The Biological Control of *Psylla uncatoides* (Ferris & Klyver) (Homoptera: Psyllidae) on Hawaii.[1,2,3]

JOHN R. LEEPER AND J.W. BEARDSLEY, JR.
UNIVERSITY OF HAWAII, HONOLULU, HAWAII

Psylla uncatoides (Ferris & Klyver) was first collected on Oahu in a mosquito light trap near the Honolulu International Airport in March, 1966 (Joyce, 1967). In July, 1970 the psyllid was first reported on the island of Hawaii although it had been observed there five months earlier (Davis and Kawamura, 1970). Gagne (1971) reported great numbers of the psyllid on the ground at the summit of Mauna Kea (4205 m) the same month. *P. uncatoides* feeds and breeds in the new terminal growth of acacias and its presence at the summit of Mauna Kea was interpreted as an indication of high psyllid populations on *Acacia koa* Gray at lower elevations. The summit is devoid of vegetation and the psyllid would have had to migrate to reach it. *P. uncatoides* has since become a serious pest of the endemic acacias at the higher, drier elevations on Hawaii (Leeper & Beardsley, 1973).

P. uncatoides was first described as *Psyllia uncatoides* from specimens collected in New Zealand (Ferris and Klyver, 1932) where acacias are exotic. Tuthill (1952) placed the species in the genus *Psylla*. The psyllid was discovered in California in 1954 (Armitage, 1955; Jensen, 1957). *P. uncatoides* was suspected of being endemic to Australia, but was not found there until 1971 by Beardsley.

The biology of *P. uncatoides* was studied in California (Koehler, Kattoulas and Frankie, 1966; Madubunyi, 1967; Madubunyi and Koehler, 1974). Munro (1965) gave a table of occurrence of *P. uncatoides* on *Acacia* and *Albizzia* species in California. Two host species found in Hawaii are not listed: the exotic *Acacia confusa* Merril, which generally supports light to moderate psyllid infestations in Hawaii; and the endemic *Acacia koaia* Hillebrand, which is often heavily infested.

STUDY SITES

Three study sites were set up along the Mauna Loa Strip Road (1280 to 2042 m), Hawaii Volcanoes National Park in May, 1971. A study site was established at the *A. koaia* sanctuary, Kawaihae Uka, Kohala Mts. (975 m) the same month. In January, 1972 a site was established just outside the Bishop Estate owned Kilauea Forest at 1646 m on the Keauhou Ranch.

[1]Published with the approval of the Director of the Hawaii Agricultural Experiment Station as Journal Series No. 1864.
[2]Contribution number 52, ISLAND ECOSYSTEMS IRP/IBP Hawaii, NSF Grant GB 23230.
[3]Portion of dissertation submitted to the Graduate Division, University of Hawaii by the senior author in partial fulfillment of the requirement for the Ph.D. degree.

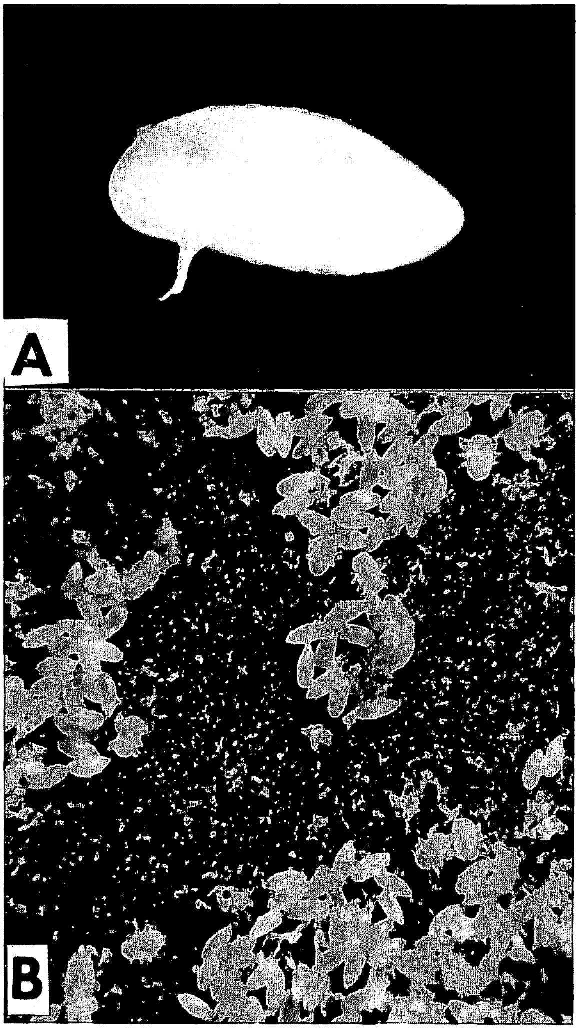

FIG. 1A. *P. uncatoides* egg showing the stalk which is normally anchored in the host plant.
1B. *P. uncatoides* eggs and newly emerged nymphs on a acacia phyllode.

Research showed a close correlation between new terminal growth, or flushing, and psyllid population explosions at all but the Kilauea Forest site. This was probably due to the climatic conditions, particularly higher, more uniformly distributed rainfall throughout the year at the latter site (Bridges and Carey, 1973, 1974, in press), which we believe inhibits the development of large *P. uncatoides* populations. Wilde (1962) reported a similar effect of high rainfall on pear psyllid, *Psylla pyricola* Foerster, populations in British Columbia, Canada. Research at the Kilauea Forest was discontinued in December, 1972.

