Contributions to the Zoogeography and Ecology of the Eastern Mediterranean Region
Vol. 1 (1999), pp.283-286

DIFFERENCES IN THE BIOLOGICAL CYCLES OF SOME SPECIES OF SUPERFAMILY ACRIDOIDEA (ORTHOPTERA) BETWEEN NORTHERN AND SOUTHERN CRETE

D. KOLLAROS & A. LEGAKIS

Abstract Differences between the biological cycles of certain Acridoidea species were recorded in sites in northern and southern Crete. Some species such as *Pyrgomorpha conica*, hibernate as nymphs in the north but can be active both as nymphs and adults in the south. Other species such as *Chorthippus brunneus*, *C. biroi*, *Pezotettix giornae* and *Calliptamus barbarus*, mostly hibernate as eggs in the north but are very active in the south. A third category such as species of the genus *Aiolopus*, overwinter actively in the adult stage both in the north and the south while finally, thermophilous species such as *Oedipoda caerulescens* hibernate at egg stage all over the island. These differences in biological cycles are attributed to the temperature difference between northern and southern Crete.

Περίληψη Καταγράφηκαν οι διαφορές ανάμεσα στους βιολογικούς κύκλους ορισμένων ειδών της υπεροικογένειας Acridoidea σε περιοχές της βόρειας και της νότιας Κρήτης. Ορισμένα είδη όπως η *Pyrgomorpha conica,* διαχειμάζουν ως νύμφες στο βορρά αλλά μπορούν να είναι δραστήριες και ως νύμφες και ως ενήλικα στο νότο. Αλλα είδη όπως τα *Chorthippus brunneus*, *C. biroi*, *Pezotettix giornae* και *Calliptamus barbarus,* διαχειμάζουν κυρίως ως αυγά στο βορρά αλλά είναι πολύ ενεργά στο νότο. Μια τρίτη κατηγορία όπως τα είδη του γένους *Aiolopus*, περνούν το χειμώνα ενεργά στην ενήλικη φάση τόσο στο βορρά όσο και στο νότο, ενώ τέλος, θερμόφιλα είδη όπως η *Oedipoda caerulescens*, διαχειμάζουν στη φάση του αυγού σε όλο το νησί. Αυτές οι διαφορές σε βιολογικούς κύκλους οφείλονται στη διαφορά θερμοκρασίας ανάμεσα στο βορρά και στο νότο.

INTRODUCTION

It is known that temperature strongly influences the biological cycle of many organisms, including insects. Recent researches on insects have studied the effect of temperature on developmental rates. In a first example, the developmental rate of *Papilio machaon asiatica* (Lepidoptera, Papilionidae) was found to have a negative relation with temperature (GUPTA & MISHRA 1988). On the contrary, the pre-reproductive period of the moth *Autographa gamma* (Lepidoptera, Noctuidae) is extended at low temperatures (HILL & GATEHOUSE 1992). Temperature also influences the hatching, the survival and the oviposition of *Nala lividipes* (Dermaptera, Labiduridae). The critical day shortens by 3 and 4.5 hours respectively in the spinach leaf miner *Pegomyia hyosciami* and the cabbage root maggot *Erioischia brassicae* (Diptera) with a 7°C rise in temperature (SAUNDERS 1982).

The island of Crete is one of the seventy largest islands in the world. However, its longitudinal axis is parallel with the equator and therefore, the difference in geographical latitude between northern and southern Crete is very small. Nevertheless, the three main

mountain massifs (White Mountains=Lefka Ori, Idi or Psiloritis and Dikti or Lasithiotika) and other smaller ones can stop the prevailing northern winds as they act as an effective barrier against them. These strong cold winds are a significant factor because they decrease the body temperature of insects. Therefore, the difference of about 2°C that exists in temperature between north and south may be critical for some species.

Some species of the superfamily Acridoidea have been noted to have intense differences in their biological cycles between sites situated in northern and southern Crete. Some of these species have an economic importance as pests in limited areas. In order to ascertain the degree of difference in the biological cycles and the possible influence of temperature, six sites were chosen, three in the north (the plains and hills around Kalesa, the Fortetsa hill near Irakleion and Giouchtas mountain) and three in the south (Frangkokastello, Sachtouria and the islet of Chrysi).

MATERIALS AND METHODS

The insects were recorded throughout the year following transects of 200m length. The observations were initiated when the temperature was satisfactory for the mobility of the insects. The selected biotopes were vineyards and olive groves as well as macchia and phrygana vegetation. The northern sites were visited frequently, at least once a month with the Giouchtas site being visited every 15 days. The southern sites were visited during winter at least twice, once at the beginning of December and once at the end of January.

