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INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES (COMPOSITAE)

Batra, S. W. T. et al.

1 of 2
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES (COMPOSITAE)
ABSTRACT


Six Eurasian species of Carduus thistles (Compositae: Cynareae) are troublesome weeds in North America. They are attacked by about 340 species of phytophagous insects, including 71 that are oligophagous on Cynareae. Of these Eurasian insects, 39 were extensively tested for host specificity, and 5 of them were sufficiently damaging and stenophagous to warrant their release as biological control agents in North America. They include four beetles: Altica carduorum Guérin-Méneville, repeatedly released but not established; Ceutorhynchus litura (F.), established in Canada and Montana on Cirsium arvense (L.) Scop.; Rhinocyllus conicus (Froelich), widely established in the United States and Canada and beginning to reduce Carduus nutans L. populations; Trichosirocalus horridus (Panzer), established on Carduus nutans in Virginia; and the fly Urophora stylata (F.), established on Cirsium in Canada.

Potentially useful and probably host-specific fungi attacking Carduus include five species of Puccinia and two species of Uredo.

KEYWORDS: Biological control, Carduus, Cirsium, phytophagous insects, rust fungi, thistles, weed control, weeds.
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES (COMPOSITAE)

by

S. W. T. BATRA, J. R. COULSON, P. H. DUNN, AND P. E. BOLDT
ACKNOWLEDGMENTS

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A terminal inflorescence of musk thistle (Carduus nutans) with its introduced biological control agent, the seed-destroying European weevil (Rhinocyllus conicus).
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES (COMPOSITAE)

By S. W. T. Batra, J. R. Coulson, P. H. Dunn, and P. E. Boldt

ECONOMIC IMPORTANCE, CONTROL, AND BIONOMICS OF CARDUUS THISTLES

The genus *Carduus* (Compositae: Cynareae: Carduinae) includes species in the subgenera *Alfredia* and *Afrocarduus* Kazmi (1963, 1964), which are not weedy. The Palaearctic subgenus *Carduus* includes 70 species, 59 apparent species hybrids, and 60 subspecies, according to the revision by Kazmi (1964); some species are noxious weeds. An additional species, four apparent hybrids, and one subspecies of Eurasian *Carduus* were included in the "Index Kewensis" in 1974. Although similar to *Cirsium* thistles, *Carduus* species may readily be distinguished from them by their simple, not feathery, pappus hairs and lack of resin streaks on involucral leaves (Kazmi, 1964).

Infestations of some introduced Eurasian species of *Carduus* (plumeless thistles) of actual or potential economic importance occur in 18 percent of the counties in the contiguous United States. Musk or nodding thistles (*C. nutans* and *C. thoermeri*) occur as economic infestations in over 10 percent of all counties, primarily in the Midwest, and appear to be spreading (Dunn, 1976). They occupy about 2 million acres in the United States, and chemical control alone cost about $6.50 per acre in 1976 (M. K. McCarty, pers.

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1S. W. T. Batra and J. R. Coulson, Beneficial Insect Introduction Laboratory, Beltsville Agricultural Research Center, Beltsville, Md. 20705; P. H. Dunn, Biological Control of Weeds Laboratory, Albany, Calif. 94706; and P. E. Boldt, Biological Control of Weeds Laboratory, Rome, Italy.

2The year in italic after an author's name refers to Literature Cited, p. 86.

3For complete scientific names with authority or describer, see index (plants).
Plumeless thistle (*C. acanthoides*) is a problem in the Appalachian region; Italian thistle (*C. pycnocephalus*) and slender flower thistle (*C. tenuiflorus*) are economically important in California; and curled or welted thistle (*C. crispus*) is common in western Virginia (Johnson, 1974; Dunn, 1976).

These large, spiny, annual or biennial plants are particularly troublesome in pastures, where they crowd out forage plants (fig. 1), and in fallow fields and along railways or roadsides, where mowing or spraying with herbicides may be uneconomical or impractical, allowing *Carduus* thistles to become a seed source for reinfestation of treated areas. They may invade cultivated areas as the use of the no-tillage method of cultivation increases.

The *Carduus* thistles from Eurasia also have become problem weeds where introduced into other continents. *Carduus nutans* and *C. thoermeri* are important weeds in South America and have recently been found in eastern Australia. In New Zealand, *C. nutans* is common (Doing et al., 1969). The slender thistles (*C. pycnocephalus* and *C. tenuiflorus*) are the major weeds in sheep pastures in Tasmania, but they may be effectively controlled by grazing management (Bendall, 1973, 1974). *Carduus pycnocephalus* is an im-

![Figure 1](PN-7015)

**Figure 1.**—Dairy cattle in a typical overgrazed pasture infested by *Carduus nutans* in Pennsylvania. Not only are the thistles not eaten, but the cattle do not reach for the edible plants growing near them.
3 INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES

important introduced weed in South Africa (Henderson and Anderson, 1966); C. nutans also occurs there, where it is used for making bows (Kazmi, 1964). In Canada, C. crispus, 2N = 16, C. nutans (ssp. nutans, leiophyllus, macrolepis), and C. acanthoides are present, as well as the hybrid C. x orthocephalus, 2N = 17 = 21 (= nutans, 2N = 16; acanthoides, 2N = 22) (Mulligan and Frankton, 1954; Moore and Frankton, 1974). These hybrids, resembling C. acanthoides, have become numerous and appear to have been ecologically and gametically selected for local survival in rocky pastures in Grey County, Ontario (Moore and Mulligan, 1956, 1959; Mulligan and Moore, 1961). In Nebraska, "musk" thistles are C. thoermeri (M. K. McCarty, pers. commun., 1978), not hybrids of C. nutans and C. acanthoides (Fuller, 1969). The identification and descriptions of these thistles are discussed by Kazmi (1964), Mulligan (1965), Furrer and McCarty (1966), Wunderlin (1969), McCarty et al. (1973), Johnson (1974), and Moore and Frankton (1974).

The readiness with which Carduus species apparently interbreed could lead to the development of some hybrids that are even more adaptable and aggressive weeds than their parents because of the enrichment of variation through introgressive hybridization. This and related problems in other weeds are discussed by Baker (1965). However, hybridization may also provide an opportunity for control by introducing clones relatively susceptible to natural enemies or herbicides.

In addition to the known hybrid C. x orthocephalus mentioned previously, possible European hybrids of the weedy species already present in the United States and Canada are as follows according to morphological studies of Kazmi (1964):

<table>
<thead>
<tr>
<th>Species in North America</th>
<th>European 'hybrids'</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. acanthoides x C. crispus (2N = 16)</td>
<td>C. x leptcephalus</td>
</tr>
<tr>
<td>C. acanthoides x C. pycnocephalus</td>
<td>= not named, morphologically resembles C. acanthoides</td>
</tr>
<tr>
<td>(2N = 54)</td>
<td></td>
</tr>
<tr>
<td>C. crispus x C. nutans</td>
<td>= C. x dubius</td>
</tr>
<tr>
<td>C. crispus x C. tenuiflorus (2N = 54)</td>
<td>= C. x crispo-tenuiflorus</td>
</tr>
<tr>
<td>C. crispus x C. thoermeri (2N = 16)</td>
<td>= C. x semiperenegrinus</td>
</tr>
<tr>
<td>C. nutans x C. pycnocephalus</td>
<td>= C. x permutanti-pycnocephalus</td>
</tr>
<tr>
<td>C. nutans x C. tenuiflorus</td>
<td>= C. x mixtus</td>
</tr>
<tr>
<td>C. pycnocephalus x C. tenuiflorus</td>
<td>= C. x theriottii</td>
</tr>
</tbody>
</table>

More cytogenetic and ecological studies of possible Carduus hybrids are much needed.

Because of its economic importance, considerable basic research has been undertaken on the bionomics and control of the musk thistle in North America (see Feldman et al. (1968), McCarty et al.
It was evidently introduced at ballast dumps on the east coast (Dunn, 1976) and in Alabama between about 1850 and 1900 (specimens at U.S. Natl. Mus.), and it was considered a weed in the mid-Atlantic States by the early 1900's (Furrer and McCarty, 1966). It rapidly spread, becoming economically important in the Midwest by 1950 (Furrer and McCarty, 1966).

This adaptable plant is now abundant in North Dakota, Louisiana, and on both coasts, but the most serious infestations are in the Central States (Dunn, 1976). In Nebraska, it is found primarily in rich, moist lowland, although it will occupy poor soils (McCarty, 1964; McCarty et al., 1973), and in Ontario, it occurs on well-drained loam or stony pastures (Mulligan and Moore, 1967). In western Virginia, it is common in the Appalachian region, but it is scarce in the Piedmont or coastal plain (Johnson, 1974). In Maryland and south-central Pennsylvania, musk thistle is locally abundant with C. acanthoides in pastures and on roadsides in the Appalachian Great Valley. Seeds may have been initially spread by wind, vehicles, and in soil from infested quarries. According to Hensley (1973), C. nutans and C. acanthoides are most plentiful in limestone soils in Virginia. In Ohio, C. nutans is most common where limestone or dolomite bedrock is less than 6 feet below the surface (Stuckey and Forsyth, 1971).

In its native Europe, musk thistle is a ruderal pioneer in disturbed environments on calcareous, loamy, or sandy soil rich in nitrogen; however, it may become a problem in overgrazed pastures. According to Doing et al. (1969), the most significant characters restricting its distribution are low tolerance for lack or excess of moisture and of deficient or acid soils and an only moderately high competitive power.

Musk thistles may be controlled by grazing management in maintaining a dense mat of perennial grasses, but the release of grazing pressure on annual grassland has resulted in an increase of these thistles in Australia (Doing et al., 1969). However, in Nebraska, Feldman et al. (1968) found that musk thistles did not become established in ungrazed pastures; survival was highest in intensively grazed pastures. This thistle may behave as a short-lived perennial, producing new shoots when grazed or sprayed in the spring (Doing et al., 1969), and may thus increase difficulty of control. Treatment with the herbicides dicamba (3,6-dichloro-o-anisic acid) plus 2,4-D (Jensen, 1970; McCarty and Hatting, 1975) or picloram (4-amino-3,5,6-trichloropicolinic acid) (Feldman et al., 1968; Jensen, 1970) was fairly effective. Control for 2 years cost from $6.25 to $14.75 per acre (Jensen, 1970). Mowing musk thistles...
within 2 days of the first terminal heads in a population showing
anthesis eliminated production of viable seed from all mowed
stalks, but repeated mowing is necessary owing to differences in
plant maturity (McCarty and Hatting, 1975).

Carduus thistles have been little used by people. The young stalks
are edible and the pappus has been used for papermaking (Moore
and Frankton, 1974). They are not considered important to
vertebrate wildlife in North America (Martin et al., 1961). Seeds of
C. nigrescens are a rich source of pentacyclic triterpenes (Madrigal
et al., 1974); C. albidos was tested but found lacking in ecdysones
(Ganiev, 1975). The fragrant, beautiful flowers of C. acanthoides
(white and purple varieties) and C. nutans are occasionally visited
by insects (Mulligan and Kevan, 1973). At Beltsville, Md., bumble
bees and halictine bees are important pollinators of these plants.
According to Crane (1975), honey bees working Carduus and Cirsium
thistles provide a light, sweet honey of good flavor; Carduus
hamulosus gives a moderate honey yield (26-50 kg per hectare). The
elaiosome-bearing seeds of the myrmechore C. pycnocephalus are
transported by ants (Uphof, 1942).

BIOLOGICAL CONTROL OF CARDUUS THISTLES

Because of the expense of controlling Carduus thistles by mowing
or applying herbicides in areas where they are prevalent, such as
pastures, fallow fields, wasteland, quarries, roadsides, or railways,
biological control by arthropods or pathogens is a reasonable alter­
native or adjunct. It has the advantage of being relatively inexpen­
sive and harmless to nontarget organisms, and biological control
agents can multiply and spread to adjacent infested areas. The
principles and procedures of biological control have been well
defined and tested with some spectacular successes (see Huffaker
(1956), Wilson (1964), Harris and Zwölfcr (1968), Andres (1971), Har­
riss (1971), Zwölfcr and Harris (1971), Harris (1973a, b), Wapshere
(1974), Andres and Bennett (1975), and Goeden and Louda (1976)).

Carduus thistles are prime candidates for biological control
because (1) it is often impractical or too expensive to mechanically
destroy or spray them; (2) they have been introduced from another
continent, leaving behind their natural enemies; (3) they are usually
biennial; (4) they build up dense populations, maintained for
several years; (5) they are not closely related to major crop plants
except artichoke, sunflower, and safflower; and (6) they have little
value to people or wildlife.

Biological control increases environmental pressure on Carduus
thistles. At best, the natural enemies may eliminate the need for
other control methods over much of the plant's range and form a sound basis for future weed-management schemes. At least these natural enemies would augment existing control practices. A comprehensive list of the natural enemies of *Carduus* species is a needed step in the process of selecting promising candidates.

Biological control of *Carduus* thistles in North America began with the introduction of the weevil *Rhinocyllus conicus* (Froelich), which was first released in Canada in 1968 after 6 years of study and testing in Europe and North America by scientists of the Commonwealth Institute of Biological Control, the Canada Department of Agriculture, and the former Agricultural Research Service (now a part of the Science and Education Administration (SEA-AR)). It is beginning to provide a significant degree of control of *C. nutans* in Virginia (Kok and Surles, 1975) and in Montana (Hodgson and Rees, 1976). *Rhinocyllus conicus* has also been established in California to control milk thistle (*Silybum marianum* (L.) Gaertn.) (Hawkes et al., 1972) and in New Zealand to control *C. nutans* (Jessep, 1975).

