculipennis* and *Culex pipiens molestus* in the laboratory conduction.

MATERIAL AND METHODS

Larval collection. The larvae of mosquitoes were collected from June to August 2017, in the village Chiauri on the border of Georgia – Azerbaijan, 08.00 to 11.00 AM by using standard dipper (350 ml) and eye dropper. After that mosquitoes were transferred into a closed container, sent to the laboratory and placed within a few cups into cages to obtain F1 generation (Silver, 2008). In urban areas, larvae were collected from barrels and open sewage reservoirs. Rural populations came from flood plains, ditches and ground pools in forests and meadows. The samples were mounted and identified by systematic keys (Shahgudian, 1960; Zaim & Cranston, 1986; Azari-Hamidian & Harbach, 2009). Mosquitoes *Anopheles maculipennis* and *Culex pipiens molestus* were counted and identified using standard identification keys of Harbach *et al*., 1985; Cranston *et al*., 1987; Harbach, 1988).

Entomopathogenic nematodes (EPNs) of the species *S. feltiae* were reared at 22 ± 2°C in last instars of the wax moth, *Galleria mellonella* (L.) (Lepidoptera: Pyralidae), following the method of Kaya and Stock (1997). IJs were stored at 4°C in sterile distilled water (SDW) and were less 3 weeks old when used in the experiments. The nematode suspensions allowed to acclimatize at ambient room temperature for 24 h prior to exposure to mosquitoes. Quantification of nematodes in the suspension was done using the dilution method (Kaya and Stock, 1997).

For the control of *Anopheles maculipennis* and *Culex pipiens molestus* was used *S. feltiae* with concentration 5000 IJs/mL water (i.e. 100 per larva) and solution of bacterial insecticides BTB, Thuringin-2 and Dipel with dose 0.1, 0.2 and 0.5 separately.

I. Experiment – fifteen larvae of the 3rd–4th stages of both species of mosquitoes were placed individually on a wet filter paper in 10×10 cm diameter Petri dishes. Suspensions of 100 IJs/ per insect were treated in each Petri dish. II. Experiment – solutions of bacterial pesticides with dichlorinated water were placed in glass jars. In the jars the amount of liquid was 300 ml. Fifteen Mosquito larvae of both species were introduced into those solutions.

In the case of biomass control, the larvae were placed only in water. White bread was used as a nutrient (1.5 g per 15 larvae). Each treatment was replicated four times including the untreated control. The dead larvae of both species of mosquitoes were removed from Petri dishes and glass jars, washed with sterile water, put individually onto10 White traps and incubated at 25°C until the emergence of a new generation of IJs. The emerging IJs were harvested and counted after 11 to 15 days.

Experiments were carried out in the laboratory conditions at a temperature of 22 ± 2°C and 80% RH. The mortality percentage was recorded and corrected by means of the Abbott formula (Abbott, 1925). One-way ANOVA was used to compare the mortality of mosquitoes. Means were compared at the P=0.05 level, and Tukey's test was used to separate means (SPSS, 1999). Arcsine transformation was carried out on mortality (%) before analyses.

RESULTS AND DISCUSSION

The estimate of insect's mortality was recorded on days 3, 4, 5 and 6 after application of pathogens.

Within 4-day exposure to the dose 100/IJs per larvae of *Anopheles maculipennis* mortality was not observed, larvae were infected on days 5 and 6, the mortality rate was 15.6 and 20.5% (Table 1). There was no significant difference between the 5th and 6th days $P < 0.05$. Larval mortality % of *Culex pipiens molestus* ranged from 55.2 to 100.

Table 1

Larval mortality % of *Anopheles maculipennis* after exposure to *S. feltiae* and Bacterial insecticides Bitoxybacillin (BTB), Thuringin-2 and Dipel

Anopheles maculipennis					
Pathogens	Concentration	Mortality %			
		Day 3	Day 4	Day 5	Day 6
S. feltiae	5000 IJs mL/water	–	–	15.6	20.5
	Biological pesticides %				
BTB	0.1	0	30.3	60.2	
	0.2	17.2	44.5	68.5	
	0.5	30.2	76.5	100	
Turingin-2	0.1	0	18	37.1	
	0.2	11.5	33	66	
	0.5	22.8	74.3	95.3	
Dipel	0.1	0	10	35.5	
	0.2	0	19.2	38.3	
	0.5	10.2	32.3	55.2	
Control	–	–	–	–	–

Using bacterial insecticides BTB, Thuringin-2 and Dipel at a concentration of 0.1%, the first 2 days larvae mortality was also not recorded, although on day 3 larvae mortality rate reached 17.2–30.2 (BTB), 11.5–22.8 (Thuringin-*2*) and 10.2% (Dipel) caused at 0.2 and 0.5% concentration of bacterial insecticide. However, efficacy of 0.1 and 0.2% concentration of Dipel was not noted.

On the following 4th and 5th days under applying higher concentrations (0.5%) of bacterial insecticides BTB, Thuringin-*2* and Dipel mortality rates reached 76.5–100%, 74.3-95.3% and 32.3–55.2%, respectively. The result shows that insecticidal activity of *BTB* of 0.5% concentration against larvae of *Anopheles maculipennis* is much more effective (76.5–100% mortality) than of Thuringin-2 and Dipel. There was no significant difference on days 4, 5 between BTB and Turingin-*2* at high concentration (0.5%). A significant difference was observed between BTB and Dipel (76.5–100% and 32.3–55.2%). All bacterial insecticides produced significantly more mortality than the control (Table 1).

The data of activities of *S. feltiae* suspension (100/IJs per larvae) and bacterial insecticides BTB, Thuringin-2 and Dipel against *Culex pipiens molestus* is presented in Table 2.

Table 2

Larval mortality % of *Culex pipiens molestus* after exposure to *S. feltiae* and bacterial insecticides Bitoxybacillin (BTB), Thuringin-2 and Dipel

Culex pipiens molestus					
Pathogens	Concentration	Mortality %			
		Day 3	Day 4	Day 5	Day 6
S. feltiae	5000 IJs/mL water	–	–	13.4	18.5
	Biological pesticides %				
BTB	0.1	0	33	59.2	
	0.2	18.5	39.2	69.3	
	0.5	35.2	81.1	95.5	
Thuringin-2	0.1	0	22.3	56.2	
	0.2	0	40.1	63.4	
	0.5	19.8	72.2	80.5	
Dipel	0.1	0	21.0	32.2	
	0.2	5.5	44.5	37	
	0.5	8.2	34.5	51.2	
Control	–	–	–	–	–

In both experiments the same concentrations of nematode suspension and bacterial insecticides were used. Larvae of *Culex pipiens molestus* were less sensitive against toxin of nematode suspension; the larval mortality reduced about 10.3–10.0% compared with larvae of *Anopheles maculipennis*, while activities of bacterial insecticides at higher concentration (0.5%) against the both insects were almost equal, 81.1–95.5, 72.2–80.5; 34.5–51.2. There was no significant difference on days 4, 5 between BTB and Turingin-*2* at high concentration (0.5%). A significant difference was observed between *BTB* and *Dipel* (81.1–95.5; 34.5–51.2). However, BTB, Turingin-2 and Dipel at high concentration (0.5) produced significantly more mortality than in control (Table 1, 2). It is clear that with the increase of concentration of bacterial insecticides, the mortality of insects increases significantly. Larvae of both species are more susceptible to BTB, than to Thuringin-2 and Dipel. When testing high concentration (0.5%) of bacterial insecticides, larval mortality on the day 4 reached 81.1%, 72% and 34.5%.

On the next 5th day with the higher dose of Dipel and Thuringin-2, mortality rate of insects increased as well, although it did not reach 100%. Larval mortality % of *Culex pipiens molestus* ranged from 51.2 to 95.5.

The maximum mortality (100%) of mosquito larvae was observed only when exposed to BTB. In control experiments all survived larvae developed up to the pupa; control pupas were stored in separate cells, where flight of normal imago was observed.

CONCLUSIONS

The action of entomopathogenic nematode *S. feltiae* and bacterial pesticides BTB, Dipel and Thuringin-2 has been studied against mosquitoes *Anopheles maculipennis* and *Culex pipiens molestus*. It can be concluded that a suspension of *S. feltiae* with a dose 100 IJs /per larvae showed a slight activity (36–40%) toward the larvae of the indicated mosquito species compared with bacterial pesticides where the mortality ranged from 51.2–100%. More effective was the action of bacterial pesticides BTB, Thuringin-2 and Dipel, the mosquito's mortality grew with the increase of concentration. The mosquito's larvae were most sensitive to the highest (0.5) concentration of bacterial pesticide BTB.

Our results indicate that generally biological agents are regarded as one of the best means for biological control and successfully used against different species of mosquitoes.

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CONTRIBUTION TO DATABASE OF ALIEN/INVASIVE HOMOPTERA INSECTS IN ROMANIA

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Through the compilation of bibliographic sources (295 papers) with 47 personal papers (as one author or co-author, published between 1969 and 2010) and some not yet published data, a total of 219 alien Homoptera species, belonging to 27 families (Acanaloniidae, Adelgidae, Aleyrodidae, Aphididae, Asterolecaniidae, Calophyidae, Cercopidae, Cicadellidae, Cixiidae, Coccidae, Cryptococcidae, Delphacidae, Diaspididae, Eriococcidae, Flattidae, Homotomidae, Issidae, Kermesidae, Margarodidae (Monophlebidae), Membracidae, Ortheziidae, Pemphigidae, Phylloxeridae, Pseudococcidae, Psyllidae, Rhizoecidae and Triozidae), were identified in Romania. Their probable origin zone, biogeographic region, first report in Romania (since 1859 till 2018), and in some cases, other subsequent bibliographical references were indicated. The species were found in greenhouses (on vegetables and ornamental plants), in houses or different other controlled temperature conditions buildings, on ornamental plants, on open field vegetables, and other field crops, in orchards, gardens, parks, forests, as well as on imported tropical or subtropical fruits.

Keywords: Homoptera, alien species, non-native, non-indigenous, Romania, origin area.

INTRODUCTION

The unprecedent phenomenon of increase of the alien species introduction represents a very important problem being the consequence of increased trade, travel, transport and globalization; which has as a result the homogenization of all biota elements (flora, fauna, and microbiota).

Alien taxa are species, subspecies or lower taxa introduced outside of their past or present natural range and outside of their natural dispersal potential. This includes any part, gamete or propagule of such species that might survive and subsequently reproduce. To alien species are used different terms as: non-indigenous, non-native, exotic, foreign, new, allochthonous, neobiota (neozoan, neophyta, neomicrobia). **Cryptogenic taxa** are those of unknown origin which cannot be ascribed as being native or alien. **Invasive taxa** are alien species that can cause significant harm to biological diversity, ecosystem functioning, socio-economic values and human health in invaded regions (Pyšek *et al.*, 2009).

The invasive alien species are recognized as a major threat to global biodiversity (at genetic, population, specific, biocenosis and ecosystems level) representing the cause of habitats loss and degradation. The impact upon biodiversity comprises native species decline or their elimination, through competition for common resources, through predation, and transmission of parasites or pathogens. Many alien species have an economic impact, being dangerous phytophagous pests for important plant categories, causing enormous economic costs through increased costs associated with their prevention, eradication and control measures, but especially through direct production losses.

Alien species that represent a threat to human health are vectors or etiologic agents for many and dangerous viral, bacterial or fungal diseases.

Biological invasion has also an implication in the accelerated evolution of species; therefore the scientific community is interested in the dimension and importance of the invasion process as well as in its evolutionary implications (Rîşnoveanu & Teodorescu, 2009).

Insecta is a main animal group with implications in invasiveness process, favourised by their flying capacity, small dimensions, resistance to different adverse factors, as well as by a lot of defence mechanisms. The Homoptera is a particular order due to their many protective adaptations (the body covered or transformed in scale or covered with wax secretion), high number of annual generations, live in colonies, high density, fecundity and degree of attack intensity, salive toxicity and their nutrition by plants sap suction. Moreover, the Homoptera have a great impact upon the host plants through their vectorial role in transmission of different diseases.

MATERIAL AND METHODS

This report compiles information published by other authors (bibliographic sources) with present author data. As well as, some unpublished new personal data are added, about outdoors and indoors Homoptera species on ornamental and vegetable plant hosts in glasshouses, houses, private gardens, parks, and on imported tropical or subtropical fruits for consumption.

RESULTS AND DISCUSSION

The aim of this paper is to provide a list of Homoptera insect species introduced in Romania since the 19th century, to 2018, indicating their probable origin area, the biogeographic region, their first report in Romania, and in some cases, attaching other subsequent bibliographical references.

The present list with Homoptera allochthonous species is based on three sources: the collation of bibliographic information (295 papers), the author's publications (47 papers referring to 64 alien species), and some recent personal observations (2010–2018). To collate the bibliographic sources was not easy for me, but I intended to complete the gaps in knowledge about the Romanian alien Homoptera species, adding new information in general database.

A total of 219 species, belonging to 27 families (Acanaloniidae, Adelgidae, Aleyrodidae, Aphididae, Asterolecaniidae, Calophyidae, Cercopidae, Cicadellidae, Cixiidae, Coccidae, Cryptococcidae, Delphacidae, Diaspididae, Eriococcidae, Flattidae, Homotomidae, Issidae, Kermesidae, Margarodidae, Membracidae, Ortheziidae, Pemphigidae, Phylloxeridae, Pseudococcidae, Psyllidae, Rhizoecidae and Triozidae), are presented (Table 1). In function of the species richness (Table 2), the Aphididae, Diaspididae, Coccidae, Eriococcidae, Pseudococcidae and Adelgidae are the largest families (75.34% from the total 219 species).

An almost insurmountable problem for me was to indicate the species origin area, the data being largely different between the bibliographic sources. Therefore, the present table contains unclear or conflicting information on this status (for example unknown, probably, uncertain, doubtful), or underlines the cryptic origin. I deliberately introduced some species in the present table to put in discussion their origin.

We must underline that the data are approximate, as regards the moment of introduction in our country of the Homoptera species, especially due to their small dimension, unintentional introductions, and in many cases, due to the long time interval between the first arrival date and that of detection and report.

According to the published data, only 11 alien species, belonging to Aphididae, Diaspididae and Phylloxeridae families were detected before 1900. The first alien Homoptera species recorded in Romania were *Diaspis echinocacti* (1859) and *Viteus vitifolii* (1864). Between 1900 and 1949, the number increased about fourfold. The biggest number of records was registered in the next period (1950–1999) being tenfold compared to the period before 1900. In the last 18 years the number of recorded species was fivefold comparatively with the period before 1900 (Table 3).

The cases of reported alien species increased after 1950, due to climate changes (global warming) and to different anthropogenic activities. The species with origin in warm zones, especially tropical and subtropical ones, are restricted in greenhouses and in other indoor locations in Romania.

The number of some species reports increased after the first detection dates, due to their certain features (the rapid multiplying, adapting and establishing in new habitat conditions), to spreading capacity in the whole country, and to the special interest of the local researchers and farmers.

Table 1

Alien Homoptera species recorded in Romania between 1859 and 2018

No.	Species	Native area/ Biogeographical region	First record in Romania: years/authors
I	**FAMILY ACANALONIIDAE**		
1.	*Acanalonia conica* (Say, 1830)	North America/ Neartic	2017b (Chireceanu *et al.*)
II	**FAMILY ADELGIDAE**		
1.	*Adelges* (*Sacchiphantes*) *abietis* (Linnaeus, 1758)	Euro-Siberian / Western Palaearctic	1985b (Lăcătuşu *et al.*); 1997 (Simionescu & **Teodorescu**); 1998 (Gusic); 2001 (**Teodorescu** & Simionescu); 2017b (Ciceoi Roxana *et al.*)
2.	*Adelges* (*Gilletteella*) *cooleyi* (Gillette, 1907)	Western North America / Nearctic	1964 (Simionescu, Mihalache *et al.*, 2000); 1971 (Simionescu *et al.*); 1973 (Nanu); 1998 (Gusic); 2006 (**Teodorescu** *et al.*); 2008 (Ciochia *et al.*)
3.	*Adelges* (*Adelges*) *laricis* Vallot, 1836	Alps and, or Central Europe / Western Palaearctic	1981 (Holman & Pintera); 1982, 1995 (Blada); 1997 (Simionescu & **Teodorescu**); 1998 (Gusic); 2001 (**Teodorescu** & Simionescu); 2010 (Brudea & Rîşca); 2011 (Vîlcan); 2017b (Ciceoi Roxana *et al.*)
4.	*Adelges* (*Dreyfusia*) *nordmannianae* (Eckstein, 1890) syn. *D. nüsslini* (Börner, 1908)	Mountain areas of Caucasus, Northeastern Turkey, Crimea / Western Palaearctic	1973a (**Teodorescu**); 1975 (Borusiewicz & Capecki); 2008 (Ciochia *et al.*) http://www.rosilva.ro/articole/daunatori_biotici_ai_padurilor__p_113.htm
5.	*Adelges* (*Dreyfusia*) *piceae* (Ratzeburg, 1844)	Central Europe / Western Palaearctic	1973a, 1974 (**Teodorescu**); 1975 (Ceianu & **Teodorescu**); 2008b (**Teodorescu**); 2012 (CABI/EPPO); 2017b (Ciceoi Roxana *et al.*) http://www.rosilva.ro/articole/daunatori_biotici_ ai_padurilor_p_113.htm
6.	*Adelges* (*Adelges*) *tardus* Dreyfus, 1888	Central and Northern Europe / Western Palaearctic	1998 (Gusic)
7.	*Adelges* (*Aphrastasia*) *tsugae* Annand, 1924	? China, Japan,or North America	2017 (Csóka *et al.*)
8.	*Adelges* (*Sacchiphantes*) *viridis* Ratzeburg, 1843	Central Europe / Western Palaearctic	1957 (Georgescu *et al.*); 1985b (Lăcătuşu *et al.*); 1998 (Gusic) http://www.rosilva.ro/articole/daunatori_biotici_ai_padurilor
9.	*Pineus* (*Pineus*) *abietinus* Underwood & Balch, 1964	Western North America / Nearctic	1980 (Drugescu); 2001 (Mihalciuc *et al.*).
10.	*Pineus* (*Pineus*) *cembrae* (Cholodkovsky, 1888)	? Europe, Japan, China	1998 (Gusic); 2016 (Olenici & Duduman) http://www.rosilva. ro/articole/daunatori_biotici_ai_padurilor – p_113.htm
11.	*Pineus* (*Pineus*) *pini* (Macquart, 1819)	Western and Central Europe / Western Palaearctic Cosmopolitan	1981 (**Teodorescu** & Ceianu); 1998 (Gusic); 2008b (**Teodorescu**); 2017b (Ciceoi Roxana *et al.*)

Table 1 (continued)

12.	*Pineus* (*Pineus*) *strobi* (Hartig, 1937) syn. *Eopineus strobus* (Hartig, 1837)	Eastern North America / Nearctic	1972, 1998 (Gusic); 1973 (Ceianu & **Teodorescu**); 2008b (**Teodorescu**); 2008 (Fora & Lauer); 2008 (Ciochia *et al.*); 2016 (Olenici & Duduman)
III	**FAMILY ALEYRODIDAE**		
1.	*Aleurothrixus floccosus* (Maskell, 1896)	South America / Neotropical	1963 (CIE); 1987 (Ioan *et al.*)
2.	*Aleyrodes proletella* (Linnaeus, 1758	Afrotropical	1969 (Dobreanu & Manolache); 1982 (Manolache *et al.*); 2006 (**Teodorescu** *et al.*)
3.	*Bemisia tabaci* (Gennadius, 1889)	Unknown, probably Asia-Pacific Cosmopolitan	1969 (Dobreanu & Manolache); 1982 (Manolache *et al.*); 2006, 2010 (**Teodorescu** *et al.*); 2006 (Roman & Glăvan)
4.	*Bulgarialeurodes cotesii* (Maskell, 1896) syn. *B. rosae* Corbet, 1936	? Western Palaearctic or Oriental	1969 (Dobreanu & Manolache); 1982 (Manolache *et al.*); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei)
5.	*Trialeurodes vaporariorum* (Westwood, 1856)	Central America / Neotropical Cosmopolitan	1929 (Anonymous, according to Paşol, 2007); 1955, 1969 (Dobreanu & Manolache); 1972 (Reus); 1973 (Jurcă & Reus); 1974 (Peiu); 1974 (Lăcătuşu *et al.*); 1975 (Iacob *et al.*); 1976 (Costache & Mihăilescu); 1977 (Reus); 1977 (Lemeni & Alexandrescu); 1979 (Rogojanu & Perju); 1980 (Costescu, *In* Boguleanu *et al.*); 1982 (Raicu & Mihăilescu); 1983a, 1984 (Lăcătuşu *et al.*); 1985a (Lăcătuşu *et al.*); 1989 (Perju *et al.*); 1990 (Byrne *et al.*); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2006 (Roman & Glăvan); 2006 (Mustaţă Mariana *et al.*); 2007 (Paşol *et al.*); 2008c (**Teodorescu**); 2008 (Pop-Balea *et al.*), 2010 (**Teodorescu** & Matei); 2010 (Tucă *et al.*); 2017a (Ciceoi Roxana *et al.*); DAISIE www.europe-aliens.org)
IV	**FAMILY APHIDIDAE**		
1.	*Acyrthosiphon caraganae* (Cholodkovsky, 1908)	Temperate Asia / Palaearctic	1909 (Henrich); 1981 (Holman & Pintera); 1996 (Ciochia & Boeriu); 1997 (Moglan Veronica); 2000 (Mustaţă *et al.*); 2000, 2008 (Ciochia *et al.*)
2.	*Acyrthosiphon ignotum* Mordvilko, 1914	Central Asia / Western Palaearctic	1968 (UK CAB International)
3.	*Acyrthosiphon loti* (Theobald, 1913)	Western Europe / Western Palaearctic	1981 (Holman & Pintera); 2008 (Ciochia *et al.*)
4.	*Acyrthosiphon malvae* (Mosley, 1841)	Palaearctic Cosmopolitan	1981 (Holman & Pintera); 2008 (Ciochia *et al.*)
5.	*Acyrthosiphon pisum* Harris, 1776	? Supposed European Cosmopolitan	1908 (Borcea); 1909 (Henrich); 1940a (Knechtel & Manolache); 1969 (Manolache *et al.*); 1974 (Lăcătuşu *et al.*); 1975 (Lăcătuşu); 1980 (**Teodorescu** & Mustaţă); 1990 (Voicu); 1980 (Perju, in Boguleanu *et al.*); 1981 (Holman & Pintera); 1982 (**Teodorescu**); 1982 (CIE); 1991 (**Teodorescu**); 1992 (Ciochia *et al.*); 1997 (**Teodorescu** & Vădineanu); 1997 (Ciochia & Boeriu); 2000 (Mustaţă *et al.*) 2006 (Roman & Glăvan); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2008 (Ciochia *et al.*); 2010 (Fericean *et al.*)
6.	*Aphis craccivora* C.L. Koch, 1854	Probable / Western Palaearctic Cosmopolitan	1896 (Henrich); 1897 (Horváth); 1908 (Borcea); 1970 (Ceianu); 1975 (Lăcătuşu); 1979 (Rogojanu & Perju); 1981 (Holman & Pintera); 1982 (Săvescu); 1983 (CIE); 1996 (Ciochia & Boeriu); 1998 (Perju); 2000 (Mustaţă *et al.*); 2004 (Feraru); 2005 (Barnea *et al.*); 2005 (Feraru *et al.*); 2008b (**Teodorescu**); 2015 (Mărginean Soporan)

