Linzer biol. Beitr.	41/2	1959-1968	18.12.2009

A contribution to the rove beetles (Coleoptera: Staphylinoidea: Staphylinidae) of Iranian rice fields and surrounding grasslands

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A b s t r a c t : The fauna of rove beetles (Coleoptera: Staphylinidae) in Iranian rice fields and surrounding grasslands is studied in this paper. In a total of 35 species from 23 genera and 10 subfamilies (including, Aleocharinae, Habrocerinae, Leptotyphylinae, Omaliinae, Paederinae, Proteininae, Pselaphinae, Staphylininae, Steninae, Trichophyinae) were collected.

K e y w o r d s : Staphylinidae, Rice field, Fauna, Iran.

Introduction

The rove beetles (Staphylinidae) are a large of beetles, primarily distinguished by their short elytra that leave more than half of their abdomens exposed. With over 46,000 species in thousands of genera, the group is the second largest family of beetles after the Curculionidae (the true weevils). It is an ancient group, with fossil rove beetles known from the Triassic, 200 million years ago (SEEVERS 1957; STAN 2004). Rove beetles are known from every type of habitat that beetles occur in, and their diets include just about everything except the living tissues of higher plants. Most rove beetles are predators of insects and other kinds of invertebrates, living in forest leaf litter and similar kinds of decaying plant matter. They are also commonly found under stones, and around freshwater margins. Several types are known to live on ocean shores that are submerged at high tide, several species have adapted to live as inquilines in ant and termite colonies, and some live in mutualistic relationships with mammals whereby they eat fleas and other parasites, benefiting the host. A few species, notably those of the genus *Aleochara*, are parasitoids of other insects, particularly of certain fly pupae (BLACKWELDER 1943; NEWTON 1990; NEWTON et al. 2000). The rove beetles have efficient role in biological control of some rice pests (POLASZEK 1998; HEINRICHS & BARRION 2004).

Rice is the most important cereal crop in the developing world and is the staple food of over half of the world's population (JULIANO 1993). Rice, an annual grass, belongs to the genus *Oryza*, which includes 21 wild species and 2 cultivated species, *O. sativa* L. and *O. glaberrima* STEUD (CHANG 1976). The rice plant is an ideal host for a large number of insect species in West Africa. All parts of the plant, from the root to the developing grains, are attacked by various species. In the world, there are about 800 insect species that can damage rice in the field or in storage, but the majority of the species that feed on rice are of minor importance (BARRION & LITSINGER 1994). In addition, species distri-

bution and abundance vary among rice ecosystems within a given location. For example, some species are primarily upland rice feeders while others are more numerous and damaging under lowland conditions. Some species may be abundant in all rice-growing environments. Rice feeding insects are dynamic and their relative importance changes with time due to changes in rice production practices, climate, yield, and varieties - and, in many cases, due to undetermined factors. The infestation of the rice crop by different species is related to the growth stage of the plants. Insects feed on all parts of the rice plant throughout the rice growing regions of the world (KHAN et al. 1991; HEINRICHS 1994; BAMBARADENIYA & AMERASINGHE 2003).

The fauna of Iranian Staphylinidae was studied very poorly so far (SAKENIN CHELAV et al. 2008) while Iran is a large country incorporating a various geographical regions and climates. This paper deals with fauna of this taxon in some Iranian rice fields especially the rice fields of northern Iran. This work is a part of the huge project "Insects fauna of Iranian rice fields" which was established by the senior author many years ago.

Materials and Methods

Materials have been collected by sweeping net, pitfall traps and aspirator from the rice fields and surrounding grasslands in different regions of Iran. The sampled regions were Guilan, Mazandaran, Golestan, Ghazvin, Chaharmahal & Bakhtiari and Isfahan provinces. In addition to the collected specimen by the authors, several other collected specimens by many researchers and amateur students have also been included in this study. The information concerning specific name, describer, locality and date of collection, and number of species (in brackets) is given. In this paper, Classification and nomenclature suggested by NEWTON & THAYER (1992), HERMAN (2001) and LÖBL & SMETANA (2004) have been followed in this study.

Result

Totally 35 staphylinid species from 23 genera and 10 subfamilies were collected from Iranian rice fields and surrounding grasslands. The list of species is given below.

Subfamily A l e o c h a r i n a e FLEMING 1821

Tribe A l e o c h a r i n i FLEMING 1821

Genus *Aleochara* GRAVENHORST 1802

***Aleochara erythroptera* GRAVENHORST 1806**

M a t e r i a l : Chaharmahal & Bakhtiari province: Shahrekord (2), September 2004.

***Aleochara verna* SAY 1833**

M a t e r i a l : Mazandaran province: Savadkooh (2), June 2003.