Assistance in locating sources of approved agents for biological control of *Carduus* thistles can be provided by the U.S. Department of Agriculture's Beneficial Insect Introduction Laboratory, Building 417, Beltsville Agricultural Research Center-East, Beltsville, Md. 20705; USDA Biological Control of Weeds Laboratory, 1050 San Pablo Avenue, Albany, Calif. 94706; and Agriculture Canada Research Station, Box 440, Regina, Saskatchewan S4P 3A2.

**PHYTOPHAGOUS INSECTS ASSOCIATED WITH CARDUUS THISTLES**

The first step in any project for the biological control of weeds is to prepare a list of natural enemies associated with the target plant. A list has been compiled here to give interested workers available information on the biological control of weeds. It incorporates data extracted from publications, as well as from reports, letters, and other unpublished material located in the files of the Insect Identification and Beneficial Insect Introduction Institute (IIBIII), SEA, USDA, Beltsville, Md., with few exceptions, as of December 31, 1976. Records from museum specimens have not been included, and the taxonomic literature is not exhaustively cited because this is not intended as a bibliography. Data on *Carduus* thistle in-

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4Although most data on which this publication is based were collected prior to 1977, the information is still valid and useful as guidelines for those interested in the biological control of weeds.
sects not in the Beneficial Insect Introduction Laboratory (BIIL) files are not summarized here. The compilers do not claim to have been able to detect or correct all possible inaccuracies in the sources available.

This list is to serve only as a source of information to aid in further studies and to make known some of the insects discovered on Carduus and what studies have been or are being conducted. It is not intended to serve as a final authority for determining host plants, geographical ranges, and so forth. Detailed information on any of the insects or laboratory tests should be obtained from those laboratories from whose reports or publications the pertinent data have been extracted. An unpublished preliminary version of this list, circulated by J. R. Coulson in 1969, has been cited, e.g., in Goeden (1974, 1976). An index to the Carduus species mentioned in the list and their associated insects and fungi is included.

Names of insects.—The names of insects have been checked by specialists of the Systematic Entomology Laboratory, SEA-AR.

Plant records.—All species of Carduus (as recognized by Kazmi (1964) and in litt. (1977)) are listed here with the particular insects with which they have been associated or recorded. This association may not always indicate a specific host plant relationship, but it may sometimes be simply a record of the insect casually feeding on the species in the field or in a laboratory test. In the field records, the location usually follows the plant species in parentheses. Explanations of these records are to be found under Remarks. These comments refer also to the records on plant genera other than Carduus. However, in these instances, only the generic name of the plant is given, and the record may refer to one or more species of that genus.

Remarks.—This section is a brief summary of available information on the insect from laboratory and field studies.

Sources.—The sources of unpublished information are referred to by the names of the stations reporting the information and the years of the reports. When data are from many sources, each item is not specifically attributed to a definite source. If such information on a specific source is desired, it can be supplied by the authors.

The laboratories that have kindly allowed the use of information from their unpublished reports for this list include the Commonwealth Institute of Biological Control stations of Delémont, Switzerland, and Rawalpindi, Pakistan; the SEA-AR Biological Control of Weeds laboratories at Rome, Italy, and Albany, Calif.; the BIIL, Beltsville, Md.; the Biological Control of Weeds Research Group of Agriculture Canada at Regina, Saskatchewan (formerly at Belleville, Ontario); and the Department of Entomology, Virginia
Polytechnic Institute and State University, Blacksburg. Data from reports of several P.L. 480 projects on biological control of weeds supported by SEA-AR are also included in this list; e.g., projects at Rawalpindi, Pakistan (A17-ENT-9 and A17-ENT-14 terminated in 1965 and 1970, respectively) and at the Ministry of Agriculture, Dokki, Egypt (F4-ENT-5 and F4-ENT-16, completed in 1970 and 1974). Much of the data included in these unpublished reports has since been published, e.g., in Zwölf er (1965a, b) and Baloch et al. (1971), and efforts have been made here to refer to the published source. However, some other records from the unpublished reports have also been included in this list for completeness.

Abbreviations used here are as follows:

**General Abbreviations**

A = Adults  
Addit. = Additional  
Agr. = Agriculture  
Ann. = Annual  
ARS = Agricultural Research Service (now SEA-AR)  
Centr. = Central  
CIBC = Commonwealth Institute of Biological Control  
Coll. = Collected  
Dept. = Department  
Distrib. = Distribution  
E. = East, eastern  
Et al. = and others  
Ft. = Fort  
Ident. = Identified, identification  
Incl. = Includes, including  
In litt. = In correspondence  
Inst. = Institute  
Is. = Island  
Km = Kilometers  
L = Larvae  
Lab. = Laboratory  
Locs. = Locations, localities  
Misident. = Misidentified, misidentification  
Mts. = Mountains  
N. = North, northern  
Nat. = National  
No(s). = Number(s)  
Nr. = Near
Insects and Fungi Associated with Carduus Thistles

Pers. comm. – Personal communication
Poss. – Possibly
Prob. – Probably
Rec(s). – Record(s), recorded
Res. – Research
Rpt(s). – Report(s)
S. – South, southern
SEA-AR – Science and Education Administration - Agricultural Research
Sp(p). – Species
Spec. – Special
Ssp. – Subspecies
SW. – Southwest, southwestern
Unident. – Unidentified
USDA – United States Department of Agriculture
Var. – Variety
VPI – Virginia Polytechnic Institute and State University
Vs. – Versus
W. – West, western
Yr(s). – Year(s)

Locality Abbreviations

Countries
U.S. – United States
USA – United States of America
USSR – Union of Soviet Socialist Republics

Canadian Provinces
Alta. – Alberta
B.C. – British Columbia
Man. – Manitoba
N.B. – New Brunswick
N.S. – Nova Scotia
Ont. – Ontario
Que. – Quebec
Sask. – Saskatchewan

United States
Amer. – America
Calif. – California
Colo. – Colorado
Del. – Delaware
United States—Continued

<table>
<thead>
<tr>
<th>State Abbreviation</th>
<th>State Name</th>
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<td>Washington</td>
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<td>Wisconsin</td>
</tr>
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<td>Wyo. -</td>
<td>Wyoming</td>
</tr>
</tbody>
</table>

**LIST OF INSECTS**

**COLLEMBOLA**

*Sminthuridae*

<table>
<thead>
<tr>
<th>Unident. sminthurid sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant recs.: <em>Carduus pycnocephalus</em> (S. Europe)</td>
</tr>
<tr>
<td>Remarks: Occasional adults feeding on leaves</td>
</tr>
<tr>
<td>Sources: Goeden (1974)</td>
</tr>
</tbody>
</table>

**THYSANOPTERA**

<table>
<thead>
<tr>
<th>Unident. thrips sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant recs.: <em>Carduus defloratus</em> (Switzerland); <em>C. nutans</em> (S. Dak.)</td>
</tr>
<tr>
<td>Remarks: In flowers</td>
</tr>
<tr>
<td>Sources: Delémont Rpt. (1963); Morihara and Balsbaugh (1976)</td>
</tr>
</tbody>
</table>

*Phlaeothripidae*

<table>
<thead>
<tr>
<th><em>Haplothrips distinguendus</em> (Uzel)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant recs.: <em>Carduus pycnocephalus</em> (S. Europe)</td>
</tr>
<tr>
<td>Remarks: Locally common; adults on flowers; polyphagous</td>
</tr>
<tr>
<td>Sources: Goeden (1974)</td>
</tr>
</tbody>
</table>

*Thripidae*

<table>
<thead>
<tr>
<th><em>Anaphothrips (Apterothrips) secticornis</em> (Trybom)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant recs.: <em>Carduus pycnocephalus</em> (S. Calif.)</td>
</tr>
<tr>
<td>Remarks: Rare; adults feeding on rosette leaves; polyphagous</td>
</tr>
<tr>
<td>Sources: Goeden (1974)</td>
</tr>
</tbody>
</table>
Frankliniella occidentalis (Pergande)

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults ectophagous on flowers; polyphagous
Sources: Goeden (1974)

DERMAPTERA
Forficulidae
Forficula auricularia L.

Plant recs.: Carduus pycnocephalus (S. Europe)
Remarks: Rare; nymphs and adults on leaves and stems; polyphagous
Sources: Goeden (1974)

ORTHOPTERA
Gryllidae
Unident. gryllid sp.

Plant recs.: Carduus pycnocephalus (S. Calif.); C. nutans (S. Dak.)
Remarks: Rare; nymphs feeding on leaves of rosette
Sources: Goeden (1974); Morihara and Balsbaugh (1976)
Oecanthus nigricornis Saussure

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs and adults ectophagous
Sources: Morihara and Balsbaugh (1976)

Tettigoniidae
Unident. tettigoniid spp. (3)

Plant recs.: Carduus pycnocephalus (S. Calif.); C. nutans (S. Dak.)
Remarks: Nymphs and adults ectophagous
Sources: Goeden (1974); Morihara and Balsbaugh (1976)

Acrididae
Unident. acridid spp. (2)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs and adults ectophagous on leaves
Sources: Morihara and Balsbaugh (1976)
Melanoplus sp.

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs and adults ectophagous on leaves; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)
ORTHOPTERA—Continued
Acrididae—Continued

Melanoplus bivittatus (Say)

- Plant recs.: Carduus nutans (S. Dak.)
- Remarks: Abundant; nymphs and adults ectophagous on leaves; polyphagous crop pest
- Sources: Morihara and Balsbaugh (1976)

Melanoplus differentialis (Thomas)

- Plant recs.: Carduus nutans (S. Dak.)
- Remarks: Abundant; adults ectophagous on leaves; polyphagous crop pest
- Sources: Morihara and Balsbaugh (1976)

Melanoplus femurrubrum (De Geer)

- Plant recs.: Carduus nutans (S. Dak.)
- Remarks: Abundant; nymphs and adults ectophagous on leaves; polyphagous crop pest
- Sources: Morihara and Balsbaugh (1976)

HEMIPTERA-HETEROPTERA

Miridae

Unident. mirid spp.

- Plant recs.: Carduus pycnocephalus (S. Europe); C. nutans (S. Dak.)
- Remarks: Nymphs and adults on foliage
- Sources: Goeden (1974); Morihara and Balsbaugh (1976)

Adelphocoris lineolatus (Goeze)

- Plant recs.: Carduus crispus (Europe); C. nutans (S. Dak.); Cirsium
- Remarks: Occasional visitor on Carduus; polyphagous crop pest
- Sources: Zwölfer (1965a); Morihara and Balsbaugh (1976)

Calocoris norvegicus (Gmelin)

- Plant recs.: Carduus crispus (Europe); C. pycnocephalus (S. Europe); Cirsium
- Remarks: Nymphs and adults from foliage of Carduus; polyphagous
- Sources: Zwölfer (1965a); Goeden (1974)

Chlamydatus associatus (Uhler)

- Plant recs.: Carduus nutans (S. Dak.)
- Remarks: Adults; ectophagous on Compositae
- Sources: Morihara and Balsbaugh (1976)

Irbisia sp. nr. I. californica Van Duzee

- Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Locally common; nymphs and adults ectophagous on flowers, leaves, and stems; polyphagous

Sources: Goeden (1974)

*Lopidea* sp.

Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Adults; uncommon
Sources: Morihara and Balsbaugh (1976)

*Lygus hesperus* (Knight)

Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Occasional nymphs and adults ectophagous on flowers; polyphagous crop pest
Sources: Goeden (1974)

*Lygus lineolaris* (Palisot de Beauvois)

Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Occasional nymphs and adults ectophagous on flowers; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)

*Lygus pratensis* (L.)

Plant recs.: *Carduus nutans* (Europe); *Cirsium*
Remarks: Occasional visitor on *Carduus*; polyphagous
Sources: Zwölfer (1965a)

*Plagiognathus* sp. nr. *P. confusus* Reuter

Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Adults on flowers
Sources: Goeden (1974)

*Plagiognathus arbustorum* (F.)

Plant recs.: *Carduus nutans* (Europe); *Cirsium*
Remarks: Occasional visitor on *Carduus*
Sources: Zwölfer (1965a)

*Plagiognathus obscurus* Uhler

Plant recs.: *Carduus sp.* (Va.); *Cirsium* (Canada)
Remarks: Frequent feeder; polyphagous
Sources: L. T. Kok in litt. (1976); Maw (1976)

*Plagiognathus politus* Uhler

Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Eggs, nymphs; ectophagous on Compositae
Sources: Morihara and Balsbaugh (1976)

*Poecilocapsus lineatus* (F.)

Plant recs.: *Carduus sp.* (Va.); *C. nutans* (S. Dak.); *Cirsium* (Canada)
Remarks: Nymphs and adults frequent feeders; polyphagous pest
Sources: L. T. Kok in litt. (1976); Morihara and Balsbaugh (1976); Maw (1976)
SEMNUM HIRTUM Reuter

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Uncommon; adults ectophagous; polyphagous
Sources: Morihara and Balsbaugh (1976)

TINGIDAE

TINGIS CARDUI (L.)

Plant recs.: Carduus defloratus (Switzerland); C. crispus (Rhine Valley); C. acanthoides (Jura, W. France); C. pycnocephalus, C. acanthoides (Europe); Cirsium, Galactites (Europe)
Remarks: Adults and nymphs found externally on leaves and stems; literature restricts hosts to Carduus-Cirsium
Sources: Delémont Rpts. (1962-63); Zwölfer (1965a); Eguagie (1974)

LYGAEIDAE

UNIDENTIFIED LYGAEID SPP.