Table 1 (continued)

7.	*Aphis euphorbiae* Kaltenbach, 1843	Unclear ? Europe	1896, 1909 (Henrich); 1897 (Horváth); 1908, 1909 (Borcea); 1981 (Holman & Pintera); 1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*)
8.	*Aphis forbesii* Weed, 1889	North America /Nearctic Cosmopolitan	1977 (Holman http://www.naro.affrc.go.jp/archive/niaes/sinfo/publish/bulletin/niaes37-2.pdf); 2008 (Ciochia *et al.*)
9.	*Aphis gossypii* Glover, 1877	Unknown Conflicting information Cosmopolitan	1877 (Horvath, 1897); 1968 (UK CAB International); 1969 (Manolache *et al.*); 1975 (Lăcătușu); 1979 (Rogojanu & Perju); 1980 (**Teodorescu** & Mustață); 1980 (Costescu, in Boguleanu *et al.*); 1982 (Săvescu *et al.*); 1982 (Raicu & Mihăilescu); 1984 (Lăcătușu *et al.*); 1987 (Mirică *et al.*); 1987 (Ioan *et al.*); 1989 (Perju *et al.*); 1992 (Ciochia *et al.*); 1997 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2005 (Feraru *et al.*); 2006 (Roman & Glăvan); 2007 (Pașol *et al.*); 2008b (**Teodorescu**); 2008 (Ciochia *et al.*); 2010 (**Teodorescu** & Matei)
10.	*Aphis* (*Anuraphis*) *nerii* Boyer de Fonscolombe, 1841	Conflicting information ? Eastern Asia ? Mediterranean Cosmopolitan	1940a (Knechtel & Manolache); 1997 (Moglan Veronica); 2007 (Pașol *et al.*); 2008 (Ciochia *et al.*); 2009 (Odagiu *et al.*); DAISIE, www.europe-aliens.org
11.	*Aphis pomi* DeGeer, 1773	Conflicting information	1969 (CIE); 1969 (Ionescu & **Teodorescu**); 1972 (Ionescu *et al.*); 1973a (**Teodorescu**); 1975 (Lăcătușu); 1980 (Peiu & Filipescu, in Boguleanu *et al.*); 1985b (Lăcătușu *et al.*); 1989 (Perju *et al.*); 1991 (**Teodorescu**); 2004 (Feraru); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2009 (Bolbose); 2010 (Țucă *et al.*); 2010 (Bunescu *et al.*); 2016b (Fericean); 2016 (Fericean & Corneanu)
12.	*Aphis spiraecola* Patch, 1914	? / Eastern Palaearctic or Oriental	2005 (Feraru & Mustață**;** 2009 (Odagiu *et al.*); 2015 (Mărginean Soporan)
13.	*Aphis spiraephaga* Müller, 1961	Central Asia / Western Palaearctic	1981 (Holman & Pintera); 1982 (Bărbulescu *et al.*, in Săvescu *et al.*); 1990 (Mustață); 2006 (Barnea *et al.*); 2009 (Bărbuceanu & Nicolaescu); 1990 (Mustață); 2000 (Mustață *et al.*); 2008 (Ciochia *et al.*); 2009 (Brudea); 2011 (Datamining - Invasive Species Databases); 2015 (Mărginean Soporan) 2017b (Ciceoi Roxana *et al.*)
14.	*Aphis viburni* Scopoli, 1763	Northern Europe / Western Palaearctic	1896, 1909 (Henrich); 1897 (Horvath); 1908, 1909 (Borcea); 1920-1921 (Brândză according to Stănescu, 2009); 1938 (Borza & Ghiuță); 1939 (Baudys); 1981 (Holman & Pintera), 1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*)
15.	*Aphis vitalbae* Ferrari, 1872	Probably Mediterranean / Western Palaearctic	1981 (Holman & Pintera)
16.	*Aulacorthum* (*Neomyzus*) *circumflexum* (Buckton, 1876)	Probably Eastern Asia / Eastern Palaearctic or Oriental Cosmopolitan	1942 (Knechtel & Manolache); 1973 (Szekely *et al.*); 1997 (Moglan Veronica); 2007 (Pașol *et al.*); 2008 (Ciochia *et al.*); 2010 (**Teodorescu** & Matei); (DAISIE, www.europe-aliens.org)
17.	*Aulacorthum solani* (Kaltenbach, 1843)	Doubtful ? Western Palaearctic Cosmopolitan Cryptogenic	1908 (Borcea); 1981 (Holman & Pintera); 1992 (Ciochia *et al.*); 1997 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2004 (Feraru); 2008 (Fericean *et al.*); 2008 (Ciochia *et al.*); 1982 (Bărbulescu *et al.*, in Săvescu); 2004 (Călin et al); 2005 (Barnea *et al.*); 2010 (Fericean *et al.*)
18.	*Brachycaudus helichrysi* (Kaltenbach, 1843)	Conflicting information Cosmopolitan	1908 (Borcea); 1981 (Holman & Pintera); 1943 (Knechtel & Manolache); 1975 (Minoiu); 1990 (Voicu); 1992 (Ciochia *et al.*); 1993 (Săpunaru *et al.*); 1998 (Isac *et al.*); 2004 (Feraru); 2016a (Fericean *et al.*)

Table 1 (continued)

19.	*Brachycaudus mordvilkoi* Hille Ris Lambers, 1931	Tropical Asia / Oriental regions	1908 (Borcea); 1981 (Holman & Pintera); 1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*)
20.	*Brachycaudus rumexicolens* (Patch, 1917)	Uncertain Europe or North America	1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2008 (Ciochia *et al.*)
21.	*Brachycolus* (=*Brachycorynella*) *asparagi* (Mordvilko, 1929)	Eastern Mediterranean / Western Palaearctic	2000 (Mustață *et al.*); 2008 (Ciochia *et al.*)
22.	*Brevicoryne brassicae* (Linnaeus, 1758)	Unclear origin; possible Northwestern Europe / Western Palaearctic Cosmopolitan	1897 (Horvath); 1908 (Borcea); 1969 (Ionescu & **Teodorescu**); 1973a (**Teodorescu**); 1974 (Peiu); 1974-1975 (Mustață); 1974 (Lăcătușu *et al.*); 1975 (Constantinescu); 1975 (Lăcătușu); 1977 (Mustață *et al.*); 1979 (Rogojanu & Perju); 1980 (**Teodorescu**); 1980 (**Teodorescu** & Mustață); 1980 (Boguleanu *et al.*); 1981 (Holman & Pintera); 1984 (Lăcătușu *et al.*); 1985a (Lăcătușu *et al.*); 1986 (Mustață); 1986 (**Teodorescu** & Borcan); 1989 (Perju *et al.*); 1996 (Mustață); 1997 (Moglan Veronica); 2000 (Mustață *et al.*); 2001 (**Teodorescu** & Vădineanu); 2004 (Călin *et al.*); 2005 (Barnea *et al.*); 2006 (**Teodorescu** *et al.*); 2006 (Antonie & **Teodorescu**); 2006 (Mustață Mariana *et al.*); 2006 (Roman & & Glăvan); 2007 (Pașol *et al.*); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2008c (**Teodorescu**); 2008 (Fericean *et al.*); 2008 (Ciochia *et al.*); 2009 (**Teodorescu**); 2010 (**Teodorescu** & Matei)
23.	*Chaetosiphon fragaefolii* (Cockerell, 1901)	Northern America / Nearctic	1958 (Arion); 1982 (Bărbulescu *et al. In* Săvescu *et al.*); 2007 (Pașol *et al.*)
24.	*Chromaphis juglandicola* (Kaltenbach, 1843)	Temperate Asia / Western Palaearctic	1979 (Rogojanu & Perju); 1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2014 (Ficker Trif)
25.	*Cinara cupressi* (Buckton, 1881)	North America / Nearctic Cosmopolitan	2005 (Ciceoi *et al.*); 2009 (Bărbuceanu & Nicolaescu)
26.	*Diuraphis noxia* (Kurdjumov, 1913)	Central Asia / Western Palaearctic Cosmopolitan	1981 (Holman & Pintera): 2008 (Ciochia *et al.*)
27.	*Dysaphis apiifolia* (Theobald, 1923)	Unclear	1977 (Mustață *et al.*); 1980 (**Teodorescu** & Mustață); 2003 (Mitroiu & Andriescu); 2008b (**Teodorescu**)
28.	*Dysaphis plantaginaea* (Passerini, 1860)	Irano-Turanian / Palaearctic	1897 (Horváth); 1908,1909 (Borcea); 1937 (Ghiuță); 1981 (Holman & Pintera); 2004 (Feraru); 2004 (Trandafirescu *et al.*); 2005 (Feraru & Mustață)
29.	*Dysaphis tulipae* (Fonscolombe, 1841)	South of Europe / Western Palaearctic Cosmopolitan	2007 (Pașol *et al.*); 2008 (Ciochia *et al.*) DAISIE, www.europe-aliens.org)
30.	*Eriosoma lanigerum* (Hausmann, 1802)	Probably Eastern North America / Nearctic Cosmopolitan	1923 (To control the *Eriosoma lanigerum*, Knechtel imported *Aphelinus mali* parasitoid, from France); 1911 (Brândză,according to Stănescu, 2009); 1957 (Georgescu *et al.*); 1960 (Săvescu); 1974 (Lăcătușu *et al.*); 1974 (Peiu); 1975 (CIE); 1979 (Rogojanu & Perju); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1982 (Duvlea & Gusic, *In* Săvescu *et al.*); 1989 (Perju *et al.*); 1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2004 (Trandafirescu *et al.*); 2006 (**Teodorescu** *et al.*); 2006 (Mustață Mariana *et al.*); 2007 2007 (Pașol *et al.*); 2008 (**Teodorescu** & Vlad Antonie); 2008 (Ciochia *et al.*); 2009 (Beșleagă & Cârdei); 2010 (Bunescu *et al.*); 2015 (Chireceanu *et al.*)

Table 1 (continued)

31.	*Hyalopterus amygdali* E. Blanchard, 1840	Eastern Asia / Eastern Palaearctic	1996 (Ciochia & Boeriu); 2000 (Mustață *et al.*); 2004 (Feraru); 2008 (Ciochia *et al.*)
32.	*Hyalopterus pruni* (Geoffroy, 1762) syn. *Hyalopterus arundinis* (Fabricius, 1775)	Mediterranean / Western Palaearctic Cosmopolitan	1908 (Borcea); 1913 (Brândză, according to Stănescu, 2009); 1943 (Knechtel & Manolache); 1969 (Săvescu, as *Hyalopterus arundinis*); 1969 (Ionescu & **Teodorescu**); 1970 (Ceianu); 1972 (Ionescu *et al.*); 1973a (**Teodorescu**); 1974 (Peiu); 1974 (Lăcătuşu *et al.*); 1975 (Lăcătuşu); 1979 (Rogojanu & Perju); 1980 (**Teodorescu** & Mustaţă); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1982 (**Teodorescu**); 1989 (Perju *et al.*); 1992, 1997 (Moglan Veronica); 1998 (Isac *et al.*); 2000 (Mustață *et al.*); 2004 (Feraru); 2005 (Feraru *et al.*); 2006 (Feraru & Mustață); 2006 (Mustață Mariana *et al.*); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2008 (Ciochia *et al.*); 2008 (Fericean *et al.*); 2009 (**Teodorescu**); 2009 (Tomescu *et al.*); 2010 (Bunescu *et al.*); 2012 (Ţucă)
33.	*Illinoia azalea* (Mason, 1925)	North America / Nearctic	2008 (Ciochia *et al.*); 2011 (Datamining Invasive Species Databases)
34.	*Impatientinum asiaticum* Nevsky, 1929	Temperate Asia / Western Palaearctic	2008 (Ciochia *et al.*); DAISIE, www.europe-aliens.org
35.	*Macrosiphoniella sanborni* (Gillette, 1908)	Temperate Asia / Western Palaearctic Cosmopolitan	1942 (Knechtel & Manolache); 1973 (Szekely *et al.*); 1982 (Bărbulescu *et al.*, *In* Săvescu *et al.*); 1997 (**Teodorescu** & Procheş); 2000 (Mustață *et al.*); 2007 (Paşol *et al.*); 2008 (Ciochia *et al.*); 2010 (**Teodorescu** & Matei); 2017b (Ciceoi Roxana *et al.*); DAISIE, www.europe-aliens.org
36.	*Macrosiphum cholodkovskyi* Mordvilko, 1909	Western Europe / Western Palaearctic Cosmopolitan	2000 (Mustață *et al.*); 2008 (Ciochia *et al.*)
37.	*Macrosiphum daphinidis* (Börner, 1940)	Western Europe / Western Palaearctic	2000 (Mustață *et al.*)
38.	*Macrosiphum euphorbiae* (Thomas, 1878	North America / Nearctic Cosmopolitan	1942 (Koehler, as *M. koehleri*); 1942 (Knechtel & Manolache, as *M. koehleri*); 1979 (Rogojanu & Perju); 1981 (Holman & Pintera); 1982 (Raicu & Mihăilescu); 1983a, 1985a, 1996 (Ciochia & Boeriu); 1997 (**Teodorescu** & Vădineanu); 2000 (Mustață *et al.*); 2001 (**Teodorescu** & Vădineanu); 2003 (Tomescu & Negru); 2004 (Călin Maria *et al.*); 2004 (Feraru); 2006 (**Teodorescu** *et al.*); 2006 (Antonie & **Teodorescu**); 2006 (Roman & Glăvan); 2007 (Paşol *et al.*); 2008a (**Teodorescu**); 2008 (Ciochia *et al.*); 2010 (Fericean *et al.*) DAISIE, www.europe- aliens.org)
39.	*Macrosiphum rosae* (Linnaeus, 1758)	Western Europe / Western Palaearctic Cosmopolitan	1896 (Henrich); 1908 (Borcea); 1970 (Ceianu); 1973 (Szekely *et al.*); 1974 (Peiu); 1975 (Lăcătuşu); 1979 (Rogojanu & Perju); 1980 (**Teodorescu** & Mustaţă); 1980 (Costescu, in Boguleanu *et al.*); 1981 (Holman & Pintera); 1982 (Bărbulescu *et al.*, *In* Săvescu *et al*); 1990 (Mustaţă); 1989 (Perju *et al.*); 1997 (**Teodorescu** & Procheş); 2000 (Mustață *et al.*); 2004 (Feraru); 2007 (Paşol); 2008 (Ciochia *et al.*); 2008 (Fericean *et al.*); 2009 (Bărbuceanu & Nicolaescu); 2009 (Odagiu *et al.*); 2010 (Tucă *et al.*); 2017a (Ciceoi Roxana *et al.*)
40.	*Metopolophium albidum* Hille Ris Lambers, 1947	Western Europe / Western Palaearctic Cosmopolitan	1981 (Holman & Pintera); 2000 (Mustață *et al.*); 2008 (Ciochia *et al.*)
41.	*Metopolophium dirhodum* (Walker, 1848)	? Europe / Western Palaearctic	1981 (Holman & Pintera); 2000 (Mustață *et al.*); 2004 (**Teodorescu** & Vîlsan); 2006 (Malschi *et al.*)

Table 1 (continued)

42.	*Myzocallis coryli* (Goeze, 1778)	? Europe / Western Palaearctic	1979 (Rogojanu & Perju); 1996 (Ciochia & Boeriu); 1997 (Ioachim & Bobârnac); 1997 (Achim & Parnia); 2000 (Mustaţă *et al.*)
43.	*Myzus ascalonicus* Doncaster, 1946	Perhap South West of Asia / Western Palaearctic Cosmopolitan	2006 (Roman & Glăvan); 2007 (Paşol et al); 2008 (Ciochia *et al.*); 2008 (Fericean *et al.*); (DAISIE, www.europe-liens.org).
44.	*Myzus ornatus* Laing, 1932 (syn. *Myzodes portulacae*)	Temperate Asia / Western Palaearctic Cosmopolitan	1942 (Knechtel & Manolache), 1973 (Szekely *et al.*); 1979 (Rogojanu & Perju); 2006 (Roman & Glăvan); 2007 (Paşol *et al.*); 2008 (Ciochia *et al.*); (DAISIE, www.europe-aliens.org)
45.	*Myzus persicae* Sulzer, 1776	Doubtful is considered to be of East Asian Cryptogenic Cosmopolitan	1896, 1909 (Henrich); 1908, 1909 (Borcea); 1943 (Knechtel & Manolache); 1969 (Ionescu & **Teodorescu**); 1971 (Duvlea); 1972 (Ionescu *et al.*); 1973a (**Teodorescu**); 1973 (Szekely *et al.*); 1974 (Peiu); 1974 (Lăcătuşu *et al.*); 1975 (Lăcătuşu); 1979 (Rogojanu & Perju); 1979 (CIE); 1980 (**Teodorescu** & Mustaţă); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1981 (Holman & Pintera); 1982 (**Teodorescu**); 1982 (Raicu & Mihăilescu); 1983a, (Lăcătuşu *et al.*); 1983b (Lăcătuşu *et al.*); 1984 (Lăcătuşu *et al.*); 1985a (Lăcătuşu *et al.*); 1989 (Perju *et al.*); 1992 (Ciochia *et al.*); 1991 (**Teodorescu**); 1996 (Ciochia & Boeriu); 1997 (**Teodorescu** & Procheş); 1997 (Moglan Veronica); 1997 (Ciochia & Boeriu); 1998 (Isac *et al.*); 2000 (Mustaţă *et al.*); 2004 (**Teodorescu** & Vîlsan); 2004 (Feraru); 2004 (Trandafirescu *et al.*); 2006 (**Teodorescu** *et al.*); 2006 (Roman & Glăvan); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2008c (**Teodorescu**); 2008 (**Teodorescu** & Vlad Antonie); 2008 (Ciochia *et al.*); 2008 (Ciochia & Stancă-Moise); 2009 (**Teodorescu**); 2015 (Mărginean Soporan) DAISIE, www.europe-aliens.org)
46.	*Myzus varians* Davidson, 1912	Eastern Asia / Eastern Palaearctic	2006, 2015 (Chireceanu *et al.*); 2011 (Sivu)
47.	*Neomyzus circumflexus* (Buckton, 1876)	Temperate Asia / Western Palaearctic Cosmopolitan	1942 (Knechtel & Manolache); 1982 (Bărbulescu *et al.*, *In* Săvescu *et al.*); 2000 (Mustaţă *et al.*); 2008b (**Teodorescu**)
48.	*Panaphis juglandis* (Goeze, 1778) syn. *Callaphis juglandis* (Goeze, 1778)	Eastern Asia / Eastern Palaearctic	2007 (Martin *et al.*); 2014 (Ficker)
49.	*Pterochloroides persicae* (Cholodkovsky, 1899)	Eastern Asia / Eastern Palaearctic	1986 (Hondru *et al.*); 1994 (EPPO), 2008b (**Teodorescu**); 2008 (Ciochia *et al.*)
50.	*Rhodobium porosum* (Sanderson, 1900)	Tropics and subtropics Cryptogenic	1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2008 (Ciochia *et al.*); 2009 (Odagiu *et al.*); 2010 (**Teodorescu** & Matei)
51.	*Rhopalosiphoninus latysiphon* (Davidson, 1912)	North America / Nearctic	2008 (Ciochia *et al.*); 2008 (Fericean *et al.*); DAISIE, www.europe-aliens.org
52.	*Rhopalosiphum insertum* (Walker, 1849)	North America / Nearctic Cosmopolitan	1908, 1909 (Borcea); 1981 (Holman & Pintera); 1996 (Ciochia & Boeriu); 2000 (Mustaţă *et al.*); 2004 (Feraru); 2005 (Feraru & Mustaţă); 2008 (Ciochia *et al.*); 2008 (Fericean *et al.*)

Table 1 (continued)

