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Some observations on the nutrition—reproduction correlation in grouse locusts (Orthoptera: Tetrigidae)

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Abstract. The correlation between nutrition and reproduction with reference to two grouse locusts, *Euscelimena harpago* (Tetrigidae: Scelimeninae) and *Potua sabulosa* (Tetrigidae: Cladonotinae) is assessed. As far as *Euscelimena harpago* is concerned the impact of nutrition on reproduction is presented with reference to ovarian development in certain nymphal stages and in the adult. On the other hand, the impact is evaluated from an altogether different angle as far as *Potua sabulosa* is concerned. This pigmy locust prefers moss as food and tides over winter and hazardous summer as adult. During this period it almost does not feed. This peculiar feature is used as a parameter to assess the nature of impact in *P. sabulosa*.

Keywords. Nutrition; reproductive biology; insect-plant interaction; preferred and non-preferred host; Tetrigids (grouse locusts).

1. Introduction

The Tetrigids essentially are phytophagous caeliferan orthoptera, considered to be primitive and phylogenetically related to the acrididoid grasshoppers and locusts on the one hand and the tridactilids on the other (Paranjape *et al* 1986). Contributions by Bhalerao and Paranjape (1986), Gangwere (1961), Hodgson (1963), Hancock (1898), Paranjape (1976, 1985), Paranjape and Bhalerao (1985), Paranjape *et al* (1986) and Poras (1979) are the most significant ones while some acridological work with reference to sensillar pattern reported by Ananthakrishnan *et al* (1985), to plant chemistry and feeding behaviour by Bernays and Chapman (1978), and to host preferences as well as biochemical parameters by Sanjayan and Ananthakrishnan (1986) are of considerable importance in relation to the grouse locusts. As no information is available on the impact of nutrition on reproduction in these insects an attempt has been made to study these aspects with reference to *Euscelimena harpago* Serville and *Potua sabulosa* Hancock.

2. Material and methods

Samples of live *E. harpago* (Subfam.: Scelimeninae) and *P. sabulosa* (Subfam.: Cladonotinae) were periodically collected from localities in Pune and Mahabaleshwar. The grouse locusts were kept in cages containing their natural food. The female specimens were periodically dissected to study mainly, the development of ovaries with reference to the nature and the number of ovarioles, the oocyte-ovariole index and accumulation of fats in the body; after measuring the body length. The different measurements were taken using calibrated eye-piece gratings, of a zoom type trinocular dissecting microscope. Since *P. sabulosa*, the pigmy locust shows an altitude-limited

distribution (Paranjape and Bhalerao 1985), to verify the behavioural change, if any, during the overwintering period, these specimens were maintained in the laboratory in Pune before the onset of winter. They were also collected periodically from their natural habitat in Mahabaleshwar in Dist. Satara, the hill station located at an altitude of about 1573 m and about 120 km from Pune.

3. Results and discussion

3.1 *Food of grouse locusts*

The tetrigids are known to be feeding mainly on algae, bryophytes (especially moss: *Funaria* sps.), fungi and lichens, on detritous material and also on humus. *E. harpago*, a predominantly semi-aquatic grouse locust, shows preference to algae and detritous material (Bhalerao and Paranjape 1986) as is also revealed by the study of foregut contents. The scelimenids as shown by *E. harpago*, are known to be occasionally feeding on sproutings of paddy and also showing necrophagy. On the other hand, the pigmy locust, *P. sabulosa* shows its preference for moss (*Funaria* sps.) that luxuriantly grows in the said habitat with humid and rather cool climate, and also feeds on humus.

Although the grouse locusts possess the biting and chewing type or mandibulate type of mouth parts that are characteristic of orthoptera in general, the molar regions of the mandibles have been shown to be lacking in molar dentes that are present in other acridoids (Paranjape 1985). Instead, the SEM studies of the molar region in these insects (Paranjape *et al* 1986) have revealed an alternating grooved and serrated ridged pattern that is suitable for eating the soft, pulpy food. Moreover, this very pattern seems to be acting as a limiting factor when tough textured monocot leaves of cereals and grasses are considered as alternate host of these phytophagous orthopterans.

