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BIOLOGICAL AND TAXONOMIC STUDIES ON IMMATURE AND ADULT FRUIT-PIERCING MOTHS IN NEPAL, WITH REFERENCE TO THAILAND

*Hans Bänziger**

ABSTRACT

Twenty-four species of fruit-piercing moths not previously reported in Nepal were found near Kathmandu. Adults pierced peach, plum and wild fruit; the damage inflicted is discussed. Most common were *Oraesia rectistria* Guenée, *Adris tyrannus* (Guenée), and *Ad. okurai* Okano which is shown to be a senior synonym of *Ad. suthepensis* Bänziger & Honey. Until recently considered a rare moth, the immatures of this species are described for the first time, as are the adult's feeding habits. The larval host plant was *Holboellia latifolia* Wallich (Lardizabalaceae), a family not present in Thailand and Malaysia where the moth also occurs. Three species of Berberidaceae and 11 of Menispermaceae were tested as food and rejected, although these seem to be the only possible alternative larval host plants in Thailand. Many of these were accepted by the related *Ad. tyrannus* and *Othreis spp. Ot. fullonia* (Clerck), a most noxious fruit-piercer in Thailand and other mainly tropical lowland areas, was scarce in Nepal; the inconsistency of larval food preference of this and of *Ad. okurai* is discussed.

INTRODUCTION

No published report seems to exist about fruit-piercing by adult moths in Nepal. The nearest observations are from India (SUSAINATHAN, 1924; SONTAKAI, 1944; RAMAKRISHNA AYYAR, 1944) where at least 14 species have been reported to be associated with fruit. RAMAKRISHNA AYYAR, however, pointed out that it is not clear if all these species are actually fruit-piercers, and what type of damage they cause.

From Sri Lanka, BAPTIST (1944) gave a detailed report on the biology and possibility of control of the well-known fruit-piercer *Othreis fullonia* (Clerck). More general accounts of overall aspects of these moths, some of which are common in most tropical, many subtropical and some temperate areas, were published by MATSUZAWA (1961), NOMURA & HATTORI (1967), COCHEREAU (1974, 1977) and BÄNZIGER (1969, 1982).

On two study trips to Nepal (during July – September, 1984 and May – July, 1985), sizeable populations of fruit-piercing moths belonging to not less than 24 different species were caught on cultivated and wild fruit, and at mercury vapour lamps, in several areas in the valley and mountains around Kathmandu, as reported below.

*Department of Entomology, Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand.

Quite common was a species of *Adris* previously considered to be rare. In fact only a few unnamed specimens, the most recent dating back some 50 years ago, were present at the British Museum (Natural History), London (BMNH). They were mixed in with a series of another very similar moth species, the common and well-known *Adris tyrannus* (Guenée). 'Rediscovered' in Thailand in 1980, the species was assumed to be undescribed since it was not distinguished from *Ad. tyrannus* and there was no name available for it; it was described as *Ad. suthepensis* Bänziger & Honey, 1984.

Through the courtesy of Dr. H. Inoue, we were recently made aware that the species had been caught also in Taiwan and was known as *Ad. okurai* Okano, 1964. This moth name was not on the index cards of the BMNH which has the most complete list of names of moths in the world, nor was it mentioned in the Zoological Record. The publication of the moth's description in a little known Japanese journal apparently escaped the attention of most workers. Nevertheless, the immatures of this species, and the adult moth's feeding habits, seem to have remained completely unknown. Both were studied during the present investigation as mentioned below.

It is interesting to note that all but two *(Othreis materna* (L.) and *Plusiodonta* sp.) of the 24 species found in Nepal are also present in Thailand. But, as will be discussed, some species which are scarce in one country are so common as to be pests in the other, and *vice versa.*

SYSTEMATICS AND TAXONOMY

Adris okurai Okano

Adris okurai Okano, 1964, Tohoku Konchu Kenkyu *1*:41 – 45.

Adris suthepensis Bänziger & Honey, 1984, Mit. schweiz. ent. Ges. *57:* 173-177.