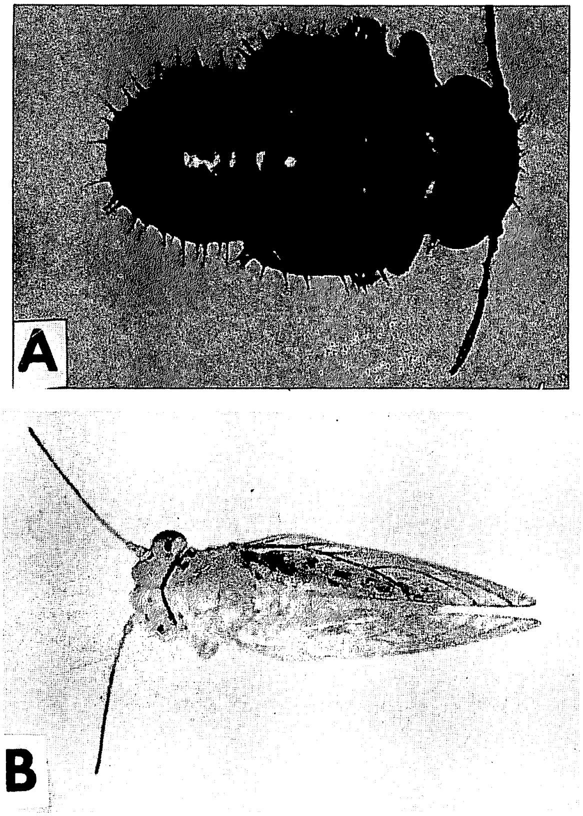

FIG. 2A. *P. uncatoides* large nymph. 2B. *P. uncatoides* adult.

METHODS

P. uncatoides counts were broken down into four categories: eggs (Fig. 1), small nymphs, large nymphs (Fig. 2A), and adults (Fig. 2B). Catling (1969) used the same categories in his work on *Trioza erytreae* (Del Guercio). Instars one through three were lumped together as small nymphs, while instars four and five were considered as large nymphs. Koehler *et al.* (1966) showed a frequency distribution of head-width measurements which illustrated graphically the difference between small and large *P. uncatoides* nymphs.

The eggs of *P. uncatoides* have a ventral stalk at one end which anchors the egg to the plant. White (1968) found that the egg stalk of the psyllid, *Cardiaspina densitexta* (Taylor), functioned for the uptake of water from the host plant. The egg stalk of *P. uncatoides* may serve a similar function.

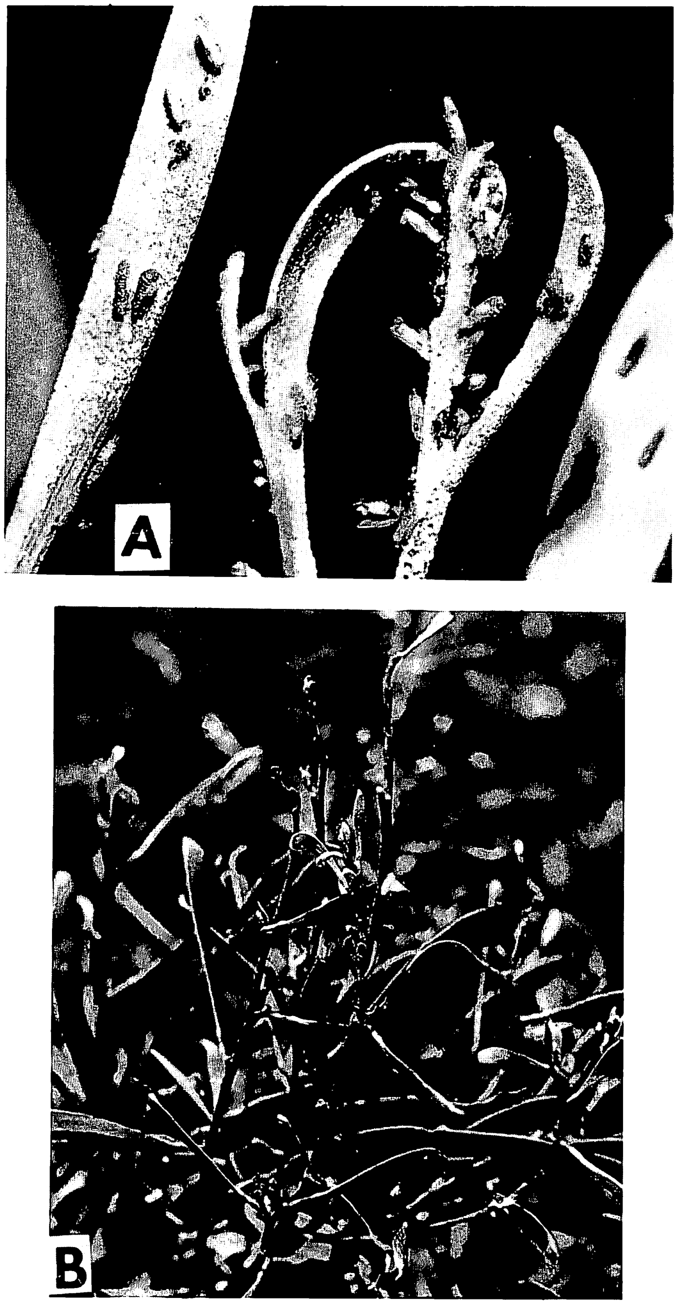

FIG. 3A. Adult *P. uncatoides* on A. koaia terminals. The adults standing on their heads are feeding. 3B. *A. koaia* terminals showing resultant dieback caused by excessive feeding during an earlier *P. uncatoides* population explosion.