Plant recs.: Carduus pycnocephalus (S. Europe); C. nutans (S. Dak.)
Remarks: Rare; adults ectophagous on leaves; polyphagous
Sources: Goeden (1974); Morihara and Balsbaugh (1976)

GEOCORIS ULIGINOSUS (Say)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Rare; adults ectophagous on flowers; on other Compositae
Sources: Morihara and Balsbaugh (1976)

LYGAEUS EQUESTER (L.)

Plant recs.: Carduus nutans (Europe); C. pycnocephalus (S. Europe)
Remarks: Occasional visitor on flowers and leaves; polyphagous
Sources: Zwölfer (1965a); Goeden (1974)

MELANOCORYPHUS BICRUCIS (Say)

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults ectophagous on flowers and stems; polyphagous
Sources: Goeden (1974)

COREIDAE

ORTHOLOMUS SP.

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Rare; adults ectophagous
Sources: Morihara and Balsbaugh (1976)

*Syromastes marginatus* (L.) (= *Coreus marginatus*)

**Plant recs.:** *Carduus nutans* (Europe); *Cirsium*

**Remarks:** Occasional visitor

**Sources:** Zwölfer (1965a)

### Pentatomidae

*Aelia* sp.

**Plant recs.:** *Carduus crispus* (Europe)

**Remarks:** Occasional visitor

**Sources:** Zwölfer (1965a)

*Carpocoris pudicus* (Poda)

**Plant recs.:** *Carduus nutans* (Europe); *Cirsium, Silybum, Centaurea*

**Remarks:** Nymphs and adults found on stem and leaves

**Sources:** Zwölfer (1965a)

*Carpocoris purpureipennis* De Geer (and/or var. *pallidus* Distant)

**Plant recs.:** *Carduus edelbergii* (Pakistan); many other hosts

**Remarks:** Polyphagous; “a known pest”; exophytic on stems and leaves

**Sources:** A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

*Chlorochroa uhleri* Stål

**Plant recs.:** *Carduus nutans* (S. Dak.)

**Remarks:** Rare; adults; polyphagous

**Sources:** Morihara and Balsbaugh (1976)

*Cosmopepla bimaculata* (Thomas)

**Plant recs.:** *Carduus nutans* (S. Dak.)

**Remarks:** Nymphs, adults on flowers and leaves; polyphagous

**Sources:** Morihara and Balsbaugh (1976)

*Dolycoris baccarum* (L.)

**Plant recs.:** *Carduus nutans* (Europe); *Cirsium, Onopordum, Centaurea, Echinops*

**Remarks:** Nymphs and adults found on stems and leaves; polyphagous; attacks crops

**Sources:** Zwölfer (1965a)

*Dolycoris indicus* Stål

**Plant recs.:** *Carduus edelbergii* (Pakistan); *Carthamus, Xanthium, Calotropis, Cannabis, Cnicus, Salvia, Ziziphus*

**Remarks:** Adults suck sap of *Carduus* and *Xanthium*; polyphagous crop pest

**Sources:** A17-ENT-9 Rpts. (1961, 1965); Baloch et al. (1968, 1971)
HEMIPTERA·HETEROPTERA—Continued
Pentatomidae—Continued

Eurydema lituriferum Walker
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Adults suck sap from leaves of Carduus
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Eurydema oleraceum (L.)
Plant recs.: Carduus nutans (Europe); Cirsium
Remarks: Occasional visitor on Carduus
Sources: Zwölfer (1965a)

Eurydema ornatum (L.) (= E. festivum L.)
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Exophytic on stems and leaves; polyphagous; attacks many crops
Sources: A17-ENT-9 Rpts. (1961, 1965); Baloch et al. (1971)

Euschistus conspersus Uhler
Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults ectophagous on flowers and leaves; polyphagous; pest of Cynara
Sources: Goeden (1974)

Euschistus euschistoidea (Vollenhoven)
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Common; nymphs and adults ectophagous on flowers and leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

Euschistus tristigmus (Say)
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs and adults ectophagous on flowers and leaves; attacks other Compositae
Sources: Morihara and Balsbaugh (1976)

Evacanthus repexus Distant
Plant recs.: Carduus edelbergii (Pakistan); many other hosts
Remarks: Polyphagous crop pest
Sources: Baloch et al. (1971)

Nezara viridula (L.)
Plant recs.: Carduus edelbergii (Pakistan); C. pycnocephalus (S. Europe); C. nutans (Va.); Xanthium, Cannabis, Salvia
Remarks: Adults feeding (sucking sap) on leaves and flowers of Carduus; polyphagous crop pest
Odontotarsus purpureolineatus (Rossi)

Plant recs.: Carduus nutans (Europe)
Remarks: Occasional visitor
Sources: Zwölfer (1965a)

Thyanta pallidovirens pallidovirens (Stål)

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults on stems; polyphagous
Sources: Goeden (1974)

Piesmatidae

Piesma cinera (Say)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Rare; adults on flowers and leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

Pyrrhocoridae

Pyrrhocoris apterus L.

Plant recs.: Carduus acaanthoides (S. Europe)
Remarks: Rare, adults on leaves; polyphagous
Sources: Goeden (1974)

Rhopalidae

Leptocoris sp. nr. L. rubrolineatus Barber

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults ectophagous on flowers and leaves; polyphagous crop pest
Sources: Goeden (1974)

Leptocoris trivittatus (Say)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs, adults ectophagous on leaves, stems, and flowers; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)

Liorhyssus hyalinus (F.)

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; nymphs ectophagous on shoots; polyphagous
Sources: Goeden (1974)

Scutelleridae

Unident. scutellerid sp.

Plant recs.: Carduus pycnocephalus (S. Europe)
Remarks: Rare; adults eat leaves
Sources: Goeden (1974)

Eurygaster amerinda amerinda Bliven

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; adults ectophagous on leaves; polyphagous
Sources: Goeden (1974)
HEMIPTERA-HOMOPTERA

Cicadellidae

Aceratagallia sp.

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Occasional adults ectophagous on stems, leaves, and flowers
Sources: Goeden (1974)

Aceratagallia uhleri (Van Duzee)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults; ectophagous
Sources: Morihara and Balsbaugh (1976)

Agallia quadripunctata (Provancher)

Plant recs.: Carduus nutans (S. Oak.); Cirsium (Canada)
Remarks: Rare; adults only; polyphagous
Sources: Morihara and Balsbaugh (1976); Maw (1976)

Agalliaopsis novella Say

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults; ectophagous; polyphagous
Sources: Morihara and Balsbaugh (1976)

Deltocephalus signatifrons (Van Duzee)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults; uncommon
Sources: Morihara and Balsbaugh (1976)

Elymana sp.

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Rare; adults; polyphagous
Sources: Morihara and Balsbaugh (1976)

Empoasca sp.

Plant recs.: Carduus pycnocephalus (S. Calif.); C. nutans (S. Dak.)
Remarks: Rare; nymphs and adults ectophagous on leaves
Sources: Goeden (1974); Morihara and Balsbaugh (1976)

Endria inimica (Say)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Nymphs and adults abundant; polyphagous crop pest; vector of aster yellows and wheat streak mosaic
Sources: Morihara and Balsbaugh (1976)

Euscelis lineolatus Brulle

Plant recs.: Carduus pycnocephalus (S. Europe)
Remarks: Rare; adults on leaves; polyphagous
Sources: Goeden (1974)
Graphocephala coccinea Forster
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Rare; adults; polyphagous
   Sources: Morihara and Balsbaugh (1976)

Latalus sp.
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Rare; adults; polyphagous
   Sources: Morihara and Balsbaugh (1976)

Macrosteles divisa (Uhler)
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Adults ectophagous on Compositae; crop pest
   Sources: Morihara and Balsbaugh (1976)

Neosteles neglecta Delong and Davidson
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Nymphs and adults ectophagous
   Sources: Morihara and Balsbaugh (1976)

Paragonia tredecimpunctata Ball
   Plant recs.: Carduus pycnocephalus (S. Calif.)
   Remarks: Nymphs and adults common; ectophagous on leaves and stems; polyphagous
   Sources: Goeden (1974)

Paraphlepsius irroratus (Say)
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Adults, nymphs moderately abundant; polyphagous
   Sources: Morihara and Balsbaugh (1976)

Psammotettix sp.
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Rare; adults
   Sources: Morihara and Balsbaugh (1976)

Aphididae

Unident. aphid spp.
   Plant recs.: Carduus edelbergii (Pakistan); C. nutans (Europe); C. pycnocephalus (Egypt)
   Remarks: None
   Sources: A17-ENT-9 Rpt. (1961); Zwölfer (1965a); F4-ENT-5 Rpt. (1967)

Aphis spp. (2)
   Plant recs.: Carduus nutans (S. Dak.)
   Remarks: Adults and nymphs; ectophagous on stems
   Sources: Morihara and Balsbaugh (1976)

Aphis craccivora Koch (= A. medicaginis (Koch))
   Plant recs.: Carduus pycnocephalus (France, S. Europe); Tribulus, Cnicus (Pakistan)
Remarks: Winter host is Robinia; polyphagous
Sources: L. Andres in litt. (1961); A17-ENT-9 Rpt. (1965); Goeden (1974)

*Aphis fabae* Scopoli

Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Occasional nymphs and adults; reproduce on leaves and stems; polyphagous crop pest
Sources: Goeden (1974)

*Aphis gossypii* Glover

Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Occasional nymphs and adults on flowers, leaves, and stems; polyphagous crop pest
Sources: Goeden (1974)

*Brachycaudus* sp.

Plant recs.: *Carduus edelbergii* (Pakistan)
Remarks: Nymphs and adults feeding on leaves of *Carduus*
Sources: A17-ENT-9 Rpt. (1965)

*Brachycaudus cardui* (L.) (= *Anuraphis cardui*, *Aphis cardui*)

Plant recs.: *Carduus pycnocephalus* (France, Italy); *C. nutans* (Italy); *Carduus* sp. (Va.); *C. edelbergii*, *Cnicus* (Pakistan); *Cynara*, *Cirsium*, *Senecio*
Remarks: Locally common on flowers and stems; winter host is *Prunus*
Sources: L. Andres in litt. (1961); Baloch et al. (1971); Goeden (1974); L. T. Kok in litt. (1976)

*Brachycaudus helichrysi* Kaltenbach (= *Aphis helichrysi* (Kalt.))

Plant recs.: *Carduus pycnocephalus* (Egypt, S. Calif.)
Remarks: This species severely infests growth of blooming *Carduus* in Egypt and is preyed on by the cecidomyiid *Phaenobremia aphidiuora* Rubs.; *B. helichrysi* also is known in N. and S. Amer., Europe, S. Asia, and N. Africa; winter host is *Prunus*; summer hosts are artichoke, sugar beets, clover, aster, chrysanthemum, iris, petunia, almond, apricot, peach, plum, and others
Sources: F4-ENT-5 Rpts. (1966–67); Goeden (1974)

*Capitophorus carduinus* (Walker) (= *C. flaveolus* (Walk.))

Plant recs.: *Carduus nutans*, *C. acanthoides*, *C. crispus*, *Cirsium* (Europe); *Cirsium* (Canada); *Cynara* (USA)
Remarks: Reported on foliage of *Carduus*; on *Cirsium* all year
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES

Sources: Zwölfer (1965a); Maw (1976)

Capitophorus elaeagni (del Guercio) (= C. braggii Gillette)

Plant recs.: Carduus edelbergii (Pakistan); C. pycnocephalus (S. Calif.); Cirsium (Canada)

Remarks: Nymphs and adults feeding on leaves of Carduus; summer hosts are several Compositae including Cynara; winter hosts are Elaeagnus hippophae and Shepherdia

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971); Goeden (1974); Maw (1976)

Capitophorus flavescens Walker

Plant recs.: Carduus acanthoides (Europe); Cirsium

Remarks: Stenophagous

Sources: Zwölfer (1965a)

Cerosipha wartenbergi Borner

Plant recs.: Carduus defloratus (Europe)

Remarks: None

Sources: Zwölfer (1965a)

Dactynotus aeneus (Hille Ris Lambers)

Plant recs.: Carduus nutans, C. defloratus, C. acanthoides, C. crispus all year (Europe); Cirsium (Europe)

Remarks: Nymphs and adults on leaves and stems

Sources: Zwölfer (1965a)

Dactynotus jaceae (L.) (= Macrosiphum jaceae (L.))

Plant recs.: Carduus pycnocephalus (Italy); Carthamus, Cirsium, Campanula (Europe, Rhodesia, India, Egypt)

Remarks: Nymphs and adults locally common on flowers and stems; on Centaurea all year

Sources: L. Andres in litt. (1961); Goeden (1974)

Dactynotus macrosiphon (Hille Ris Lambers)

Plant recs.: Carduus defloratus, C. personatus, Cirsium, Carlina (Europe)

Remarks: Nymphs and adults on stems and leaves

Sources: Zwölfer (1965a)

Rhopalosiphum sp.

Plant recs.: Carduus nutans (S. Dak.)

