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Evolutionary Patterns of Host Plant Use by Delphacid Planthoppers and Their Relatives

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Introduction

Planthoppers (Homoptera: Fulgoroidea) are found on every continent except Antarctica and in all major biomes, including tropical rainforests, deserts, grasslands, and the arctic tundra (O'Brien and Wilson 1985). The more than 9000 described species are divided into 19 families (O'Brien and Wilson 1985; Wheeler and Wilson 1987). All species of Fulgoroidea are phytophagous, sucking fluids from leaves, stems, roots, or fungal hyphae. There are species which feed on woody plants (both angiosperms and gymnosperms), herbs, ferns, and even fungi (O'Brien and Wilson 1985).

The largest and most studied family of planthoppers is the Delphacidae which includes more than 2000 species in approximately 300 genera and 6 subfamilies (Asche 1985, 1990). Most continental delphacids are associated with monocots, particularly grasses and sedges (Wilson and O'Brien 1987; Denno and Roderick 1990), whereas some species, especially those on oceanic archipelagos, have radiated on dicots as well (Giffard 1922; Zimmerman 1948). Their predilection for monocots, phloem-feeding habit, oviposition behavior and ability to transmit pathogens have contributed to the severe pest status of several delphacid species on rice, corn, sugarcane, and several cereal crops (Wilson and O'Brien 1987).

Delphacids are intimately associated with their host plants and use them for feeding, mating, oviposition, and protection during winter and from their natural enemies (Claridge 1985a; Denno and Roderick 1990). As

might be expected for delphacids from this close association, host plant nutrition, and allelochemistry have figured prominently in studies of host plant selection (Sogawa 1982; Woodhead and Padgham 1988), performance (Mitsuhashi 1979; Denno et al. 1986; Metcalfe 1970), population dynamics including dispersal (McNeill and Prestidge 1982; Denno and Roderick 1990), and community structure (McNeill and Prestidge 1982; Waloff 1980). Moreover, other aspects of the host plant, such as persistence and growth form, play an important role in shaping the life history strategies of planthoppers (Denno and Roderick 1990, Denno et al. 1991). Thus, elucidating the causes of current patterns of host plant use in the Delphacidae is central to understanding many aspects of their biology. Toward that end, we examine planthopper/host plant relationships from a phylogenetic and evolutionary perspective.

Synopsis of Issues

A recurring question concerning the evolution of host plant use by insects has been the degree to which it is genetically "constrained" (Mitter and Farrell 1991). If the genetic variation required for recognition and use of novel hosts were readily available, host preference might be locally optimized by natural selection with respect to intrinsic plant traits such as phenology or chemistry and to ecological variables such as plant and natural enemy abundance. If this were the case, there should be little phylogenetic pattern to host plant associations, which would be best understood as adaptation to local environments. The genetic variation for host use traits commonly observed in phytophage populations (Futuyma and Peterson 1985), and the rapid accumulation of herbivore species on some introduced plants (Strong et al. 1984), suggest that host use evolution might be relatively unconstrained by genetic barriers.

If, in contrast, adoption of a novel host required simultaneous change in a number of genetically independent traits, genotypes capable of such a shift might rarely occur. Such genetic "constraint" could slow or channel the evolution of host associations and impede local optimization of host preference (Mitter and Farrell 1991). Most species might be expected to feed on hosts similar or identical to those of their near relatives elsewhere, with local host use only fully interpretable in a phylogenetic context (Farrell and Mitter, in press).

The association of many insect genera or higher-ranking taxa with particular taxa of host plants (Ehrlich and Raven 1964) is consistent with the existence of strong genetic limits on host use. If major host shifting were rare, the association of particular herbivore and plant lineages might persist over geological time and through their subsequent diversification. One

result of such "parallel phylogenesis" is that the present-day distribution of phytophage species across host taxa might reflect simply the age or phylogenetic divergence sequence of the associated taxa (Zwölfer 1978). Second, lineages which evolve while associated could have the opportunity to strongly influence each other's evolution. Such "coevolution," in the broad sense, might take several forms. For example, Ehrlich and Raven (1964) envisioned an "arms race" between plant defense and insect counteradaptation, with each innovation permitting an episode of radiation.

A major expectation, if a given insect and plant lineage have diversified significantly while in association, is that phylogenetic relationships among the host taxa should correspond in some fashion to those among their respective herbivores. If insect species were so host specific that each plant species were attacked by just the descendants of the herbivores of its immediate ancestors, there should be an exact match between insect and plant phylogenies, except where one lineage has speciated while its partner has not (Mitter and Brooks 1983). Such strict "parallel phylogenesis" may occur between some vertically transmitted endosymbionts and their hosts (Munson et al. 1991), but seems unlikely for planthoppers, in which the dispersive adults have the opportunity to select alternative hosts. However, substantial cladogram correspondence between synchronously evolving insect and plant lineages is also expected if insects colonize (transfer or shift to) host plant species other than the ones on which they developed, provided that these hosts are related (Farrell and Mitter 1990). Ehrlich and Raven's (1964) model, for example, implies periodic radiation by plants that evolve temporary immunity from herbivores, with subsequent colonization most likely to come from herbivores on related plants bearing the antecedent defense. Even if newly available hosts were colonized at random, cladistically basal (and hence older) herbivore taxa should tend to occur on correspondingly primitive plant taxa, unless early host associations were rapidly obscured through extinction or phyletic evolution of host choice.

Although concordance of phylogenies suggests diversification in concert, it could also result from herbivore colonization and speciation entirely subsequent to plant diversification if the plant similarities (in secondary chemistry or other traits) constraining host transfers were correlated with phylogenetic relatedness. To reject such "host tracking" in favor of parallel diversification, independent evidence is needed from fossils, distribution patterns, or "molecular clocks" that plant lineages are comparable in age to their associated insect lineages. Note that parallel phylogenesis itself does not necessarily imply coevolution, as the associated lineages might have simply responded independently to a shared history of geographic vicariance. However, the existence or apparent absence of parallel phylogenesis

is an important indicator of the potential influence of evolutionary history, including coevolution, on present-day host use patterns. A review of the sparse evidence to date suggests that although closely parallel phylogenesis is rare, partial concordance of insect and host plant cladograms is widespread (Mitter and Farrell 1991). Close examination of many additional herbivore groups is needed to determine the overall influence of parallel phylogenesis on patterns of host use by phytophagous insects.

Distinct from the issue of which host plant taxa are attacked, much attention has also focused on how many host taxa are used (Futuyma 1983; Jermy 1984; Thompson 1988b; Jaenike 1990). Many selective factors have been invoked to explain the predominance of host specificity in phytophagous insect species, including plant toxins, repellents, and attractants (Dethier 1954; Levins and MacArthur 1969; Futuyma 1983), host plant abundance (Hsiao 1978; Futuyma 1983), the extent to which herbivores mate on their hosts (Jaenike 1990), and natural enemy attack rates (Price et al. 1980; Bernays and Graham 1988; Denno et al. 1990). It is becoming more apparent, however, that host plant range itself, like affiliation with a particular host taxon, may be phylogenetically conserved. Thus, host plant range in any given species should also be studied in a phylogenetic context. However, such studies on the phylogenetic patterns of host range are rare for herbivorous insects (but see Jermy 1984; Bernays and Chapman 1987; Mitter and Farrell 1991).

In this chapter, we synthesize the scattered data on delphacid host plants in order to establish broad patterns of host use including the degree of feeding specialization. We use this information, in conjunction with estimates of delphacid and host plant phylogenetic relationships and geological age, to explore the degree of phylogenetic conservatism of host use exhibited by the delphacids and to examine the possibility of parallel phylogenesis. To place delphacid patterns in a broader context, we provide first a review of phylogeny and host use in the Fulgoroidea as a whole. Our analysis was limited by the lack of delphacid phylogenies below the tribal level, by the uncertainty about phylogenetic position for many host plant groups, and by the relative dearth of information on the feeding habits for tropical as compared to temperate planthoppers and for most fulgoroid groups other than delphacids. Nonetheless, we are able to provide at least provisional evidence on the issues raised above and demonstrate statistically several phylogenetic trends in planthopper host use.

Phylogenetic Relationships Among Fulgoroid Families

There is ample evidence that members of the Fulgoroidea (= Fulgoromorpha) form a monophyletic group (Muir 1923, 1930a; Evans 1963, 1964;

Hennig 1981; Bourgoin 1986; Asche 1987; Emeljanov 1987, 1991). The extant families include the Tettigometridae, Delphacidae, Cixiidae, Kinnaridae, Meenoplidae, Derbidae, Achilidae, Achilixiidae, Dictyopharidae, Fulgoridae, Issidae including Acanaloniidae, Nogodinidae, Ricaniidae, Flatidae, Hypochthonellidae, Tropiduchidae, Lophopidae, Eurybrachidae, and Gengidae. The fulgoroids together with their apparent sister group the Cicadomorpha (Cicadoidea, Cercopoidea, and Cicadelloidea) make up the Auchenorrhyncha, which, in turn, is probably the sister group to the Heteroptera + Coleorrhyncha [Carver et al. 1991; but see Emeljanov (1987) and Hamilton (1981) for alternative views].

A preliminary cladistic assessment of phylogenetic relationships among the fulgoroid families (Fig. 1.1A) was provided by Asche (1987), who built on the work of Muir (1923, 1930a). Asche's hypothesis was subsequently criticized and expanded on by Emeljanov (1987, 1991), whose arrangement is depicted in Figure 1B. Although an exhaustive, quantitative cladistic study has yet to be conducted, synthesis of these largely concordant views provides a reasonable working hypothesis for our subsequent discussion of host plant relationships.

At least some character evidence has been advanced for the monophyly of most fulgoroid families, although a phylogenetic definition is still lacking for some, such as the Kinnaridae and Issidae (Asche 1987; Emeljanov 1991). Like Muir (1923), both Asche (1987) and Emeljanov (1991) regard the Tettigometridae as the most primitive family of Fulgoroidea, although Bourgoin (1985) offered some evidence for affinity with the higher fulgoroids. There is also agreement that cixiids and delphacids are basal to the remaining, more advanced families (see also Muir 1930a); the only disagreement concerns the exact placement of these two families. Emeljanov (1987, 1991) disputes the hypothesis of a delphacid–cixiid sister group relationship, offering four characters to support grouping of the cixiids with the more advanced families; this scheme requires parallel origin or loss of the fusion of the median gonapophyses of the ovipositor (Asche 1987). Both authors regard the Kinnaridae plus Meenoplidae as a monophyletic group, a relationship recognized by Muir (1930a); Emeljanov (1991) further postulates these to be sister group to the remaining, higher fulgoroids, an arrangement consistent with the sequence of families in the classification of Muir (1930a). Asche (1987) and Emeljanov (1991) agree with Muir (1930a) in grouping the Dictyopharidae with the Fulgoridae, and agree that all seven families named so far plus the Derbidae and Achilidae are excluded from an advanced clade consisting of the Issidae, Flatidae, Tropiduchidae, and their relatives; Muir (1930a) provides a very similar ordering of families.

In summary, the phylogeny (Fig. 1B) which we provisionally adopt for

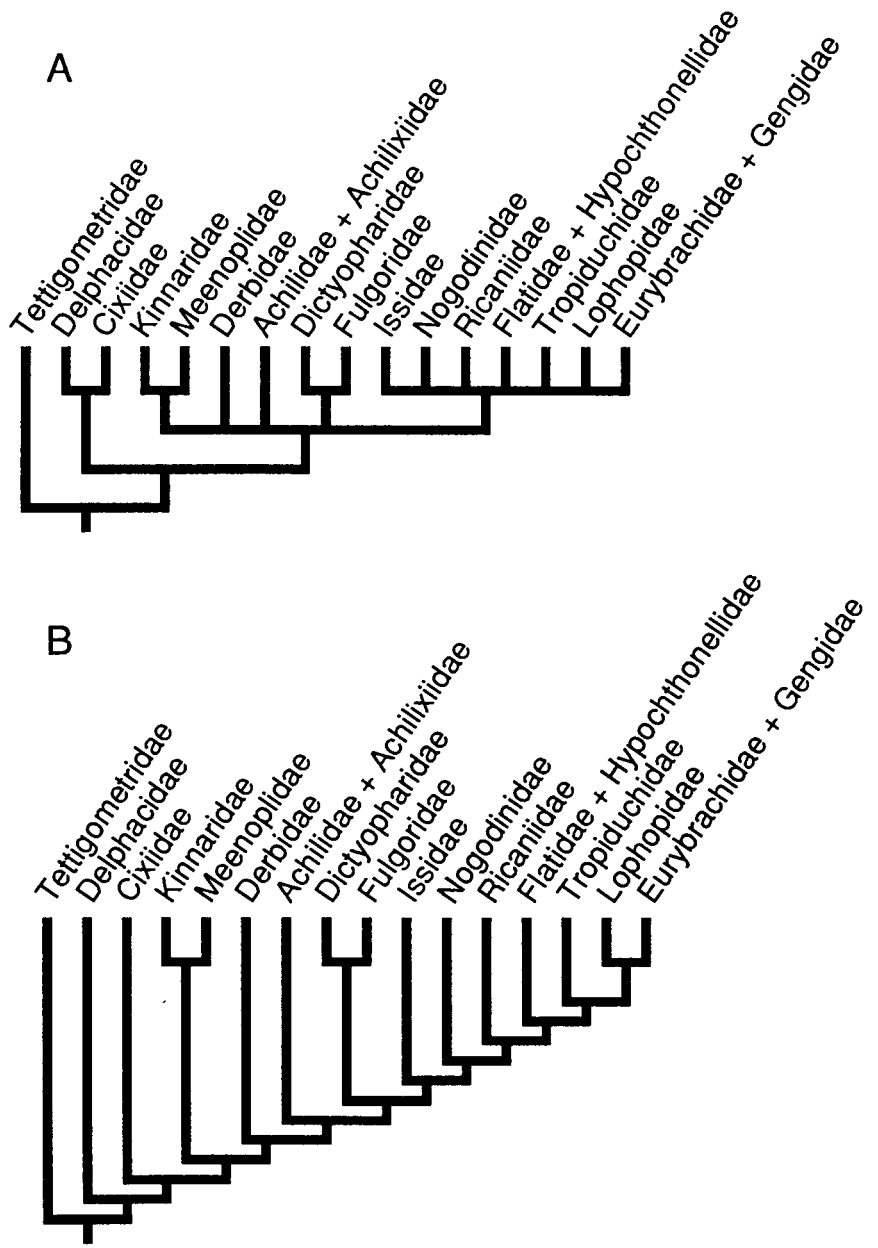

Figure 1.1. Hypotheses for phylogenetic relationships among fulgoroid families. (**A**) Phylogeny inferred from text and figures in Asche (1987); (**B**) phylogeny from Emeljanov (1991).

subsequent discussion of feeding habit evolution is consistent with, and at many nodes supported by, the main previous hypotheses, save for the precise placement of Cixiidae.

Fossil Record of the Fulgoroidea

Undoubted members of the Hemiptera *sensu lato* are first known from the Permian (Wootton 1981; Hennig 1981; Hamilton 1990). The Permian forms probably include true Auchenorrhyncha (but see Hamilton 1990), but assignments to modern subgroups are uncertain (Wootton 1981; Hennig 1981; Hamilton 1990). The time of first appearance for the Fulgoroidea has been particularly controversial. Some Permian fossils have been interpreted as possible fulgoromorphs (Evans 1963, 1964; Hennig 1981; Wootton 1981), and several extant families of Fulgoroidea have been reported from the Triassic (Muir 1923; Metcalf and Wade 1966; Hennig 1981). However, most of these fossils consist only of forewings (Evans 1964), which provide few characters useful for defining them as Fulgoroidea, let alone as members of extant families (Evans 1963, 1964; Hennig 1981; Emeljanov 1987). Numerous fossils of Fulgoriidae are known from the Jurassic, but assignment of this family to the Fulgoroidea has now been convincingly rejected (Hamilton 1990; Emeljanov 1987). Although two other Jurassic fossils may be fulgorids (Hamilton 1990), the most definitive early fulgoroid remains appear in the Lower Cretaceous, with an especially rich deposit in Brazil (Hamilton 1990). This fauna appears to include representatives of the modern family Achilidae and possibly the Cixiidae (see also Fennah 1987), as well as a profusion of species which may belong to the stem groups of several modern clades (Hamilton 1990). Dictyopharidae are known from the Upper Cretaceous, but definite fossils of other fulgoroid families, including the Delphacidae and higher families such as the Fulgoridae, Flatidae, Issidae, and Ricaniidae, appear first in the Tertiary, with most records from the Eocene, Oligocene, and Miocene (Metcalf and Wade 1966; Fennah 1968; Hamilton 1990).

In conjunction with Emeljanov's phylogenetic estimate (Fig. 1B), these data suggest the following conclusions. Although surely incomplete, the fossil record generally supports the hypothesized phylogeny in that families represented by the oldest fossils (Achilidae and Cixiidae) are relatively basal in the phylogeny. Given that the Achilidae arose by the Lower Cretaceous, their phylogenetic position implies that the cladistically more basal lineages (Tettigometridae, Delphacidae, Cixiidae, Kinnaridae/Meenoplidae, and Derbidae) must have arisen still earlier, even though Mesozoic fossils of these groups are largely lacking. Divergence of the Fulgoro-

morpha from the Cicadomorpha must have occurred even earlier. Among the more advanced fulgoroids, the Fulgoridae must be as old as their sister group, the Dictyopharidae, which occurred in the Upper Cretaceous; it is possible that the remaining higher families did not differentiate until the Tertiary (Hamilton 1990). Thus, although the evolution of the Fulgoroidea as a whole greatly overlaps the radiation of the angiosperms, the divergences among and perhaps within the older fulgoroid families including the Delphacidae may have preceded the appearance of angiosperms in the Lower Cretaceous (130 million years ago) and their proliferation in the Upper Cretaceous (Cronquist 1981).

Host Plant Relationships of the Fulgoroidea

Appendices 1 and 2 are the result of our effort to compile as complete a list of host plant records for the Fulgoroidea as possible. The data were assembled by examining the taxonomic, ecological, and agricultural literature, in addition to faunal surveys. Spurious records can result when adults are collected from nonhost vegetation, especially by sweep net, in the absence of information on feeding or presence of nymphs. To minimize such false records, we excluded reports for species (1) collected by general sweeping, (2) stated by the author to have been observed resting but not feeding on the plant, (3) taken in surveys of crops of which they are not known to be pests (e.g., Ballou 1936; Bruner et al. 1945; Kramer 1978; Maes and O'Brien 1988), or (4) whose taxonomic identities were questionable (Swezey 1904).

Our subsequent discussion of evolutionary patterns in host use is based on the following synopsis of host associations for each fulgoroid family, in conjunction with the data summaries in Tables 1.1–1.4. A "record" within any table is the occurrence of one planthopper species on one of the plant taxa specified in that table. Multiple observations of a species on the same plant taxon were not considered separate records. The number of records contributed by any individual species is the number of plant taxonomic categories on which it occurs. Table 1.1 gives the percentage of host records for each planthopper family from the Pteridophyta, Gymnospermae, Monocotyledoneae, and Dicotyledoneae. Table 1.2 summarizes the proportion of just monocot records that occur on each monocot family. Table 1.3 gives the percentage of dicot records occurring on each of the dicot subclasses recognized by Cronquist (1981).

The degree of host plant specialization for each family (Table 1.4) was assessed by sorting species into one of three categories: 1) **monophagous** (feeding primarily on one plant species or plant species in the same genus),

Table 1.1. Percentage of planthopper species records on the Pteridophyta, Gymnospermae, Monocotyledoneae, and Dicotyledoneae for the families of Fulgoroidea. Polyphagous species were scored on all of their host plant taxa. Summarized from host plant records in Appendices 1 and 2.

Planthopper Family	Pter. (%)	Gym. (%)	Monocot. (%)	Dicot. (%)	No. Records
Tettigometridae	0	0	33	67	6
Delphacidae[a]	3	0	65	32	482
Delphacidae[b]	7	0	6	87	150
Delphacidae[c]	1	0	92	7	332
Cixiidae	5	7	30	58	174
Kinnaridae	15	8	8	69	13
Meenoplidae	0	0	80	20	5
Derbidae[d]	4	0	54	42	81
Achilidae[d]	0	34	6	60	50
Dictyopharidae	4	2	14	80	44
Fulgoridae	0	3	16	81	31
Issidae	0	12	17	71	104
Nogodinidae	0	0	0	100	4
Ricaniidae	5	0	25	70	20
Flatidae	0	0	16	84	69
Hypochthonellidae	0	0	50	50	2
Tropiduchidae	5	0	40	55	42
Lophopidae	0	0	71	29	7
Eurybrachidae	0	0	0	100	2
Total	3	4	42	51	1143

[a]All records.
[b]Oceanic island (Hawaiian Archipelago, Polynesia, S. Pacific) records (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948) only.
[c]Nonisland records only.
[d]Nymphs mycophagous.

2) **oligophagous** (feeding on several genera in the same plant family), and 3) **polyphagous** (feeding on two or more plant families). Patterns of host plant specialization may change as our knowledge of planthopper host plants becomes more sophisticated. For example, many tropical species have been observed or sampled only once on a host taxon. As a consequence, we would categorize such a species as monophagous when indeed it may be polyphagous. Thus, our estimates of diet breadth should be taken in the context of the rather incomplete state of knowledge concerning the host plant relationships of planthoppers, particularly tropical taxa.

The following is a brief discussion of the host plant affiliations, degree of host plant specialization and feeding habits (subterranean or above ground)

Table 1.2. Percentage of planthopper species records on the families of Monocotyledoneae for the families of Fulgoroidea. Only monocot-feeding species considered. Polyphagous species were scored on all of their host plant taxa. Summarized from host plant records in Appendices 1 and 2.

	Family of Monocotyledoneae														
Planthopper Family	AC (%)	AG (%)	AR (%)	CM (%)	CY (%)	HE (%)	JU (%)	LI (%)	NY (%)	PA (%)	PO (%)	PN (%)	TY (%)	ZI (%)	No. Records
Tettigometridae								50			50				2
Delphacidae	1[a]		2[a]	<1	18[a]	<1[a]	5[a]	1[b]	<1[a]	2[a,b]	69[a]	<1[a]	1		334
Cixiidae		24[a]	25	2	3		10	2[b]		3[b]	31[a]				59
Kinnaridae		100[a]													1
Meenoplidae	25[a]			12	38						25				8
Derbidae	16		56		2	2				2[b]	18			4	45
Achilidae			33								67				3
Dictyopharidae		50[a]									50				6
Fulgoridae			40								60[a]				5
Issidae			11[a]	5	11			5			68[a]				18
Ricaniidae	20		20							40[b]	20				5
Flatidae			27[a]							18[b]	55[a]				11
Hypochthonellidae											100				1
Tropoduchidae			38[a]		6[a]					6	50[a]				18
Lophopidae			60[a]								40[a]				5
Total	2	4	12	1	13	<1	5	1	<1	3	57	<1	1	<1	520

Note: AC (Araceae); AG (Agavaceae); AR (Arecaceae); CM (Commelinaceae); CY (Cyperaceae); HE (Heliconiaceae); JU (Juncaceae); LI (Liliaceae); NY (Nymphaceae); PA (Pandanaceae); PO (Poaceae); PN (Pontederiaceae); TY (Typhaceae); ZI (Zingiberaceae).

[a]Nymphs observed or sampled in some cases.

[b]Most records from Oceanic Islands (Hawaiian Archipelago, Polynesia, S Pacific) (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948).

for species in each of the fulgoroid families. We were unable to locate any host plant records for planthoppers in the Achilixiidae and Gengidae.

Tettigometridae

Most species of tettigometrids occur in the Ethiopian tropics and Palaearctic region and are associated primarily with dicots (75% of records) in the three subclasses Magnoliidae, Rosidae, and Asteridae, although monocot feeding (Liliaceae and Poaceae) has been reported (Weaving 1980; Gunthart 1987; Wilson and O'Brien 1987). Most species (62%) appear to be monophagous, with the remainder polyphagous [e.g., *Hilda patruelis* Stål (Weaving 1980)].

Table 1.3. Percentage of planthopper species records for the families of Fulgoroidea occurring on the subclasses of Dictoyledoneae listed from primitive to advanced. Summarized from host plant records in Appendices 1 and 2.

Planthopper Family	Magnoliidae (%)	Hamamelidae (%)	Caryophillidae (%)	Dilleniidae (%)	Rosidae (%)	Asteridae (%)	No. Records
Tettigometridae	40				40	20	5
Delphacidae[a]	2	5	6	10	32	45	191
Delphacidae[b]	2	5	3	11	36	43	167
Delphacidae[c]			25	4	8	63	24
Cixiidae		11	16	21	24	28	114
Kinnaridae				12		88	8
Meenoplidae					50	50	2
Derbidae		26		26	33	15	46
Achilidae	4	29		26	24	17	46
Dictyopharidae		5	15	8	13	59	39
Fulgoridae		11		17	55	17	29
Issidae	5	7	10	14	34	30	83
Nogodinidae				33	33	33	3
Ricaniidae		13		31	31	25	16
Flatidae	5	9	6	14	34	32	65
Hypochthonellidae						100	1
Tropiduchidae	4	12	12	16	32	24	25
Lophopidae					67	33	3
Eurybrachidae					100		2

[a]All records.

[b]Oceanic island (Hawaiian Archipelago, Polynesia, S. Pacific) records (Fennah 1957, 1958, 1962a, 1964, 1976; Zimmerman 1948) only.

[c]Nonisland records only.

Table 1.4. Diet breadth of the nymphs and adults of planthopper species in the families of Fulgoroidea. The percentage of (M) monophagous (feeding primarily on one plant species or plant species in the same genus), (O) oligophagous (feeding on several genera in the same plant family), and (P) polyphagous planthopper species (feeding on 2 or more plant families) and the number of species records for each family is shown. Summarized from host plant records in Appendices 1 and 2.

	Nymphs				Adults			
Planthopper Family	M (%)	O (%)	P (%)	No. Rec.	M (%)	O (%)	P (%)	No. Rec.
Tettigometridae	—	—	—		62	0	38	8
Delphacidae[a]	—	—	—		74	14	12	472[b]
Delphacidae[c]	—	—	—		73	4	23	158[b]
Delphacidae[d]	—	—	—		74	19	7	314[b]
Cixiidae	70	15	15	13	67	13	20	158
Kinnaridae	100	0	0	1	64	9	27	11
Meenoplidae	100	0	0	1	14	0	86	7
Derbidae		Mycophagous			63	16	21	75
Achilidae		Mycophagous			37	8	55	38
Dictyopharidae	100	0	0	12	84	5	11	43
Fulgoridae	75	0	25	4	62	9	29	21
Issidae	50	23	27	22	64	9	27	96
Nogodinidae	100	0	0	2	100	0	0	4
Ricaniidae	50	0	50	2	47	6	47	17
Flatidae	58	21	21	14	48	6	46	70
Hypochthonellidae	0	0	100	1	0	0	100	1
Tropiduchidae	36	18	46	11	62	8	30	37
Lophopidae	67	33	0	3	43	43	14	7
Eurybrachidae	100	0	0	1	100	0	0	2

[a]All records.
[b]Records of diet breadth for adult delphacids approximates pattern of host use by nymphs.
[c]Oceanic island (Hawaiian Archipelago, Polynesia, S. Pacific) records (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948) only.
[d]Nonisland records only.

Tettigometrid nymphs typically live on plant roots, whereas adults are found above ground on the foliage of their hosts (Emeljanov 1987). However, both the nymphs and adults of *H. patruelis* feed on peanut leaves during the early morning and move to subterranean chambers surrounding the roots as the day becomes warmer (Weaving 1980).

Delphacidae

The Delphacidae are cosmopolitan, occurring in both the Old and New World from the tropics to arctic latitudes (O'Brien and Wilson 1985). The

nymphs and adults of delphacids occur together on the above-ground parts of their host plants, although many species inhabit the basal portion of their host and are associated with the crown (Denno 1980; Cook and Denno Chapter 2). Delphacids are relatively host-specific, and most mainland species (92% of records) attack monocots; dicot feeding dominates (82% of records) only on oceanic islands (Zimmerman 1948). Delphacid host associations are discussed in detail in a later section.

Cixiidae

The Cixiidae occur at both temperate and tropical latitudes in the Old and New World (Kramer 1983). Nymphs are subterranean, feeding on plant roots and perhaps fungi (O'Brien and Wilson 1985; Emeljanov 1987; Hoch and Howarth 1989a, 1989b). For nymphs, 62% of the records are from grasses and are represented by *Tachycixius pilosus* (Olivier) (Le Quesne 1960), *Oliarus felis* Kirkaldy (Hacker 1925a), *Pentastiridius pachyceps* (Matsumura) (Tsaur et al. 1988a), and *Myndus crudus* (Van Duzee) (Tsai and Kirsch 1978). Nymphs have also been reported feeding on the roots of ferns (Swezey 1906; Zimmerman 1948), gymnosperms (Pinaceae, Sheppard et al. 1979), other monocots (Agavaceae, Cumber 1952; Arecaceae, Sheppard et al. 1979),) and dicots in the Asteraceae, Chenopodiaceae, Convolvulaceae (Brĉak 1979), and Tamaricaceae (Hopkins and Carruth 1954).

