Mitt. Münch. Ent. Ges.	**95**	19-29	München, 31.01.2006	ISSN 0340-4943

Distribution, phenology, ecology, behaviour and issues of conservation of the Israeli tiger moth, *Olepa schleini* WITT et al., 2005 (Lepidoptera, Arctiidae)

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Abstract

The distribution of the newly described *Olepa schleini* WITT, 2005 is restricted to a very small area which is fragmentized in itself to sub-units along some of the streamlets in the Israeli Coastal Plain. In this paper details on its distribution, habitat preference, phenology, dispersal, ecology and behaviour are given. *O. schleini* is critically endangered according to the IUCN Red List criteria. Suggestions to protect *O. schleini* are proposed.

Introduction

Widespread and intensive collection of Lepidoptera has been carried out in Israel from 1986 to 2004 in the framework of the Israeli-German project for the study of the Israeli Lepidoptera fauna. The project was a joint effort of The Hebrew University, Tel Aviv University, the Nature Reserves and National Parks Authority of Israel, the Zoologische Staatssammlung Munich and Museum Witt, Munich, Germany. The collection effort included about 3,000 night catches with mobile light traps powered by generator (250 Watt bulbs HQL & ML, 20 Watt Black light UV tubes) and about 1,500 nights catches with mobile light trap systems powered by batteries (12Volt 8 Watt & 20Watt, 6 Volt 4 Watt Black light UVB tubes) that were relocated on a daily basis. In addition there was a vast network of permanent light traps (220V 20W Black light UVB & UVC tubes) that was constantly maintained and relocated on an annual basis. The Lepidoptera collected in this project almost doubled the number of the species known from Israel including numerous new species for science (HAUSMANN 1991; 1993a-c; 1994a-b; 1995a-b; 1996a-b; 1997a-b; 2005a, 2006b; MÜLLER et al. 2006a, 2005b-j; KRAVCHENKO et al. 2001; 2002; 2004; 2005a-m; HACKER 2001; HACKER et al. 2001a-b; 2004; EITSCHBERGER et al. 2005; GERSHENSON et al. 2001; DE FREINA 2004). Nevertheless, little attention was paid to the Coastal Plain, particularly to areas where the vegetation is mainly synanthropic as in the Nahals (Nahal = river/stream in Hebrew) close to the Sea. Several rare Lepidoptera species, now probably extinct, were found until the 1940's in some coastal swamps and other wetlands but it was a surprise to find this spectacular new Arctiid species nowadays, after so much annihilation of the natural habitats.

Distribution

The first adult of *Olepa schleini* was collected at Nahal Shiqma in the Southern Coastal Plain of Israel in mid-August, 1999. Two further specimens were collected in Nahal Ayalon in the Central Coastal Plain in 2000 and 2001. The first larvae were found on castor oil trees, *Ricinus communis* L. (Euphorbiaceae) in Nahal Gerar in mid-September, 2001, and in Nahal Shiqma in mid-October, 2001.

A special survey that covered the Coastal Plain of Israel was carried out near streamlets, ponds and drained wetland areas where *Ricinus* trees were found. The search was carried out, once a month with four

automatic New Jersey light traps that were operated in 16 different locations in each Nahal from July to October, 2002. A thorough search for larvae-infested trees was carried out during the days; all the suitable places were combed and the castor oil trees were meticulously examined.

Specimens of *O. schleini* were found only along six Nahals in the central and southern Coastal Plain (Taninim, Alexander, Ayalon and its tributary Yarqon, Shiqma and Gerar a tributary of Besor). It was absent from other suitable sites in this area (Nahal: Galim, Daliyya, Hadera, Poleg, Soreq, Lakhish and its tributaries Ha'Ela and Guvrin, Evtah, and Besor with its tributaries Mefallesim, Bohu and Patish) and all the locations in the northern Coastal Plain (Nahal: Bezet, Keziv, Sha'al, Ashrat, Bet Ha'Emeq, Yasef, Kavul, Na'aman, Qishon and the Kefar Masaryk fish ponds).