Remarks: Nymphs, adults ectophagous on stems

Sources: Morihara and Balsbaugh (1976)

Toxopterina acanthoides (Borner)

Plant recs.: Carduus acanthoides (Europe)

Remarks: Nymphs and adults on leaves and stems

Sources: Zwölfer (1965a)

Cercopidae

Unident. cercopid spp.
HEMIPTERA-HOMOPTERA—Continued
Cercopidae—Continued

Plant recs.: *Carduus pycnocephalus* (S. Calif., S. Europe)
Remarks: Nymphs locally common to rare on stems; ectophagous
Sources: Goeden (1974)

*Philaenus spumarius* (L.)
Plant recs.: *Carduus pycnocephalus* (S. Europe)
Remarks: Nymphs and adults on shoots; polyphagous
Sources: Goeden (1974)

Delphacidae

Unident. delphacid sp.
Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Nymphs and adults; ectophagous
Sources: Morihara and Balsbaugh (1976)

Dictyopharidae

*Orgerius concordus* Ball and Hartzell
Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Rare; adults on shoots; polyphagous
Sources: Goeden (1974)

Issidae

*Danephteryx* sp. nr. *D. manca* Uhler
Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Rare; adults on leaves; polyphagous
Sources: Goeden (1974)

Acanaloniidae

*Acanalonia bivittata* (Say)
Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Rare; adults; polyphagous
Sources: Morihara and Balsbaugh (1976)

Pseudococcidae

Unident. pseudococcid sp.
Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Rare; nymphs on leaves
Sources: Goeden (1974)

COLEOPTERA

Staphylinidae

*Mesomorphus* sp.
Plant recs.: *Carduus edelbergii* (Pakistan)
Remarks: Adults; feeding on leaves
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Melyridae

Unident. melyrid spp.
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Adults; locally common on flowers
Sources: Goeden (1974)

Procerallus (= Acanthocnemus) altivolans Champ.
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Adults taken from flowers; no other hosts known
Sources: A17-ENT-9 Rpts. (1962–63, 1965)

Phalacridae
Phalaerus sp.
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Adults found on plant; occasional visitors; no other host known
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Nitidulidae
Unident. nitidulid sp.
Plant recs.: Carduus acanthoides (France)
Remarks: Larvae in flower heads
Sources: Delémont Rpt. (1963)

Meligethes sp.
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Adults feeding on flowers; polyphagous; a polyphagous Meligethes also known from "thistles" in Europe
Sources: A17-ENT-9 Rpts. (1962–63, 1965); Baloch et al. (1971)

Meligethes nigrescens Stephens
Plant recs.: Carduus pycnocephalus (S. Europe)
Remarks: Rare; adults endophagous in flowers
Sources: Goeden (1974)

Oedemeridae
Oedemera sp.
Plant recs.: Carduus nutans (Austria); C. crispus (Rhine Valley)
Remarks: Ovipositing in stems of C. nutans; adult on leaves of C. crispus
Sources: Delémont Rpts. (1962–63)

Mordellidae
Unident. mordellid sp.
Plant recs.: Carduus acanthoides (France); C. crispus (Rhine Valley); C. nutans, C. tenuiflorus (Europe)
Remarks: Larvae on leaves of C. acanthoides, in stems of C. crispus, C. nutans, and C. tenuiflorus
Sources: Delémont Rpt. (1963); Zwölfer (1965a)
COLEOPTERA—Continued
Mordellidae—Continued

*Mordella* sp.
Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Adults; larvae endophagous in leaves and stems
Sources: Morihara and Balsbaugh (1976)

*Mordellistena* spp.
Plant recs.: *Carduus nutans* (Rhine Valley, S. Dak.); *C. crispus* (Europe); *C. pycnocephalus* (S. Calif.)
Remarks: Larvae in stems of *C. nutans* and listed as endophytic in stems of *C. crispus*; adults occasional on leaves, stems, and flowers
Sources: Delémont Rpt. (1963); Zwölfer (1965a); Goeden (1974); Morihara and Balsbaugh (1976)

Meloidae

*Epicauta atrata* (F.)
Plant recs.: *Carduus nutans* (Sask.)
Remarks: None
Sources: M. G. Maw in litt. (1976)

*Epicauta ferruginea* (Say)
Plant recs.: *Carduus nutans* (Sask.)
Remarks: None
Sources: M. G. Maw in litt. (1976)

*Nemognatha lutea* LeConte
Plant recs.: *Carduus nutans* (Sask.)
Remarks: None
Sources: M. G. Maw in litt. (1976)

Aleculidae

Unident. aleculid sp.
Plant recs.: *Carduus nutans* (Europe)
Remarks: Occasional visitor
Sources: Zwölfer (1965a)

Byturidae

Unident. byturid sp.
Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Rare; larva
Sources: Morihara and Balsbaugh (1976)

Anobiidae

*Lasioderma* sp.
Plant recs.: *Carduus pycnocephalus* (S. Europe)
Remarks: Larvae common; endophagous in flowers; also in other Cynareae
Sources: Goeden (1974)
Lasioderma baudii Schilsky

Plant recs.: Carduus pycnocephalus, C. tenuiflorus (Italy); Cirsium, Centaurea, Cynara, Carthamus

Remarks: Larvae reared from capitula, feed in seeds; first identified as L. serricorne

Sources: Rome Rpts. (1963–64)

Lasioderma redtenbacheri Bach

Plant recs.: Carduus nutans, Onopordum, Centaurea (Europe); Centaurea (Egypt)

Remarks: Larvae endophytic in flower heads and buds; main hosts in Egypt listed as chestnuts; distrib. Sicily and Egypt

Sources: Zwölfer (1965a); F4-ENT-5 Rpt. (1967)

Lasioderma serricorne (F.)

Plant recs.: Carduus nutans, C. tenuiflorus, Centaurea, Cynara (Italy); Centaurea (France, Egypt); Silybum (Lebanon)

Remarks: Some earlier recs. (by Rome) are L. baudii; larvae feed in receptacle and are probably secondary in their attack following weevils and seed flies; numerous reports of attacking Cynara, following L. baudii in Italy


Scarabaeidae

Cetonia aurata (L.)

Plant recs.: Carduus pycnocephalus (S. Europe)

Remarks: Rare; adults in flowers; polyphagous

Sources: Goeden (1974)

Oxythyrea sp.

Plant recs.: Carduus edelbergii (Pakistan)

Remarks: Adults found in flowers; occasional visitor

Sources: A17-ENT-9 Rpts. (1961–62, 1965); Baloch et al. (1971)

Oxythyrea funesta Poda

Plant recs.: Carduus nutans, C. pycnocephalus, Cirsium, Centaurea, Onopordum (Europe)

Remarks: Occasional visitor on thistles; adults common on flowers; polyphagous

Sources: Zwölfer (1965a); Goeden (1974)

Potosia hungarica Herbst

Plant recs.: Carduus nutans, C. acanthoides, Cirsium (Europe)

Remarks: Occasional visitor on thistles

Sources: Zwölfer (1965a)
**COLEOPTERA—Continued**

**Scarabaeidae—Continued**

*Potosia morio* (F.)

- **Plant recs.:** *Carduus pycnocephalus* (S. Europe)
- **Remarks:** Occasional adults feeding on flowers; polyphagous
- **Sources:** Goeden (1974)

*Tropinota hirta* (Poda)

- **Plant recs.:** *Carduus nutans* (Europe); *C. pycnocephalus* (S. Europe)
- **Remarks:** Rare; occasional visitor; adults ectophagous on flowers; polyphagous
- **Sources:** Zwölfer (1965a); Goeden (1974)

*Tropinota squalida* Scopoli

- **Plant recs.:** *Carduus pycnocephalus* (Egypt)
- **Remarks:** None
- **Sources:** F4-ENT-5 Rpts. (1967, 1971)

*Cerambycidae*

Unident. cerambycid spp.

- **Plant recs.:** *Carduus nutans*, *C. pycnocephalus*, *C. tenuiflorus*, *Silybum*, *Onopordum* (adults only, Italy); *C. nutans* (larvae, Italy)
- **Remarks:** Small adults found on these plants with no associated larvae; large larvae commonly found boring in pith of larger stems of *C. nutans*, but apparently predaceous
- **Sources:** Rome Rpt. (1963)

*Agapanthia* sp.

- **Plant recs.:** *Carduus crispus* (Rhine Valley)
- **Remarks:** Larvae endophytic in stems
- **Sources:** Delémont Rpt. (1963); Zwölfer (1965a)

*Agapanthia cardui* (L.)

- **Plant recs.:** *Carduus nutans* (Rhine Valley); *C. nutans*, *C. acanthoides*, *C. tenuiflorus*, *C. pycnocephalus*, *Cirsium*, *Galactites*, *Onopordum*, *Centaurea*, *Cynara* (Europe); ? *Centaurea* (France, Bulgaria)
- **Remarks:** Larvae (endophytic in stem) reared only from *Cirsium*; other recs. here are adults only (on foliage); identity of larvae in *Centaurea* in France and Bulgaria in question, given as "possibly cardui"
- **Sources:** Delémont Rpts. (1963, 1965, 1967); Zwölfer (1965a); Goeden (1974)
Agapanthia dahlì Richter

Plant recs.: Carduus nutans (Austria); C. nutans, C. acanthoides, C. pycnocephalus, C. ligiosius, Cirsium, Arctium (Europe); Carduus pycnocephalus, Centaurea (Egypt)

Remarks: Larvae (feeding in stem) reared only from Carduus acanthoides, C. pycnocephalus, and Centaurea; other recs. shown here are adults only (feeding on foliage); A. dahlì studied in lab. at Delémont; reared in lab. in Egypt from C. pycnocephalus and Centaurea; one of main pests of C. pycnocephalus in Egypt; an economic pest of sunflower in USSR


Agapanthia lateralis Ganglbauer

Plant recs.: Carduus pycnocephalus, Centaurea, Silybum (Egypt)

Remarks: One of main pests of C. pycnocephalus in Egypt; reared in lab. in Egypt from C. pycnocephalus and Centaurea; larvae feed in stems

Sources: F4-ENT-5 and F4-ENT-16 Rpts. (1967–68, 1976)

Agapanthia villosoviridebennis De Geer

Plant recs.: Carduus nutans, C. pycnocephalus, Cirsium, Onopordum, Echinops (Europe)

Remarks: Larvae (feeding in stems) recorded only from Cirsium and Echinops; other recs. here are adults only, eating stems or foliage; literature rec. hosts are Angelica, Aconitum, Eupatorium, Heraclenum, Senecio, and Cirsium

Sources: Delémont Rpts. (1962–63); Zwölfer (1965a); Goeden (1974)

Agapanthia violacea (F.)

Plant recs.: Carduus pycnocephalus, Centaurea (Europe)

Remarks: Occasional visitor (adults)

Sources: Zwölfer (1965a)

Purpuricenus kaehleri (L.)

Plant recs.: Carduus pycnocephalus (S. Europe)

Remarks: Rare; adults ectophagous on flowers; polyphagous

Sources: Goeden (1974)
COLEOPTERA—Continued

Chrysomelidae

Unident. chrysomelid spp.

Plant recs.: Carduus pycnocephalus and/or C. tenuiflorus (Calif.)

Remarks: Feeding habits unknown

Sources: Albany Rpt. (1963)

Altica sp. nr. A. viridicyanea Baly (= Haltica sp.)

Plant recs.: Carduus edelbergii (Pakistan)

Remarks: Adults feeding on foliage; possibly oligophagous; morphologically different from European Altica spp.

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Altica carduorum Guérin-Ménéville

Plant recs.: Carduus pycnocephalus, C. nutans, C. crispus, C. tenuiflorus, C. defloratus, C. personatus, C. acanthoides, Cirsium, Silybum, Onopordum, Chicus, Arctium, Xeranthemum, Cynara, Echinops, Helianthus, Chrysanthemum, Carthamus, Lactuca, flax (Europe and lab. recs.—see remarks)

Remarks: Adults and larvae skeletonize leaves of host, desiccating plant incl. roots; believed to be host specific to Cirsium, with Carduus and Silybum being marginal hosts, probably not in nature

Field recs. (adults only); Cirsium arvense (L.) Scop. (Switzerland, France, Spain), C. vulgare (Savi) Ten. (Spain), and Carduus pycnocephalus (Europe)

Other distrib. (from museum specimens): Germany, Czechoslovakia, Yugoslavia, Greece, Albania, Italy, Sicily, Sardinia, Corsica, Cyprus, ?Austria, and ?Asiatic USSR


Results of lab. screening tests (D = Delémont, B = Belleville, A = Albany): Adults fed regularly on Carduus nutans (D), C. crispus (D), C. tenuiflorus (D), C. acanthoides (B), C. sp. prob.
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES

tenuiflorus (A), C. pycnocephalus (A), Cirsium (D, B, A), Silybum (D, B, A), and occasionally on Carduus defloratus (D), C. personatus (D), Cnicus (D), Arctium (D, B), Xeranthemum (B), Onopordum (D, B), Centaurea (B, A), Helianthus (B), Chrysanthemum (B), Lactuca (A), and especially the new tender growth of Cardhamus (A) and Cynara (A); larvae fed and developed successfully only on Carduus acanthoides (B), C. pycnocephalus (A), Cirsium (D, B, A), and Silybum (D, B); fed occasionally, but could not develop on Cnicus (D), Xeranthemum (D), Cynara (D, A), Centaurea (B), Onopordum (B), Echinops (B), Carthamus (A), and flax; eggs deposited only on Cirsium (D, B, A) and Silybum (D, B, A); detailed results of specificity tests in Harris (1964); distrib. and ecology in Zwölfer (1965b).

Releases (A = adults, L = larvae) against Cirsium arvense: Canada - 21 A in Ont. and 100 A and L in Alta. in 1963; 600 A and L in Ont. (2 locs.), and 100 A and L in B.C. (82 A and L sent to Albany for lab.) in 1964; 149 A in Alta., 72 A in B.C., and 1,460 A and L in Ont. (2 locs.) in 1965; 60 A in N.S. and 35 A (+482 L in field cage study) in Ont. in 1966; 367 A (+64 in field cage study) in B.C. and 490 A in Ont. in 1967; 1,147 A in B.C. (2 locs.), 1,160 A and 107 L in Alta., and 291 A in Ont. in 1968; 5,534 A in B.C. (2 locs.) and 170 A in Alta. in 1969; and 1,363 A (from lab. culture and France); in Ont. (2 locs.) in 1970.