As adults, cixiids occur above ground and most host records (58%) are from woody dicots, spanning five subclasses (Le Quesne 1960; Reinert 1980; Kramer 1983). Some cixiid adults are reported from ferns (*Iolania* spp., Zimmerman 1948), gymnosperms (*Ankistrus pini* Tsaur and Hsu and several *Cixius* spp. on Pinaceae; Kramer 1981 and Tsaur et al. 1988b) and monocots. Within the Monocotyledoneae, most records are from the Poaceae (some species of *Bothriocera*, *Kirbyana*, *Myndus*, *Oecleus*, and *Oliarus*), Arecaceae (species of *Myndus*, *Nymphocixia*, *Oecleus*, and *Oliarus*), and Agavaceae (some species of *Myndus*, *Oecleus*, and *Platycixius*).

Most species (70% of nymphal and 67% of adult records) have been reported from only a single host genus. However, within cixiid genera, there are no clear patterns of association with particular host plant taxa, raising the possibility that the adults are less host-specific than these figures would indicate. For example, within the genera *Bothriocera* and *Oecleus*, there are some species associated with monocots and others with dicots, and in the genera *Cixius*, *Myndus*, and *Oliarus*, there are several species associated with gymnosperms and others with angiosperms (Appendix 1).

Kinnaridae

The Kinnaridae is a primarily tropical, mostly Neotropical and Oriental family (O'Brien and Wilson 1985). Nymphs are subterranean, feeding on roots. For example, nymphs of *Quilessa grenadana* Fennah and two species of *Oeclidius* have been found feeding on roots (Fennah 1948, 1980). Adults are generally collected from the upper portions of plants, but the adults of *Oeclidius* have also been found on the roots of their hosts (Fennah 1980). Most kinnarid species (69%) are associated with dicots in the Asteridae and Dilleniidae (Fennah 1948; Goeden and Ricker 1989). The remaining records are from ferns, gymnosperms in the Ephedraceae, and monocots in the Agavaceae. As adults, most kinnarid species (64%) have been reported on a single host plant genus.

Meenoplidae

The Meenoplidae is an Old World family with many tropical species (O'Brien and Wilson 1985). Few studies, however, have provided details of their life histories. The limited information which exists suggests that adults and nymphs occur above ground on their hosts (Tsaur 1989a). Most species (80% of records) are associated with monocots, particularly the Cyperaceae, Poaceae, Araceae, and Commelinaceae, and the remainder (20%) with dicots in the Rosidae and Asteridae (Synave 1961; Tsaur et al. 1966).

As adults, meenoplid species (86%) may be among the most polyphagous in the Fulgoroidea. For example, species of *Nisia* feed across several families of monocots (Tsaur et al. 1986; Wilson and Claridge 1991). However, some apparently polyphagous species may, in fact, represent clusters of sibling species with more limited host plant ranges (Wilson and Claridge 1991). Thus, meenoplids may be more specialized in their use of host plants than the present records indicate.

Derbidae

Derbids occur both in the tropical and temperate regions. Nymphs are thought to be obligate fungal feeders (O'Brien and Wilson 1985; Emeljanov 1987). Nymphs have been collected under the bark of living (*Apache degeerii* Kirby; Wilson 1982b) and dead trees (*Otiocerus coquebertii* Kirby; Felt 1916), from palm stumps (*Heronax maculipennis* Melichar; Muir 1917) and from decaying logs (*Sikiana harti* Metcalf; Willis 1982), whereas adults occur above ground on their hosts (O'Brien and Wilson 1985).

Adult derbids are associated primarily with monocots (54% of records)

and woody dicots (42%), and a few species (4%) occur on ferns (Gagne 1972; Flynn and Kramer 1983). Of the monocot records, 56% were on the Arecaceae, 18% on Poaceae, and 16% on Araceae (Schumacher 1920; Howard and Mead 1980; Wilson and O'Brien 1987). Dicotyledonous hosts range across four subclasses.

Adults of most derbid species (63%) have been reported on only one host plant genus. Some genera appear to be restricted to a single plant family (*Neocenchrea* and genera in the Sikaianini to Arecaceae, *Vekunta* to the Poaceae, and *Malenia* to Salicaceae); however, others are not so constrained. For example, there are records of *Cedusa* on ferns, monocots, and dicots, and records of *Omolicna* on monocots and dicots.

Achilidae

Like the Derbidae, achilids are thought to feed on decaying vegetation or fungi as nymphs and the sap of higher plants as adults (O'Brien 1971; Emeljanov 1987; Wilson 1989). Nymphs are typically collected under the bark of decaying logs (Downes 1927; Hepburn 1967; Chen et al. 1989), whereas adults occur above ground on their hosts (O'Brien 1971). Nymphs of *Synecdoche nemoralis* (Van Duzee) were reared on fungi (O'Brien 1971) and adults of the myconine *Epiptera slossonae* (Van Duzee) were collected in rotten wood or under stumps. Adults of this temperate family are associated primarily with dicots (60% of records, spanning five subclasses). However, achilids are more strongly associated with gymnosperms (Pinaceae and Cupressaceae; 34% of records) than any other fulgoroid family. The few monocot associations (6% of records) are with Poaceae and Arecaceae. As adults, a majority of species (55%) are polyphagous. For example, species of *Catonia* have been taken on both gymnosperms and angiosperms. However many achilids (45%) are known from a single plant family (e.g., several species of *Junipertha* on Cupressaceae, and several species of *Synecdoche* from Ericaceae; O'Brien 1971).

Dictyopharidae

This family occurs in both temperate and tropical regions of the Old and New World (O'Brien and Wilson 1985; Wilson and O'Brien 1987). Both nymphs and adults occur above ground on their hosts (Ball 1930; Goeden and Ricker 1975). Most species (80% of records) are associated with dicots in the Hamamelidae, Caryophyllidae, Dilleniidae, Rosidae, and Asteridae. Of the remaining species records, 14, 4, and 2% are from monocots (Poaceae and Agavaceae), ferns, and gymnosperms (Ephedraceae) respectively.

Most dictyopharid species (84%) are monophagous, more so than spe-

cies in most of the other families of Fulgoroidea. For instance, some species such as *Phylloscelis pallescens* Germar and *P. rubra* Ball are monophagous on dicots as are all known species of *Scolops*. A few species (11%) are polyphagous on dicots (e.g., *Dictyophara europeae* L. and *Nersia florens* Stål).

Fulgoridae

Both the nymphs and adults of this primarily tropical family occur above ground on their host plants (Kershaw and Kirkaldy 1910; Chu 1931; Wilson and O'Brien 1987; Wilson and Wheeler 1992). Most fulgorid species (81%) are affiliated with dicots in the Hamamelidae, Caryophyllidae, Dilleniidae, Rosidae, and Asteridae. Some species (16%) are associated with monocots in the Poaceae and Arecaceae and one species has been reported feeding on gymnosperms (Pinaceae). Nymphs are rarely collected with adults and the nymphs of some species may feed on hosts not used by adults. For example, nymphs of *Rhabdocephala brunnea* Van Duzee were found on a grass, a host apparently not fed upon by the adults (Wilson and Wheeler 1992). Many fulgorid species (62%) have been reported on a single host and 29% are polyphagous.

Issidae

The Issidae occur in both tropical and temperate regions in the Old and New World (O'Brien and Wilson 1985). Issids, in general, feed as nymphs and adults on the above-ground parts of their host plants (Denno 1980; Wheeler and Hoebeke 1982; Wilson 1987; Wheeler and Wilson 1988; Goeden and Ricker 1989). Most issid host plant records (71%) are from dicots, including all subclasses, with some on monocots (17%) and a few on gymnosperms (12%). Of the monocot records, most are on the Poaceae (68%) followed by the Arecaceae (11%) and Cyperaceae (11%). More issids are monophagous (64%) than polyphagous (27%).

Host plant associations differ among the subfamilies of Issidae. As both nymphs and adults, acanaloniines are polyphagous on a wide variety of mainly woody dicots (Wheeler and Hoebeke 1982, Wilson and McPherson 1980). Most Issinae feed on woody dicots with a few species feeding on gymnosperms. For example, *Thionia simplex* (Germar) is polyphagous on dicots (Wheeler and Wilson 1988), *Thionia elliptica* Germar is associated with oaks (Wheeler and Wilson 1987), *Thionia bullata* (Say) feeds as adults and nymphs on three species of pines (Wheeler and Wilson 1988), and *Thionia producta* Van Duzee is found on junipers (Doering 1938). Some issines deposit mud egg cases on a variety of woody plants on which

they apparently do not feed (Caldwell and DeLong 1948; Doering 1958, Schlinger 1958). All host records of Tonginae are from dicots (Fennah 1958; Ward et al. 1977). Bladinines were transferred from Issidae to Nogodinidae by Fennah (1984) and then back to Issidae by Emeljanov (1991). *Bladina* occurs primarily on monocots, whereas *Dictyssa* is primarily on dicots (Fennah 1945, 1952; Doering 1940). All species of Caliscelinae feed on monocots, especially grasses, sedges, and palms, and most species restrict their feeding to plants in the same family (Ball 1935a, 1935b; Denno 1980).

Nogodinidae

Very little is known about the biology of this primarily tropical family. Nogodinids apparently feed above ground as nymphs and adults. All known nogodinids are monophagous on woody dicots (Fennah 1978; Dlabola 1981; Carver et al. 1991).

Ricaniidae

Ricaniids are a primarily tropical Old World group (O'Brien and Wilson 1985). Both nymphs and adults occur above ground on their host plants (Cumber 1966). Host associations are primarily with woody dicots (70% of records) in the Dilleniidae, Rosidae, and Asteridae, but some records (25%) are from monocots (Poaceae, Pandanaceae, and Araceae) and ferns (5%). Polyphagy is common (47% of species) (Lee and Kwon 1977; Williams and Fennah 1980). For example, *Scolypopa australis* Walker feeds on ferns, clubmosses, and angiosperms (Cumber 1966), and *Ricania taeniata* Stål feeds on both monocots and dicots (Lee and Kwon 1977).

Flatidae

The Flatidae is a large, mostly pantropical family (O'Brien and Wilson 1985). Both the nymphs and adults occur on the above-ground parts of their host plants (Metcalf and Bruner 1948; Wilson and McPherson 1980; Goeden and Ricker 1986a). Most species (84% of records) feed on woody dicots, and all subclasses are used (Fennah 1941, 1942b). The remaining records are from monocots, mostly in the Poaceae and Arecaceae (Howard and Mead 1980, Wilson and Tsai 1984).

Many flatid species (46%) are polyphagous (Hoffman 1935; Fletcher 1985). For example, the polyphages *Anormenis chloris* (Melichar), *Metcalfa pruinosa* (Say), and *Ormenoides venusta* (Melichar) have been recorded from 41, 85, and 4 species of plants, respectively (Wilson and

McPherson 1980). Nymphs of some species may have narrower host ranges than adults; for example, adults of *Ormenaria rufifascia* (Walker) fed on 15 species of palms and 3 species of dicots, but nymphs developed only on 2 species of palms (Howard and Mead 1980, Wilson and Tsai 1984).

Hypochthonellidae

This monotypic family is known only from the Ethiopian region (O'Brien and Wilson 1985). Nymphs and adults of *Hypochthonella caeca* China and Fennah are subterranean, feeding on the roots of plants in the Fabaceae, Solanaceae, and Poaceae (China and Fennah 1952).

Tropiduchidae

The tropiduchids are primarily pantropical (O'Brien and Wilson 1985; Wilson and O'Brien 1987). Both nymphs and adults feed above ground on their hosts (Caldwell and Martorell 1950; Wilson 1986, 1987; Yang et al. 1989). The majority of species (55% of records) feed on woody dicots, spanning all subclasses (Carnegie 1980; Wilson and Wheeler 1984; Wilson and Hilburn 1991). Monocot feeding (40% of records) occurs primarily on the Poaceae and Arecaceae (species in the Catulliini, Tambiniini, and Trypetimorphini) (Asche and Wilson 1989a; Yang et al. 1989). *Ommatissus lybicus* Bergevin is a pest of date palms (Asche and Wilson 1989a). As adults, most tropiduchids (62%) have been taken on a single host genus, whereas 30% are polyphagous (Carnegie 1980; Wilson and Wheeler 1984; Wilson and Hilburn 1991).

Lophopidae

Lophopids occur largely in the Old World tropics (Wilson and O'Brien 1987). Adults and nymphs occur above ground on their hosts (Rahman and Nath 1940; Smith 1980; Wilson 1987). Although there are few data, most lophopid records (71%) are from monocots (Arecaceae and Poaceae), with the remainder from dicots in the Rosidae and Asteridae (Rahman and Nath 1940; Ghauri 1966; Woodward et al. 1970; Smith 1980; Wilson 1987). Most lophopid species are either monophagous (43%) or oligophagous (43%) as adults; nymphs are even more specialized (67% monophagous; Rahman and Nath 1940; Smith 1980; Wilson 1987).

Eurybrachidae

Very little is known about the biology of this small Australasian family (O'Brien and Wilson 1985). The only species for which any detailed bio-

logical information is available, *Platybrachys leucostigma* Walker, has been found above ground as both nymphs and adults on *Eucalyptus maculatus* (Hacker 1925b).

Host Plant Use Patterns in the Fulgoroidea: Parallel Phylogenesis?

The ages of origin of the fulgoroid families appear to span at least those of the angiosperms. It is, therefore, of interest to ask whether the present distribution of fulgoroid families across plant taxa in some way reflects that shared history. This inquiry faces several difficulties. First, although we have attempted to eliminate incidental host records, plant associations of fulgoroids apart from delphacids are known with little precision; this may be reflected by the apparent high proportion of polyphagous species. Second, the more basal families tend to be subterranean feeders as immatures, some using only fungi. Plants used by the free-living adults, which constitute the great majority of records, may not be the "definitive" hosts to which long-term fidelity is most likely; the nymphal host range is known to be narrower than that of adults. Third, fulgoroid families show great overlap in their use of host taxa of subclass and higher rank. Thus, for an explicit comparison to plant phylogeny, it may be desirable to examine fulgoroid phylogeny and patterns of host use at a finer taxonomic scale, or at least to identify the ancestral habit within each family. Except in the Delphacidae, however, phylogenetic relationships within fulgoroid families are little understood. Finally, higher-level relationships within the angiosperms remain poorly known (Dahlgren and Bremer 1985; Olmstead et al. 1992).

Given the obstacles to an explicit comparison of planthopper and host plant phylogenies, we take a heuristic, statistical approach following Zwölfer (1978). Based on our summary of the phylogenetic and fossil evidence, fulgoroids can be objectively divided into a set of relatively ancient, primitive lineages and a set of more derived, recent lineages. The "primitive" grouping includes the families Tettigometridae, Delphacidae, Cixiidae, Derbidae, and Achilidae, plus the lineage Meenoplidae + Kinnaridae, all of which we infer (sometimes indirectly) to have arisen by the Lower Cretaceous. For the remaining 12 derived families there is no evidence for appearance before the late Cretaceous, and some may date only from the Tertiary (Hamilton 1990). In the analyses below, we test for quantitative phylogenetic trends in fulgoroid host use by contrasting mean percentage of associations of various kinds (e.g., angiosperms versus nonangiosperms) between these two fulgoroid groupings, using individual families or lineages as quasi-independent replicates. For reasons discussed be-

low, oceanic island records for delphacids were excluded from this analysis. Statistical significance was evaluated by the Mann–Whitney U test, which was performed both with all families included and with those providing fewer than five records excluded.

Suppose, as seems probable from the fossil evidence, that the primitive families are older than the angiosperms, whereas the younger families diverged contemporaneously with the angiosperms. If the fulgoroids diversified in tandem with the vascular plants over this period, we might expect the earlier-diverging families to show an elevated proportion of records from plant groups that became distinct before the angiosperms did, such as ferns and most groups of gymnosperms. The mean fraction of nonangiosperm records (Pteridophyta and Gymnospermae) is, in fact, somewhat higher for the basal lineages (11% versus 3%); however, the difference is not quite significant if planthopper families with less than five records are excluded from the analysis ($P<0.1$, $P>0.05$, one-tailed test).

If the fulgoroids were still older, such that all the families predate the angiosperms, the tendency for nonangiosperm habits to be cladistically basal might be more apparent within than among families. Lack of phylogenies for all families but the Delphacidae prevents a test of this hypothesis; however, several authors have opined that nonangiosperm feeders are derived from angiosperm feeders (Emeljanov 1987; Hamilton 1990). In any case, nonangiosperm associations constitute a small fraction of records even for primitive fulgoroids. Either planthoppers did not actually predate and feed on older relatives of the angiosperms or the host associations of present-day species have largely departed from the original habits.

Finally, suppose that the fulgoroids, including the primitive families, are equal in age to, and have diversified with their predominant hosts, the angiosperms. Then we might expect the older fulgoroid families to show a greater proportion of records on the earliest-diverging angiosperms. Phylogenetic relationships among the host plant families of fulgoroids are poorly resolved (Dahlgren and Bremer 1985; Olmstead et al. 1992), but following Zwölfer (1978) we can make one reasonably secure broad contrast: Families in the basal subclasses Magnoliidae and Hamamelidae are mostly older than those in the recent, most diverse subclass, the Asteridae. There is a tendency for the basal compared to the advanced fulgoroids to be more strongly associated with the Magnoliidae and Hamamelidae (18% versus 7%; Table 1.3), but the difference is not significant ($P\gg0.10$). Moreover, the basal fulgoroid lineages are recorded slightly more often from Asteridae than are the more advanced lineages.

Perhaps the strongest trend is that the primitive fulgoroid families tend to be associated more with monocots than with dicots, whereas the reverse is true of the more recent families (Table 1.1). The difference in mean frac-

tion of records on dicots (48% versus 72% for primitive and advanced fulgoroids, respectively) is significant ($P<0.05$, two-tailed test), although that for monocot records (48% versus 25%) is not ($P>0.10$).

This pattern, if real, would be difficult to interpret as parallel phylogenesis. The monocots are neither cladistically basal to nor more primitive in features than the dicots; rather they appear to be sister group to, and to have diversified contemporaneously with, the bulk of the dicots (Dahlgren and Bremer 1985; Duvall et al. in press). Moreover, the families representing the major portion of planthopper monocot records, the Poaceae, Cyperaceae and Arecaceae, are relatively derived within the monocots (Dahlgren and Bremer 1985; Duvall et al. in press).

Thus, as far as we can judge from adult records, the distribution of fulgoroid families across host taxa is largely modern and not relictual: old versus young planthopper lineages are associated very weakly at best with correspondingly old versus young plant taxa.

Host Plant Use Patterns in the Fulgoroidea: Subterranean to Above-ground Life

Although there is little evidence for parallel phylogenesis of fulgoroid families with their hosts, there are marked phylogenetic progressions in the location and type of plant tissue fed on by the fulgoroid families (Table 1.5). In five (Tettigometridae, Cixiidae, Kinnaridae, Derbidae, and Achilidae) of the seven primitive families, the nymphs, and sometimes the adults as well, feed in concealment either underground or under bark. Of the two exceptions, Meenoplidae and Delphacidae, the latter, while feeding above ground, are often located near the base of the plant (Cook and Denno Chapter 2). In contrast, among the more advanced families, only the Hypochthonellidae appear to be concealed (subterranean) feeders. These proportions are significantly different ($X^2 = 6.1$, $P<0.01$). Subterranean feeding is probably ancestral for fulgoroids and for Auchenorrhyncha as a whole, as it is also widespread in the Cicadomorpha (Carver et al. 1991). However, Emeljanov (1987) doubts this conclusion and hints at independent acquisition of subterranean feeding in the Tettigometridae and Cixiidae.

A correlated trend among fulgoroids is that, although exposed feeders (including the adults of most primitive families) tap the phloem, concealed feeders feed on only the relatively undifferentiated cells of either fungi (nymphs of Achilidae, Derbidae, and some Cixiidae) or of root parenchyma (most Cixiidae) (Hamilton 1990). Feeding on undifferentiated cells, which also occurs in the moss-feeding Coleorrhyncha, could be primitive for Hemiptera *sensu lato* (Hamilton 1990), particularly because the probable

Table 1.5. Feeding locations[a] on the host plant of the nymphs and adults of the families of Fulgoroidea.

Planthopper Family	Nymphs	Adults
Etttigometridae	Subterranean (roots)	Above ground
Delphacidae	Above ground (some sp. near surface)	Above ground (some sp. near surface)
Cixiidae	Subterranean (roots)	Above ground
Kinnaridae	Subterranean (roots)	Subterranean/ above ground
Meenoplidae	Above ground	Above ground
Derbidae	Under bark and logs (mycophagous)	Above ground
Achilidae	Under bark and logs (mycophagous)	Above ground
Dictyopharidae	Above ground	Above ground
Fulgoridae	Above ground	Above ground
Issidae	Above ground	Above ground
Nogodinidae	Above ground	Above ground
Ricaniidae	Above ground	Above ground
Flatidae	Above ground	Above ground
Hypochthonellidae	Subterranean (roots)	Subterranean (roots)
Tropiduchidae	Above ground	Above ground
Lophopidae	Above ground	Above ground
Eurybrachidae	Above ground	Above ground

[a]Information on feeding locations extracted from: Kershaw and Kirkaldy (1910); Muir (1917); Hacker (1925a, 1925b); Ball (1930); Hoffman (1935); Rahman and Nath (1940); Metcalf and Bruner (1948); Cumber (1966); Ghauri (1966); China and Fennah (1952); O'Brien (1971); Goeden and Ricker (1975, 1986a, 1989); Fennah (1978, 1980); Denno (1980); Reinert (1980); Weaving (1980); Williams and Fennah (1980); Wilson and McPherson (1980); Dlabola (1981); Wheeler and Hoebeke (1982); Willis (1982); Wilson (1982, 1987, 1989); Kramer (1983); Wilson and Wheeler (1984); O'Brien and Wilson (1985); Emeljanov (1987); Gunthart (1987); Wheeler and Wilson (1987, 1988); Chen et al. (1989); Hoch and Howarth (1989a); Tsaur (1989a); Yang et al. (1989); Wilson and Wheeler (1992).

sister order to the Hemiptera (Homoptera + Heteroptera), the Thysanoptera, consists primarily of cell piercers feeding on fungi and higher plants (Mound et al. 1980). Moreover, the earliest fossil Homoptera appear to have had small cibarial chambers, judging from the small overlying frons (Hamilton 1990). Among extant groups, reduction or absence of the filter chamber is typically associated with feeding on nonvascular plant tissues (Emeljanov 1987). In contrast, Emeljanov (1987) postulates a hemipteran ancestor feeding on the phloem of arboreal gymnosperms.

These observations on feeding location suggest an explanation for the possible phylogenetic trend in the degree of association with monocots.

Ancestral fulgoroids probably fed as nymphs on roots or fungi in concealed habitats such as in the soil or under bark or logs. These nymphal habitats were probably moist, like those of most extant primitive fulgoroids including the Delphacidae (Ossiannilsson 1978; Denno and Roderick 1990). This habitat association may have predisposed early fulgoroids to the colonization of monocots, which were probably primitively aquatic (Cronquist 1981).

Finally, the trend toward above-ground feeding on woody dicots, among successively more advanced fulgoroids, may be associated with a progression in ovipositor morphology (Table 1.6). The sword-shaped orthopteroid ovipositor seen in the Delphacidae and Cixiidae, in which a piercing–sawing structure is formed from the fusion of the median gonapophyses of the ninth abdominal segment (Asche 1987; Emeljanov 1987), is probably ancestral for the superfamily. Ancestral fulgoroids may have used this structure to bury their eggs in soil or plant debris, as some Cixiidae do today (Zimmerman 1948; Kramer 1981). Such ovipositors may also have allowed ancestral fulgoroids to oviposit into the above-ground, soft plant tissues of monocots, a behavior exhibited by extant Delphacidae and some Cixiidae (Asche 1987).

Higher planthoppers have a "fulgoroid ovipositor," in which a piercing, excavating, or raking structure is formed from the gonapophyses of the eighth segment; the gonapophyses of the ninth segment may be paired and lobate or reduced (Muir 1923; Stephan 1975; Asche 1987). The families Derbidae, Meenoplidae, Kinnaridae, Achilidae, Dictyopharidae, and Fulgoridae possess a more primitive, "egg deposition" version of this ovipositor; they cover or cement the eggs rather than inserting them. The ovipositor is used to excavate soil or loose material, to cover eggs with wax or exogenous material, or to glue eggs to the substrate (Asche 1987; Table 1.6). The most advanced ovipositor type, found in the Issidae (some), Nogodinidae, Ricaniidae, Flatidae, Hypochthonellidae, Tropiduchidae, and Gengidae is a piercing–excavating ovipositor in which the gonapophyses of the eighth abdominal segment function in excavating cavities for egg deposition in tough woody tissues.

This phylogenetic progression may be related to the greater difficulty of ovipositing into woody plants with tough tissues and to selection for protection from the increased risk of mortality from natural enemies or desiccation for eggs positioned on above-ground woody tissues.

Phylogeny of the Delphacidae

The higher taxa of Delphacidae have recently been the focus of phylogenetic analysis by Asche (1985, 1990). The following discussion and cla-

Table 1.6 Structure of the ovipositor in the families of Fulgoroidea.

Planthopper Family	Ovipositor Structure[a]	Reference
Tettigometridae	Reduced[b]	Muir (1923), Asche (1987), Emeljanov (1987)
Delphacidae	Orthopteroid (piercing–sawing)[c]	Asche (1987), Emeljanov (1987)
Cixiidae	Orthopteroid (piercing–sawing)[c] or reduced[d]	Asche (1987), Emeljanov (1987)
Kinnaridae	Fulgoroid (egg deposition)[e]	O'Brien and Wilson (1985)
Meenoplidae	Fulgoroid (egg deposition)[e] or reduced[f]	O'Brien and Wilson (1985), Tsaur et al. (1986)
Derbidae	Fulgoroid (egg deposition)[e]	Muir (1923)
Achilidae	Fulgoroid (egg deposition)[f]	Muir (1923), Fennah (1950)
Dictyopharidae	Fulgoroid (egg deposition)[e]	Emeljanov (1987), Wilson and McPherson (1981b)
Fulgoridae	Fulgoroid (egg deposition)[e]	Emeljanov (1987)
Issidae	Fulgoroid (piercing–excavating)[g] or reduced[h]	Muir (1923), Stephan (1975)
Nogodinidae	Fulgoroid (piercing–excavating)[g]	Stephan (1975)
Ricaniidae	Fulgoroid (piercing–excavating)[g]	O'Brien and Wilson (1985), Stephan (1975)
Flatidae	Fulgoroid (piercing–excavating)[g] or reduced[h]	Stephan (1975), Muir (1923)
Hypochthonellidae	Fulgoroid (piercing–excavating)[g]	Stephan (1975)
Tropiduchidae	Fulgoroid (piercing–excavating)[g]	Stephan (1975), Asche (1987)
Lophopidae	Reduced[i]	Muir (1923), Stephan (1975)
Eurybrachidae	Reduced[i]	Muir (1923), Stephan (1975)
Gengidae	Fulgoroid (piercing–excavating)[j]	Fennah (1949b)

[a]Ovipositor formed of the gonapophyses of the eighth (**g8**) abdominal segment (= 1st valvula), the lateral gonapophyses of the ninth (**lg9**) abdominal segment (= 3rd valvula), and the median gonapophyses of the ninth (**mg9**) abdominal segment (= 2nd valvula).

[b]**g8** and **lg9** reduced to lobes or absent; assumed to be an apomorphic reduction.

[c]**mg9** fused and serves as a piercing structure.

[d]Gonapophyses reduced, platelike wax producing structure present.

[e]**g8** expanded, often with teeth or lobes, can be variably reduced; used for egg deposition by raking or sweeping substrate and placing eggs therein. **mg9** not fused, generally greatly reduced.

[f]**g8** and **mg9** greatly reduced.

[g]**g8** serve as piercing–excavating structure.

[h]**g8** greatly reduced.

[i]**g8** lost or fused to valvifer on 8th abdominal segment, **lg9** greatly expanded.

[j]Inferred from description and illustration in Fennah (1949b).

dogram are summarized from Asche's (1985, 1990) examination of more than half of the world species using 52 characters (Fig. 1.2). The presence of the moveable hind tibial spur, a sclerotized diaphragm on the male pygofer, pincerlike styles, and reduction of the frontal ocellus support monophyly of the family Delphacidae. Six subfamilies and five tribes are currently recognized (Asche 1985, 1990). In phylogenetic sequence they are as follows: Asiracinae (176 spp.) including the Ugyopini (148 spp.) and Asiracini (28 spp.); Vizcayinae (5 spp.); Kelisiinae (44 spp.); Stenocraninae (64 spp.); Plesiodelphacinae (7 spp.); and Delphacinae (1221 spp.) including the Delphacini (1090 spp.), Tropidocephalini (122 spp.), and Saccharosydnini (9 spp.).