New synonymy

Method of identification: the figures and descriptions of the two species were compared, and Taiwanese specimens of *Ad. okurai* (generously sent by Dr. H. Inoue) were analyzed, the genitalia dissected and compared with paratypes of *Ad. suthepensis.*

Description of Immature Stages

Egg (Fig. 17)

Diameter 1.1 – 1.2 mm, height 0.89 mm. Colour light yellow. 1½ days after being laid a thin ring consisting of tiny brownish flecks formed roughly above the equator. One day before hatching, which occurred 5-6 days after laying (min-max. temp. 20 – 25°C) hairs, eyes and mandibles become visible through the egg wall.

First instar larva (Fig. 11)

Head light yellow, body light greenish, legs dark. Abdominal hairs long, black as are their sockets which are situated in the center of black flecks. These are much less wide and do not merge with nearby flecks as is the case with *Ot. materna.*

Second instar larva (Fig. 12)

Entirely black, though the 'eyes' on abdominal segments 3 and 4 can be anticipated as very faint ring sections of yellowish-brown colour at the proximal-ventral side.

Third instar larva (Fig. 13)

As second instar but the 'eyes' are very clear rings, the antero-dorsal ⅓-¼ ring section of the anterior 'eye' being white, the remaining orange, as is the entire posterior 'eye'. Below the center of both is a bluish spot. A whitish area is above the 4 pairs of prolegs. A fair number of tiny speckles, mostly blue but some white, are distributed in transverse rows or more irregularly over the whole body.

Fourth instar larva (Fig. 14)

As third instar but 'eyes' better defined, the blue speckles clearer and larger, the white above the 4th proleg assuming a net-like appearance; some irregular light brown and yellow flecks are also present distally to this as well as proximally to the first 'eye'.

Fifth instar larva (Figs. 1-4)

Overall colour bright brownish. Head, neck and legs very dark brown. 'Eyes' as in fourth instar but yet more evident, with the antero-dorsal 2/3 section of the anterior 'eye' light yellow and much widened. Brownish and some yellowish marbling on sides of the whole body, with greyish on the latero-dorsal area between abdominal segments 5 and 7; rest of dorsum brown.

Sixth instar larva (Fig. 15)

As fifth instar but lighter and more brillantly coloured.

In captivity, the caterpillars went through 6 instars only; it is assumed that in nature there are generally 7 instars as occur in related species. However, the colouration of the last instar, be it the sixth or the seventh, generally does not differ and the size is also comparable. There may, however, be appreciable differences between single individuals and between populations, as in the related *Ot. fullonia.*

Some provisional measurements. First instar: width of head 0.64 mm, body length 3.7 mm; second and third instars not noted; fourth instar: width of head 2.9 mm, body length 25 mm; fifth instar: width of head 4 mm, body length 40 mm; sixth instar: width of head 5.5 mm, body length 65 mm.

Ad. okurai's last instar larva differs from that of *Ad. tyrannus* mainly in the brillant yellow-brown lateral marbling where *Ad. tyrannus* is dark brown (Figs. 15, 16).

Pupa

No details noted but generally pupae differ very little, if at all, between species.

Adult

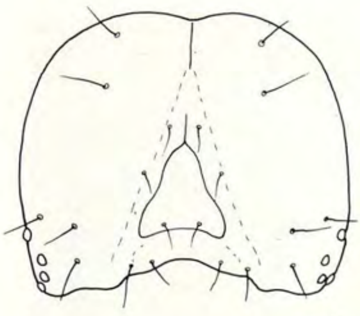
Described in detail in BANZIGER & HONEY (1984), including the morphology of the piercing mouth parts. Externally *Ad. okurai* can most readily be distinguished from the very similar *Ad. tyrannus* by the lack of the hook-like fore wing extension at the tornus and the narrower yellow hind wing margin (Figs. 18, 19). The male genitalia differ in the aedeagus with a much larger cornutus and in the juxta with much shorter processi which generally have more prominent teeth than in *Ad. tyrannus*, though in some specimens these may by nearly completely lacking.

FAUNISTIC AND BIOLOGICAL NOTES

Species with Fruit-piercing Adults

Below is a list of fruit-piercing moth adults observed on fruits and/or caught at mercury vapour lamps (MVL) near Godavari, 1520-1570 m, unless otherwise stated.