Also, no larvae were found in other low land regions of Israel in the year 2003-2004 (Esdraelon Plain (Yizre'el Valley) the Rift Valley, from the Jordan Springs in the Hula Valley around the Sea of Galilee, the Lower Jordan Valley to the Dead Sea area with all its western tributaries).

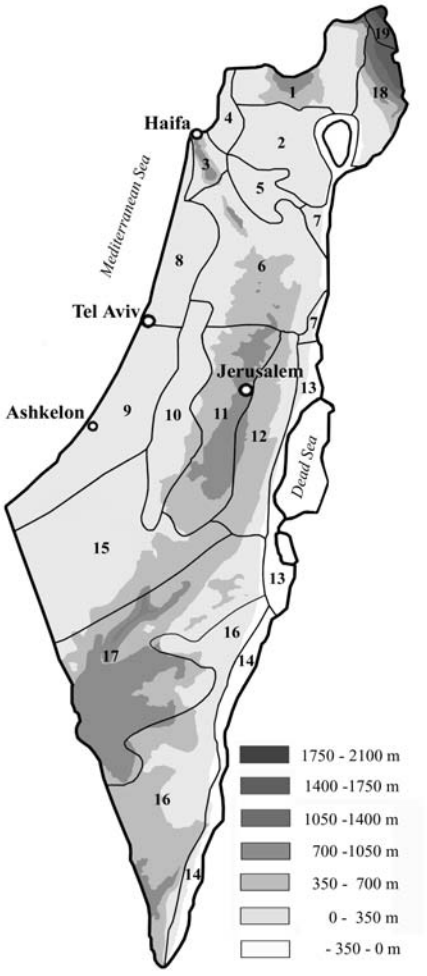


Fig. 1. Zoogeographical subdivision of Israel, map modified from Flora Palaestina (ZOHARI 1966; Vol. I). **1,** Upper Galilee. **2,** Lower Galilee. **3,** Mt Carmel. **4,** Coastal Galilee. **5,** Esdraelon Plain. **6,** Samaria. **7,** Lower Jordan Valley. **8,** Northern Coastal Plain. **9,** Southern Coastal Plain. **10,** Shefela. **11,** Judean Mountains. **12,** Judean Desert. **13,** Dead Sea Area. **14,** Arava Valley. **15,** Northern Negev. **16,** Southern Negev. **17,** Central Negev. **18,** Golan Heights. **19,** Mt Hermon.

The distribution of *O. schleini* was also very limited in the six Nahals where populations were observed and none were found upstream (eastwards) in the direction of the Judean and Samarian hills.

Altogether, only twenty-seven adults were collected in 640 trapping nights in 2002. At the same time, about 200 larval clusters (L1 and L2) and about 100 batches of eggs were recorded in 92 field days.

Signs of feeding on the host-plant were the initial indication for the presence of *O. schleini* and larvae were usually found at the site afterwards. This is a practical manner of search for this species since it is the only one known to feed on *R. communis* in Israel (Y. SCHLEIN & M. ROTHSCHILD, personal communication). One the host-plant was recognized, it was easy to find the small, young, greenish larvae on the plant as well as the larger brown ones in the leaf litter under the host-tree.

Year	Nahals with populations of *Olepa schleini*					
	Taninim	Alexander	Yarqon	Ayalon	Shiqma	Gerar
1999	--	--	--	--	A	--
2000	--	--	0	A	0	--
2001	--	--	0	A	L	L
2002	A L	L	A L	A L	A L	L
2003*	L	0	0	L	0	--
2004*	0	L	0	L	L	--

Recorded as: A: adults, L: larvae, --: not searched, 0: not found

* The search concentrated on larvae only

Table 1. Sites in which adults and larvae of *O. schleini* were observed.

