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Host plants and feeding patterns of some South African tortoise beetles (*Coleoptera*: *Chrysomelidae*: cassidoid *Hispinae*)

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ABSTRACT. Host plants, representing 10 families and 20 genera, utilised by 33 South African tortoise beetles currently being studied are listed. Those known only from collection labels and not confirmed in the field are marked with an asterisk (*). Since the cassidoid *Hispinae* are seldom encountered far from their host plants and almost nothing is known of the biology of Afrotropical fauna, an appeal is made to entomologists collecting the group to record host plants, and other pertinent data, on collection labels. *Cassida muirana* SHARP, 1904, is an new synonym of *C. vespertilio* BOHEMAN, 1862. *Crossocassis pilosa* SPAETH, 1911, is transferred to the genus *Trichaspis* SPAETH, 1911. Imaginal feeding patterns are briefly considered as a guide to species identification in the field.

Key words: entomology, taxonomy, bionomics, *Coleoptera*, *Chrysomelidae*, cassidoid *Hispinae*, South Africa.

Despite the fact that the Afrotropical region, including Madagascar, is, after the Neotropics, one of the richest in species diversity, few serious works have been published on the biology of its cassidoid *Hispinae* since the pioneering work of MUIR & SHARP (1904). The biology and host plants are almost completely unknown (BOROWIEC 1994). Since these beetles are seldom encountered far from their host plants (and are most readily found by locating them), entomologists have, by neglecting to record such plants, greatly hindered their study. This note serves to place on record the host plants thus far verified for 34 species.

CASSID SPECIES AND THEIR HOST PLANTS

The traditional classification of SPAETH, in HINCKS (1952), has recently been revised (BOROWIEC 1995) and these beetles have now been combined with the *Hispinae* as the cassidoid *Hispinae*. The following host plant family preferences have emerged for the 34 species reported here.

Tribe	Genus	Host-plant family	Number of species noted using family
Notosacanthini	*Notosacantha*	*Rubiaceae*	1
Cassidini	*Laccoptera*	*Convolvulaceae*	2
	Conchyloctenia	*Convolvulaceae*	1
		Solanaceae	2
	Aspidimorpha	*Convolvulaceae*	5
	Acrocassis	*Convolvulaceae*	1
	Chiridopsis	*Convolvulaceae*	1
	Cassida	*Acanthaceae*	2
		Asteraceae	4
		Amaranthaceae	3
		Chenopodiaceae	2
		Polygonaceae	1
		Salvadoraceae	2
		Solanaceae	3
	Basipta	*Asteraceae*	1
	Aethiopocassis	*Acanthaceae*	1
	Oxylepus	*Chenopodiaceae*	3
	Trichaspis	*Asteraceae*	1
		Sapindaceae	1

Many cassidoid *Hispinae* make use of exotic plants and some beetles exhibit a strong preference for certain host-plant species. The review below lists all the host-plants thus far identified for the species under study. Most imagines have distinctive feeding patterns which betray their presence on host-plants, and silhouette figures of some of these are presented.

HOST-PLANTS UTILISED BY SOME SOUTH AFRICAN CASSIDOID *HISPINAE*

Notosacantha laticollis (BOHEMAN, 1862)

Hoplionota laticollis BOHEMAN, 1862: 4; SHAW, 1956 a: 258 (in *Notosacantha*).

Rubiaceae: *Canthium inerme* (L. f.) KUNTZE.

Comment: Imagines only, on two occasions. An unidentified *Notosacantha* sp. has also been observed on *Gardenia* sp. (possibly *G. jasminoides* ELLIS). The lack of host plant information may, in part, account for the fact that c. 80% of all *Notosacantha* spp. (220 in world fauna) have not been recorded again following their original description (DĄBROWSKA & BOROWIEC 1996: 451).

Laccoptera cicatricosa BOHEMAN, 1855

Laccoptera cicatricosa BOHEMAN, 1855: 62 (not *L. cicatricosa* auct. = *L. rotundicollis* BOROWIEC). syn. *Laccoptera abyssinica* (BOHEMAN, 1856: 117).

Convolvulaceae: *Convolvulus farinosus* L., *Hewittia sublobata* (LINN. f.) O. KTZE., *Ipomoea alba* L., *I. batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. congesta* R. BR., *I. ficifolia* LINDL., *I. wightii* (WALL.) CHOISY.

Comment: *Ipomoea ficifolia* and *I. wightii* (both with hirsute leaves) appear to be reluctantly used in the presence of other host-plants.

Laccoptera excavata BOHEMAN, 1855

Laccoptera excavata BOHEMAN, 1855: 56.

Convolvulaceae: *Ipomoea cairica* (L.) SWEET, *I. ficifolia* LINDL., *I. pes-caprae* (L.) R. BR., *I. wightii* (WALL.) CHOISY.

Conchyloctenia hybrida (BOHEMAN, 1854)

Cassida hybrida BOHEMAN, 1854: 338; SPAETH, 1902: 450 (in *Conchyloctenia*).

Solanaceae: *Solanum panduraeforme* E. MEY.

Comment: PATERSON (1941: 4) gave *Solanum incanum* L. as also did BOROWIEC (1994: 74) who included *S. mauritianum* SCOP. The species *S. campylacanthum* HOCHST. was given for Kenya (SHAW 1956: 263).

Conchyloctenia tigrina (OLIVIER, 1808)

Cassida tigrina OLIVIER, 1808: 957; SPAETH, 1902: 450 (in *Conchyloctenia*).

Solanaceae: *Solanum panduraeforme* E. MEY.

Comment: OLCKERS & HULLEY (1989: 110) gave three additional host-plants, viz. *Solanum hermannii* DUN. (common), *S. rigescens* JACQ. and *S. coccineum* JACQ. (rarely used). Although they specifically state that *S. mauritianum* SCOP. was never used in their study area of the eastern Cape, that species was listed by BOROWIEC (1994: 114).

Conchyloctenia punctata (FABRICIUS, 1787)

Cassida punctata FABRICIUS, 1787: 64; SPAETH, 1902: 450 (in *Conchyloctenia*).

Convolvulaceae: *Convolvulus farinosus* L., *Hewittia sublobata* (LINN. f.) O. KTZE., *Ipomoea batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. ficifolia* LINDL.

Comment: *Ipomoea ficifolia* was a single record of a young imago. PATERSON (1941: 6) gave *Ipomoea purpurea* (L.) ROTH.

Aspidimorpha areata (KLUG, 1835)

Cassida areata KLUG, 1835: 48; WEISE, 1896 c: 20 (in *Aspidomorpha*).

Convolvulaceae: *Ipomoea batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. fistulosa* M. & DE BARY, *I. plebeia* R. BR.

Comment: Rare on *I. fistulosa*: two records of imagines and one of oothecae.

Aspidimorpha confinis (KLUG, 1835)

Cassida confinis KLUG, 1835: 47; BOHEMAN, 1854: 256 (in *Aspidomorpha*).

Convolvulaceae: *Ipomoea batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. ficifolia* LINDL., *I. obscura* (L.) KER-GAWL., *I. wightii* (WALL.) CHOISY, *Merremia tuberosa* (L.) RENDLE.

Comment: MUIR and SHARP (1904) gave *Ipomoea holosericea* E. MEY. ex CHOISY which is an obsolete synonym for *I. ficifolia* (pers. comm.: R. WILLIAMS, Natal Herbarium).

Aspidimorpha icterica Boheman, 1854

Aspidomorpha icterica BOHEMAN, 1854: 306
syn.: *Aspidomorpha flavens* SPAETH, 1912 b: 506

Convolvulaceae: *Convolvulus farinosus* L., *Hewittia sublobata* (Linn. f.) O. KTZE., *Ipomoea alba* L., *I. arborescens* (HUMB. & BONPL.) Don., *I. batatas* (L.) LAMK.,

I. cairica (L.) SWEET, *I. congesta* R. BR., *I. ficifolia* LINDL., *I. fistulosa* M. & DE BARY, *I. plebeia* R. BR., *I. wightii* (WALL.) CHOISY.

Comment: This species probably also uses *Ipomea purpurea* (L.) ROTH. and *Merremia tuberosa* (L.) RENDLE but has not been unambiguously distinguished from *Aspidimorpha tecta* BOHEMAN on those species. See further under *A. tecta*, below.

Aspidimorpha puncticosta BOHEMAN, 1854

Aspidomorpha icterica BOHEMAN, 1854: 246.

Convolvulaceae: *Ipomoea arborescens* (HUMB. & BONPL.) DON., *I. ficifolia* LINDL., *I. fistulosa* M. & DE BARY, *I. pes-caprae* (L.) R. BR., *Meremia truberosa* (L.) RENDLE.

Comment: *Ipomoea fistulosa* was a single record of two young imagines. Rare on *Merremia tuberosa*. *Ipomoea pes-caprae* appears to be the principal host plant in coastal Natal.

Aspidimorpha submutata WEISE, 1899

Aspidomorpha submutata WEISE, 1899 a: 256
syn.: *Aspidomorpha debilis* SPAETH, 1934 b: 385.

Convolvulaceae: *Ipomoea batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. ficifolia* LINDL., *I. obscura* (L.) KER-GAWL., *I. wightii* (WALL.) CHOISY, *Merremia tuberosa* (L.) RENDLE.

Acrocassis gibbipennis (BOHEMAN, 1854)

Cassida gibbipennis BOHEMAN, 1854: 488, SPAETH, 1924: 313 (in *Acrocassis*).

Convolvulaceae: *Convolvulus farinosus* L., *Ipomoea batatas* (L.) LAMK., *I. cairica* (L.) SWEET, *I. congesta* R. BR., *I. fistulosa* M. & DE BARY, *I. plebeia* R. BR..

Comment: *Ipomoea congesta* and *I. fistulosa* were single records of imagines.

Chiridopsis nigrosepta (FAIRMAIRE, 1891)

Coptocycla nigrosepta FAIRMAIRE, 1891: 306, SPAETH, 1922 b: 1003 (in *Chiridopsis*).
syn.: *Coptocycla vernicata* FAIRMAIRE, 1891: 306.

Convolvulaceae: *Ipomoea arborescens* (HUMB. & BONPL.) DON., *I. ficifolia* LINDL., *I. fistulosa* M. & DE BARY, *I. wightii* (WALL.) CHOISY.

Comment: *Ipomoea ficifolia* was a single record of an imago over two days. *I. wightii* was also a single record of three imagines, but return visits to the locality could not be made and it is not known whether the species reproduced on the plant.

Cassida coagulata BOHEMAN, 1854

Cassida coagulata BOHEMAN, 1854: 468.

Amaranthaceae: *Achyranthes aspera* L., *Amaranthus viridis* L., *Celosia argentea* L.

Comment: *Amaranthus viridis* was a single record of an imago. *Achyranthes aspera* was the glabrous form (see further under *Cassida viridipennis*, below).

Cassida distinguenda SPAETH, 1928

Cassida distinguenda SPAETH, 1928: 7.

Solanaceae: *Lycium ferrocissimum* MIERS.

Comment: Five imagines observed in the field by J.K. SCOTT of Wembly, Australia, whilst working at the University of Cape Town.

Cassida granulicollis SPAETH, 1905

Cassida granulicollis SPAETH, 1905: 108.

Asteraceae: *Brachylaena discolor* DC.

Cassida guttipennis BOHEMAN, 1862

Cassida guttipennis BOHEMAN, 1862: 301.
syn.: *Cassida coloraria* BOHEMAN, 1862: 309.

Asteraceae: *Berkheya bipinnatifida* (HARV.), *B. speciosa* (DC.) O. HOFFM.

Cassida irregularis BOHEMAN, 1854

Cassida irregularis BOHEMAN, 1854: 398.

Acanthaceae: *Isoglossa ciliata* (NEES) LINDAU, *I. cooperi* C.B. Cl., *I. woodii* C.B. Cl.