At present, the group Asiracinae is maintained only for convenience as the taxa within this subfamily are united by symplesiomorphies. Two tribes, the Ugyopini and Asiracini, have been recognized. The Ugyopini has been shown to represent a monophyletic taxon based on the presence of a quadrangular metatibial spur bearing four rows of bristles and proximal loca-

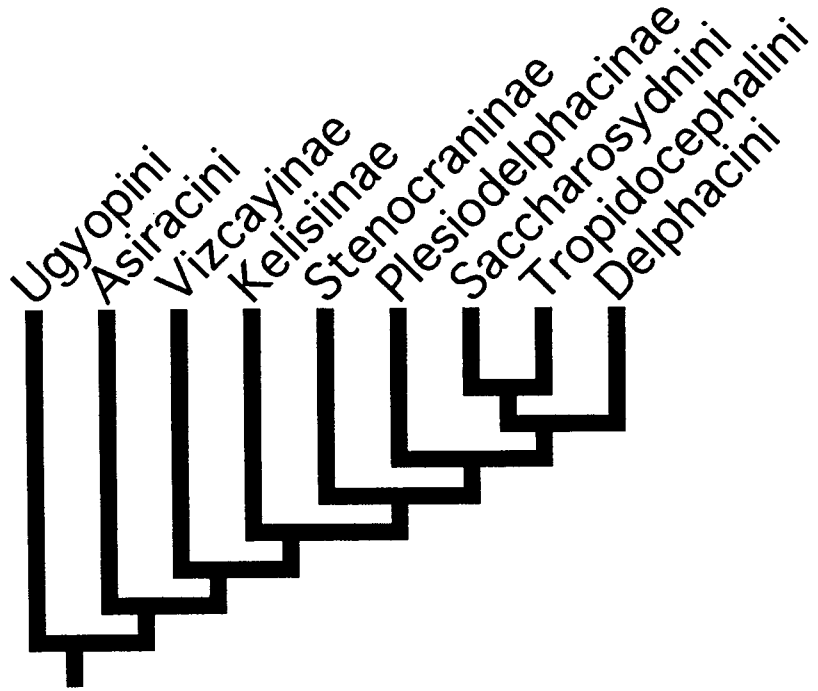

Figure 1.2. Phylogeny for the subfamilies and tribes of the Delphacidae, following Asche (1985, 1990).

tion of the middle spine on the first metatarsomere. The Asiracini appears to be a paraphyletic assemblage (see Asche 1990).

The remaining non-asiracine delphacids form a monophyletic assemblage based on nine synapomorphies, including structures associated with the sexually dimorphic drumming organ, teeth on the metatibial spur, spination on the hind legs, and reduction of the distal portion of the aedeagus. The Vizcayinae have retained some asiracine features and are characterized by four autapomorphies involving shape of the male drumming organ, apex of the vertex, spination of the basal metatarsomere, and form of the antennal segments. The remaining delphacids form a monophyletic group based on five apomorphies including sclerotization of a portion of the aedeagus, presence of a central plate on the male drumming organ, venation of the hind wing, number of nymphal pits on the head, and number and arrangement of antennal sensory fields.

The taxa forming Kelisiinae are united by the presence in males of a subanal appendage and fusion of parts of the aedeagus. The remaining, "higher" delphacids form a monophyletic group based on the presence of a ringlike opening on the egg chorion. Synapomorphies uniting Stenocraninae are the ditrysic female genitalia and a basal process arising from the aedeagus. The rest of the higher delphacids are united by the presence of elongate, dorsally-directed processes in the male drumming organ. Plesiodelphacinae are characterized by carination of the vertex, partial fusion of M and Cu veins on the hind wing, and a ugyopinelike first metatarsomere.

The monophyly of the Delphacinae is supported by several features, the most important of which is the thin-walled central part of the aedeagus. This subfamily is subdivided into three tribes, the Tropidocephalini, Saccharosydnini, and Delphacini. Synapomorphies uniting the Tropidocephalini include asymmetry of the base of the aedeagus. The Saccharosydnini are characterized by an elongate aedeagus contained within a large phragma bag. These two tribes are considered sister taxa united by reduction of the anal tube and a close connection between it and the aedeagus. Monophyly of the Delphacini is supported by the presence of an aedeagal suspensorium, loss of symbiont x, and the presence of symbionts H and f. Another possible delphacine synapomorphy, although examined in relatively few taxa, is an oviduct gland in the female, lacking only in three genera.

Host Plant Relationships within the Delphacidae

Most delphacid species (65%) feed and develop on monocots, with 32% of records from dicots and only 3% from ferns (Tables 1.1 and 1.7). Of the monocot records (Tables 1.2 and 1.8), most are on the Poaceae (69%), Cyperaceae (18%), and Juncaceae (5%).

Table 1.7. Percentage of planthopper species records on the Pteridophyta, Gymnospermae, Monocotyledoneae, and Dicotyledoneae for the subfamilies and tribes of Delphacidae. Polyphagous species were scored on all of their host plant taxa. Summarized from host plant records in Appendix 2.

Delphacid Taxon	Pter. (%)	Gym. (%)	Monocot. (%)	Dicot. (%)	No. Records
Asiracinae	25	0	25	50	12
Ugyopini	25	0	12	63	8
Asiracini	25	0	50	25	4
Kelisiinae	0	0	100	0	19
Stenocraninae	0	0	100	0	13
Plesiodelphacinae	0	0	100	0	2
Delphacinae[a]	3	0	63	34	437
Tropidocephalini	0	0	100	0	42
Saccharosyndnini	0	0	100	0	6
Delphacini	3	0	58	39	389
Delphacinae[b]	1	0	93	6	286
Delphacini[b]	7	0	5	88	151
Delphacini[c]	1	0	92	7	238

[a]All records.
[b]Oceanic Islands (Hawaiian Archipelago, Polynesia, S. Pacific) records (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948) only.
[c]Nonisland records only.

A preponderance of the dicot records are from tropical islands in the Hawaiian archipelago and Polynesia (e.g., Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948), mostly in the Delphacinae. Insular host plant records include woody species in all subclasses of dicots (Cronquist 1981). If these island records are removed, the proportion of monocot hosts for the Delphacidae rises to approximately 92%, dicots fall to 7%, and ferns constitute about 1% (Table 1.1). Denno and Roderick (1990) suggested that the prevalence of dicot feeders on the Hawaiian archipelago might be unique to islands rather than typical of the tropics as a whole. Comparison of Zimmerman's (1948) records from the Hawaiian Islands with those of Fennah from other tropical islands indicates that tropical islands do have an unusually high proportion of dicot-feeding species (87%), whereas monocots dominate the limited host records of delphacids from the Neotropical mainland (Muir 1926; Table 1.1). Therefore, our discussion on host use patterns takes into account this evolutionary difference of mainland clades from those on islands, which are likely to be much more recent. We discuss possible causes for the radiation of island delphacids on dicots in a later section.

Table 1.8. Percentage of planthopper species records on the families of Monocotyledoneae for the subfamilies and tribes of Delphacidae. Only monocot-feeding species considered. Polyphagous species were scored on all of their host plant taxa. Summarized from host plant records in Appendix 2.

	Family of Monocotyledoneae												
Delphacid Taxon	AC (%)	AR (%)	CM (%)	CY (%)	HE (%)	JU (%)	LI (%)	NY (%)	PA (%)	PO (%)	PN (%)	TY (%)	Total Records
Asiracinae		33		67									3
Ugyopini		100											1
Asiracini				100									2
Kelisiinae				83		17							23
Stenocraninae				38						62			13
Plesiodelphacinae					100								2
Delphacinae	1	2[a]	<1	11		4	1[a]	<1	2[a]	76	<1	4	293
Tropidocephalini										100			42
Saccharosyndnini										100			6
Delphacini	1	2[a]	<1	13		5	1[a]	<1	3[a]	71	<1	2	245

Note: AC (Araceae); AR (Arecaceae); CM (Commelinaceae); CY (Cyperaceae); HE (Heliconiaceae); JU (Juncaceae); LI (Liliaceae); NY (Nymphaceae); PA (Pandanaceae); PO (Poaceae); PN (Pontederiaceae); TY (Typhaceae).

[a]Most records from Oceanic Islands (Hawaiian Archipelago, Polynesia, S. Pacific) (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948).

Host use patterns of the major delphacid clades can be summarized, in phylogenetic sequence, as follows (see Fig. 1.2 and Tables 1.7 and 1.8). The small tribe Ugyopini, the most primitive delphacids, appear to feed mostly on woody dicots (63% of records) and ferns (25%); of the monocots, only Arecaceae have been recorded as hosts (Table 1.8). However, because many of the records for the Ugyopini are from islands (Appendix 2), the predominance of dicot records may reflect insular radiation, possibly obscuring the ancestral host associations in this tribe.

The four records for the small tribe Asiracini include dicots, ferns, and monocots (Cyperaceae). Host plants of the Vizcayinae are unknown. The Kelisiinae feed only on monocots and appear restricted to the Cyperaceae (83% of records) and Juncaceae (17%), and the Stenocraninae occur only on the Poaceae (62%) and Cyperaceae (38%). For the Plesiodelphacinae there are so far only two records, both from the monocot genus *Heliconia* (Heliconiaceae; Muir 1926; Fennah 1959a; Asche, personal communication).

Within the Delphacinae, the Tropidocephalini and Saccharosydnini feed exclusively on Poaceae (Table 1.8). The Delphacini also show very strong affiliation with the Poaceae and Cyperaceae (71% and 13% of monocot records, respectively). Nonetheless, it is this tribe which has radiated on all subclasses of dicots on the Hawaiian archipelago and Polynesia (Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948; Table 1.3), probably within the last 6 million years based on the age of the large Hawaiian Islands (Howarth 1990). On the temperate mainland, dicot feeding in the Delphacini is most prominent in *Pissonotus* and *Stobaera*, both occurring mostly on the Asteraceae.

Host Plant Use Patterns in the Delphacidae: Parallel Phylogenesis?

Host associations in delphacids show marked evolutionary conservatism. Except on islands, most genera and some higher taxa are restricted to a single or a few related plant families, and delphacids, as a whole, primarily attack just three monocot families (Poaceae, Cyperaceae, and Juncaceae). To what extent might this fidelity have led to parallel diversification, as evidenced by concordant plant and delphacid relationships? We examine this question at four plant taxonomic levels (Tracheophyta [vascular plants], Angiospermae, Monocotyledoneae, and Poaceae) over which such concordance might be expected.

Because the Delphacidae may date to at least the Lower Cretaceous, they could have begun diversifying on nonflowering plants and evolved subse-

quently with the angiosperms, a possibility explored previously for the fulgoroids as a whole. The only observations that might represent such ancient relictual associations are the occurrence of two species of Ugyopini (one Polynesian) and one of Asiracini, the two oldest clades, on ferns (Table 1.7; Appendix 2). In more advanced delphacids, fern feeding is known only for nine species, mostly Hawaiian, in the huge tribe Delphacini, two species of which are also recorded on *Equisetum*. No other nonisland delphacids feed on any nonflowering plant or on the relatively primitive dicot subclasses Magnoliidae or Hamamelidae. Even within the Ugyopini and Asiracini, it is not known if the fern feeders are cladistically basal. Thus, present-day host use by the Delphacidae shows little sign of any shared history with the major lineages of the Tracheophyta or of the Angiospermae.

Most delphacids feed on, and are restricted to habitats dominated by, herbaceous monocots (Table 1.8). Thus, it might be more plausible that delphacids diversified with the monocot families rather than with seed or vascular plants as a whole. A recent DNA-sequence-based estimate of relationships among the major monocot-host families for each delphacid clade is shown in Figure 1.3 (Duvall et al. in press); this hypothesis largely agrees

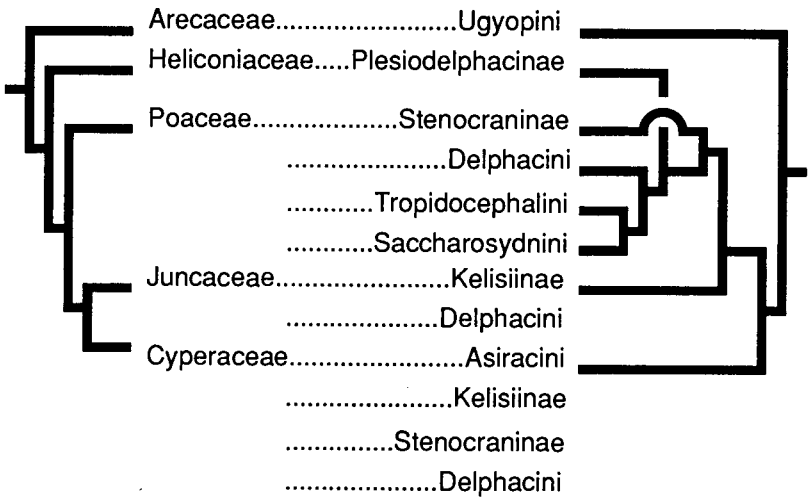

Figure 1.3. Phylogenetic relationships among monocot families serving as major hosts to the Delphacidae, following Duvall et al. (in press). Across from and below each plant family are given the delphacid taxa for which that family constitutes 5% or more of host records. The delphacid phylogeny (right-hand side of figure) is identical to that in Figure 1.2. The host plant associations and phylogenies in this figure form the basis for the cladogram concordance analysis in the text.

with a prior assessment based on plant morphology (Dahlgren and Bremer 1985). A strong point of possible concordance with delphacid phylogeny, reproduced on the right-hand side of Figure 1.3, is the occurrence of an island ugyopine species (*Ugyops osborni*) on the Arecaceae (Caldwell and Martorell 1950). However, several points of cladogram disagreement are evident as well. For example, the plant cladogram would predict that the Plesiodelphacinae, restricted to Heliconiaceae, should branch off before the Asiracini, in which both monocot records are from Cyperaceae, rather than the reverse as is evident from delphacid phylogeny (Fig. 1.2).

A widely used measure of overall cladogram agreement is the "component analysis" of Nelson and Platnick (1981), which counts the number of unseen speciation and extinction events required to account for present-day host associations if the insects had diversified strictly in tandem with the hosts. We used the COMPONENT package of Page (1990; FIT command under assumption 1) to enumerate these "items of error." We excluded the small scattering of records for Delphacini on several other monocot families which are mostly from islands and seem clearly secondary (see Table 1.8).

The fit of the monocot phylogeny to the delphacid phylogeny (Fig. 1.3) is closer than expected for host phylogenies generated under several random models (Page 1990; "items of error" = 26, $P<0.05$). Thus, although there is some suggestion that delphacids have evolved in association with monocots, this inference is weak. It is questionable whether the single ugyopine record on palms represents a retained ancestral association. This species, like other Pacific island endemics, may have undergone a relatively recent host shift; moreover, it appears to feed on other trees in addition to palms and may be polyphagous (Caldwell and Martorell 1950). Cladogram congruence is lacking if the ugyopine record is deleted ("items of error" = 26, $P = 0.20$). Similarly, if attention is restricted to associations with Poaceae, Cyperaceae, and Juncaceae, the hosts of nearly all mainland delphacids, all three possible host phylogenies fit the delphacid phylogeny equally well.

Another potential phylogenetic trend in association of delphacids with monocot families is a gradual shift from concentration on the Cyperaceae, seen in the relatively basal Asiracini and Kelisiinae, through association with both Cyperaceae and grasses, as in the Stenocraninae and Delphacinae, to strict association with Poaceae, seen in the Tropidocephalini and Saccharosydnini (Table 1.8). This progression is unlikely to reflect parallel phylogenesis as the Cyperaceae cannot be regarded as basal to the Poaceae. However, relationships of these delphacid taxa with different subfamilies of grasses, leaving aside other host associations, seem a more likely possibility for parallel delphacid/host phylogenesis. Of the delphacine tribes, the cla-

distically basal Delphacini are associated most often with the subfamily Pooideae (78% of records). The Tropidocephalini are found mostly on bambusoid grasses (78% of records), and their sister taxon, the Saccharosydnini, occur primarily on the Panicoideae (64%); the remainder of species are found on the Bambusoideae. The branching order of grass subfamilies implied by that of their delphacine herbivores conflicts with the view best supported by recent molecular studies, namely, that bambusoids are basal with respect to pooids and panicoids (Doebley et al. 1990; Duvall et al. in press; Fig. 1.4). However, parallel phylogenesis cannot be ruled out, as grass subfamily relationships are not conclusively settled (Doebley et al. 1990; Kellogg and Campbell 1987).

An alternative scenario of evolution of the Delphacinae with the grasses is suggested by Asche's (1985) view that the Delphacini are morphologically advanced in comparison to their sister tribes. The present-day association of the morphologically primitive Tropidocephalini with (possibly primitive) bambusoid grasses might reflect retention of primitive feeding habits. The morphologically advanced Delphacini, in contrast, might have subsequently shifted to the (possibly more derived) pooid grasses.

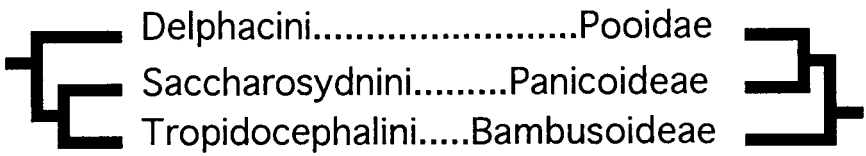

Figure 1.4. Comparison of branching relationships among delphacid tribes with relationships among the grass subfamilies used predominantly by each. Tree for grasses is the one best supported by the analyses of Doebley et al. (1990).

Host Plant Use Patterns in the Delphacidae: Plant Taxonomy Versus Habitat

While delphacid host use patterns seem little attributable to parallel diversification, they do exhibit an evolutionary conservatism comparable to that found in other phytophagous insects. Mapping of host associations onto published species-level cladograms for a variety of phytophages (Mitter and Farrell 1991) suggested that, on average, a major host shift (e.g., to a new plant family) accompanies about 20% of herbivore speciation events. Species-level cladograms are not available for any delphacids, but we can make a minimum estimate of host shift frequency by examining the habits of congeners. The minimum number of speciation events in the history of a

genus is one less than the number of species, and the minimum number of host plant-family shifts is one less than the number of different host family associations among those species. Polyphagous species, which complicate this calculation somewhat, were taken as evidence for a host family shift only if they were recorded from at least one family that was not fed on by congeners.

Considering just mainland delphacids with known hosts (Appendix 2) and summing over genera containing at least two species (so that a host shift is in principle detectable), we find a minimum of 41 host family shifts out of 199 speciation events, a frequency of 0.21 per speciation event. Thus, delphacid species appear to retain the host-taxon association of their immediate ancestor, to a degree (~80%) approximately typical for phytophagous insects. The actual frequency of shifts in delphacids may be larger than this minimum estimate if the same host has been independently acquired by two or more congeneric species. On the other hand, the plant-family criterion for host shift may underrepresent the conservatism of delphacid habits, because the records are concentrated on just a few closely related families.

Conservatism of host plant-taxon affiliation, in delphacids as in other phytophages, is probably traceable in large part to host chemistry, though exactly how is still debated (Jaenike 1990). Host chemistry may pose a "constraint" on diet evolution, in the sense that genotypes required for a shift to a chemically novel host probably occur less frequently than those permitting a shift to a chemically similar host. Direct evidence for such genetic limitation, however, has rarely been sought (Futuyma and McCafferty 1990).

Exceptions to the general pattern of host-taxon conservatism in delphacids and other phytophages suggest that under some circumstances, genetic constraints imposed by host plant chemistry are somehow less stringent or that other kinds of constraint such as adaptation to extreme environments become more important. However, such alternative phylogenetic patterns are difficult to define and quantify. One factor suggested by some host use patterns is host proximity, hence probable frequency of encounter by host-seeking adults (Mitter and Farrell 1991). The relative importance of host proximity may be reinforced by the abundance of the alternative host and by specialization to a physically extreme environment. A possible example of lability mediated by habitat specialization and host proximity is the genus *Megamelus*, which feeds on a variety of aquatic hosts in the taxonomically distant Pontederiaceae and Nymphaeaceae, in addition to Cyperaceae, Juncaceae, and Poaceae. Similar habitat constraint is suggested by transfers among distantly related hosts in some other fulgoroid groups. For example, species in *Oecleus* (Cixiidae) and *Scolops* (Dictyopharidae) ex-

ploit xerophytic plants in distantly related families such as Chenopodiaceae, Asteraceae, and others which commonly co-occur in desert and prairie habitats (Ball 1930; Kramer 1977).

In delphacids and other fulgoroids, it will be difficult to separate the influence of chemical or taxonomic relatedness from that of ecological proximity because the main host families (Poaceae, Cyperaceae, and Juncaceae) are closely related, chemically similar, and occurr in similar, moist habitats (Cronquist 1981). Much further work will also be needed to assess the relative importance of other possible influences on host shift patterns of planthoppers such as differences in plant abundance (Nielson and Don 1974; Wasserman and Futuyma 1981; Futuyma 1983; Thompson 1988a), suitability as a mate location site (Claridge 1985a; Jaenike 1990), and resident natural enemies (Price et al. 1980).

The most strikingly consistent departure from host-taxon conservatism is found on oceanic islands. Exaggerated niche divergence in island versus continental radiations has been widely accepted but not often quantitatively demonstrated (Schluter 1988). The eight delphacid genera endemic to Pacific islands (primarily the Hawaiian chain) show significantly greater rates of host plant family shift than the remaining, mostly mainland genera, both in overall rate (53 shifts/134 speciation events versus 41/199; $X^2 = 14.1, P<0.01$) and in generic mean (0.43 versus 0.20, Mann–Whitney U-statistic = 291.5, $P<0.01$). This is due primarily to the much greater fraction of mainland genera which are restricted to a single host family (31/52 versus 2/8). The oceanic Pacific species also include a significantly larger proportion of polyphages (23% versus 7% for mainland species; $X^2 = 10.0$, $P<0.01$) and are recorded from a total of 62 families, mostly dicots, whereas the remaining genera (mostly mainland) use only 20 families, nearly all monocots.

Although it is not certain that the island genera are all phylogenetically independent, delphacids clearly exhibit exaggerated divergence in host use on Pacific islands, analogous to such examples as the greater diversity in beak dimensions, correlated with seed selection, among island versus continental species of granivorous finches (Schluter 1988). Both genetic and ecological causes may underlie such island radiations (reviewed in Schluter 1988). The typical conservatism of ecological traits such as host plant use might reflect the resistance to change of underlying coadapted gene complexes, in conjunction with the stabilizing effect of gene flow among populations (Mayr 1963). The "genetic revolutions" resulting from repeated "founder events," coupled with relative isolation from gene flow, might then greatly facilitate divergence in island populations (Carson and Templeton 1984).

Ecological hypotheses for island radiation have emphasized both re-

source availability and "release" from enemies and/or competitors (Schluter 1988). Departure of island colonists from the ancestral monocot niche may be initially mandated by the unique island environment. Thus, limited availability on Pacific islands of habitats dominated by herbaceous monocots may explain in part the predominant shift of endemic delphacids to woody, often arboreal dicots. Subsequent repeated shifts among host families might similarly arise by isolation of founder populations in floristically different local habitats on the same or nearby islands. It is also possible that island dicots are less chemically distinct than their mainland relatives, diminishing the barriers to host transfer; several examples of such loss in defense are known in island plant species (Carlquist 1970).

Absence of continental competitors has been a favored explanation for some island radiations (Schluter 1988), but the degree to which phytophagous insect niches are molded by interspecific competition is very uncertain (Lawton and Strong 1981; Strong et al. 1984). Natural enemies, including both predators and parasitoids, have been accorded a larger role in the population dynamics and community structure of phytophagous insects (Price et al. 1980; Bernays and Graham 1988). It is possible that delphacid host use radiation on islands is facilitated by a paucity of native invertebrate predators; for example, the Hawaiian Islands completely lack native species of ants (Howarth 1990). Closer inquiry into insular radiations may help illuminate the causes of host specificity and conservatism in mainland delphacids.

Host Range in the Delphacidae and Other Fulgoroids

The Delphacidae show a strong tendency toward monophagy. Of species with recorded habits, 74% are reported from a single host plant genus; only 14% are oligophagous and 12% polyphagous (Table 1.9). Even though the delphacids on tropical islands have radically different host plant affinities from mainland species (dicots versus monocots) and a higher percentage of polyphages, they show the same prevalence of monophagy (73% of island species versus 74% of mainland species; Table 1.4).

Narrow host range is characteristic of the species in all delphacid subfamilies and tribes (Table 1.9), from primitive (e.g., Asiracinae) to advanced (e.g., Delphacinae), and is probably the ancestral condition. Examples include the asiracine genus *Pentagramma*, all species of which are restricted to *Scirpus* (Cyperaceae), the kelisiine *Anakelisia*, reported only on *Carex*, and the plesiodelphacine genus *Burnilia*, known only from *Heliconia*. In the Delphacini, *Conomelus* feeds only on *Juncus*, *Nilaparvata* feeds on *Oryza* and the closely related *Leersia*, and *Tarophagus* is restricted to

Table 1.9. Diet breadth of planthopper species in the subfamilies and tribes of Delphacidae. The percentage of (M) monophagous (feeding primarily on one plant species or plant species in the same genus), (O) oligophagous (feeding on several genera in the same plant family), and (P) polyphagous planthopper species (feeding on two or more plant families), and the number of species records for each family is shown. Summarized from host plant records in Appendix 2.

Delphacid Taxon	M (%)	O (%)	P (%)	No. Records
Asiracinae	83	0	17	12
Ugyopini	89	0	11	9
Asiracini	67	0	33	3
Kelisiinae	68	11	21	19
Stenocraninae	77	23	0	13
Plesiodelphacinae	100	0	0	2
Delphacinae	74	14	12	426
Tropidocephalini	83	17	0	42
Saccharosydnini	83	17	0	6
Delphacini[a]	72	14	14	378
Delphacini[b]	73	4	23	158
Delphacini[c]	72	21	7	220

[a]All records.
[b]Oceanic island (Hawaiian Archepelago, Polynesia, S. Pacific) records (from Fennah 1957, 1958, 1959a, 1962a, 1964, 1976; Zimmerman 1948) only.
[c]Nonisland records only.

Colocasia. Detailed ecological studies on several taxa further corroborate a monophagous feeding habit for most delphacids. For example, most species of *Javesella* (*J. pellucida* excepted, Mochida and Kisimoto 1971; Ossiannilsson 1978; de Vrijer 1981), *Muellerianella* (Drosopoulos 1977; Asche 1982b; Booij 1982a), *Nilaparvata* (Claridge et al. 1988; Yang 1989), *Prokelisia* (Denno et al. 1987; S. Wilson unpublished data), and *Ribautodelphax* (den Bieman 1987a, 1987b) have been conclusively shown to be either monophagous or to feed on related plant genera in the same family.

All cases of "polyphagy" in the Kelisiinae (*Anakelisia* and *Kelisia*) and some in the Delphacini consist of species feeding on the closely related Cyperaceae and Juncaceae. Similarly, all instances of "polyphagy" in the Stenocraninae (*Stenocranus* spp.) and some in the Delphacini (e.g., *Javesella pellucida*) represent feeding on Cyperaceae and Poaceae. Thus, our somewhat arbitrary criterion for polyphagy, feeding on two or more plant families, results in the underrepresentation of the degree of feeding specialization in Delphacidae.

Monophagy is also the predominant condition in most other families of Fulgoroidea, including basal families such as the Tettigometridae, Kin-

naridae, and nymphs of the Cixiidae (Table 1.4). The percentages of adult monophagy in Table 1.4 probably underestimate the degree of host specificity because in planthopper families for which early stages are known (e.g., Cixiidae, Meenoplidae, Kinnaridae, Dictyopharidae, Fulgoridae, and Flatidae), nymphs develop on a narrower range of hosts than that on which adults feed (Table 1.4). Monophagy may well represent the ancestral condition for the superfamily, with the exceptional degree of polyphagy seen in a few families (e.g., Ricaniidae, Flatidae, Lophopidae, and adult meenoplids and achilids) representing a derived condition.