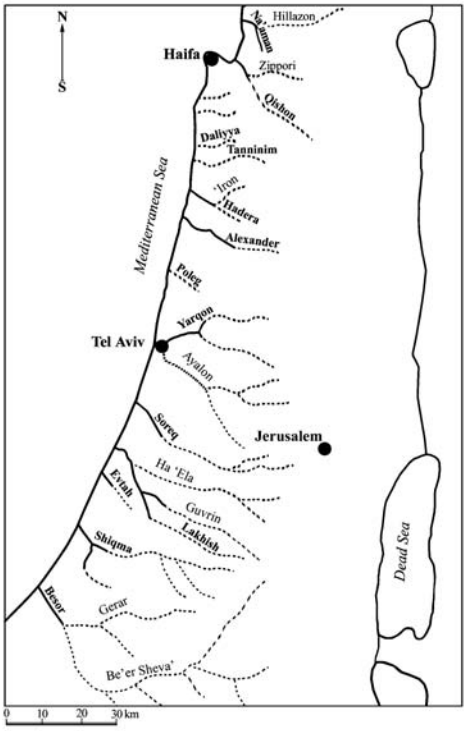


Fig. 2. Israel Coastal drainage system: "full line": permanent stream. "dashed line": intermittent or seasonal stream. "bold letters" main stream. "regular letters" tributary.

Characteristics of the habitat

In nature, larvae of *Olepa schleini* were observed only on *Ricinus* trees and adults were caught only close to groups of the trees. *Ricinus* is a fairly common synanthropic plant in Israel that sometimes grows in dense groups and nowadays is often found at roadsides and in wasteland (DANIN 2005). It is most common in the Sharon Plain (Central Coastal Plain), Philistean Plain (Southern Coastal Plain), Yizre'el (Esdraelon) Plain, Samaria, Judean Hills, the Western and Northern Negev, Hula Valley, Bet Shean Valley and the Golan Heights (ZOHARI 1972).

In the Coastal Plain, *R. communis* is often found in thickets along streamlets, near seasonally dry river beds, in swamp relics or any kind of other wet areas with eutrophic soil. The trees are regarded as weeds because of their toxicity and rapid growth, and therefore they are usually eliminated from urban and cultivated areas.

Larval infestations of *O. schleini* usually occur close to streamlets, dry riverbeds (12/ 19) that flood during the rainy season and in the direct vicinity of drained wetlands (5/19). Only two colonies with small populations have been found in dry places. Typically, old, large trees were infested while only satellite colonies were seen on small bushes. Many of the sites were close to cities in small pockets of disturbed natural islands surrounded by intensively cultivated orchards and fields.

Phenology and dispersal

At the accidental colony of the Zoological Garden of Tel Aviv University (TAU), adults were recorded from mid-May to mid-November with July to September as the main flight period. The first caterpillars were normally observed in the field in early June and the last ones were seen as late as mid-October. According to our observations in the field and outdoor breeding (MÜLLER et al. 2006a), *Olepa schleini* is found in two overlapping and a third partial generation.

Male adults were observed flying in search of females soon after sunset. In a light trap close to the infested trees (20m), the highest catch rate was generally within one hour after sunset and again from 3:00 – 5:00 h in the morning. On average, this trap caught about 8 times more males than females.

The flight distance appears to be short. Generally, males were caught no further than 500m and females no further than 300m from the breeding site which shows the males to be more active flyers.

Ecology and behaviour of the early stages

Eggs were typically laid on the underside of leafs often at a height of 0.5-1.5 m above the ground preferably in the shady parts of the tree. The number of eggs in a clutch varied in nature from 26 to187 with an average of 124 eggs (n: 105).

During daytime, only caterpillars in the first three “greenish” stages were observed on the foliage. Larvae of the first two stages were often feeding on the underside of leaves, leaving the veins and the upper dermis intact. First stage larvae are grouped in dense clusters on a silky web attached to the plant. Whereas, L2 larvae formed smaller groups that were attached to the plant with a single thread, and left consumed leaves. L3 larvae spread indiscriminately over the leaves and consumed all the tissues including the main veins.

L4 – L6 larvae, the “brownish” stages, were on the trees at night and not during the day. They are solitary feeders and ingest all the parts of the leaves indiscriminately. At sunrise, they migrate to the lowest part of the trunk and to the ground where they hide in the shadow. Here they form dense groups of 50 or more mixed L4 to L6 larvae. During the day, they find shelter among dry leaves, loose soil, branches, stones and other suitable substrates, and within a short time after sunset they migrate simultaneously up to the crown of the tree. Larvae of the brownish stages, which were exposed to light from strong projectors during nocturnal feeding in the foliage, stopped feeding and migrated towards the ground. Artificial light by night seems to have no effect on the young greenish stages.