Cassida litigiosa BOHEMAN, 1854

Cassida litigiosa BOHEMAN, 1854: 481.

Amaranthaceae: *Amaranthus hybridus* L., *A. viridis* L.
Chenopodiaceae: *Atriplex nummularia* LINDL.*, *Chenopodium album* L., *Rhagodia parabolica* R. BR.
Salvadoraceae: *Salvadora persica* L.*
Polygonaceae: *Emex australis* STEINH.

Comment: record from *Salvadoraceae* based on a single adult collected on the plant leaves. The family has not been recorded as host plants for Cassids before and this record may be of a nomadic specimen. At least one other *Rhagodia* species is used. The beetle was raised on *Emex australis* by J.K. SCOTT.

Cassida melanophthalma BOHEMAN, 1854

Cassida melanophthalma BOHEMAN, 1854: 480.

Solanaceae: *Lycium ferocissimum* MIERS.
Salvadoracae: *Azima tetracantha* LAM.*

Comment: Reared on *Lycium ferocissimum* by C.A. KLEINJAN and J.K. SCOTT at University of Cape Town. The record of *Salvadoraceae* is based upon numerous imagines collected by Beth GROBBELAAR of the Plant Protection Research Institute, Pretoria. That family has not been recorded as being used by Cassids before. Another *Cassida* sp., close to *C. melanophthalma*, has been recorded on a member of the *Aizoaceae*.

Cassida sphaerula BOHEMAN, 1854

Cassida sphaerula BOHEMAN, 1854: 434.

Asteraceae: *Arctotheca calendula* (L.) LEVYNS.

Comment: Reared on leaves by M. WAY at CSIRO (label data).

Cassida subplana SPAETH, 1928

Cassida subplana SPAETH, 1928: 5.

Asteraceae: *Othonna quinquedentata* THUNB.

Comment: This species was described generally from "Afrika". In the National Collection of Insects, Pretoria, there are specimens bearing the label "Cape, St. Jones, 27 IV 1989, leg. SCOTT & KLEINJAN". Several adults were reared by those two researchers.

Cassida unimaculata BOHEMAN, 1854

Cassida unimaculata BOHEMAN, 1854: 466.

Asteraceae: *Brachylaena discolor* DC.

Cassida viridipennis BOHEMAN, 1854

Cassida viridipennis BOHEMAN, 1854: 394.

Amaranthaceae: *Achyropsis avicularis* (E. MEY. & MOQ.) HOOK f., *Achyranthes aspera* L., *Amaranthus hybridus* L., *A. spinosus* L., *A. viridis* L., *Celosia argentea* L., *C. cristata* L., *Cyathula cylindrica* MOQ., *C. uncinulata* (SCHRAD.) SCHINZ, *Pupalia lappacea* (L.) JUSS.

Chenopodiaceae: *Beta vulgaris* L., *Chenopodium album* L., *Rhagodia parabolica* R. BR.

Comment: There appear to be two forms of *Achyranthes aspera*: one with hirsute leaves and white flowers, the other with dark glabrous leaves and magenta flowers. Although both were identified as the same species, their very different appearances in the same environments suggests that the two species may be involved. The beetle is readily found on both forms. At least one other *Rhagodia* sp. is also used. Probably also uses *Alternanthera* sp.

Cassida sp. nov. 1

Cassida sp. nov. near *C. andreinii* SPAETH, 1933 b: 48.

Acanthacae: *Asystasia gangetica* (L.) T. ANDERS.

Comment: This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation).

Cassida sp. nov. 2

Cassida sp. nov.near *C. melanophthalma* BOHEMAN, 1854: 480.

Solanaceae: *Lycium ferrocissimum* MIERS.

Comment: This species was described generally from "Afrika". In the National Collection of Insects, Pretoria, there are specimens bearing the label "Cape, St. Jones, 27 IV 1989, leg. SCOTT & KLEINJAN". Several adults were reared by those two researchers.

Cassida unimaculata BOHEMAN, 1854

Cassida unimaculata BOHEMAN, 1854: 466.

Asteraceae: *Brachylaena discolor* DC.

Cassida viridipennis BOHEMAN, 1854

Cassida viridipennis BOHEMAN, 1854: 394.

Amaranthaceae: *Achyropsis avicularis* (E. MEY. & MOQ.) HOOK f., *Achyranthes aspera* L., *Amaranthus hybridus* L., *A. spinosus* L., *A. viridis* L., *Celosia argentea* L., *C. cristata* L., *Cyathula cylindrica* MOQ., *C. uncinulata* (SCHRAD.) SCHINZ, *Pupalia lappacea* (L.) JUSS.

Chenopodiaceae: *Beta vulgaris* L., *Chenopodium album* L., *Rhagodia parabolica* R. BR.

Comment: There appear to be two forms of *Achyranthes aspera*: one with hirsute leaves and white flowers, the other with dark glabrous leaves and magenta flowers. Although both were identified as the same species, their very different appearances in the same environments suggests that the two species may be involved. The beetle is readily found on both forms. At least one other *Rhagodia* sp. is also used. Probably also uses *Alternanthera* sp.

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Cassida sp. nov. 2

Cassida sp. nov.near *C. melanophthalma* BOHEMAN, 1854: 480.

Solanaceae: *Lycium ferrocissimum* MIERS.

Comment: This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation). Several imagines reared by J.K. SCOTT.

Cassida sp. nov. 3

Cassida sp. nov. near *C. spatiosa* SPAETH, 1928: 7.

Chenopodiaceae: *Atriplex* sp.

Comment: This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation).

Basipta glauca CHEVROLAT, 1842

Basipta glauca CHEVROLAT in D'ORBIGNY, 1842: 489.
syn. *Basipta stolida* BOHEMAN, 1854: 186.

Asteraceae: *Brachylaena discolor* DC.

Comment: SHAW (1956: 266) gave *Grewia occidentalis* L. (*Tiliaceae*) from a label in the CAPENER collection, Manchester Museum. This record is here questioned. Both *Grewia occidentalis* and *Brachylaena discolor* are common in Natal's coastal bush and, when pupating, the larvae of *B. glauca* frequently abandon their host plant. It is suggested that the imagines collected by CAPENER were either newly emerged on *Grewia* growing close to a *Brachylaena*, or that they were nomadic specimens.

Aethiopocassis vigintimaculata (THUNBERG, 1789)

Cassida vigintimaculata THUNBERG, 1789: 219, SPAETH, 1924: 321 (in *Aethiopocassis*).

Acanthacae: *Thunbergia atriplicifolia* E. MEY., *T. dregeana* NEES.

Oxylepus capensis (SPAETH, 1933)

Oxylepus capensis SPAETH, 1933 a: 357.

Chenopodiaceae: *Salsola* sp.

Oxylepus sp. nov. 1

Oxylepus sp. nov. 1 unique.

Chenopodiaceae: *Salsola zeyheri* (MOQ.) BUNGE, *Salsola* sp.

Comment: This unique species will be described in the third volume of a monograph of Afrotropical *Cassidinae* (BOROWIEC in preparation). Has been verified in the field.

Oxylepus sp. nov. 2

Oxylepus sp. nov. 2 near sp. nov. 1.

Chenopodiaceae: *Salsola zeyheri* (MOQ.) BUNGE, *Salsola* sp.

Comment: This species will be described in the third volume of a monograph of Afrotropical *Cassidinae* (BOROWIEC in preparatin). Has been verified in the field.

Trichaspis pilosula (BOHEMAN, 1854)

Cassida pilosula BOHEMAN, 1862: 332; SPAETH, 1911: 270 (in *Trichaspis*).

Asteraceae: *Pechuel-Loeschea leubnitziae* (KUNTZE) O. HOFFM.

Comment: Although known from the Naukluft Park, near Gobabeb, Namibia, this record is retained since the host plant extends into the Cape and Transvaal (pers. comm.: R. WILLIAMS, Natal Herbarium, Durban).

Trichaspis pilosa (SPAETH, 1911) n. comb.

Crossocassis pilosa SPAETH, 1911: 275.

Sapindaceae: *Pappea capensis* ECKL. & ZEYH.*

Comment: SPAETH (1911) proposed for this species a new genus *Crossocassis*. Based on several undescribed species from South Africa, it was decided that the genus *Crossocassis* should be synonymized with *Trichaspis* SPAETH, 1911, **new synonymy**. The family *Sapindaceae* has never before been recorded as host-plant of cassids. This record based on single adult shaken from the plant: it may represent a nomadic specimen.

ADDITIONAL SPECIES FROM THE LITERATURE

Laccoptera rugosicollis (SPAETH, 1902)

Orphonoda rugosicollis SPAETH, 1902 c: 22, 1914: 84 (in *Laccoptera*).
syn.: *Laccoptera contigua* SPAETH, 1919 a: 18; *Laccoptera warchalowskii* BOROWIEC, 1985 c: 445.

Convolvulaceae: species not given.

Ref.: BOROWIEC, 1994: 159-163. In the National Collection of Insects, Pretoria there is an adult specimen with host-plant label "ex *Solanum panduriforme*". This record needs confirmation. The genus *Laccoptera* has, thus far, only been known to use the *Convolvulaceae*.

Aspidimorpha tecta (BOHEMAN, 1854)

Aspidomorpha tecta BOHEMAN, 1854: 276 (in *Aspidomorpha*).

Convolvulaceae: *Ipomoea ficifolia* LINDL., *I. purpurea* (L.) ROTH.

Refs: MUIR & SHARP (1904), PATERSON (1941). MUIR and SHARP (1904) gave *Ipomoea holosericea* E. MEY. ex CHOISY which is an obsolete synonym for *I. ficifolia* (pers. comm.: R. WILLIAMS, Natal Herbarium).

Comment: *Aspidimorpha icterica* and *A. tecta* are very similar in appearance and it is the senior writer's opinion that these two species have been confused in the references. SHAW (1956: 261) commented upon the difficulties of separating the two species and, although apparently common in Natal, the senior writer has yet to encounter *A. tecta*. MUIR & SHARP (1904: 6) noted that the oothecae of *A. tecta* they examined hosted 14-20 eggs, but those studied by PATERSON (1941: 2) only hosted 8. All the oothecae of *A. icterica* studied by the senior writer on *Hewittia sublobata* hosted 8 eggs, and the larvae on this, as well as other host-plants, exhibited the same markings as described by PATERSON (1941: 3). It is suggested that PATERSON's species was probably *A. icterica*.

Cassida spatiosa SPAETH, 1928

Cassida spatiosa SPAETH, 1928: 7.

Asteraceae: *Chrysanthemoides monilifera subcanescens* (DC.) T. NORL.

Ref.: KLEINJAN & SCOTT (1996).

Cassida vespertilio BOHEMAN, 1862

Cassida vespertilio BOHEMAN, 1862: 310.
Syn.: *Cassida muirana* SHARP in MUIR and SHARP, 1904: 13, **new synonymy**.

Solanaceae: *Solanum* sp.

Ref.: MUIR & SHARP (1904).

Comment: Based on type of *Cassida muirana* SHARP preserved in British Museum, Natural History, London and type of *Cassida vespertilio* BOHEMAN preserved in Naturhistoriska Riksmuseet, Stockholm both names are synonymous.

Cassida sp. nov. 1

Cassida sp. nov.near *C. subplana* SPAETH, 1928: 5.

Asteraceae: *Chrysanthemoides monilifera pisifera* (L.) T. NORL., *Chrysanthemoides monilifera monilifera* (L.) T. NORL.

Ref.: KLEINJAN & SCOTT (1996).

Comment: Took *Calendula officinalis* L. (*Asteraceae*) in captivity. This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation).

Cassida sp. nov. 2

Cassida sp. nov.near *C. sublana* SPAETH, 1928: 5.

Asteraceae: *Chrysanthemoides monilifera pisifera* (L.) T. NORL., *Chrysanthemoides incana* T. NORL.

Ref.: KLEINJAN & SCOTT (1996).

Comment: Took *Calendula officinalis* L. (*Asteraceae*) in captivity. This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation).

