

the taxonomic structure of several taxa based on the synthesis of the classic (ecologo-geographic, morphological, cytogenetic) and modern (molecular/phylogeographic) approaches. Comparative studies of acoustic patterns of different taxa of Orthoptera relative to their taxonomy, phylogeny, and ecology are also continued.

In April, 2013, several orthopterists from East Europe attended the Workshop European Orthoptera in Leiden, took part in some intensive discussions concerning conservation

strategies for European Orthoptera and practiced in assessing some rare species for the IUCN Red List.

During the last years, applied acridologists from Central Asia and Russia were involved in the special project of FAO, namely "Locust Watch: Locusts in Caucasus and Central Asia". The special website was developed in English and Russian (<http://www.fao.org/ag/locust-CCA>). The site includes different information about three main pest species of the region: the Italian, Migratory, and

Moroccan locusts. The general situation with pest species was relatively serious in the different parts of Central Asia and in Russia (mainly in the North Caucasian, Lower Volga and South Ural areas). This would mean that some long-term studies should be organized and strong cooperation between acridologists of neighboring countries and territories and between fundamental and applied science should be developed anew.

## Japan

By **SEIJI TANAKA**  
National Institute of Agro-biological  
Sciences at Ohwashi  
Japan

**T**he Japanese branch is a small group and I have received news from only a few members. Dr. Kouichi Moroi, an amateur entomologist, witnessed a female adult of *Teleo-*

*gryllus emma* at a platform of Tokyo station and wondered where she came from. This species has a short period of migratory flight after adult emergence and his observation confirms that it is a strong flyer.

Dr. Haruki Tatsuta (Ryukyu University) and his colleagues are working on clarifying phylogenetic relationships and evolutionary process of genital shapes of a phasmid, *Entoria okinawaensis* and closely related spe-

cies. They are also studying a mechanism of chromosomal rearrangements and genetic population structures in some *Podisma* species.

Dr. Seiji Tanaka (National Institute of Agro-biological Sciences at Ohwashi) is retired and started working as a part-time scientist at the same institute. He is working on phase polyphenism in locusts and seasonal life-cycle adaptation in crickets and others.

## Mermithid parasite (Nematoda: Mermithida, Mermithidae) of katydids

### (Orthoptera: Tettigoniidae) in Kazakhstan

**N**ematodes of the family Mermithidae parasitize arthropods, mostly insects, as well as arachnids and crustaceans. Some species infect round worms and mollusks. They are usually specific to just one type of host (or one or two families), causing its death in the course of development. Nematodes either completely devour the host from the inside, leaving only an empty exoskeleton, or cause parasitic castration, inhibit molting and produce other damages to insects (Rubtsov, 1978). Mermithidae as a group are of ancient origin – they were found in spiders

from the Baltic amber aged 40 million years old (Poinar, 2000).

The following description of mermithid biology is based on publications of Rubtsov (1978) and Baker and Capinera (1997).

*Mermis* spp. females display the curious habit of depositing their eggs on vegetation, where they are accidentally ingested by herbivorous insects; other mermithids lay their eggs in the soil

**Fig. 1.** *Glyphonotus alacataga*, female, Mermithidae katydid

By **IZBASAR TEMRESHEV**  
**MURATBEK CHILDEBAEV**  
**SERGEY KOLOV**  
Institute of Zoology  
Ministry of Education and Science  
Republic of Kazakhstan, Kazakhstan







Fig. 2. *Glyphonotus coniciplicus*, female, Mermithidae katydid

and when they hatch the larvae move to the surface and penetrate the hosts. After ingestion, the *M. nigrescens* eggs quickly hatch and the immature nematodes break through the gut wall and enter the body cavity of the host insect. Infection by *M. nigrescens* inhibits development of the ovaries in grasshoppers, and the host may perish before or after the nematodes emerge from the insect. After emerging, the nematodes enter the soil where they reach the adult stage after 2-4 months. They are not sexually mature for another 6 months, and may remain in the soil for up to 3 years, though a two-year life cycle is normal. *M. nigrescens* may either mate, or reproduce parthenogenetically. Males are not as long-lived as the females. Males are about 40-60 mm long, females 60 to 160 mm. Females produce large quantities of eggs, estimated to be up to 14,000 per female. Irrigation can increase parasitism of grasshoppers by these nematodes by simulating rainfall conditions; rainfall is a prerequisite for adult female nematodes to leave the soil to deposit eggs.