United States - 1,000 A in Calif. (4 locs.), 400 A in Idaho, 200 A in Oreg., 200 A in Wash., and in Mont. (640 A sent, but prob. only 200 released, 2 locs.) in 1966; 1,700 A in Calif. (Ft. Bragg area) and 175 in Idaho (in field cage) in 1967; 500 A in Calif. (Ft. Bragg field cage), 150 A in Colo. (2 locs.), 200 A in Idaho, 100 A in Wash., 200 A in Minn., 200 A in Wis., 200 A in Ind., 200 A in Del., and 200 A (+ some larvae reared in lab.) in N.J. in 1968; unknown No. A in Calif. (Ft. Bragg area) in 1969; 500 A and 242 L in S. Dak. (field cages) and 360 L in Md. (field
cages) in 1970; 160 A in Md. and 65 sent to S. Dak. in 1971; and 52 A sent to S. Dak. in 1972 (S. Dak. and Md. releases from French material)

Recovery data: Little survival in Canada, not established on Cirsium in B.C., Alta., Ont., or N.S. by 1975 and studies discontinued; possible reasons are predation and low summer temperatures; no overwintering observed at Ft. Bragg, Calif., release site; no known establishment elsewhere in U.S.; in Canada, it survived only when protected by field cages from predation; the mites Leptus sp. nr. curtipes Schweitzer and Sphaerolophus sp. ate the eggs (Peschken et al., 1971); over 2,100 adults were released in 1969 at 3 sites in England (Claridge et al., 1970); poor survival in cages was attributed to the cool climate (Baker et al., 1972); in S. Dak., establishment was limited by the hot, dry summers and predation by Lebia viridis Say and Harpalus pennsylvanicus De Geer (Schaber et al. 1975)


Aphthona pygmaea Kutschera

Plant recs.: Carduus pycnocephalus (S. Europe)
Remarks: Rare; adults on leaves
Sources: Goeden (1974)

Arima marginata (F.)

Plant recs.: Carduus nutans, Centaurea (France); other hosts from literature: Carduus, Cirsium, Onopordum, Arctium, Asteraceae, Heliantheae, Anthemideae, Calenduleae, Contaureinae, Lactuca (lab. tests)
Remarks: Adults and larvae on leaves
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES  31

Sources: Grandi (1952); Heikertinger (1954); Zwölf er (1969)

**Cassida deflorata** Suffr ian

**Plant recs.:** Carduus tenuiflorus, C. personatus, C. pycnocephalus, C. defloratus, C. nutans, C. crispus, Cnicus, Arctium, Cynara, Cirsium, Onopordum, Silybum, Centaurea, Chrysanthemum, Echinops, Xeranthemum, Card hamus, Carlina, Tagetes, Leontodon, Erigeron (Europe and in lab. tests — see remarks)

**Remarks:** Field recs.: Carduus sp., C. tenuiflorus, C. pycnocephalus (S. Europe), Cynara, Silybum (France), Cirsium (Switzerland), and Cynara (Italy); adults and larvae on all species here except on C. tenuiflorus (adults and eggs only) and on Cirsium in Switzerland (adults only); identity of “sp. prob. deflorata” in Italy on Cynara in question

Results of lab. tests (Delémont): Adults fed heavily or regularly on foliage of Carduus personatus, C. defloratus, C. nutans, C. tenuiflorus, C. crispus, Arctium, Cynara, Onopordum, Silybum, Cirsium, Centaurea, and rather inconsistently or occasionally on Cnicus, Chrysanthemum, Cardhamus, Echinops, Xeranthemum, and Carlina; larvae fed regularly on Carduus (same 5 spp. as above), Cnicus, Cardhamus, Arctium, Cynara, Onopordum, Silybum, Centaurea, and inconsistently or occasionally on Echinops, Xeranthemum, Tagetes, and Leontodon; adults show high feeding indices in Cynara and Onopordum; cannot be considered in biological control program because of feeding on Cynara

Sources: Delémont Rpts. (1961-63); Zwölfer (1965a, 1969); Zwölfer and Eichhorn (1966); Goeden (1974)

**Cassida rubiginosa** Mueller

**Plant recs.:** Carduus pycnocephalus, C. aca nthoides, C. defloratus, C. crispus, C. nutans, C. personatus, C. tenuiflorus, Cirsium, Onopordum, Arctium, Centaurea, Carthamus, Cynara, Silybum, Lappa, Tanacetum, Xeranthemum, Cnicus, Echinops, Helianthus, Erigeron, Solidago, Aster, Carlina, Taraxacum (Europe, N. Amer., and in lab. tests — see remarks)
COLEOPTERA—Continued

Chrysomelidae—Continued

Remarks: Adults and larvae skeletonize and severely damage leaves of hosts; prefer Cirsium, Carduus, and Silybum, but also feed on Cynara, Carthamus, and other plants.

Field recs.: Adults and larvae from Carduus nutans and C. pycnocephalus (Europe), C. thoermeri and C. nutans (abundant in N. Va., Md., Pa., 1975), C. crispus (Rhine Valley), C. personatus (Europe), C. aceanthoides (Swabian Jura), C. defloratus (Switzerland), Carduus (Canada), Cirsium (Switzerland, Canada, France, Swabian Jura, Rhine Valley), and Onopordum, Arctium, and Centaurea (Europe); adults only from Carduus aceanthoides and Onopordum (France), Carduus nutans and Cirsium (Austria), and Carduus defloratus and C. personatus (Europe); unknown stages from C. pycnocephalus (France, Italy), Cirsium, Lappa, and Silybum (N. Amer.)

Other distrib.: Germany, England, Ont. (found 1927), Que. (1940), N.Y. (1945), and N.J. (1962)

Results of lab. screening tests (Delémont, 1962–63): Adults fed regularly on Carduus personatus, C. defloratus, C. nutans, C. tenuiflorus, C. crispus, Cirsium, Silybum, Onopordum, Cynara, Arctium, Centaurea, Carthamus, and occasionally (or nibbled) on Xeranthemum, Cnicus, Echinops, and Helianthus; larvae fed and developed on same 5 Carduus spp. in adult test plus Cirsium, Silybum, Onopordum, Cynara, Arctium, Centaurea, and fed but did not develop on Carthamus, Cnicus, Echinops, and Erigeron; oviposition obtained on Carduus defloratus, C. nutans, Cirsium, Silybum, Onopordum, Cynara, Arctium, Centaurea, and Taraxacum (fate of eggs not studied in this test); parasitism may prevent high populations in parts of N. Amer.

Sources: L. Andres in litt. (1961); Delémont Rpts. (1962–63, 1967); Rome Rpt. (1963); Zwölfer
INSECTS AND FUNGI ASSOCIATED WITH CARDUUS THISTLES

(1965a, 1969); Zwölfer and Eichhorn (1966); Mohr (1966); Zwölfer and Pattullo (1970); S. W. T. Batra and L. T. Kok in litt. (1976); Maw (1976)

*Cassida* sp. nr. *C. vibex* (L.)

**Plant recs.**: *Carduus* sp. (Austria, Switzerland); *C. acaanthoides* (Switzerland); *C. personatus* (France); *C. edelbergii* (Pakistan)

**Remarks**: Eggs and larvae found on plants in Europe; adults feeding on leaves of *C. edelbergii* in Pakistan

**Sources**: Delémont Rpts. (1962–63); A17-ENT-9 Rpt. (1965); Zwölfer and Eichhorn (1966); Baloch et al. (1971)

*Cassida vibex* (L.)

**Plant recs.**: *Carduus defloratus*, *C. crispus*, *C. pycnocephalus*, *C. tenuiflorus*, *C. nutans*, *C. personatus*, *Cirsium*, *Centaurea*, *Arctium*, *Onopordum*, *Silybum*, *Serratula*, *Cnicus*, *Carthamus*, *Cynara*, *Tanacetum*, *Xeranthemum*, *Echinops*, *Carlina*, *Helianthus*, *Chrysanthemum*, *Solidago*, *Erigeron*, *Aster*, *Taraxacum*, *Lactuca* (Europe and in lab. tests – see remarks)

**Remarks**: Adults and larvae skeletonize the leaves of the host; a potential pest of *Cynara* and *Carthamus*

**Field recs.**: Adults and larvae from *Carduus defloratus* and *Cirsium* (Switzerland, France, Austria, Rhine Valley), *Onopordum* and *Arctium* (France), and *Centaurea* and *Serratula* (Europe); adults only from *Carduus crispus*, *C. pycnocephalus*, *C. personatus*, *C. tenuiflorus*, and *Silybum* (Europe)

Results of lab. tests (Delémont, 1962–63) for *Cirsium arvense*: Adults fed heavily or regularly on *Carduus nutans*, *C. defloratus*, *C. tenuiflorus*, *C. crispus*, *C. personatus*, *Cirsium*, *Silybum*, *Centaurea*, *Onopordum*, *Cynara*, *Carthamus*, *Arctium*, *Cnicus*, and occasionally on *Xeranthemum*, *Echinops*, *Carlina*, and *Helianthus*; larvae fed and developed on *Carduus* (same 5 spp. as for adult test), *Cirsium*, *Silybum*, *Centaurea*, *Onopordum*, *Cynara*, *Carthamus*, *Cnicus*, and nibbled (but did not develop) on *Carlina* and *Chrysanthemum*; oviposition obtained (fate of eggs not studied) on *Carduus defloratus*, *Cirsium*,...
Silybum, Centaurea, Onopordum, Cynara, Arctium, Chicus, Xeranthemum, Echinops, Chrysanthemum, Solidago, Erigeron, Aster, Taraxacum, and Lactuca

Sources: Delémont Rpts. (1961, 1963); Zwölfer (1965a, 1969); Zwölfer and Eichhorn (1966); Mohr (1966)

Chaetocnema confinis Crotch
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults ectophagous on leaves; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)

Chrysomela banksi F.
Plant recs.: Carduus pycnocephalus (S. Europe); Compositae, Labiatae
Remarks: Rare; adults on leaves; prob. polyphagous
Sources: Zwölfer (1969); Goeden (1974)

Chrysomela fuliginosa Olivier
Plant recs.: Centaurea (Europe); Carduus nutans, Cirsium, Cynara, Chicus, Curthamus, Centaurea (lab. tests)
Remarks: Adults and larvae on leaves
Sources: Zwölfer (1969)

Crepidodera ferruginea Scopoli
Plant recs.: Carduus defloratus, C. personatus, Cirsium, Carlina, other Compositae (Europe)
Remarks: These recs. are adults only on foliage; larvae generally attack plant stem base
Sources: Zwölfer (1965a, 1969)

Crepidodera transversa Marsham
Plant recs.: Carduus defloratus, Cirsium, Carlina (Austria, Switzerland)
Remarks: These recs. are adults only on foliage; oviposition and screening tests conducted with this sp. at Delémont in 1962 and 1963
Sources: Delémont Rpts. (1962-63)

Cryptocephalus sericeus (L.)
Plant recs.: Carduus nutans (Europe)
Remarks: Occasional visitor
Sources: Zwölfer (1965a)

Diabrotica undecimpunctata undesimmpunctata Mannerheim
Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Occasional adults; poss. breeding on flowers, leaves, and stems; polyphagous crop pest
Sources: Goeden (1974)
Diachus auratus (F.)
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults on leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

Enneamera variabilis Baly
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Adults exophytic on stems and leaves
Sources: Baloch et al. (1971)

Epithrix cucumeris (Harris)
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Adults on leaves; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)

Galeruca pomonae (Scopoli)
Plant recs.: Carduus crispus, C. nutans, C. defloratus, C. personatus (in lab. tests only); Centaurea, Cirsium, Carlina (Europe)
Remarks: Adults and larvae feed on leaves of host, often causing defoliation; Centaurea believed to be main host plant.
Field recs.: Larvae reared from Centaurea (Switzerland); adults and larvae found from Cirsium and Carlina (Europe)
Results of lab. tests (Delemont, 1962–63) for Cirsium arvense: Adults fed heavily or regularly on Carduus crispus, Centaurea, Cirsium, Arctium, Cnicus, and occasionally on Carduus nutans and C. defloratus; larvae fed heavily or regularly on C. nutans, C. personatus, Achillea, Silybum, Centaurea, Cnicus, Cynara, Cirsium, and occasionally on Carduus defloratus
Sources: Delémont Rpts. (1962–63); Zwölfer, (1965a, 1969); Mohr (1966)

Galeruca tanaceti (L.)
Plant recs.: Carduus nutans (Europe); C. defloratus (in lab. tests only); Achillea (Switzerland and in lab. tests); Cirsium (Switzerland, France, Swabian Jura, and in lab. tests); Centaurea (Europe and in lab. tests); Rudbeckia, Solidago, Erigeron, Aster, Chrysanthemum, Xeranthemum, Silybum, Helianthus (in lab. tests only)
Remarks: Adults and larvae feed externally on foliage; apparently relatively polyphagous; these field recs. are all of adults and larvae except Carduus nutans (adults only)
Results of lab. tests (Delemont, 1962–63) for *Cirsium arvense*: Adults fed heavily or regularly on *Carduus defloratus*, *Rudbeckia*, *Achillea*, *Cirsium*, *Centaurea*, *Solidago*, *Erigeron*, *Aster*, *Chrysanthemum*, *Xeranthemum*, *Silybum*, and occasionally on *Helianthus*

**Sources:** Heikertinger (1954); Delemont Rpts. (1962–63); Zwölfer (1965a, 1969)

**Hoplasoma sexmaculata** Hope

- **Plant recs.:** *Carduus edelbergii* (Pakistan)
- **Remarks:** Adults feeding on leaves
- **Sources:** A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

**Lachnea cylindrica** LeConte

- **Plant recs.:** *Carduus pycnocephalus* (S. Europe)
- **Remarks:** Rare; adults ectophagous on flowers; polyphagous
- **Sources:** Goeden (1974)

**Lema cirsicola** Chujo (= *L. cyanella*, "misident.")

- **Plant recs.:** *Carduus nutans*, *Silybum*, *Cynara*, *Carthamus*, *Centaurea*, *Helianthus* (in lab. tests only); *Cirsium* (Japan and in lab. tests)
- **Remarks:** Coll. from *Cirsium* in Japan, as "cyanella"

**Sources:** Albany Rpts. (1971–73)

**Lema cyanella** L. (= *L. puncticollis* Curtis)

- **Plant recs.:** *Carduus defloratus*, *Silybum*, *Onopordum* (in lab. tests only); *Cirsium* (France, Switzerland, and in lab. tests)
- **Remarks:** Adults and larvae feed on leaves of *Cirsium*

In lab. tests (Delémont, 1962–63, 1967 as *puncticollis*, *rugicollis*; 1964 as *puncticollis*, *ruficollis*, *rugicollis*; and 1967 as cyanella) for *Cirsium arvense*: Adults fed regularly on *Cirsium*, *Silybum*, *Carduus defloratus*, and occasionally on *Onopordum*; host plants apparently
limited to Carduus, Cirsium, and Silybum; also fed on Cirsium arvense, C. occidentale, and Carduus nutans; being tested in Sask., Canada (1976)


Leptinotarsa decemlineata (Say)

Plant recs.: Carduus nutans (S. Dak.)