FIG. 4. Senior author using "D-Vac, Model 24" vacuum collecting apparatus.

Psyllid nymphs tend to cling to the foliage when disturbed while the adults tend to jump and fly away. These differences in habit necessitated the use of two sampling techniques. The counts of eggs and nymphs were made by taking ten, four-inch terminal samples at each study site. The samples were placed individually in plastic bags and chilled in a refrigerator until they could be observed under a dissecting microscope and the counts made. Adult populations were sampled by means of a "D-Vac, Model 24" vacuum collecting apparatus (Fig. 4). Three minutes was selected as a convenient time unit for D-Vac samples. After completing a sample the excess debris was removed, and the arthropods were killed with ethyl acetate and stored in 70% ethyl-alcohol until they could be sorted and counts taken.

The new terminal growth at each study site was monitored by averaging the percent flush in three counts of 100 terminals. Aspect on the tree did not appear to affect the amount of flush. Lamoureux (1973, unpublished) used another method of measurement; we are pleased with how well our data agree with his at shared and proximate study sites.

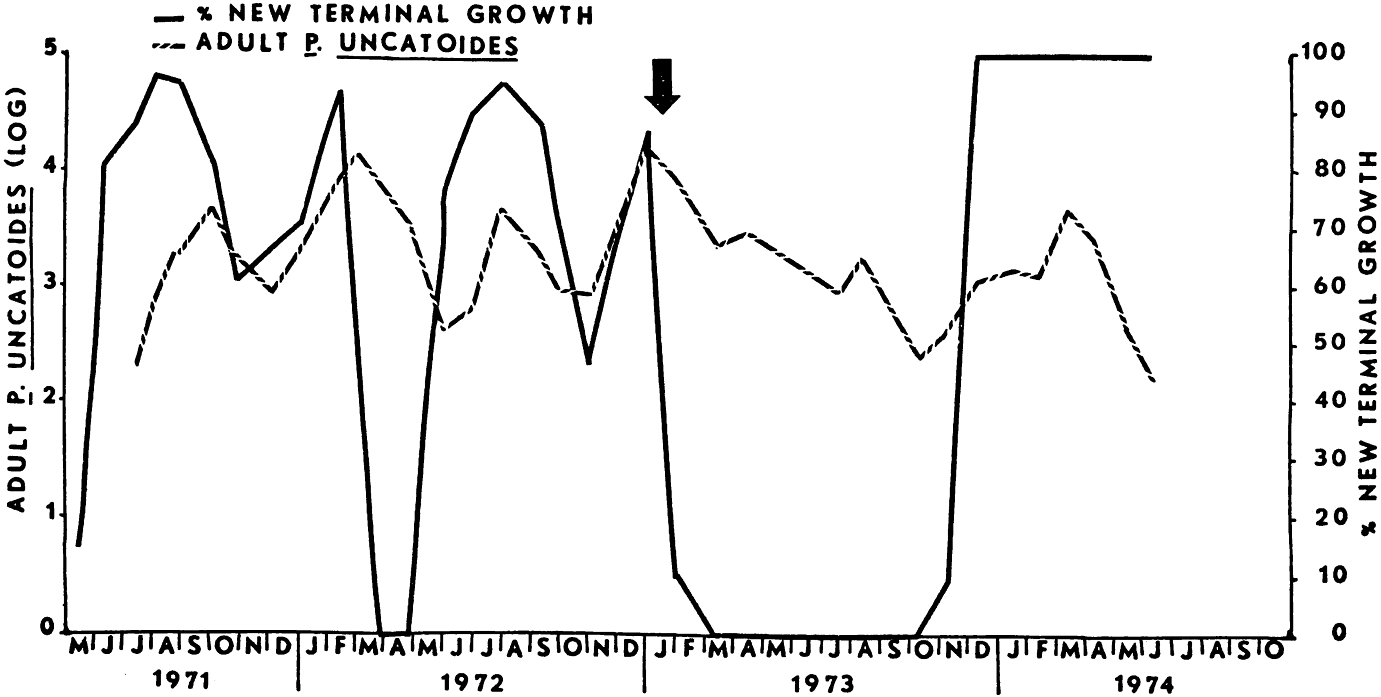

FIG. 5. Percent new terminal growth and adult *P. uncatoides* counts at the *A. koaia* sanctuary plotted to show correlation between the two. Arrow indicates *H. conformis* introduction date.

NATURAL CONTROL PRIOR TO PURPOSEFUL INTRODUCTIONS

Several insect orders were represented by species that were predacious on *P. uncatoides* in Hawaii. However, these predators were not effective in controlling the psyllid since high psyllid populations repeatedly followed flushing and resulted in 100 percent dieback of new terminal growth (Fig. 3). Fig. 5 shows this graphically for the *A. koaia* sanctuary. Satisfactory biological control could not be considered achieved until flush dieback due to excessive psyllid feeding was significantly reduced.