Summary

1. The family Delphacidae belongs to a monophyletic assemblage of 19 families constituting the Fulgoroidea. A provisional phylogeny shows delphacids to be among the oldest fulgoroid lineages. The sparse fossil record, interpreted according to this phylogeny, suggests that a set of basal lineages including the Tettigometridae, Delphacidae, Cixiidae, Derbidae, Meenoplidae/Kinnaridae, and Achilidae were probably extant by the Lower Cretaceous. The remaining, more advanced families form a monophyletic group and are first represented by fossils from the Upper Cretaceous and Tertiary.
2. At least some host plant associations are known for nearly all fulgoroid families, but by far the most complete and accurate information available is for the Delphacidae. Fulgoroid associations span all major groups of vascular plants, including all the subclasses of angiosperms. Evidence was sought for parallel diversification of the Fulgoroidea with their host plant taxa by contrasting basal and advanced families for the fraction of adult records on angiosperms versus nonangiosperms, and on primitive versus advanced angiosperms. No significant trends were found, though the basal families are associated somewhat more strongly with both nonangiosperms and basal angiosperms. There was a slight tendency, not interpretable as parallel phylogenesis, for primitive families to feed more on monocots, whereas advanced families favor dicots.
3. In contrast to the lack of phylogenetic trends in host-taxon association, at least for adult fulgoroids, there were clear phylogenetic patterns in feeding location. There was a significant tendency for the primitive families to feed underground or under bark, on roots or fungi, which may have predisposed fulgoroids to preference for moist habitats, and hence to association with monocots. The trend toward exposed feeding

on woody dicots among more advanced fulgoroids appears correlated with evolution of an ovipositor capable of excavating cavities for egg deposition in woody tissues.

4. The Delphacidae are recorded from a great range of vascular plant taxa, but comparisons of host phylogeny with a morphology-based phylogeny for delphacid tribes/subfamilies yields no evidence for parallel phylogenesis with either vascular plants or angiosperms as a whole. Delphacids feed primarily on monocots, and the relationships among just their monocot host families show significant concordance to the ordering of those hosts on the delphacid cladogram. However, this pattern results primarily from the occurrence on the Arecaceae of a single island-endemic and possibly polyphagous species in the most basal tribe (Ugyopini); it is, thus, weak evidence for parallel diversification. Delphacids are concentrated on two closely related and phytochemically similar families, the Cyperaceae and Poaceae. There is a tendency for primitive lineages (Asiracini and Kelisiinae) to feed on Cyperaceae, whereas two more advanced subfamilies (Stenocraninae and Delphacinae) feed mostly on Poaceae. Each of the three tribes of Delphacinae is associated most strongly with a different grass subfamily. Branching relationships among the three tribes of Delphacinae conflict with the view of grass subfamily phylogeny best supported by recent molecular studies; however, grass relationships are still debated, and parallel phylogenesis of delphacids with grasses cannot be ruled out.
5. Although delphacids show little sign of parallel diversification with their host plants, their host-taxon associations appear about as evolutionarily conservative as those of other phytophagous insects; up to 80% of species feed within the same host family as their nearest relatives. Departures from this pattern suggest that host shifts are sometimes more constrained (or facilitated) by habitat fidelity than by intrinsic host similarity as reflected in plant taxonomy.
6. The large delphacid fauna endemic to Pacific islands, mostly Hawaiian, shows significantly elevated rates of shifting to new host families and frequency of polyphagous species, and in contrast to mainland groups occurs mainly on dicots. One of several plausible explanations for this island radiation is reduced pressure from predators.
7. Delphacids are strongly host specific, with 74% of species restricted to a single host plant genus and often to a single species, and only 12% recorded from more than one plant family. The predominance of monophagy holds for both monocot and dicot feeders, and both primitive and advanced tribes/subfamilies, suggesting that host specialization represents the ancestral state in the Delphacidae. Monophagy is

prevalent in the other primitive planthopper families and may be ancestral for the Fulgoroidea. There is a slight tendency toward increased polyphagy in the advanced fulgoroid families (e.g., Ricaniidae, Flatidae, and Lophopidae).

8. Further understanding of planthopper/host plant relationships will require, above all, an increased knowledge of planthopper phylogeny and of the biology of immature stages and tropical species.

ACKNOWLEDGMENTS

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Appendix 1. Recorded host plants* of the Fulgoroidea excluding the Delphacidae. Host plant records are for adult planthoppers unless marked (N) indicating that nymphs were observed, sampled or collected.

Planthopper taxon	Host Plant		Reference
	Genus and Species	Family	
TETTIGOMETRIDAE			
Egropinae			
Egropa breviceps (Stål)	*Annona squamosa*	Annonaceae	Baker (1915)
Hildinae			
Hilda patruelis Stål	Polyphygous		Weaving (1980)
Hilda undata (Walker)	*Anacardium occidentale*	Anacardiaceae	Akingbohungbe (1982)
	Arachis hypogaea	Fabaceae	
	Helianthus	Asteraceae	
Megahilda rhodesiana Fennah	*Aloe excelsa*	Liliaceae	Fennah (1959b)
Tettigometrinae			
Phalix titan Fennah	*Acacia decurrens* var. *mollis*	Fabaceae	Ghauri (1964)
Tettigometra hexaspina Kolenati	*Papaver somniferum*	Papaveraceae	Weaving (1980)
Tettigometra impressopunctata Duf.	Polyphagous		Gunthart (1987)
Tettigometra leucophaea (Preysster)	*Secale cereale*	Poaceae	Wilson and O'Brien (1987)
CIXIIDAE			
Bothriocerinae			
Achaemenes synavei Williams	*Dodonaea viscosa*	Sapindaceae	Williams (1975)
Bothriocera cognita Caldwell	*Spartina*	Poaceae	Kramer (1983)
	Juncus	Juncaceae	
	Cephalanthus occidentalis	Rubiaceae	
	Quercus	Fagaceae	
Bothriocera drakei Metcalf	Pteridophyta	?	Kramer (1983)
Bothriocera eborea Fennah	*Coccoloba uvifera*	Polygonaceae	Fennah (1949a)

Bothriocera maculata Caldwell	*Spartina patens* (N)	Poaceae	Denno (unpublished data)
	Spartina cynosuroides	Poaceae	Kramer (1983)
	Spartina patens	Poaceae	
	Juncus roemerianus	Juncaceae	
	Eupatorium capillifolium	Asteraceae	
Bothriocera signoreti Stål	*Cyperus papyrus*	Cyperaceae	Myers (1929)
	Commelina nudiflora	Commelinaceae	
	Two spp. of ferns		
	Polygonum acre	Polygonaceae	
Bothriocera transversa Caldwell	*Chrysobalanus icaco*	Chrysobalanaceae	Kramer (1983)
	Cestrum nocturnum	Solanaceae	
	Cocos nucifera	Arecaceae	
	Borrichia arborescens	Asteraceae	
Bothriocera venosa Fowler	*Coffea*	Rubiaceae	Dozier (1931)
Bothriocera sp.	*Veitchia merrillii*	Pinaceae	Howard and Mead (1980)
Brixia belouvensis bipunctata Synave	*Quivisia mauritiana*	Meliaceae	Williams (1975)
Brixia discolor Williams	*Murraya paniculata*	Rutaceae	Williams (1975)
Brixia fulgida Van Duzee	Pimento bush	?	Van Duzee (1907)
Brixia mauritii Synave	*Coffea macrocarpa*	Rubiaceae	Williams (1975)
	Myonima multiflora	Rubiaceae	
Brixia vaughani Williams	*Coffea vaughani*	Rubiaceae	Williams (1975)
Brixia venulosa Williams	*Embelia*	Myrsinaceae	Williams (1975)
Nymphocixia caribbea Fennah	*Cocos nucifera*	Arecaceae	Howard et al. (1981)
Nymphocixia unipunctata Van Duzee	*Corypha elata*	Arecaceae	Howard and Mead (1980)
	Rhizophora mangle	Rhizophoraceae	Kramer (1983)
	Laguncularia racemosa	Combretaceae	
	Avicennia nitida	Avicenniaceae	
Cixiinae			
Euryphlepsia cocos Muir	*Cocos nucifera*	Arecaceae	Muir (1924a)
Euryphlepsia pallescens (Metcalf)	*Hibiscus tiliaceus*	Malvaceae	Fennah (1956)
Hemitropis limonii Emeljanov	*Limonium suffruticosum*	Plumbaginaceae	Emeljanov (1964)
	Limonium gmelini	Plumbaginaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Hemitropis seticulosa (Lethierry)	*Tamarix*	Tamaricaceae	Linnavuori (1964)
Hemitropis tamaricus (Puton & Leth.)	*Tamarix*	Tamaricaceae	Dlabola (1981)
Hemitropis tatianae Emeljanov	*Tamarix*	Tamaricaceae	Emeljanov (1964)
Hemitropis sp.	*Tamarix gallica*	Tamaricaceae	Hopkins and Carruth (1954)
Kirbyana pagana Melichar	*Saccharum officinarum*	Poaceae	Schumacher (1920)
Kuvera ligustri Matsumura	*Ligustrum*	Oleaceae	Lee and Kwon (1977)
Microledrida arida Caldwell	*Cordia nitida*	Ehretiaceae	Caldwell and Martorell (1950)
Microledrida fuscata Van Duzee	*Heteromeles*	Rosaceae	Kramer (1983)
Cixiini			
Cixius adornatus iranicus Dlabola	*Pterocarya*	Juglandaceae	Dlabola (1979b)
Cixius alpestris Wagner	*Pinus montana*	Pinaceae	Gunthart (1987)
Cixius angustatus Caldwell	*Prunus*	Rosaceae	Kramer (1981)
Cixius balli Kramer	*Pinus*	Pinaceae	Kramer (1981)
Cixius basalis Van Duzee	*Abies balsamea*	Pinaceae	Beirne (1950)
	Picea mariana	Pinaceae	
Cixius cinctifrons Fitch	*Carya*	Juglandaceae	Packard (1890)
Cixius coloepium Fitch	*Gaylussacia*	Ericaceae	Van Duzee (1905)
Cixius cultus Ball	Polyphagous	Dicots	Kramer (1981)
Cixius cunicularis (L.)	Polyphagous on woody plants		Gunthart (1987)
Cixius dubius Wagner	*Prunus spinosa*	Rosaceae	Gunthart (1990)
	Quercus pubescens	Fagaceae	
	Trees and bushes		
Cixius ephratus Ball	*Salsola kali*	Chenopodiaceae	Kramer (1981)
Cixius haupti Dlabola	*Pinus*	Pinaceae	Gunthart (1984)
Cixius misellus Van Duzee	*Abies balsamea*	Pinaceae	Beirne (1950)
	Picea glauca	Pinaceae	

Cixius nervosus (L.)	Polyphagous on woody plants		Gunthart (1987)
Cixius pallipes Fieber	*Tamarix*	Tamaricaceae	Gunthart (1990)
Cixius pini Fitch	*Gaylussacia*	Ericaceae	Procter (1938)
	Pinus, Picea, Abies	Pinaceae	Kramer (1981)
Cixius pinicola Dufour	*Pinus*	Pinaceae	Synave (1951)
Cixius praecox Van Duzee	*Salix, Populus*	Salicaceae	Kramer (1981)
Cixius setinervis Stål	*Cliffortia scrabilifera*	Rosaceae	Van Stalle (1988)
Cixius simplex (Herrich-Schaffer)	Polyphagous on woody plants		Gunthart (1987)
Cixius sp.	*Atriplex canescens*	Chenopodiaceae	Stroud (1950)
Tachycixius pilosus (Olivier)	*Prunus spinosa*	Rosaceae	Gunthart (1987)
	Grass (N)	Poaceae	Le Quesne (1960)
	Picea	Pinaceae	Gunthart (1990)
	Juniperus	Cupressaceae	
	Quercus pubescens	Fagaceae	
	Crataegus monogyna	Rosaceae	
	Trees and bushes		
Oecleini			
Myndus beameri Ball	*Agave americana*	Agavaceae	Kramer (1979)
	Yucca	Agavaceae	
Myndus catalinus Ball	*Yucca*	Agavaceae	Kramer (1979)
Myndus crudus Van Duzee	*Phoenix canariensis*	Arecaceae	Meyerdirk and Hart (1982)
	Cocos nucifera	Arecaceae	Tsai et al. (1976)
	Grasses (N)	Poaceae	Tsai and Kirsch (1978)
	Stenotaphrum secundatum (N)	Poaceae	Reinert (1980)
	Paspalum notatum (N)	Poaceae	
	Cynodon dactylon (N)	Poaceae	
Myndus dibaphus Fennah	*Pandanus tectorius*	Pandanaceae	Fennah (1956)
Myndus enotatus Van Duzee	Grass	Poaceae	Osborn (1926)
	Juncus	Juncaceae	Kramer (1979)
	"Marsh grasses"	Poaceae	
Myndus gabrielensis (Flock)	*Yucca whipplei*	Agavaceae	Kramer (1979)
	Sedges	Cyperaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant		Reference
	Genus and Species	Family	
Myndus glyphis Kramer	*Populus*	Salicaceae	Kramer (1979)
Myndus irreptor Fennah	*Pandanus*	Pandanaceae	Fennah (1956)
Myndus lophion Kramer	*Pinus*	Pinaceae	Kramer (1979)
Myndus mojavensis Ball	*Yucca brevifolia*	Agavaceae	Kramer (1979)
Myndus musivus Germar	*Salix*	Salicaceae	Villiers (1977)
Myndus nigrifrons Ball	*Nolina*	Agavaceae	Ball (1937)
Myndus nolinus Ball	*Nolina microcarpa*	Agavaceae	Kramer (1979)
	Triodia pulchella	Poaceae	
Myndus occidentalis Van Duzee	*Juncus*	Juncaceae	Kramer (1979)
	Washingtonia filifera	Arecaceae	
Myndus radicis Osborn	*Impatiens* (N)	Balsaminaceae	Osborn (1903)
	Nettles (N)	Urticaceae	
	Grasses (N)	Poaceae	
Myndus rubidus Ball	Palmetto	Arecaceae	Kramer (1979)
Myndus simplicatus (Caldwell)	*Panicum barbinode*	Poaceae	Kramer (1979)
Myndus slossonae Ball	*Juncus*	Juncaceae	Dozier (1926)
	"Grasses"	Poaceae	Kramer (1979)
Myndus taffini Bonfils	*Cocos nucifera*	Arecaceae	Bonfils (1982); Julia (1982)
Myndus tekmar Kramer	*Agave*	Agavaceae	Kramer (1979)
Myndus texensis Kramer	*Yucca thompsoniana*	Agavaceae	Kramer (1979)
Myndus yuccandus Ball	*Yucca*	Agavaceae	Kramer (1979)
Oecleus arnellus B & K	*Chrysothamnus speciosus*	Asteraceae	Kramer (1977)
Oecleus balli Kramer	*Atriplex* (two sp.)	Chenopodiaceae	Kramer (1977)
	Pluchea sericea	Asteraceae	
Oecleus borealis Van Duzee	*Chilopsis linearis*	Bignoniaceae	Kramer (1977)
Oecleus campestris Ball	*Artemesia filifolia*	Asteraceae	Kramer (1977)
Oecleus centronus B & K	*Salicornia*	Chenopodiaceae	Kramer (1977)

Oecleus cucullus Kramer	*Trixis californica*	Asteraceae	Goeden and Ricker (1989)
	Artemesia	Asteraceae	Kramer (1977)
	Chilopsis linearis	Bignoniaceae	
Oecleus fulvidorsum Ball	*Atriplex canescens*	Chenopodiaceae	Kramer (1977)
Oecleus glochin Kramer	*Chrysothamnus, Hymenoclea*	Asteraceae	Kramer (1977)
Oecleus lineatus Ball	*Lygodesmia spinosa*	Asteraceae	Kramer (1977)
Oecleus lyra Kramer	*Dasylirion*	Agavaceae	Kramer (1977)
Oecleus marthurum Kramer	*Atriplex* (three sp.)	Chenopodiaceae	Kramer (1977)
Oecleus monilipennis Van Duzee	*Atriplex*	Chenopodiaceae	Van Duzee (1923)
Oecleus natatorius Ball	Grasses	Poaceae	Ball (1937)
Oecleus nolinus B & K	*Nolina, Yucca*	Agavaceae	Kramer (1977)
Oecleus obtusus Ball	*Pluchea*	Asteraceae	Kramer (1977)
Oecleus perpictus Van Duzee	*Muhlenbergia porteri*	Poaceae	Kramer (1977)
Oecleus pigmy B & K	*Atriplex* (three sp.)	Chenopodiaceae	Kramer (1977)
Oecleus piperatus B & K	*Atriplex linearis*	Chenopodiaceae	Kramer (1977)
Oecleus planus B & K	*Chrysothamnus panniculatus*	Asteraceae	Kramer (1977)
Oecleus productus Metcalf	Grasses	Poaceae	Kramer (1977)
	Composites	Asteraceae	
Oecleus sagittanus B & K	*Pluchea sericea*	Asteraceae	Kramer (1977)
Oecleus snowi Ball	*Baccharis glutinosa*	Asteraceae	Kramer (1977)
Oecleus subreflexus Van Duzee	*Atriplex lentiformis*	Chenopodiaceae	Kramer (1977)
	Pluchea, Franseria, Chrysoth.	Asteraceae	
Oecleus texanus Ball	*Yucca glauca*	Agavaceae	Ball (1937)
Oecleus sp.	*Cocos nucifera*	Arecaceae	Howard et al. (1981)
Oecleus sp.	*Tamarix gallica* (N)	Tamaricaceae	Hopkins and Carruth (1954)
Pentastirini			
Helenolius dividens (Walker)	*Aster glutinosa*	Asteraceae	Van Stalle (1986c)
	Commidendron rugosum	Asteraceae	
Helenolius insulicola Van Stalle	*Frankenia postulatifiola*	Frankeniaceae	Van Stalle (1986c)
	Commidendron rugosum	Asteraceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant		Reference
	Genus and Species	Family	
Hyalesthes angustulus Horvath	Polyphagous		Hoch and Remane (1985)
Hyalesthes flavipennis Horvath	Polyphagous		Hoch and Remane (1985)
Hyalesthes obsoletus Signoret	*Betula*	Betulaceae	Villiers (1977)
	Convolvulus arvensis L. (N)	Convolvulaceae	Brĉak (1979)
	Lepidium (N)	Brassicaceae	
	Chenopodium (N)	Chenopodiaceae	
	Amaranthus (N)	Amaranthaceae	
	Solanum (N)	Solanaceae	
	Cirsium (N)	Asteraceae	
Mnemosyne consoleae Van Stalle	*Consolea moniliformis*	Cactaceae	Van Stalle (1987b)
Norialsus elytropappi Van Stalle	*Elytropappus rhinocerotis*	Asteraceae	Van Stalle (1986b)
Norialsus salsolarum Van Stalle	*Salsola*	Chenopodiaceae	Van Stalle (1986b)
Oliarus acaciae Kirkaldy	*Acacia koa*	Fabaceae	Zimmerman (1948)
Oliarus acicus Caldwell	*Phoenix canariensis*	Arecaceae	Meyerdirk and Hart (1982)
	Prosopis	Fabaceae	Ward et al. (1977)
Oliarus annandalei cocosivora Muir	*Cocos nucifera*	Arecaceae	Wilson and O'Brien (1987)
Oliarus artemisiae Matsumura	*Artemisia*	Asteraceae	Lee and Kwon (1977)
Oliarus aridus Ball	*Phoenix canariensis*	Arecaceae	Meyerdirk and Hart (1982)
	Prosopis	Fabaceae	Ward et al. (1977)
Oliarus atkinsoni Myers	*Phormium tenax* (N)	Agavaceaae	Cumber (1952)
Oliarus barajus Dlabola	*Tamarix*	Tamaricaceae	Dlabola (1981)
Oliarus beieri (Wagner)	*Alnus*	Betulaceae	Gunthart (1987)
	Myricaria	Tamaricaceae	
	Salix	Salicaceae	
Oliarus borinquensis Caldwell	*Rhizophora mangle*	Rhizophoraceae	Caldwell and Martorell (1950)
Oliarus cocosivora Muir	*Cocos nucifera*	Arecaceae	Howard and Mead (1980)

Oliarus complectus Ball	*Cocos nucifera*	Arecaceae	Howard et al. (1981)
	Carica papaya	Caricaceae	Martorell and Adsuar (1952)
	Solanum melongena	Solanaceae	Caldwell & Martorell (1950)
	Castilla elastica	Moraceae	
	Volkameria aculeata	Verbenaceae	
	Batis maritima	Batidaceae	
	Swept from many plants		
	Saccharum (N)	Poaceae	Sein (1932, 1933)
	Panicum purpuracscens (N)		
Oliarus ecologus Caldwell	*Chamaedaphne*	Ericaceae	Beirne (1950)
Oliarus discrepans Giffard	*Gossypium tomentosum*	Malvaceae	Zimmerman (1948)
Oliarus euphorbiae Giffard	*Euphorbia*	Euphorbiaceae	Zimmerman (1948)
Oliarus felis Kirkaldy	*Sporobolus virginicus* (N)	Poaceae	Hacker (1925a)
Oliarus fici Van Stalle	*Ficus thorningii*	Moraceae	Van Stalle (1987a)
Oliarus filicola Kirkaldy	*Cibotium*	Dicksoniaceae	Zimmerman (1948)
Oliarus frontalis Melichar	*Acacia*	Fabaceae	Linnavuori (1964)
Oliarus haleakalae Kirkaldy	*Cibotium chamissoi*	Dicksoniaceae	Zimmerman (1948)
	Cyrtandra	Gesneriaceae	
Oliarus halehaku Giffard	*Cibotium*	Dicksoniaceae	Zimmerman (1948)
	Sadleria	Blechnaceae	
	Pipturus	Urticaeae	
Oliarus hodgarti Distant	*Xanthium strumarium*	Asteraceae	Hilgendorf and Goeden (1982)
Oliarus hottentottus (Stål)	*Diospyros mepiliformis*	Ebenaceae	Van Stalle (1987a)
Oliarus immaculatus Giffard	Ferns		Zimmerman (1948)
Oliarus kahavalu Kirkaldy	*Metrosideros*	Myrtaceae	Zimmerman (1948)
Oliarus kanakanus Kirkaldy	*Metrosideros*	Myrtaceae	Zimmerman (1948)
Oliarus kaonohi Kirkaldy	*Broussaisia*	Hydrangiaceae	Zimmerman (1948)
	Rotting tree fern fronds		
Oliarus kasachstanicus Emeljanov	*Atriplex cana*	Chenopodiaceae	Emeljanov (1964)
Oliarus koae Giffard	*Acacia koa*	Fabaceae	Zimmerman (1948)
Oliarus koanoa Kirkaldy	Tree fern roots (N)		Swezey (1906)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
	Maba sandwicensis	Ebenaceae	Zimmerman (1948)
Oliarus koele Giffard	Ferns		Zimmerman (1948)
Oliarus lacotei Dlabola	*Thymus vulgaris*	Lamiaceae	Dlabola (1970)
Oliarus littoralis Ball	*Distichlis, Sporobolus*	Poaceae	Mead and Kramer (1982)
Oliarus lupialensis Synave	*Cocos nucifera*	Arecaceae	Van Stalle (1987a)
Oliarus maidis Fennah	*Zea mays*	Poaceae	Fennah (1945)
Oliarus major (Kirschbaum)	*Zygophyllum*	Zygophyllaceae	Dlabola (1981)
Oliarus mori Matsumura	*Morus alba*	Moraceae	Tsaur et al. (1988a)
Oliarus myoporicola Giffard	*Myoporum sandwicense*	Myoporaceae	Zimmerman (1948)
Oliarus oleae Van Stalle	*Olea africana*	Oleaceae	Van Stalle (1987a)
Oliarus olympus Giffard	*Metrosideros*	Myrtaceae	Zimmerman (1948)
Oliarus opuna Kirkaldy	*Astelia*	Liliaceae	Zimmerman (1948)
	Dubautia	Asteraceae	
	Nephrolepis exaltata	Oleandraceae	
Oliarus orithyia Fennah	*Salicornia*	Chenopodiaceae	Van Stalle (1987a)
Oliarus oryzae Matsumura	*Saccharum offinarum*	Poaceae	Tsaur et al. (1988a)
Oliarus pele Kirkaldy	Tree ferns		Zimmerman (1948)
Oliarus pinicolus Osborn	*Pinus*	Pinaceae	Osborn (1926)
Oliarus sonoitus Ball	*Prosopis*	Fabaceae	Ward et al. (1977)
Oliarus texanus Metcalf	*Prosopis*	Fabaceae	Ward et al. (1977)
Oliarus vicarius (Walker)	Saw palmetto	Arecaceae	Thompson et al. (1979)
	Pine	Pinaceae	
Oliarus zyxus Caldwell	*Prosopis*	Fabaceae	Ward et al. (1977)
Pentastiridius apicalis (Uhler)	*Oryza sativa*	Poaceae	Wilson and O'Brien (1987)
Pentastiridius ipbis (Linnavuori)	*Ludia*	Flacourtiaceae	Van Stalle (1986a)
Pentastiridius pachyceps (Matsum.)	*Cynodon dactylon* (N)	Poaceae	Tsaur et al. (1988a)
Pseudoliarus circularis Dlabola	*Tamarix*	Tamaricaceae	Dlabola (1981)

Subfamily Undetermined			
Ankistrus pini Tsaur & Hsu	*Pinus*	Pinaceae	Tsaur et al. (1988b)
Pintalia delicata (Fowler)	*Saggittaria latifolia*	Alismataceae	Kramer (1983)
Platycixius calvus Van Duzee	*Yucca*	Agavaceae	Kramer (1983)
Solonaima sp.	"Tree roots" (N) *Ficus?*	Moracerae?	Hoch and Howarth (1989b)
Undarana sp.	"Tree roots" (N)	Myrtaceae?	Hoch and Howarth (1989a)
KINNARIDAE			
Kinnarinae			
Adolendini			
Adolenda ephedrina Emeljanov	*Ephedra equisetina*	Ephedraceae	Emeljanov (1985)
Emeljanopleromini			
Kinnacana clara Remane	*Bystropogon*	Lamiaceae	Remane (1985b)
	Micromeria	Lamiaceae	
	Lavandula	Lamiaceae	
Kinnoccia chromata Remane	*Lavandula*	Lamiaceae	Remane (1985b)
	Argyranthemum	Asteraceae	
	Schizogyne sericea	Asteraceae	
Oeclidius brickellus Ball	*Trixis californica*	Asteraceae	Goeden and Ricker (1989)
Oeclidius sp.	*Hymenoclea salsola*	Asteraceae	Goeden and Ricker (1986a)
Southia nemoralis (Fennah)	*Theobroma cacao*	Sterculiaceae	Fennah (1945)
Prosotropinae			
Oreopenes luteifacies Ramos	*Petitia domingensis*	Verbenaceae	Ramos (1957)
Prosoptropis decorata Uhler	*Tabernaemontana*	Apocynaceae	Fennah (1942a)
Prosoptropis trinervosa Fennah	*Tabernaemontana*	Apocynaceae	Fennah (1942a)
Quilessa lutea Fennah	*Cyathea*	Cyatheaceae	Fennah (1942a)
Quilessa gladiolata Fennah	Ferns, shrubs		Fennah (1942a)
Quilessa grenadana Fennah	*Sanseveria* roots (N)	Agavaceae	Fennah (1948)
Quilessa maculata Fennah	Ferns, shrubs		Fennah (1942a)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
MEENOPLIDAE			
Kermesiinae			
Eponisia albovittata Fennah	On seven herbaceous plants swept from many others		Synave (1961)
Eponisia brunnescens Synave	On four herbaceous plants swept from many others		Synave (1961)
Kermesia plurimaculata Synave	*Vitex doniana*	Verbenaceae	Synave (1961)
	Eriosema psoraleoides	Fabaceae	
	Stereospermum kunthianum	Bignoniaceae	
Nisia australiensis Woodward	*Cyperus rotundus*	Cyperaceae	Tsaur et al. (1986)
	Commelina diffusa	Commelinaceae	
Nisia carolinensis Fennah	*Cyperus rotundus*	Cyperaceae	Tsaur et al. (1986)
	Oryza sativa	Poaceae	
Nisia nervosa (Motschulsky)	Sedges	Cyperaceae	Wilson and Claridge (1991)
	Colocasia esculenta	Araceae	Mitchell and Maddison (1983)
	Saccharum officinarum	Poaceae	Schumacher (1920)
	Oryza sativa	Poaceae	
Nisia serrata Tsaur	*Alocasia cucullata* (N)	Araceae	Tsaur (1989a)
DERBIDAE			
Cenchreini			
Cedusa aburiensis Muir	*Elaeis*	Arecaceae	Howard and Mead (1980)
	Raphia vinifera	Arecaceae	
Cedusa californica (Van Duzee)	*Salix*	Salicaceae	Van Duzee (1914)
Cedusa caribbensis Caldwell	*Pennisetum purpureum*	Poaceae	Caldwell and Martorell (1950)