The habitat together with the climatic conditions in a year, availability of the food/host-plants and host plant preference by the two grouse locusts under study and the impact of these on their reproductive biology as is revealed by the observations done so far, are briefly given in the account to follow (table 1).

3.2 *Observations in E. harpago*

These grouse locusts are found in semi-aquatic habitat that also ensures their preferred food almost throughout the year excepting the summer months that are hazardous. *E. harpago* therefore shows ability to lay eggs almost from June through February/March in natural conditions that are available during major parts of the year. This is supported by the observation that one can find different nymphal stages, adults and periodically even gravid females, practically throughout the year. During the summer months however the population declines and consists of aestivating 5th/6th instar nymphs and a few adults. As far as the impact of food is concerned the findings are as under:

The zero day female adults when fed on paddy sproutings as an intermediate preferred food, died after 5/6 days. Furthermore, the maize plant turned out to be a

Table 1. Impact of seasonal variations on the ovaries of two grouse locusts.

	Stage	Month	Body length (mm) Mean	Nature of ovary	Ovariole No. Average	Oocyte—Ovariole index (Mean)
E. harpago	Nymph-III	Nov.	6·35	Panoistic, translucent	32	0·041
	Nymph-V	Nov.–Dec. (Winter)	9·04	Panoistic, translucent	38	0·057
	Zero day	Nov.–Dec.	22·56	Panoistic, light yellow	46	0·092
	Adult	Nov.	24·26	Panoistic, deep yellow	·50	0·148
	Adult (Gravid)	Jan.	25·08	Panoistic, deep yellow	50	0·232
P. sabulosa	Adult (Lab.)	Nov.–Dec. (Winter)	7·50	Panoistic, almost transparent	24	0·110
	Adult (Nature)	Nov.–Dec.	8·00	Panoistic, almost transparent	23	0·142
	Adult (Gravid)	June (Monsoon)	8·20	Panoistic, deep yellowish brown	22	0·519

non-preferred host because the zero day female adults died in about 26 h. The modified mandibular molar region makes it difficult for these insects to feed on the said hosts, by acting as some kind of a limiting factor.

3.3 *Observations in P. sabulosa*

The pigmy locust on account of its habitat peculiarities and relative preference for moss-humus complex, presents an altogether different case for study. The gravid females (table 1) lay eggs in June–July. The hatchlings metamorphose and become adults by the following October. The adults are seen to be overwintering (November–December/mid January or so). During this period there is very little food intake, large quantities of fat accumulate in the body, while ovarial filaments show hardly any growth, save the large basal oocyte. The entire ovary appears transluscent indicating that the process of vitellogenesis as such is not active. The pigmy locusts kept in the laboratory from October through January showed similar ovarian development when compared with the specimens collected periodically from their natural habitat (table 1). During February through May, the adults try to overcome unfavourable summer conditions by burrowing in soil (Paranjape and Bhalerao 1985). During this period they practically do not feed. With the beginning of monsoon the ovarian development is activated and the adults copulate and lay eggs as stated earlier. Further the above aspects will throw more light on the impact of various environmental factors on the reproductive biology of the males and females of the pigmy locust.

4. Conclusions

(i) The studies carried out so far indicate that in the grouse locusts nutrition has an impact on reproduction.

(ii) As compared to acridoids the grouse locusts have relatively specific habitat and trophic requirements.
(iii) The peculiar modification of the mandibular molar region acts as an adaptation to the type of food that these insects prefer and at the same time as a limiting factor when it comes to their feeding on tough textured leaves.
(iv) Along with food the climatic factors also influence reproductive biology of these insects although the degree is different in the grouse locusts under study.
(v) The primitive phylogenetic status of the grouse locusts, their habitat and their peculiar feeding preferences on lowly evolved food plants, provides an interesting case for study from the point of view of plant-animal coevolution, since the importance of this topic has already been suggested by Swain (1978).

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