Cassida sp. nov. 3

Cassida sp. nov.near *C. subplana* SPAETH, 1928: 5.

Asteraceae: *Chrysanthemoides monilifera rotundata* (DC.) T. NORL.

Ref.: KLEINJAN & SCOTT (1996).

Comment: Took *Calendula officinalis* L. (*Asteraceae*) in captivity. This species will be described in the fourth volume of a monograph of Afrotropical *Cassidinae* by L. BOROWIEC (in preparation).

FEEDING PATTERNS

Imagines and larvae produce a range of feeding patterns or traces which, particularly in the case of the former, may be characteristic of the species for a given host plant. Larvae are more problemmatical, their patterns sometimes being ambiguous, and in this paper are only mentioned where they exhibit a special feature. Most imagines feed from the lower leaf surface. Feeding patterns may be broadly divided into four groups as follows:

Group 1: Scrapings	The upper, or lower, leaf cuticle is left intact.
Group 2: Holes	Large (>5 mm) or small (<5 mm), regular to irregular in shape. Seldom penetrate leaf margin and usually do not coalesce except during intensive feeding phase.
Group 3: Marginal feeding	Usually irregular.
Group 4: Leaf mining	No examples known to the senior writer but anticipated for the larvae of the *Notosacanthini* (see MEDVEDEV and EROSHKINA 1988, HAWKESWOOD 1989, MONTEITH 1991).

The whole subject of feeding patterns will be examined in another paper but, here, they are considered as a possible guide to species identification in the field; particularly where two or more beetles share the same host plant. Imaginal feeding patterns are fairly constant for particular plants but the following points need to be born in mind:

1. The feeding pattern for a given species may vary on different host plants. *Aspidimorpha confinis*, for example, has rounded to oval holes in glabrous leaves (Fig. 36) but curvilinear holes and scrapings on pubescent leaves (Fig. 56).
2. During the intensive feeding phase (10 to 14 days after eclosion or during periods of relative inactivity such as during cool, dry, spells) the pattern may be distorted by crowding and/or overlapping of holes or scrapings. Some leaves may be largely consumed.
3. Where numerous imagines are present, the characteristic patterns of individuals may be obscured.
4. Feeding traces in young growing leaves may be considerably enlarged and distorted as the leaf develops.
5. Other invertebrates, including molluscs and, in particular, Chrysomelid beetles, may produce superficially similar feeding patterns.

The observations presented here are based on records principally from the Durban-Queensburgh-Pinetown region of Natal and the silhouette figures were prepared from leaf specimens in the collection of the senior author. Since Cassids are most readily found by locating their host plants, the silhouettes are arranged by plant family.

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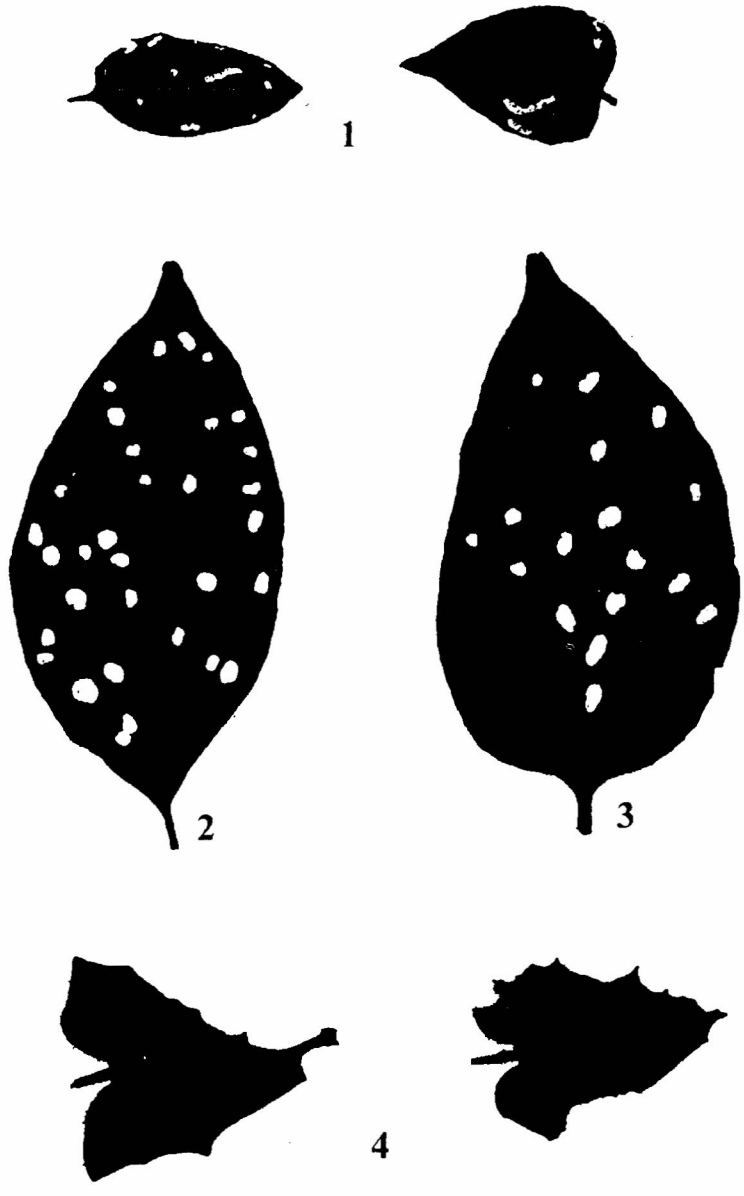
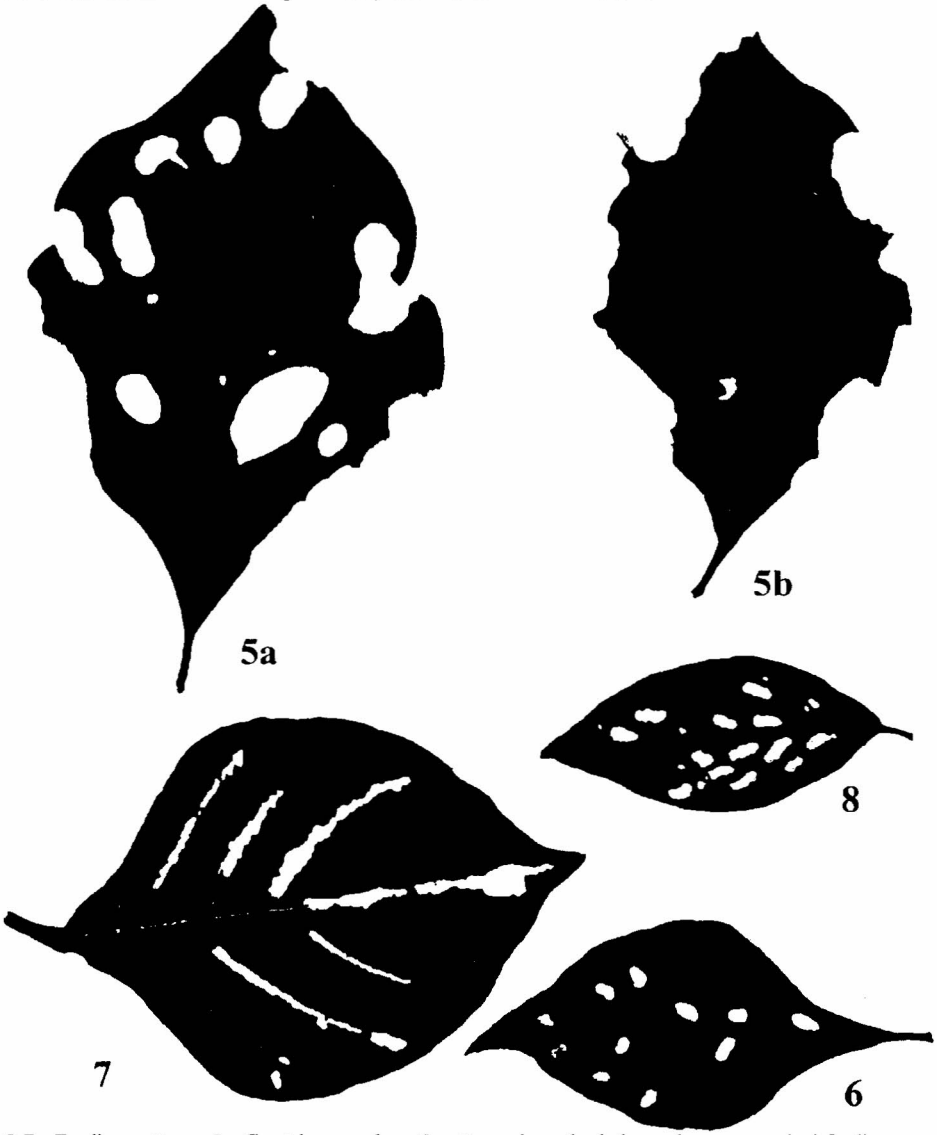
Family: ***Acanthaceae***



1-4. Feeding patterns: 1. *Cassida* sp. nov. I (near *C. andreinii*), imagines; vermiform scrapings on upper surface of *Asystasia gangetica* leaf. Nos: 652/11& 832/23; 2. *Cassida irregularis* imago on glabrous leaf of *Isoglossa ciliata*; feeding from lower surface. No: 1195/51; 3. *C. irregularis* imago on pubescent *I. woodii* leaf No: 680/43; 4. *Aethiopocassis vigintimaculata* imago on *Thunbergia dregeana*; Marginal feeding: imagines frequently found on upper leaf surface. Nos: 711/30 & 712/31.

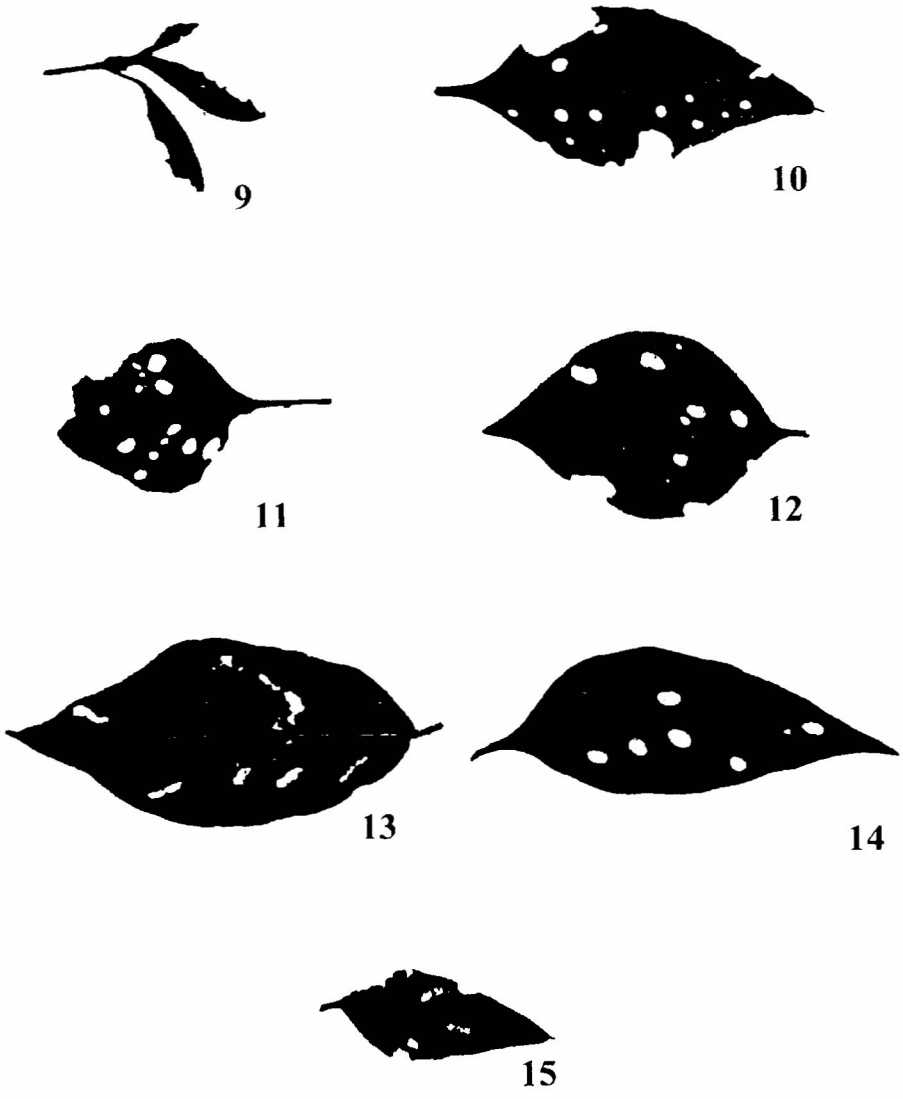
Family: ***Amaranthaceae***

Achyranthes aspera is used by both *Cassida coagulata* and C. *viridipennis* in the case ofthe glabrous-leafed form (only the latter species uses the pubescent-leafed form) and are readily distinguished by the sizes of the holes produced. C. *coagulata* frequently feeds along the margins. During 5th instar, the larvae of *C. coagulata* may take out the leaf veins (fig 7).