Cedusa cedusa McAtee	*Carex*	Cyperaceae	Ball (1928)
	Osmunda	Osmundiaceae	
Cedusa chuluota Ball	*Woodwardia*	Blechnaceae	Ball (1928)
Cedusa incisa Metcalf	*Betula*	Betulaceae	Ball (1928)
	Andropogon	Poaceae	
Cedusa kedusa McAtee	*Platanus occidentalis*	Platanaceae	Ball (1928)
Cedusa mallochi McAtee	*Rosa*	Rosaceae	Wray (1950)
Cedusa nigripes Muir	Palms	Arecaceae	Muir (1930b)
Cedusa vulgaris (Fitch)	*Crataegus*	Rosacee	Wellhouse (1920)
Cedusa wolcotti Muir	Palms	Arecaceae	Howard and Mead (1980)
Lamenia caliginea (Stål)	*Colocasia esculenta*	Araceae	Mitchell and Maddison (1983)
Lamenia caliginea charon Fennah	*Messerschmidia*	Boraginaceae	Fennah (1956)
Lamenia epiensis Muir	*Cocos nucifera*	Arecaceae	Bonfils (1982)
Malenia licea Dlabola	*Salix*	Salicaceae	Dlabola (1979b)
Malenia mesasiatica Dubovsky	*Salix*	Salicaceae	Anufriev (1968)
Malenia sarmatic Anufriev	*Salix*	Salicaceae	Anufriev (1968)
Malenia turanica Anufriev	*Salix*	Salicaceae	Anufriev (1968)
Malenia turkestanica Dubovsky	*Salix*	Salicaceae	Anufriev (1968)
Malenia ussurica Anufriev	*Populus*	Salicaceae	Anufriev (1968)
Neocenchrea sp.	*Cocos nucifera*	Arecaceae	Howard et al. (1981)
	Sabal umbraculifera	Arecaceae	
	Veitchia merrillii	Arecaceae	
Nesorhamma chalcas chalcas Fennah	*Pandanus*	Pandanaceae	Fennah (1956)
Omolicna mcateei (Dozier)	*Physalis*	Fabaceae	Wray (1950)
Omolicna puertana Caldwell	*Carica papaya*	Caricaceae	Martorell and Adsuar (1952)
	Solanum melongena	Solanaceae	Caldwell and Martorell (1950)
	Melia azedarach	Meliaceae	
	Swept from many plants		
Omolicna sp.	*Pritchardia thurstonii*	Arecaceae	Howard and Mead (1980)
	Cocos nucifera	Arecaceae	Howard et al. (1981)
	Roystonea hispaniolana	Arecaceae	
	Sabal umbraculifera	Arecaceae	
	Veitchia merrillii	Arecaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Paraphenice mbaleensis Synave	*Theobroma cacao*	Sterculiaceae	Synave (1973)
Patara albida Westwood	*Inga vera*	Fabaceae	Caldwell and Martorell (1950)
Patara eloeidis Muir	*Elaeis guineensis*	Arecaceae	Muir (1930b)
Patara hargreavesi Muir	*Elaeis guineensis*	Arecaceae	Muir (1930b)
Phaciocephalus carolinensis Metcalf	*Wedelia biflora*	Asteraceae	Fennah (1956)
Phaciocephalus onoi Fennah	*Wedelia biflora*	Asteraceae	Fennah (1956)
	Artocarpus altilis	Moraceae	
Phaciocephalus phaedra Fennah	*Alocasia*	Araceae	Fennah (1956)
Phaciocephalus sigaleon Fennah	*Alpinia*	Zingiberaceae	Fennah (1967b)
Phenice stellulata (Boh.)	*Elaeis guineensis*	Arecaceae	Muir (1928)
Vekunta nigrolineata Muir	*Saccharum offinarum*	Poaceae	Schumacher (1920)
Vekunta stigmata Matsumura	*Saccharum offinarum*	Poaceae	Schumacher (1920)
Derbini			
Dysimia maculata Muir	*Sabal*	Arecaceae	Ball (1928)
	Coccothrinax gracilis	Arecaceae	Dozier (1931)
	Inga vera	Fabaceae	Muir (1924b)
	Inga laurina	Fabaceae	
Mysidia mississippiensis Dozier	*Acer*	Aceraceae	Ball (1928)
	Sabal palmetto	Arecaceae	
Otiocerini			
Anotia fitchi (Van Duzee)	*Saccharum officinarum*	Poaceae	Osborn (1926)
	Spartina pectinata	Poaceae	Holder (1990)
	Carya	Juglandaceae	Van Duzee (1894)
Anotia uhleri (Van Duzee)	*Acer*	Aceraceae	Van Duzee (1894)
Apache degeerii (Kirby)	*Fagus*	Fagaceae	Van Duzee (1889)
	Quercus (N under bark)	Fagaceae	Wilson (1982b)
	Acer	Aceraceae	
	Carya	Juglandaceae	

Kamendaka pulchra (Muir)	*Cocos nucifera*	Arecaceae	Muir (1917)
Kamendaka saccharivora (Matsum.)	*Saccharum offinarum*	Poaceae	Schumacher (1920)
Kamendaka spio Fennah	*Heliconia*	Heliconiaceae	Fennah (1967b)
	Alpinia	Zingiberaceae	
	Colocasia esculenta	Araceae	Mitchell and Maddison (1983)
Muiralyricen ruber Metcalf	*Icacorea* (*Ardisia*)	Myrsinaceae	Metcalf (1946b)
Mysidioides tagalica Muir	*Asplenium nidus*	Aspleniaceae	Muir (1917)
Nesokaha lineata Muir	*Cocos nucifera*	Arecaceae	Muir (1917)
Nesokaha phillipina Muir	*Cocos nucifera*	Arecaceae	Muir (1917)
Otiocerus coquebertii Kirby	*Acer*	Aceraceae	Van Duzee (1889)
	Fagus	Fagaceae	
Otiocerus stollii Kirby	*Quercus*	Fagaceae	Van Duzee (1889)
Otiocerus wolfi Kirby	*Acer*	Aceraceae	Ball (1928)
	Fagus	Fagaceae	Van Duzee (1894)
Paralyricen tephrias Fennah	*Fitchia speciosa*	Asteraceae	Fennah (1958)
Pyrrhoneura maculata Muir	*Cocos nucifera*	Arecaceae	Muir (1917)
Pyrrhoneura saccharicida Kirkaldy	*Colocasia esculenta*	Araceae	Mitchell and Maddison (1983)
Shellenius balli McAtee	*Acer*	Aceraceae	Ball (1928)
	Carpinus caroliniana	Betulaceae	
	Sabal palmetto	Arecaceae	
	Fraxinus	Oleaceae	Wilson (unpublished data)
Shellenius schellenbergi	*Acer*	Aceraceae	Ball (1928)
	Carpinus caroliniana	Betulaceae	
	Sabal palmetto	Arecaceae	
	Fraxinus	Oleaceae	Wilson (unpublished data)
Swezeyia lyricen Kirkaldy	*Colocasia esculenta*	Araceae	Mitchell and Maddison (1983)
Swezeyia polyxo Fennah	*Artocarpus altilis*	Moraceae	Fennah (1956)
	Mangifera	Anacardiaceae	
Rhotanini			
Levu africanum Muir	*Theobroma cacao*	Sterculiaceae	Synave (1973)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Levu pallescens pagana Fennah	*Alocasia*	Araceae	Fennah (1956)
Levu pallescens baedulus Fennah	*Cyrtospermum*	Araceae	Fennah (1956)
Sikaianini			
Distantinia nigrocacuminis Muir	Palms	Arecaceae	Muir (1917)
Leomelicharia delicata Muir	Palms	Arecaceae	Muir (1917)
Leomelicharia nigrovittata Muir	Palms	Arecaceae	Muir (1917)
Mula resonans Ball	Sabal palmetto	Arecaceae	Ball (1928)
Sikaiana makii Muir	Palms	Arecaceae	Muir (1917)
Sikaiana vitriceps Muir	Palms	Arecaceae	Muir (1917)
Zoraidini			
Diostrombus alcmena Fennah	*Theobroma cacao*	Sterculiaceae	Synave (1973)
Diostrombus cocos Muir	*Cocos nucifera*	Arecaceae	Muir (1928)
Diostrombus politus Uhler	Polyphagous		Lee and Kwon (1977)
Lydda elaeidis Muir	*Elaeis guineensis*	Arecaceae	Muir (1928)
Pamendanga matsumurai Muir	*Carpinus cordata*	Betulaceae	Anufriev (1968)
	Acer	Aceraceae	Anufriev (1968)
Proutista lurida Muiry	*Musa*	Musaceae	Van Stalle (1986d)
Proutista moesta (Westwood)	*Saccharum officinarum*	Poaceae	Schumacher (1920)
	Zea mays	Poaceae	Wilson and O'Brien (1987)
Proutista sacchari Van Stalle	*Saccharum officinarum*	Poaceae	Van Stalle (1986d)
ACHILIDAE			
Myconini			
Epiptera woodworthi (Van Duzee)	*Pinus jeffreyi*	Pinaceae	Van Duzee (1916)
	Juniperus (N)	Cupressaceae	

Plectoderini			
Ballomarius mongaensis Synave	*Ixora radiata*	Rubiaceae	Synave (1962b)
	Bridelia micrantha	Euphorbiaceae	
	Setaria sphacelata	Poaceae	
	Sporobolus pyramidalis	Poaceae	
Catonia arbutina Ball	*Pinus cembroides*	Pinaceae	O'Brien (1971)
Catonia bicinctura Van Duzee	*Pinus*	Pinaceae	O'Brien (1971)
	Callicarpa americana	Verbenaceae	
Catonia cinerea Osborn	*Montezuma speciosissima*	Bombacaceae	Caldwell and Martorell (1950)
	Inga vera	Fabaceae	
	Piper aduncum	Piperaceae	
	Swept from many plants		
Catonia cinctifrons (Fitch)	*Pinus clausa*	Pinaceae	O'Brien (1971)
	Pinus	Pinaceae	
	Quercus	Fagaceae	
	Carya	Juglandaceae	
Catonia lunata Metcalf	*Pinus*	Pinaceae	O'Brien (1971)
	Quercus	Fagaceae	
	Vaccinium macrocarpon	Ericaceae	
Catonia nava (Say)	*Cornus*	Cornaceae	O'Brien (1971)
	Platanus	Platanaceae	
	Acer	Aceraceae	
Catonia picta Van Duzee	*Pinus*	Pinaceae	O'Brien (1971)
Catonia pini Metcalf	*Baptisia tinctoria*	Fabaceae	O'Brien (1971)
Catonia pumila Van Duzee	*Pinus*	Pinaceae	O'Brien (1971)
	Quercus	Fagaceae	
	Carya	Juglandaceae	
Cnidus naevius Jacobi	*Erythrophleum guineensis*	Fabaceae	Synave (1962b)
	Sorghum	Poaceae	
	Swept from others		
Cnidus pallidus Synave	*Piliostigma thonningii*	Asclepiadaceae	Synave (1962b)
	Swept from many others		

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant		Reference
	Genus and Species	Family	
Juniperthia indella (Ball)	*Juniperus occidentalis*	Cupressaceae	O'Brien (1971)
	Juniperus californica	Cupressaceae	
	Libocedrus decurrens	Cupressaceae	
	Arctostaphylos tomentosa	Ericaceae	
	Baccharis	Asteraceae	
	Salix	Salicaceae	
Juniperthia majuscula (Van Duzee)	*Juniperus deppeana*	Cupressaceae	O'Brien (1971)
Juniperthia producta (Van Duzee)	*Juniperus californica*	Cupressaceae	O'Brien (1971)
	Libocedrus decurrens	Cupressaceae	
Juniperthia succinea (Van Duzee)	*Juniperus californica*	Cupressaceae	O'Brien (1971)
	Libocedrus decurrens	Cupressaceae	
Juniperthia unimaculata O'Brien	*Juniperus californica*	Cupressaceae	O'Brien (1971)
Leptarciella saegeri Synave	*Stereospermum kunthianum*	Bignoniaceae	Synave (1962b)
	Naulea latifolia	Rubiaceae	
	Canthium	Rubiaceae	
	Irvingia smithii	Araliaceae	
	Erythrophleum guineensis	Fabaceae	
	Swept from many others		
Momar fumidus (Ball)	*Platanus wrightii*	Platanaceae	O'Brien (1971)
Momar maculifrons (Van Duzee)	*Platanus wrightii*	Platanaceae	O'Brien (1971)
	Quercus	Fagaceae	
	Vitis	Vitaceae	
Synecdoche albicosta (Van Duzee)	*Arctostaphylos*	Ericaceae	O'Brien (1971)
Synecdoche autumnalis O'Brien	*Pinus lambertiana*	Pinaceae	O'Brien (1971)
	Quercus chrysolepis	Fagaceae	
Synecdoche cara (Van Duzee)	*Platanus*	Platanaceae	O'Brien (1971)
	Libocedrus decurrens	Cupressaceae	
	Alnus rhombifolia	Betulaceae	
	Chrysopsis villosa	Asteraceae	

Synecdoche clara (Van Duzee)	*Baccharis*	Asteraceae	O'Brien (1971)
Synecdoche constellata (Ball)	*Pinus sabiniana*	Pinaceae	O'Brien (1971)
	Cercocarpus betuloides	Rosaceae	
	Pseudotsuga menziesii	Pinaceae	
Synecdoche dimidiata (Van Duzee)	*Pinus*	Pinaceae	O'Brien (1971)
	Fagus	Fagaceae	
Synecdoche fusca (Van Duzee)	*Arctostaphylos bicolor*	Ericaceae	O'Brien (1971)
	Arbutus menziesii	Ericaceae	
	Quercus	Fagaceae	
Synecdoche grisea (Van Duzee)	*Tilia*	Tiliaceae	O'Brien (1971)
Synecdoche helenae (Van Duzee)	*Washingtonia filifera*	Arecaceae	O'Brien (1971)
Synecdoche impunctata (Fitch)	*Quercus*	Fagaceae	O'Brien (1971)
	Prunus	Rosaceae	
Synecdoche irrorata (Van Duzee)	*Arctostaphylos*	Ericaceae	O'Brien (1971)
Syncecdoche necopina (Van Duzee)	*Arctostaphylos pringlei*	Ericaceae	O'Brien (1971)
Synecdoche nemoralis (Van Duzee)	Fungi (N)		O'Brien (1971)
	Pinus muricata	Pinaceae	
	Pinus sabiniana	Pinaceae	
	Pinus murrayana	Pinaceae	
	Pinus muricata	Pinaceae	
	Pinus radiata	Pinaceae	
	Tsuga	Pinaceae	
Synecdoche nervata (Van Duzee)	*Arctostaphylos glauca*	Ericaceae	O'Brien (1971)
	Cercocarpus ledifolius	Rosaceae	
	Alnus rhombifolia	Betulaceae	
	Pinus lambertiana	Pinaceae	
	Mint	Lamiaceae	
Synecdoche ocellata O'Brien	*Umbellularia californica*	Lauraceae	O'Brien (1971)
Synecdoche pseudonervata O'Brien	*Arctostaphylos glandulosa*	Ericaceae	O'Brien (1971)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Synecdoche rubella (Van Duzee)	*Arctostaphylos glauca*	Ericaceae	O'Brien (1971)
	Arctostaphylos canescens	Ericaceae	
	Arctostaphylos montana	Ericaceae	
	Arctostaphylos tomentosa	Ericaceae	
	Arbutus menzesii	Ericaceae	
	Pasania	Fagaceae	
	Ceanothus cuneatus	Rhamnaceae	
	Quercus	Fagaceae	
DICTYOPHARIDAE			
Dictyopharinae			
Dictyopharini			
Dictyophara europea L.	Polyphyagous		Synave (1951)
Dictyophara nakanonis Matsumura	*Quercus*	Fagaceae	Lee and Kwon (1977)
Dictyophara patruelis Stål	*Saccharum offinarum*	Poaceae	Schumacher (1920)
	Oryza sativa	Poaceae	
Dictyophara sp.	*Xanthium strumarium*	Asteraceae	Hilgendorf and Goeden (1982)
Hastini			
Thanatodictya tillyardi Myers	*Pteridium esculentum*	Pteridiaceae	Myers (1923)
Nersiini			
Nersia florens Stål	*Rumex crispus* (N)	Polygonaceae	Wilson and McPherson (1981b)
	Eupatorium rugosum	Asteraceae	
Retiala viridis Fennah	*Coffea*	Rubiaceae	Fennah (1945)
	Casuarina	Casuarinaceae	
	Hibiscus	Malvaceae	

Orthopagini			
Orthopagus helios Melichar	*Saccharum offinarum*	Poaceae	Schumacher (1920)
Orthopagus lunulifer Uhler	*Pueraria*	Fabaceae	Lee and Kwon (1977)
	Mallotus	Euphorbiaceae	
Phylloscelini			
Phylloscelis pallescens Germar	*Pycnathemum tenuifolium* (N)	Lamiaceae	Wilson (unpublished data)
Phylloscelis rubra Ball	*Vaccinium macrocarpon* (N)	Ericaceae	Sirrine and Fulton (1914)
Scoloptini			
Scolops abnormis Ball	*Asclepias eriocarpa*	Asclepiadaceae	Isman et al. (1977)
Scolops graphicus Ball	*Gutierrezia californica* (N)	Asteraceae	Ball (1930)
Scolops grossus Uhler	*Melilotus*	Fabaceae	Strickland (1940)
Scolops luridus Breakey	*Artemesia*	Asteraceae	Breakey (1928)
Scolops osborni Ball	*Silphium laciniatum* (N)	Asteraceae	Beamer (1929)
Scolops pallidus Uhler	*Ambrosia confertiflora* (N)	Asteraceae	Goeden and Ricker (1975)
Scolops perdix Uhler	*Helianthus angustifolius*	Asteraceae	Ball (1930)
Scolops pungens (Germar)	*Ambrosia artemisifolia*	Asteraceae	Breakey (1928)
Scolops robustus Ball	*Ambrosia psilostachya*	Asteraceae	Ball (1930)
Scolops snowi Breakey	*Solidago trinervata* (N)	Asteraceae	Ball (1930)
Scolops stonei Breakey	*Stillingia angustifolia* (N)	Euphorbiaceae	Ball (1930)
Scolops sulcipes Say	*Convolvulus*	Convolvulaceae	Wirtner (1905)
Scolops ubleri Ball	*Dondia depressa*	Chenopodiaceae	Ball (1930)
Scolops ubleri marginatus Ball	*Dondia torreyana* (N)	Chenopodiaceae	Ball (1930)
Scolops viridis Ball	*Atriplex canescens* (N)	Chenopodiaceae	Ball (1930)
Taosini			
Taosa herbida (Walker)	*Coffea*	Rubiaceae	Fennah (1945)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Orgeriinae			
Orgeriini			
Almanina			
Nymphorgerius balchanicus Emeljan.	*Ephedra equisetina*	Ephedraceae	Emeljanov (1979)
Nymphorgerius emaljanovi Dlabola	*Astragalus*	Fabaceae	Dlabola (1979b)
Nymphorgerius mullah Dlabola	*Astragalus*	Fabaceae	Dlabola (1979b)
Nymphorgerius prasinus Emeljanov	*Cirsium*	Asteraceae	Emeljanov (1981)
Nymphorgerius tryphema Emeljanov	*Seriphidium*	Asteraceae	Emeljanov (1981)
Orgeriina			
Acinaca lurida Ball & Hartzell	*Eriogonum fasciculatum*	Polygonaceae	Ball and Hartzell (1922)
Aridia compressa Ball	*Artemesia tridentata*	Asteraceae	Ball and Hartzell (1922)
Deserta obesa Ball	*Artemesia*	Asteraceae	Ball and Hartzell (1922)
Deserta obscura Ball	*Artemesia tridentata* (N)	Asteraceae	Ball and Hartzell (1922)
Deserta raptoria Ball	*Chrysathmnus*	Asteraceae	Ball (1937)
Loxophora dammersi Van Duzee	*Agave deserti*	Agavaceae	Comstock (1942)
Orgamara argentia Ball	*Yucca brevifolia*	Agavaceae	Ball (1937)
Orgerius foliatus Doering & Darby	*Atriplex canescens*	Chenopodiaceae	Stroud (1950)
Orgerius sp.	*Cirsium californicum* (N)	Asteraceae	Goeden and Ricker (1986b)
	Cirsium proteanum (N)	Asteraceae	
	Cirsium	Asteraceae	
Yucanda albida Ball	*Yucca baccata* (N)	Agavaceae	Ball and Hartzell (1922)
Subfamily Undetermined			
Doryphorina sobrina (Stål)	*Hibiscus*	Malvaceae	Fennah (1956)
	Helianthus	Asteraceae	
	Sida	Malvaceae	
Nesolyncides to Fennah	*Asplenium nidus* (N)	Aspleniaceae	Fennah (1958)
Raivuna sinica (Walker)	*Saccharum offinarum*	Poaceae	Schumacher (1920)
	Oryza sativa	Poaceae	

FULGORIDAE			
Amyclinae			
Rhabdocephala brunnea Van Duzee	*Muhlenbergia porteri* (N)	Poaceae	Wilson and Wheeler (1992)
Aphaeninae			
Lycorma delicatula (White)	*Ailanthus altissima* (N)	Simaroubaceae	Chu (1931)
	Melia azederach (N)	Meliaceae	
Enchophorinae			
Enchophora longirostris Distant	*Simarouba amara*	Simaroubaceae	Johnson and Foster (1986)
	Quararibea asterolepis	Bombacaceae	
	Trees		
Fulgorinae			
Diareusa conspersa Schmidt	*Poulsenia armata*	Moraceae	Johnson and Foster (1986)
	Ficus tonduzii	Moraceae	
Diareusa conspersa Schmidt	*Poulsenia armata*	Moraceae	Johnson and Foster (1986)
	Ficus tonduzii	Moraceae	
Diareusa imitatrix Ossiannilsson	*Cocos nucifera*	Arecaceae	Hogue et al. (1989)
Fulgora candelaria L.	*Nephelium longana*	Sapindaceae	Kershaw and Kirkaldy (1910)
	Mangifera indica	Anacardiaceae	
	Xanthium strumarium (N)	Asteraceae	
	Urena lobata (N)	Malvaceae	
	Citrus decumana (N)	Rutaceae	
Fulgora castresii Guerin Meneville	*Jacaranda acutifolia*	Bignoniaceae	Hogue et al. (1989)
Fulgora laternaria (L.)	*Hymenaea coubaril*	Fabaceae	Janzen and Hogue (1983)
	Hymenaea oblongifolia	Fabaceae	
	Simarouba amara	Simaroubaceae	
	Zanthoxylum	Rutaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Fulgora sp.	*Hymenaea coubaril*	Fabaceae	Hogue (1984)
	Vochysia tucanorum	Vochysiaceae	
	Lecythis	Lecythidaceae	
	Myroxylon balsamum	Fabaceae	
	Simaba versicolor	Simaroubaceae	
	Aspidosp. tambopatense	Apocynaceae	Hogue et al. (1989)
	Hura crepitans	Euphorbiaceae	
	Eugenia oerstediana	Myrtaceae	Johnson and Foster (1986)
Phrictus diadema (L.)	*Theobroma cacao*	Sterculiaceae	Kershaw and Kirkaldy (1910)
Phrictus quinquepartitus	*Terminalia oblonga*	Combretaceae	Johnson and Foster (1986)
Phenacinae			
Cerogenes auricoma (Burmeister)	*Quercus reticulata* (N)	Fagaceae	Hogue et al. (1989)
Poiocerinae			
Acmonia dichroa Germar	*Capparis*	Capparidaceae	O'Brien (unpublished data)
Cyrpoptus belfragei Stål	*Pinus*	Pinaceae	Osborn (1926)
Cyrpoptus metcalfi Ball	*Pluchea sericea*	Asteraceae	Ball (1933)
	Prosopis	Fabaceae	
Cyrpoptus reineckei Van Duzee	*Panicum repens*	Poaceae	Dozier (1926)
Cyrpoptus vanduzeei Ball	*Muhlenbergia porteri*	Poaceae	Ball (1933)
	Prosopis glandulosa	Fabaceae	Ward et al. (1977)
Hypaepa illuminata Distant	*Trichilia arborea*	Meliaceae	O'Brien (unpublished data)
Itzalana submaculata Schmidt	*Baccharis*	Asteraceae	Wilson and O'Brien (1986)
Lystra lanata L.	*Simarouba amara*	Simaroubaceae	Hogue (1984)
Poblicia fuliginosa Olivier	*Rhus*	Anacardiaceae	Dozier (1926)

ISSIDAE

Acanaloniinae

Acanalonia agilis (Melichar)	*Eugenia aeruginea*	Myrtaceae	Caldwell and Martorell (1950)
	Swept from many others		
Acanalonia bivittata (Say)	Polyphagous		Wilson and McPherson (1980)
Acanalonia bonducellae Fennah	*Caesalpinia bonducella*	Fabaceae	Fennah (1955)
Acanalonia clypeata Van Duzee	*Prosopis*	Fabaceae	Ward et al. (1977)
	Baccharis	Asteraceae	
	Atriplex canescens (N)	Chenopodiaceae	
	Salsola pestifer	Chenopodiaceae	Doering (1932)
Acanalonia conica (Say)	Polyphagous		Wilson and McPherson (1980)
Acanalonia badensis Caldwell	*Prosopis*	Fabaceae	Ward et al. (1977)
Acanalonia impressa Metcalf & Brun.	*Phoebe elongata*	Lauraceae	Metcalf and Bruner (1930)
Acanalonia invenusta Doering	*Prosopis*	Fabaceae	Ward et al. (1977)
Acanalonia laticosta Doering	*Prosopis*	Fabaceae	Ward et al. (1977)
	Helenium	Asteraceae	Doering (1932)
	Croton	Euphorbiaceae	
	Anthemis arvensis	Asteraceae	
	Chrysopsis	Asteraceae	
	Siderocarpus flexicaula	Fabaceae	
Acanalonia pumila Van Duzee	*Borrichia arborescens*	Asteraceae	Wheeler and Hoebeke (1982)
	Mallotinia gnaphalodes (N)	Bombacaceae	
	Batis maritima (N)	Batidaceae	
	Salicornia virginica (N)	Chenopodiaceae	
	Suaeda linearis (N)	Chenopodiaceae	
Acanalonia servillei Spinola	*Capparis comosa*	Capparidaceae	Dozier (1931)
Acanalonia theobromae Fennah	*Theobroma cacao*	Sterculiaceae	Fennah (1945)
	Flacourtia	Flacourtiaceae	
	Caesalpinia pulcherrima (N)	Fabaceae	
Acanalonia umbellicauda Fennah	*Theobroma cacao*	Sterculiaceae	Fennah (1945)
	Caesalpinia	Fabaceae	
	Asparagus	Liliaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Euthiscia tuberculata Van Duzee	*Lippia wrightii*	Verbenaceae	Ball (1935a)
Bladininae			
Bladina fuscana Stål	*Ananus comosus*	Bromeliaceae	Fennah (1945)
	Bromelia pinguin	Bromeliaceae	
	Rhoeo discolor	Commelianaceae	
Bladina fuscovenosa Stål	*Setaria poiretiana*	Poaceae	Fennah (1952)
Bladina molorchus Fennah	*Saccharum officinarum*	Poaceae	Kramer (1976)
Danepteryx artemesiae Kirkaldy	*Artemisia*	Asteraceae	Doering (1940)
Danepteryx manca Uhler	*Adenostoma* (N)	Rosaceae	Doering (1940)
	Artermisia (N)	Asteraceae	
Dictydea intermedia Uhler	*Prunus illicifolia*	Rosaceae	Doering (1940)
Dictydea texana O'Brien	*Ephedra aspersa*	Ephedraceae	O'Brien (1986b)
Dictyobia atra Van Duzee	*Cirsium proteanum*	Asteraceae	Goeden and Ricker (1986b)
Dictyobia permutata Uhler	*Trixis californica* (N)	Asteraceae	Goeden and Ricker (1989)
Dictyssa fenestrata Ball	*Simmondsia chinensis*	Buxaceae	Pinto and Frommer (1980)
Dictyssa leonilae O'Brien	*Juniperus californicus*	Cupressaceae	O'Brien (1986a)
Dictyssa marginepunctata (Melichar)	*Simmondsia chinensis*	Buxaceae	Pinto and Frommer (1980)
Dictyssa obliqua Ball	*Ambrosia chenopodiifolia*	Asteraceae	Goeden and Ricker (1976b)
Dictyssa schuhi O'Brien	*Purshia tridentata*	Rosaceae	O'Brien (1986b)
	Ceanothus velutina	Rhamnaceae	
Dictyssa transversa Van Duzee	*Artemisia*	Asteraceae	Doering (1936)
	Sideroxylon	Fabaceae	Van Duzee (1923)
	Zea mays	Poaceae	
Neaethus bicornis Doering	*Arctostaphylos manzanita*	Ericaceae	Doering (1941)
Neaethus consuetus Doering	*Arctostaphylos sensitiva*	Ericaceae	Doering (1941)
	Arctostaphylos tomentosa	Ericaceae	
Neaethus unicus Doering	*Arctostaphylos pechoensis*	Ericaceae	Doering (1941)
Osbornia arborea Ball	*Juniperus*	Cupressaceae	Doering (1940)