53.	*Rhopalosiphum maidis* (Fitch, 1856)	Eastern Asia / Eastern Palaearctic Cosmopolitan	1944 (Knechtel & Manolache); 1969 (Manolache *et al.*); 1971 (CIE); 1973a (**Teodorescu**); 1978 (Lăcătuşu *et al.*); 1979 (Rogojanu & Perju); 1980 (**Teodorescu**); 1980 (**Teodorescu** & Mustaţă); 1981 (Holman, &. Pintera); 1982 (**Teodorescu**); 1982 (Bărbulescu *et al.*, *In* Săvescu *et al.*); 1989 (**Teodorescu** & Cuţaru); 1989 (Voicu & Mureşan); 1990 (Voicu); 1990 (Mustaţă); 1996 (Ciochia *et al.*); 1996 (Ciochia & Boeriu); 1997, 1999 (Mustea); 2000 (Mustaţă *et al.*); 2001 (**Teodorescu** & Vădineanu); 2004 (**Teodorescu** & Vîlsan); 2006 (**Teodorescu** *et al.*); 2006 (Antonie & **Teodorescu**); 2008a (**Teodorescu**); 2008b (**Teodorescu**); 2008 (Ciochia *et al.*); 2009 (**Teodorescu**).
54.	*Rhopalosiphum padi* (Linnaeus, 1758)	Unclear Supposed to be European Cosmopolitan	1908 (Borcea); 1979 (Rogojanu & Perju); 1981 (Holman & Pintera); 1997 (Moglan Veronica); 2000 (Mustaţă *et al.*); 2003 (Malschi *et al.*) 2004 (**Teodorescu** & Vîlsan); 2006 (**Teodorescu** *et al.*); 2006, 2013 (Malschi *et al.*); 2008 (Ciochia *et al.*); 2008, 2010 (Fericean *et al.*)
55.	*Rhopalosiphum rufiabdominale* (Sasaki, 1899)	Eastern Asia / Eastern Palaearctic	2000 (Mustaţă *et al.*)
56.	*Schizaphis graminum* (Rondani, 1852)	Conflicting information Middle Eastern or Central Asia Cosmopolitan	1908 (Borcea); 1965, 1973, 1975 (Bărbulescu); 1979 (Rogojanu & Perju); 1980 (**Teodorescu** & Mustaţă); 1980 (Lăcătuşu *et al.*); 1980 (Paşol, *In* Boguleanu *et al.*); 1981 (Holman & Pintera); 1982 (**Teodorescu**); 1987 (Voicu & Nagler); 1989 (**Teodorescu** & Cuţaru); 1994 (**Teodorescu** & Stănescu) 1998a (**Teodorescu**); 1999 (CABI and EPPO); 2000a (Mustaţă *et al.*); 2001 (**Teodorescu** & Vădineanu); 2004 (**Teodorescu** & Vîlsan); 2006 (Antonie & **Teodorescu**); 2006 Mustaţă Mariana *et al.*); 2006, 2013 (Malschi *et al.*); 2008a (**Teodorescu**); 2009 (Mustaţă & Mustaţă); 2009 (Malschi); 2010 (**Teodorescu**)
57.	*Tetraneura ulmi* (Linnaeus, 1758)	Seems to be northwestern Europe / Western Palaearctic	1907 (Brândză, according to Stănescu, 2009, on *Ulmus minor*); 1939 (Baudys); 1957 (Georgescu *et al.*); 1979 (Rogojanu & Perju); 1985b (Lăcătuşu *et al.*); 2008 (**Teodorescu** & Vlad Antonie); 2008d (**Teodorescu**); 2008 (Ciochia *et al.*); 2009 (**Teodorescu**); 2011 (Ilie & Marinescu); 2015 (Chireceanu *et al.*); 2017a (Ciceoi Roxana *et al.*)
58.	*Thecabius affinis* (Kaltenbach, 1843	? / Palaearctic	1905 (Brândză, according to Stănescu, 2009); 1939 (Baudys); 1957 (Georgescu); 1998 (Gusic); 2008d (**Teodorescu**); 2008 (Ciochia *et al.*); 2009 (**Teodorescu**); http://www.rosilva.ro/articole/daunatori_biotici_ai_padurilor_p_113.htm
59.	*Tinocallis* (*Eotinocallis*) *platani* (Kaltenbach, 1843)	Japan / Eastern Palaearctic	1996 (Ciochia & Boeriu); 2000 (Mustaţă *et al.*)
60.	*Tinocallis* (*Sappocallis*) *saltans* (Nevsky, 1929)	Eastern Asia / Eastern Palaearctic	2008 (Ciochia *et al.*)
61.	*Toxoptera aurantii* Boyer de Fonscolombe, 1841	? Eastern Asia / Eastern Palaearctic or Oriental Cosmopolitan	2008 (Ciochia *et al.*); DAISIE, www.europe-aliens.org
62.	*Uroleucon erigeronense* (Thomas C., 1878)	North America / Nearctic Cosmopolitan	2008 (Ciochia *et al.*); 2011 (Datamining-Invasive Species Databases)
63.	*Uroleucon telekiae* (Holman, 1965)	Southeastern Europe, Asia Minor and Transcaucasia / Western Palaearctic	2008 (Ciochia *et al.*); 2011 (Datamining-Invasive Species Databases)

Table 1 (continued)

V	**FAMILY ASTEROLECANIIDAE**		
1.	*Asterodiaspis variolosa* (Ratzeburg, 1870)	Unclear Western Palaearctic or Oriental	1957 (Georgescu *et al.*); 1972-1973 (Andriescu); 1975 (Rogojanu); 2010 (Fetyko *et al.*) http://www.rosilva.ro/articole /daunatori_biotici_ai_padurilor__p_113.htm
VI	**FAMILY CALOPHYIDAE**		
1.	*Calophia rhois* (Löw, 1877)	Mediterranean / Western Palaearctic	1962 (Dobreanu & Manolache)
VII	**FAMILY CERCOPIDAE**		
1.	*Cercopis sanguinolenta* (Scopoli, 1763)	Mediterranean / Western Palaearctic	1975 (Cantoreanu); 1985b (Lăcătuşu *et al.*); 1999 (Popa & Cojocneanu); 2008 (Orosz)
VIII	**FAMILY CICADELLIDAE**		
1.	*Empoasca decipiens* Paoli, 1930	Central and Southern Europe / Western Palaearctic	1972 (Nast); 1975 (Cantoreanu); 2002 (Popa); 2006 (Orosz); 2013 (Acs *et al.*)
2.	*Empoasca pteridis* (Dahlbom, 1850)	Central Europe / Western Palaearctic	1971 (Cantoreanu); 1999 (Popa & Cojocneanu); 2002 (Popa); 2013 (Acs *et al.*)
3.	*Empoasca vitis* (Göthe, 1875)	Conflicting information	1972 (Nast); 1999 (Popa & Cojocneanu); 2002 (Popa); 2008 (Orosz); 2009 (Stan *et al.*); 2010, 2011, 2013 (Tomoioagă *et al.*); 2011 (Chireceanu *et al.*); 2017 (Ficiu *et al.*)
4.	*Japananus hyalinus* Osborn, 1900	Eastern Asia (Japan) / Eastern Palaearctic	1961 (Wagner & Franz, the first European records, from Austria and Romania, published in 1961); 1972, 1987 (Nast); 2002 (Popa); 2011 (Chireceanu & Gutue)
5.	*Macropsis elaeagni* Emeljanov, 1964	Central Asia Western Palaearctic	1984 (Lauterer); 1987 (Nast); Roques Alain, DAISIE Species Factsheet
6.	*Orientus ishidae* (Matsumura, 1902)	Eastern Asia / Eastern Palaearctic	2017b (Chireceanu *et al.*)
7.	*Phlogotettix cyclops* (Mulsant et Rey, 1855)	Unclear ?Asia and Russia	1977, 1981 (Dlabola); 2017a (Chireceanu *et al.*)
8.	*Scaphoideus titanus* Ball, 1932	Northeastern parts of USA and South Canada /Nearctic	2011b (Chireceanu *et al.*); 2012 (Ploaie & Chireceanu) 2016 (Orosz & Tóth); 2017a (Chireceanu *et al.*)
IX	**FAMILY CIXIIDAE**		
1.	*Reptalus panzeri* (Löw,1883)	? Central Europe / Western Palaearctic	2009 (Jović *et al.*); 2010 (Bertin *et al.*); 2011b (Chireceanu *et al.*); 2012 (EPPO); 2013 (Acs *et al.*)
2.	*Cixius nervosus* (Linnaeus, 1758)	North of Mexic / Neotropical	1975 (Cantoreanu); 2014 (Bartlett *et al.*)
3.	*Cixius pallipes* Fieber, 1876	Central and est Mediterranean / Western Palaearctic	1972, 1987 (Nast)
4.	*Cixius wagneri* China, 1942	? East Mediterranean and Middle East / Western Palaearctic	1987 (Nast)
5.	*Hyalesthes obsoletus* Signoret, 1865	Middle Asia / Western Palaearctic	1971, 1975 (Cantoreanu); 2011 (Ember *et al.*)
X	**FAMILY COCCIDAE**		
1.	*Ceroplastes sinensis* Del Guerco, 1900	Central or South America (based on cladistic analysis) / Neotropical	1982 (Tudor); DAISIE Species Factsheet (Giuseppina Pelizzari, Germain Jean-Francois)
2.	*Coccus hesperidum* Linnaeus, 1758 (syn. *Lecanium hesperidum*)	Tropical, subtropical Cosmopolitan Cryptogenic	1930 (Knechtel); 1982 (Săvescu); 1974 (Peiu); 1980 (Costescu, *In* Boguleanu *et al.*); 1982 (Săvescu *et al.*); 1985 (Kozár); 1989 (Perju *et al.*); 1993 (Ben-Dov); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2008c (**Teodorescu**); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei); 2010 (Tucă *et al.*)

Table 1 (continued)

3.	*Eriopeltis lichtensteini* Signoret, 1877	Euro-Siberian / Western Palearctic	2002 (Fusu *et al.*); 2003 (Fusu & Popescu)
4.	*Lecanopsis turcica* (Bodenheimer, 1951)	? / Western Palaearctic	2016 (Kaydan *et al.*)
5.	*Luzulaspis dactylis* Green, 1928	? / Western Palaearctic	2010 (Fetyko *et al.*); 2016 (Kaydan *et al.*)
6.	*Parasaissetia nigra* (Nietner, 1861)	Africa /Afrotropical Cosmopolitan	2012 (Ben Dov, 2013)
7.	*Parthenolecanium corni* (Bouché, 1844)	Doubtful North America or Europe Cosmopolitan	1943, 1944, 1960 (Săvescu); 1957 (Georgescu *et al.*); 1960 (Suciu); 1971 (Simionescu *et al.*); 1974 (Lăcătuşu *et al.*); 1974 (Peiu); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1982 (Săvescu); 1982 (Tudor); 1988 (Kosztarab & Kozár); 1990a (Moglan); 1989 (Perju *et al.*); 1993 (Ben-Dov); 1997 (Simionescu & **Teodorescu**); 1997, 2000, 2007 (Moglan); 1999 (CABI & EPPO); 2000 (Simionescu, Mihalache *et al.*); 2001 (**Teodorescu** & Simionescu); 2003 (Fusu & Popescu); 2006 (Mustaţă Mariana *et al.*); 2012 (Ţucă)
8.	*Parthenolecanium fletcheri* (Cockerel, 1893)	Northern America / Nearctic	1961, 1982 (Săvescu); 2003 (Fusu & Popescu)
9.	*Parthenolecanium persicae* (Fabricius, 1776)	Unknown ? nemoral and subtropical forests of East Asia Cosmopolitan	1963 (Rogojanu); 1977 (Zahradník); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1979 (CIE); 1978 (Drugescu); 1997 (Moglan); 1985 (Kozár); 2003 (Fusu & Popescu); 2012 (Ţucă)
10.	*Parthenolecanium rufulum* (Cockerell, 1903)	Central Europe / Western Palaearctic	1944 (Săvescu); 1954 (Eliescu & Disescu, according to Săvescu 1982); 1957 (Georgescu *et al.*); 1971 (Simionescu *et al.*); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1979 (CIE); 1982 (Săvescu); 1982 (Tudor); 1985 (Kozár); 1997 (Simionescu & **Teodorescu**); 1997 (Moglan); 2000 (Simionescu); 2001 (**Teodorescu** & Simionescu); 2003 (Fusu & Popescu); 2006 (Moglan & Fusu): 2007 (Moglan)
11.	*Physokermes hemicryphus* (Dalman, 1826)	? Central Europe / Western Palaearctic	1985 (Kozár); 2010 (Fetyko *et al.*)
12.	*Physokermes inopinatus* Danzig & Kozár, 1973	? Central Europe / Western Palaearctic	2010 (Fetykó *et al.*)
13.	*Physokermes piceae* (Schrank, 1801)	North America / Nearctic	1961 (Săvescu); 1962, 1975 (Rogojanu); 1982 (Săvescu); 1985b (Lăcătuşu *et al.*); 1985 (Kozar); 2000 (Simionescu *et al.*); 2007 (Moglan): 2010 (Fetyko *et al.*)
14.	*Pulvinaria floccifera* (Westwood, 1870)	Asia temperate (Japan) / Eastern Palaearctic Cosmopolitan	1960, 1982 (**Săvescu**); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei)
15.	*Pulvinaria regalis* Canard, 1968	?Asia temperate / Eastern Palaearctic	1982 (Săvescu); 1993 (Ben-Dov, as *Pulvinaria savescui*); 2009 (Preda *et al.*)
16.	*Pulvinaria vitis* (Linnaeus, 1758) syn. *P. betulae* (Linnaeus) Signoret, 1873	Apparently Europe / Western Palaearctic Cosmopolitan	1960, 1962 (Săvescu); 1975 (Rogojanu); 1978 (Drugescu); 1980 (**Teodorescu** & Ceianu); 1982 (Tudor); 1986 (Duschin); 1989 (Perju *et al.*); 2007 (Paşol *et al.*); 2008b (**Teodorescu**); 2009 (Stan *et al.*); 2009 (Mitrea *et al.*); 2010 (Fetyko *et al.*); 2017 (Ficiu *et al.*)
17.	*Pulvinariella mesembryanthemi* (Vallot, 1829)	South Africa / Afrotropical Cosmopolitan	1997 (**Teodorescu** & Procheş): 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei)

Table 1 (continued)

18.	*Saissetia coffeae* (Walker, 1852) syn. *Saissetia haemisphaerica* Hall, 1922	Afrotropical Cosmopolitan	1930 (Knechtel); 1982 (Săvescu); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei): 2010 (Fetykó *et al.*)
19.	*Saissetia oleae* (Olivier, 1791	Southern districts of Cape Province, South Africa / Afrotropical Cosmopolitan	1982 (Săvescu); 2003 (Fusu & Popescu); 2006 (**Teodorescu** *et al.*); 2010 (Fetykó *et al.*); DAISIE www.europe-aliens.org)
20.	*Sphaerolecanium prunastri* (Fonscolombe, 1834)	Southern and central Europe / Western Palaearctic	1961 (Săvescu); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1965 (Boţoc); 1978 (Drugescu); 1982 (Săvescu); 1982 (Tudor); 1988, 1990c, 1994b (Moglan); 1999 (Moglan & Cojocaru); 1995-1997 (Moglan); 1997 (Moglan); 2005, 2007 (Moglan); 2003 (Fusu & Popescu); 2005 (Kozar); 2012 (Ţucă)
XI	**FAMILY CRYPTOCOCCIDAE**		
1.	*Cryptococcus fagisuga* Lindinger, 1936	Based on studies of mitochondrial DNA, origin can be in south western Asia (Gwiazdowski, 2006)	1957 (Georgescu *et al.*); 1963 (Hoy); 1975 (Rogojanu); 1979 (CIE); 1988 (Kosztarab & Kozar); 1997 (Simionescu & **Teodorescu**); 2000 (Simionescu, Mihalache *et al.*); 2001 (**Teodorescu** & Simionescu); 1996, 2003 (Chira *et al.*); 1997, 1998 (Chira & Chira); 2007b (& Cicák); 2011 (Roibu *et al.*); 2015 (Mihál *et al.*)
2.	*Pseudochermes fraxini* (Kaltenbach, 1860)	Sibero-European / Palaearctic	1985 (Kozar); 2010 (Fetyko)
XII	**FAMILY DELPHACIDAE**		
1.	*Conomelus anceps* (Germar, 1821)	? /Western Palaearctic	1972, 1987 (Nast); 2008 (Pricop); 2014 (Bartlett *et al.*)
2.	*Conomelus lorifer* Ribaut, 1948	? / Western Palaerctic	1972, 1987 (Nast); 2006 (Orosz)
3.	*Conomelus odryssius* Dlabola, 1965	? / Western Palaearctic	1987 (Nast)
4.	*Herbalima eforie* (Dlabola, 1961)	? / Western Palaearctic	1972 (Nast)
5.	*Unkanodes tanasijevici* (Dlabola, 1965)	? / Western Palaearctic	1972 (Nast); 1982 (Asche)
XIII	**FAMILY DIASPIDIDAE**		
1.	*Aonidiella aurantii* (Maskell, 1879)	Tropical Asia / Oriental Cosmopolitan	1930 (Knechtel); 1997 (**Teodorescu** & Procheş); 1998 (Danzig & Pellizzari); 2010 (**Teodorescu** & Matei)
2.	*Aspidiotus nerii* (Bouché, 1833) syn. *A. hederae* Leonardi, 1898	Afrotropical or Mediterranan Cosmopolitan	1897 (Horvath); 1912 (Arion); 1961 (Săvescu); <1970 (CIE); 1974 (Lăcătuşu *et al.*); 1974 (Peiu); 1997 (**Teodorescu** & Procheş); 1980 (Costescu, in Boguleanu *et al.*); 1982 (Săvescu); 2006 (**Teodorescu** *et al.*); 2007 (Paşol *et al.*); 2008c (**Teodorescu**); 2010 (**Teodorescu** & Matei); 2010 (Tucă *et al.*); DAISIE, www.europe-aliens.org)
3.	*Aulacaspis rosae* Bouché, 1833	Unclear origin ?Asia Possible / Eastern Palaearctic Cosmopolitan	1897 (Horvath); 1961 (Săvescu); 1974 (Lăcătuşu *et al.*); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1980 (Costescu, *In* Boguleanu *et al.*); 1982 (Tudor); 1997 (**Teodorescu** & Procheş); 1998 (Danzig & Pellizzari); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei); 2015 (Mărginean Soporan) 2017a (Ciceoi Roxana *et al.*)
4.	*Carulaspis minima* (Signoret, 1869)	Mediterranean / Western Palaearctic Cosmopolitan	1988 (Kosztarab & Kozár); 2005 (Miller & Davidson)
5.	*Chionaspis salicis* (Linnaeus, 1758)	? Palaearctic	1988 (Kosztarab & Kozár); 1998 (Danzig & Pellizzari)

Table 1 (continued)

6.	*Chionaspis wistariae* Cooley, 1897	Asia (Japan, China) / Eastern Palaearctic	2010 (Pellizzari); 2010 (Pellizzari & Germain)
7.	*Chrysomphalus aonidum* (Linnaeus, 1758)	Southern America / Neotropical Cosmopolitan	1930 (Knechtel), 1988 (CIE); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei); 2013, 2014 (EPPO)
8.	*Chrysomphalus dictyospermi* (Morgan, 1889	Tropical Asia / Oriental Cosmopolitan	1930 (Knechtel); 1982 (Săvescu); 1997 (**Teodorescu** & Procheş); 1998 (Danzig & Pellizzari); 2006 (**Teodorescu** *et al.*); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei); 2014 (EPPO); DAISIE, www.europe-aliens.org)
9.	*Diaspidiotus gigas* (Thiem & Gerneck, 1934a)	? Eurasia Palaearctic	1961 (Săvescu); 1975 (Rogojanu); 1978 (Drugescu); 1982 (Săvescu); 2001a (Moglan)
10.	*Diaspidiotus ostreaeformis* (Curtis, 1843)	Probably the colder part of Europe / Western Palaearctic Cosmopolitan	1960 (Săvescu); 1974 (Peiu); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1982 (Săvescu); 1988 (Kosztarab & Kozár); 1985a (Lăcătuşu *et al.*); 1997 (Moglan); 2012 (Ţucă)
11.	*Diaspidiotus perniciosus* (Comstock, 1881)	East Asia China, Korea / Eastern Palaearctic Cosmopolitan	1933 (in Arad, Bihor, Timiş district. (http://www botanistii. ro/blog/insecte-daunatoare-plante-paduchele-din-san-jose/); 1954, 1960 (Săvescu); 1955 (Rogojanu); 1965 (Boţoc); 1966 (Borchsenius); 1969, 1975 (Săvescu & Isac); 1972 (Ciochia, Andriescu et al); 1972-1973 (Andriescu); 1974 (Lăcătuşu *et al.*); 1974 (Peiu); 1975 (Rogojanu); 1978 (Ciochia *et al.*); 1979 (Rogojanu & Perju); 1979-1980 (Ciochia *et al.*); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1982 (Săvescu); 1982 (Manolache & Boguleanu); 1983 (Perju *et al.*); 1988 (Kosztarab & Kozár); 1989 (Perju *et al.*); 1991 (**Teodorescu**); 1992 (Ciochia *et al.*); 1997 (Ciochia); 1997 (Ciochia & Boeriu); 1997 (Moglan Veronica); 1997, 2004 (Moglan); 1998b (**Teodorescu**); 2004 (Trandafirescu *et al.*); 2006 (**Teodorescu** *et al.*); 2006 (Mustaţă Mariana *et al.*); 2007 (Paşol *et al.*); 2008c (**Teodorescu**); 2008 (**Teodorescu** & Vlad Antonie); 2008 (Ioana & Frasin); 2010 (Fetykó *et al.*); 2012 (Ţucă); 2014 (EPPO)
12.	*Diaspis boisduvalii* Signoret, 1869	Southern America / Neotropical	1920 (Leonardi); 1997 (**Teodorescu** & Procheş); 1982 (Săvescu); 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei); 2010 (Fetykó *et al.*)
13.	*Diaspis bromeliae* (Kerner, 1778)	Southern America / Neotropical	2010 (Fetykó *et al.*); (DAISIE, www.europe-aliens.org)
14.	*Diaspis echinocacti* (Bouché, 1833)	Central America / Neotropical Cosmopolitan	1859 (according to Paşol, 2007); 2006 (**Teodorescu** *et al.*); 1997 (**Teodorescu** & Procheş); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei); 2010 (Fetykó *et al.*)
15.	*Dynaspidiotus abietis* (Schrank, 1776) syn. *Nuculaspis abietis*	Euro Siberian Irano Turanian / Western Palaearctic	1962, 1975 (Rogojanu); 2001 (Simon *et al.*); 2001 (Dieter *et al.*); 2010 (Fetykó *et al.*); 2011 (Isaia)
16.	*Epidiaspis leperii* (Signoret, 1869)	? Eurasia	1960, 1961 (Săvescu); 1974 (Peiu); 1975, 1979 (Rogojanu & Perju); 1980 (Peiu & Filipescu, *In* Boguleanu *et al.*); 1998 (Danzig & Pellizzari); 2007 (Paşol *et al.*); 2012 (Ţucă)
17.	*Fiorinia fioriniae* (Targioni-Tozzetti, 1869)	Tropical Asia (Southeast Asia) / Oriental Cosmopolitan	1930 (Knechtel); 1998 (Danzig & Pellizzari); DAISIE, www.europe-aliens.org
18.	*Gymnaspis aechmeae* Newstead, 1898	Cryptogenic Cosmopolitan	1953 (Balachowsky); 1982 (Nakahara); 2010 (Fetykó *et al.*); 2011 (Datamining-Invasive Species Databases)
19.	*Hemiberlesia lataniae* (Signoret, 1869)	Cryptogenic Cosmopolitan	1976 (CIE); 1998 (Danzig & Pellizari)
20.	*Hemiberlesia rapax* (Comstock, 1881)	Cryptogenic Cosmopolitan	1998 (Danzig & Pellizzari); DAISIE, www.europe-aliens.org)

Table 1 (continued)