L4-L6 stage larvae that had been marked with color while in their diurnal hiding places were found, on consecutive days, at the same location. In fact, larvae were not observed to change their host-plants

even if they were almost bare of foliage and undamaged bushes were available nearby. After the host-plants have been stripped of foliage, starved larvae of the "brownish stages" were observed to feed on the green twigs, green seeds and the bark of small branches. This manner of feeding bared many bushes and, at least, on one occasion, killed a small tree within a few days.

The majority of the caterpillars pupated in the shadow of the infested tree but some moved away and pupated at a distance of up to 100m. Cocoons were found mainly on the ground in layers of dry leafs, under stones and under old branches but a few were attached or close to the lower part of the trunk. Groups of cocoons, up to 20 attached to each other, were seen in favorable locations and sometimes they were concentrated to such an extent that the emergence of the adults was interrupted. During this stage, the only predation on the species was observed when about 20-30% of the cocoons the pupae were eaten, possibly by mice, shrews and/or Carabidae (Coleoptera).

Infestation with parasitic wasps or flies did not occur during the four years in which eggs and larvae were collected and reared but lethal microsporidial infections were common (MÜLLER et al. 2006a).

'Brown stage' larvae (L4 – L6), particularly the last stage, are densely covered with long hairs that are easily shed and always cause a quick and very strong allergic skin reaction comparable only to that of Thaumetopoeidae moths (KETTLE 1995; MUMCUOGLU & RUFLI 1982). It is noteworthy that the areas below the host-trees were heavily contaminated with larval hairs and a search there for larvae or cocoons contaminated clothes and caused immediate skin irritation. However, unlike Thaumetopoeidae, there were no airborne hairs and the irritation was caused by contact with the substrate. Contaminated clothes had to be washed several times before they ceased to be allergenic.

Disturbed "brownish stages" shake their head vigorously and vomit a viscous green liquid. Under major irritation, the L4 and L5 stages mainly curl up while L6 stages try to escape by fast running. In similar situations, the "greenish" stages shake their heads but rarely vomit and, generally, they are very reluctant to drop off their leaves.

The threat to *Olepa schleini* and possible preservation measures

Olepa schleini is probably a Paleo-Tropical relic (WITT et al. 2005) that appears to be endemic to the Coastal Plain of Israel since the wide and intensive search in other areas of the country, as specified above, yielded no results. Almost all colonies were found in former wetlands. Many of the Israeli wetlands had been drained for agricultural reasons or for mosquito control at the beginning of the 20th century (AVIZUR 1977; KITRON 1987). Most of the water from the Nahals of the Coastal Plain is exploited and the remainder is often severely polluted (GOREN & ORTAL 1999). The marshlands that once accompanied these water courses were mostly drained and dried, and particularly in the Coastal Plain they have become endangered habitats. As a result, many vertebrate and invertebrate species depending on these habitats have become regionally or generally extinct (DOLEV & PEREVOLOTSKY 2004). The Coastal Plain of Israel merely covers a few thousand of square kilometers and the density of human population in the area is one of the highest in the World (ORNI & EFRAT 1980). Almost all arable land is cultivated and the only stretches of semi-natural landscape are the coastal sand dunes where *O. schleini* is not found. Also, the species is confined to only a few Nahals in the whole Coastal Plain. An additional characteristic of *O. schleini* is that specimens were only found on single trees or small groups of trees and they did not disseminate over a larger area in any of these Nahals. Hence, this species is restricted to a very small area that is probably not larger than several square kilometers. Also, the populations seem to fluctuate greatly from year to year and many colonies vanished and were re-established without any obvious reason.