5-7 . Feeding patterns: 5 . *Cassida coagulata:* 5a - Large irregular holes and some marginal feeding on glabrous *Achyranthes aspera;* feeding from lower surface; imago. No:537/24; 5b - Marginal feeding on glabrous *A. aspera;* imago. No: 531/23; 6. *C. viridipennis* imago on glabrous *A. aspera;* small holes mostly from underside. No: I5I/13; 7. *C. coagulata* instar 5 larva taking out veins from underside of glabrous *A. aspera* leaf. No: 1249/40; 8. *C. viridipennis* imago on pubescent *A. aspera* leaf. Feeding usually from upper leaf surface. No: 45/10.

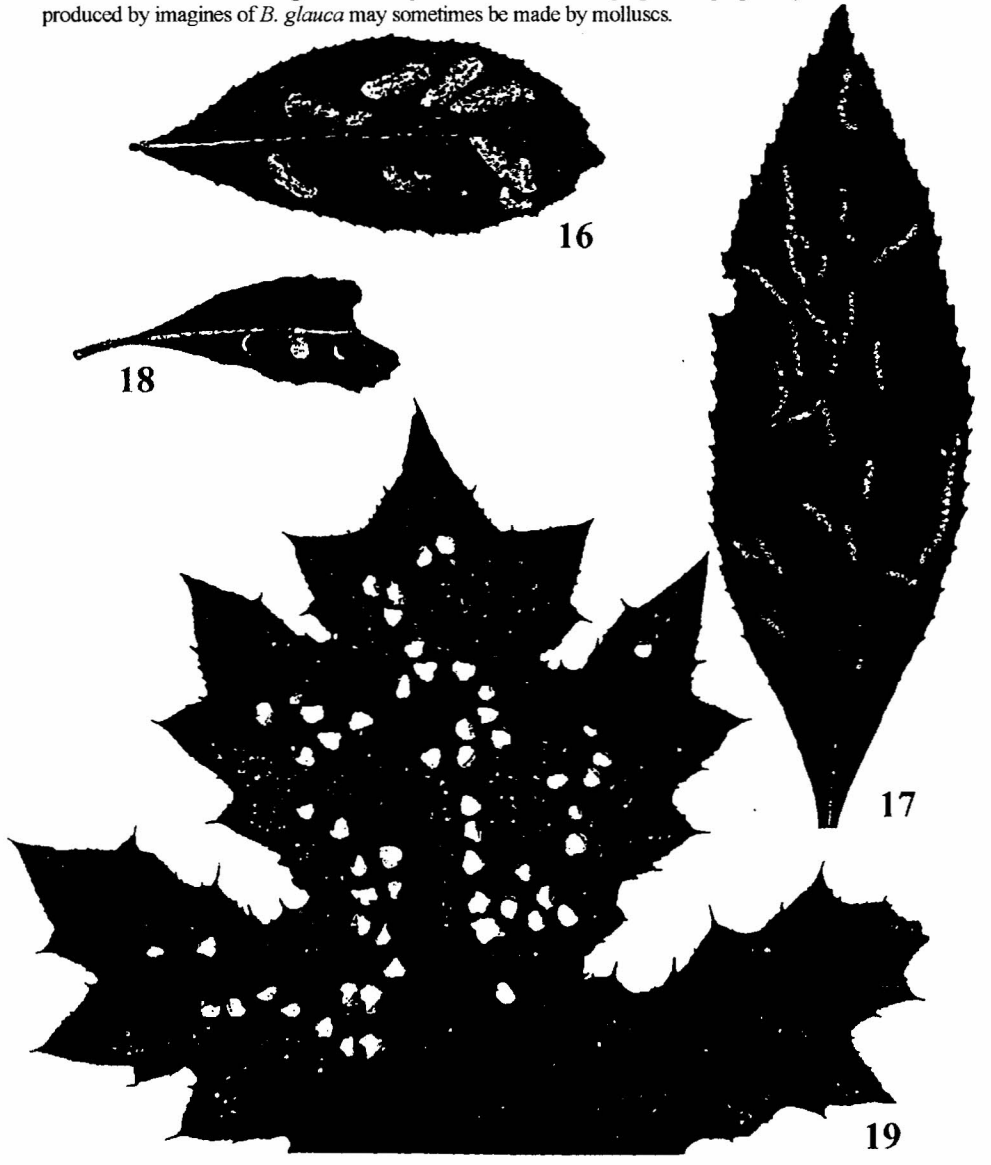
Family: ***Amaranthaceae***



9-15. Feeding patterns: 9-14. *Cassida viridipennis:* 9 - Imago on *Achyropsis avicularis;* marginal feeding. No: 684/80; 10 - Small holes in *Amaranthus spinosus* leaf; feeding from underside; imago. No: 1179/119; 11 - Imago in *A. viridis;* feeding from underside. No: 136/19; 12 - Holes of imago in *Cyathula cylindrica.* No: 393/57; 13 - Holes of imago in *C. uncinulata;* 14 - Holes of imago in *Pupalia lappacea.* No: 744/87; 15. *Cassida litigiosa*; elongated scrapings (sometimes small holes) in *Amaranthus hybridus*; imago. No: 614/7.

Family: ***Asteraceae***

Brachylaena discolor is used by three species, all of which produce scrapings on the upper leaf surface. *Basipta glauca* produces relatively wide elongated scrapings whilst those of *Cassida unimaculata* are narrow and curvilinear. *C. granulicollis* produces rounded scrapings. Scrapings very similar to those produced by imagines of *B. glauca* may sometimes be made by molluscs.



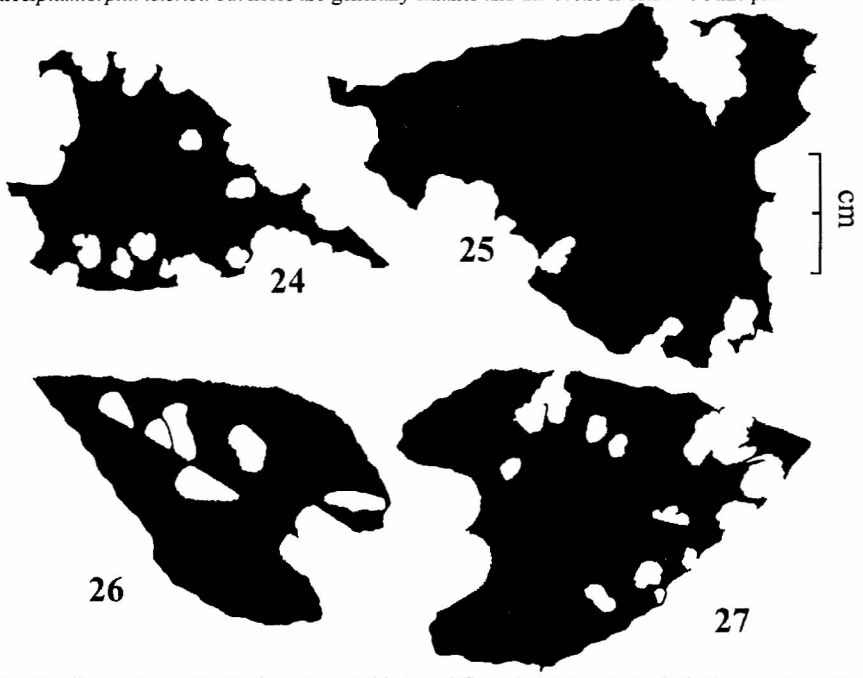
16-19 Feeding patterns: 16. Scrapings of *Basipta glauca* imago on upper surface of *Brachylaena discolor* leaf. No: 698/24; 17. Curvilinear scrapings of *Cassida unimaculata* on *B. discolor*; imago. No: 831/30; 18. Rounded scrapings of *C. granulicollis* in upper surface of *B. discolor* leaf; imago. No. 657/16; 19. Portion of *Berkheya bipinnatifida* leaf with scrapings of *Cassida guttipennis;* feeding from underside, leaving upper epidermal cuticle intact; tiny scrapings of instar 1 & 2 larvae also present. No: 300/8.

Family: ***Chenopodiaceae***

Two species are known to feed upon *Chenopodium album*, viz *Cassida litigiosa* and *C. viridipennis*. The latter's preference for marginal feeding serves to distinguish it.

Family: ***Chenopodiaceae***

Four beetles have been noted to use *Convolvulus farinosus* in the Durban area. Both *Aspidimorpha icterica* and *Conchyloctenia punctata* are marginal feeders with superficially similar patterns. *A. icterica*, however, also frequently produces irregularly rounded holes and larvae are almost always present. The large oval to pyriform holes of *Laccoptera cicatricosa* are distinctive. *Acrocassis gibbipennis* may be confused with *Aspidimorpha icterica* but holes are generally smaller and the beetle is scarce on this plant.