The larvae of a syrphid, *Allograpta obliqua* (Say), were found in low numbers at all the study sites and were observed feeding on *P. uncatoides* eggs. Madubunyi (1967) reared this syrphid on *P. uncatoides* but doubted that it, and other syrphids present in California, were effective in controlling the psyllid. We concur with his opinion.

Fourteen coccinellid (Coleoptera) species were separated from the D-Vac samples. Table 1 lists the coccinellid species collected at the study sites between May 15, 1971 and September 10, 1972. The *A. koaia* site had the highest populations, the greatest diversity of species, and the only immature coccinellids collected. *Rhizobius ventralis* (Erich.) was only collected at the 1646 and 2042 m Mauna Loa Strip Road sites. Several other coccinellid species were collected only once or twice at the *A. koaia* study site. Larvae of only 4 of the 13 species present at that site were collected. The larvae were neither collected with regularity nor in great numbers, except in one sample when 10 *Olla abdominalis* (Say) larvae were obtained. In comparison to the 13 coccinellid species found at the *A. koaia* study site, 4 and 5 species were found at the 1646 m and the 2042 m study sites respectively. No coccinellids were found at the 1280 m study site during the first year and a half.

The Neuroptera were represented by both the Chrysopidae and the Hemerobiidae. Table 2 gives a breakdown of the Neuroptera found at each of the study sites between May 15, 1971 and September 10, 1972. The endemic *Anomalochrysa hepatica* McLachlan and the introduced *Hemerobius pacificus* Banks were the principal species collected for their respective families. No reliable means of identifying Hawaiian Neuroptera larvae any further than to family has yet been developed. Moreover, first instar Hemerobiidae could not be differentiated from the Chrysopidae and were therefore included under the Chrysopidae undetermined spp. grouping. Zimmerman (1957) listed the presence of *Chrysopa lanata* Banks, later shown by Adams (1963) to be a synonym of *Chrysopa comanche* Banks, on Hawaii, as questionable. Prior to our collecting 8 adults over a 4-month period, it had not been recorded from that island. *C. comanche* is present and probably established in the

The Hemiptera were represented among possible psyllid predators by the Miridae and the Nabidae. Mirid populations occasioally became high, but it is not known whether the species present on the *Acacia* spp. were plant feeders, predators, or both. Gagne (1975) reported an endemic mirid, *Psallus sharpianis* Kirkaldy, preying on *P. uncatoides* at 1829 m (6000 ft) elevation, Mauna Loa Strip Road. Spiders and mites are also possible psyllid predators which occurred in the *Acacia* spp. ecosystems, but these appeared to be of very minor importance in controlling *P. uncatoides*.

It was obvious from the data collected between May 15, 1971 and September 10, 1972 that none of the actual or possible predators present were, singularly or collectively, capable of controlling the psyllid. Also, no parasites or diseases of *P. uncatoides* were found in the Hawaiian Islands.

Beardsley and Hagen (unpublished) found several encyrtid parasitoids and three predators associated with *P. uncatoides* in southeastern Australia. These were subsequently introduced to California in an attempt to control the psyllid in that State. Establishment of all biological control agents appears to have failed in California (Hagen, personal discussion). Because these natural enemies were obtained from endemic *Psylla* and *Acacia* communities in Australia, we believed they would have a greater potential for controlling *P. uncatoides* populations in Hawaii than any of the psyllid enemies presently established in the State.

Beneficial Insect Introductions

Two coccinellids were introduced in our attempt to control *P. uncatoides*. In cooperation with the Hawaii State Department of Agriculture, we released 60 adult *Harmonia conformis* (Boisduval) (Fig. 6) on January 11, 1973 at the *A. koaia* sanctuary and 58 *Diomus pumilio* Weise on February 5, 1973 along the Mauna Loa Strip Road (Leeper and Beardsley, 1975, Leeper, 1975b).

TABLE 1. *Numbers of coccinellids, by species, found at each study site between May 15, 1971 and September 10, 1972.*

Species	*A. koaia*	*Study sites* 1280 m.	1646 m. Mauna Loa Strip	2042 m.	*Kilauea* Forest*
Coelophora inaequalis (Fab.)	169			1	
Curinus coeruleus Mulsant	22				
Cryptolaemus montrouzieri Mulsant	81			1	
Olla abdominalis (Say)	58				
Scymnodes lividigaster (Mulsant)	1				
Orcus chalybeus (Bois.)	163				
Lindorus lophanthae (Blaisd.)	1		1		
Diomus notescens (Blackburn)	28				
Scymnus (Pullus) loewii Mulsant	13		3		1
Rhizobius ventralis (Erich.)			4	10	
Rodolia cardinalis (Mulsant)	1		3	2	
Hippodamia convergens Guerin	2			1	

*Sampling started January, 1972.

Subsequent releases were made by ourselves and others (Tables 3, 4). Both coccinellids were received by the Hawaii State Department of Agriculture from Australia via laboratory colonies maintained at the University of California, Division of Biological Control, Albany, California. *D. pumilio* was also received directly from Australia from Dr. T.C. New, La Trobe University, Bundoora, Victoria, through the Hawaii State Department of Agriculture.