Along the Yarqon streamlet, two large colonies of *O. schleini* were destroyed in 2003 when the *Ricinus* trees were cut and the grove was burned. In the following two years, the species was no longer found along this Nahal. Also, the sites along the Ayalon were repeatedly destroyed by burning, landfill and, at least in one case, a colony was destroyed by pesticides from a nearby field. It is doubtful that the species will survive there for more than a few years. It seems that the species is able to cope with the cutting of the host trees, and although the larvae are starving hatching adults are apparently able to colonize new trees at a distance of several hundred meters. Complete colonies can be wiped out by a relatively small fire since it kills the pupae that concentrate in the leaf-litter close to the trunks of the host trees. Considering the comparatively small dispersal activities, *O. schleini* is hardly able to re-establish

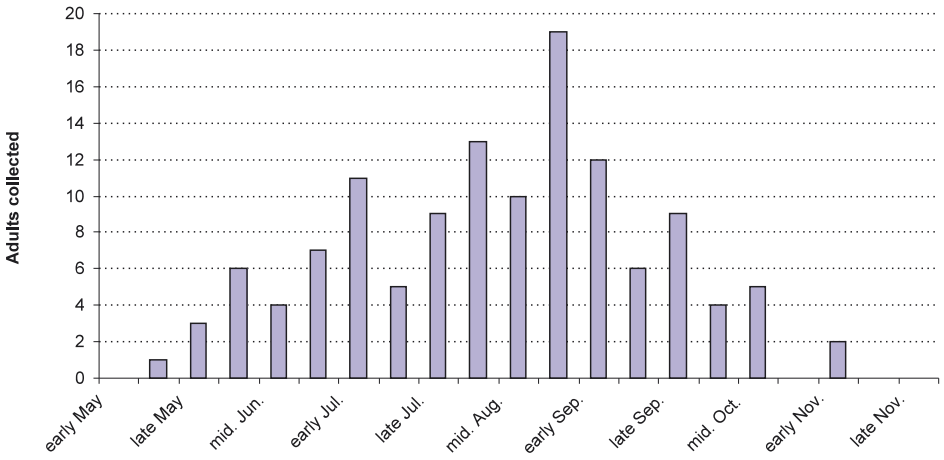
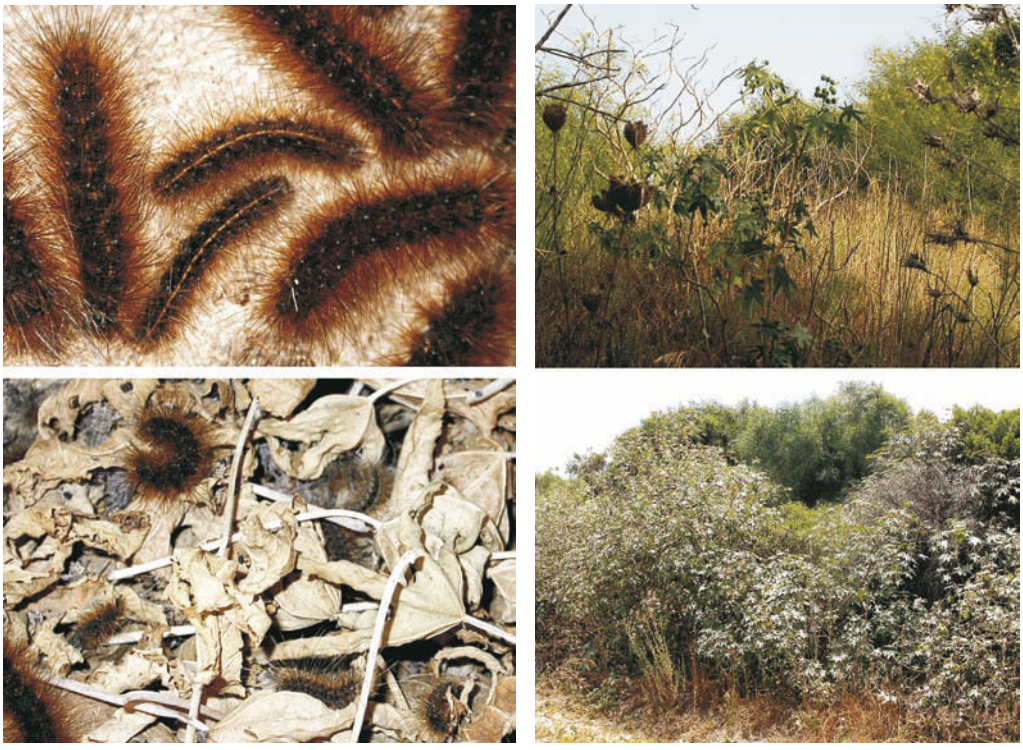