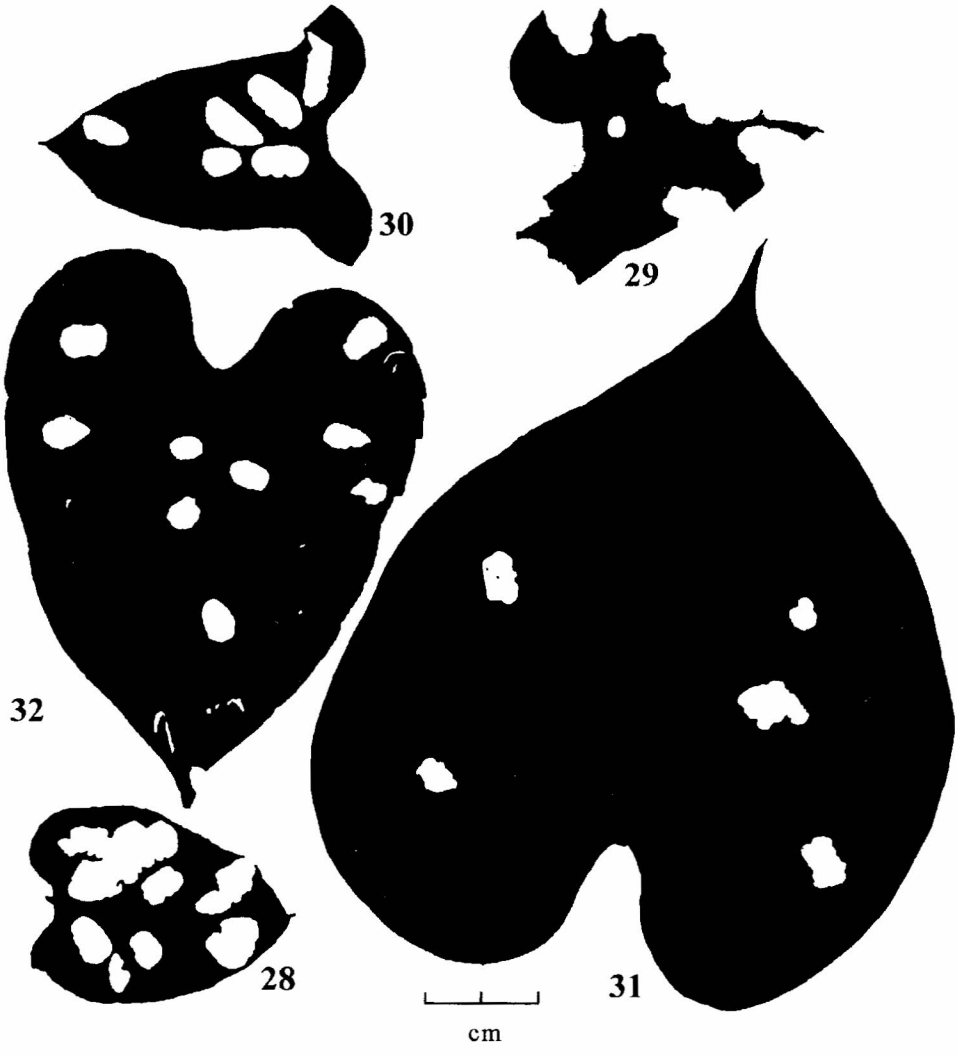


20-27. Feeding patterns: 20. Oval to elongated holes of *Cassida litigiosa* in leaf of *Chenopodium album*; imago. No: 615/8; 21-22. *Cassida viridipennis:* 21 - Marginal feeding on *Ch. album*; imago.No: 963/99; 22 - Marginal feeding on *Rhagodia parabolica*; imago; larvae produce irregular scrapings on upper leaf surface. Nos: 1061/107 & 1062/108; 23. Holes of *C. litigiosa* in leaf of *Rhagodia* sp. No: 720/19; 24. *Aspidimorpha icterica* imago on *Convolvulus farinosus* showing both holes and marginal feeding. No: 155/30; 25. Irregular marginal feeding *of Conchyloctenia punctata* on *C. farinosus*; larvae exhibit cycloalexic behaviour. No: 894/54; 26. *Laccoptera cicatricosa* imaginal feeding on *C. farinosus*. No: 244/21; 27. Irregular single and coalesced holes, several penetrating margin, of *Acrocassis gibbipennis* on *C. farinosus*. No: 502/11.

Family: ***Convolvulaceae***

Hewittia sublobata is used by three species. The most common is *Aspidimorpha icterica* which produces large oval to irregular holes, frequently penetrating the leaf margin. *Conchyloctenia punctata* is a marginal feeder, and *Laccoptera cicatricosa* produces characteristic oval holes.

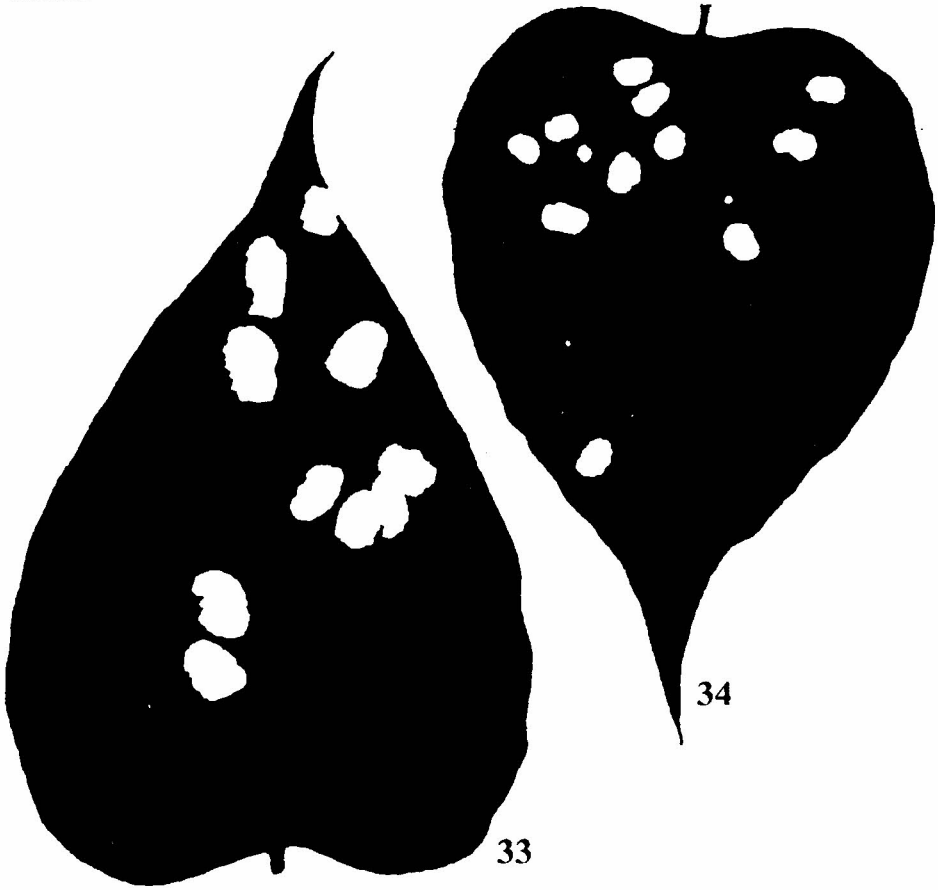
Ipomoea alba is used by both *A . icterica* and *L . cicatricosa* but is relatively unpopular with both species.



28-32. Feeding patterns: 28. *Aspidimorpha icterica* imago in *Hewittia sublobata* leaf No: 380/54; 29. Marginal feeding of *Conchyloctenia punctata* on *H. sublobata.* No: 402/20; 30. *Laccoptera cicatricosa* on *H. sublobata.* No: 445/30; 31. Irregular holes of *A . icterica* in *Ipomoea alba;* larvae very similar; imago. No: 1253/170; 32. Oval holes of *L. cicatricosa* in *I. alba.* No: 235/19.

Family: ***Convolvulaceae***

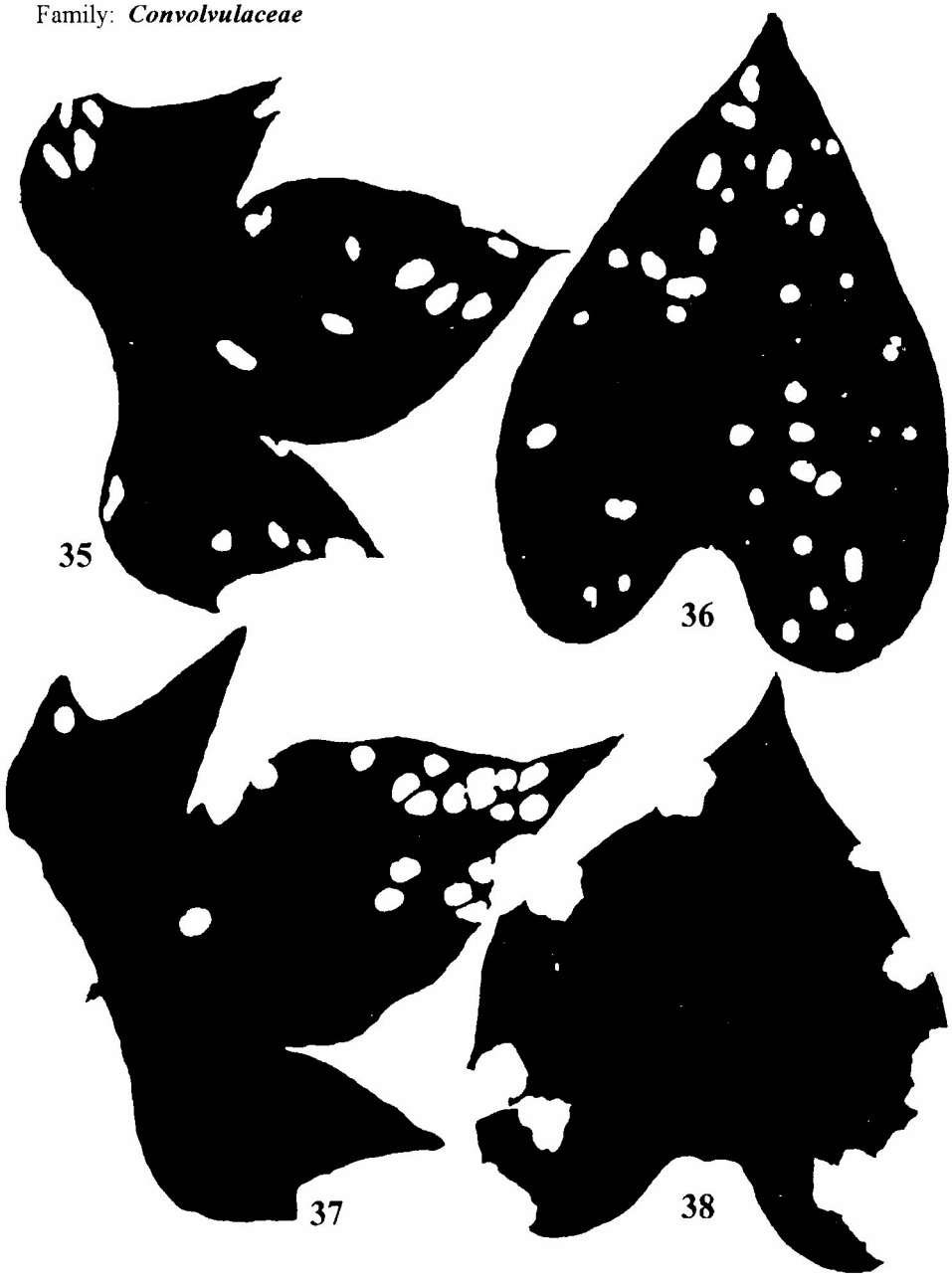
Ipomoea arborescens is utilised byt hree beetles. The feeding pattern of *Aspidimorpha icterica* consists of irregular holes and marginal indentations, not unlike the ones it produces on *Convolvulus farinosus*. *A. puncticosta* produces large oval holes and, during the intensive feeding stage when numerous imagines may cluster (the species is cycloalexic), the leaves may be almost entirely consumed. *Chiridopsis nigrosepta* is distinguished by its smaller relatively neat holes. The holes produces by its 5th instar larvae are almost identical.



33-34. Feeding patterns: 33. *Aspidimorpha puncticosta* imago on *Ipomoea arborescens*; feeding from lower surface. No: 1267/45: 34. *Chiridopsis nigrosepta* on *I. arborescens*; feeding from upper surface. No: 1216/43.