21.	*Lepidosaphes beckii* (Newman, 1869)	Cryptogenic Cosmopolitan	1998 (Danzig & Pellizzari); 1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2010 (Fetykó *et al.*); 2010 (**Teodorescu** & Matei); DAISIE, www.europe-aliens.org; CIE
22.	*Lepidosaphes conchiformis* (Gmelin, 1790)	Uncertain Probably Asia Cosmopolitan	1961, 1982 (Săvescu); 1985 (Kozar); 2010 (Fetykó *et al.*)
23.	*Lepidosaphes gloverii* (Packard, 1869)	Cryptogenic Cosmopolitan	2010 (Fetykó *et al.*); DAISIE, www.europe-aliens.org)
24.	*Lepidosaphes newsteadi* (Šulc, 1895)	Central and western Europe /Western Palaearctic	1978 (Drugescu); 1988 (Kosztarab & Kozár)
25.	*Lepidosaphes pinnaeformis* (Bouche, 1851)	Uncertain Subtropical /Tropical zones, possibly Asia	2010 (Fetykó *et al.*)
26.	*Lepidosaphes ulmi* Linnaeus, 1758 syn. *Mytilaspis pomorum* Signoret, 1870	Uncertain Cosmopolitan	1944 (Săvescu); 1957 (Săvescu, as *Lepidosaphes populi* and *L. tiliae*); 1957 (Georgescu *et al.*); 1961 (Săvescu); 1971 (Simionescu *et al.*); 1974 (Lăcătuşu *et al.*); 1974 (Peiu); 1978 (Drugescu); 1975 (Rogojanu); 1979 (Rogojanu & Perju); 1982 (Săvescu); 1982 (Tudor); 1985b (Lăcătuşu *et al.*); 1991 (**Teodorescu**); 1994a, 1997, 2003 (Moglan); 1997 (Simionescu & **Teodorescu**); 2001 (**Teodorescu** & Simionescu); 2012 (Ţucă)
27.	*Leucaspis loewi* Colvee, 1882	Mediterranean / Western Palaearctic	1930 (Knechtel); 1975 (Rogojanu); 1998 (Danzig & Pellizzari); 2008 (Isaia & Manea); 2011 (Isaia)
28.	*Leucaspis pini* (Hartig, 1839)	Mediterranean / Western Palaearctic Cosmopolitan	1930 (Knechtel); 2008 (Isaia & Manea); 2011 (Isaia); 2010 (Fetykó *et al.*)
29.	*Leucaspis pusilla* Löw, 1883	Mediterranean / Western Palaearctic	1975 (Rogojanu); 2008 (Isaia & Manea); 2011 (Isaia)
30.	*Oceanaspidiotus spinosus* (Comstock, 1883)	Cryptogenic Cosmopolitan	2011 (Datamining-Invasive Species Databases DAISIE, www.europe-aliens.org
31.	*Parlatoria oleae* (Colvée, 1880)	Middle East or South Africa Cryptogenic Cosmopolitan	1966 (Rogojanu); 1988 (Kosztarab & Kozar); 1998 (Danzig & Pellizzari); 2010 (Fetykó *et al.*)
32.	*Parlatoria ziziphi* (Lucas, 1853)	Tropical Asia / Oriental Cosmopolitan	1998 (Danzig & Pellizzari); 2010 (Fetykó *et al.*) DAISIE, www.europe-aliens.org
33.	*Pinnaspis aspidistrae* (Signoret, 1869)	Tropical Asia, especially India, Ceylon / **O**riental	2010 (Fetyko *et al.*); (DAISIE, www.europe-aliens.org)
34.	*Pinnaspis buxi* (Bouche, 1851)	?Cosmopolitan Cryptogenic	2010 (Fetykó *et al.*)
35.	*Pseudaulacaspis pentagona* (Targioni-Tozzetti, 1886)	East Asia (Japan or China) / Eastern Palaearctic Cosmopolitan	1982 (Tudor); 1998 (Brăiloiu-Tanase): 2010 (Fetykó *et al.*); 2017b (Ciceoi Roxana *et al.*); DAISIE, www.europe-aliens.org
36.	*Targionia vitis* (Signoret, 1876)	? / Western Palaearctic	1975 (Rogojanu); 1982 (Săvescu); 1993 (Danzig)
37.	*Unaspis euonymi* (Comstock, 1881)	Temperate Asia / Eastern Palaearctic Cosmopolitan	1988 (Kosztarab & Kozar) 2015 Gutue *et al.*); 2017b (Ciceoi Roxana); 2017b (Ciceoi Roxana *et al.*) (DAISIE, www.europe-aliens.org)
XIV	**FAMILY ERIOCOCCIDAE**		
1.	*Acanthococcus aceris* Signoret, 1875	? / Holarctic	1966b (Rogojanu); 1985 (Kozár); 2010 (Fetyko *et al.*)

Table 1 (continued)

2.	*Acanthococcus roboris* (Goux, 1931)	? / Palaearctic	1966a (Rogojanu); 1982 (Tudor); 2010 (Fetyko *et al.*)
3.	*Anophococcus Agropyri* (Borchsenius, 1949)	? Central Europe / Western Palaearctic	1966a (Rogojanu); 1982 (Tudor); 1985 (Kozar); 1988 (Kosztarab & Kozár); 2003 (Fusu & Popescu); 2010 (Fetykó *et al.*)
4.	*Anophococcus Cingulatus* (Kiritchenko, 1940)	? / Eastern Palaearctic	2010 (Fetyko *et al.*)
5.	*Anophococcus inermis* (Green, 1915)	? Central Europe / Western Palaearctic	2010 (Fetyko *et al.*)
6.	*Anophococcus insignis* (Newstead, 1891)	? / Holarctic	2010 (Fetyko *et al.*)
7.	*Gossyparia spuria* (Modeer, 1778)	? / Cosmopolitan	1930 (Knechtel); 1961 (Săvescu); 1963 (Hoy); 1975 (Rogojanu); 1982 (Tudor); 2010 (Fetyko *et al.*)
8.	*Greenisca brachypodii* Borchsenius & Danzig, 1966	? / Western Palaearctic	1998 (Kozár & Nagy); 2010 (Fetyko *et al.*)
9.	*Kaweckia glyceriae* (Green, 1921)	? China, Corea, Rusia, Mongolia Kazahstan / Eastern Palaearctic	2010 (Fetyko *et al.*)
10.	*Neoacanthococcus centaurea* (Săvescu, 1985)	? Romania / Western Palaearctic	1985 (Săvescu); 2009 (Kozar); 2010 (Fetyko *et al.*); 2013 (Kozar *et al.*)
11.	*Eriococcus buxi* (Boyer de Fonscolombe, 1834)	Turanian-European / Western Palaearctic	1966a (Rogojanu); 1982 (Tudor); 1985 (Kozar); 2010 (Fetyko *et al.*)
12.	*Rhizococcus erinaceus* (Kiritchenko, 1940	? Romania, Ucraina / Western Palaearctic	2010 (Fetyko *et al.*)
13.	*Rhizococcus greeni* (Newstead, 1898)	? Central Europe / Western Palaearctic	2003 (Fusu & Popescu); 2010 (Fetyko *et al.*)
14.	*Rhizococcus munroi* (Boratynski, 1962)	Sibiric-European / Palaearctic	2013 (Kozár *et al.*)
15.	*Rhizococcus zygophylli* (Archangelskaya, 1931)	? / Eastern Palaearctic	2010 (Fetyko *et al.*)
XV	**FAMILY FLATTIDAE**		
1.	*Metcalfa pruinosa* (Say, 1830)	Eastern North America / Nearctic	2009a,b, 2011 (Preda & Skolka); 2009 (Preda *et al.*); 2009 (Bărbuceanu & Nicolaescu); 2010 (Gogan *et al.*); 2011, 2014, 2015a,b,c (Grozea *et al.*); 2011a (Chireceanu & Gutue); 2013 (Cean & Cean); 2014 (Grozea *et al.*); 2014 (EPPO); 2015, 2016 (Vlad & Grozea); 2015 (Bărbuceanu & Mihăescu); 2015 (Bărbuceanu *et al.*); 2016 (Vlad); 2013, 2016 (Don *et al.*); 2017a (Ciceoi Roxana *et al.*)
XVI	**FAMILY HOMOTOMIDAE**		
1.	*Homotoma ficus* (Linnaeus, 1758)	Central-Southern Europe and the Middle East / Western Palaearctic	1962 (Dobreanu & Manolache)
XVII	**FAMILY ISSIDAE**		
1.	*Palaeolithium distinguendum* (Kirschbaum, 1868)	Mediterranean / Western Palaearctic	1972 (Nast); 2005 (Mazzoni)

Table 1 (continued)

XVIII	**FAMILY KERMESIDAE**		
1.	*Kermes greeni* Bodenheimer, 1931	Mediterranean / Western Palaearctic	2003 (Fusu & Popescu)
2.	*Kermes quercus* (Linnaeus, 1758)	? Mediterranean / Western Palaearctic	1930 (Knechtel); 1957 (Georgescu *et al.*); 1961 (Săvescu); 1975 (Rogojanu); 1982 (Tudor); 1988 (Kosztarab & Kozar); 2003 (Fusu & Popescu)
3.	*Kermes roboris* (Fourcroy, 1785)	? Mediterranean ? Palaearctic or Oriental	1930 (Knechtel); 1961 (Săvescu); 1975 (Rogojanu); 1982 (Tudor); 1990b (Moglan); 2003 (Fusu & Popescu); 2011 (Roşca *et al.*)
XIX	**FAMILY MARGARODIDAE**		
1.	*Icerya purchase* (Maskell, 1878)	Australia /Australasian Cosmopolitan	1971 (CIE); 1988 (Kosztarab and Kozár); 1990-1996 (**Teodorescu** & Simionescu, 1997); 1997 (Simionescu & **Teodorescu**); 1993, 2014 (EPPO)
XX	**FAMILY MEMBRACIDAE**		
1.	*Stictocephala bisonia* Kopp &Yonke, 1977 (syn. *Ceresa bubalus* Fabricius, 1794)	North America / Nearctic	1955 (Popescu-Gorj); 1974 (Peiu); 1971, 1975 (Cantoreanu); 1979 (Rogojanu & Perju); 1980 (Peiu & Filipescu, in Boguleanu *et al.*); 1983 (Stoian); 1985b (Lăcătuşu *et al.*); 2002 (Popa); 2006 (**Teodorescu** *et al.*); 2006 (Mustaţă Mariana *et al.*); 2007 (Paşol *et al.*); 2009 (**Teodorescu**): 2009 (Stan *et al.*); 2011 (Popa & Roşca); 2011 (Datamining-Invasive Species Databases); 2012 (Ţucă); 2014 (Velichi); 2016 (Orosz & Tóth) DAISIE Species Factsheet Roques Alain
2.	*Stictocephala alta* (Walker, 1851)	Conflicting information	Datamining 2011 - Invasive Species Databases
XXI	**FAMILY ORTHEZIIDAE**		
1.	*Arctorthezia cataphracta* (Olafsen, 1772)	Unknown / boreoarctique des hauts sommets alpins	1958 (Rogojanu); 1978 (Kosztarab & Kozár)
2.	*Insignorthezia insignis* (Browne, 1887)	South America, probably Guyana and neighbouring countries / Neotropical	1935 (Rogojanu)
3.	*Newsteadia floccosa* (De Geer, 1778)	Boreal (Eurosiberian) / Palaearctic	1930 (Knechtel); 1952 (Morrison)**;** 1958, 1975 (Rogojanu); 2016 (Kaydan *et al.*)
4.	*Ortheziola marottai* Kaydan & Szita, 2014	Turanian-European / Western Palaearctic	2016 (Kaydan *et al.*)
5.	*Ortheziola vejdovkyi* Šulc, 1895	Vestern-European and montano-boreal / Palaearctic	1988 (Kosztarab & Kozár); 2014, 2016 (Kaydan *et al.*)
XXII	**FAMILY PEMPHIGIDAE**		
1.	*Pemphgus borealis* Tullgren, 1909	? / Northern Palaearctic	1939 (Baudys); 1998 (Gusic)
2.	*Pemphigus bursarius* (Linnaeus, 1758)	Western Palaearctic Cosmopolitan	1909 (Brândză according to Stănescu, 2009); 1940b (Knechtel & Manolache); 1957 (Georgescu); 1975, 1998 (Gusic); 1981 (Holman & Pintera); 2006 (Roman & Glăvan); 2009 (**Teodorescu**); 2011 (Ilie & Marinescu); 2015 (Ilie).
3.	*Pemphigus immunis* Buckton, 1896	? North-western Himalayan ?European and Asian	1998 (Gusic)

Table 1 (continued)

4.	*Pemphigus populitransversus* Riley ex Riley & Monell, 1879	North America / Nearctic	2011 (Roşca & Istrate)
5.	*Pemphigus populinigrae* (Schrank, 1801)	? / Europe, Asia	2009 (Hac)
XXIII	**FAMILY PHYLLOXERIDAE**		
1.	*Viteus vitifoliae* (Fitch, 1855) (syn. *Daktulosphaira vitifoliae* (Fitch, 1855) *Phylloxera vastatrix*) (Planchon, 1868)	Eastern North America / Nearctic	1864 (Knechtel & Knechtel, 1879, in Satu Mare, 1884); 1880 (Szanisló); 1884 (Chiţorani locality, Dealu Mare vineyards, Prahova district, Knechtel & Knechtel 1909), 1891 (Nicoleanu); 1959 (Manolache & Boguleanu); 1972 (Manolache *et al.*): 1974 (Lăcătuşu *et al.*); 1974 (Peiu); 1979 (Rogojanu & Perju); 1987 (Dumitru & Mărmureanu); 1989 (Perju *et al.*); 2006 (**Teodorescu** *et al.*); 2006 (Mustaţă Mariana *et al.*); 2007 (Paşol *et al.*); 2007 (Perju *et al.*); 2008c (**Teodorescu**); 2008 (**Teodorescu** & Vlad Antonie); 2011 (Popa & Roşca); 2014 (EPPO); 2015 (Ficiu *et al.*); 2017 (Galan & Petculescu).
XXIV	**FAMILY PSEUDOCOCCIDAE**		
1.	*Balanococcus boratynskii* Williams, 1962	Euro-Siberian / Palaearctic	2016 (Kaydan *et al.*)
2.	*Balanococcus orientalis* Danzig & Ivanova, 1976	? / Palaearctic	2016 (Kaydan *et al.*)
3.	*Fonscolombia europaea* (Newstead, 1897)	? / Palaearctic	2016 (Kaydan *et al.*)
4.	*Heterococcus nudus* (Green, 1926) syn. *H. agropyri* Săvescu	? Cosmopolitan	1985 (Săvescu); 1994 (Ben-Dov); 2013 (Danzig & Gavrilov-Zimin)
5.	*Mirococcopsis subterranean* (Newstead, 1893)	Euro-Siberian? Palaearctic	2016 (Kaydan *et al.*)
6.	*Peliococcus calluneti* (Lindinger, 1912 b)	Boreal (Eurosiberian) / Western Palaearctic	2010 (Fetyko *et al*., as *Spilococcus nanae* Schmutterer, 1957, as *Rhizoecus albidus* Goux)
7.	*Peliococcus turanicus* (Kiritshenko, 1932)	? Cosmopolitan	1985 (Săvescu, as *Eupeliococcus tragopogoni E. drabae*); 1994 (Ben-Dov)
8.	*Phenacoccus insularis* Danzig, 1971	Far East (Sakhalin and Kuril islands) Palaearctic	1984 (Săvescu, as *Phenacoccus prunispinosi*)
9.	*Phenacoccus aceris* (Signoret, 1875)	? / Tanspalaearctic	1975 (Rogojanu); 1978 (Danzig); 1985 (Săvescu, as *Paroudablis ulmi*); 1994 (Ben-Dov); 2010 (Fetyko *et al.*)
10.	*Phenacoccus piceae* (Löw, 1883)	? / Transpalaearctic	???? 1985 (Săvescu); 1985 (Kozar); 1994 (Ben-Dov); 2010 (Fetyko *et al.*)
11.	*Phenacoccus pumilus* Kiritshenko, 1936	? Possible Central Asia	1984 (Săvescu, as *Phenacoccus rehacekii*); 1994 (Ben-Dov)
12.	*Planococcus citri* (Risso, 1813) syn *Pseudococcus citri* (Risso, 1813)	Unclear Cosmopolitan Cryptogenic	1960, 1982 (Săvescu); 1997 (**Teodorescu** & Procheş); 1999 (CABI/EPPO); 2006 (**Teodorescu** *et al.*); 2007 (Paşol *et al.*); 2010 (**Teodorescu** & Matei), 2010 (Fetykó *et al.*)

Table 1 (continued)

13.	*Pseudococcus longispinus* Targioni-Tozzetti, 1867) syn. *P. adonidum* (L.)	Australia / Australasian Cosmopolitan	1930 (Knechtel); 1974 (Lăcătuşu *et al.*); 1982 (Săvescu); 1997 (**Teodorescu** & Procheş); 2005 (Ecobici *et al.*); 2004 (Porca & Biró); 2006 (**Teodorescu** *et al.*); 2007 (Paşol *et al.*); 2008c (**Teodorescu**); 2010 (**Teodorescu** & Matei); 2010 (Tucă *et al.*)
14.	*Pseudococcus mammilariae* (Bouché, 1844) syn. *Spilococcus mamillariae* (Bouche, 1844)	Subtropical and Mediterranean / Western Palaearctic	1997 (**Teodorescu** & Procheş); 2006 (**Teodorescu** *et al.*); 2010 (**Teodorescu** & Matei)
15.	*Volvicoccus volvifer* (Goux, 1945)	West Asia / Palaearctic)	2016 (Kaydan *et al.*)
XXV	**FAMILY PSYLLIDAE**		
1.	*Cacopsylla bidens* (Šulc, 1907) In many paper *C. pyricola*	? Central Asia / Eastern Palaearctic	1962 (Dobreanu & Manolache); 1992 (Straulea *et al.*); 1994, 2002 (Branişte *et al.*); 1999, 2007 (Chireceanu Constantina); 2006 (Mustaţă Mariana); 2008 (Ploaie *et al.*); 2008 (Branişte & Militaru); 2009 (Sestras *et al.*); 2012 (Cean *et al.*)
XXVI	**.FAMILY RHIZOECIDAE**		
1.	*Rhizoecus albidus* Goux, 1942	? / Transpalaearctic	1985 (Kozar); 2016 (Kaydan *et al.*); 2010 (Fetyko *et al.*)
XXVII	**FAMILY TRIOZIDAE**		
1.	*Trioza neglecta* Loginova, 1978	Southeastern and Central Asia / Eastern Palaearctic	1988 (Burckhardt); 1959 (Dobreanu & Manolache); 1998 (Zeidan-Gèze & Burckhardt); 2010 (Mifsud *et al.*); 1995 (Glowacka *et al.*); 2002 (Lauterer and Malenovský); DAISIE (Christian Cocquempot)
2.	*Trioza schrankii* Flor, 1861	Central Europe / Western Palaearctic	1962 (Dobreanu & Manolache); 1996 (Conci *et al.*); 2002 (Lauterer & Malenovský)
3.	*Trioza tatrensis* Klimaszewski, 1965	Northern Europe Western Palaearctic	1992 (Ossiannilsson)

Table 2

The species richness of alien Homoptera families reported in Romania

No.	Homoptera families	No. of species	%	No.	Homoptera families	No. of species	%
1	Acanaloniidae	1	0.456	15	Flattidae	1	0.456
2	Adelgidae	12	5.479	16	Homotomidae	1	0.456
3	Aleyrodidae	5	2.283	17	Issidae	1	0.456
4	Aphididae	63	28.767	18	Kermesidae	3	1.369
5	Asterolecaniidae	1	0.456	19	Margarodidae	1	0.456
6	Calophyidae	1	0.456	20	Membracidae	2	0.913
7	Cercopidae	1	0.456	21	Ortheziidae	5	2.283
8	Cicadellidae	8	3.652	22	Pemphigidae	5	2.283
9	Cixiidae	5	2.283	23	Phylloxeridae	1	0.456
10	Coccidae	23	10.502	24	Pseudococcidae	15	6.849
11	Cryptococcidae	2	0.913	25	Psyllidae	1	0.456
12	Delphacidae	5	2.283	26	Rhizoecidae	1	0.456
13	Diaspididae	37	16.894	27	Triozidae	3	1.369
14	Eriococcidae	15	6.849		Total	**219**	

Table 3
Dynamics of number of alien Homoptera species reported in Romania

Number of reported Homoptera species			
1859–1889	1900–1949	1950–1999	2000–2018
11	**44**	**112**	**52**

One or few reports do not mean that the species are not established or cannot establish in Romania. The cause of their accidental detection is their low capacity to multiply and spread, or their preference to the wild plants as hosts, their olygophagy or even low peculiar interest of researchers. But it is necessary to confer special attention to these species even if initially they have not a negative effect or only minor impact upon native biodiversity and ecological systems. In the invasiveness process, perhaps in all cases, after establishing in new zones, the alien species can develop rapidly high polyphagy, becoming invasive or pests.

In function of the capacity to carry out their normal vital activities, their adaptation degree to environmental changes ("the ecological valence") the non-native Homoptera species identified in Romania belong to four main categories: 1. species found only and typically overwinter outdoor; 2. species that live and reproduce only indoors, on ornamental and vegetable plants, in greenhouses, or on ornamental plants in different heated buildings; 3. few species found in indoor conditions but which can escape and develop outdoor during summer, and 4. species that are accidentally introduced with imported fruits. The species that can live, nourish and reproduce outdoor during summer have the possibility to spread and enter in other indoor locations, where they continue to multiply, but they do not resist in winter conditions and do not establish in the Romanian fauna. But, if actual climate change phenomenon continues and the temperature values increase, some of these species will be able to find some outdoor favourable microhabitats, to survive over winter and establish in new outdoor zone.

From the biogeographical point of view, the alien Homoptera species in Romania are included into the following regions: Palaearctic, Nearctic, Neotropical, Oriental, Afrotropical and Australasian, with dominance of the Palaearctic zone (Western and Eastern). Many species (at least 33%) now have a worldwide distribution (cosmopolitan species).

In Romania, similar to other countries, the Homoptera insects were probably introduced with fresh cut flowers, potted flowering plants, seeds, bulbs, grafts, potting mix and other planting materials.

NEW DATA ON ALIEN/INVASIVE HOMOPTERA SPECIES BETWEEN 2000 AND 2018

A number of 33 insect species, which attacked plant, was observed between 2000 and 2018 (Table 4). In five cases, the mean density values, attack intensity, effect on plant hosts were assessed and some control measures were applied.

The *Metcalfa pruinosa* presence and attack were registered in Bucharest, in two private gardens, in 2015–2018. In 2015, the first attack of huge intensity was observed in one garden in the Bucharest centre, on young *Albizia julibrisin* tree (under three meter height and only 8 cm diameter), weakened and stressed by a shadowed place with improper soil. The tree was practically defoliated due to a lot of factors: sap sucking by larvae, decreased photosynthesis rate because the leaves were covered with an abundant vax secretion, with honeydew eliminated by insects and with a black fungus growing on honeydew. The *Metcalfa* larvae were disposed along the main nerve of characteristic, long, bipinnately compound leaves and on the nerve of each leaflet (pinnae) facilitating the access to sap. The vax and honeydew were in so high quantities that they were present not only on the leaves but also even on the ground. The young tree was very seriously damaged, and in a few weeks died. The second attack was registered in 2016 in a northern Bucharest garden on one basal branch of high and vigorously *Albizia* tree (over 10 meters). The moderate attack intensity was solved by chemical control and later by mechanical control (sawing the attacked branch, before the adult insect appearance). This pest was also installed on a high number of cultivated and wild plants (Table 3), but the attack intensity was low or moderate. In 2017, *Metcalfa* was again present in this garden, but the number of attacked plants and the attack intensity decreased, and in 2018 attacks were observed only on few *Rosa*, *Ulmus* and *Parthenocissus quinquefolia*.