1. *Adris okurai* Okano (Figs. 6, 18)
   27 specimens (only 1 ♀) found piercing plums (*Prunus domestica* L.) and peaches (*P. persica* Batsch). Dates of records in Fig. 5.
2. *Adris tyrannus* (Guenée) (Figs. 7, 19)
   29 specimens seen piercing plums and peaches, 2 specimens pierced berries of *Rubus acuminatus* Smith; 1 was caught at MVL, 20.8.84. Dates of records in Fig. 5.
3. *Anomis flava* Fabricius
   1 specimen pierced *R. acuminatus*, 15.9.84.
4. *Anomis mesogona* (Walker) (Fig. 9)
   7 specimens pierced peach, plum, and *R. acuminatus*, 14., 15.9.84, 13., 19., 22., 28.6.85; 1 was caught at MVL, Kakani, 2070 m, 8.8.84.
5. *Anomis metaxantha* (Walker)
   1 specimen pierced *R. acuminatus*, 14.9.84 and 1 was caught at MVL, 2100 m, on Phulchoki mountain, 23.6.85.
6. *Anua olista* Swinhoe
   At least 10 specimens pierced broken peach and plum, 12., 30.6. and 2.7.85.
7. *Artena dotata* (Fabricius)
   2 specimens pierced *R. acuminatus*, 14.9.84, and broken plum and peach on 19., 24., 26., 28.6. and 2.7.85. 1 specimen was caught at MVL at Kakani, 7.8.84, and 1 at 2650 m on Phulchoki, 21.8.84.



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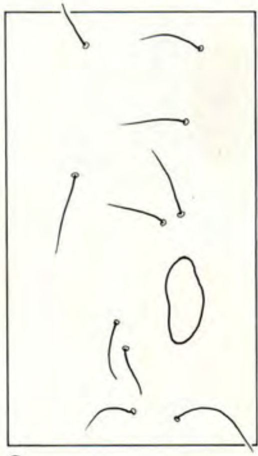

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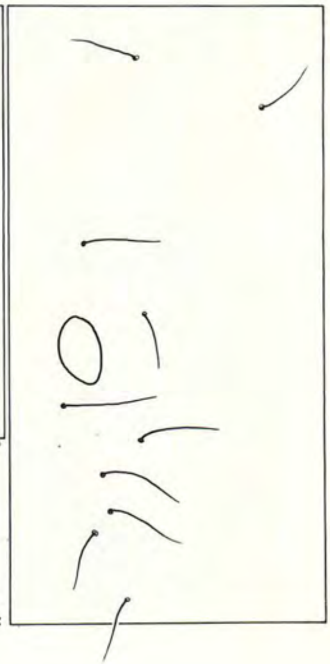

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Figures 1-4. 5th instar caterpillar of *Adris okurai*. 1, frontal view of head capsule; 2, left mandible seen from inside; 3, setal map of prothorax and, 4, of 1st abdominal segment (left halves).

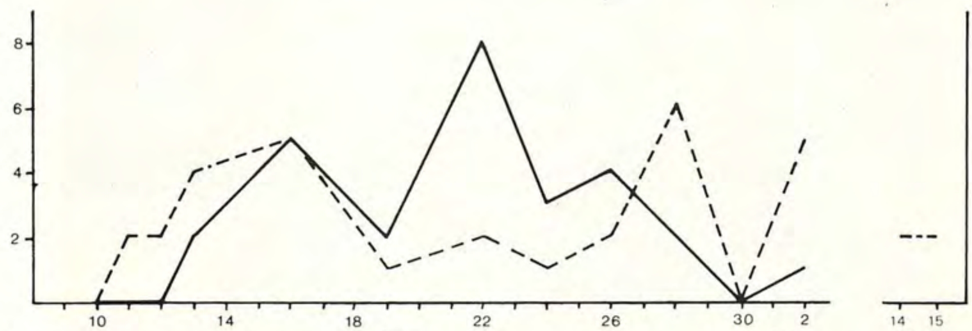

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Figure 5. Records of *Adris okurai* (full line) and *Ad. tyrannus* (dotted line) piercing fruit near Godavari, C. Nepal.

Figure 6. *Adris okurai* piercing a peach fruit.

Figure 7. *Adris tyrannus* piercing a plum fruit.

Figure 8. *Oraesia rectistria* sucking sap from a plum; note part of the piercing proboscis still outside the fruit between the fore leg and the palpus below the eye.