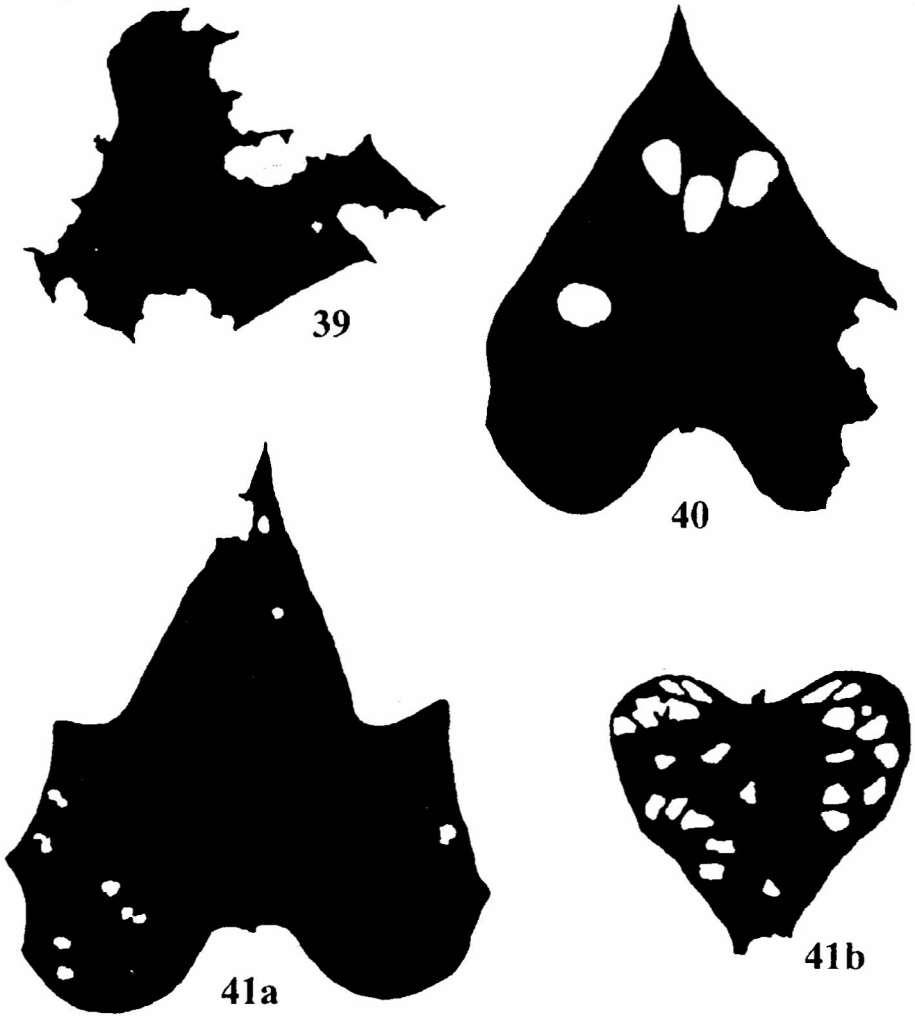
Although it is an exotic species, *Ipomoea batatas* is used by no fewer than seven tortoise beetles. Most produce small to medium-sized holes which may be ambiguous. *Aspidimorpha areata* may be distinguished by its oval to pyriform holes scattered across the leaf. *A. confinis* has more rounded to oval holes, also scattered across the leaf, and the adult beetle is commonly to be seen on the upper leaf surface. The rounded holes of *A . submutata* are commonly grouped and not scattered. Large untidy holes and marginal feeding distinguish *A. icterica* imagines and the lack of holes with marginal feeding is a fair guide to the presence of *Conchyloctenia punctata*. *Laccoptera cicatricosa* produces large rounded to oval holes. *Acrocassis gibbipennis* tends to produce small rounded to moderately-sized angular holes, frequently grouped (see pp. 23, 24).

Family: ***Convolvulaceae***



35-38. Feeding patterns: 35. Pyriform to oval holes of *Aspidimorpha areata* in *Ipomoea batatas* leaf; imago. No: 42/4; 36. Scattered *A. confinis* holes in *I. batatas* leaf. Imagines feed from upper leaf surface. No: 113/6; 37. Grouped holes of *A. submutata* imago in *I. batatas* leaf. No: 41/6; 38. *A. icterica* imago on *I. batatas* leaf; marginal feeding with irregular holes penetrating margin. No: 985/133.

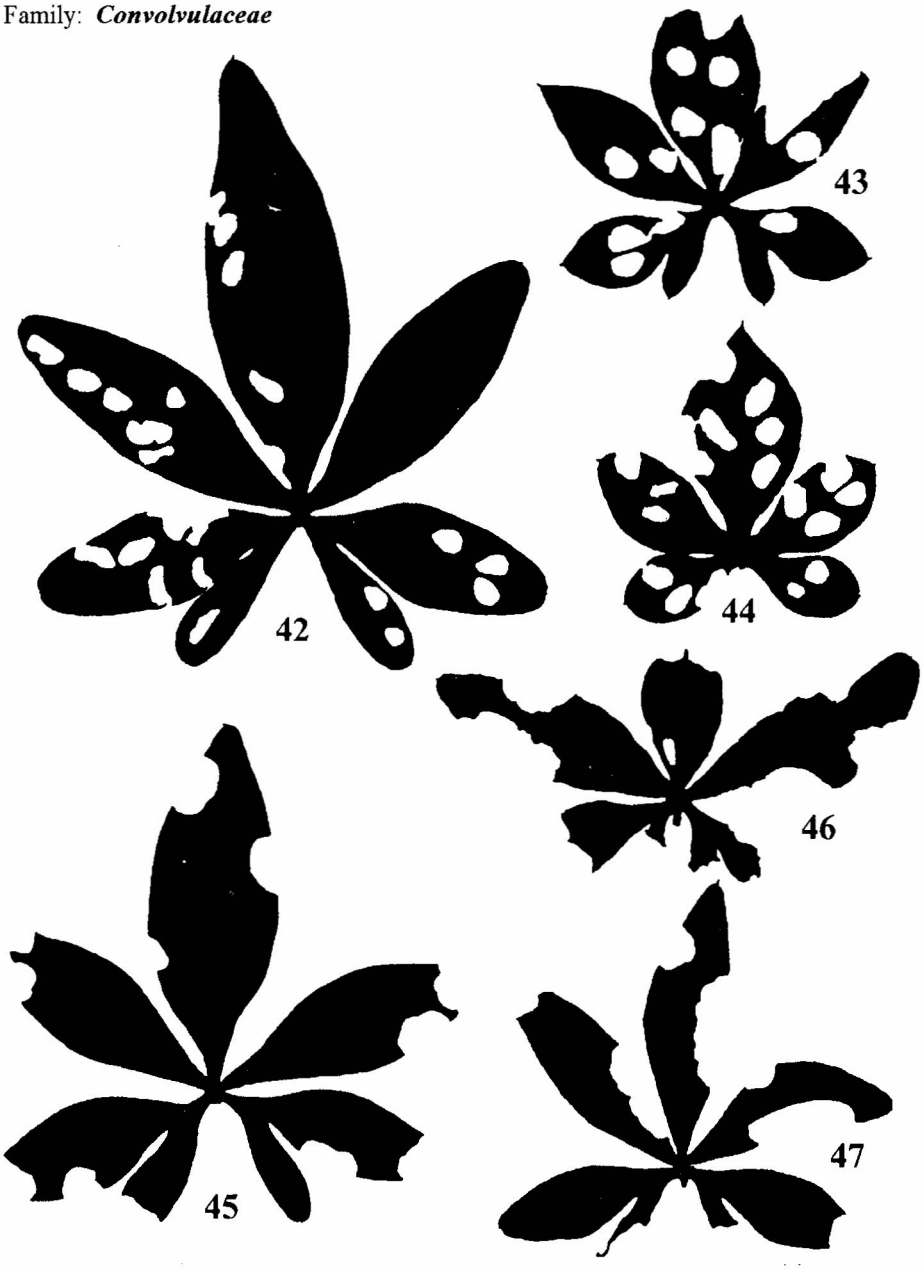
Family: ***Convolvulaceae***



39-41. Feeding patterns: 39. Marginal feeding of *Conchyloctenia punctata* on *Ipomoea batatas*. No: 887/50; 40. *Laccoptera cicatricosa* imago on *I. batatas;* typical large holes, marginal feeding was *Aspidimorpha icterica*. No: 1123/11 3; 41a. *Acrocassis gibbipennis* on *I. batatas*; roughly grouped small holes. 41b. Larger angular holes of *A. gibbipennis* in *I. batatas* leaf. Nos: 308/7 & 30/1.

Ipomoea cairica is a common and widespread creeper in the eastern coastal regions of South Africa, extending up to the lowveld. It is used by eight tortoise beetles but the deeply lobed leaf structure results in feeding patterns that frequently penetrate the margin and this may lead to confusion. *Aspidimorpha areata* is generally recognised by the frequent pyriform shape to the holes. The holes of *A. confinis* are more rounded than those produced by *A. submutata* but they may be confused. *A. icterica* tends to feed marginally, as also does *Conchyloctenia punctata*, and *L. excavata* produce large holes. Those of the latter species less frequently penetrating the leaf margin. *Acrocassis gibbipennis* does not appear to make ready use of this plant and its pattern is a mixture of oval holes and marginal indentations (see pp. 25, 26).

Family: ***Convolvulaceae***



42-47. Feeding patterns: 42. Pyriform to oval holes of *Aspidimorpha areata* in *Ipomoea cairica*. No: 215/14; 43. *A. confinis* imago in *I. cairica;* the rounded holes are produced from the upper surface. No: 858/60; 44. Oval holes of A. *submutata* in *I. cairica*. No: 449/34; 45. *A. icterica* marginal feeding and holes penetrating margin of *I. cairica*. No: 895/94; 46. Marginal feeding of *Conchyloctenia punctata* on *I. cairica*. No: 562/27; 47. Large holes of *Laccoptera cicatricosa* penetrating margins of *I. cairica* leaf. No: 719/71.

Family: ***Convolvulaceae***

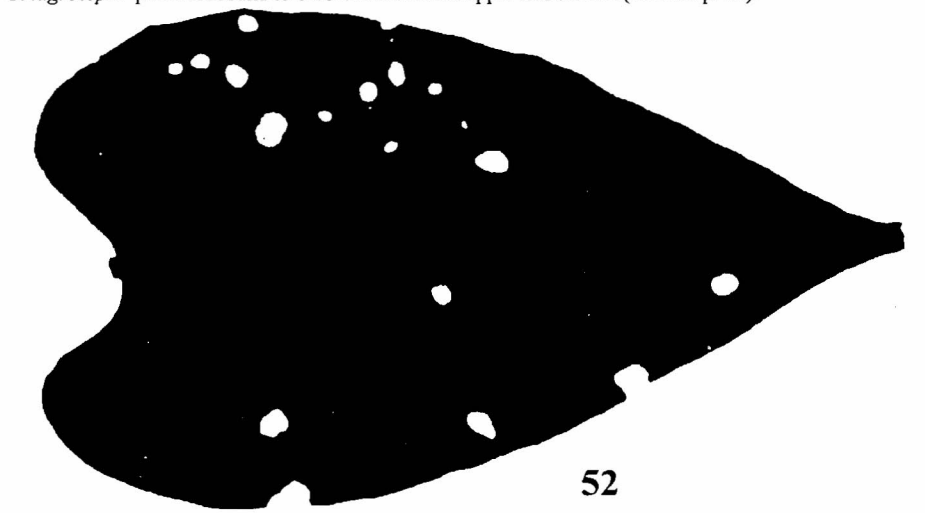
48-49. Feeding patterns: 48. Large holes of *Laccoptera excavata* imago in *Ipomoea cairica* leaf; feeding from upper surface. No: 817/36; 49. *Acrocassis gibbipennis* imago in *I. cairica;* holes and marginal feeding. No: 675/14.

Ipomoea congesta is used by three species. *Aspidimorpha icterica* may be recognised by its untidy marginal feeding and irregular holes whilst *Laccoptera cicatricosa* produces large oval holes. *Acrocassis gibbipennis* has only been observed on one occasion when it produced small rounded holes which all coalesced.

50-51. Feeding patterns: 50. Irregular hole and marginal feeding of *Aspidimorpha icterica* imago on *I. congesta.* No: 1034/152; 51. Large holes of *Laccoptera cicatricosa* imago in *I. congesta* leaf. No: 799/85.

Family: ***Convolvulaceae***

Four beetles have been recorded as using *Ipomoea fistulosa*. *Aspidimorpha areata* has been noted twice and the holes it produced, from the upper surface, were superficially similar to those of *Chiridopsis nigrosepta* but of variable size The presence of narrow surface scrapings interspersed with holes of varying size would probably indicate that the larvae of *C. nigrosepta* had been present. *A. icterica* produces characteristic irregular holes and marginal feeding. *A . puncticosta* has large oval holes, sometimes crowded. *C. nigrosepta* produces round to oval holes from the upper leaf surface (see also p. 28).