Subfamily H a b r o c e r i n a e MULSANT & REY 1877

Genus *Habrocerus* ERICHSON 1839

***Habrocerus capillaricornis* (GRAVENHORST 1806)**
M a t e r i a l : Isfahan province: Isfahan (3), August 2000.

Subfamily L e p t o t y p h y l i n a e FAUVEL 1874

Tribe L e p t o t y p h y l i n i FAUVEL 1874

Genus *Kenotyphlus* COIFFAIT 1957

***Kenotyphlus pisidicus* COIFFAIT 1957**
M a t e r i a l : Isfahan province: Lenjan (2), August 2000.

Subfamily O m a l i i n a e MACLEAY 1825

Tribe Anthophagini THOMSON 1859

Genus *Anthobium* LEACH 1819

***Anthobium Anthobium melanocephalum* (ILLIGER 1794)**
M a t e r i a l : Golestan province: Kordkoy (1), June 2005.

Genus *Geodromicus* REDTENBACHER 1857

***Geodromicus asiaticus* BERNHAUER 1902**
M a t e r i a l : Guilan province: Rasht (1), July 2005.

Genus *Olophrum* ERICHSON 1839

***Olophrum puncticolle* EPPELSHEIM 1880**
M a t e r i a l : Mazandaran province: Savadkooh (1), June 2003.

Tribe E u s p h a l e r i n i HATCH 1957

Genus *Eusphalerum* KRAATZ 1857

***Eusphalerum foveolatum* (LUZE 1910)**
M a t e r i a l : Mazandaran province: Chalus (2), May 2006.

***Eusphalerum rufoscutellatum* (EPPELSHEIM 1881)**
M a t e r i a l : Guilan province: Roodsar (1), April 2007.

Tribe O m a l i i n i MACLEAY 1825

Genus *Omalium* GRAVENHORST 1802

***Omalium oxyacanthae* GRAVENHORST 1806**
M a t e r i a l : Golestan province: Kordkoy (3), June 2005.

Subfamily P a e d e r i n a e FLEMING 1821

Tribe P a e d e r i n i FLEMING 1821

Subtribe A s t e n i n a HATCH 1957

Genus *Astenus* STEPHENS 1833

***Astenus thaboris* (SAULCY 1865)**
M a t e r i a l : Mazandaran province: Ghaemshahr, Savadkooh (3), June 2003.

Subtribe P a e d e r i n a FLEMING 1821

Genus *Paederus* FABRICIUS 1775

***Paederus fuscipes* CURTIS 1826**
M a t e r i a l : Guilan province: Rasht (4), July 2005.

***Paederus littoralis* GRAVENHORST 1802**
M a t e r i a l : Mazandaran province: Chalus (1), October 2006.

Genus *Paederidus* MULSANT & REY 1878

***Paederidus ruficollis* (FABRICIUS 1777)**
M a t e r i a l : Isfahan province: Isfahan (1), August 2000.

Subfamily P r o t e i n i n a e ERICHSON 1839

Tribe P r o t e i n i n i ERICHSON 1839

Genus *Protenus* LATREILLE 1797

***Protenus atomarius* ERICHSON 1840**
M a t e r i a l : Isfahan province: Isfahan (1), August 2000.

Subfamily P s e l a p h i n a e LATREILLE 1802

Tribe B a t r i s i n i REITTER 1882

Genus *Batrisodes* REITTER 1882

***Batrisodes insularis* (BAUDI DI SELVE 1870)**
M a t e r i a l : Chaharmahal & Bakhtiari province: Shahrekord (1), September 2004.