Caliscelinae			
Aphelonema decorata (Van Duzee)	Sedges	Cyperaceae	Doering (1941)
	Spartina alterniflora (N)	Poaceae	Denno (unpublished data)
Aphelonema scurrilis (Stål)	*Carex diriuscula*	Cyperaceae	Emeljanov (1977)
Aphelonema simplex (Uhler)	*Spartina patens* (N)	Poaceae	Denno (1980)
Asarcopus palmarum Horvath	*Caryota urens*	Arecaceae	O'Brien (1988)
	Phoenix dactylifera (N)	Arecaceae	Stickney et al. (1950)
	Phoenix roebelini	Arecaceae	
	Phoenix canariensis	Arecaceae	
	Washingtonia filifera	Arecaceae	
Bruchomorpha decorata Metcalf	*Chaetochloa grisebachii*	Poaceae	Ball (1935b)
Bruchomorpha rugosa Metcalf	Grasses	Poaceae	Ball (1935b)
Bruchomorpha triunata Ball	Grasses (N)	Poaceae	Ball (1935b)
Caliscelis bonellii (Latreille)	*Cynodon dactylon*	Poaceae	O'Brien (1967)
Papagona papoosa Ball	*Muhlenbergia porteri*	Poaceae	Ball (1935a)
Papagona succinea Ball	*Trodia mutica* (N)	Poaceae	Ball (1935a)
Issinae			
Agalmatium grylloides (Fabricius)	*Ficus*	Moraceae	Picard (1921)
Colpoptera brunneus Muir	*Piper aduncum*	Piperaceae	Caldwell and Martorell (1950)
	Swept from many others		
Colpoptera clerodendri Dozier	*Clerodendron fragrans* (N)	Verbenaceae	Dozier (1931)
Colpoptera cyatheae Fennah	*Cyathea* (N)	Cyatheaceae	Fennah (1955)
Colpoptera elevans Walker	*Cocos nucifera* (N)	Arecaceae	Wilson (1987)
	Coccoloba uvifera (N)	Polygonaceae	
Colpoptera maculifrons Dozier	*Volkameria aculeata*	Verbenaceae	Caldwell and Martorell (1950)
	Swept from many others		
Colpoptera rugosa Van Duzee	*Lantana*	Verbenaceae	Van Duzee (1907)
Colpoptera thyone Fennah	*Lantana* (N)	Verbenaceae	Fennah (1955)
Hysterodus taftanicus Dlabola	*Astragalus*	Fabaceae	Dlabola (1980)
	Artemisia	Asteraceae	Dlabola (1980)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant		Reference
	Genus and Species	Family	
Hysteropterum bufo Van Duzee	*Lycium*	Solanaceae	Doering (1938)
Hysteropterum c. cornutum Melichar	*Artemisia tridentata*	Asteraceae	Doering (1938)
Hysteropt. cornutum utahnum Ball	*Artemisia cana*	Asteraceae	Doering (1938)
Hysteropterum fruticulinum Emeljan.	*Atriplex cana*	Chenopodiaceae	Emeljanov (1964)
	Suaeda physophora	Chenopodiaceae	
Hysteropterum sepulcralis Ball	*Flourensia cernua*	Asteraceae	Ball (1935a)
Hysteropterum severini Cald. & DeL.	*Avena sativa* (N)	Poaceae	Schlinger (1958)
Hysteropterum unum Ball	*Chrysothamnus nauseosus*	Asteraceae	Stroud (1950)
Issus cahipi Remane	*Pinus canariensis* (N)	Pinaceae	Remane (1985a)
	Pinus radiata (N)	Pinaceae	
Issus coleoptratus (Geoffroy)	Polyphagous on woody dicots		Le Quesne (1960)
Issus distinguendus Lindberg	*Euphorbia balsamifera*	Euphorbiaceae	Remane (1985a)
	Euphorbia obtusifolia	Euphorbiaceae	
Issus gratehigo Remane	*Euphorbia*	Euphorbiaceae	Remane (1985a)
	Hypericum	Hypericaceae	
Issus muscaeformis (Schrank)	Polyphagous woody plants (N)		Gunthart (1987)
Latematium cingulatum Dlabola	*Cupressus*	Cupressaceae	Dlabola (1983)
Latissus dilatatus (de Fourcroy)	*Quercus cerris*	Fagaceae	D'Urso et al. (1984)
Mycterodus hakkaricus Dlabola	*Quercus*	Fagaceae	Dlabola (1980)
Mycterodus izmiticus Dlabola	*Corylus avellana*	Corylaceae	Dlabola (1979b)
Mycterodus lodosicus Dlabola	*Pinus*	Pinaceae	Dlabola (1980)
Mycterodus pozanticus Kartal	*Verbascum*	Scrophulariaceae	Kartal (1983)
Mycterodus spinicordatus Dlabola	*Pinus eleagnifolia*	Pinaceae	Dlabola (1983)
	Arbutus	Ericaceae	
	Prunus communis	Rosaceae	
Neocolpoptera puertoricensis Dozier	*Vitex*	Vitaceae	Caldwell and Martorell (1950)
	Piper aduncum	Piperaceae	
	Swept from many others		

Phasmena cardinalis Emeljanov	*Atraphaxis*	Polygonaceae	Emeljanov (1979)
Phasmena ephedrae Emeljanov	*Ephedra przewalskii*	Ephedraceae	Emeljanov (1977)
Phasmena tardiviva Emeljanov	*Atraphaxis*	Polygonaceae	Emeljanov (1979)
Picumna maculata (Melichar)	*Pinus*	Pinaceae	Doering (1938)
Quadrastylum beysebiricum Dlabola	*Pyrus malus*	Rosaceae	Dlabola (1983)
Quadrastylum campanuliforma Dlab.	*Pinus eleagnifolia*	Pinaceae	Dlabola (1979a)
Quadrastylum conspurcatum (Spin.)	*Quercus*	Fagaceae	Dlabola (1980)
Sarima nigroclypeata Melichar	*Santalum album* (N)	Santalaceae	Chatterjee (1933)
	Polyphagous		Chatterjee (1933)
Thionia argo Fennah	*Coccoloba uvifera* (N)	Polygonaceae	Caldwell and Martorell (1950)
Thionia borinqueta Caldwell	*Coccoloba uvifera*	Polygonaceae	Caldwell and Martorell (1950)
Thionia clusiae Fennah	*Clusia* (N)	Clusiaceae	Fennah (1955)
Thionia bullata (Say)	*Pinus taeda* (N)	Pinaceae	Wheeler and Wilson (1988)
	Pinus echinata (N)	Pinaceae	
	Pinus virginiana (N)	Pinaceae	
Thionia elliptica Germar	*Quercus ilicifolia* (N)	Fagaceae	Wheeler & Wilson (1987)
	Quercus marilandica	Fagaceae	
Thionia producta Van Duzee	*Juniperus*	Cupressaceae	Doering (1938)
Thionia simplex (Germar)	Polyphagous on dicots (N)		Wheeler and Wilson (1988)
Thionia sp.	*Prosopis*	Fabaceae	Ward et al. (1977)
Tshurtshurnella bicornuta Dlabola	*Arbutus*	Ericaceae	Dlabola (1983)
	Tamarix	Tamaricaceae	
Tshurtshurnella diyarbakira Dlabola	*Punicum* (sic)	?	Dlabola (1980)
Tshurtshurnella extrema Dlabola	Grasses	Poaceae	Dlabola (1980)
Tshurtshurnella verbasci Dlabola	*Verbascum*	Scrophulariaceae	Dlabola (1983)
	Quercus	Fagaceae	
Tonginae			
Atylana astydamia Fennah	*Sophora*	Fabaceae	Fennah (1958)
Atylana palanto Fennah	*Metrosideros*	Myrtaceae	Fennah (1958)
Atylana parmula Fennah	*Glochidion* (N)	Euphorbiaceae	Fennah (1958)
Atylana vesontio Fennah	*Alyxia*	Apocynaceae	Fennah (1958)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Atylana volumna Fennab	*Hernandia*	Hernandiaceae	Fennah (1958)
Tylana ustulata Uhler	*Prosopis juliflora*	Fabaceae	Ward et al. (1977)
Tylanira bifurca Ball	*Prosopis*	Fabaceae	Ward et al. (1977)
Subfamily Undetermined			
Acrestia quadracuta Dlabola	*Artemesia*	Asteraceae	Dlabola (1980)
Bubastia jatagana Dlabola	*Verbascum*	Scrophulariaceae	Dlabola (1980)
NOGODINIDAE			
Nogodinini			
Biolleyana costalis Fowler	*Theobroma cacao*	Sterculiaceae	Fennah (1945)
Epacriini			
Psiadicola brevipennis Fennah	*Psiadia trinervia* (N)	Asteraceae	Fennah (1978)
Tribe Undetermined			
Hadjia nerii Dlabola	*Nerium* (N)	Apocynaceae	Dlabola (1981)
Nurunderia chrysopoides (Walker)	*Eucalyptus*	Myrtaceae	Carver et al. (1991)
RICANIIDAE			
Armacia clara clara (Stål)	*Pandanus*	Pandanaceae	Fennah (1956)
	Hibiscus tiliaceus	Malvaceae	
Armacia clara trukensis Fennah	*Cyrtospermum*	Araceae	Fennah (1956)
Armacia simaethis Fennah	*Gardenia*	Rubiaceae	Fennah (1956)
Euricania clara Kato	*Pueraria*	Fabaceae	Lee and Kwon (1977)
Euricania japonica Melichar	*Pueraria*	Fabaceae	Lee and Kwon (1977)
	Morus	Moraceae	
	Vicia	Fabaceae	

Pochazia fasciata (Fabricius)	*Cocos nucifera*	Arecaceae	Wilson (1987)
	Palm	Arecaceae	
Privesa laevifrons (Stål)	*Olea lancea*	Oleaceae	Williams and Fennah (1980)
Ricania fenestrata (Fabricius)	*Camellia sinensis*	Theaceae	Ghauri (1973)
	Santalum album	Santalaceae	
Ricania japonica Melichar	*Morus alba*	Moraceae	Schumacher (1920)
	Camellia sinensis	Theaceae	
	Cannabis sativa	Cannabidaceae	Takahashi (1919)
Ricania speculum (Walker)	*Camellia sinensis* (N)	Theaceae	Ghauri (1973)
Ricania taeniata Stål	*Pueraria*	Fabaceae	Lee and Kwon (1977)
	Oryza	Poaceae	
	Vicia	Fabaceae	
	Saccharum officinarum	Poaceae	Schumacher (1920)
Ricanoptera opaca Distant	*Camellia sinensis*	Theaceae	Hutson (1921)
Ricanoptera syrinx Fennah	*Wedelia biflora*	Asteraceae	Fennah (1956)
Scolypopa australis Walker	Polyphagous on clubmosses, ferns, and angiosperms (N)		Cumber (1966)
Tarundia cinctipennis Stål	*Pittosporum senacia*	Pittosporaceae	Williams and Fennah (1980)
	Eugenia tinifolia	Myrtaceae	
Tarundia servillei (Spinola)	*Gaetnera*	Rubiaceae	Williams and Fennah (1980)
	Erythrospermum mauritianum	Flacourtiaceae	
Tarundia straminea Muir	*Pandanus*	Pandanaceae	Williams and Williams (1988)
FLATIDAE			
Flatinae			
Flatini			
Byllisana brunnea Metcalf & Bruner	*Centrosema* (N)	Fabaceae	Metcalf and Bruner (1948)
	Miebomia supina (N)	Fabaceae	
Carthaemorpha balloui Metcalf & Brn.	*Amydalus persica*	Sterculiaceae	Metcalf and Bruner (1948)

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Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Dakshiana katharina Metcalf & Bruner	*Nectandra coriacea*	Lauraceae	Metcalf and Bruner (1948)
Flata ferrugata Fabricius	*Xanthium strumarium*	Asteraceae	Hilgendorf and Goeden (1982)
Lawana candida (Fabricius)	Polyphagous		Hoffman (1935)
Lawana conspersa (Walker)	Polyphagous		Hoffman (1935)
Lawana imitata (Melichar)	Polyphagous		Wilson and O'Brien (1987)
Mimophantia maritima Matsumura	*Miscanthus sinensis* (N)	Poaceae	Tsaur (1989b)
Salurnis formosana Jacobi	*Mussaenda parviflora* (N)	Rubiaceae	Tsaur (1989b)
Siphanta acuta (Walker)	*Eucalyptus*	Myrtaceae	Myers (1922)
Siphanta spp.	Polyphagous		Fletcher (1985)
Nephesini			
Anormenis chloris (Melichar)	Polyphagous		Wilson and McPherson (1980)
Anzora unicolor (Walker)	*Malus*	Rosaceae	Fletcher (1988)
	Pyrus	Rosaceae	
Cryptoflata vuattouxi Synave	*Cassonia barteri*	Araliaceae	Synave (1964)
	Baubinia thonningii	Fabaceae	
Epormenis fuliginosa (Fennah)	*Coffea* (N)	Rubiaceae	Fennah (1945)
Epormenis unimaculata (Fennah)	*Theobroma cacao*	Sterculiaceae	Fennah (1945)
Flatormenis duplicata Caldwell	*Trema lamarkiana*	Ulmaceae	Caldwell and Martorell (1950)
	Inga	Fabaceae	
Flatormenis nefuscata Caldwell	*Canella winterana*	Lauraceae	Caldwell and Martorell (1950)
	Weeds and grasses		
Flatormenis pseudomarginata (Muir)	*Piper aduncum*	Piperaceae	Caldwell and Martorell (1950)
	Melastomes, shrubs	Melastomataceae	
	Weeds and bushes		

Flatormenis squamulosa (Fowler)	*Coffea* (N)	Rubiaceae	Fennah (1945)
Geisha distinctissima (Walker)	Polyphagous woody dicots		Lee and Kwon (1977)
Melicharia obtusanguloides Ghauri	*Camellia sinensis*	Theaceae	Ghauri (1973)
Melormenis antillarum (Kirkaldy)	Polyphagous		Caldwell and Martorell (1950)
Melormenis assymetrica Met. & Brun.	Polyphagous		Metcalf & Bruner (1948)
Melormenis basalis (Walker)	*Coccoloba uvifera*	Polygonaceae	Fennah (1965b)
	Acacia	Fabaceae	
	Polyphagous		Caldwell and Martorell (1950)
Metcalfa pruinosa (Say)	Polyphagous (N)		Wilson and McPherson (1980)
Metcalfa pruinosa cubana (Met.& Br.)	Polyphagous		Metcalf and Bruner (1948)
Ormenaria rufifascia (Walker)	*Latania lontaroides* (N)	Arecaceae	Wilson and Tsai (1984)
	Sabal palmetto (N)	Arecaceae	
Ormenis albigyna Campos	*Theobroma cacao*	Sterculiaceae	Wilson and O'Brien (1987)
Ormenis antoniae Melichar	*Coffea* (N)	Rubiaceae	Fennah (1945)
	Mangifera indica (N)	Anacardiaceae	
Ormenis coffeacola Dozier	*Coffea*	Rubiaceae	Dozier (1931)
Ormenis pygmaea Fabricius	*Coffea*	Rubiaceae	Van Zwaluwenburg (1917)
	Polyphagous		
Ormenis saucia Van Duzee	*Ambrosia acanthicarpa*	Asteraceae	Goeden and Ricker (1974a)
	Ambrosia dumosa (N)	Asteraceae	Goeden and Ricker (1976a)
	Ambrosia eriocentra	Asteraceae	
	Ambrisia psilostachya	Asteraceae	
	Hymenoclea salsola (N)	Asteraceae	Goeden and Ricker (1986a)
	Cirsium californicum	Asteraceae	Goeden and Ricker (1986b)
	Cirsium proteanum	Asteraceae	
	Cirsium	Asteraceae	
	Prosopis	Fabaceae	Ward et al. (1977)
Ormenis yumana Ball	*Tamarix gallica* (N)	Tamaricaceae	Hopkins and Carruth (1954)
	Prosopis	Fabaceae	Ward et al. (1977)
Ormenis sp.	*Bebbia juncea* (N)	Asteraceae	Goeden and Ricker (1989)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Ormenoides venusta (Melichar)	Polyphagous		Wilson and McPherson (1980)
Petrusa marginata (Brunnich)	*Batis maritima*	Batidaceae	Caldwell and Martorell (1950)
	Lippia nodiflora	Verbenaceae	
	Beaten from many others		
Rhinophantia longiceps (Puton)	*Artemisia monosperma*	Asteraceae	Linnavuori (1964)
Trisephena anomala Medler	*Pipturus*	Urticaceae	Medler (1990)
Trisephena zestreya Medler	*Lantana camera*	Verbenaceae	Medler (1990)
Phantiini			
Mesophantia kanganica Dlabola	*Seidlitzia rosmarinus*	Chenopodiaceae	Krampl and Dlabola (1983)
Falcophantus acuminatus Fletcher	*Spinifex*	Poaceae	Fletcher (1988)
Falcophantus westcotti Fletcher	*Spinifex*	Poaceae	Fletcher (1988)
Phromniini			
Psenoflata brevis Van Duzee	*Cocos nucifera* (N)	Arecaceae	Wilson (1987)
Poekillopterini			
Poekilloptera phalaenoides (L.)	*Samanea* (N)	Fabaceae	Fennah (1945)
Selizini			
Barsac cocoa Fletcher	*Eucalyptus gamophylla*	Myrtaceae	Fletcher (1988)
Cyarda sp. nr. *acutissima* Metcalf	Polyphagous (N)		Wheeler and Hoebeke (1982)
Cyarda casuarinae Fennah	*Casuarina*	Casuarinaceae	Fennah (1965b)
Cyarda fuscifrons Metcalf & Bruner	*Casuarina*	Casuarinaceae	Metcalf and Bruner (1948)
Cyarda difformis Walker	*Cordia serrata* (N)	Ehretiaceae	Dozier (1931)
Cyarda haitiensis Metcalf & Bruner	*Pandanus*	Pandanaceae	Howard et al. (1981)
	Acacia lutea	Fabaceae	Metcalf and Bruner (1948)
Cyarda melichari Van Duzee	*Lantana camara*	Verbenaceae	Krauss (1953)
Cyarda salina (Dozier)	*Batis maritima*	Batidaceae	Caldwell and Martorell (1950)
Cyphopterum quartaui Linnavuori	*Suaeda vera*	Chenopodiaceae	Quartau (1975)
	Agropyron junceiforme	Poaceae	

Cyphopterum salvagensis Lindberg	*Suaeda vera*	Chenopodiaceae	Quartau (1975)
	Agropyron junceiforme	Poaceae	
Derisa pallida Fennah	*Tamarix*	Tamaricaceae	Linnavuori (1964)
Eubyloptera corticalis Fennah	*Lantana camara*	Verbenaceae	Fennah (1945)
	Cordia	Ehretiaceae	
	Bushes		
Jamella australiae Kirkaldy	*Pandanus*	Pandanaceae	Swezey (1906)
Ketumala thea Ghauri	*Camellia sinensis*	Theaceae	Ghauri (1971)
	Erythrina lithosperma	Fabaceae	
	Gliricidia sepium	Fabaceae	
Mistharnophantia caudata (Van Duz.)	*Helianthus*	Asteraceae	Van Duzee (1914)
Mistharnophantia sp.	*Prosopis*	Fabaceae	Ward et al. (1977)
Paradascalia edax (Van Duzee)	*Laccodesmia*	?	Van Duzee (1923)
	Prosopis	Fabaceae	
	Sideroxylon	Sapotaceae	
	Other plants		
Planodascalia sp.	*Sabal umbraculifera*	Arecaceae	Howard et al. (1981)
Seliza sp.	*Xanthium strumarium*	Asteraceae	Hilgendorf and Goeden (1982)
Flatoidinae			
Flatoides fecalfusca Caldwell	*Prosopis*	Fabaceae	Ward et al. (1977)
Flatoidinus caesalpiniae Fennah	*Acacia riparia*	Fabaceae	Fennah (1965b)
	Caesalpinia bundacella	Fabaceae	
	Tecoma leucoxylon	Bignoniaceae	
Flatoidinus cordiae Fennah	*Cordia cylindrostachya*	Ehretiaceae	Fennah (1945)
	Mangifera indica	Anacardiaceae	
	Various shrubs		
Flatoidinus fumatus (Melichar)	*Inga laurina*	Fabaceae	Caldwell and Martorell (1950)
	Inga vera	Fabaceae	
	Byrsonima spicata	Malpighiaceae	

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Flatoidinus fumatus angulatus Cald.	*Trema lamarkiana*	Ulmaceae	Caldwell and Martorell (1950)
Flatoidinus litoralis Fennah	*Acacia*	Fabaceae	Fennah (1965b)
Flatoidinus monae Fennah	*Jasminum multiflorum*	Oleaceae	Fennah (1965b)
Flatoidinus pallescens Met. & Brun.	*Lonchocarpus*	Fabaceae	Metcalf and Bruner (1948)
	Coffea arabica	Rubiaceae	
	Casuarina	Casuarinaceae	
HYPOCHTHONELLIDAE			
Hypochthonella caeca China & Fen.	*Nicotiana tabacum* (N)	Solanaceae	China and Fennah (1952)
	Zea mays	Poaceae	
	Arachis hypogaea	Fabaceae	
TROPIDUCHIDAE			
Alcestini			
Alcestis ingens Fennah	*Theobroma cacao*	Sterculiaceae	Fennah (1982a)
Alcestis vitrea Fennah	*Cecropia peltata*	Moraceae	Fennah (1982a)
Catulliini			
Catullia subtestacea Stål	*Digitaria*	Poaceae	Yang et al. (1989)
	Grasses (N)	Poaceae	
Numicia gauhati Wilson	*Oryza sativa*	Poaceae	Wilson (1984)
Numicia ghesquierei Lallemand	*Citrus*	Rutaceae	Lallemand (1938)
Numicia maculosa (Distant)	*Saccharum officinarum*	Poaceae	Fennah (1982b)
Numicia pusana Ghauri	*Saccharum officinarum*	Poaceae	Wilson (1984)
Numicia viridis Muir	Polyphagous on grasses and sedges (N)	Poaceae Cyperaceae	Carnegie (1980)
Cyphoceratopini			
Colgorma campestris Metcalf & Brun.	*Coffea arabica*	Rubiaceae	Metcalf and Bruner (1930)

Eporini			
Mesopora onukii Matsumura	*Citrus*	Rutaceae	Schumacher (1920)
Eutropistini			
Sakina boulardi Synave	*Triumphetta rhomboidea*	Tiliaceae	Synave (1978)
Remosini			
Neurotmeta sponsa (Guerin-Menev.)	*Psidium guajava*	Myrtaceae	Fennah (1982b)
	Coffea arabica	Rubiaceae	Metcalf and Bruner (1930)
Neurotmeta viridis (Walker)	*Croton humilis*	Euphorbiaceae	Caldwell and Martorell (1950)
	Suriana maritima (N)	Surianaceae	
	Swept from other plants		
	Coccoloba uvifera (N)	Polygonaceae	Fennah (1949a)
Remosa spinolae Guerin-Meneville	*Cestrum diurnum*	Solanaceae	Metcalf and Bruner (1930)
Tambiniini			
Athestia chariclo (Fennah)	*Chamaedorea* (N)	Arecaceae	Fennah (1974)
Kallitambinia australis Muir	*Aegiceras corniculatum* (N)	Myrsinaceae	Fletcher (1979)
	"Mangroves"	?	
Kallitaxila apicalis (Melichar)	*Cocos nucifera* (N)	Arecaceae	Wilson (1987)
Lanshu glochidionae Yang, Yang & W.	*Glochidion rubrum*	Euphorbiaceae	Yang et al. (1989)
	Woody plants		
	Miscanthus	Poaceae	
Ossoides lineatus Bierman	*Miscanthus* (N)	Poaceae	Yang et al. (1989)
Tambinia bizonata Matsumura	*Capillipedium kwashotensi*	Poaceae	Yang et al. (1989)
	Grasses (N)	Poaceae	
Tambinia guamensis Metcalf	*Hernandia*	Hernandiaceae	Metcalf (1946b)
	Piper guahamense	Piperaceae	
Tambinia theivora Fennah	*Camellia sinensis*	Theaceae	Fennah (1982b)
Tambinia verticalis Distant	*Cocos nucifera* (N)	Arecaceae	Wilson (1986)
	Coffea arabica (N)	Rubiaceae	
	Canthium	Rubiaceae	Wilson (1987)

(*continued*)

Appendix 1. (*Continued*)

Planthopper taxon	Host Plant: Genus and Species	Host Plant: Family	Reference
Tangiini			
Neotangia angustata (Uhler)	*Coffea*	Rubiaceae	Fennah (1982b)
Pelitropis rotulata Van Duzee	Polyphagous		Wilson and Wheeler (1984)
Tangella schaumi (Stål)	*Distictis lactiflora* (N)	Bignoniaceae	Caldwell and Martorell (1950)
	Coccoloba uvifera (N)	Polygonaceae	
	Melia azedarach (N)	Meliaceae	
	Swept from trees & shrubs		
Tangia breviceps (Metcalf & Bruner)	*Cocoloba uvifera*	Polygonaceae	O'Brien (1992)
Tangia litoralis (Fennah)	Polyphagous		Wilson and Hilburn (1991)
Tangia viridis (Walder)	*Citrus*	Rutaceae	Fennah (1982b)
Tropiduchini			
Leptovanua telamon Fennah	*Artocarpus altilis*	Moraceae	Fennah (1982b)
Swezeyaria viridana Metcalf	*Artocarpus altilis*	Moraceae	Fennah (1982b)
	Pandanus	Pandanaceae	Metcalf (1946b)
Tropiduchus biermani Bierman	*Mangifera indica*	Anacardiaceae	Fennah (1982b)
Trypetimorphini			
Ommatissus binotatus Fieber	*Chamaerops humilis*	Arecaceae	Asche and Wilson (1989a)
Ommatissus lofouensis Muir	Grasses	Poaceae	Asche and Wilson (1989a)
	Miscanthus	Poaceae	Yang et al. (1989)
Ommatissus lybicus Bergevin	*Phoenix dactylifera* (N)	Arecaceae	Asche and Wilson (1989a)
Ommatissus magribus Asche & Wils.	*Chamaerops humilis*	Arecaceae	Asche and Wilson (1989a)
Ommatisssus tumidulus Linnavuori	*Phoenix*	Arecaceae	Asche and Wilson (1989a)
Neommatissus basifuscus Kato	Pteridophyta	?	Yang et al. (1989)
Neommatissus formosanus Kato	*Cyathea lepifera*	Cyatheaceae	Yang et al. (1989)
	Pteridophyta	?	Yang et al. (1989)

LOPHOPIDAE			
Lophopinae			
Elasmoscelis similis Synave	*Canthium*	Rubiaceae	Synave (1962a)
	Lonchocarpus laxiflorus	Fabaceae	
	Kigelia aethiopica	Bignoniaceae	
	Swept from many other herbaceous plants		
Lophops saccharicida Kirkaldy	*Saccharum officinarum*	Poaceae	Woodward et al. (1970)
	Grasses	Poaceae	
Pyrilla perpusilla Walker	12 spp. grasses (N)	Poaceae	Rahman and Nath (1940)
Silvanana omani Metcalf	*Britoa acida*	Myrtaceae	Metcalf (1947)
Subfamily Undetermined			
Symplana major Fennah	Unspiked sandal	Arecaceae	Fennah (1962b)
Virgilia luzonensis Muir	*Cocos nucifera* (N)	Arecaceae	Wilson (1987)
Zophiuma lobulata Ghauri	*Cocos nucifera* (N)	Arecaceae	Smith (1980)
	Areca catechu	Arecaceae	Ghauri (1966)
EURYBRACHIDAE			
Eurybrachinae			
Eurybrachini			
Eurybrachys tomentosa (Fabricius)	*Santalum album*	Santalaceae	Wilson and O'Brien (1987)
Platybrachinae			
Platybrachini			
Platybrachys leucostigma Walker	*Eucalyptus maculatus* (N)	Myrtaceae	Hacker (1925b)

Note: Host plant records for the Fulgoroidea were compiled by examining the taxonomic (e.g., Beamer 1945; Metcalfe 1969; Kramer 1973; Hoch and Remane 1983; Wilson and Wheeler 1986), ecological (e.g., Mochida and Kisimoto 1971; Denno 1977; Tallamy and Denno 1979; Booij 1982a; den Bieman 1987a; Claridge et al. 1988), and agricultural literature (e.g., Wilson and O'Brien 1987) as well as faunal surveys (e.g., Zimmerman 1948; Mochida and Okada 1971, 1973; Ossiannilsson 1978) (also Appendix 2). The actual host plant on which planthopper feeding and development occurs can be difficult to assess because records are often based on sweep-net collections of adults. Spurious records result when adults are collected from nonhost vegetation in the absence of information on feeding or the presence of nymphs. Nevertheless, we made a sincere attempt to exclude spurious host records from our survey by omitting reports of species: (1) collected by general sweep netting, (2) observed simply resting and not feeding on the plant as noted by the author, (3) taken in surveys of particular crops on which the species in question are not known to be pests (e.g., Ballou 1936; Bruner et al. 1945, Kramer 1978, Maes and O'Brien 1988) and (4) whose taxonomic identities were questionable (e.g., Swezey 1904).