Remarks: Adults ectophagous on leaves; polyphagous crop pest

Sources: Morihara and Balsbaugh (1976)

Longitarsus ?testaceus (Melsheimer)

Plant recs.: Carduus nutans (S. Dak.)

Remarks: Adults on leaves; feeds on other thistles

Sources: Morihara and Balsbaugh (1976)

Merista quadrifasciata Hope

Plant recs.: Carduus edelbergii, Cnicus (Pakistan)

Remarks: Adults feeding on leaves; no other host plants known

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Monolepta signata Olivier

Plant recs.: Carduus edelbergii (Pakistan)

Remarks: Adults feeding on leaves; polyphagous on crops

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Oulema melanopus (L.) (= Lema melanopus L.)

Plant recs.: Carduus tenuiflorus (France); C. pycnocephalus (S. Europe); Centaurea (Europe)

Remarks: Occasional visitor (adult); pest of grains in Europe and N. Amer.

Sources: Delémont Rpt. (1962); Zwölfer (1965a); Goeden (1974)

Psylliodes sp.

Plant recs.: Carduus nutans (Europe)

Remarks: Occasional visitor

Sources: Zwölfer (1965a)

Psylliodes chalcomera (Illiger)

Plant recs.: Carduus acanthoides (Germany); C. nutans and C. pycnocephalus (Germany, Italy, and in lab. tests); C. crispus (Italy); Cynara, Carthamus, Centaurea (in lab. tests only)
COLEOPTERA—Continued
Chrysolinae—Continued

Remarks: Adults feed on leaves, eggs laid on soil, larvae bore in growing tips of host plants at the crown; of these field recs., only Italian recs. on Carduus nutans and C. pycnocephalus are definitely adults and larvae; rec. from C. crispus is adult only.

Results of lab. tests (Rome, 1966–71) for Carduus spp.: Adults fed on Carduus nutans, C. pycnocephalus, Cynara, Carthamus, and Centaurea; oviposition obtained on Carduus nutans, C. pycnocephalus, Cirsium, Silybum, and Cynara; 1st instar larvae successfully transferred to Carduus spp., Silybum, and Cirsium; adults produced only on C. nutans, mature larvae on Carduus and Cynara; introduced in quarantine to USA (Albany, Calif.) in 1972 (600), 1973 (3,362), and 1974 (3,600).

In lab. tests (Albany, 1972–74) adults fed on 4 Cirsium spp.; oviposition and larval development on Carduus nutans, Centaurea, and Cynara; some pupation and adult emergence on Cynara; this insect rejected as biocontrol agent (Albany Rpt., 1974); gregarine parasite, in 79 percent of sample, influences oviposition behavior; Microctonus sp. also parasitic (Rome Rpt., 1971).

Sources: Heikertinger (1954); K. E. Frick in litt. (1966); Rome Rpts. (1966–74); Albany Rpts. (1972, 1974); Goeden (1974); Dunn and Rizza (1976).

Psylliodes punctulata Melsheimer

Plant recs.: Carduus nutans (Sask.)

Remarks: None

Sources: M. G. Maw in litt. (1976).

Sphaeroderma rubidum Graells (= S. “rubrum”)

Plant recs.: Carduus pycnocephalus, C. crispus, C. personatus, Cirsium, Cynara, Galactites, Onopordum, Serratula, Centaurea, Arctium, Carthamus (Europe and in lab. tests – see remarks)

Remarks: Adults feed externally on leaves; larvae mine leaves of host plants

Field recs.: Adults only (ident. questioned in all cases) from Cirsium (Rhine Valley), Centaurea, Galactites, Onopordum, and Carduus
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*pycnocephalus* (S. France or N. Spain); larvae and adults from *Serratula, Cynara,* and *Centaurea* (Europe); stage unknown from *Cynara* (Italy)

Results of lab. tests (Delemont, 1963, 1965) for *Cirsium arvense*: Adults fed heavily or regularly on *Centaurea, Carthamus, Arctium, Cynara, Onopordum, Cirsium, Carduus crispus,* and *C. personatus; Centaurea* is apparently main host, but *Cynara* and *Carthamus* are heavily damaged; therefore not considered for biological control

Sources: Delémont Rpts. (1963–65); Rome Rpt. (1963); Zwölfer (1965a, 1969); Mohr (1966); Goeden (1974)

*Sphaeroderma testaceum* Weise

**Plant recs.:** *Carduus nutans, C. crispus, C. personatus, C. defloratus, Cirsium, Carlina, Onopordum, Silybum* (Europe and in lab. tests – see remarks)

**Remarks:** Adults feed on foliage; larvae mine leaves of host plants; apparently prefers *Carduus, Cirsium,* and *Silybum;* appears to be a promising biological control candidate

**Field recs.:** Adults (only) from *Carduus defloratus, C. nutans, C. personatus, Carlina* (Switzerland), *Carduus crispus* (Rhine Valley, poss. ovipositing), *Cirsium* (Switzerland, France), and *Onopordum* (Europe); larvae from *Carduus nutans* and *Cirsium* (Europe)

Results of lab. tests (Delemont, 1962–63) for *Cirsium arvense*: Adults fed heavily or regularly on *Carduus nutans, C. crispus, C. personatus, C. defloratus,* and *Cirsium;* some feeding on *Onopordum* and *Silybum*


*Systena blanda* Melsheimer

**Plant recs.:** *Carduus pycnocephalus* (S. Calif.)

**Remarks:** Rare; adults feeding on leaves and stems; polyphagous crop pest

Sources: Goeden (1974)

*Systena elongata* (F.)

**Plant recs.:** *Carduus nutans* (S. Dak.)
COLEOPTERA—Continued

Chrysomelidae—Continued

Remarks: Rare; adults on leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

*Systena frontalis* (F.)

Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Adults on leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

Curculionidae

Unident. curculionid spp.

Plant recs.: *Carduus acanthoides* (Austria, Switzerland); *C. nutans* (Italy)
Remarks: Feeding in roots and flower heads; larvae in crowns

*Acalles* sp.

Plant recs.: *Carduus pycnocephalus* (Sicily)
Remarks: None
Sources: L. Andres in litt. (1961)

*Acalles diocletianus* (Germar)

Plant recs.: *Carduus nigrescens, Silybum* (Europe)
Remarks: Occasional visitor
Sources: Zwölfer (1965a)

*Apion* spp.

Plant recs.: *Carduus pycnocephalus* (Sicily, Italy, France); *C. acanthoides* (Austria, Switzerland); *C. crispus* (Rhine Valley); *C. defloratus* (Switzerland); *Carduus* ssp. (Sicily, Switzerland); *Cirsium* (Switzerland, France, Rhine Valley); *Cynara* (France); *Centaurea* (Europe)
Remarks: Adults attack crowns and stems, larvae burrow in pith and pupate in cortical layer of *C. pycnocephalus*; adults on, and larvae boring in, stems of *C. acanthoides*; adults in stems of *C. crispus*; larvae in stems of *C. defloratus*; adults on *Carduus* ssp., *Cynara*, and *Centaurea*; adults on, and larvae boring in, stems of *Cirsium*; although often recorded as "numerous" or "abundant," damage attributed to these beetles is "little" or none
**Apion (Ceratapion) sp. nr. A. armatum** Gerstaecker

**Plant recs.**: *Carduus pycnocephalus*, *C. tenuiflorus*, *C. nutans*, *Centaurea* (Italy)

**Remarks**: Most common weevil attacking *Carduus* crowns in Italy (up to 65 larvae found in single large crown); damage to host is negligible; same sp. or closely related sp. also feeds on pith of stems; these plant recs. are rearing recs.

**Sources**: Rome Rpt. (1963)

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**Apion (Ceratapion) alliariae** Herbst

**Plant recs.**: *Carduus tenuiflorus*, *C. pycnocephalus* (France); *Centaurea* (Yugoslavia, Italy); *Onopordum* (Italy)

**Remarks**: Reared from *Centaurea* in Yugoslavia; other recs. here are of adults on foliage

**Sources**: Zwolfer (1965a); Albany Rpt. (1966)

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**Apion (Ceratapion) carduorum** Kirby (and ssp. *galactitis* Wencker)

**Plant recs.**: *Carduus pycnocephalus*, *C. personatus*, *C. nutans*, ?*C. acanthoides*, *Cirsium* (Europe — see remarks); ssp. *galactitis* — *C. nutans*, *C. pycnocephalus*, *C. tenuiflorus* (France, Italy, or Sicily; reared); *Galactites*, *Cynara*

**Remarks**: Adults only reared from *Carduus nutans* (larvae also, but identity questioned), *C. pycnocephalus*, and *C. personatus* (all from Europe); larvae reared from *Cirsium* (Europe); adults from *Cirsium* (Switzerland, Germany); adults (France) and larvae (Europe, identity of both recs. questioned) from *Carduus acanthoides*; adults on foliage, larvae within stems

**Sources**: Delémont Rpt. (1963); Zwolfer (1965a); Albany Rpt. (1966)

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**Apion (Ceratapion) onopordi** Kirby

**Plant recs.**: *Carduus nutans*, *C. acanthoides*, *C. crispus*, *C. pycnocephalus*, *Carduus sp.*, *Cirsium*, *Centaurea*, *Onopordum*, *Silybum* (Europe — see remarks)

**Remarks**: Adults on foliage, larvae in stems (and crowns); larvae reared from *Carduus acanthoides* and *C. nutans* (Germany), *C. pycnocephalus* and Carduus sp. (France), *Onopordum* and *Silybum* (Italy), and *Cirsium* (identity not verified) and *Centaurea* (Europe); adults (only)
recorded from foliage of *Carduus crispus* (Europe) and *C. acanthoides* (France, ident. not verified); screening tests for *A. onopordi* vs. *Centaurea* at Delémont (1965)

**Sources:** Delémont Rpts. (1963, 1965); CIBC Ann. Rpt. (1965); Zwölfer (1965a); Albany Rpt. (1966); Goeden (1974)

**Apion (Ceratapion) pisi** F.

**Plant recs.:** *Carduus nutans* (Italy)

**Remarks:** One specimen "probably" reared from *C. nutans*

**Sources:** Albany Rpt. (1966)

**Apion (Pseudapion) fulvirostre** Gyllenhall

**Plant recs.:** *Carduus acanthoides* (Europe)

**Remarks:** Occasional visitor

**Sources:** Zwölfer (1965a)

**Brachynotus** sp.

**Plant recs.:** *Carduus pycnocephalus* (S. Europe)

**Remarks:** Rare; adults and larvae on leaves

**Sources:** Goeden (1974)

**Ceutorhynchus** sp.

**Plant recs.:** *Carduus edelbergii* (Pakistan)

**Remarks:** Adult feeding on *Carduus* in Pakistan, poss. only an occasional visitor; different from *Ceutorhynchus* spp. of Europe

**Sources:** A17-ENT-9 Rpts. (1963, 1965); Baloch et al. (1971)

**Ceutorhynchus** sp. nr. *C. litura* (F.)

**Plant recs.:** *Carduus acanthoides, C. nutans* (E. Austria)

**Remarks:** Eggs and larvae common in rosettes of *C. acanthoides*; poss. an ecotype of *Ceutorhynchus litura* preferring *Carduus* over *Cirsium*

**Sources:** Delémont Rpt. (1966)

**Ceutorhynchus (Hadroplontus) litura** (F.)

**Plant recs.:** *Carduus defloratus, C. nutans, C. tenuiflorus, C. personatus, C. acanthoides, C. crispus, Cirsium, Silybum, Onopordum, Centaurea, Cynara, Chicus, Aster, Carthamus, Echinops, Xeranthemum, Lactuca* (Europe and in lab. tests — see remarks)

**Remarks:** Adults feed on foliage; larvae endophytic in leaves, stems, root collars, and occasionally in roots; hosts limited to *Cirsium, Carduus, and Silybum*

**Field recs.:** Adults and larvae from *Carduus*
defloratus (Switzerland), Cirsium (Switzerland, Sweden, France, Germany), and Carduus nutans and C. crispus (France)

History: Screening tests at Delémont, 1961–66; shipments made to Canada, 1963–67; Working Group on Biological Control of Weeds approved release in Canada, 1965; small field cage study, 1965; first field release, 1967; insect studied and released to control Canada thistle (Cirsium arvense)

Results of lab. screening tests (D = Delémont, B = Belleville): Adults fed regularly on Carduus defloratus (D), C. nutans (D), C. tenuiflorus (D), C. personatus (D), C. acaenthoides (B), Cirsium (D, B), Silybum (D, B), and occasionally ate Onopordum (D, B), Centaurea (D), Cynara (D, B), Chicus (D), Aster (D), Carchamus (D), Echinops (D), Lactuca (D, B), and Xeranthemum (D); larvae fed and developed only on Carduus defloratus (D) and Cirsium (D), and fed but did not develop on Silybum (D); eggs deposited in C. defloratus (D) and Cirsium and Silybum (D) only

Releases in Canada on Cirsium arvense: 22 A in field cage study in Ont. in 1965; 270 A released in Ont. (2 locs.) in 1967; 70 A in Sask. in 1973; 100 A in Sask. in 1974; 69 A in B.C., 57A in Alta, and 41 A in Sask. in 1975; 56 A in Sask. in 1976; cleared for release on Cirsium arvense in U.S. by the Working Group on Biological Control of Weeds in 1969; 25 Canadian collected adults sent to SEA-AR lab., Albany, Calif., in 1970 (rearing attempt failed); adults (2,900+) collected on Cirsium arvense and Carduus nutans sent to Albany from Germany and Switzerland in 1971–75

Recovery data: Recovered at 1967 Ont. release site in 1968 and spreading at one site in Ont. (established on Cirsium); established and increasing in Sask. by 1976; established in Mont.; some evidence of potential establishment in Idaho and Calif.; 1967 release population at Belleville, Ont., has caused decline of C. arvense shoots from 28.8 to 0.24/m² in density.