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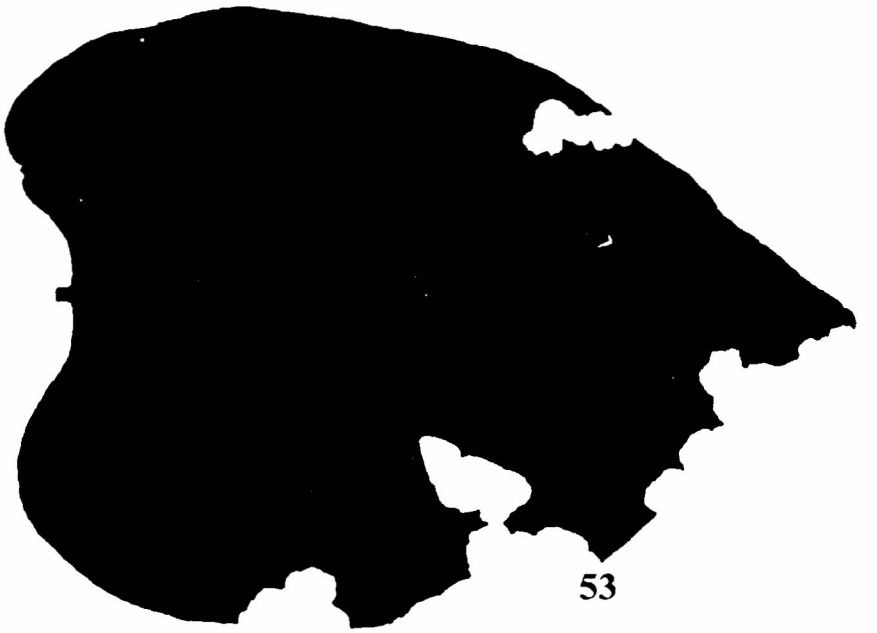
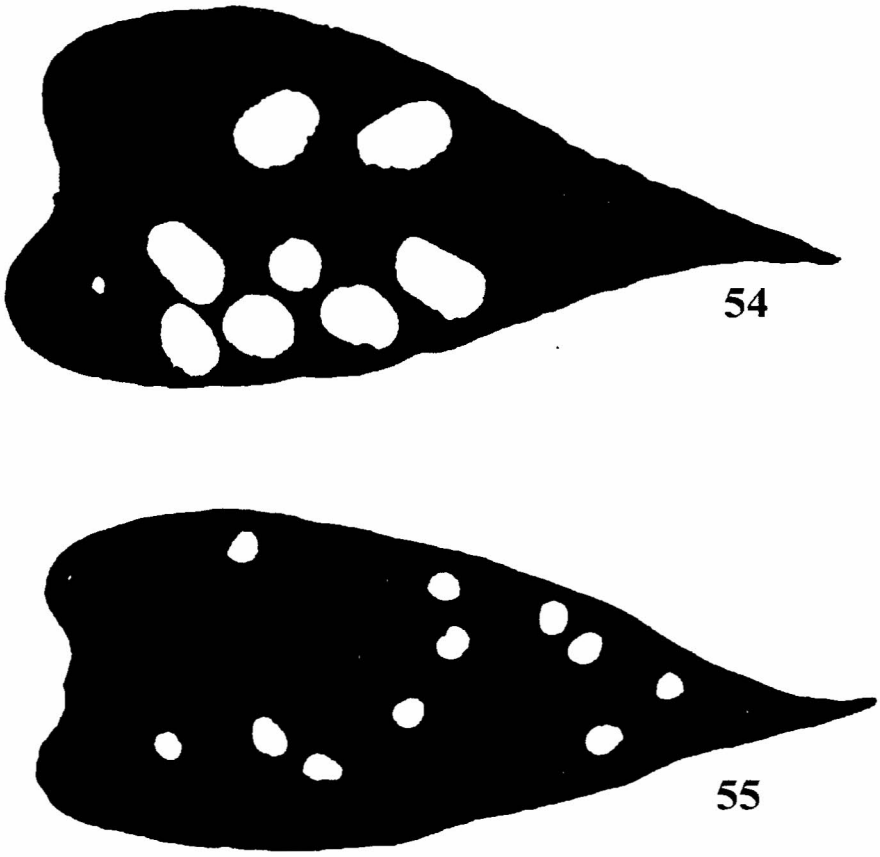


53

52-53. Feeding patterns: 52. *Aspidimorpha areata* imago on *Ipomoea fistulosa*. No: 959/38; 53. *A. icterica* imago on *I. fistulosa*. No: 966/120.

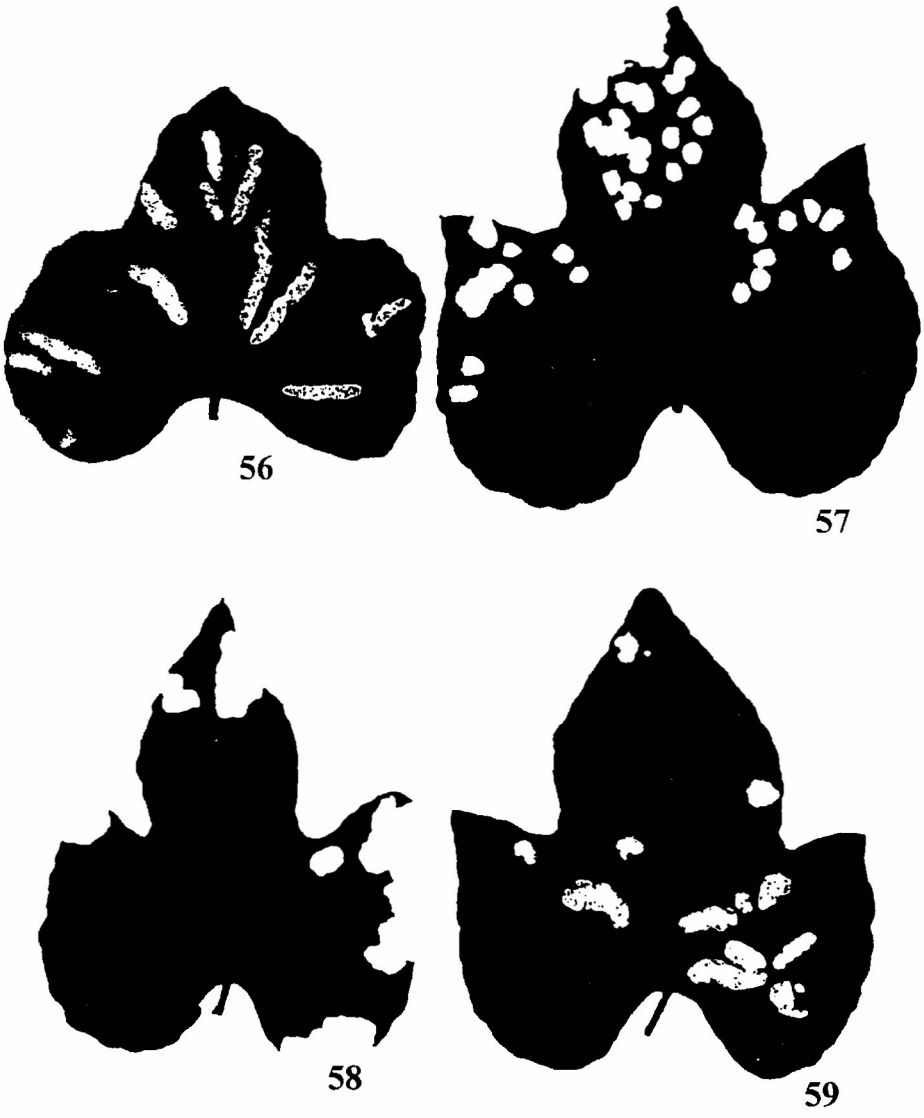
Family: ***Convolvulaceae***



54-55. Feeding patterns: 54. Large oval holes of *Aspidimorpha puncticosta* in *Ipomoea fistulosa* leaf. No: 512/15; 55. *Chiridopsis nigrosepta* imago holes in *I. fistulosa* leaf. No: 1161/22.

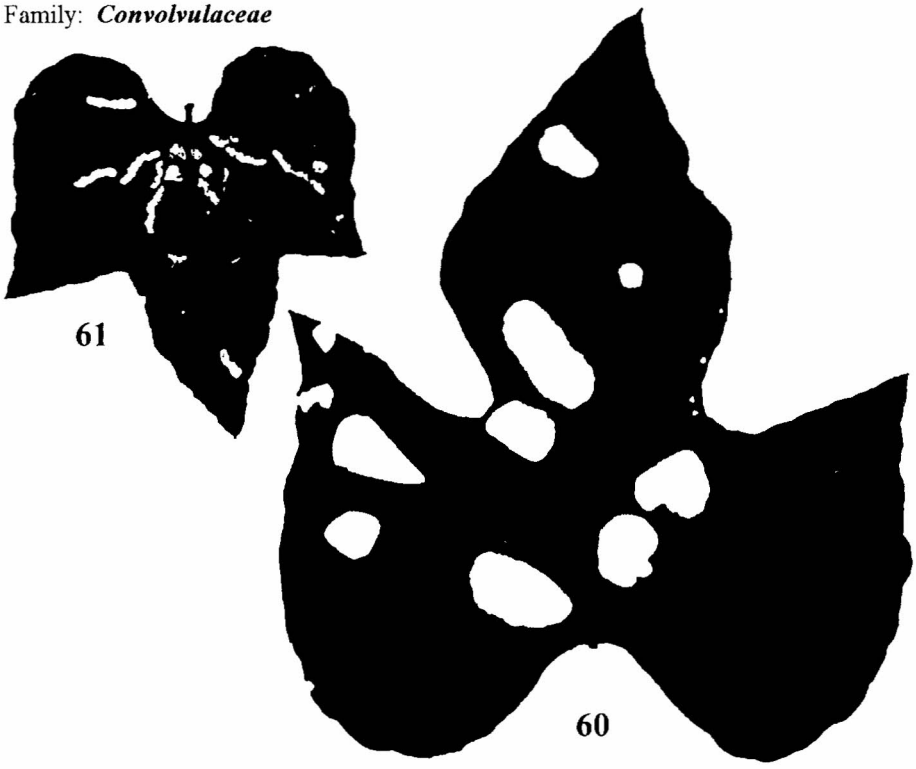
Four species readily make use of *Ipomoea ficifolia* (= *I. holosericea* of older references) in the Durban area. *Aspidimorpha confinis* leaves narrow elongated scrapings or holes from the upper surface, and *A. submutata,* feeding from below, produces groups of rounded to oval holes. Wider elongated oval holes may be produced on occasions. *A. icterica* feeds marginally and also leaves irregular holes. *Laccoptera excavata* produces large oval holes from the upper surface. The pubescent leaves of the creeper are probably responsible for it being rarely used by *L. cicatricosa* when other host plants are available (although larvae of that species are not uncommonly found). Irregular holes and scrapings are produced by imagines Two additional species may be mentioned: *Chiridopsis nigrosepta* (a single record but no feeding pattern collected) and *A. puncticosta* (also a single record of two young imagines - possibly nomads, which fed marginally). An unidentified Hispinid, possibly *Pseudispella* sp., produced narrow scrapings superficially similar to those of *A. confinis* (see pp. 29, 30).