Appendix 2. Recorded host plants of delphacid planthoppers.

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
	SUBFAMILY ASIRACINAE		
	Tribe Ugyopini		
Neopunana			
puertoricensis (Muir)	*Castilla elastica*	MR	Caldwell and Martorell (1950)
Ugyops			
caelatus (White)	*Leptospermum* sp.	MY	Fennah (1965a)
	Muehlenbeckia australis	PL	
	Coprosma rhamnoides	RU	
	Knightia excelsa	PR	
baliacmon Fennah	*Asplenium nidus*	AN	Fennah (1958)
kinbergi Stål	*Intsia bijuga*	FA	Metcalf (1946b)
osborni Metcalf	*Euterpe globosa*, trees	AR	Caldwell and Martorell (1950)
pelorus Fennah	*Muelenbeckia australis*	PL	Fennah (1965a)
samoaensis Muir	*Pemphis* sp.	LY	Metcalf (1946b)
tripunctatus (Kato)	Pteridophyta	PY	Yang and Yang (1986)
	Tribe Asiracini		
Asiraca			
clavicornis (Fabricius)	Polyphagous on dicots	DI	Asche (1982c)
Pentagramma			
longistylata Penner	*Scirpus americanus*	CY	Wilson and Wheeler (1986)
variegata Penner	*Scirpus validus*	CY	S. Wilson (unpublished data)
vittatus (Matsumura)	Pteridophyta	PY	Yang and Yang (1986)
	SUBFAMILY KELISIINAE		
Anakelisia			
fasciata (Kirschbaum)	*Carex* spp., *Carex riparia*	CY	Drosopoulos et al. (1983)
perspicillata (Boheman)	*Carex montana/humilis*	CY	Drosopoulos et al. (1983)

Kelisia			
brucki Fieber	*Juncus* sp.,	JU	Asche (1982a)
	Scirpus holoschoenus	CY	Drosopoulos et al. (1983)
confusa Linnavuori	*Carex riparia*	CY	Drosopoulos et al. (1983)
creticola Asche	*Juncus* sp.	JU	Asche (1982a)
	Scirpus holoschoenus	CY	Drosopoulos et al. (1983)
gargano Remane and Asche	*Carex montana/humilis*	CY	Drosopoulos et al. (1983)
guttula (Germar)	*Carex flacca*	CY	den Bieman and Booij (1984)
guttulifera (Kirschbaum)	*Carex divulsa*	CY	Drosopoulos et al. (1983)
haupti Wagner	*Carex montana/humilis*	CY	Drosopoulos et al. (1983)
henschii Horvath	*Carex* sp.	CY	Asche (1982b)
melanops Fieber	*Carex* sp.	CY	Drosopoulos et al. (1983)
monoceros Ribaut	*Carex verna*	CY	Gunthart (1987)
perrieri Ribaut	*Juncus* sp.	JU	Drosopoulos et al. (1983)
	Scirpus holoschoenus	CY	
preacox Haupt	*Carex* sp., *Cyperus* sp.	CY	Drosopoulos et al. (1983)
ribauti Wagner	*Carex elongata*	CY	den Bieman and Booij (1984)
riboceros Asche	*Carex* sp.	CY	Asche (1986)
sabulicola Wagner	*Carex arenaria*	CY	den Bieman and Booij (1984)
vittipennis Sahlberg	*Carex* sp., *Eriophorum* sp.	CY	Gunthart (1987)
yarkonensis Linnavuori	*Juncus* sp.	JU	Asche (1982b)
	Scirpus holoschoenus	CY	Drosopoulos et al. (1983)

SUBFAMILY STENOCRANINAE

Stenocranus			
agamopsyche Kirkaldy	*Phragmites communis*	PO	Yang (1989)
arundineus Metcalf	*Arundinaria* sp.	PO	Beamer (1946)
fuscovittatus (Stål)	*Carex* sp.	CY	Asche (1982b)
	Claudia mariscus	CY	Drosopoulos et al. (1983)
gialovus Asche & Hoch	*Phalaris aquatica*	PO	Asche and Hoch (1983)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Host Plant: Family[a]	References
harimensis Matsumura	*Carex thunbergii*	CY	Kisimoto (personal communication)
lautus Van Duzee	*Carex lurida*	CY	Calvert and Wilson (1986)
major (Kirschbaum)	*Phalaris arundinacea*	PO	Ossiannilsson (1978)
matsumurai Metcalf	*Phragmites communis*	PO	Yang (1989)
minutus (Fabricius)	*Dactylis glomerata*	PO	Asche (1982b)
	Brachypodium pinnatum	PO	Cobben and Rozeboom (1983)
rufilinearis Kuoh	*Eleocharis tuberosa*	CY	Ding and Kuoh (1981)
	Cyperus rotundatus	CY	
similis Crawford	*Arundinaria tecta*	PO	Dozier (1922)
yasumatsui Ishihara	*Carex* sp.	CY	Lee and Kwon (1980)
Terauchiana			
nigripennis Kato	*Imperata cylindrica*	PO	Lee and Kwon (1980)
	SUBFAMILY PLESIODELPHACINAE		
Burnilia			
heliconiae Muir	*Heliconia* sp.	HE	Muir (1926)
spinifera antillana Fennah	*Heliconia* sp.	HE	Fennah (1959a)
	SUBFAMILY DELPHACINAE		
	Tribe Tropidocephalini		
Arcofaciella			
verrucosa Fennah	*Bambusa oldhamii*	PO	Yang and Yang (1986)
	B. multiplex	PO	
Arcofacies			
fullawayi Muir	*Bambusa dolichoclada*	PO	Yang and Yang (1986)
	B. oldhamii/multiplex	PO	
huangi Ding and Hu	*Bambusa affinis*	PO	Ding and Hu (1982)

luodianensis Ding	Bamboo	PO	Ding (1982)
membranacea Yang and Yang	*Dendrocalamus latiflorus*	PO	Yang and Yang (1986)
taiwanensis (Muir)	*Dendrocalamus latiflorus*	PO	Yang and Yang (1986)
Belocera			
sinensis Muir	*Bambusa multiplex*	PO	Yang and Yang (1986)
Columbisoga			
chusqueae Muir	*Chusquea* sp.	PO	Muir (1926)
gynericola Muir	*Gynerium saccharoides*	PO	Muir (1926)
gynerii Muir	*Gynerium* sp.	PO	Muir (1926)
ornata Muir	*Gynerium* sp.	PO	Muir (1926)
Epeurysa			
abatana Asche	*Bambusa dolichoclada*	PO	Yang and Yang (1986)
	B. oldhamii	PO	
bengueta Asche	Bamboo	PO	Asche (1983)
infumata Huang & Ding	*Phyllostachys* sp.	PO	Yang and Yang (1986)
	Chimonobambusa naibunensis	PO	
maculata Yang & Yang	*Fargesia niitakayamensis*	PO	Yang and Yang (1986)
nawaii Matsumura	*Phyllostachys makinoi*	PO	Yang and Yang (1986)
	Chimonobambusa quadrangularis	PO	
remanei Asche	Bamboo	PO	Asche (1983)
sinobambusae Yang & Yang	*Sinobambusa kunishii*	PO	Yang and Yang (1986)
Jassidaeus			
lugubris (Signoret)	*Festuca* sp.	PO	Asche and Hoch (1982)
Macrocorupha			
gynerii Muir	*Gynerium sagittatum*	PO	Muir (1926)
Malaxa			
aurunca Yang and Yang	*Bambusa multiplex*	PO	Yang and Yang (1986)
bakeri Muir	*Bambusa stenosachya*	PO	Yang and Yang (1986)
	B. dolichoclada/oldhamii	PO	
fusca Yang and Yang	*Bambusa multiplex*	PO	Yang and Yang (1986)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
occidentalis Muir	*Gynerium* sp.	PO	Muir (1926)
Paranectopia			
lasaensis Ding and Tian	Poaceae	PO	Ding and Tian (1981)
Purohita			
cervina Distant	*Phyllostachys* sp.	PO	Yang and Yang (1986)
maculata Muir	*Dendrocalamus* sp.	PO	Yang and Yang (1986)
	Bambusa multiplex	PO	
nigripes Muir	*Bambusa vulgaris*	PO	Yang and Yang (1986)
picea Yang and Yang	*Dendrocalamus giganteus*	PO	Yang and Yang (1986)
	D. latiflorus	PO	
sinica Huang and Ding	*Dendrocalamus latiflorus*	PO	Yang and Yang (1986)
taiwanensis Muir	*Phyllostachys pubescens*	PO	Yang and Yang (1986)
	Bambusa arundinacea	PO	
	B. beechyana/multiplex	PO	
	B. oldhamii/stenostachya	PO	
	B. vulgaris, Dendrocalamus	PO	
	giganteus/latiflorus	PO	
Specinervures			
liquida Yang and Yang	*Bambusa edulis*	PO	Yang and Yang (1986)
Tropidocephala			
andropogonis Horvath	*Chrysopogon gryllus*	PO	Drosopoulos et al. (1983)
brunipennis Signoret	*Imperata cylindrica*	PO	Lee and Kwon (1977)
	Miscanthus sinensis	PO	
	Oryza sativa	PO	
dimidia Yang and Yang	*Imperata cylindrica*	PO	Yang and Yang (1986)
festiva (Distant)	*Imperata cylindrica*	PO	Yang and Yang (1986)
formosana Matsumura	*Miscanthus* spp.	PO	Yang and Yang (1986)

grata Yang and Yang	*Imperata cylindrica*	PO	Yang and Yang (1986)
	Miscanthus spp.	PO	
maculosa Matsumura	*Miscanthus* spp.	PO	Yang and Yang (1986)
saccharivorella Matsumura	*Miscanthus* spp.	PO	Yang and Yang (1986)
	Saccharum spp.	PO	
sinuosa Yang and Yang	*Imperata cylindrica*	PO	Yang and Yang (1986)
tuberipennis (Mulsant and Rey)	*Imperata cylindrica*	PO	Asche (1982c)
	Tribe Saccharosydnini		
Neomalaxa			
flava Muir	*Brachiaria adspersa*	PO	Wheeler (personal communication)
Saccharosydne			
ornatipennis Muir	*Paspalum intermedium*	PO	Muir (1926)
procerus (Matsumura)	*Zizania aquatica*	PO	Yang (1989)
	Z. caduciflora	PO	Ding et al. (1982)
	Z. latifolia	PO	Vilbaste (1968)
rostrifrons (Crawford)	*Paspalum virgatum*	PO	Metcalfe (1969)
saccharivora (Westwood)	*Andropogon bicornis*	PO	Metcalfe (1969)
	A. glomeratus	PO	
	Saccharum officinarum	PO	
	Sorghum sudanense	PO	
viridis Muir	*Oryza sativa*	PO	Muir (1926)
	Tribe Delphacini		
Acanthodelphax			
denticauda (Boheman)	*Deschampsia caespitosa*	PO	den Bieman and Booij (1984)
spinosus (Fieber)	*Nardus stricta*	PO	Gunthart (1987)
	Festuca cyllenica, F. spp.	PO	Drosopoulos et al. (1983)
Achorotile			
distincta Scudder sp.	*Calamagrostis rubescens*	PO	Scudder (1963)
	Carex sp.	CY	S. Wilson (unpublished data)
stylata Beamer	*Poa pratensis*	PO	Scudder (1963)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Host Plant: Family[a]	References
Aloha			
artemisiae (Kirkaldy)	*Artemisia australis*	AS	Zimmerman (1948)
campylothecae Muir	*Campylotheca* sp.	AS	Zimmerman (1948)
dubautiae (Kirkaldy)	*Dubautia laxa*	AS	Zimmerman (1948)
	D. plantaginea	AS	
flavocollaris Muir	*Dubautia laxa*	AS	Zimmerman (1948)
	D. plantaginea	AS	
ipomoeae Kirkaldy	*Ipomoea batatas*	CO	Zimmerman (1948)
	I. bona-nox	CO	
	I. insularis	CO	
	I. pes-caprae	CO	
	I. pentaphylla	CO	
	I. tuberculata	CO	
kirkaldyi Muir	*Euphorbia hillebrandi*	EU	Zimmerman (1948)
majuma Fennah	*Cyrtandra* sp.	GE	Fennah (1958)
myoporicola Kirkaldy	*Myoporum sandwicense*	MP	Zimmerman (1948)
	Pelea volcanicola	RT	
plectranthi Muir	*Plectranthus parviflorus*	LA	Zimmerman (1948)
swezeyi Muir	*Bidens pilosa*	AS	Zimmerman (1948)
	Campylotheca macrocarpa	AS	
	Cheirodendron gaudichaudii	AL	
	Lipochaeta sp.	AS	
	Lythrum sp.	LY	
Ambarvalia			
pyrops Distant	*Stevensonia* sp.	AR	Fennah (1964)
Anchodelphax			
bagnon Fennah	*Pimelea* sp.	TH	Fennah (1965a)
olenus Fennah	*Muehlenbeckia australis*	PL	
	Lepidium oleraceum	BR	

Bakerella			
bidens Beamer	*Carex* sp.	CY	Beamer (1945)
cinerea Beamer sp.	*Eleocharis palustris*	CY	
	Juncus sp.	JU	S. Wilson (unpublished data)
Calligypona			
reyi (Fieber)	*Juncus* sp.	JU	Ossiannilsson (1978)
	Scirpus lacustris	CY	
	S. tabernaemontani	CY	
	Cyperus sp.	CY	Drosopoulos et al. (1983)
Changeondelphax			
velitchkovski (Melichar)	*Typha laxmanni*	TY	Kwon (1982)
Chloriona			
chinai Ossiannilsson	*Phragmites* sp.	PO	Ossiannilsson (1978)
clavata Dlabola	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
dorsata Edwards	*Phragmites* sp.	PO	den Bieman and Booij (1984)
flaveola Lindberg	*Phragmites communis*	PO	Asche (1982c)
	Arundo donax	PO	
glaucescens Fieber	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
ponticana Asche	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
smaragdula (Stål)	*Phragmites* sp.	PO	den Bieman and Booij (1984)
stenoptera (Flor)	*Phragmites* sp.	PO	Vilbaste (1974)
tateyamana Matsumura	*Phragmites communites*	PO	Yang (1989)
	Typha laxmanni	TY	Vilbaste (1968)
unicolor (Herrich-Schaffer)	*Phragmites communis*	PO	Asche (1982b)
	Arundo donax	PO	
vasconica Ribaut	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
Chlorionidea			
bromi Emeljanov	*Bromus inermis*	PO	Emeljanov (1977)
flava Low	*Carex montana*	CY	Drosopoulos et al. (1983)
Conomelus			
anceps (Germar)	*Juncus effusus*	JU	Waloff and Solomon (1973)
odryssius Dlabola	*Juncus effusus/inflexus*	JU	Drosopoulos et al. (1983)
sagittifer Remane and Asche	*Juncus inflexus*	JU	Drosopoulos et al. (1983)
Coracodelphax			
obscurus Vilbaste	*Zoysia japonica*	PO	Kwon (1982)
Cormidius			
nigrifrons (Kusnezov)	*Agropyron pseudagropyrum*	PO	Emeljanov (1977)
Criomorphus			
albomarginatus Curtis	*Festuca rubra*	PO	den Bieman and Booij (1984)
	Holcus spp.	PO	Waloff and Solomon (1973)
borealis (Sahlberg)	*Calamagrostis canescens*	PO	den Bieman and Booij (1984)
moestus (Boheman)	*Calamagrostis canescens*	PO	Ossiannilsson (1978)
Delphacinus			
griceus Emeljanov	*Elymus* sp.	PO	Emeljanov (1977)
Delphacodes			
arcuata Beamer	*Manihot utilissima*	EU	Caldwell and Martorell (1950)
axonopi Fennah	*Axonopus compressa*	PO	Caldwell and Martorell (1950)
bellicosa Muir and Giffard	*Paspalum distichum*	PO	Wilson (1985)
capnodes (Scott)	*Carex riparia*	CY	Drosopoulos et al. (1983)
campestris (Van Duzee)	*Agropyron* sp.	PO	DuBose (1960)
	Agropyron cristatum	PO	S. Wilson (unpublished data)
	Calamavilfa longifolia	PO	
	Poa pratenensis	PO	

	Agrostis sp., *Festuca ovina*	PO	
	Stipa cornata	PO	
	Carex scoparia	CY	
cerberus Fennah	*Drimys confertifolia*	WI	Fennah (1957)
detecta (Van Duzee)	*Spartina patens*	PO	Raupp and Denno (1979)
idonea Beamer	*Panicum repens*	PO	Ballou et al. (1987)
laminalis (Van Duzee)	*Leersia hexandra*	PO	S. Wilson (unpublished data)
latidens Beamer	*Setaria texana*	PO	S. Wilson (unpublished data)
lutulenta (Van Duzee)	*Andropogon repens*	PO	S. Wilson (unpublished data)
	Poa pratensis	PO	
	Puccinellia nuttalliana	PO	
mutrella Metcalf	*Corokia* sp.	CN	Fennah (1958)
	Metrosideros sp.	MY	
	Blechnum sp.	BL	
nigerrima Ishihara	*Murkania keisak*	CM	Kisimoto (personal communication)
nigrifacies Muir	*Paspalum notatum*	PO	Calvert et al. (1987a)
nigrigena Matsumura and Ishihara	*Poa sphondylodes*	PO	Lee and Kwon (1977)
parvula (Ball)	*Andropogon scoparius*	PO	S. Wilson (unpublished data)
penedetecta Beamer	*Spartina alterniflora*	PO	S. Wilson (unpublished data)
puella (Van Duzee)	*Galinsoga parviflora*	AS	Batra (1979)
	Panicum capillare	PO	S. Wilson (unpublished data)
rotundata Beamer	*Agrostis scabra*	PO	S. Wilson (unpublished data)
	Andropogon gerhardi	PO	
	Juncus marginatus	JU	S. Wilson (unpublished data)
schinias Asche and Remane	*Cyperus* sp.	CY	Drosopoulos et al. (1983)
	Phragmites sp.	PO	
stricklandi Metcalf	*Amaranthus elapious*	AM	Metcalf (1946a)
Delphacodoides			
anaxarchi (Muir)	*Hemarthia altissima*	PO	Drosopoulos et al. (1983)
Delphax			
armeniacus Anufriev	*Phragmites communis*	PO	Drosopoulos et al. (1983)
crassicornis (Panzer)	*Phragmites communis*	PO	Ossiannilsson (1978)
inermis Ribaut	*Phragmites communis*	PO	Asche (1982c)
	Arundo donax	PO	

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
meridionalis (Haupt)	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
pulchellus (Curtis)	*Phragmites communis*	PO	Ossiannilsson (1978)
ribautianus Asche and Drosopoulos	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
Dicentropyx			
sublineata (Emeljanov)	*Elymus* sp.	PO	Emeljanov (1977)
Dicranotropis			
divergens Kirschbaum	*Nardus* sp.	PO	Gunthart (1987)
	Deschampsia flexuosa		
fumosa Matsumura	*Saccharum officinarum*	PO	Yang (1989)
hamata (Boheman)	Grasses	PO	Asche (1982b)
	Dactylis glomerata	PO	Gunthart (1987)
	Holcus sp.	PO	
Dictyophorodelphax			
mirabilis Swezey	*Euphorbia clusiaefolia*	EU	Zimmerman (1948)
	E. billebrandi	EU	
predicta Bridwell	*Euphorbia hookeri*	EU	Zimmerman (1948)
swezeyi Bridwell	*Euphorbia celastroides*	EU	Zimmerman (1948)
usingeri Swezey	*Euphorbia* sp.	EU	Zimmerman (1948)
Ditropis			
pteridis (Spinola)	*Pteridium aquilinum*	PT	Asche (1982b)
Eoeurysa			
arundina Kuoh & Ding	*Arundo donax*	PO	Yang (1989)
flavocapitata Muir	*Saccharum officinarum*	PO	Yang (1989)
Euconomelus			
lepidus (Boheman)	*Juncus* spp.	JU	Drosopoulos et al (1983); Asche (1982b)
	Carex sp.	CY	

Euidelloides			
montana Muir	*Chusquea* sp.	PO	Muir (1926)
Euides			
alpina Wagner	*Phragmites communis*	PO	Lauterer (1983)
elegans (Muir)	*Guadua* sp.	PO	Muir (1926)
gerhardi (Metcalf)	*Scirpus americana*	CY	S. Wilson (unpublished data)
guaduae (Muir)	*Guadua* sp.	PO	Muir (1926)
speciosa (Boheman)	*Phragmites communis*	PO	Drosopoulos et al. (1983)
	Arundo donax	PO	
Euidopsis			
truncata Ribaut	*Imperata cylindrica*	PO	Drosopoulos et al. (1983)
Eurybregma			
nigrolineata Scott	*Dactylis glomerata*	PO	Drosopoulos et al. (1983)
pseudoagropyri Emeljanov	*Agropyron pseudoagropyrum*	PO	Emeljanov (1966)
Eurysa			
brunnea Melichar	*Secale montanum*	PO	Drosopoulos et al. (1983)
flavobrunnea Dlabola	*Helictotrichon convolutum*	PO	Drosopoulos et al. (1983)
fornasta Asche, Drosopoulos and Hoch	*Arrhenatherum elatius*	PO	Drosopoulos et al. (1983)
obesa Beamer	*Elymus* sp.	PO	S. Wilson (unpublished data)
rubripes (Matsumura)	*Dactylis glomerata*	PO	Drosopoulos et al. (1983)
Eurysula			
lurida (Fieber)	*Calamagrostis epigeios*	PO	Ossiannilsson (1978)
	C. canescens	PO	
Falcotoya			
miniscula (Horvath)	*Cynodon dactylon*, grasses	PO	Drosopoulos et al. (1983)
Flastena			
fumipennis (Fieber)	*Cyperus longus*	CY	Le Quesne (1983)
	Carex sp.	CY	Drosopoulos et al. (1983)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
Florodelphax			
leptosoma (Flor)	*Juncus* spp.	JU	Drosopoulos et al. (1983)
	Cyperus	CY	
mourikisi Drosopoulos	*Juncus acutus/maritimus*	JU	Drosopoulos et al. (1983)
Gravesteiniella			
boldi (Scott)	*Ammophila arenaria*	PO	Ossiannilsson (1978)
	Lasiagrostis splendens	PO	Vilbaste (1965)
mitjaevi Emeljanov	*Achnatherum splendens*	PO	Emeljanov (1982)
Halmyra			
aeluropodis (Emeljanov)	*Aeluropus littoralis*	PO	Drosopoulos et al. (1983)
Harmalia			
commelinae Yang	*Commelina diffusa*	CM	Yang (1989)
Horvathianella			
palliceps (Horvath)	*Chrysopogon gryllus*	PO	Drosopoulos et al. (1983)
Ilburnia			
dianae Fennah	Fern brakes	PY	Fennah (1976)
ignobilis White	*Dicksonia arborescens*	DK	Fennah (1976)
	Fern brakes	PY	
Ishiharodelphax			
matsuyamensis Ishihara	*Zoysia japonica/tenuifolia*	PO	Kwon (1982)
	Agrostis clavata	PO	
Iubsoda			
stigmatica (Melichar)	*Hyparrhenia hirta*	PO	Asche (1982c)
Javesella			
discolor (Boheman)	*Deschampsia flexuosa*	PO	de Vrijer (1981)
	Deschampsia cespitosa	PO	
	Poa nemoralis	PO	
	Avena sativa, Holcus mollis	PO	Wilson and O'Brien (1987)

dubia (Kirschbaum)	*Agrostis stolonifera*	PO	de Vrijer (1981)
	A. tenuis	PO	
	Arrhenatherum elatior	PO	
forcipata (Boheman)	*Poa pratensis/annua*	PO	de Vrijer (1981)
kilmani (Van Duzee)	*Equisetum* sp.	EQ	Strickland (1940)
obscurella (Boheman)	*Alopecurus geniculatus*	PO	de Vrijer (1981)
	Avena sativa	PO	Wilson and O'Brien (1987)
pellucida (Fabricius)	Polyphagous, grasses	PO	de Vrijer (1981)
	Festuca pratensis/rubra	PO	Gunthart (1987)
	Agrostis tenuis	PO	
	Dactylis glomerata	PO	
	Sieglingia decumbens	PO	
	Avena sativa	PO	Ossiannilsson (1978)
	Lolium perenne	PO	
	Carex rostrata/limosa	CY	DuBose (1960)
	Scirpus microcarpus	CY	S. Wilson (unpublished data)
salina (Haupt)	*Triglochin maritima*	JG	de Vrijer (1981)
	Juncus gerardi	JU	Ossiannilsson (1978)
simillima (Linnavuori)	*Eriophorum* sp., *Carex* sp.	CY	Ossiannilsson (1978)
stali (Metcalf)	*Equisetum* sp.	EQ	Ossiannilsson (1978)
Kakuna			
albipennis (Matsumura)	*Pennisetum alopecuroides*	PO	Yang (1989)
kuwayamai Matsumura	*Phragmites communis*	PO	Lee and Kwon (1977)
sapporonis (Matsum.)	*Typha laxmanni*	TY	Vilbaste (1968)
"*Kelisia*"[b]			
emoloa Muir	*Eragrostis variabilis*	PO	Zimmerman (1948)
eragrosticola Muir	*Eragrostis variabilis*	PO	Zimmerman (1948)
sporobolicola Kirkaldy	*Eragrostis atropiodes*	PO	Zimmerman (1948)
	Sporobolus virginicus	PO	
	Vincentia angustifolia	CY	
s. immaculata Kirkaldy	*Deschampsia australis*	PO	Zimmerman (1948)
	Vincentia angustifolia	CY	