Tribe C l a v i g e r i n i LEACH 1815

Genus *Claviger* PREYSSLER 1790

***Claviger katharinae* ESCHERICH 1897**
M a t e r i a l : Mazandaran province: Ghaemshahr (4), June 2003.

Tribe E u p l e c t i n i STREUBEL 1839

Genus *Euplectus* LEACH 1817

***Euplectus verticalis* REITTER 1884**
M a t e r i a l : Mazandaran province: Amol (2), September 2005.

Tribe T r i c h o n y c h i n i REITTER 1882

Genus *Panaphantus* KIESENWETTER 1858

***Panaphantus atomus* KIESENWETTER 1858**
M a t e r i a l : Guilan province: Rasht (2), July 2005.

Subfamily S t a p h y l i n i n a e LATREILLE 1802

Tribe O t h i i n i THOMSON 1859

Genus *Atrecus* JACQUELIN DU VAL 1856

***Atrecus affinis* (PAYKULL 1789)**
M a t e r i a l : Mazandaran province: Sari (3), June 2007.

Tribe S t a p h y l i n i n i LATREILLE 1802

Subtribe P h i l o n t h i n a KIRBY 1837

Genus *Bisnius* STEPHENS 1829

***Bisnius reitteri* (EPPELSHEIM 1889)**
M a t e r i a l : Ghazvin province: Ghazvin (1), July 2007.

Genus ***Gabrius*** STEPHENS 1829

***Gabrius lividipes* (BAUDI DI SELVE 1848)**
M a t e r i a l : Guilan province: Roodsar (2), April 2007.

***Gabrius toxotes* JOY 1913**
M a t e r i a l : Mazandaran province: Behshahr (1), July 2004.

Genus *Philonthus* STEPHENS 1829

***Philonthus intermedius* (LACORDAIRE 1835)**
M a t e r i a l : Guilan province: Fooman (3), July 2005.

***Philonthus punctus* (GRAVENHORST 1802)**
M a t e r i a l : Golestan province: Gorgan (1), October 2008.

***Philonthus rufipes* (STEPHENS 1832)**
M a t e r i a l : Ghazvin province: Ghazvin (1), July 2007.

***Philonthus velatipennis* SOLSKY 1869**
M a t e r i a l : Mazandaran province: Amol (1), September 2005.

Subtribe Q u e d i i n a KRAATZ 1857

Genus *Quedius* STEPHENS 1829

***Quedius coloratus* FAUVEL 1875**

M a t e r i a l : Isfahan province: Lenjan (1), August 2000.

C o m m e n t : *Cerdistus zelleri* SCHINER 1862 (Diptera: Asilidae) was collected as the predator of *Q. coloratus* from Isfahan.

***Quedius nitipennis* (STEPHENS 1833)**

M a t e r i a l : Chaharmahal & Bakhtiari province: Shahrekord (3), September 2004.

***Quedius vicinus* (MÉNÉTRIÉS 1832)**

M a t e r i a l : Mazandaran province: Freydonkenar (1), September 2005.

Subfamily S t e n i n a e MACLEAY 1825

Genus *Stenus* LATREILLE 1797

***Stenus ater* MANNERHEIM 1830**

M a t e r i a l : Mazandaran province: Behshahr (2), July 2004.

***Stenus circularis* GRAVENHORST 1802**

M a t e r i a l : Golestan province: Kordkoy (2), June 2005.

***Stenus pusillus* STEPHENS 1833**

M a t e r i a l : Isfahan province: Lenjan (4), August 2000.

C o m m e n t : *Erax tenuicornis* (LOEW 1848) (Diptera: Asilidae) was collected as the predator of *S. pusillus* from Isfahan.

***Stenus maculiger* WEISE 1875**

M a t e r i a l : Mazandaran province: Ghaemshahr (2), June 2003.

Subfamily T r i c h o p h y i n a e THOMSON 1859

Genus *Trichophya* MANNERHEIM 1830

***Trichophya pilicornis* (GYLLENHAL 1810)**

M a t e r i a l : Mazandaran province: Freydonkenar (3), September 2005.

Discussion

Biological control employs natural enemies such as predators, parasitoids, and pathogens to reduce pest population density and/or pest damage. Natural enemies regulate organisms in their natural environment and interactions are relatively stable. The principal methods employed in biological control are 1) introduction and establishment of exotic natural enemies (classical biological control), 2) augmentation and enhancement of natural enemies, and 3) conservation of indigenous natural enemies. Biological control is a major component of sustainable agricultural systems that are designed and managed to reduce dependence on chemical and other energy-based inputs, minimize ecological risk

resulting from farming practices, and enhance agricultural productivity in relation to the resources available. Sustainable agriculture attempts to prevent pest losses by maintaining a healthy and balanced agroecosystem. Thus, biological control is central to the management of crop production systems for long-term sustainability (MACKAUER 1989; SYNDER & WISE 1999; BONHOF 2000).

To ensure that biological control will contribute to sustainable agriculture, several steps must be taken. These steps apply to both native and introduced pests and to biological control involving the introduction of exotic natural enemies and the augmentation and conservation of indigenous natural enemies (MACKAUER 1989). First, it is necessary to establish an inventory of all the natural resources. Knowledge of the indigenous natural enemies is needed to assess environmental changes and the risks associated with various crop production systems. Biological control of rice-feeding insects is at the inventory phase where some knowledge is available on the natural enemy species present in the various rice ecosystems (WHITCOMB 1981).

The second step involves research to identify the agricultural practices that contribute to pest outbreaks. This may include rice cultivars that are poorly adapted to local conditions and agronomic practices that adversely affect natural enemies. The importance of natural enemies in regulating pest populations must be determined. The proper assessment of biological control requires the measurement of the impact of natural enemies on pest numbers over time (YASUMATSU & TORII 1968; WAAGE & SCHULTHESS 1989).