Parasite: C. litora may disseminate the thistle rust Puccinia punctiformis (Str.) Kohl. in Ont.; the fly Phaonia trimaculata (Bouche) is a European enemy as is the protozoan Nosema sp.

Sources:

Ceutorhynchus (Hadroplontus) trimaculatus

Plant recs.: Carduus nutans, C. pycnocephalus, C. tenuiflorus, C. myriacanthus, Galactites, Cirsium (Europe); Carduus acanthoides, Cirsium, Cynara, Silybum, Onopordum, others (in lab. tests – see remarks)

Remarks: Adults feed on foliage, oviposit on new growing tips; larvae bore into crown itself, feed gregariously

Field recs.: Adults and larvae from Carduus nutans, C. pycnocephalus, and Galactites (Italy), C. pycnocephalus (S. France, N. Spain), Carduus myriacanthus (Algeria), and C. tenuiflorus and Cirsium (Europe)

Tests for Carduus spp. at SEA-AR lab., Rome, 1968–73: In tests, adults fed on Carduus pycnocephalus, C. nutans, C. acanthoides, Cirsium, Cynara, Galactites, Silybum, Onopordum, Echinops, and nibbled other plants; oviposited on Carduus spp., Cirsium, Cynara, Silybum, and Galactites; larvae developed to adult on Carduus nutans, C. acanthoides, Cirsium, Cynara, Onopordum, and Galactites

Field tests to study biology and survival on Cynara begun at Rome, 1975: Adults (1,400+)
sent to SEA-AR lab., Albany, Calif., to test for potential release against *Carduus tenuiflorus*, *C. nutans*, and *C. pycnocephalus*, 1970–73; tests unsuccessful, few adults, no egg production; some adult feeding on *Carduus nutans, Cirsium* spp., and *Cynara*; in 1975, adults (900+) sent from Rome lab. to VPI for initiation of testing of *C. trimaculatus* at that lab.


*C. viridis* (L.)

**Plant recs.:** *Cirsium* (Austria, Rhine Valley); *Carduus tenuiflorus*, *C. crispus*, *C. personatus*, *Aster*, *Chrysanthemum*, *Tussilago*, *Rudbeckia*, *Achillea*, *Senecio*, *Calendula*, *Echinops*, *Silybum*, *Centaurea*, *Taraxacum*, *Sonchus*, *Inula*, *Cnicus*, *Cynara* (in lab. tests only)

**Remarks:** In lab. tests (Delémont, 1963), sp. fed heavily or regularly on all these listed plants except last three, on which only nibbling occurred; polyphagous sp. of no biological control interest

Sources: Delémont Rpt. (1963); Zwölfer (1965a)

*C. piger* Scopoli

**Plant recs.:** *Carduus nutans*, *C. acanthoides*, *C. pycnocephalus*, *C. defloratus*, *C. crispus*, *C. edelbergii*, *Cirsium*, *Arctium*, *Onopordum*, *Silybum*, *Centaurea*, *Cnicus*, *Rumex*, *Inula*, *Zinnia*, *Rudbeckia*, *Carthamus*, *Cynara*, *Taraxacum*, *Lactuca*, *Sonchus*, *Leontodon*, *Carpinus*, *Cicera*, *Cannabis*, *Ziziphus*, *Tanacetum* (Europe, Asia, N. Amer., and in lab. tests – see remarks)

**Remarks:** A crown and root borer; adults feed on foliage; larvae bore into basal part of roots and also attack rosettes of blooming host plant; larvae inflict damage, causing stunting and premature dying; reported as an economic pest of *Cynara* in Italy, will feed on wide range of Compositae

Field hosts: *Carduus nutans* (Italy, Europe), *C. edelbergii* (Pakistan, Kashmir), *C. acanthoides*
(Europe), *Cirsium* (Pakistan, Switzerland, Italy, N. Amer.), *Cnicus* and *Rumex* (Pakistan; stage unknown), *Silybum* (Europe; adults only, Pakistan), and *Centaurea* (USSR – Caucasus); N. Amer. distrib.: N.Y. (since 1929), Pa. (1956), Mich. (1974), and Ont. and Que. on *Cirsium arvense* (1940, 1971)

Results of lab. tests (Delémont 1963, 1968): Adults fed heavily or regularly on *Carduus nutans*, *C. defloratus*, *C. crispus*, *Inula*, *Zinnia*, *Rudbeckia*, *Cnicus*, *Cardamum*, *Arctium*, *Cynara*, *Onopordum*, *Silybum*, *Cirsium*, *Centaurea*, *Taraxacum*, *Lactuca*, *Sonchus*, *Leontodon*, and occasionally on *Tanacetum*; found breeding on *Carduus nutans*, *Cirsium*, and *Cortina*

Sources: Mellini (1951a); Anderson (1956); A17-ENT-9 Rpts. (1960–62, 1965); Delémont Rpts. (1962–63, 1968); Rome Rpt. (1963); Zwölfer (1965a); Peschken (1971); Harris and Zwölfer (1971); Baloch et al. (1971); Goeden (1974); Maw (1976); D. Whitehead, pers. comm. (1977)

*Conotrachelus* sp.

Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Rare; adults on leaves; polyphagous crop pest
Sources: Morihara and Balsbaugh (1976)

*Donus crinitus* (Boheman)

Plant recs.: *Carduus pycnocephalus* (S. Europe)
Remarks: Occasional larvae and adults eat leaves
Sources: Goeden (1974)

*Hypera* spp.

Plant recs.: *Carduus nutans* (Italy, Europe); *C. pycnocephalus* (Italy, S. Calif.)
Remarks: Occasional visitor on *C. nutans* in Europe, locally common; larvae and adults eat leaves in Calif.
Sources: L. Andres in litt. (1961); Zwölfer (1965a); Goeden (1974)

*Hypera comata* Boheman

Plant recs.: *Carduus nutans*, *Cirsium* (Switzerland); *Tussilago, Aconitum, Chaerophyllum* (literature); *Solidago, Erigeron, Aster, Zinnia, Achillea, Chrysanthemum, Tussilago, Calendula, Echinops, Arctium, Silybum, Cirsium, Lactuca* (in lab. tests)
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Remarks: Field rec. on *C. nutans* was of larvae; in lab. tests, species found to have wide host range and thus of no interest for biological control

Sources: Delémont Rpt. (1962)

*Hyperapostica Gyllenhall (= Phytonomus variabilis Herbst)*

Plant recs.: *Carduus edelbergii*, *Cynoglossum*, *Medicago*, *Polygonum*, *Ziziphus* (Pakistan); *Cirsium* (Canada)

Remarks: Larvae feeding on leaves of *C. nutans*; polyphagous; pest of alfalfa

Sources: A17-ENT-9 Rpts. (1961, 1965); Baloch et al. (1971); Maw (1976)

*Larinus* spp.

Plant recs.: *Carduus defloratus* (Europe); *C. crassifolius*, *C. acanthoides* (Austria); *C. pycnocephalus*, *C. nutans* (Italy); *C. chrysacanthus* (Yugoslavia)

Remarks: Larvae (only) found in flower heads of first of these three listed plants; stage of insect found on last three of these recs. is unknown

Sources: L. Andres in litt. (1961); Delémont Rpt. (1962); Zwölfer (1965a); Zwölfer et al. (1971)

*Larinus australis* Capimont

Plant recs.: *Centaurea* (Austria, France, Switzerland, Yugoslavia, Italy, Spain, Hungary); *Carduus defloratus*, *C. nutans*, *C. tenuiflorus*, *C. personatus*, *Centaurea*, *Arctium*, *Cirsium*, *Silybum*, *Cynara*, *Onopordum*, *Cnicus*, *Lactuca* (in lab. tests)

Remarks: In lab. tests, *L. australis* adults fed heavily on *Centaurea* and regularly on all plants listed here except *Lactuca* and 4 *Carduus* spp., on which only slight feeding occurred; listed as meriting further study for biological control of *Centaurea*

Sources: Delémont Rpts. (1963–64); Rome Rpt. (1963); Zwölfer (1965a); Zwölfer et al. (1971)

*Larinus brevis* (Herbst) (= *L. sanctaebalmae* Alberville)

Plant recs.: *Carlina* (Switzerland, Austria, Germany); *Atractylis* (France); *Carduus nutans*, *C. personatus*, *Carlina*, *Rudbeckia*, *Tussilago*, *Echinops*, *Cirsium*, *Cynara*, *Onopordum*, *Centaurea* (in lab. tests)

Remarks: Adults feed on young leaves; larvae feed within receptacle, destroying ovaries and
seeds; species prefers Carlina; specimens from Carlina vulgaris differ from C. acaulis (ident. questioned)

In lab. tests: L. brevis adults fed heavily on Carlina or regularly on all these listed plants

Recorded parasites: Exeristes roborator (F.), Tetrastiehus sp., and braconid sp.

Sources: Delémont Rpts. (1963–64); Zwölfer (1965a); Zwölfer et al. (1971)

Larinus carlinae Olivier (= L. planus Germar)

Plant recs.: Carduus crispus, C. pycnocephalus, C. acanthoides, C. nutans, C. nigrescens, C. litigosus, C. tenuiflorus, C. personatus, C. defloratus, Galactites, Cirsium, Centaurea, Carlina, Arctium, Cynara, Onopordum, Silybum, Zinnia, Erigeron, Helianthus, Echinops, Xeranthemum, Cnicus, Carthamus (Europe and lab. recs. – see remarks)

Remarks: Adults feed on foliage, damage not particularly noticeable; larvae feed on flower buds, destroying ovarioles, etc.; feeding preference: Carduinae and some Centaureinae, indices high on Silybum-Cirsium-Carduus

Field recs.: Adults and larvae from Carduus crispus (Rhine Valley, Europe), C. pycnocephalus and C. acanthoides (Europe, France, Italy), Galactites (Europe), and Cirsium (France, Switzerland, Austria); adults (only) from Carduus acanthoides, C. nutans, C. nigrescens, C. litigosus, and Centaurea (Europe); larvae from Carduus tenuiflorus, Centaurea, and Carlina; other distrib. S. Germany and Caucasus

Results of lab. tests (Delémont): Adults fed heavily or regularly on Carduus nutans, C. tenuiflorus, C. crispus, C. personatus, Silybum, Cirsium, Centaurea, Arctium, Cynara, Onopordum, Zinnia, and occasionally or irregularly on Erigeron, Helianthus, Echinops, Xeranthemum, Cnicus, Carthamus, and Carduus defloratus; successful oviposition obtained on Cirsium and Carduus defloratus; successful development of larvae observed on Carduus crispus, C. defloratus, and Cirsium; small number of adults shipped to Canada in 1962 and 1964 for testing
Recorded parasites: "Ephialtes sp." (France) and Bracon sp.

Sources: Delémont Rpts. (1961–64); L. Andres in litt. (1961); Rome Rpt. (1963); CIBC Ann. Rpt. (1964); Zwölfer (1965a); Zwölfer et al. (1971)

*Larinus cynarae* F.

**Plant recs.**: Carduus pycnocephalus, C. nutans, Cirsium, Silybum, Onopordum, Cynara (Europe)

**Remarks**: Adults and larvae oligophagous; in flowers

**Sources**: Zwölfer et al. (1971)

*Larinus flavescens* Germar

**Plant recs.**: Carduus chrysacanthus (Yugoslavia); Silybum, Centaurea, Carthamus, Echinops, other plants (S. Europe, N. Africa)

**Remarks**: Adults rec. in flower heads of Carduus; larvae in flower heads of other plants

**Sources**: F4-ENT-5 Rpt. (1969); Zwölfer et al. (1971); F4-ENT-16 Rpt. (1974)

*Larinus jacae* F.