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
Kormus			
artemisiae Fieber	*Limonium gmelini*	PU	Emeljanov (personal communication)
Kusnezoviella			
antinoma Emeljanov	*Elymus* sp.	PO	Emeljanov (1977)
chalchica Emeljanov	*Hordeum* sp.	PO	Emeljanov (1977)
dimidatifrons (Kusnezov)	*Agropyron pseudagropyrum*	PO	Emeljanov (1977)
Laccocera			
obesa	*Thinopyrum ponticum*	PO	Spangler and MacMahon (1990)
sp.	*Stipa cornata*	PO	S. Wilson (unpublished data)
	Muhlenbergia richardsonis	PO	
	Puccinellia sp.	PO	
Laodelphax			
elegantulus (Boheman)	*Festuca rubra*	PO	Waloff and Solomon (1973)
	Deschampsia flexuosa	PO	Gunthart (1987)
striatellus (Fallen)	Polyphagous	PO	Wilson and O'Brien (1987)
	Oryza sativa	PO	
	Avena sativa	PO	
	Arrhenatherum elatius	PO	
	Triticum sp.	PO	
	Zea mays	PO	
	Hordeum vulgare	PO	
Leialoha			
cajeta Fennah	*Reynoldsia* sp.	AL	Fennah (1958)
	Rapanea sp.	MS	
	Weinmannia parviflora	CU	
	Metrosideros collina	MY	
	Alstonia sp.	AP	
	Cyrtandra sp.	GE	
	Cheirodendron sp.	AL	
hawaiiensis (Muir)	*Metrosideros* sp.	MY	Zimmerman (1948)

kauaiensis (Muir)	*Metrosideros* sp.	MY	Zimmerman (1948)
lanaiensis (Muir)	*Metrosideros* sp.	MY	Zimmerman (1948)
lebuae (Kirkaldy)	*Metrosideros* sp.	MY	Zimmerman (1948)
mauiensis (Muir)	*Metrosideros* sp.	MY	Zimmerman (1948)
nanticola (Kirkaldy)	*Metrosideros* sp.	MY	Zimmerman (1948)
oahuensis (Muir)	*Metrosideros* sp.	MY	Zimmerman (1948)
oceanides (Kirkaldy)	*Osmanthus sandwicensis*	OL	Zimmerman (1948)
obiae (Kirkaldy)	*Metrosideros* sp.	MY	Zimmerman (1948)
scaevolae Muir	*Scaevola chamissoniana*	GO	Zimmerman (1948)
suttoniae Muir	*Myrsine sandwicensis*	MS	Zimmerman (1948)
Leptodelphax			
cyclops Haupt	*Saccharum* sp.	PO	Drosopoulos et al. (1983)
Liburniella			
ornata (Stål)	*Rhynchospora globularis*	CY	S. Wilson (unpublished data)
Maculidelphax			
maculipennis (Linnavuori)	*Imperata cylindrica*	PO	Drosopoulos et al. (1983)
Malaxodes			
farinosus Fennah	*Melinis minutiflora*	PO	Fennah (1967a)
Matutinus			
putoni (A. Costa)	*Typha latifolia/angustifolia*	TY	D'Urso and Guglielmino (1986)
Megadelphax			
sordidula (Stål)	*Avena sativa*	PO	Wilson and O'Brien (1987)
	Phleum pratense	PO	
	Triticum sp.	PO	
Megamelodes			
quadrimaculatus (Signoret)	Polyphagous	MO	Asche (1982b)
Megamelus			
davisi Van Duzee	*Nuphar advena*	NY	Wilson and McPherson (1981a)
lobatus Beamer	*Spartina patens*	PO	Raupp and Denno (1979)
metzaria Crawford	*Spartina pectinata*	PO	S. Wilson (unpublished data)
notula (Germar)	*Carex lasiocarpa*	CY	Vilbaste (1971)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
	Juncus sp.	JU	
	Carex riparia	CY	Drosopoulos et al. (1983)
palaetus (Van Duzee)	*Pontederia cordata*	PN	Wilson and McPherson (1979)
sp.	*Eleocharis* sp.	CY	S. Wilson (unpublished data)
	Distichlis stricta	PO	
sp.	*Spartina alterniflora*	PO	Denno 1977, S. Wilson (unpublished)
Metropis			
achnatheri Emeljanov	*Achnatherum splendens*	PO	Emeljanov (1977)
aris Asche, Drosop. and Hoch	*Festuca* sp.	PO	Drosopoulos et al. (1983)
inermis Wagner	*Festuca ovina*	PO	Gunthart (1987)
	Carex sp.	CY	
mayri Fieber	*Festuca cyllenica*	PO	Drosopoulos et al. (1983)
tolerans Emeljanov	*Festuca* spp.	PO	Emeljanov (1977)
Muellerianella			
brevipennis (Boheman)	*Deschampsia cespitosa*	PO	Booij (1982)
extrusa (Scott)	*Molinia caerulea*	PO	Asche (1982b)
fairmairi (Perris)	*Holcus lanatus/mollis*	PO	Asche (1982b)
relicta Logvinenko	*Luzula* sp.	JU	Drosopoulos (1977)
sp.	*Carex divulsa*	CY	Drosopoulos (1983)
	Setaria pumila	PO	
Muirodelphax			
atratus Vilbaste	*Zoysia japonica*	PO	Kwon (1982)
aubei (Perris)	*Ammophila arenaria*	PO	Drosopoulos et al. (1983)
	Elymus pycnanthus	PO	
matsuyamensis (Ishihara)	*Agrostis clavata*	PO	Lee and Kwon (1980)
	Zoysia japonica/tenuifolia	PO	
Neomegamelanus			
dorsalis (Metcalf)	*Spartina patens*	PO	Raupp and Denno (1979)

elongatus (Ball)	*Spartina patens*	PO	McDermott (1952)
elongatus reductus Caldwell	*Sporobolus virginicus*	PO	Caldwell and Martorell (1950)
Nesodryas			
antiope Fennah	*Cocos nucifera*	AR	Wilson (1987)
freycinetiae Kirkaldy	*Freycinetia arborea*	PA	Zimmerman (1948)
gigantea (Muir)	*Pritchardia* sp.	AR	Wilson (1987)
oenone Fennah	*Pandanus* sp.	PA	Fennah (1958)
swezeyi Zimmerman	*Pritchardia* sp.	AR	Wilson (1987)
Nesorestias			
filicola Kirkaldy	*Cibotium* sp.	DK	Zimmerman (1948)
	Elaphoglossum gorgonum	AN	
nimbata (Kirkaldy)	*Phegopteris* sp.	TL	Zimmerman (1948)
Nesorthia			
paronychiae Fennah	*Paronychia manicata*	CA	Fennah (1962a)
Nesosydne			
acastus Fennah	*Crossostylis biflora*	RH	Fennah (1958)
acuta (Muir)	*Cyrtandra mauiensis*	GE	Zimmerman (1948)
agenor Fennah	*Premna tahitensis*	VE	Fennah (1958)
	Morinda citrifolia	RU	
ahinahina (Muir)	*Argyroxiphium* sp.	AS	Zimmerman (1948)
aku (Muir)	*Cyanea tritomantha*	CP	Zimmerman (1948)
amaumau (Muir)	*Sadleria* sp.	BL	Zimmerman (1948)
anceps Muir	*Freycinetia* sp.	PA	Zimmerman (1948)
argyroxiphii Kirkaldy	*Argyroxiphium sandwicense*	AS	Zimmerman (1948)
asteliae Muir	*Astelia veratroides*	LI	Zimmerman (1948)
boehmeria (Muir)	*Boehmeria* sp.	UR	Zimmerman (1948)
bridwelli (Muir)	*Argyroxiphium virescens*	AS	Zimmerman (1948)
	A. sandwicense	AS	
	Dubautia sp.	AS	
calypso Fennah	*Drimys confertifolia*	WI	Fennah (1957)
	Gunnera masafuerae	GU	
campylothecae (Muir)	*Campylotheca* sp.	AS	Zimmerman (1948)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant		References
	Genus and Species	Family[a]	
chambersi Kirkaldy	*Raillardia ciliolata*	AS	Zimmerman (1948)
cheesmanae (Muir)	*Weinmannia* sp.	CU	Fennah (1958)
cleanthes Fennah	*Weinmannia* sp.	CU	Fennah (1958)
clitarchus Fennah	*Piper latifolium*	PI	Fennah (1958)
coprosmicola (Muir)	*Coprosma ernodiodes*	RU	Zimmerman (1948)
cyane Fennah	*Reynoldsia* sp.	AL	Fennah (1958)
	Weinmannia sp.	CU	
	Glochidion ramiflorum	EU	
	Loranthus sp.	LO	
	Cyrtandra sp.	GE	
cyathodis Kirkaldy	*Styphelia tameiameiae*	EP	Zimmerman (1948)
cyrtandrae Muir	*Cyrtandra* sp.	GE	Zimmerman (1948)
cyrtandricola Muir	*Cyrtandra* sp.	GE	Zimmerman (1948)
	Charpentiera obovata	AM	
dinomache Fennah	*Cyrtandra* sp.	GE	Fennah (1958)
	Sclerotheca sp.	CP	
	Vaccinium sp.	ER	
	Weinmannia sp.	CU	
dubautiae (Muir)	*Dubautia plantaginea*	AS	Zimmerman (1948)
eeke (Muir)	*Argyroxiphium* sp.	AS	Zimmerman (1948)
elatus Fennah	*Cyrtandra* sp.	GE	Fennah (1958)
	Bidens lantanoides	AS	
	Freycinetia sp.	PA	
fullawayi (Muir)	*Styphelia* sp.	EP	Zimmerman (1948)
geranii (Muir)	*Geranium arboreum*	GR	Zimmerman (1948)
giffardi Muir	*Cyrtandra grandiflora*	GE	Zimmerman (1948)
	Rollandia crispa	CP	

gigantea (Muir)	*Pritchardia* sp.	AR	Zimmerman (1948)
gouldiae Kirkaldy	*Cyrtandra grandiflora*	GE	Zimmerman (1948)
	Cyrtandra sp.	GE	
gunnerae Muir	*Gunnera petaloidea*	GU	Zimmerman (1948)
halia Kirkaldy	*Dubautia plantaginea*	AS	Zimmerman (1948)
	Freycinetia sp.	PA	
imbricola Kirkaldy	*Coprosma montana*	RU	Zimmerman (1948)
ipomoeicola Kirkaldy	*Antidesma* sp.	SG	Zimmerman (1948)
	Brassica sp.	BR	
	Cibotium sp.	DK	
	Cynodon dactylon	PO	
	Cyrtandra sp.	GE	
	Dolichos lablab	FA	
	Gouldia elongata	RU	
	Ipomoea batatas	CO	
	Ipomoea bona-nox	CO	
	Jussiaea villosa	ON	
	Lythrum maritimum	LY	
	Mucuna gigantea	FA	
	Pipturus sp.	UR	
	Polygonum sp.	PL	
	Rumex sp.	PL	
	Sadleria sp.	BL	
	Solanum tuberosum	SO	
	Strongylodon lucidum	FA	
koae Kirkaldy	*Acacia koa*	FA	Zimmerman (1948)
koae-phyllodii Muir	*Acacia koa*	FA	Zimmerman (1948)
kokolau (Muir)	*Campylotheca* sp.	AS	Zimmerman (1948)
kuschei (Muir)	*Cyrtandra* sp.	GE	Zimmerman (1948)
lanaiensis (Muir)	*Styphelia* sp.	EP	Zimmerman (1948)
lanista Fennah	*Piper latifolium*	PI	Fennah (1958)
	Weinmannia sp.	CU	
	Sida sp.	MA	

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
latona Fennah	*Weinmannia parviflora*	CU	Fennah (1958)
leahi (Kirkaldy)	*Lipochaeta calycosa*	AS	Zimmerman (1948)
linus Fennah	*Freycinetia* sp.	PA	Fennah (1958)
	Cyathea sp.	CT	
	Bidens lantanoides	AS	
	Hibiscus tiliaceus	MA	
	Metrosideros collina	MY	
lobeliae Muir	*Lobelia hypoleuca*	CP	Zimmerman (1948)
longipes (Muir)	*Cyrtandra mauiensis*	GE	Zimmerman (1948)
mamake (Muir)	*Pipturus* sp.	UR	Zimmerman (1948)
mauiensis (Muir)	*Campylotheca mauiensis*	AS	Zimmerman (1948)
	Lipochaeta integrifolia	AS	
	Raillardia menziesii	AS	
	Tetramolopium artemisia	AS	
melampus Fennah	*Weinmannia parviflora*	CU	Fennah (1958)
minos Fennah	*Gunnera masafuerae*	GU	Fennah (1957)
	Pernettya rigida	ER	
monticola Kirkaldy	*Coprosma montana*	RU	Zimmerman (1948)
montis-tantalus Muir	*Lobelia hypoleuca*	CP	Zimmerman (1948)
	Broussaisia arguta	HY	
naenae (Muir)	*Dubautia* sp.	AS	Zimmerman (1948)
	Raillardia sp.	AS	
neocyrtandrae (Muir)	*Gunnera mauiensis*	GU	Zimmerman (1948)
neoraillardiae (Muir)	*Lipochaeta subcordata*	AS	Zimmerman (1948)
neowailupensis (Muir)	*Coprosma longifolia*	RU	Zimmerman (1948)
nephrolepidis Kirkaldy	*Nephrolepis exaltata*	DV	Zimmerman (1948)
nesopele (Muir)	*Astelia veratroides*	LI	Zimmerman (1948)
nigrinervis (Muir)	*Styphelia* sp.	EP	Zimmerman (1948)

oahuensis Muir	*Charpentiera obovata*	AM	Zimmerman (1948)
olympica (Muir)	*Lobelia* sp.	CP	Zimmerman (1948)
oroanda Fennah	*Melochia velutina*	ST	Fennah (1958)
osborni Muir	*Raillardia* sp.	AS	Zimmerman (1948)
otus Fennah	*Fitchia* sp.	AS	Fennah (1958)
	Ferns	PY	
	Veronica sp.	SC	
painiu (Muir)	*Astelia veratroides*	LI	Zimmerman (1948)
phyllostegiae Muir	*Phyllostegia racemosa*	LA	Zimmerman (1948)
pilo (Muir)	*Coprosma ernodiodes*	RU	Zimmerman (1948)
pipturi Kirkaldy	*Pipturus* sp.	UR	Zimmerman (1948)
pseudorubescens Muir	*Acacia koa*	FA	Zimmerman (1948)
raillardiae Kirkaldy	*Raillardia scabra*	AS	Zimmerman (1948)
	R. ciliolata	AS	
	Rollandia sp.	CP	
raillarditicola (Muir)	*Raillardia menziesii*	AS	Zimmerman (1948)
	R. platyphyllum	AS	
rubescens (Kirkaldy)	*Acacia koa*	FA	Zimmerman (1948)
satyrion Fennah	*Coprosma* sp.	RU	Fennah (1958)
sharpi Muir	*Broussaisia* sp.	HY	Zimmerman (1948)
	Boehmeria stipularis	UR	
siderion Fennah	*Reynoldsia tahitensis*	AL	Fennah (1958)
sophonisba Fennah	*Fitchia* sp.	AS	Fennah (1958)
	Lautea sp.	CN	
	Asplenium nidus	AN	
sorix Fennah	*Metrosideros collina*	MY	Fennah (1958)
stenogynicola (Muir)	*Stenogyne kamehameha*	LA	Zimmerman (1948)
sulcata (Muir)	*Cyrtandra* sp.	GE	Zimmerman (1948)
tetramolopii (Muir)	*Tetramolopium humile*	AS	Zimmerman (1948)
timberlakei Muir	*Cyrtandra garnotiana*	GE	Zimmerman (1948)
	Cyanea truncata	AS	
ulebibi (Muir)	*Smilax sandwicensis*	SM	Zimmerman (1948)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Host Plant: Family[a]	References
umbratica Kirkaldy	*Charpentiera obovata*	AM	Zimmerman (1948)
	Clermontia spp.	CP	
	Cyrtandra sp.	GE	
	Pipturus sp.	UR	
	Stenogyne sp.	LA	
	Urera sandwicensis	UR	
viridis (Muir)	*Phyllostegia* sp.	LA	Zimmerman (1948)
vulcan Fennah	*Rea micrantha*	AS	Fennah (1957)
waikamoiensis (Muir)	*Cyanea aculeatiflora*	CP	Zimmerman (1948)
	Pipturus sp.	UR	
wailupensis (Muir)	*Rollandia crispa*	CP	Zimmerman (1948)
Nesothoe			
antidesmae (Muir)	*Antidesma platyphyllum*	SG	Zimmerman (1948)
bobeae Kirkaldy	*Bobea* sp.	RU	Zimmerman (1948)
dodonaeae (Muir)	*Alphitonia* sp.	RA	Zimmerman (1948)
	Dodonaea sp.	SA	
	Myrsine sp.	MS	
dryope (Kirkaldy)	*Antidesma platyphyllum*	SG	Zimmerman (1948)
elaeocarpi (Kirkaldy)	*Cyrtandra paludosa*	GE	Zimmerman (1948)
	Elaeocarpus bifidus	EL	
	Scaevola mollis	GO	
eugeniae (Kirkaldy)	*Eugenia sandwicensis*	MY	Zimmerman (1948)
	Straussia kaduana	RU	
fletus Kirkaldy	*Antidesma platyphyllum*	SG	Zimmerman (1948)
	Myrsine sp.	MS	
giffardi (Kirkaldy)	*Cyrtandra grandiflora*	GE	Zimmerman (1948)
	Touchardia latifolia	UR	

gulicki (Muir)	*Euphorbia* sp.	EU	Zimmerman (1948)
	Metrosideros sp.	MY	
	Osmanthus sandwicensis	OL	
haa (Muir)	*Antidesma platyphyllum*	SG	Zimmerman (1948)
hula Kirkaldy	*Osmanthus sandwicensis*	OL	Zimmerman (1948)
	Pelea sp.	RT	
	Phyllostegia sp.	LA	
	Sideroxylon sp.	SP	
	Myrsine sp.	MS	
laka Kirkaldy	*Sida* sp.	MA	Zimmerman (1948)
maculata (Muir)	*Diospyros sandwicensis*	EB	Zimmerman (1948)
	D. hillebrandii	EB	
	Osmanthus sandwicensis	OL	
munroi (Muir)	*Dodonaea* sp.	SA	Zimmerman (1948)
perkinsi Kirkaldy	*Clermontia kakeana*	CP	Zimmerman (1948)
	Metrosideros sp.	MY	
	Myrsine sp.	MS	
pilani Kirkaldy	*Osmanthus sandwicensis*	OL	Zimmerman (1948)
pluvialis Kirkaldy	*Antidesma* sp.	SG	Zimmerman (1948)
semialba (Muir)	*Osmanthus sandwicensis*	OL	Zimmerman (1948)
seminigrofrons (Muir)	*Campylotheca* sp.	AS	Zimmerman (1948)
terryi Kirkaldy	*Osmanthus sandwicensis*	OL	Zimmerman (1948)
Nilaparvata			
bakeri (Muir)	*Leersia japanica*	PO	Yang (1989)
lugens (Stål)	*Oryza sativa*	PO	Claridge et al. (1988)
muiri China	*Leersia sayanuka*	PO	Mochida and Okada (1979)
sp.	*Leersia hexandra*	PO	Claridge et al. (1988)
Nothodelphax			
albocarinatus (Stål)	*Eriophorum* sp.	CY	Ossiannilsson (1978)
consimilis (Van Duzee)	*Scirpus microcarpus*	CY	DuBose (1960)
distinctus (Flor)	*Eriophorum vaginatum*	CY	Ossiannilsson (1978)
Nothorestias			
badia Muir	Ferns	PY	Zimmerman (1948)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Host Plant: Family[a]	References
swezeyi Muir	*Aspidium* sp.	PY	Zimmerman (1948)
Numata			
muiri (Kirkaldy)	*Saccharum officinarum*	PO	Yang (1989)
Opiconsiva			
nigra Ding and Tian	*Paspalum distichum*	PO	Ding and Tian (1980)
paludum (Kirkaldy)	*Herpestis monnieria*	SC	Zimmerman (1948)
	Juncus sp.	JU	
	Sedge	CY	
Paracorbulo			
sirokata (Matsumura and Ishihara)	*Oryza sativa*	PO	Kwon (1982)
	Echinochloa crusgalli	PO	
	Phragmites communis	PO	
	Persicaria thunbergii	PL	Kwon (1982), Kisimoto (personal communication)
Paradelphacodes			
litoralis (Reuter)	*Carex rostrata*	CY	Anufriev (1980)
paludosa (Flor)	*Carex* sp.	CY	Asche (1982b)
Paraliburnia			
adela (Flor)	*Phalaris arundacea*	PO	Ossiannilsson (1978)
	Glyceria spp.	PO	
clypealis (Sahlberg)	*Calamagrostis canescens*	PO	den Bieman and Booij (1984)
	Eriophorum vaginatum	CY	
	E. angustifolium	CY	
	Molinia caerulea	PO	
	Carex spp.	CY	
Paraliburniella			
dalei (Scott)	*Agrostis tenuis*	PO	Waloff and Solomon (1973)
Parametopina			
yusbaniae Yang	*Fargesia niitakayamensis*	PO	Yang (1989)

Peregrinus			
maidis (Ashmead)	*Zea mays*	PO	Wilson and O'Brien (1987)
	Sorghum halepense	PO	
Perkinsiella			
rivularis Linnavuori	*Saccharum* sp.	PO	Drosopoulos et al. (1983)
saccharicida Kirkaldy	*Saccharum officinarum*	PO	Wilson and O'Brien (1987)
sinensis Kirkaldy	*Saccharum officinarum*	PO	Yang (1989)
	Andropogon sorghum	PO	
	Phragmites communis	PO	
	Oryza sativa	PO	
thompsoni Muir	*Saccharum officinarum*	PO	Metcalf (1946b)
vastatrix (Breddin)	*Saccharum officinarum*	PO	Yang (1989)
Pissonotus			
albovenosus Osborn	*Lygodesmia grandiflora*	AS	Morgan and Beamer (1949)
aphidoides Van Duzee	*Castillija coccinea*	SC	Strickland (1940)
basalis Van Duzee	*Grindelia squarosa*	AS	Strickland (1940)
delicatus Van Duzee	*Grindelia* sp.	AS	Morgan and Beamer (1949)
	Happlopappus ciliatus	AS	
delicatus melanurus Morgan and Beamer	*Grindelia camporum*	AS	Morgan and Beamer (1949)
piceus (Van Duzee)	*Polygonum hydropiperoides*	PL	S. Wilson (unpublished data)
Prokelisia crocea (Van Duzee)	*Spartina pectinata*	PO	S. Wilson (unpublished data)
dolus Wilson	*Spartina alterniflora*	PO	Denno et al. (1987)
marginata Van Duzee	*Spartina alterniflora*	PO	Denno et al. (1987)
salina (Ball)	*Calamovilfa longifolia*	PO	Wilson 1982a, (unpublished data)
	Distichilis stricta	PO	
Pseudaraeopus			
bolivari (Melichar)	*Panicum turgidum*	PO	Linnavuori (1964)
lethierryi (Mulsant and Rey)	*Hyparrhenia hirta*	PO	Drosopoulos et al. (1983)
Pygospina			
aurantii (Crawford)	*Cyperus luzulae*	CY	Muir (1926)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Host Plant: Family[a]	References
Remanodelphax			
cedroni Drosopoulos	*Dichanthium ischaemum*	PO	Drosopoulos et al. (1983)
Ribautodelphax			
albostriatus (Fieber)	*Poa pratensis*	PO	den Bieman (1987a)
	Agrostis sp.		Gunthart (1987)
	Dactylis sp.	PO	
	Bromus sp.	PO	
angulosus (Ribaut)	*Anthoxanthium odoratum*	PO	den Bieman (1987a)
collinus (Boheman)	*Agrostis capillaris*	PO	den Bieman (1987a)
falakron Asche, Drosopoulos and Hoch	*Festuca cyllenica*	PO	den Bieman (1987a)
fanari Asche, Drosopoulos and Hoch	*Elymus hispidus*	PO	den Bieman (1987b)
	E. pycnanthus	PO	
imitans (Ribaut)	*Festuca arundinacea fenas*	PO	den Bieman (1987b)
imitantoides Bieman	*Brachypodium phoenicoides*	PO	den Bieman (1987b)
kalonerensis Bieman	*Arrhenatherum elatius*	PO	den Bieman (1987b)
nogurae Bieman	*Carex nigra*	CY	den Bieman (1987b)
ochreata Vilbaste	*Setaria* sp.	PO	Vilbaste (1965)
pallens (Stål)	*Festuca ovina*	PO	den Bieman (1987a)
pungens (Ribaut)	*Brachypodium pinnatum*	PO	den Bieman (1987b)
	B. phoenicoides	PO	
	B. sylvaticum	PO	
ventouxianus Bieman	*Festuca rubra rubra*	PO	den Bieman (1987b)
vinealis Bieman	*Agrostis vinealis*	PO	den Bieman (1987b)
Sardia			
rostrata pluto (Kirkaldy)	*Cyperus rotundus*	CY	Beardsley (1990)
Sogata			
hakonensis (Matsum.)	*Miscanthus floridulus*	PO	Yang (1989)
hyalipennis (Matsumura)	*Miscanthus floridulus*	PO	Yang (1989)

mukwaensis Yang	*Miscanthus floridulus*	PO	Yang (1989)
nigrifrons (Muir)	*Miscanthus floridulus*	PO	Yang (1989)
Sogatella			
furcifera (Horvath)	*Oryza sativa*	PO	Asche and Wilson (1990)
kolophon (Kirkaldy)	*Panicum repens*	PO	Ballou et al. (1987)
molina (Fennah)	*Panicum purpurascens*	PO	Fennah (1963)
vibix (Haupt)	*Oryza sativa*	PO	Asche and Wilson (1990)
Stiroma			
affinis Fieber	*Dactylis glomerata*	PO	Drosopoulos et al. (1983)
bicarinata (Herrich-Schaffer)	*Deschampsia caespitosa*	PO	Drosopoulos et al. (1983)
Stiromella			
obliqua (Wagner)	*Phragmitetum* sp.	PO	Vilbaste (1974)
Stobaera			
affinis Van Duzee	*Ambrosia* sp.	AS	Kramer (1973)
bilobata Van Duzee	*Haplopappus squarrosus*	AS	Kramer (1973)
caldwelli Kramer	*Ambrosia* spp.	AS	Goeden and Ricker (1974a)
	Hymenoclea salsola	AS	Goeden and Ricker (1986a)
	Bebbia juncea	AS	Goeden and Ricker (1989)
	Trixis californica	AS	
concinna (Stål)	*Ambrosia* spp.	AS	Goeden and Ricker (1975)
			Calvert et al. (1987b)
	Parthenium hysterophorus	AS	McClay (1983)
giffardi Van Duzee	*Artemesia* sp.	AS	Kramer (1973)
muiri Kramer	*Ambrosia* spp.	AS	Goeden and Ricker (1974b)
pallida Osborn	*Baccharis halimifolia*	AS	Kramer (1973)
tricarinata (Say)	*Ambrosia* spp.	AS	Kramer (1973)
	Helianthus argophyllus	AS	
Struebingianella			
lugubrina (Boheman)	*Glyceria maxima*	PO	Ossiannilsson (1978)
	Glyceria aquatica	PO	Vilbaste (1971)
Sulix			
meridianalis (Muir)	*Scirpus frondosus*	CY	Fennah (1965a)

(*continued*)

Appendix 2. (*Continued*)

Planthopper Taxon	Host Plant: Genus and Species	Family[a]	References
tasmani (Muir)	*Muehlenbeckia* sp.	PO	Fennah (1965a)
vetranio Fennah	*Scirpus frondosus*	CY	Fennah (1965a)
Tagosodes			
cubanus (Crawford)	*Oryza sativa*	PO	Asche and Wilson (1990)
	Echinochloa sp.	PO	
	Cocos nucifera	AR	Wilson and O'Brien (1987)
orizicolus (Muir)	*Oryza sativa*	PO	Asche and Wilson (1990)
	Echinochloa sp.	PO	
Tarophagus			
colocasiae (Matsumura)	*Colocasia esculenta*	AC	Asche and Wilson (1989b)
persephone (Kirkaldy)	*Colocasia esculenta*	AC	Asche and Wilson (1989b)
proserpina (Kirkaldy	*Colocasia esculenta*	AC	Asche and Wilson (1989b)
Terthron			
albovittata (Matsum.)	*Oryza sativa*	PO	Yang (1989)
Toya			
ibiturca Asche	*Cynodon dactylon*, grasses	PO	Drosopoulos et al. (1983)
obtusangula (Linnavuori)	*Cynodon dactylon*, grasses	PO	Drosopoulos et al. (1983)
propinqua (Fieber)	*Cynodon dactylon*, grasses	PO	Drosopoulos et al. (1983)
tuberculosa (Distant)[c]	*Panicum repens*	PO	Yang (1989)
	Cynodon dactylon, grasses	PO	Drosopoulos et al. (1983[c])

Tumidagena			
minuta McDermott	*Spartina patens*	PO	Raupp and Denno (1979)
Unkanodella			
ussuriensis Vilbaste	*Miscanthus sinensis*	PO	Kwon (1982)
Unkanodes			
excisa (Melichar)	*Elymus arenarius*	PO	Ossiannilsson (1978)
sapporana (Matsumura)	*Arundinella hirta*	PO	Lee and Kwon (1980)
	Imperata sp.	PO	
	Ischaemum anthephoroides	PO	
	Miscanthus sinensis	PO	

[a]AC —Araceae; AL—Araliaceae; AM—Amaranthaceae; AN—Aspleniaceae; AP—Apocynaceae; AR—Arecaceae; AS—Asteraceae; BL—Blechnaceae; BR—Brassicaceae; CA—Caryophyllaceae; CM—Commelinaceae; CN—Cornaceae; CO—Convolvulaceae; CP—Campanulaceae; CT—Cyatheaceae; CU—Cunoneaceae; CY—Cyperaceae; DI—Dicotyledonae; DK—Dicksoniaceae; DV—Davalliaceae; EB—Ebenaceae; EL—Elaeocarpaceae; EP—Epacridaceae; ER—Ericaceae; EQ—Equisetaceae; EU—Euphorbiaceae; FA—Fabaceae; GE—Gesnericaceae; GO—Goodeniaceae; GR—Geraniaceae; GU—Gunneraceae; HE—Heliconiaceae; HY—Hydrangeaceae; JG—Juncaginaceae; JU—Juncaceae; LA—Lamiaceae; LI—Liliaceae; LO—Loranthaceae; LY—Lythraceae; MA—Malvaceae; MO—Monocotyledonae; MP—Myoporaceae; MR—Moraceae; MS—Myrsinaceae; MY—Myrtaceae; NY—Nymphaeaceae; OL—Oleaceae; ON—Oleandraceae; PA—Pandanaceae; PI—Piperaceae; PL—Polygonaceae; PN—Pontederiaceae; PO—Poaceae; PR—Proteaceae, PT—Pteridiaceae, PU—Plumbaginaceae, PY—Pteridophyta, RA—Rhamnaceae, RH—Rhizophoraceae; RT—Rutaceae; RU—Rubiaceae; SA—Sapindaceae; SC—Scrophulariaceae; SG—Stilaginaceae; SM—Smilaceae; SO—Solancaecea; SP—Sapotaceae; ST—Sterculiaceae; TH—Thymelaeaceae; TL—Thylopteridaceae; TY—Typhaceae; UR—Urticaceae; VE—Verbenaceae; WI—Winteraceae.

[b]Species (and 1 subspecies) listed by Zimmerman (1948) in *Kelisia* are not members of the Kelisiinae and belong in Delphacini (Asche, personal communication).

[c]Listed as *Toya hispifimena* Asche, a synonym of *T. tuberculosa* (Distant) (Asche, personal communication).