Figure 9. *Anomis mesogona* piercing a plum, part of the proboscis visible. Note that the fruit had been similarly pierced twice earlier in the gray, now rotting area around two holes.

Figure 10. *Lagoptera juno* sucking nectar from the flowers of night jessamine *(Cestrum nocturnum)*. All photographs of moths were made in natural conditions in the field at night.

Figure 11. First instar larva of *Adris okurai* on *Holboellia latifolia*.

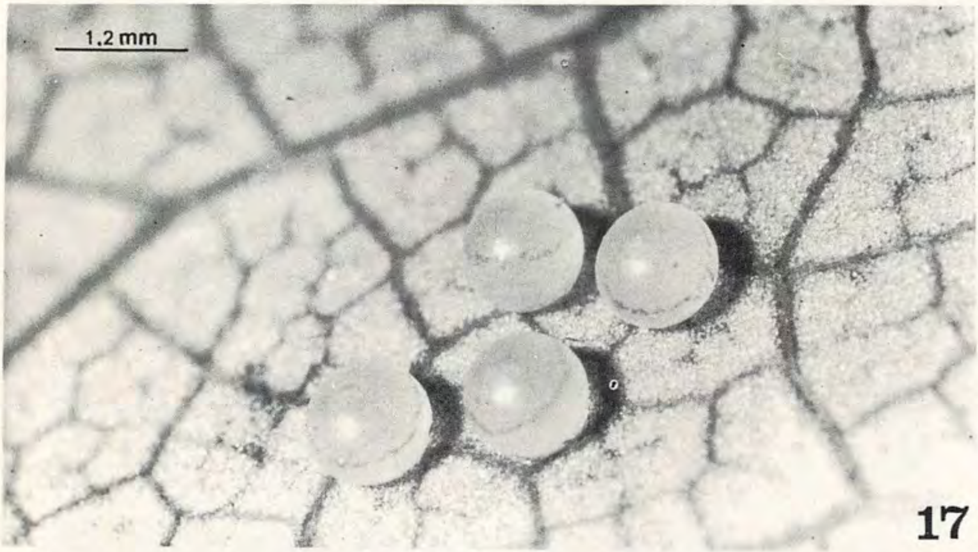
Figure 12. Second instar larva of *Ad. okurai* eating the leaf of *H. latifolia*.

Figure 13. Third instar caterpillar of *Ad. okurai* on *H. latifolia*.

Figure 14. Fourth instar caterpillar of *Ad. okurai* on *H. latifolia*.

Figure 15. Last (sixth) instar larva of *Adris okurai* on *Holboellia latifolia* in typical defensive-threat posture, the rear resembling a snake ready to strike, the anterior rolled up to protect the head.

Figure 16. Last (sixth) instar larva of *Ad. tyrannus*.