While it is possible that these predators may feed on other sessile, colonial insects such as aphids, all species of which are introduced pests in Hawaii, we do not believe they will exert any appreciable effect on the endemic Psyllidae as the immature stages of the latter occur mostly in cryptic situations (e.g.: within plant galls or under bracts) where they are protected from predation by coccinellids. Furthermore, population densities of the endemic psyllids are generally maintained at relatively low levels by endemic parasitoid wasps and predators, and it is probable that even if these psyllids were acceptable to the coccinellids, the populations would be too sparse to be attractive to these predators. To date we have seen no evidence of either of these coccinellids preying on endemic psyllids or other endemic insects.

TABLE 2. *Numbers of Neuroptera, by species, found at each study site between May 15, 1971 and September 10, 1972.*

Species	*A. koaia*	*Study sites* 1280 m.	*1646 m. Mauna Loa Strip*	*2042 m.*	*Kilauea* Forest*
Chrysopidae spp.? (larvae)	8	22	38	15	8
Anomalochrysa hepatica McLachlan	3	37	39	4	6
Anomalochrysa frater (Perkins)		15			
Anomalochrysa fulvescens (Perkins)	2				
Chrysopa comanche Banks	8				
Hemerobiidae spp.? (larvae)	2	7	55	21	3
Hemerobius pacificus Banks	2	55	143	41	6
Nesomicromus vagus Perkins		4	1	1	
Nesobiella hospes Perkins			1		1

*Sampling started January, 1972.

H. conformis had been introduced into Hawaii in 1894 by Koebele and again in 1904, but disappeared after 1906 (Swezey, 1923; Timberlake, 1943). It was reported at the time as a citrus aphid predator (Kirkaldy, 1907). *H. conformis* was introduced into California in 1893 to control *Aspidiotus aurantii* (Maskell) but soon disappeared (Coquillet, 1893a, 1893b). We attempted rearing this coccinellid on *Aphis nerii* Boyer de Fonscolombe and *Amphorophora sonchi* (Oestland) and got a progressive larval mortality, reduction in

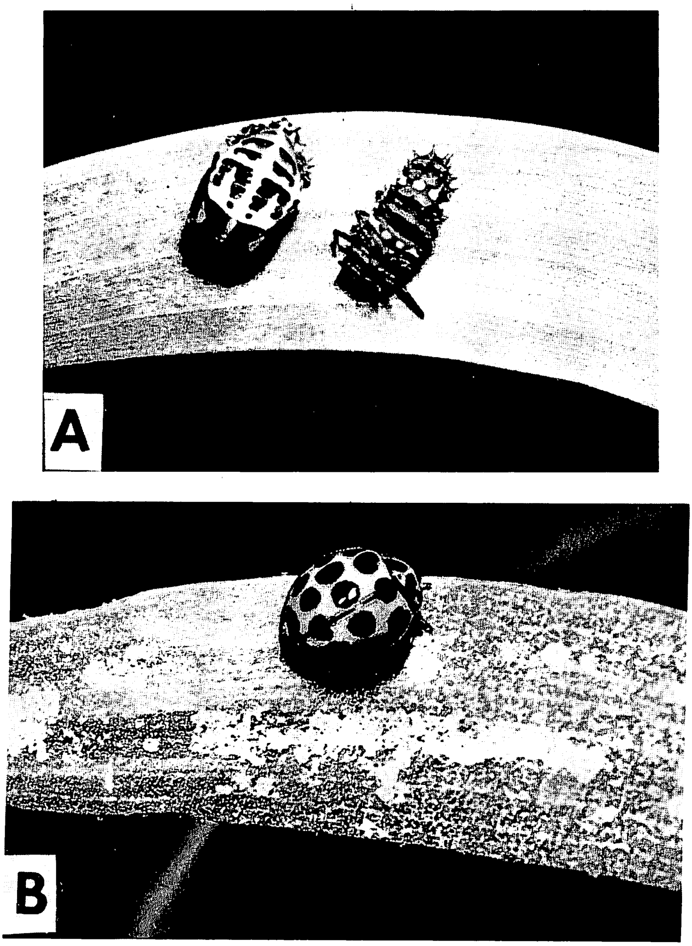

FIG. 6A. *H. conformis* prepupal larva and pupa on *A. koaia* phyllode. 6B. Close-up of *H. conformis* adult feeding on *P. uncatoides* eggs and small nymphs.

adult size and reduced fecundity, all resulting in the loss of the colonies after the third laboratory generation. We believe *H. conformis* to be an obligate predator of *P. uncatoides,* and other related *Acacia* psyllids in Australia, in that these psyllids are required for its continued reproduction.