A *Hyalopterus pruni* attack was discovered on leaves and sprigs of young *Prunus* tree (four meter high and 12 centimeter diameter) between 2015 and 2017, in the same garden. The pest was extremely abundant, with very high density (>10/cm^2), and attack intensity. The pests were present also on the ground being knocked down by wind. The chemical treatments and washing with water jet under pression applied in 2015 and 2016 remained without effect, and the tree died.

A high attack of *Cacopsylla bidens* nymphs was registered on two old *Pyrus communis* trees, in May 2018. Following the attack, numerous black spots were observed on the foliage, while the leaves and the young fruits fell down prematurely and an abundant honeydew secretion covered all leaves, branches and stems. The honeydew droplets fell also on the ground, similar to raindrops. In order to decrease this very high level of attack intensity the two trees were washed using water jet under pression, five weeks consecutively.

An impressively and probably old attack of *Pseudalacaspis pentagona* was registered in 2017 on *Syringa vulgaris* stem and basal branches, with a high density of female scales (>12/cm^2). The attack was stopped with chemical treatment (concentrated soap solution and oil emulsion).

An attack of *Macrosiphum rosae* was registered on about all 70 *Rosa* varieties in the same garden, in 2016–2018. The attack was on young leaves and especially on buds, the very young leaves being rolled (pseudocecidia) and buds not flourished. The older leaves remained unattacked and the varieties with dark red flowers usually remained unattacked or with very low level of attack intensity.

On a little number of *Vitis vinifera* plants, *Viteus vitifolii* aerial galls were present on all young leaves (100% attack frequency) and with a high number of galls on each leaf. To diminish the level of the next generation of pests, all sprigs with attacked leaves were cut and destroyed.

Table 4

New data with alien Homoptera species and their host plants detected between 2000 and 2018

No.	Alien species	Plant hosts species/Families
1	*Aspidiotus nerii* (*A. hederae*)	*Nerium oleander* (Apocynaceae), *Hedera helix* (Araliaceae), *Asparagus acutifolius* (Asparagaceae), *Bugainvillaea glabra* (Nyctaginaceae), *Buxus sempervirens* (Buxaceae), *Parthenocissus quinquefolia* (Vitaceae)
2	*Asterodiaspis variolosa*	*Quercus robur* (Fagaceae)
3	*Aulacaspis rosae*	*Rosa* sp. (Rosaceae)
4	*Cacopsylla bidens*	*Pyrus communis* (Rosaceae)
5	*Chromaphis juglandicola*	*Juglans regia* (Juglandaceae)
6	*Chrysomphalus dictyosperni*	Fruit of *Citrus maxima*, *C. paradise*, *C. sinensis* (Rutaceae)
7	*Cryptococcus fagisuga*	*Fagus* (Fagaceae)
8	*Diaspidiotus perniciosus*	*Malus pumila* var. *domestica* (Rosaceae), *Parthenocissus tricuspidata* (Vitaceae), *Vaccinium myrtillus* (Ericaceae), *Ribes nigrum*, *Ribes uva-crispa* (Grossulariaceae)
9	*Epidiaspis leperii*	*Prunus*, *Pyrus* (Rosaceae)
10	*Hyalopterus pruni*	*Prunus domestica*, *Prunus armeniaca* (Rosaceae)
11	*Lecanium hesperidum*	Indoor: *Citrus limon*, *Murraya exotica* (Rutaceae); *Bugainvillaea glabra* (Nyctaginaceae)
12	*Lepidosaphes beckii*	*Citrus* fruits (Rutaceae)
13	*Lepidosaphes conchiformis*	*Pyrus communis* (Rosaceae); *Syringa vulgaris* (Oleaceae); *Tilia cordata* (Malvaceae)
14	*Lepidosaphes gloverii*	*Murraya* (Rutaceae)
15	*Lepidosaphes ulmi*	*Cornus mas* (Cornaceae); *Malus*, *Pyrus* (Rosaceae); *Robinia pseudoacacia* (Fabaceae)
16	*Macrosiphoniella sanborni*	*Chrysanthemum* (Asteraceae)
17	*Macrosiphum rosae*	*Rosa* sp. *Aurora*, *Bonica*, *First Lady*, *Floribunda*, *Fragonard*, *Honey Vanilla*, *Ingrid Bergman*, *Macha*, *Message*, *Pauls Scarlet*, *Rainbow Sorbet*, *Santana*, *Valencia*,*Velasquez*, *White Meidiland*, *Rosa canina* (Rosaceae)
18	*Metcalfa pruinosa*	*Acer negundo* (Aceraceae); *Albizia julibrissin*, *Robinia pseudoacacia* (Fabaceae); *Aesculus hippocastanum* (Sapindaceae); *Amaranthus* sp. (Amaranthaceae); *Atriplex hortensis*, *Chenopodium ficifolium*, *Spinacia oleracea* (Chenopodiaceae); *Prunus armeniaca*, *P. domestica*, *P. persica*, *Pyrus communis*, *Malus pumila* var. *domestica*, *Rosa* sp., *Rubus* sp. (Rosaceae); *Buxus sempervirens* (Buxaceae); *Campsis radicans* (Bignoniaceae); *Cirsium arvense* (Asteraceae); *Bellis perenis* (Compositae); *Cucumis sativus*, *Cucurbita pepo* (Cucurbitaceae); *Ficus carica*, *Morus alba* (Moraceae); *Ligustrum vulgare*, *Fraxinus* sp. (Oleaceae); *Lonicera japonica* (Caprifoliaceae); *Melissa officinalis* (Lamiaceae); *Mirabilis jalapa* (Nyctaginaceae); *Parthenocissus quinquefolia*, *P. tricuspidata*, *Vitis vinifera* (Vitaceae); *Philadelphus coronaries* (Hydrangaceae); *Ribes grossularia* (Grossulariaceae); *Sambucus nigra* (Adoxaceae); *Spathyphyllium floribundum* (Araceae); *Ulmus* (Ulmaceae)
19	*Myzus persicae*	- Indoor: *Capsicum annuum*, *Lycopersicon lycopersicum*, *Solanum melongena* (Solanaceae) - Outdoor: *Prunus persica*, *Armeniaca vulgaris* (Rosaceae)
20	*Panaphis juglandis*	*Juglans regia* (Juglandaceae)
21	*Parthenolecanium corni*	*Albizia julibrissin* (Fabaceae); *Buxus* (Buxaceae); *Morus* (Moraceae); *Prunus*, *Ribes nigrum* (Grossulariaceae); *Robinia pseudacacia* (Fabaceae); *Rosa canina* (Rosaceae); *Sambucus nigra* (Adoxaceae); *Vitis vinifera* (Vitaceae)
22	*Physochermes piceae*	*Picea abies* (Pinaceae)

Table 4 (continued)

23	*Pineus pini*	*Pinus* (Pinaceae)
24	*Pineus strobi*	*Pinus strobus* (Pinaceae)
25	*Pseudalacaspis pentagona*	*Syringa vulgaris* variety *Charles Joly* (Oleaceae)
26	*Quadraspidiotus gigas*	*Populus* (Salicaceae)
27	*Saissetia oleae*	*Asparagus acutifolius* (Asparagaceae); *Nerium oleander* (Apocynaceae)
28	*Stictocephala bisonia*	*Malus*, *Pyrus*, *Prunus*, *Persica*, *Cerasus* (Rosaceae) ; *Vitis vinifera* (Vitaceae); *Salix*, *Populus* (Salicaceae); *Tilia* (Malvaceae)
29	*Tetraneura ulmi*	*Ulmus minor* (Ulmaceae)
30	*Thecabius affinis*	*Populus pyramidalis* (Salicaceae)
31	*Trialeurodes vaporariorum*	- Indoor: *Hibiscus rosa-sinensis*, *botanika* and *brilliant* varieties (Malvaceae); *Pelargonium domesticum*, *P. peltatum* (Geraniaceae); *Saintpaulia ionantha*, *Desdemona* and *Snow Bunny* varieties (Gesneriaceae). - Outdoor: *Brassica oleracea* (Brassicaceae); *Capsicum annuum*, *Lycopersicon lycopersicum*, *Solanum melongena* (Solanaceae); *Cleome hassleriana* (Cleomaceae); *Cucumis sativus*, *Cucurbita maxima*, *C. pepo* (Cucurbitaceae); *Lactuca sativa* (Asteraceae); *Lonicera japonica* (Caprifoliaceae); *Mirabilis jalapa* (Nyctaginaceae); *Pelargonium domesticum*, *P. peltatum* (Geraniaceae); *Phaseolus vulgaris*, *Ph. coccineus* (Fabaceae); *Rumex patientia* (Polygonaceae); *Spinacia oleracea* (Chenopodiaceae)
32	*Unaspis euonymi*	*Syringa vulgaris* (Oleaceae)
33	*Viteus vitifolii*	*Vitis vinifera* (Vitaceae)

CONCLUSIONS

A series of non-native Homoptera species, recorded in Romania since the 19th century, to 2018 is presented in the present paper, indicating their presumably origin zone, biogeographic region, their first report in Romania, and in some cases, other subsequent bibliographical references. Through the compilation of bibliographic sources (295 papers) with 47 personal papers (one author or co-author, published between 1969 and 2010) and some not yet published data, a total of 219 Homoptera species belonging to 27 families, were identified in greenhouses (on vegetables and ornamental plants), in houses or different other controlled temperature conditions buildings, on ornamental plants, on open field vegetables, and other field crops, in orchards, gardens, parks, forests, as well as on imported tropical or subtropical fruits.

Certainly, this list is not complete, and can be supplemented with new or unknown records, but the present paper can complete the gaps in knowledge about the alien Homoptera species in Romania and offer new information in existing data base referring to these insects.

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NEW ICHNEUMONID PARASITOIDS (HYMENOPTERA: ICHNEUMONIDAE) OF THE EAST ASIAN INVASIVE SPECIES OF SAWFLY, *APROCEROS LEUCOPODA* (HYMENOPTERA: ARGIDAE), DEFOLIATOR OF THE FIELD ELM, *ULMUS MINOR* IN SOME DECIDUOUS FORESTS IN MOLDOVA (ROMANIA)

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In this paper we present some aspects about attack and biology of *Aproceros leucopoda* and two parasitoid species for this defoliator pest, native in the East Asia (Japan, China and the Eastern part of Russia). In Romania this defoliator pest was observed for the first time in 2005 on *Ulmus minor* Mill., but its presence was published later, in 2010 (Blank *et al.*). We obtain by rearings two new ichneumonid parasitoids species: *Itoplectis maculator* (Fabricius) and *Pimpla turionellae* (L.), (Hymenoptera: Ichneumonidae: Pimplinae) for *Aproceros leucopoda*. Both ichneumonid species *Itoplectis maculator* (F.) and *Pimpla turionellae* (L.) are larval parasitoids of *Aproceros leucopoda*, but its adults emerged from the pupae of the host.

Keywords: *Aproceros leucopoda*, *Ulmus*, new larvar parasitoid species, new host.

INTRODUCTION

Aproceros leucopoda Takeuchi, 1939 (Hymenoptera: Argidae) is an invasive defoliator pest of the *Ulmus* genus, introduced passively in Europe. It is native from Eastern Asia: Japan (Takeuchi, 1939), Russian Far East (Zhelochovtsev, Zinoviev, 1995), China (Wen & Wei, 1998). *Aproceros leucopoda* is a monophagous or oligophagous species of the *Ulmus* genus. In Europe, this defoliator was collected for the first time in Hungary and Poland (2003), then from Romania (Dulceşti, Neamţ county, 2005) and Ukraine (Luhansk, 2005).

The spreading of *Aproceros leucopoda* extended in its new areal, Europe, which had enlarged. Thus, *Aproceros leucopoda* was recorded from the Republic of Moldova (Timuş *et al.*, 2008, misidentified as *Arge* sp.), Austria (Altenhofer, 2009, in Blank *et al.*, 2010), Slovakia (Blank *et al.*, 2010), Serbia (Hirka, 2010), Italy (Zandigiacomo *et al.*, 2012), Germany (Kraus *et al.*, 2012), Croatia (Matošević, 2012), European Russia (Lengesova, 2012), Slovenia (de Groot *et al.*, 2012), Czech Republic (Roques *et al.*, 2013), Serbia (Glavendekić *et al.*, 2013), Belgium (Boevé, 2014), Netherlands (Mol & Vonk, 2015), Letonia (Mihailova, 2015), Bulgaria (Doychev, 2015), Switzerland (Roques *et al.*, 2016).

The first studies on the biology and control of *Aproceros leucopoda* were made in the Eastern Asia, in China, by Wu & Xin (2006). In Europe, the new area of this invasive sawfly, the studies on the biology and ecology were made by Lengesova & Mishchenko (2013) in the Middle Volga region, Russia.

However, *Aproceros leucopoda* was recorded for the first time in Europe and in all Western Palaearctic subregions by Stephan Blank, Raoul Constantineanu, Csóka György and Hideho Hara, published in a part of the project: "Identification of the wasp pest species of plants" (2004–2010) of the German Institute of Entomology, Leibniz Center for the Agricultural Research.

Anyway, Blank *et al*. (2010) have published the first paper on the recording of the *Aproceros leucopoda* in Europe. *Aproceros leucopoda* is a parthenogenetic and a multivoltine species, with four generations in Eastern Asia. In Romania it has at least two generations per year. In Eastern Asia, the only known natural enemy of *Aproceros leucopoda* is the parasitoid *Blondelia nigripes* (Fallén, 1810) (Diptera: Tachinidae) (Blank *et al*., 2010). Although, this parasitoid is a widespread Palaearctic species, not being recorded as a parasitoid of *Aproceros leucopoda* in Europe until now. In Romania it was recorded for the first time only the egg parasitoid, *Asecodes erxias* (Walker, 1848) (Hymenoptera: Eulophidae: Entedoninae) (Pricop *et al*., 2012). Milka Glavendekić (2013) had recorded in Serbia the larvae of the the predatory Harlequin ladybeetle, *Harmonia axyridis* (Pallas, 1773) (Coleoptera: Coccinellidae) feeding with larvae of *Aproceros leucopoda*, being the only predator known for this elm defoliator pest. Thus, in a nursery in the western part of Serbia (Šabac) she had observed a larva of *Harmonia axyridis* feeding on larvae of *A. leucopoda*.

MATERIAL AND METHODS

The field observations on the attack of *Aproceros leucopoda* and the collectings of its larvae, were made in the forests: Truşeşti, Botoşani county (Fig. 1), Roşcani and Gorban, Iaşi county. In the laboratory, the larvae of *Aproceros leucopoda* (Fig. 2) were fed with elm leaves, then they weaved a cocoon (Fig. 3), until they became pupae (Fig. 4) and adults (Fig. 5).

Fig. 1. A strong attack of *Aproceros leucopoda* with losing a substantial volume of leaves of *Ulmus minor* (Truşeşti forest, Botoşani county, June 2009).

Fig. 2. Larva of *Aproceros leucopoda.*

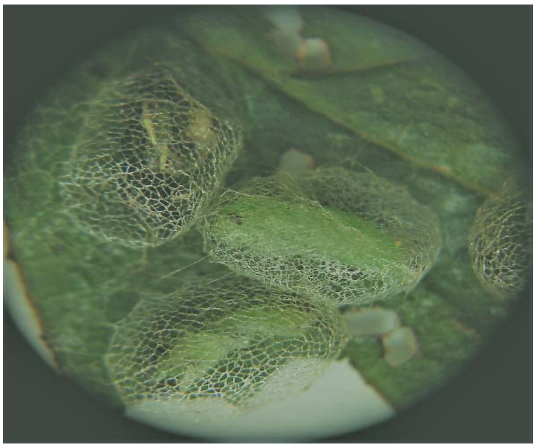

Fig. 3. Cocoons of *Aproceros leucopoda*.

A B

Fig. 4. The pupa of *Aproceros leucopoda*: A – dorsal view; B – ventral view.

A B

Fig. 5. Adult of *Aproceros leucopoda:* A – on elm leaves; B – dorsal view.

RESULTS

On 8.05.2009, 200 larvae of *Aproceros leucopoda* were collected from Truşeşti forest, Botoşani county. On 26.05.2009 one male emerged of the ichneumonid species *Itoplectis maculator* (F.), ♂ (Fig. 6).

Fig. 6. *Itoplectis maculator*, ♂, emerged.

On 3.06.2008, 200 larvae of *Aproceros leucopoda* were collected from Roşcani, near Paşcani town, Iaşi county. In the laboratory they became pupae and from one pupa one male of the ichneumonid species *Itoplectis maculator* (F.), ♂ emerged on 9.06.2008.

On 26.05.2009 200 larvae of *Aproceros leucopoda* were collected from Gorban forest, Iaşi county. In the laboratory they became pupae and from a pupa an ichneumonid species of *Itoplectis maculator* (F.), ♂ emerged on 10.06.2009.

Itoplectis maculator (F.) (Hymenoptera: Ichneumonidae: Pimplinae) (Fig. 6). The basic color of the body is black, with length of 8–10 mm. The female ovipositor is 2–5 mm length. It is a polyphagous species, its larvae parasitize over 75 species of pest insects of agriculture and forestry. It is a Holarctic species, in Romania being widespread, with large populations.

Aproceros leucopoda is a new host in science for *Itoplectis maculator* (F.).

On 28.05.2008, 50 larvae of *Aproceros leucopoda* were collected from Roşcani forest, Iaşi county and reared in the laboratory. In the laboratory they became pupae and 1 ♀ and 1 ♂ of the ichneumonid species *Pimpla turionellae* (L.) (Fig. 7) emerged, each from a pupa of the host, on 8.06.2008.

Fig. 7. *Pimpla turionellae*, ♀ from a cocoon of *Aproceros leucopoda.*

Pimpla turionellae (L.) (Hymenoptera: Ichneumonidae: Pimplinae) (Fig. 7). The basic color of the body is black, with a length of 5–12 mm, the female with an ovipositor not outrun ½ of the abdomen length. It is a polyphagous species, its larvae parasitize over 100 species of pest insects of agriculture and forestry. It is a Holarctic species, in Romania being widespread, with large populations. In the U.S.A., *Pimpla turionellae* (L.) was introduced in 1906 to control the gypsy moth, *Lymantria dispar* (L.). This ichneumonid parasitoid was established there. Also, *Pimpla turionellae* (L.) was introduced in 2009 and established in Central Asia to control gypsy moth, *Lymantria dispar* (L.) (Orozumbekov *et al*., 2009).

Aproceros leucopoda is a new host in science for *Pimpla turionellae* (L.).

CONCLUSIONS

In the present paper we record two larval ichneumonid species, emerged from pupae of *Aproceros leucopoda*: *Itoplectis maculator* (F.) and *Pimpla turionellae* (L.) (Hymenoptera: Ichneumonidae: Pimplinae).

Aproceros leucopoda Takeuchi is a new host in science for parasitoids *Itoplectis maculator* (F.). and *Pimpla turionellae* (L.).

Acknowledgements. We are especially grateful to Dr. Stephan Blank, Senckenberg German Entomological Institute Müncheberg for his correct identification of the defoliator of the field elm, *Aproceros leucopoda*.

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ABUNDANCE, LENGTH-WEIGHT RELATIONSHIP AND CONDITION FACTOR OF LUTJANIDS (SNAPPER) FROM SOMBREIRO RIVER, NIGERIA

OLANIYI ALABA OLOPADE, HENRY EYINA DIENYE

A study was conducted to investigate abundance, length-weight relationship and condition factor of Lutjanidae fishes in the Sombreiro River, Nigeria from January to June, 2018. A total of 173 specimens representing fish species were collected from five different sampling stations all along the river. The mean total lengths ranged from 23.97 ± 0.94 cm recorded for *Lutjanus goneensis to* 30.59 ± 2.47 cm for *Lutjanus campechanus* and mean weight varied between 188.67 ± 17.83 and 283.00 ± 35.69 for *Lutjanus goneensis* and *Lutjanus campechanus* respectively. The exponent b ranged from 2.52 recorded for *Lutjanus campechanus* to 3.48 recorded for *Lutjanus dentatus*. The mean values condition factor of the *five lutjanid* species studied ranged from 1.03 ± 0.08 to 1.39 ± 0.09. The estimated status of this fish family could provide valuable information for protection and conservation of these valuable stocks.

Keywords: length-weight relationships, condition factor, Lutjanidae, Sombreiro River.

INTRODUCTION

The Niger Delta region of Nigeria is blessed with the numerous river systems that are very rich in fish species and huge fishing opportunities for small scale fisheries. Sombreiro River a tributary of Niger River is one of the important rivers in Niger Delta, runs downwards into the Southern tip of the Niger Delta basin and empties into coastal lagoons and creeks bordering the Atlantic Ocean. (Ezekiel *et al*., 2011). The River occupies important place because of its fishery production, providing breeding grounds and nursery grounds for many commercially important species (Ezekiel *et al*., 2002) as well as fishing ground for artisanal fishery in the region.

Lutjanidae fishes are important ichthyofaunal components of Sombreiro River and are of considerable economic value. The fish family has 17 genera with about 113 species and the genus Lutjanus forms the largest genus (Allen, 1985). Schneider (1990) reported six species in the Gulf of Guinean water while Longhurst (1961) identified seven species in Nigerian water. Mostly marine in habitat but with some members inhabiting estuaries, feeding in fresh water (Nelson, 1984). Lutjanidae are estimated to have 10 spines, 14 soft dorsal rays, 3 anal spines and 8–9 anal soft rays, which is a determinant features that distinguished lutjanids from other similar fishes especially the so-called popular lady fish (Allen, 1985). Nigerian fish production by species for Lutjanidae was estimated at 9,742 tonnes out of 1027058 tones fish produced in 2015 (NBS, 2017). Previously it was abundant in coastal waters and rivers but now the populations are declining due to destruction of their habitats and overfishing (Ezenwa & Ayinla 1994). Exploitation status of the snapper species is suggested to be over-exploited in Nigerian coastal waters (Amiengheme, 1997, 2001).

Information on length-weight relationship of fish is important in fisheries assessment (Haimovici & Velasco, 2000). Length-weight relationship is an important input to the regional stock assessment as it is used to convert catches in weight into catch in number (Farley *et al*., 2012). Estimation of the population size of a fish stock for the purpose of its rational exploitation often requires knowledge of these relationships (Le Cren, 1951). Length-weight relationship also provides information on the condition factor.

In spite of its abundance and economic importance, studies on the lutjanid species from Nigeria are few and fragmentary. The objective of the present study was to provide size structure, and length-weight relationships and status of the family Lutjanidae from the Sombreiro River, Niger Delta region of Nigeria.

MATERIAL AND METHODS

The study was carried out in the Sombreiro River, Niger Delta region of Nigeria between latitude 60 301 and 70 01 E, and longitudes 40121 N and 600 171 N (Fig. 1) were chosen and sampled every month from April to September, 2018.