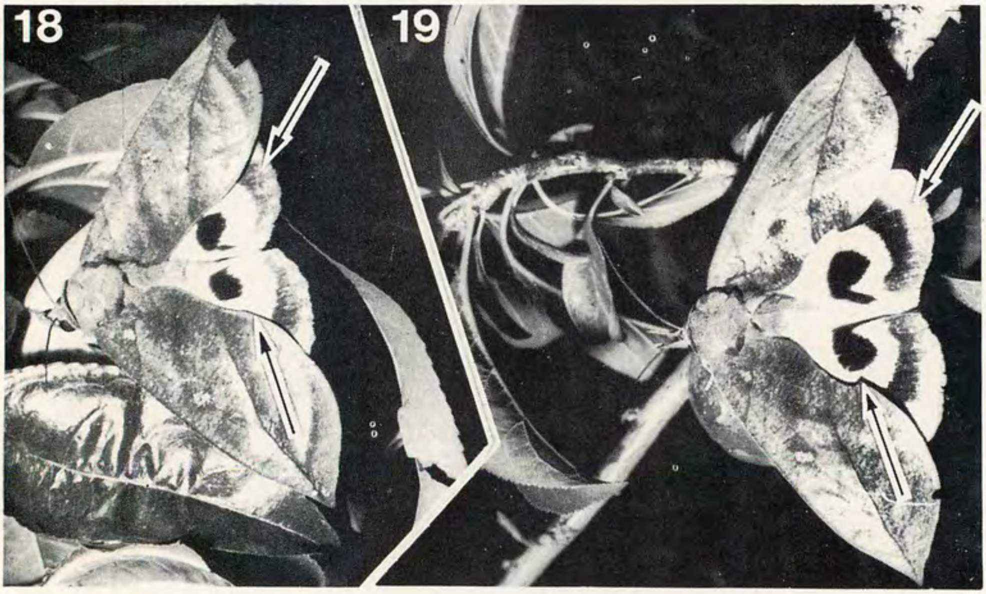


Figure 17. Eggs of *Adris okurai* a few days after being laid on *Holboellia latifolia*.

Figure 18. *Ad. okurai* piercing peach. Note (arrows) the lack of the hook at the fore wing tornus and the narrow yellow band on the hind wing margin.

Figure 19. *Ad. tyrannus* piercing plum. Note (arrows) the presence of the hook at the tornus and the broad yellow band at the hind wing margin.

8. *Calyptra* sp.
A few specimens of 4 species of *Calyptra* were seen on fruits or caught at MVL. These will be treated in more detail elsewhere (Bänziger, in prep.).
9. *Eudocima salaminia* (Cramer)
3 specimens pierced peach, plum and *R. acuminatus*, 14.9.84, 28.6. and 2.7.85; 2 were caught at MVL, 20. and 27.8.84.
10. *Ischyja manlia* (Cramer)
1 specimen caught at MVL, Phulchoki, 2650 m, 21.8.84.
11. *Lagoptera juno* (Dalmüller) (Fig. 10)
1 specimen sucked from broken plum, 1 sucked nectar from the flower of *Cestrum nocturnum* L., 2.7.85. Several were caught at MVL, Phulchoki, 2650 m, 16., 21.8.84.
12. *Ophiusa coronata* (Fabricius)
1 specimen was caught at MVL, 27.8.84.
13. *Ophiusa trapezium* (Guenée)
1 specimen pierced peach, 30.6.85; 1 was caught at MVL, Kakani, 7.8.84.
14. *Oraesia emarginata* (Fabricius)
A few specimens were seen piercing peach and plum from June to early July, 1985.
15. *Oraesia rectistria* Guenée (Fig. 8)
Very common, exact number not counted but up to 15-20 specimens per night were seen piercing peach and plum during June to early July, 1985; also caught at MVL June to August up to at least 2650 m, Phulchoki.
16. *Othreis fullonia* (Clerck)
5 specimens observed to pierce peach, 16., 22., 26., 30.6.85. 4 were caught at MVL, 21. and 27.8.84 at 2650 m, and 17.6.85 at 2100 m, Phulchoki.
17. *Othreis materna* (L.)
1♀ was caught at MVL, Phulchoki, 2100 m, 17.6.85.
18. *Parallelia crameri* (Moore)
A few specimens were caught at MVL, Phulchoki, 2650 m, 21.8.84.
19. *Parallelia* sp.
1 specimen was caught at MVL, Phulchoki, 2650 m, 21.8.84.
20. *Plusiodonta auripicta* Moore
2 specimens were caught at MVL, Sundarijal, 1680 m, 24.8.84.
21. *Plusiodonta* probably *chalsitoides* Guenée
1 specimen pierced *R. acuminatus*, 8.9.84.
22. *Plusiodonta* sp.
2 specimens were caught on 29.9.84.
23. *Serrodes campana* Guenée
1 specimen pierced peach, 2.7.85; 1 was caught at MVL, Phulchoki, 2650 m, 21.8.84.

24. *Thyas honesta* Huebner
1 specimen sucked broken plum, 2.7.85. (Cover photo shows specimen from Thailand.)

Immatures Found on Host Plants

Adris tyrannus (Fig. 16)

One 2nd instar caterpillar was found on *Berberis asiatica* Roxb. ex DC. (Berberidaceae) at 1850 m, one 4th-5th instar caterpillar on the same plant species at 1650 m, Nagarjung Forest, 6.6.85, and one 6th-7th instar caterpillar again on this species at 1600 m above Sundarijal, 25.8.84. A dozen 4th to 7th instar caterpillars were collected on *Mahonia napaulensis* DC. (Berberidaceae) and *B. asiatica* at 1520 m, Godavari, 18.8.84. One 3rd instar caterpillar was caught on *Holboellia latifolia* Wallich (Lardizabalaceae) at 2000 m, Phulchoki, 11.6.85.