Soon after the introduction of *H. conformis* to the *A. koaia* sanctuary a drought period began. This prevented the trees from attempting a characteristic second period of flush growth after the total dieback of the first flush, and the resulting crash of the psyllid population (fig. 5). *H. conformis* was not seen again at the sanctuary for about nine months prior to its dramatic comeback in January, 1974, coinciding with the annual spring flush of the trees and the accompanying increase in the *P. uncatoides* population at that time. *H. conformis* completely controlled the psyllid population and resulted in the

TABLE 3. Harmonia conformis *Releases.*

Date	*Location*	*Number & Stage*
1/11/73	*A. koaia* sanctuary	60 adults
2/23/73	Mauna Loa Strip road	89 adults
2/27/73	Mauna Loa Strip Road	83 adults
3/8/73	Mauna Loa Strip road	22 adults
		10 pupae
		2 larvae
4/16/73	Mauna Loa Strip road	46 adults
		37 larvae
4/19/73	Mauna Loa Strip road	4 adults
		215 larvae
4/23/73	Mauna Loa Strip Road	33 larvae
1/17/74	Mauna Loa Strip Road	2000 adults*

* Collected at the *A. koaia* sanctuary.

TABLE 4. Diomus pumilio *Releases.*

Date	*Location*	*Number & Stage*
2/3/73		
2/5/73	Mauna Loa Strip Road	58 adults
2/23/73	Mauna Loa Strip road	47 adults
2/27/73	Mauna Loa Strip Road	43 adults
5/2/73	Mauna Loa Strip Road	21 adults
5/8/73	Mauna Loa Strip Road	21 adults
5/10/73	Mauna Loa Strip road	21 adults
6/6/73	Mauna Loa Strip Road	140 adults
6/10/73	Mauna Loa Strip Road	40 adults

TABLE 5. *Comparison of* P. uncatoides *populations at* Acacia koaia *sanctuary, before and after introduction of* Harmonia conformis.

		Prior to release (January, 1972 to January, 1973)					
		Eggs	*Small Nymphs*	*Large Nymphs*			*Adults*
ΣX	=	18,036	8467	967			63,755
(ΣX/10)11*	=	163.96	76.97	8.79	(ΣX/1284)/11*	=	4.51
log	=	2.2147	1.8863	0.9940			0.6545
% survival	=	100	46.94	5.36			2.75
		After release (November, 1973 to February, 1974)					
		Eggs	*Small Nymphs*	*Large Nymphs*			*Adults*
ΣX	=	4341	1293	106			12,588
(ΣX/10)/8*	=	54.26	16.16	1.32	(ΣX/1284)/8*	=	1.22
log	=	1.7345	1.2085	0.1222			0.0883
% survival	=	100	29.78	2.44			2.26

*Conversion factors to facilitate data comparison; see explanation in text.

cessation of the psyllid-caused dieback (Fig. 5). We are confident of the permanent establishment of *H. conformis* at the *A. koaia* sanctuary and are hopeful of its eventual spread to other areas of the island. In November, 1974 the coccinellid was observed on acacias as far away as Waimea (@10 km).

To determine what effect *H. conformis* had on *P. uncatoides* populations we compared the average numbers of each life history interval (eggs, small nymphs, large nymphs and adults) for periods before and after the establishment of the coccinellid at the *A. koaia* sanctuary. These data are summarized in Table 5. The length of the periods is not significant as long as the psyllid population curve is carried through its entire cycle. For the "before" picture a twelve-month period, February, 1972 to February, 1973, with two cycles was used. For the "after" picture an eight-month period, November, 1973 to June, 1974, consisting of one complete cycle, was followed. The total number of individuals (ΣX) for each life history interval was found. This figure was then divided by the number of terminals counted during each observation (10) and the number of observations (11 for the "before" and 8 for the "after"). This gave the average number of each interval (egg, small nymphs and large nymphs) counted for the entire period. In determining the average number of adult *P. uncatoides* the ΣX was divided by the average number of terminals D-Vaced in three minutes (1284) and by the number of observations. The data were then converted to logs and percentages and plotted (Fig. 7). Figure 7 shows that there were significantly fewer individuals in each life history interval present per terminal after the establishment of *H. conformis*. The difference in the survival from egg to small nymph stage is 17.16 percent. There is very little difference in the large nymph and adult intervals. This indicates that *H. conformis* preys primarily on the eggs and small nymphs. Once the psyllid has reached the large nymph interval it is fairly safe from predation by the coccinellid.

With a reduction of over 3.0, 4.7, 6.6 and 3.6 times in the numbers of eggs, small nymphs, large nymphs and adults per terminal, respectively, since the establishment of *H. conformis* it is not surprising that phenologic differences have been observed in the trees. New terminal growth on *A. koaia* has remained at 100% since January, 1974. In October, 1974 the trees had their first heavy bloom since before 1971. Seedpod set seems to be high and budding has begun for another flowering which we think will occur in March or April, 1975.[1] This will represent a change from little or no flowering to two flowering periods a year.

H. conformis has been released along the Mauna Loa Strip Road and has been seen in decreasing numbers for up to six months, but there is no evidence that it has become permanently established there.

No hosts for *D. pumilio* were found in literature other than *P. uncatoides* (Leeper and Beardsley, 1975, Leeper 1976). *D. pumilio* is primarily an egg predator but will feed also on very small psyllid nymphs. No recoveries of *D. pumilio* have been made.

[1]Second flowering and heavy pod set were confirmed by observations made by us on March 26, 1975.