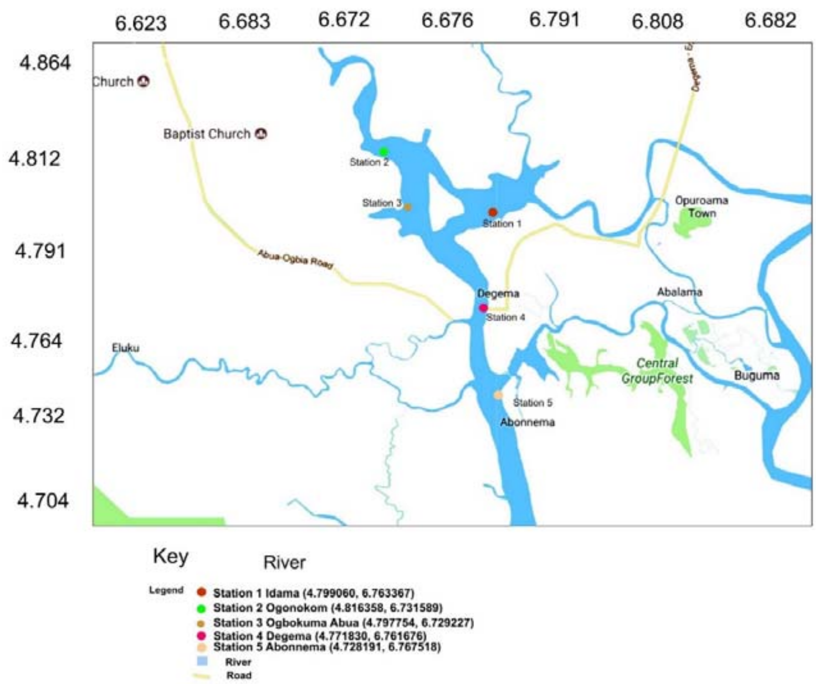

Fig. 1. Map of Sombreiro River showing study sites.

Fish samples were collected from five major fishing landing sites (Degema, Ogonokomi, Ogbokuma Abua and Abonnema). Captured fishes were identified to species level according to Schneider (1990). Total Length (TL) was measured to the nearest 0.01 cm using measurement boards and Body Weight (BW) was weighed by an electronic balance with 0.01 g accuracy for each individual. Length-weight relationship was calculated using the formula W = a Lb (Le Cren, 1951), where W is weight (g) and L is length (cm), a is a coefficient related to body form and b is an exponent indicating isometric/ allometric growth. Condition factor (K) was computed using the formula K = 100 w/L3 (Pauly, 1983); where W = weight (g) of a fish, L = total fish length (cm).

STATISTICAL ANALYSIS

Data were analysed using statistical analysis software (SAS 9.2) and Microsoft Excel 2003 software. Data were expressed as mean ± standard error of mean.

RESULTS

SIZES AND CATCH COMPOSITION OF LUTJANID SPECIES

A total of 173 specimens of five lutjanid species were caught during the study (Table 1). The most prevalent species was *Lutjanus endecancathus* (25.7%) followed by *L. goneensis* (25.2%) and *L. agennes* (24.0%) while of these five species the least occurrence species was *L. campechanus* (5.8%). The results of the size distribution for lutjand species are presented in Table 2. The length range obtained for *Lutjanus agennes. L. campechanus, L. dentatus, L. endecancathus*, and *L. goneensis* were 9.8–48.5 cm, 20.1–50.1 cm, 10.3–39.5 cm, 10.8–40 cm and 10.1–38.5 cm respectively. The mean total lengths ranged from 23.97 ± 0.94 cm recorded for *L. goneensis* to 30.59 ± 2.47 cm for *L. campechanus* and mean weights were 188.67 ± 17.83 g, 204.02 ± 18.32 g, 205.61 ± 16.67 g, 216.79 ± 17.91 g and 283.00 ± 35.69 g for *L. goneensis*, *L. agennes*, *L. endecancathus*, *L. dentatus* and *L. campechanus* respectively.

Table 1

Monthly fish catch of Lutjanid species

Species	**April**	**May**	**June**	**July**	**Aug.**	**Sept.**	**Total**	**Percentage**
Lutjanus agennes	5	0	24	0	6	6	41	24.0
Lutjanus campechanus	0	5	0	5	0	0	10	5.8
Lutjanus dentatus	11	11	0	7	4	0	33	19.3
Lutjanus endecancathus	8	4	10	10	12	0	44	25.7
Lutjanus goneensis	12	0	6	9	10	6	43	25.2
							171	100

Table 2
Mean weight, total length and standard length of Lutjanid species

Species	Weight (g)		Total Length (cm)	
	Mean ± SE	Range	Mean ± SE	Range
Lutjanus agennes	204.02 ± 18.32	20–500	24.75 ± 1.20	9.8–48.5
Lutjanus campechanus	283.00 ± 35.69	100–500	30.59 ± 2.47	20.1–50.1
Lutjanus dentatus	216.79 ± 17.91	20–411	26.53 ± 1.21	10.3–39.5
Lutjanus endecancathus	205.61 ± 16.67	25–411	24.73 ± 1.04	10.8–40
Lutjanus goneensis	188.67 ± 17.83	25–500	23.97 ± 0.94	10.1–38.5

The parameters of the length-weight relationships of lutjanid species are presented in Table 3. The exponent b ranged from 2.52 recorded for *Lutjanus campechanus* to 3.48 recorded for *L. dentatus*. The coefficients of determination (r2) of the length-weight relationships regressions ranged between 0.77 and 0.94. The mean condition factors of the lutjanid species studied were 1.36 ± 0.08, 1.03 ± 0.08, 1.20 ± 0.08, 1.39 ± 0.09 and 1.30 ± 0.07 for *L. agennes*, *L. campechanus*, *L. dentatus*, *L. endecancathus* and *L. goneensis* respectively.

Table 3
Overall condition factors and the growth pattern of fish catch

Species	N	a	b	r^2	K	Range	Growth pattern
Lutjanus agennes	41	-5.82	3.48	0.87	1.36 ± 0.08	0.44–2.60	Positive allometry
Lutjanus campechanus	10	2-.94	2.52	0.82	1.03 ± 0.08	0.40–1.30	Negative allometry
Lutjanus dentatus	33	-3.93	2.92	0.77	1.20 ± 0.08	0.53–2.39	Negative allometry
Lutjanus endecancathus	44	-3.48	2.73	0.79	1.39 ± 0.09	0.54–3.46	Negative allometry
Lutjanus goneensis	43	-3.02	2.59	0.94	1.30 ± 0.07	0.27–3.02	Negative allometry

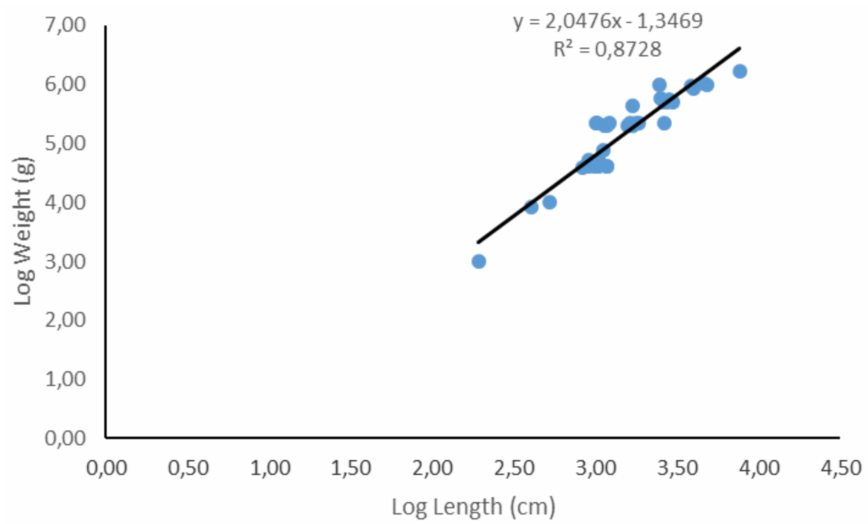

Fig. 2. Allometry growth patterns for the species *Lutjanus agennes*.

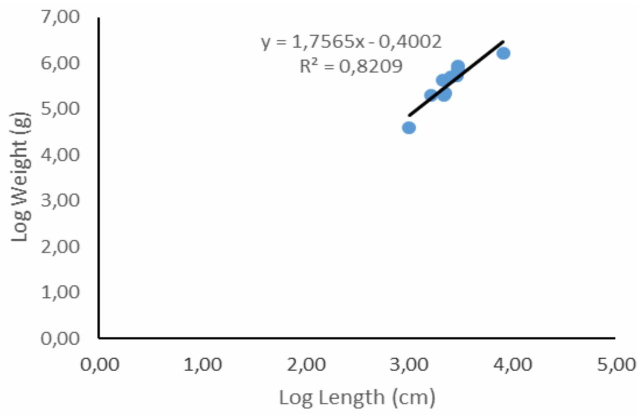

Fig. 3. Allometry growth patterns for the species *Lutjanus campechanus*.

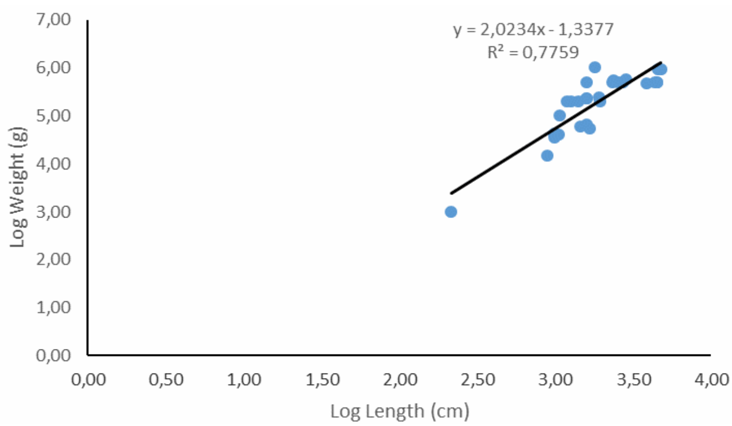

Fig. 4. Allometry growth patterns for the species *Lutjanus dentatus*.

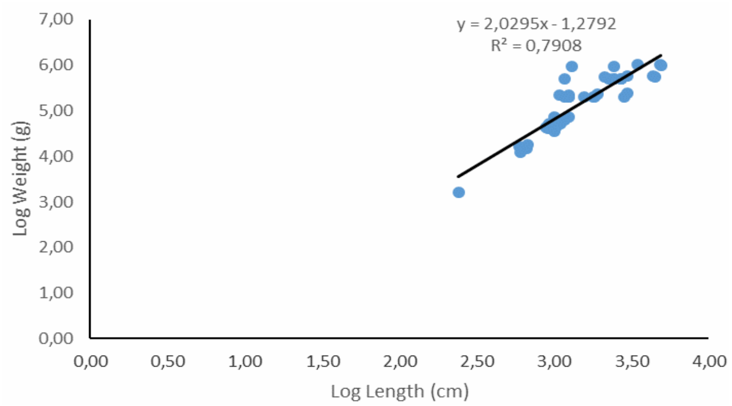

Fig. 5. Allometry growth patterns for the species *Lutjanus endecancathus*.

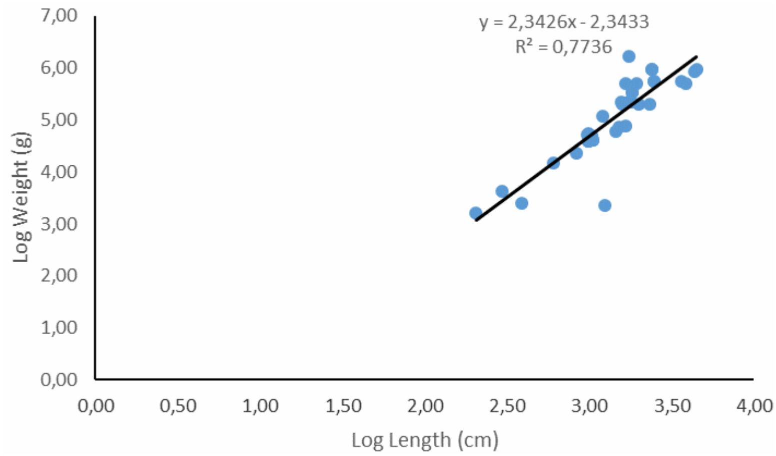

Fig. 6. Allometry growth patterns for the species *Lutjanus goneensis.*

DISCUSSION

Lutjanid species recorded in the current study included *Lutjanus agennes, L. campechanus, L. dentatus, L. endecancathus* and *L. goneensis*. The result is similar to Schneider (1990) who reported six species in the Gulf of Guinea. This is in contrast with the findings of Ibim & Bongilli (2016) who recorded only two species from the middle reach of the same river. These species recorded in this study appear to be more susceptible to artisanal fishing gear used by local fishers in the study area. The number of species could vary depending upon differences in the sampling methods and sampling effort, as well as fish abundance (Olopade & Rufai, 2014).

The mean sizes of lutjanid species obtained in this study ranged from 23.97 ± 0.94 to 30.59 ± 2.47 cm. Allen (1985) recorded the maximum total length of 80 cm for most lutjanids in the Gulf of Guinea. These results revealed that the size distributions of species studied were mainly juveniles. Apart from *L. endecancathus* with maximum total length of 20 cm the remaining five species recorded in the Gulf of Guinea varied in length from size range of 60–90 cm (Schneider, 1990). Kafayat *et al*. (2015) observed that *L. goneensis* with sizes ranging from 7.90–19.99 cm and 20.00–34.99 cm were believed to be juveniles and sub-adult members of the species, respectively. Schneider (1990) reported that young are frequently encountered in coastal waters, particularly estuaries and sometimes in rivers.

The results obtained in this study (Figs. 2–6) similar to Allen's (1985) reported that juveniles were more common on mangrove estuaries, creeks, coastal rivers and lower reaches of freshwater.

The exponent b is close to 3.0 for most species (Figs. 2–6) but when the value of b exceeds 3.0 (Fig. 3), fish become fatter and when the value falls below

3.0, fish become leaner. In this study four out of five species demonstrated allometry growth patterns with the b values varied between 2.52 and 2.92. These results suggest a pattern of distinct morphological similarity in the stocks of lutjanid species from the Sombreiro River. Only *L. dentatus* showed isometric growth and implies that fish become rotund as they grow in length (Anderson & Gutreuter, 1985). Ralston (1988) reported allometric growth for some lutjanid species from the Mariana Archipelago.

Growth pattern and growth rates are highly species specific .However, the variations in the value of the exponent 'b' could be attributed to factors such as seasonal fluctuations, physiological conditions of the fish at the time of collection, sex, gonadal development and nutritive conditions of the environment (Le Cren, 1951). Variations in these factors affect the growth rate and result in varying degrees of fluctuations in the growth rate within population (Gupta & Gupta, 2006). The correlation coefficient of lutjanids obtained in the present study varied between 0.77 (moderate) and 0.94 (high).

In this study the (K) condition factor of *Lutjanus* species ranged from 1.03 ± 0.08 to 1.39 ± 0.09 .This implies that fish species are in good condition during the study. But the values recorded are below that of Bagenal & Tesch (1978) which indicated a range of 2.9–4.8 as the ideal range of K value for the normal growth and utilization of nutrients by a normal fresh water fish. The value of condition factor depends upon the external environment of the fish. Based on the results of this study proper steps should be taken for the protection and conservation of these valuable fish species through effective fishing regulation measures.

CONCLUSIONS

This study has demonstrated that Sombreiro River harbors five lutjanid species with *L. endecancathus*, *L. goneensis* and *L. agennes*, account for almost 70% of the landings. The total length ranged from 23.97 ± 0.94 to 30.59 ± 2.47 cm indicating juveniles and sub-adult members of the species. Of the species examined, all were characterized by allometric growth and condition factor of *Lutjanus* species ranged from 1.03 ± 0.08 to 1.39 ± 0.09. The information gained in the present survey may be a valuable tool for the protection and conservation of lutjanid species in the Sombreiro River.

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THE CONCEPT OF ECOLOGICAL RE-ESTABLISHMENT OF SOME LARGE BAT POPULATIONS IN WOMEN CAVE FROM BAIA DE FIER (ROMANIA)

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All over the world, at least for some bat populations there is an alarming decreasing number of individuals. In most cases, this is a result of human pressure either using pesticides in forests and agriculture, disturbing their most preferred underground shelters and not in the least – because of wrong beliefs about bats, the man has a hostile attitude. In this article we are referring to a case of using a cave for touristic purposes and improvements there disturbed up to extinction some importand bat colonies. It is about Women Cave, close to Iron Bath (Baia de Fier, Gorj County). After several years of observations and finding explanation for lack of bats there we offer several concrete solutions to restore this underground habitat and to rehabilitate the former bat colonies. The project should allow both habitat and bat conservation, and prosperity for local human community. Up to our knowledge, this project has a unique character.

Keywords: anthropic pressure, habitat restoration, bat conservation, interest of local community, Women Cave from Iron Bath (Baia de Fier) locality.

INTRODUCTION

Important climate changes all over the world, with mildy winters are favoured conditions to agricultural pests (mainly insects) to develop up to invasion phenomena. A new topic for entomologists and for farmers is invasive alien species and their distribution both on latitude and altitude. This is why we are considering that international and national regulations for bat protection are important to preserve and as much as it is possible to increase bat populations. According to the EUROBATS policy to protect bats, since 2000 there is Law No. 90 for bat conservation in Romania.

No more necessary to comment bat importance in ecosystem physiology. At the beginning of XIX-th century, the German biologist Johann Leisler (1771–1813) wrote about the need to protect bats. Up to him, these mammals are the only which can control nocturnal pests for agriculture, orchards and forestry.

Unfortunately 6th and 7th decades of the last century were with drastic decrease of some bat populations from Romania, and in Europe some species became extinct. These happened because of abusive use of insecticids and pesticids.

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On the other side, in the same period it was an unusual development of uncontrolled tourism. Under the increased anthropic pressure on the underground shelters, both hibernation and nursery colonies were drastically disturbed and the result was numerically decreased individuals of bat species populations.

With this article we want to remember and promote some success projects in rehabilitation of underground habitats and restauration of former bat colonies.

CASE STUDIES

A. Our own data on bat populations from Romania are mainly after 1990. In 1995 we visited St. Grigore Decapolitul Cave (Fig. 1), close to Bistrița Monastery (Vâlcea County). In the past, that cave was an incredible shelter for bats. Dumitrescu *et al*. (1955) reported only three specimens of *Plecotus austriacus,* but there were visible parts of torches, fireplaces and arrangements of bivuacs in the cave.

After 1990, the Monastery's staff together with superior mother Mihaela Tamaş were very receptive to our suggestion to close the cave with a metallic gate to protect the speleothemes, disturbing bats and against vandalization of the monarchic building from inside the cave. In this way bat populations were better protected.

In 1997, we observed first a small colony of *Minioptrus schreibersii* installed in this cave for hibernation. Only in three years (in 2000) the colony of Schreibers' long-fingered bat was with 400 individuals for hibernation and 900 individuals for nursery colony.

However, we observed on the 18th December 2001 a decreased number of bats in St. Grigore Decapolitul Cave. Therefore on the occasion of a LIFE 00 NATURE/RO/7187 Project we decided to monitorize the site for four years. Thus we found that the decreasing number of bats was because of touristic activities organized by Monastery's staff to get money. Also, occasionally it was fire in the hermitage stove (Fig. 2 A, B).

Firstly we established a certain way for visitors, avoiding the entrance in the neighbour galleries where bats were sheltered.

Secondly it was prohibited fire in cave and in 2004 it was possible to use an electric heater in hermitage.

Third – Monastery's guide was informed and advised to ask visitors to respect regulations for persons who are visiting sites with bats; tourists were also informed with these rules printed on large panels in front of the entrance in the gallery.

Fourth – the electric light for visitor track avoided places with bats.

Fifth – we provided the Monastery library with flyers to inform visitors about the need to protect bats (Decu *et al.*, 2003; Murariu *et al.*, 2007).

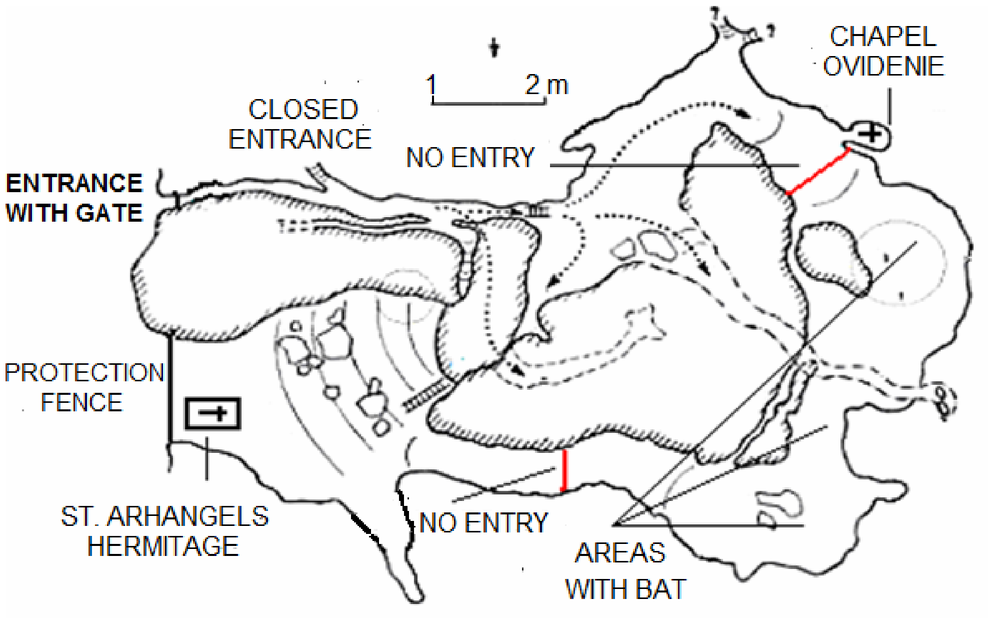


Fig. 1. Map of St. Grigore Decapolitul Cave (Bat Cave from Bistrița Monastery) (Dumitrescu *et al*., 1955).

We can conclude that measures for minimum protection (*e.g.*, setting a gate) and control of tourism in the cave, respecting regulations for bat protection, led to an incresing number of hibernating bats from 180 individuals in December 2001, to 998 individuals in December 2002. After 2002, Schreibers' long-fingered bat formed a colony of about 1000 individuals and *Rhinolophus ferrumequinum*, *R. hipposideros*, *Myotis myotis* and *M. blythii* – about 200–250 individuals.

The nursery colonies increased constantly: 2950 individuals in 2002; 3040 individuals – in 2003 and 3800 – in 2004. They were species of *Myotis* – mostly *M. myotis*, *M. oxignatus* and *Minioptrus schreibersii*. Dumitrescu *et al*. (1962–1963) evaluated only *Myotis myotis* to about 3000 individuals.