Family: ***Convolvulaceae***



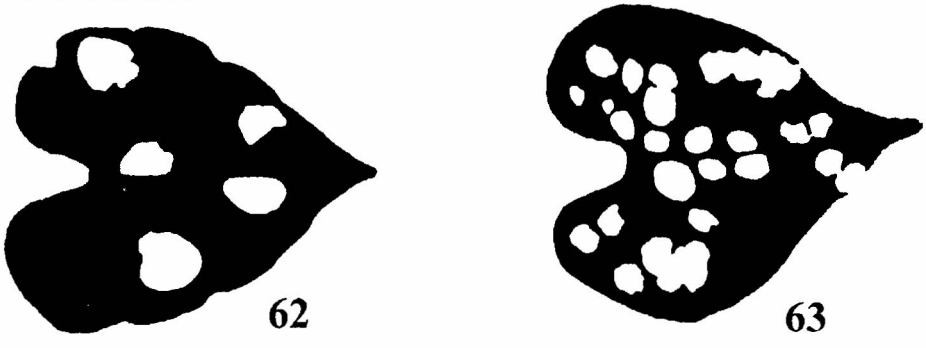
56-59. Feeding pattern: 56. Scrapings and holes of *Aspidimorpha confinis* imago in *Ipomoea ficifolia* leaf. No: 857/59; 57. *A. submutata* imago holes grouped in *I. ficifolia* leaf. Feeding from underside. No: 361/20; 58. Marginal feeding and irregular holesof *A. icterica* in *I. ficifolia.* No: 566178; 59. Irregularly elongated holes and scrapings of *Laccoptera cicatricosa* in upper surface of *I . ficifolia* leaf; not a preferred host plant. No: 618/55.

Family: ***Convolvulaceae***



60-61. Feeding pattern: 60. *Laccoptera excavata* holes from upper surface of *Ipomoea ficifolia* leaf. No: 559/28; 61. Narrow surface scrapings of a Hispinid beetle, possibly *Pseudispella* sp., in *I. ficifolia* leaf; close mimic of *Aspidimorpha confinis* feeding pattern. No: C8/1.

Ipomoea obscura has been found to host two species thus far: *Aspidimorpha confinis* and *A. submutata*. Both species produce rounded to oval holes with those of the former being more than twice than size of the latter.

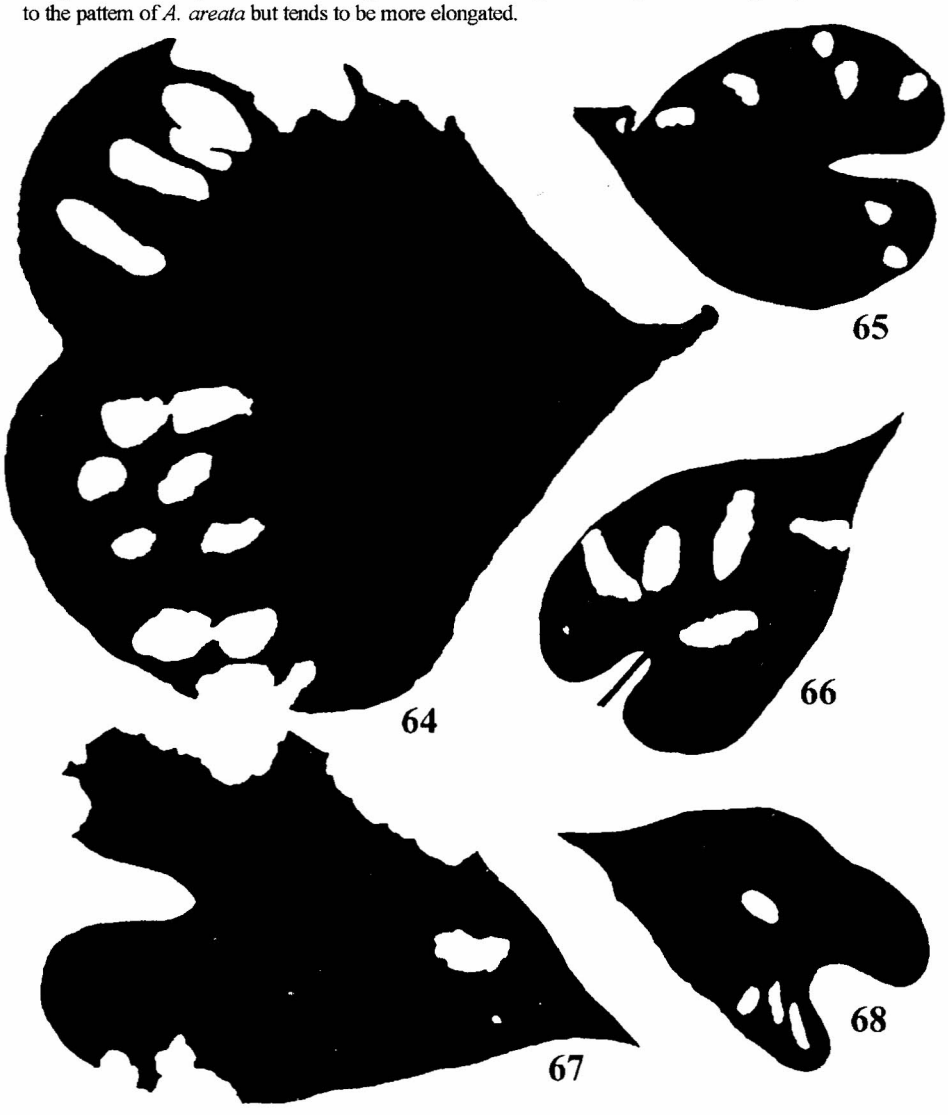


62-63. Feeding pattern: 62. Large holes of *Aspidimorpha confinis* in *Ipomoea obscura* leaf. No: 812/49; 63. Rounded holes of A. *submutata* in *I. obscura* leaf. No: 816/51.

Family: ***Convolvulaceae***

Ipomoea pes-caprae ssp . *brasiliensis* is commonly seen on beach dunes along the coast where it is used by *Aspidimorpha puncticosta.* At times, large sections may be defoliated by the gregarious larvae which exhibit cycloalexic behaviour. Rarely, *Laccoptera excavata* has been observed but, unlike the large holes of *A. puncticosta,* it leaves irregular surface scrapings.

Four species use *Ipomoea plebeia. A. areata* produces oval to pyrifomm holes, *A. confinis* has oval to elongated oval holes, and *A. icterica* irregular holes and marginal feeding. *Acrocassis gibbipennis* is similar to the pattern of *A. areata* but tends to be more elongated.



64-68. Feeding patterns: 64. *Aspidimorpha puncticosta* imago holes *in Ipomoea pes-caprae* leaf. No: 776/24. 65. Oval to pyrifomm holes of *A. areata* in *I. plebeia* leaf. No: 1005/39; 66. Elongated oval holes of *A. confinis* in *I. plebeia* leaf; imago. No: 1272/114; 67. Marginal feeding and irregular hole of *A. icterica* imago in *I. plebeia* leaf. No: 987/135; 68. Elongated holes of *Acrocassis gibbipennis* imago in *I. plebeia* leaf. No: 747/19.

Family: ***Convolvulaceae***

Like *Ipomoea ficifolia, I. wightii* has pubescent leaves. Thus far, six species have been observed using it. *Aspidimorpha confinis* leaves characteristic narrow scrapings on the upper leaf surface which may sometimes be conffised with the same Hispinid (=*Pseudispella* sp.?) patterns as described for *I. ficifolia. A. submutata* produces larger more oval to elongated oval holes than on I *ficifolia,* and *A . icterica* produces the typical marginal feeding and irregular holes. It is rarely used by *Laccoptera cicatricosa* imagines (irregular oval scrapings) but commonly by *L. excavata* (large elongated upper surface scrapings). *Chiridopsis nigrosepta* produces elongated angular oval holes and scrapings (see also p. 33).

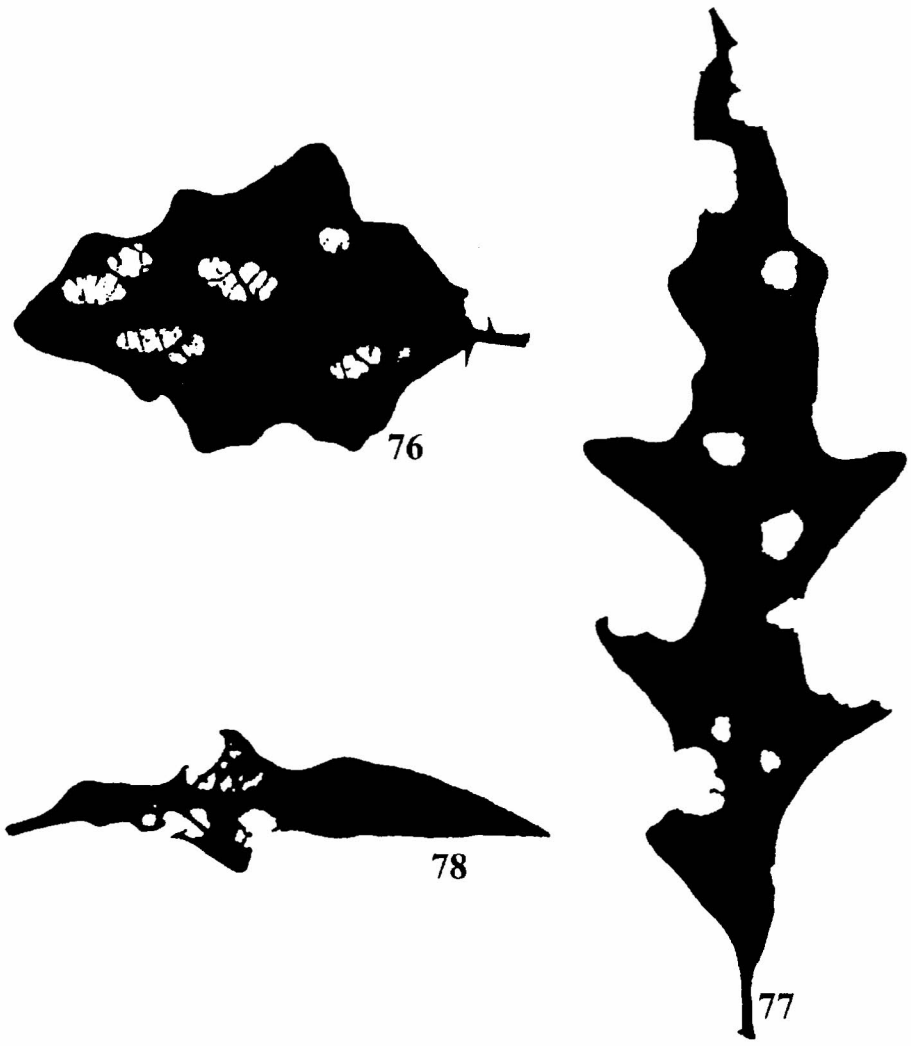
69-72. Feeding patterns: 69. *Aspidimorpha confinis* holes in *Ipomoea wightii* leaf; imago feeds from upper surface. No: 824/55; 70. Oval holes produced by *A. submutata* in leaf of *I. wightii.* No: 507/38; 71. *A. icterica* imago marginal feeding pattern in *I. wightii* leaf. No: 547/74; 72. Irregularly oval upper surface scrapings of *Laccoptera cicatricosa* in *I. wightii* leaf. No: 499/38.

Family: ***Convolvulaceae***

73-75. Feeding patterns: 73. Elongated surface scrapings of *Laccoptera excavata* in *Ipomoea wightii* leaf. No: 251/11 ; 74. On thinner leaves of *I. wightii, L. excavata* produces large oval holes similar to the ones it produces on *I. ficifolia.* No: 223/5; 75. Narrow angular surface scrapings and holes of *Chiridopsis nigrosepta* in *I. wightii* leaf, captive specimen. No: 451/1.

Family: ***Solanaceae***

Two species have been observed to use *Solanum panduraeforme*. *Conchyloctenia hybrida* produces irregularly oval to rounded surface scrapings, frequently penetrating the lower epidermis, as well as infrequent marginal indentations. *C. tigrina* has not been fully investigated as yet but appears to prefer marginal feeding.



76-78. Feeding patterns: 76. Surface scrapings of *Conchyloctenia hybrida* in *Solanum panduraeforme* leaf. No: 455/3; 77. Holes and marginal penetrations of *C. hybrida* in *S. panduraeforme* leaf. No: 470/11, 78. Marginal feeding of *C. tigrina* imagi in *S. panduraeforme* leaf. No: 459/2.