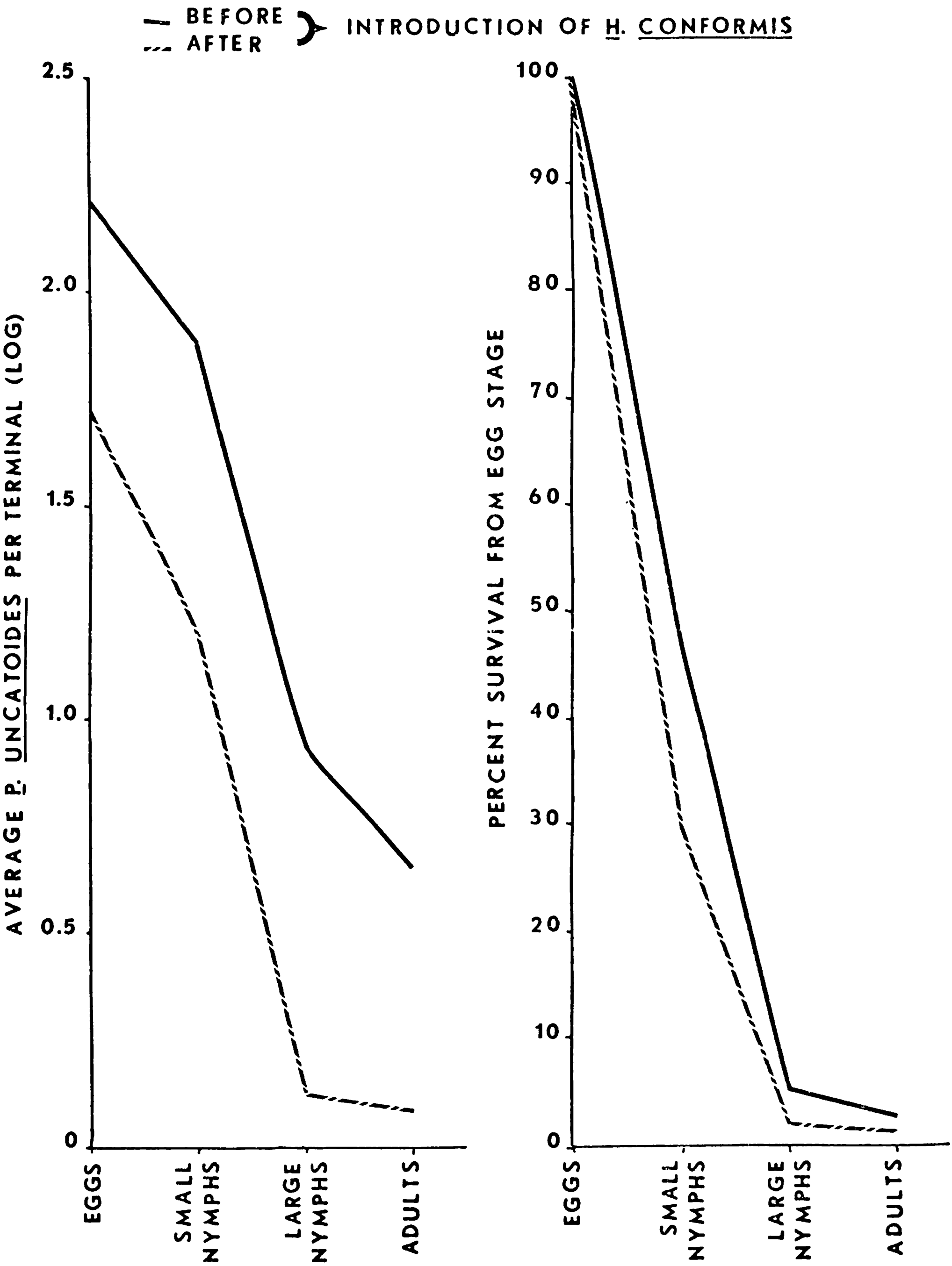

FIG. 7. Graphs comparing survival in logs (A) and percent (B) of *P. uncatoides* for before and after the introduction and establishment of *H. conformis* in *A. koaia* sanctuary.

Conclusion

This research is an example of "classical" biological control of an exotic pest. A pest species invaded a niche; its biology and ecology were studied to better understand its relationship with its host plants and its potential for damage in the absence of effective natural controls. Biological control agents were then found and introduced; and the impact of these predators on the psyllid pest populations, as well as the response of the trees to the suppression of the pest, were monitored.

The degree of biological control at the *A. koaia* sanctuary has been quite dramatic. Yet the failure to establish a biological control agent along the Mauna Loa Strip Road has been a disappointment. We recommend the continued search for parasites and/or predators in Australia that may be introduced to control *P. uncatoides* in areas where *H. conformis* cannot be established. The dramatic difference in *A. koaia* phenology after the control of *P. uncatoides* underscores the importance of finding some biological control agent to effectively reduce the psyllid populations along the Mauna Loa Strip Road. Phenologic studies have been conducted on *A. koa* in that area since 1971. To establish the true phenology of the trees, *P. uncatoides* should be controlled and the trees monitored several years. If this can be accomplished, we believe dramatic differences in the flushing, flowering and growth rates will be observed.

Acknowledgements

This research was funded in part by the National Science Foundation, ISLAND ECOSYSTEMS Integrated Research Program of the US/International Biological Program, and by McIntire-Stennis Forestry Research funds through the college of Tropical Agriculture, University of Hawaii.

We would like to thank the Hawaii Volcanoes National Park, the Hawaii State Department of Forestry and the Bishop Estate for allowing us to conduct the research on lands under their control. We also thank Drs. K.S. Hagen and T.C. New for sending the predators, and the Hawaii State Department of Agriculture for its aid in receiving the predators.