A positive factor for presence of bats in St. Grigore Decapolitul Cave was also a decreasing number of tourists, because most of them were more attracted by the neighbour underground karstic structures – Polovragi and Women Caves (Gheorghiu & Murariu, 2007; Gheorghiu *et al.*, 2007). This experience with success in rehabilitation a shelter with nursery and hibernating chiroptera was the first one in Romania and one of the less known at those time in the world.

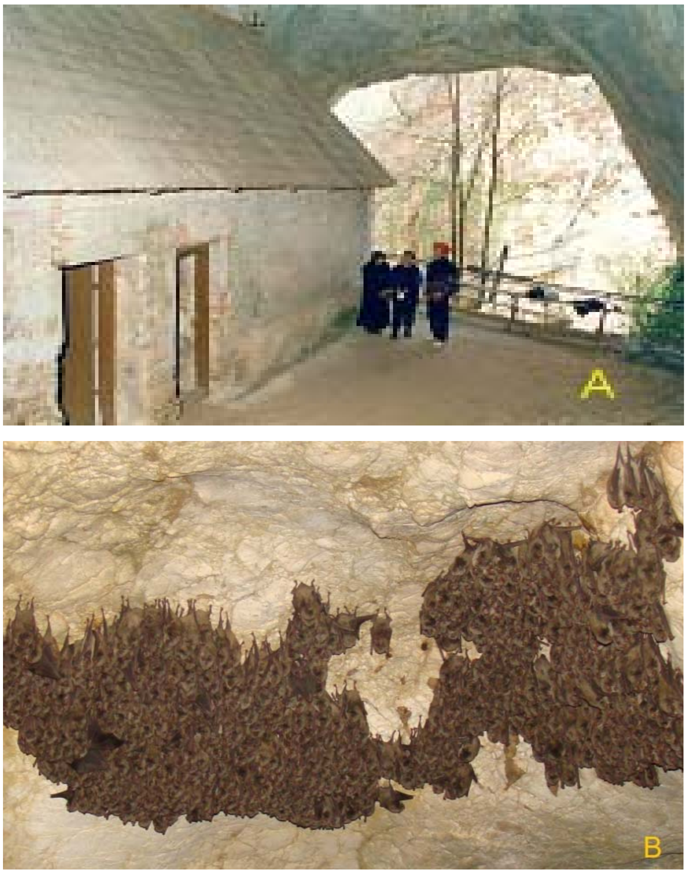


Fig. 2. A – St. Arhangels Hermitage; B – Hibernating colony of *Miniopterus schreibersii* in St. Grigore Decapolitul Cave from Bistrița Monastery.

B. Another interesting and successful experience in bat's shelter protection we had between 2004–2008. In November 2003, visiting Dry Ciclovina (Ciclovina Uscată) Cave in Septei Room (Fig. 3) we observed a small group of bats. They were no more than 10 individuals of (probably) *Myotis myotis/M. blythii*.

Dry Ciclovina Cave is one of the underground shelters from Romania, which between 1912–2003 supported one of the most aggressive anthropic pressures. From there a deposit of guano-phosphate was under industrial exploatation for more than nine decades.

Also, in that cave there is an important paleontological deposit, with some fossils of *Homo sapiens* too. For geologists, this cave is *locus tipicus* of *Ardealit* phosphatic mineral.

All these characteristics justified inclusion of Ciclovina Uscată Cave on the UNESCO List of the World Heritage and urgently Intitute of Speleology "Emile

Racovitza", Romanian National Geographic specialists, the Group of Speleological Exploration and Diving, together with a group of volunteers from the United States of America have taken measures to protect this site. The Project was named "Romania 2004 – Cave Bear Project" and was financed by the American Group of explorers.

A local NGO – the Speleological Association "Proteus" from Hunedoara County and Speleological Association "Live Fire" ("Focul Viu") were implied in the Project and made a documentary movie entitled "The second extinction of the cave bear". Since 2005, the financial support of the Project was granted by the Romanian Academy (GAR 69/2005; 72/2006; 87/2007 and 147/2008) to the Bucharest's Institute of Speleology "Emil Racovitza" as a topic of scientific research.

Since the beginning we considered necessary an ecological restoration of Dry Ciclovina (Fig. 3). First it was necessary to restore the environmental conditions which were before the anthropic works in site. In 2004 and in 2005 at about 130 m distance from the entrance we set tight gates to separate the Anthropic Tunnel of access in the cave. This tunnel was degt between the First and Second World War to facilitate the guano-phosphate exploitation. Closing this hall it was re-established the ecological microclimate in the cave, on the one side, and it has avoided the entrance of the unauthorized visitors inside the cave on the other side. At about 10 m behind the Natural Entrance in the cave, we mounted a metallic gate (Fig. 4 A and B), with horizontal bars to allow bats flights.

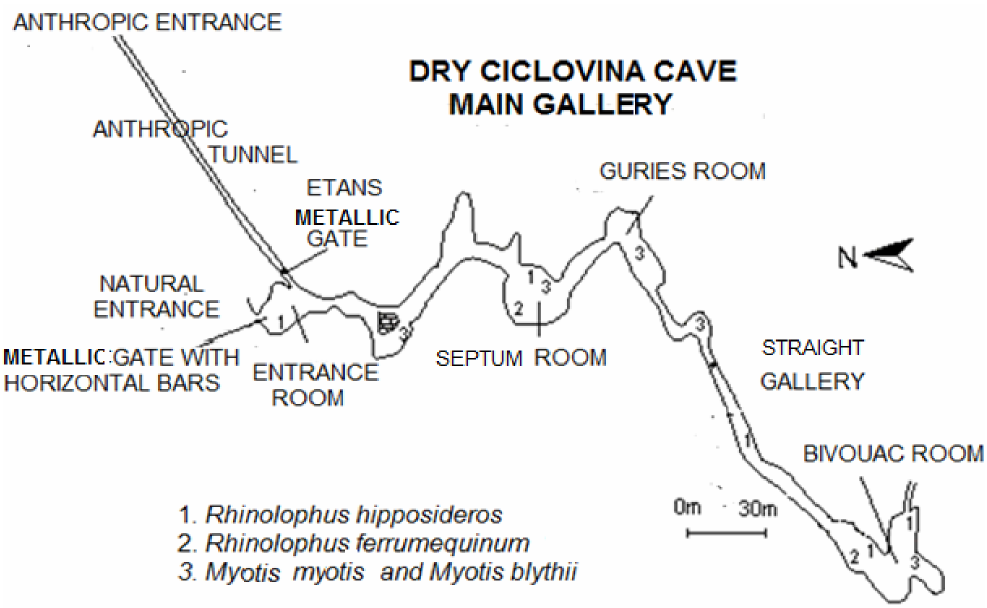


Fig. 3. Map of the Dry Ciclovina Cave (after "Proteus" Speleological Club from Hunedoara County).

In the monitoring process of ecological factors restoration in the underground habitat and changing unfourable effects of the anthropic impact on biodiversity from Dry Ciclovina Cave we considered as an important part to observe as principal vector the presence and dynamics of bat populations in this site. It is known that the bats are the best bioindicators about the new ecological conditions and are the first beings which repopulate a habitat with favourable conditions for their low metabolism in the hibernating period. To these we also considered important bats fidelity for a shelter with suitable conditions (Fig. 4 C). On the other hand, only 5% of total caves (more than 12,000 in Romania) are favourable for nursing colonies. At the same time, bat colonies in a subterranean habitat increase organic substances or guano deposits important as a trophic base for cavernicolous invertebrate fauna.

However, the results in ecological restauration of Ciclovina Uscată Cave as an underground habitat prove increasing bat populations: 10 individuals in 2003; 83 individuals – 2004; 406 individuals – 2005; 520 individuals – 2006; 801 individuals in the winter 2007–2008 (Table 1). The success was not only numerical, but also qualitative. If in 2004 there were identified only four bat species, in 2008 there were ten species.

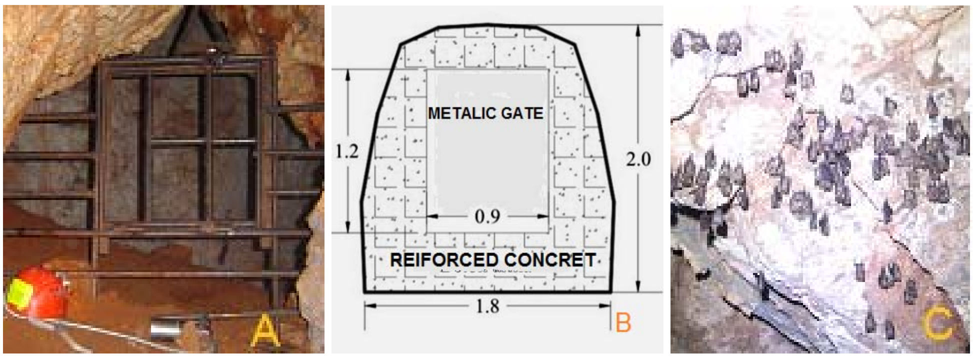


Fig. 4. A – Protecting gate at the Natural Entrance; B – Diaphragm of protection in the Anthropic Tunnel; C – Colony of *Rhinolophus ferrumequinum* in Bivouac Room of Dry Ciclovina Cave.

The serious quantitative and qualitative improvement of bat populations (increasing 80 times) was recorded in only four years of monitoring. Therefore this project could be considered as a model of ecological reconstruction which can be applied in other similar cases.

At the same time, on the occasion of ecological restoration monitoring they were also developed important surveys of mineralogy, sedimentology and palaeomagnetism in Dry Ciclovina Cave (Dumitraş *et al*., 2009). A cooperation relation of biologists with archaeologists allowed to be published some interdisciplinary articles on palaeoanthropology and anthropology.

Considering that our successful experience can be used as working tool to rehabilitate and preserve underground habitats we co-operated with 14 scientists and printed a volume with our above mentioned results (Gheorghiu *et al*., 2007; Petculescu & Murariu, 2009).

Table 1

Dynamics of increasing chiroptera populations in Dry Ciclovina Cave

Species	2003*	Hibernating period			
		2004–2005**	2005–2006	2006–2007	2007–2008
Myotis myotis/M. blythii	**10**	–	–	–	–
Rhinolophus hipposideros		**4**	**24**	**45**	**99**
R. ferrumequinum		**8**	**138**	**182**	**140**
Myotis myotis/M. oxygnatus		**71**	**244**	**286**	**562**
Miniopterus schreibersii		–	–	**8**	–
Total	**10**	**83**	**406**	**520**	**801**

Legend:
* Observation on 18.11.2003, before starting the ecological of the site.
**First visit for observation was on 14.11.2004, after closing Anthropic Tunnel in Dry Ciclovina in July 2004) and beginning the ecological reconstruction.

CONCLUSIONS FOR CASE STUDIES

1. Protecting systems placed in site proved their viability and resisted to the attitudes of vandalization; prohibiting auto access in that area decreased touristic pressure.
2. The model and methods used for ecological rehabilitation of Dry Ciclovina Cave (constructions and setting the diaphragm in ther Anthropic Tunnel) proved to be of great success.
3. All along the year, the temperature inside the cave became relatively constant; missing air flow allowed increase of the Relative Humidity.
4. The spectacular increase of the number of bats in only four years: 2003 – 10 individuals; 2004 – 83 individuals; 2005 – 406 individuals; in 2006 – 520 individuals; in 2007 – 801 individuals, was because of the new climatic conditions inside the cave.
5. In all Ponorici – Ciclovina karstic systems, Dry Ciclovina Cave became the most important hibernation shelter for bats (Table 1).
6. Observations and surveys using Bat Detector in 2006 allowed identification of more bat species in Dry Ciclovina Cave.
7. Monitoring bat species using a Bat detector, in 2006 we identified ten bat species, comparing with six species identified in 2005.

8. According to our observations, because of a reduced amount of guano, the invertebrate cavernicolous fauna is very poor in this cave.

9. Entomologists should mainly observe less collecting cavernicolous arthropods.

10. Next observation and monitoring of numerical and specific increase of chiroptera populations in Dry Ciclovina Cave should be compared with bat population structures in Ciclovina II Cave, Cioclovina with Water and Ponorici Caves from the area.

11. The results of this first monitoring project in Romania and ecological rehabilitation of one underground habitat drastically affected by anthropic pressure must encourage chiropterologists to trust in the possibility of rehabilitation of any underground habitat, to offer more shelters with optimum conditions both for hibernating and for nursery colonies.

A NEW PROJECT

Having success with rehabilitation of a bat population from St. Grigore Decapolitul Cave (Bistrița Monastery – Vâlcea County) as well as the ecological reconstruction of Dry Ciclovina cave as an underground habitat, we answered to a new provocation. It is about ecological reconstruction and restauration of one important shelter both for nursery and hibernating bat colonies in Women Cave from Iron Bath (Baia de Fier locality – Gorj County) up to half 20th century.

In a project LIFE NATURA 2000 we monitored chiroptera populations in this site, because in the Altar Room there are hibernating several hundreds of *Rhinolophus*. Based on our observations we recommended reorientation of lights to be off bat colony and for winter time to be prohibited Altar Room visits. The result was a three times increased number of bats for hibernation. Referring to the nursery colony in Guano Room, we observed a number of pregnant females of *Myotis myotis*, which dissapeared in May, when touristic pressure was increased.

In the last century, this site was deeply transformed by new improvements for touristic purposes, the Women Cave becoming the most visited in Romania. In the so-called Altar Room (Sala Altarului) it was an important colony of *Rhinolophus* and in time no more bats were there.

Visiting the cave we noticed that the lights were directed to the traditional place of bat colony. Changing the direction of lights and asking the administrator to close for visitors that room, immediately bats came back for hibernation. More, in spring, in a next-door room – Guano Room (Sala cu Guano) came several females of *Myotis myotis* to shelter for nursery period. Unfortunately, visitor’s track was under this small colony and bats moved away.

A first analysis of the situation was in May 2007 in a workshop organized by the Gorj County Environmental Protection Agency with Mayor of Baia de Fier locality, scientists from the "Emile Racovitza" Institute of Speleology in Bucharest, the Romanian Federation of Chiropterology and the Romanian Association for Bat Protection. In order to protect bats in Women Cave, in that meeting there was discussed the possibility to cease public tourism, but because of a project to develop agro-tourism in the area, the local community rejected this idea.

The conclusion of the Workshop was that scientists from the Romanian Academy offered an alternative both to protect bats and to continue tourism in the cave. For this it was necessary a deep improvement of visiting tracks to reconstruct former ecological conditions according to Law 90/2000 – before to open cave for public tourism.

Localisation: The Women Cave is situated close by the National Road 67, between Râmnicu Vâlcea and Târgu Jiu – 4 km distance. The lateral secondary road is modernized and and close to the entrance in cave there is a generous parking place, two hotels, one camping, two restaurants, three accomodation buildings plus agro-touristic units in the village.

A short history of the site and deep transformations in the cave could be useful to better understand the topic of bat protection there.

Women Cave from Iron Bath-Baia de Fier is located in Căpăţânii Mountains, on the Sabrupt slope Galbenu river gorges. It is to the western end of Garba Top (751 m altitude), toward south-eastern part of Parâng Mountains at only 2 km North, far from this locality (Fig. 5 and Fig. 6 A, B). The gazeteer is: 45° 10`N and 23°45`E. The Women Cave is included in Romanian Law 5/6 March 2000 being classified to position 2,424 with 19 ha area (Fig. 5). It is a speleological reservation of III-rd IUCN category (Monument of Nature).

According to the Environmental Minister Order No. 604/2005, the cave is evaluated in the Class A, except for the touristic part which is of Class B. We are interested only in this part.

The mentioned area of 19 ha is the cave projection outside in the Garba block limestone which has a statute of Natural Reserve (Fig. 5). Grateful to speogenetic, archaeological, palaeontological, mineralogical and biological importance, the cave is under the protection of the Nature Monuments Commission of the Romanian Academy.

In this cave there was first discovered in all karstic system from Romania a speleotheme association of *dahlitt* – in the Red Room. Here were also discovered fossils of *Homo sapiens.* So that because of the scientific and of specific *dahlitt* the Women Cave is on the patrimonial list of UNESCO.

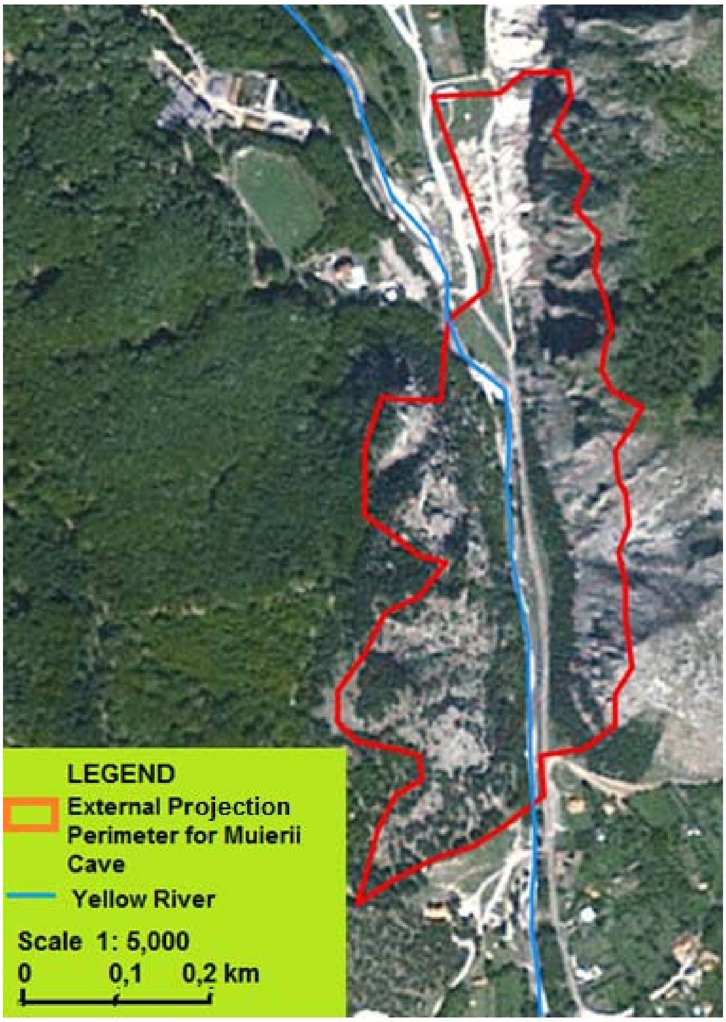


Fig. 5. External projection of Women Cave – Iron Bath.

This cave is like a tunnel, situated at 40 m above Galbenului Valley thalweg or the lowest level there and has two entrances: one to North (Fig. 6 A and B) and another one to South. The second entrance is before the river gorges.

But toward the East it was a third entrance, which was walled on the occasion of improvements for the touristic purpose. The geographers explain that when Galbenu river's gorges were forming, the infiltration waters degt the cave in Tithonic limestones.

Women Cave is laid on four different levels and the general orientation of all system of galleries is NNV-SSV (Fig. 7), according to some fracture line from the right slope of Galbenu river Valley (Diaconu *et al.*, 1980) .

Considering our interest to restore underground shelter for nursery bat colonies we will refer to the first level. In the upper level there is a main gallery of 573 m length which is crossing Garbei limestone summit. Together with the alveolate net of the main gallery the total length of upper level is 1228 m.

Before improvements for touristic purposes, the main gallery has had three entrances: Northern (Fig. 6 C) – today entrace for tourists; Southern – former place of water reappearance from underground; Eastern – today walled. The third entrance was opened in the abrupt gorges slope.

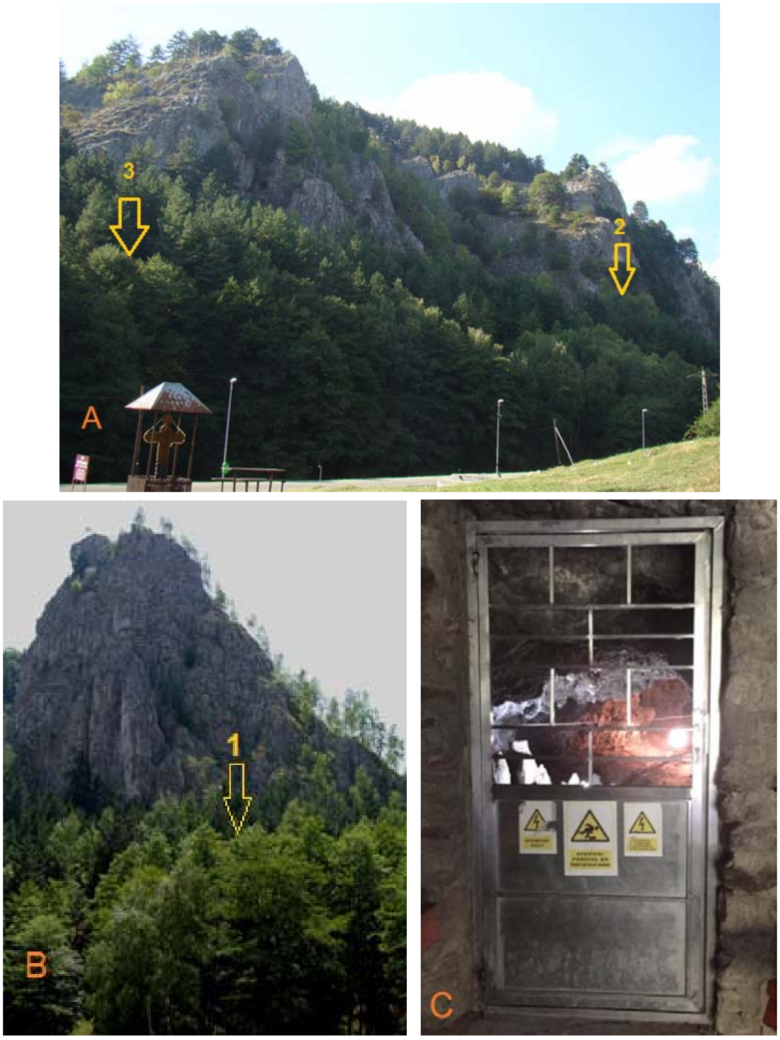


Fig. 6. A – Garba summit (lateral view 751 m altitude) in which it was developed. Women Cave from Iron Bath; B – Garba summit (front view with localization (1) of Northern Entrance (upstream); C – Entrance gate for tourists.

At 30 m distance from Northern entrance (Fig. 6 C), in the west wall is opening a prime diverticula or alveola which is steering to the Northern part of lower level – *Electricians Gallery* (Fig. 7) and after about 130 m is connecting with the *Altar Room* of 4–6 m width and 2 m height. The *Altar Room* is highly concretionate, at the entrance being an impressive chimney of 17 m height. Right here there is maximum density of a hibernating colony of bats; some solitary individuals are spread along all the *Electricians Gallery*.

From the *Altar Room*, continuing toward East, the gallery has many boulders and is opening a new room with the ceiling painted with chiropterit and on the floor there is deposit of guano. Both, spots of chiropterit on the ceiling and guano deposit on the floor are evidences of a former large nursery and hibernating colony, most probably of *Myotis myotis, M. blythii, M. capaccinii, M. dasycneme* and *Miniopterus schreibersii*. It is estimated to about 4000 individuals.