The three host plant species represent new records for *Ad. tyrannus;* also, these seem to be the first observations of immatures of this moth in the subcontinent.

Eudocima salaminia

One 2nd-3rd instar caterpillar was observed on *Stephania japonica* (Thunb.) Miers (Menispermaceae) at Sauraha (Terai), 1.6.85. One 7th instar caterpillar was found on the same host species at Godavari, 10.9.84.

Results of Rearing Experiments

The detailed information on the identity of Menispermaceae presented here has been possible only through the long term collaboration with Mr. L. L. Forman. Some of the most pertinent works are FORMAN (1981, 1986, and in press).

Adris okurai

The immatures and their host plants seem to have been fully unknown before the present study. The assessment (carried out both in Nepal and Thailand) of the host plant spectrum of the larvae is based on caterpillars reared from eggs laid by the only Nepalese female caught.

Accepted plants. Lardizabalaceae: *Holboellia latifolia.*

Rejected plants. Berberidaceae: *B. asiatica, M. napaulensis, M. siamensis* Takeda. Menispermaceae: *Cocculus laurifolius* DC., *C. orbiculatus* (L.) DC. (= *trilobus* (Thunb.) DC.), *Pericampylus glaucus* (Lam.) Merr., *St. elegans* Hook.f. & Thoms, *St. oblata* Craib (= *St. kerrii* Craib), St. sp. 15 (aff. *glabra* (Roxb.) Miers), *Tinomiscium petiolare* Miers, *Tinospora baenzigeri* Forman, *Tinos. crispa* (L.) Hook.f. & Thoms, *Tinos. sinensis* (Lour.) Merr., *Tinos.* sp. nov. aff. *glabra* (Burm.f.) Merr. (this species is being described by Forman (in press)).

Fresh, young leaves of *M. napaulensis* and *M. siamensis* were sometimes gnawed upon but the larvae soon ceased and eventually died.

Development times of the immature stages were: egg, 5–6 days; larval instars 3–4 days each except the last which took 6–7 days; pupa, 14–16 days.

Adris tyrannus

The caterpillar of this well-known fruit-piercing pest has been reported in Japan to feed from such Lardizabalaceae as *Akebia quinata* (Thunb.) Decne., *Ak. trifoliata* (Thunb.) Koidz., *Stauntonia hexaphylla* Decne., Menispermaceae as *C. orbiculatus* (MATSUZAWA, 1961), and Berberidaceae as *B. sieboldii* Miq., *M. fortunei* (Lind.) Fedde, *M. japonica* (Thunb.) (NOMURA & HATTORI, 1967).

Trials with Nepalese larvae collected in the field indicate the following host plant spectrum.

Accepted plants. Berberidaceae: *B. asiatica, M. napaulensis.* Lardizabalaceae: *H. latifolia.*

Accepted to a lesser, variable extent. Menispermaceae: *C. laurifolius, C. orbiculatus, Sinomenium acutum* Rehd. & Wils., *Tinos. sinensis.*

Except for *C. orbiculatus* these represent all new host plant records.

Fruit Damage Caused by Adult Moths

Attack rate on peaches at the study site was over 100%, i.e. all fruits were pierced and most of them several times by the moths. Decay, however, was relatively slow and since the fruit was for local home consumption, the loss was not total as many fruits could still be eaten after the rotten parts were cut off. Also, the fruits did not drop as readily as was observed with citrus in Thailand. Plums were less seriously affected, partly because they were picked earlier.

Such heavy attack is at least in part due to the fact that the two orchards under study were the last ones to bear fruit. All other orchards in the area had been harvested a couple of weeks earlier so that the remaining orchards had to take the brunt of the whole fruit-piercing moth population of the area.