Literature Cited

Adams, P.A. 1963. Taxonomy of Hawaiian *Chrysopa* (Neuroptera, Chrysopidae). Proc. Hawaii. Entomol. Soc. 18(2):221.

Armitage, H.M. 1955. Current insect notes. Calif. Dept. Agri. Cull. 44:164-166.

Bridges, K.W., and G.V. Carey. 1973. The climate of the IBP sites on Mauna Loa, HAWAII. US/IBP Island Ecosystems IRP. Tech. Rept. No. 22. 141 pp.

———. 1974. Climate data for the IBP sites on Mauna Loa, Hawaii. US/IBP Island Ecosystems IRP. Tech. Rept. No. 38. 97 pp.

———. in press. Climate data for the IBP sites on Mauna Loa, Hawaii. US/IBP Island Ecosystems IRP. Tech. Rept.

Catling, H.D. 1969. The bionomics of the South African citrus psylla, *Trioza erytreae* (Del Guercio) (Homoptera: Psyllidae). 1. The influence of the flushing rhythm of citrus and factors which regulate flushing. Jour. Entomol. Soc. South Africa. 32(1):191-208.

Coquillett, D.W. 1893 a. Report on the Australian insects sent by Albert Koebele to Ellwood Cooper and B.M. Lelong. Insect Life. 5(4):251-254.

______. 1893 b. The present status of the recent Australian importations. A.—Report by D.W. Coquillett. Insect Life. 6(1):24-26.

Davis, C. and K. Kawamura. 1970. Island record for *P. uncatoides*: Hawaii, 5400 ft Mauna Loa Strip. Hawaii Cooperative Economic Insect Rept. July 31.

Ferris, G.F., and F.D. Klyver. 1932. Report upon a collection of Chermidae (Homoptera) from New Zealand. Roy. Soc. New Zealand Trans. 63:34-61.

Gagne, W.C. 1971. Notes and exhibitions. Proc. Hawaii. Entomol. Soc. 21(1):25.

______. 1975. Notes and exhbitions. Proc. Hawaii. Entomol. soc. 22(1):6.

Jensen, D.D. 1957. The albizia psyllid, *Psylla uncatoides* (Ferris & Klyver) in California. Pan-Pacific Entomol. 33(1):29-30.

Joyce, C.R. 1967. Notes and exhibitions. Proc. Hawaii. Entomol. Soc. 19(3):334.

Kirkaldy, G.W. 1907. On some peregrine Aphidae in Oahu (Hem.). Proc. Hawaii. Entomol. Soc. 1(3):99-102.

Koehler, C.S., M.E. Kattoulas, and G.W. Frankie. 1966. Biology of *Psylla uncatoides*. Jour. Eco. Entomol. 59(5):1097-1100.

Lamoureux, C.H. 1973. Phenology and growth of Hawaiian plants, a preliminary report, US/IBP Island Ecosystems IRP. Tech. Rept. No. 24. 62 pp.

Leeper, J.R. 1975. Notes and exhibitions. Proc. Hawaii. Entomol. Soc. 22(1):2.

______. 1976. A review of the Hawaiian Coccinellidae. Proc. Hawaii. Entomol. Soc. 22(2):

Leeper, J.R. and J.W. Beardsley. 1973. The bioecology of *Psylla uncatoides* in the Hawaii volcanoes National Park and the *Acacia koaia* sanctuary. US/IBP. Island Ecosystems IRP. Tech. Rept. No. 23. 13 pp.

______. 1975. Notes and exhibitions. Proc. Hawaii. Entomol. Soc. 22(1):7-8.

Madubunyi, L.C. 1967. Ecological investigations on the *Albizzia* Psyllid, *Psylla uncatoides* (Ferris & Klyver) (Homoptera: Psyllidae). Unpublished Masters Thesis, Univ. of Calif. Berkeley. 121 pp.

Madubunyi, L.C., and C.S. Koehler, 1974. Development, survival and capacity for increase of the *Albizzia* psyllid at various constant temperatures. Environ. entomol. 3(6):1013-1016.

Munro, J.A. 1965. Occurences of *Psylla uncatoides* on *Acacia* and *Albizzia*, with notes on control. Jour. Econ. Entomol. 88(6):1171-1172.

Swezey, O.H. 1923. Records of introduction of beneficial insects into the Hawaiian Islands. Pro. Hawaii. Entomol. Soc. 5(2):299-304.

Timberlake, P.H. 1943. The Coccinellidae or ladybeetles of the Koebele collection—Part 1. Bull. Expt. Stat. Hawaii Sugar Plant. Assoc. Entomol. Series bull. No. 22. 67 pp.

Tuthill, L.D. 1952. On the Psyllidae of New Zealand (Homoptera). Pac. Sci. 6:83-125.

White, T.C.R. 1968. Uptake of water by eggs of *Cardiaspina densitexta* (Homoptera:Psyllidae) from leaf of host plant. Jour. Insect Physiol. 14:1669-1683.

Wilde, W.H.A. 1962. Bionomics of the Pear *Psylla, Psylla pyricola* Foerster, in pear orchards of the Kootenay Valley of British Columbia, 1960. Canad. Entomol. 94:845-849.