Third, the relative economic importance of the various pests must be assessed to identify those that are key pests for which control intervention must be established. If the key pest has been introduced, a classical biological control program involving the introduction of exotic natural enemies can be considered. However, most key rice pests in Iran are believed to be native species and thus a biological control program involving the release of laboratoryproduced natural enemies to augment populations and/or the conservation or enhancement of indigenous natural enemy populations should be employed (YANINEK & COCK 1989).

For augmentative biological control, there are only two categories of natural enemies that can be reliably mass-produced: trichogrammatid egg parasitoids and some groups of insect pathogens (YANINEK & COCK 1989). To provide an effective control strategy using these agents, it is necessary to have an appropriate infrastructure and social organization to mass produce the organisms, to maintain them until used, to get them to the target area when needed, and to release them. These conditions are not available in Iranian rice fields, at present, and until they are, augmentation is not considered an effective means of biological control of rice insect pests. Conservation and enhancement of indigenous natural enemies offer the greatest potential for control of insect pests in Iranian rice ecosystems. The important insect pests in Iranian rice ecosystems require detailed ecological research to evaluate their indigenous natural enemies. Based on this information, methods can be developed to conserve or enhance them, and thus increase their effectiveness within the context of an integrated rice crop protection program.

Most of the research on natural enemies of rice-feeding insects has been devoted to the identification of natural enemies attacking stem borers. Potential predators collected in Asian and West African rice fields are in the insect orders Coleoptera, Dermaptera, Hemiptera, Hymenoptera, Mantodea, Odonata, and Orthoptera and also consist of numerous spider species. Four coleopteran families present in rice are the Anthicidae,

Carabidae, Coccinellidae, and Staphylinidae (HEINRICHS & BARRION 2004). Information is lacking on the importance of the various natural enemy species and their role in the biological control of rice-feeding insects. The few reports that are available concern parasitoids and they indicate that parasitism plays a major role in the regulation of rice insect pest populations (MOHYUDDIN 1990; RUBIA et al. 1990). Many studies have been conducted on polyphagous beetles, both in natural settings and in various agro-ecosystem habitats (LUFF 1987). However, these insects have not been well surveyed in paddy fields, probably because of the inundated environment (WOIN et al. 2002). In Africa and Latin America, where upland rice represents 60 and 73 % of the rice-growing area, respectively, the use of predatory soil-dwelling beetles can be considered when establishing any insect IPM program. The value of predators in an IPM program is widely recognized. They can play an important role in reducing pest numbers in field crops. WRATTEN et al. (1984) proved through exclusion experiments that the removal of polyphagous predators generally leads to an increase in the density of insect pests.

The results of this research indicate that there is a diverse fauna of Staphylinidae in Iranian rice fields and surrounding grasslands. Although upon the present work totally 35 species were collected, but Iran is a large country and many other provinces which included rice fields were not sampled in this research. Also, several samplings of this research indicated that among the 35 species, *Paederus fuscipes* CURTIS has the highest population density in the rice fields of northern Iran (Mazandaran and Guilan provinces). This species is an efficient egg predator of lepidopteran pests in rice fields including, *Chilo suppressalis* WALKER (Pyralidae) and *Naranga aenescens* MOORE (Noctuidae) which are the key pests in rice fields of northern Iran. Since Iran is a large country with cover of rather vast rice fields especially in north (southern Caspian Sea), and Isfahan and Khuzestan provinces, it would be expected that a large number of staphylinid species remain to be discovered. Surely, to find new species and distributional records, more studies should be conducted on this important insect group especially in rice fields and surrounding grasslands. Finally, greater numbers of rove beetles were collected in pitfall traps in the small and medium fields than in the large field. This pattern may be related to the fact that the small and medium fields are more shaded with a greater number of trees encroaching, providing a more suitable habitat for Staphylinidae.

Acknowledgments

The authors are indebted to Dr. A.F. Newton of USA, Dr. J. Willers of Germany, Dr. P. Vicentini of Italy and Dr. V. Assing of Germany for valuable helps in progress of the project and sending the necessary resources. We are also thanks to M. Havaskary for loaning some specimens. The research was supported by Shahre Rey and Ghaemshahr Islamic Azad Universities, Ege University and Fars Science & Research Branch.

Zusammenfassung

Die Kurzflüglerfauna (Coleoptera: Staphylinidae) iranischer Reisfelder und umliegender Grasflächen wurde studiert. 35 Arten aus 23 Gattungen der Unterfamilien Aleocharinae, Habrocerinae, Leptotyphylinae, Omaliinae, Paederinae, Proteininae, Pselaphinae, Staphylininae, Steninae sowie Trichophyinae wurden nachgewiesen.

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