Most of the damage was caused by *Or. rectistria,* by far the most common species; much less by *Or. emarginata.* In second place because less frequent came *Ad. okurai* and *Ad. tyrannus,* followed by the much scarcer *Anomis* spp., *Ot. fullonia, E. salaminia, Calyptra* spp., *Se. campana.* These are all primary fruit-piercers of peach and plum, i.e. they are capable of piercing the intact skin of these fruits. The secondary fruit-piercers of peach and plum include species of *Anua, Ophiusa, Parallelia* and *Thyas.* They can pierce the pulp only through an opening already present in the skin of the fruit, such as a hole made by a primary fruit-piercer; the aspect and significance of primary and secondary fruit-piercers have been explained in detail (BANZIGER, 1982). *Plusiodonta* spp. are probably capable of piercing intact, very ripe peach, as this is particularly soft; *Ar. dotata,* perhaps some *Ophiusa* and *Thyas* spp. may also be able to do so. *I. manlia* on the other hand, seems to pierce, if at all, only the softest fruit, such as *Rubus* spp. or overripe broken guava *(Psidium guajava* L.*).* Also *L. juno* seems to be a rather weak piercer and indeed it also sucks nectar from flowers such as night jessamine (*Cestrum nocturnum* L.) (Fig. 10).

From the above it can be concluded that, at least in the Central Midlands of

Nepal, potential fruit-piercing moth pests pertain mainly to *Oraesia* and *Adris* spp. These can also pierce citrus, and the latter even lichi (*Litchi chinensis* Sonn.) and longan (*Dimocarpus longan* Lour.) besides, of course, all other softer skinned fruits.

A specimen of *Ad. tyrannus*, recognizable from a dent in the hind wing, pierced 3 different peaches over a period of 3 hours. Observed patterns of behaviour of *Ad. okurai* are like those of *Ad. tyrannus* and *Othreis* spp. *Ad. tyrannus* is one of the most serious fruit-piercers in some subtropical areas of Eastern Asia (MATSUZAWA, 1961; NOMURA & HATTORI, 1967; WOO et al., 1975), while *Ot. fullonia* is one of the most damaging in many tropical regions from W. Africa eastwards to the Pacific (KÜNCKEL, 1875; SUSAINATHAN, 1924; HARGREAVES, 1936; BAPTIST, 1944; COMSTOCK, 1963; COCHEREAU, 1974; BÄNZIGER, 1982) (see also Discussion). However, since the present study was limited in time and space, it is premature to make an overall assessment of the agroeconomic role which these moths may play in Nepal.

DISCUSSION

The finding that adult *Ad. okurai* have reached pest status at the study site in Nepal was not expected. It was believed to be a rare species, only few specimens being present at the BMNH, none having been caught for 50 years except a very few specimens recently in Thailand and a series in Taiwan. But at present it is difficult to assess whether this mountain species is only locally common in a few of its distribution areas, or whether it was just incidentally frequent in the year studied.

On the other hand, the finding of *Ad. tyrannus* in Nepal is not surprising. There are museum specimens (mainly BMNH) and records (e. g. ROMANOFF, 1892) of localities from N. Pakistan, N.W. and N.E. India, S. and N. China including E. Tibet and Manchuria, S.E. Siberia of the U.S. S.R., and especially Japan where it can be a serious pest. The southernmost part of its range seems to be N. Thailand where it is very rare; 2 specimens were recently caught for the first time in the country (BÄNZIGER, 1982). In southern regions it is found only in the mountains.

The few specimens of *Ot. fullonia* caught in Nepal seem to point out that, although the species has a very wide geographical distribution from tropical Africa (probably as a different subspecies) and Asia to the Pacific, it is mainly a tropical lowland species. In Thailand, as elsewhere, pest status has been reported only in lowland fruit cultivation (citrus, pomegranates, guava, longan, etc.). However, there are a few MVL captures from 2650 m (present report) and even one from 3750 m (Choche Lekh, Nepal, 8.7.84, Mr. M. G. Allen leg., pers. comm.), and occasional specimens from as far north as N. Korea (BMNH). The species is a strong flyer and it may migrate.