Many species of mermithids have potential as agents of biological control of pests and vectors of infectious diseases attacking harmful Orthoptera, Lepidoptera, Coleoptera and Diptera. Currently, biological

insecticides based on entomopathogenic nematodes are being developed against arthropod pests in many countries of the world, such as Nema-bakt, Entonem-F etc. Among Orthoptera, the list of Mermithidae hosts includes katydids *Tettigonia caudata* (Charpentier), *T.*

*viridissima* L., *Platypleis intermedia* (Audinet-Serville), *Tessellana vittata* (Charpentier) (Sandner, 1974; Zemlyanskaya, Lysikova, 1979; Rubtsov, 1979; Danilova, Karpov, 1990; Baker, Capinera, 1997; Sambeek, Wiesner, 1999; Shternshis, Tsvetkova, 2002), Desert locust *Schistocerca gregaria* (Forskål) (Craig and Webster, 1974), Asian locust *Locusta migratoria* L. (Allal-Benfekih, 2006), Moroccan locust *Dociostaurus maroccanus* (Thunberg) (Hernandez-Crespo and Santiago-Alvarez, 1997; Quesada-Moraga and Santiago-Alvarez, 2000), grasshoppers *Arcyptera microptera* (Fischer de Widhelm) (Zemlyanskaya, Lysikova, 1979), as well as many American grasshoppers of the genus *Melanoplus* Stål and *Hesperotettix viridis* (Thomas) (De Bach, 1968).

One of the species of nematodes which often affects Orthoptera is *Mermis nigrescens* Dujardin. This is one of the most widespread Mermithidae species attacking a wide range of hosts. Its distribu-

tion range covers North and South America, Europe, Asia, and parts of Africa. Also, this nematode was found on Tasmania, although not in Australia. Typically, it is associated with Orthoptera (Acrididae, Romaleidae, Tettigoniidae), but may also attack earwigs, beetles, butterflies and even Hymenoptera (bees). Some specialists showed that annually, this mermithid infects on the average 17% of North American grasshoppers (Denner, 1970) although there are documented cases of infection rates in *Melanoplus* spp. reaching 76% (Burges, Hussey, 1979; Baker, Capinera, 1997).

In 2012 we documented emergence of mermithids from 2 katydid species of the genus *Glyphonotus*, *G. coniciplicus* Uvarov and *G. alactaga* Miram (Figures 1-2). Also, we found the same mermithid infecting a protected katydid species from the Red Book of Kazakhstan, *Ceraeocercus fuscipennis fuscipennis* Uvarov (Figure 3). The infections of these katydid species by Mermithidae have never been recorded.

Material: South Kazakhstan area, Karatau mounts, floodplain, Ikansu river, N 43°30'50.3 " / E 68°46'48.8", 735 m, 24.06.2011, Childebaev, Temreshev, Kolov, in the body cavity of grasshoppers *Glyphonotus*, 3 ex.; 25.06.2011, Childebaev, Temreshev, Kolov, in the body cavity of grasshoppers



Fig.3. *Ceraeocercus fuscipennis*, female



*Glyphonotus*, 3 ex.; 25.06.2011, Temreshev, water, coming out of grasshoppers *C. fuscipennis*, 2 ex.; South Kazakhstan area, Karatau mounts, floodplain, Hantagy gorge, N 43° 33'32 .4 " / E 68° 40'52 .7", 570 m, 26.05.2011, Childebaev, Temreshev, Kolov, in the body cavity of grasshoppers *Glyphonotus*, 4 ex. Percentage of infected population reached 0.08 % for *G. coniciplicus*, 15% for *G. alactaga* and 50 % for *C. fuscipennis* in the floodplain, Ikansu river, 24 % for *G. coniciplicus* and 0.08% for *G. alactaga* in the floodplain, Hantagy gorge.

According to our observations, Mermithidae extracted from the body cavity of grasshoppers were of a very light coloration. However, when they emerged from the hosts their color was rather dark. In this characteristic they resemble the above-mentioned *M. nigrescens*, or a species close to it, probably a new species. It may be promising as a biological agent of control for locust infestations. On the other hand, we recorded cases when it killed a rare species of Orthoptera listed in the Red Book of Kazakhstan, such as *C. f. fuscipennis*. As such, the identification and further clarification of the host range of this mermithid deserves a careful study.

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## The Rancher's Worry

By **DOUGLAS SMITH**  
Ecosystem Science and Management  
University of Wyoming

We are growing cattle not grasshoppers  
Though some years it seems the other way round  
All those pest experts, rangeland managers  
Telling us again hoppers will abound

With beef at one seventy at the market  
I don't think a hopper leg; fried, sautéed  
Stuffed, steamed, or otherwise will cut it  
Bunch to sell but no USDA grade

Late June with Angus calves in the pasture  
Snow is gone, rain has come, grass has grown tall  
Hoping that this crop makes it the best year  
And praying those hoppers don't eat it all

Thank the Lord for those who know these pests  
Delivering us from *Melanoplus*