Because of the walled Eastern entrance, bats avoided this cave and today there is no more nursery colony and fresh guano.

Coming back to the main gallery, the track is directed to South and after 270 m *Turkish Room* is situated – one of the most concretionate chambers. From here a narrow passage is starting, with a ditch on the floor and visitors are arriving in the *Wanders Room*. The name of this room comes from the nicest microgures and stalactitic domes there.

After passing a very narrow part, the gallery is continuing toward the *Guano Room*, which also in former times was sheltering a huge nursery and hibernating colony of *Rhinolophus ferrumequinum*, *R. hipposideros*, *Myotis myotis, M. blythii* and *Miniopterus schreibersii.* Dumitrescu *et al*. (1962–1963) estimating up to 14,000 individuals in this colony.

The *Guoano Room* is at 70 m distance up to the Southern exit. When touristic track was built, first it was necessary to excavate an important quantity of guano from the floor.

At about 40 m before the exit, on the western wall there is the entrance toward lower levels through a highly descending gallery. This one is continued by *Bears Gallery* at the lower level of Southern District. Exploration of this gallery revealed very important palaeontological and anthropological discoveries. All lower floors are included in a Scientific Reserve and access there should be restricted, setting metallic gates.

To us it is of interest the tourism effect with many disturbing activities in the cave, which finally ended with nursery and hibernating bat colony extinction. This risk was mentioned by Professor Margareta Dumitrescu (1955) and by Dumitrescu & Tanasachi (1961).

Examining carefully all disturbing factors because of anthropic activities in the cave we suggested an ecological reconstruction in order to recover, in new optimum conditions, both the nursery and hibernating bat colony (Murariu *et al*., 2008; Murariu *et al.,* 2010; Gheorghiu *et al*., 2009; Gheorghiu *et al*., 2010).

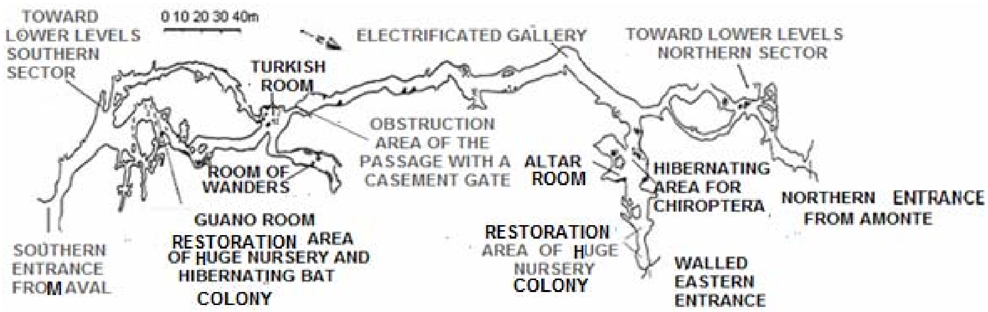


Fig. 7. Map of the touristic floor in Women Cave – Iron Bath.

We must remember that in former times, this cave was used as a refuge for women when the Turkish invaded the area. Therefore the cave name is Women. But without disturbing activities, two bat colonies continued to shelter together with quiet people. At those times, the access in the cave was in Southern entrance (Fig. 7) and the gallery was ending to the *Turkish Room.* The nursery colony was in *Guano Room.*

A second entrance (like in a second cave at those time) was in the Eastern part which today is walled. So that the second nursery colony of bats was in two rooms close to the Eastern entrance.

The Northern entrance (Fig. 7) which we mentioned before was artificially opened with detonation on the occasion of limestone expoatation for a chalk factory. Close to the cave there are still remnants of lime ovens. Later, exploring the cave, bat habitat from the Eastern entrance rooms was connected with *Turkish Room,* crossing the bat habitat from *Guano Room*.

In conclusion, bat habitat were disturbed by:

– opening the actual Northern entrance by occasional detonation, to get limestone for local use (Fig. 9 C);

– along the main gallery there were opened some stone barriers and connections between the former Women cave and sectors were estblished;

– these new openings allowed to increase the air flow speed decreasing the relative humidity; the climate and ecological balance were modified;

– in the second half of the 20th century there were mentioned improvements in the underground shelter, necessary for tourism purposes. But these improvements were missed measures to preserve the ecological balance and the optimum conditions for underground fauna, because:

a. the tourist track is crossing the *Guano Room*, exactly under the nursery and hibernation colony of bats, causing its extinction there;

Fig. 8. In the electrified cave green algae (lamp leprosy) were developed because of warm light.

b. Walling Eastern entrance as a measure to protect cave vandalization ended with extinction of nursery colony of bats in the next-door rooms;

c. Between 1952–1970 the cave was electrified without care of wires lines and searchlights orientation. There were used red-hot bulbs which facilitated the development of a kind of vegetation (Fig. 8) on walls, named “lamp leprosy”;

d. In the *Altar Room* and in *Guano Room*, the projector’s light was directed to the bat groups, to be seen by tourists. This idea was not suitable with the need of darkness and quiet condition, especially in the nursery and hibernation periods.

e. On crowded days, cave visit is organized in groups of 100 individuals each and this supposes increasing of anthropic pressure on bats and underground fauna extinction.

There are also some other sorts of negative effect of anthropic activities in the cave, outside of it and generally in all protected areas. One example is lack of tracks and directories for tourists which, after visiting the cave, do not know where to walk for a parking place. Therefore, they are spreading all over the protected area, leaving damages in the foraging habitat for bats. There are not enough pannels to present information about this Natural Reserve and at the entrace an Information Center for visitors would be necessary (Fig. 13 A, B and C). In this Center they can learn regulations to be respected both inside and outside of the cave.

Between 2003–2005 we insisted and finally lights were changed. Thus from 700–800 bats, the bat colony increased up to 2500–2800 individuals in 3–5 years only.

Gheorghiu *et al.* (2007) mentioned that all these successfully applied measures of ecological reconstruction and chiroptera population restoration were a first perfomance in Romania. All these rooms (close to the Eastern entrance, *Guano Room and Altar Room* – Fig. 9 B) became populated with larger colonies of bats.

Fig. 9. A – Panel with Visiting Program all over the year, organized in groups of 4–100 visitors;
B – *Altar Room* – former hibernating place for a large colony of bats in Women Cave;
C – Oven to burn limestone for Iron Bath community.

For better conditions offered to bat colonies we are suggesting:

1. Along *Guano Room* an artificial passage should be built (Fig. 10) of 30 m length, with an elastic tartan carpet on the floor to absorb walking vibrations. This construction will isolate bats all over the year, so that polluted air will not touch them, lights will not be seen, and visitors could observe bats without disturbing them in nursery and in hibernating periods.

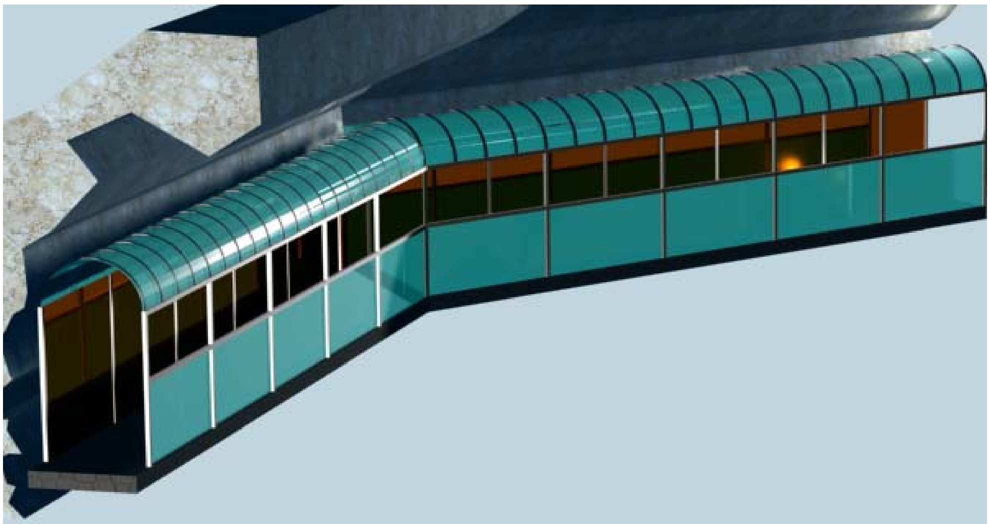


Fig. 10 – Sketch of the artificial passage of 30 m length and 2 m height on the touristic track, under bat colony in *Guano Room* – Women Cave.

2. In order to avoid the “light flora” development, the old system of lightening with LED system must be replaced, with cold light and in the area with chiroptera, light will be red – disturbing bats much less.

3. In order to reduce the air flow in the cave comparable with a tunnel, the door from the Northern entrance will be replaced with a compact metallic one.

4. In order to facilitate bats access in the cave with their span wings, the Southern gate will be replaced with a new one, with 15 cm between the horizontal bars and 70–80 cm between the vertical ones (Fig. 10).

5. In the narrow place toward *Turkish Room* two metal pannels like doors with two parts should be placed. Their role is to avoid access of tourists to the nursery colony and to diminish the air flow speed in the cave and will be opened for bat access to the *Altar Room* in the hibernating period. In this way initial habitats with optimum conditions for bats will be restaured.

Fig. 11. Southern entrance with an actually unsuitable gate (15 × 15 cm net of lattice) not allowing bat flying access.

6. Partial reopening Eastern walled entrance and mounting metal bars (15 cm between horizontal bars and 70–80 cm between those vertical) to facilitate bat access and restoration of a large (up to 4000 individuals) nursery colony (Fig. 12 A, B).

7. Over metallic bars set to the Eastern entrance a mobile metalic pannel will be placed which will be opened in summer time for nursery colony and will totally close the entrance in winter, to protect hibernating colony from the *Altar Room*.

8. Two metallic gates will be set to avoid entrances to the Northern and Southern Scientific reservations from the lower levels.

9. Totally rehabilitate the touristic track and improved it with lateral balustrades, both to protect tourists and to regulate their access in the cave.

A B

Fig. 12 A. Project's team in the room close to the Eastern entrance, under former location (B) of a huge nursery colony driven away after walling this entrance.

10. Rehabilitation and moder building of the entire external tracks with lights (for night), from Southern exit to the parking place.

11. In restoration works only suitable materials will be used for underground conditions and avoiding habitat pollution.

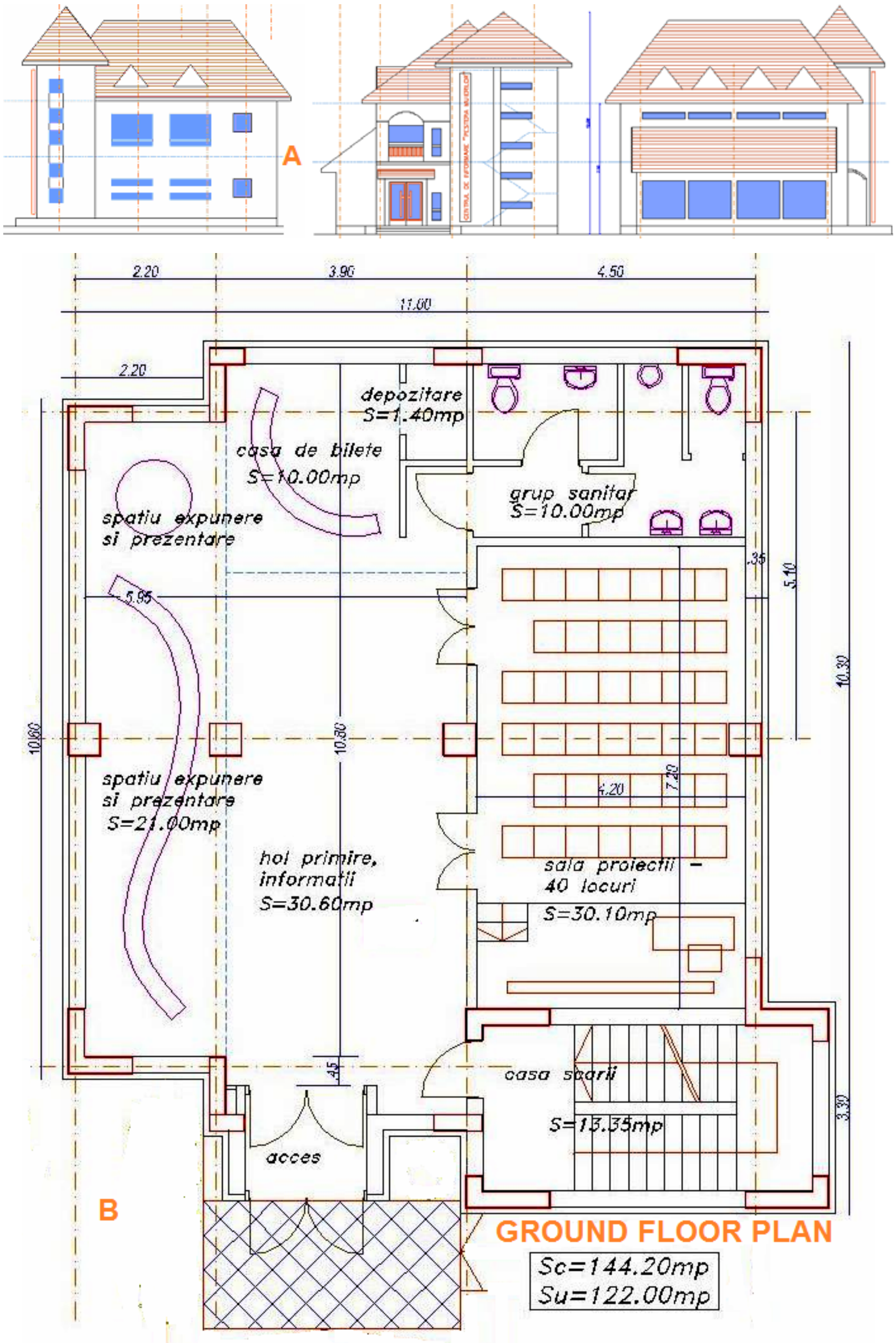
12. Monitoring bat population and disturbing works will be according to their life circle – between nursery and hibernating activities.

13. In monitoring time the bat answers to new ecological improvements in site will be observed.

14. The Project's team will adapt the strategy of rehabilitation according to the monitoring results.

15. Use of Video-traps suppose to avoid human presence inside the cave. But, using of different items to measure the temperature, relative humidity, air flow speed, pH, etc. will be connected to the monitors outside of the cave and checked online.

16. The Information Center (Fig. 13 A, B, C) will reduce the man impact on bats especially for monitoring purposes. Bat activities will be also watched by tourists inside this Information Center (Fig. 13 B). Also, in this Center will be rooms for administration staff and available information for tourists about the importance of the cave as well as recommendations to be protected.


A
B
GROUND FLOOR PLAN
Sc=144.20mp
Su=122.00mp
depozitare
S=1.40mp
casa de bilete
S=10.00mp
grup sanitar
S=10.00mp
spatiu expunere
si prezentare
spatiu expunere
si prezentare
S=21.00mp
hol primire,
informatii
S=30.60mp
sala proiectii –
40 locuri
S=30.10mp
casa scarii
S=13.35mp
acces

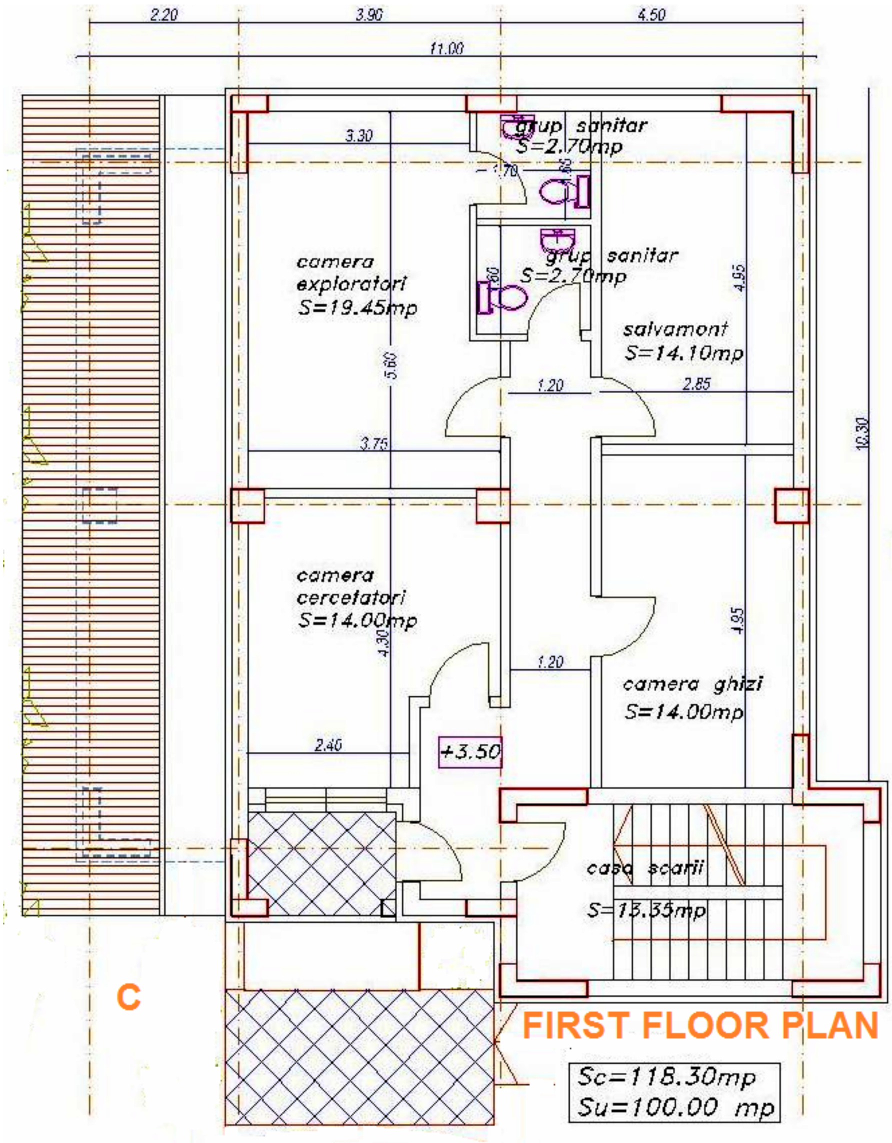


Fig. 13 A, B, C. Plans of Information Center to Women Cave – Iron Bath (architect Nadina Nistor).

CONCLUSIONS

1. The previous experience, research and results in reconstruction of some habitats allow us to be optimistic that after the suggested ecological restoration the bat colonies will be rehabilitated in only 5–8 years. The estimated number of bats

will be up to 4000 individuals for hibernation and 10–12,000 individuals in the nursery period. The most important will be to take into consideration all project details, including the monitoring method.

2. As we have already mentioned, realizing this poject will achieve two main purposes: restoration and conservation of nursery and hibernating shelters for bats, according to Law (90/2000); much better conditions to receive and to offer information to visitors and this will be beneficial to the local community, increasing agrotouristic opportunities in the area.

3. Considering the Project's purposes to imply technical conditions and solutions compatible with touristic activities in a shelter for nursery and hibernating bat colonies and to realize their conservation we can emphasize its oneness character both for a protected area and bat conservation in a touristic cave.

4. Bat protection movement increased all over the world not only because of the anthropic pressure, but also because of their importance as bioindicators on the state of habitats, because of their important role in ecosystem physiology, controlling pest insects and not in the least some diseases which may decimate bat populations.

5. The Project is important considering the scarcity of suitable shelters and we can think more to fit up new undergorund refuges for bats, which today are not totally suitable to host chiropteran fauna.

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This book contains 10 chapters dealing with important topics of nowadays aquaculture. The first two chapters: *Aquaculture and the Environment: Towards Sustainability* and *Sustainable Aquaculture: Socio-Economic and Environmental Assessment* offer a comprehensive description of the importance and relevance of aquaculture for mankind and environment/our planet. These first two chapters offer a clear view on the main topics linking productivity to environmental protection with special emphasis on fish health, aquaculture hazards and risk analysis. Two other important chapters of the book are focused on aquaponics *Aquaponics Production, Practices and Opportunities* and *Aquaponics: A Commercial Niche for Sustainable Modern Aquaculture*, the first one giving a good introduction to aquaponics whereas the second one is more focused on commercial aspects of aquaponics. Following the description of Aztec facilities (XVIth century) and Chinese achievements [dick pond systems (mid XIVth century) to modern recirculating aquculture systems (RAS)], the book offers a living history of sustainable aquaculture being also an invitation to personal innovation and creative thinking. The comparison between the efficiency of food conversion by cold blood animals (e.g. fish) and warm blood animals further argue some advantages of fishes as compared with mammals. Again, these advantages are strongly related to the practice of recirculating aquaculture systems, in which the net consumption of fresh water is strongly diminshed, with a concomitant significant reduction of environmental pollution. The chapter *Sustainable Aquafeed* discusses different trends in the production of good food for aquaculture, containing natural ingredients that offer functional benefits which allow optimal nutrient composition at a competitive price. Two other chapters, *Sustainable Fishing Methods in Asia Pacific Region* and *Sustainable Production of Shrimp in Thailand* deal with achievements done in specific/given geographical areas, but relevant for the whole domain of aquaculture. The attention done on sustainable fishing and industrial fishing is a very good example of responsible analysis concerning different aspects of this activity and mutual effects between environment and society, which could be important not only for those geografical areas, but also at global level. The last three chapters focuss on very important aspects of aquaculture. The chapter called *Impact of Pharmaceutically Active Compounds in Marine Environment on Aquaculture* offers a critical discussion on the effect of the use of pharmaceuticals to prevent fish disease, whereas the chapter *Estimating Carbon Footprint Under an Intensive Aquaculture Regime* concerns the fate of greenhouse gases emission and cumulative energy demand during turbot cultivation in Spain under superintensive regime. Essential activities of any recirculating aquaculture systems are discussed in the chapter *Waste Treatment in Recirculating Shrimp Culture Systems*. Special attention is devoted to the use of pilot (500L) sequencing batch reactors (SBR) operating in aerobic and anaerobic conditions for 3 and 6 days, respectively strongly linking basic and applied microbiology with modern aquaculture techniques. Starting from lab scale SBFR (19L) to pilot ones (500L), the authors argue the usefulness of this technology in decreasing the carbon oxygen demand, ammonia, nitrite and nitrate.

The editors and contributors are well known personalities in the field, belonging to a rather limited (as compared with the spread of aquaculture around the world) number of countries. The book is well illustrated, thus helping the readers to understand it more easily.

In my opinion, this book is an essential read for advanced students, experimental researchers as well as policy makers and other professionals working in the field of aquaculture.

Dr. Ioan I. ARDELEAN