The trials carried out to assess the larval host plant spectrum give valuable information on the actual and potential geographical distribution, biology and ecology of two of the more interesting fruit-piercers. The finding that Nepalese *Ad.*

okurai caterpillars accept only *H. latifolia,* and presumably some other species of the genus, and die rather than eat any other of the related, potential host plants tested, is intriguing. No *Holboellia* spp., and in fact none of the Lardizabalaceae are present in Thailand, or in W. Malaysia, where the moth also occurs. The plant's nearest relatives are the Berberidaceae, of which *M. siamensis* is the only member found in Thailand. This small tree was present in the close neighbourhood where Thai *Ad. okurai* adults were caught. However, Nepalese caterpillars accepted neither this nor the Himalayan *M. napaulensis* or *B. asiatica*. On the other hand, the closest relative of the moth, the sister species *Ad. tyrannus,* develops normally on *Mahonia* spp., *Berberis* spp., and others. *Ad. okurai* rejected also all the 11 species of Menispermaceae tested. Many of these belong to the most commonly eaten host plants of the moth's other near relatives *Othreis, Rhytia, Eudocima,* etc.

A similar, even more perplexing food selectivity is shown by larvae of *Ot. fullonia.* South and Southeast Asian, and Australian populations live on various, but by no means all, Menispermaceae (TRYON, 1924; SUSAINATHAN, 1924; MARJABANDHU, 1933; SONTAKAY, 1944; BAPTIST, 1945; PHOLBOON, 1965; BÄNZIGER, 1982) but in New Caledonia and Fiji they feed primarily on *Erythrina* spp. (Leguminosae, completely unrelated to Menispermaceae) (JEPSON, 1917; COCHEREAU, 1977), though to some extent also on Menispermaceae (COCHEREAU, 1977). Northern Thai populations completely reject *Erythrina* spp. (KAEWRAKON, 1982; BÄNZIGER, unpubl.). Even within a country like Thailand there may be individual and/or population variations in food preference. In the mid 70s, mainly in C. Thailand, BÄNZIGER (1982) found the principal food plants to be *Tinos. baenzigeri, Tinos. sinensis,* and *Tinos. crispa.* In the early 80s KAEWRAKON (1982) found the larvae of populations in an area south of Chiang Mai only on *Tiliacora triandra,* and they reportedly did not develop on *Tinos. crispa.* In the most recent findings in N. Thailand (BÄNZIGER, unpubl.) caterpillars were collected on *Tinos. crispa,* albeit infrequently, and most but not all caterpillars developed fully on the excised leaves of this plant. Cultivated *Tinos. baenzigeri* and *Tinos.* sp. nov. aff. *glabra* were more frequently attacked and clearly preferred to *Tinos. crispa.*

An additional factor complicating the understanding of the larval food preference may be the ability of some hosts to respond to heavy attack by producing physiological changes in the leaves so as to make them less palatable (e.g. FEENY, 1970), or qualitatively inferior over periods as long as a few years. This in turn can strongly decrease the immatures' speed of development, size, survival, and the adult's fecundity, as found for the caterpillars *Oporinia autumnata* Borkh. on *Betula pubescens* Ehrh. or for *Zeiraphera diniana* (Guenée) on *Larix decidua* Miller (HAUKIOJA & NIEMELAE, 1976; BENZ, 1977). It is likely that the mass population outbreaks of *Ot. fullonia* every 5-10 years are due to the interplay of environmental factors with possible physiological reactions of the host plants, along with the dynamics of a lepidopteran with variable food preference. These fluctuations are superimposed on an apparent long term increase in damage due to fruit-piercing moths which I have blamed on forest destruction which favours the development of many Menispermaceae (BÄNZIGER, 1982).

It is not yet clear whether the inconsistency in the host plant preference is due to individual aberrations, to the presence of ecological-geographical races, or to some other as yet unknown factor. In *Ad. okurai* the second explanation seems most likely. The specimens captured in Thailand were mostly fresh and intact and hence it is most unlikely that they immigrated from such distant places as N. Burma or S.W. China where Lardizabalaceae have been reported. The moths represent local populations, and the larvae are likely to live on *M. siamensis.* It can be assumed, therefore, that sub-Himalayan and Southeast Asian populations of *Ad. okurai* are somewhat differentiated, at least in the choice of the immature's food plants although the adults cannot be distinguished on external characters or genitalia.

The only other alternative would be that *Holboellia* or some other member of the Lardizabalaceae family may have remained undetected in some remote corner of Thailand. This would be an interesting prediction in which a rare insect leads to the discovery of a plant family not known to occur in Thailand—quite unlikely but not altogether impossible if one considers that several Menispermaceae new to science or to the country were discovered during studies such as the present one.

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