Fig. 3. Temporal distribution of *O. schleini* adults, monitored by an automatic trap near the colony of the Zoological Garden Tel Aviv (TAU) in 2004. Time intervals are of 10 days.



4 + 5 **6 + 7**

Figs. 4, 5. *Olepa schleini* WITT et al., 2005, larvae of the brownish stage, **4,** resting on lower part of *Ricinus* trunc, and **5,** resting in leaf litter. **Figs. 6, 7.** Habitats of *Olepa schleini* WITT et al., 2005. **6,** young shrub of *Ricinus*. **7,** larger shrubs in their environment.

colonies in distant Nahals from which it has vanished. The different active colonies are severely fragmented at the present time and there is no habitat network which will allow the spread of the species.

According to the IUCN Red List categories (IUCN, 1996, 1998), *Olepa schleini* must be considered regionally and world wide 'Critically Endangered'. Though it is enough to meet only one of the threat criteria, *O. schleini* fulfills almost all of them. The species is facing in the near future an extremely high risk of extinction because of the following criteria:

- drastic reduction of
  - the total population (suspected)
  - the extent of occurrence (suspected)
  - the area of occupancy (suspected)
  - the habitat quality (projected)
- extreme fluctuations
  - in the extent of occurrence (observed)
  - in the area of occupancy (observed)
  - in the number of individuals (observed)
- extent of occurrence estimated to be less than 100 km^2
- area of occupancy estimated to be less than 10 km^2
- population severely fragmented

The fact that this species was mentioned about 2500 years ago in the book of Jonah should make it a national asset in Israel (HAUSMANN & MÜLLER 2006). In addition, *O. schleini* deserves special protection because of its biological value as an endemic relic species and because of its special behaviour.

Probably 'Jonah's tiger moth' (to be called 'Ash Kikayon Yonah' in Hebrew), *Olepa schleini*, will only survive in Israel if proper conservation measurements are started in the near future.
The following actions seem appropriate and are suggested:

- Monitoring the colonies
- Collecting early stages in the field and establishing breading colonies for careful re-colonization programmes
- Establishing colonies in suitable Nature Reserves and National Parks
- Strengthening existing colonies
- Protecting sites in which stable colonies are found
- Arranging suitable habitats in the vicinity or inside Nature Reserves and National Parks

Preliminary release experiments showed that the fragmentized populations of the species can be strengthened and new colonies can be established successfully in suitable habitats (MÜLLER et al. 2006a).

Zusammenfassung

Die Gesamtverbreitung des Bärenspinners *Olepa schleini* WITT et al., 2005 beschränkt sich auf ein sehr kleines Gebiet im westlichen Israel, das in einige isolierte Teilflächen entlang von Flußläufen zerfällt. In diesem Artikel werden weitere Einzelheiten zu Verbreitung, Habitat, Phänologie, Dispersionsaktivität, Ökologie, und Verhalten der Präimaginalstände mitgeteilt. *O. schleini* ist nach den Rote-Liste-Kriterien der IUCN vom Aussterben bedroht. Ein sechs Punkte umfassender Maßnahmenkatalog zum Schutz der Art wird vorgeschlagen.

Acknowledgements

We thank all our colleagues and the many generous Israeli citizens who helped with this survey. We are grateful to the Israeli Nature and Parks Authority (NPA) for the collecting permits and to the staff of the NPA- regional rangers and the regional & district ecologists for help with the field work. This study would not have been possible without the generous help of Prof. Y. SCHLEIN, The Hebrew University, Medical School. We are grateful to Dr. L. SCHNUR for revising the manuscript.

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