Critical events in the biological cycles of the observed insects were recorded throughout the year. Such events are final ecdysis, copulation and death.

RESULTS

Table 1 summarizes the differences and similarities of the cycles of the observed species in north and south while Table 2 presents the differences of the time of appearance of the critical events in the cycles of these species.

There are species like *P. conica* which hibernate as nymphs in the north but can continue their development (as many as 30% of the individuals) as early as the middle of December, in the south. For example, on the small island of Chrysi, both nymphs (70%) and adults (30%) were recorded during December 1991 (KOLLAROS 1993).

There are also many species which cannot retain living and active adults or nymphs in the north during winter (meaning from December till February). These species either hibernate at the stage of the egg (*C. brunneus, P. giornae*) or retain a small percentage of almost inactive adults (*C. biroi*). In the south, these species are usually active during winter. *C. barbarus* was recorded during January in Frangkokastello. The insects were kinetically active, they were feeding and also some copulations were recorded. The months of courtship for this species in northern Crete are usually August, September and October (KOLLAROS 1993). The two species of the genus *Chorthippus* similarly have good populations in southern Crete (Sachtouria) during winter.

Table 1 Differences and similarities of developmental status in northern and southern Crete during winter.

Species	Status in north	Status in south
Calliptamus barbarus	Absent	Present & active (F)
Pyrgomorpha conica	Present as nymph	Adults 30%, nymphs 70% (C)
Chorthippus brunneus	Absent	Present (S)
Chorthippus biroi	Absent	Present (S)
Pezotettix giornae	Absent	Present (S)
Aiolopus spp.	Present (*A. strepens*)	Present (*A. thalassinus*)
Oedipoda caerulescens	Absent	Absent (S)

Table 2 Differences in the timing of critical events of the biological cycles of the observed species in northern and southern Crete.

Species and event	North	South
C. barbarus (copulation)	August-October	at least until end of January
P. conica (final ecdysis)	April-May	30% from middle of December
C. brunneus (adult population)	June-October	at least until end of January
C. biroi (adult population)	September-November	at least until end of January
P. giornae (adult population)	October	at least until end of January
Aiolopus spp. (activity)	February-November	all around the year

Finally, two cases of similarity between north and south must be noted. In the first case, species of the genus *Aiolopus* (*A. strepens* in the north - Giouchtas, and *A. thalassinus thalassinus* in the south - Sachtouria) overwinter actively at the adult stage. However only the southern species is active during January.

In the second case, the very thermophilous species *O. caerulescens*, hibernates at the egg stage all over Crete.

DISCUSSION

The basic differences between the northern and southern sites that were studied in Crete are temperature and humidity. The habitats where these species were observed are similar and so are the human influences such as the use of pesticides or the type of agricultural practices. It is therefore reasonable to assume that temperature plays the most important role in determining the timing of the various events in the biological cycles of these species. Species adapted to arid environments such as *O. caerulescens* find the south of Crete too cold to survive as nymphs or adults. On the other hand, species with a more

northern distribution such as *P. conica* which exists in Greek Macedonia, can support active adult populations in southern Crete during winter.

The temperature difference between northern and southern Crete also has a biogeographical importance. African species have been known to survive in southern Crete following strong southern winds that allow them to cross the gap of 300km between Libya and Crete. Such an example is *Schistocerca gregaria*.

REFERENCES

GUPTA P.R. & MISHRA R.C. 1988. Biology of *Papilio machaon asiatica* Menetries with special reference to temperature and host plants. *Indian J. Ecol.* 15(2): 151-155.

HILL J.K. & GATEHOUSE A.G. 1992. Effects of temperature and photoperiod on development and pre-productive period of the silver Y moth *Autographa gamma* (Lepidoptera, Noctuidae). *Bull. Ent. Res.* 82(3): 335-341.

KOLLAROS D. 1993. *Biology and ecology of the superfamily Acridoidea (Orthoptera) on Mt. Giouchtas of Crete*. Doctoral thesis. Dept. of Biology, Univ. Of Crete, 117 pp. (in Greek).

SAUNDERS D.S. 1982. *Insect clocks*. Pergamon Press, Oxford. 410 pp.

DK: School of Technological Agronomy, Technological Education Institute of Irakleion, Estavromenos, Irakleion, Crete, Greece

AL: Zoological Museum, Dept. of Biology, Univ. of Athens, Athens, Greece