**Plant recs.**: Carduus acanthoides, C. nutans, C. personatus, C. pycnocephalus, C. tenuiflorus, C. crispus, C. defloratus, C. chrysacanthus, Cirsium, Galactites, Silybum, Cynara, Centaurea, Carthamus, Onopordum, Arctium, Carlina, Echinops, Chrysanthemum, Zinnia, Erigeron, Aster, Achillea, Xeranthemum (Europe and lab. recs. – see remarks)

**Remarks**: Adults feed on host leaves and peduncles without causing visible damage; larvae (1–3) feed in capitulum; subtribe Carduinae preferred

**Field recs.**: Adults and larvae from Carduus acanthoides (France, Austria, Europe), C. nutans (Austria, Italy, Europe), C. personatus (France), C. pycnocephalus, C. tenuiflorus (Italy), and Cirsium, Centaurea, Galactites (Europe); adults (only) from Cynara (Italy, 1 “resting”); stage unknown from Carduus chrysacanthus (Yugoslavia); distrib. also in SW Asia to Turkestan; not observed in Rhine Valley or Swiss Valais

**Results of lab. tests** (Delémont): Adults fed heavily or regularly on Carduus nutans, C. crispus, C. defloratus, C. tenuiflorus, C. personatus, Cirsium, Silybum, Cynara, Zinnia, Echinops, Chrysanthemum, Carlina, Arctium,
Onopordum, Centaurea, Carthamus, and occasionally on Erigeron, Aster, Achillea, and Xeranthemum; successful larval development on Carduus acaanthoides, C. nutans, and C. personatus

Recorded parasites: Tetrastichus sp., Bracon urinator F., and Exeristes roborator (F.)

Sources: Mellini (1951b); L. A. Andres in litt. (1961); Delémont Rpts. (1963–64); Rome Rpt. (1963); Zwölfer (1965a); Zwölfer et al. (1971)

Larinus scolyti Olivier

Plant recs.: Carduus pyencocephalus (Italy, France); C. nutans (Europe); Cynara (Italy, France, Europe); Cirsium (Europe); Onopordum (Europe); Echinops (Algeria)

Remarks: Recorded as pest of Cynara in Italy and S. France; all these other recs. are of adults only

Sources: L. A. Andres in litt. (1961); Rome Rpt. (1963); Delémont Rpt. (1964); Zwölfer (1965a); Zwölfer et al. (1971)

Larinus sturnus Schaller

Plant recs.: Carduus acaanthoides, C. nutans, C. crispus, C. nigrescens, C. personatus, C. defloratus, C. tenuiflorus, Cirsium, Centaurea, Arctium, Silybum, Cynara, Onopordum, Carthamus, Echinops, Rudbeckia, Erigeron, Zinnia, Xeranthemum, Caicus, Aster, Carlina (Europe and lab. tests – see remarks)

Remarks: Adults feed on foliage and peduncle; larvae mine receptacle destroying ovarioles

Field recs.: Adults and larvae from Carduus nutans (Swiss Alps, French Rhine Valley, Italy), C. acaanthoides (centr. Europe), C. nigrescens (France), C. personatus (Europe), Cirsium (Swiss Alps, French Rhine Valley, Italy), Centaurea (French Rhine Valley, Italy), and Arctium (Austria); adults (only) from Carduus crispus (Switzerland); distrib. also E. Asia and N. Africa (from literature) and N. Yugoslavia (Cynara given as host in literature); Austrian population is only Larinus found in Europe to attack Arctium; adults from Austria prefer Arctium over Carduus or Centaurea; those bred from Carduus (from Rhine Valley) pre-
ferred Carduus to Arctium or Centaurea, and those from Centaurea (from Rhine Valley) preferred Centaurea over Carduus or Arctium.

Results of lab. tests (Delémont): Adults (Rhine Valley Carduus population) fed heavily or regularly on Carduus nutans (also in lab. tests at SEA-AR lab. in Rome), C. crispus, C. personatus, C. tenuiflorus, C. defloratus, Cirsium, Centaurea, Silybum, Cynara (also at Rome), Onopordum, Carthamus, Echinops, Arctium, Rudbeckia, and occasionally on Erigeron, Zinna, Xeranthemum, Cnicus, Aster, and Carlina; oviposition obtained on Carduus defloratus, Cirsium, Centaurea, and Arctium (by Arctium population only); larvae bred successfully from Arctium (Austrian population only), Cirsium, Carduus nutans, and Centaurea.

Recorded parasites: Bracon sp. and chalcidoids; a possible biocontrol agent for Centaurea or Carduus.

Sources: Delémont Rpts. (1962, 1964); Rome Rpt. (1963); Zwölfer (1965a); Zwölfer et al. (1971); CIBC Rpt. (1971).

Larinus turbinatus Gyllenhall

Plant recs.: Carduus nutans, C. pycnocephalus, C. crispus, C. personatus, C. tenuiflorus, C. defloratus, Cirsium, Onopordum, Galactites, Centaurea, Serratula, Echinops, Cnicus, Arctium, Cynara, Silybum, Tanacetum, Zinnia, Xeranthemum, Carlina, Senecio, Leontodon (Europe and/or in lab. tests — see remarks)

Remarks: Adults feed on leaves, stems, buds, and peduncles of hosts; larvae in flower heads seem restricted to Cirsium.

Field recs.: Adults and larvae from Cirsium (Germany, France, Switzerland, Austria, Yugoslavia, Italy) and Carduus nutans and Silybum (France); larvae (only) from Serratula (Austria); adults (only) from C. nutans (Austria), C. pycnocephalus (France, Italy), Onopordum (Italy), Galactites (Italy), and Galactites and Centaurea (Europe).

Results of lab. tests (Delémont): Adults fed heavily or regularly on Carduus nutans, C.
crispus, C. personatus, C. tenuiflorus, Cirsium, Echinops, Cnicus, Arctium, Cynara, Onopordum, Silybum, Centaurea, Tanacetum, and occasionally (nibbled) on Carduus defloratus, Leontodon, Senecio, Carlina, Xeranthemum, and Zinnia; oviposition obtained only on Cirsium

Recorded parasites: Bracon sp. and chalcidoids; small shipments of L. turbinatus adults made to Canada in 1962 and 1965 for tests

Sources: H. L. Parker in litt. (1957); Delémont Rpts. (1961, 1964); Rome Rpt. (1963); CIBC Ann. Rpt. (1964); Zwölfer (1965a); Zwölfer et al. (1971)

Larinus ursus F.

Plant recs.: Carduus nutans, Centaurea, Carlina (S. Europe)

Remarks: Adults rec. on Carduus and Centaurea; larvae on Carlina; in flower heads

Sources: Zwölfer (1965a); Zwölfer et al. (1971)

Leptomias jekeli Faust

Plant recs.: Carduus edelbergii, Cnicus, Dipsacus, Abies (Pakistan)

Remarks: Adults feeding on leaves

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Leptomias stolickzae Faust

Plant recs.: Carduus edelbergii (Pakistan)

Remarks: Adults feeding on leaves; no other hosts known

Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Lixus spp.

Plant recs.: Carduus pycnocephalus, C. nutans (Italy, France); C. crispus (Rhone Valley)

Remarks: Larvae in flower head of C. crispus

Sources: Rome Rpts. (1960–61); L. A. Andres in litt. (1961); Delémont Rpt. (1963)

Lixus algirus (L.)

Plant recs.: Carduus nutans, C. litigiosus, C. acaanthoides, C. pycnocephalus, C. defloratus, C. personatus, C. crispus, C. tenuiflorus, Cirsium, Onopordum, Galactites, Cnicus, Silybum, Malva, Aithea, Vicia, Centaurea, Sonchus, Carthamus, Arctium, Cynara, Rudbeckia, Zinnia, Calendula, Xeranthemum, Chrysanthemum, Senecio, Echinops, Carlina (Europe, Pakistan, and/or in lab. tests — see remarks)
Remarks: Adults feed on leaves and oviposit in stems of hosts; found to be rather polyphagous (see following remarks); a "potential pest" in Europe and a "known pest" in Pakistan

Field recs.: Ovipositing adults and larvae from Cirsium (Switzerland, France, Rhine Valley), Carduus nutans (Austria, Europe), and C. litigiosus (France); adults (only) from Onopordum and Galactites (France), Carduus acanthoides, C. pycnocephalus, and Silybum (Europe), and Cnicus (Pakistan); further literature recs. (adults only) from Centaurea, Malva, Althea, and Vicia (damage reported to flowers and foliage of vetch); larvae recorded from 'Malvaceae' in literature

Results of lab. tests (Delemont): Adults fed heavily or regularly on Cirsium, Silybum, Carduus crispus, C. defloratus, C. nutans, C. personatus, Sonchus, Carthamus, Arctium, Cynara, Centaurea, Rudbeckia, Onopordum, and occasionally on Zinnia, Calendula, Xeranthemum, Cnicus, Chrysanthemum, Senecio, Echinops, and Carlina; of no interest in biological control

Sources: Delémont Rpts. (1962, 1964); A17-ENT-9 Rpt. (1965); Zwölfer (1965a); Goeden (1974)

Lixus (Lixoehelus) cardui Olivier

Plant recs.: Onopordum (Austria, Europe); Carduus nutans (Austria, Italy?); C. pycnocephalus (Europe, Italy?); C. acanthoides, Cirsium (Europe); Silybum (Syria); Carduus defloratus, C. tenuiflorus, C. crispus, Arctium, Cynara, Silybum, Centaurea, Carlina (in lab. tests only)

Remarks: Larvae found breeding in field only on Onopordum; other field recs. listed here are of adults only; Italian recs. are of L. "prob. cardui"

Results of lab. tests (Delémont): Adults fed heavily or regularly on Onopordum, Cirsium, Carduus defloratus, C. nutans, C. tenuiflorus, C. crispus, Arctium, Cynara, Silybum, Centaurea, and occasionally on Carlina

Sources: Delémont Rpt. (1962); Rome Rpt. (1963); Zwölfer (1965a); F4-ENT-16 Rpt. (1976)
COLEOPTERA—Continued
Curculionidae—Continued

*Lixus* sp. nr. *L. elongatus* Goeze (or *L. rufitarsis* Boheman)

**Plant recs.:** *Carduus pycnocephalus* (Lebanon, Syria); *C. tenuiflorus*, *C. pycnocephalus*, *C. nutans*, *C. litigiosus*, *C. defloratus*, *Galactites*, *Cirsium*, *Silybum*, *Cynara*, *Onopordum*, *Xeranthemum*, *Helianthus* (Europe and/or in lab. tests – see remarks)

**Remarks:** Field recs.: Ovipositing adults from *Carduus tenuiflorus*, *C. pycnocephalus*, and *C. litigiosus* (France); larvae observed breeding only on *C. tenuiflorus*; adults (France) and larvae (Rhine Valley) from *Cirsium*; adults from *Carduus nutans* and *Galactites* (Europe)

Results of lab. tests (Delemont): Adults fed heavily or regularly on *Carduus tenuiflorus*, *C. nutans*, *Cirsium*, *Silybum*, *Onopordum*, *Cynara*, and *Xeranthemum*; in early tests, also fed on *Carduus defloratus* and *Helianthus*; 130 adults sent to Canada in 1964

**Sources:** Delemont Rpts. (1962-64); CIBC Ann. Rpt. (1964); Zwölfer (1965a); F4-ENT-16 Rpt. (1974)

*Lixus (Lixochelus) elongatus* Goeze

**Plant recs.:** *Carduus nutans*, *C. acaenthoides*, *C. crispus*, *C. pycnocephalus*, *C. Inigrescens*, *C. defloratus*, *C. tenuiflorus*, *C. personatus*, *Cirsium*, *Silybum*, *Onopordum*, *Centaurea*, *Cynara*, *Arctium*, *Carlina*, *Xeranthemum*, *Erigeron* (Europe and/or in lab. tests – see remarks)

**Remarks:** Adults feed on foliage, often skeletonizing host; larvae feed in root collars and in lower parts of stem; feeding restricted enough to warrant further testing for biological control of *Carduus* spp. or *Cirsium vulgare* (not *C. arvense*)

Field recs.: Adults and larvae from *Carduus acaenthoides* (France, Europe), *C. nutans* (Italy, Austria, Rhine Valley, Europe), *C. crispus* (Europe), and *Cirsium* (Rhine Valley, Switzerland, Austria, France); adults (only) from *Carduus pycnocephalus* (Italy) and *C. nigrescens*, *Silybum*, and *Onopordum* (Europe)

Results of lab. tests (Delemont): Adults fed heavily or regularly on *Cirsium*, *Silybum*, *Car-
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duus crispus, C. personatus, C. tenuiflorus, C. nutans, C. defloratus, Centaurea, and occasionally on Xeranthemum, Carlina, Arctium, Cynara, Onopordum, and Erigeron; oviposition obtained only on Carduus and Cirsium; shipment of 110-120 adults made to Canada in 1963; judged unsuitable for biological control of Cirsium arvense in Canada, larvae do not survive on this species


Lixus juncei Boheman
Plant recs.: Carduus nutans, Cirsium (Europe)
Remarks: Occasional visitor on C. nutans
Sources: Zwölf er (1965a)

Lixus sp. prob. L. scolopax Boheman
Plant recs.: Carduus pycnocephalus, C. nutans, Silybum, Cynara (Italy)
Remarks: Adult feeding and oviposition observed on C. nutans only
Sources: Rome Rpt. (1963); Goeden (1974)

Lixus spartii Olivier
Plant recs.: Carduus crispus (Europe)
Remarks: Occasional visitor
Sources: Zwölf er (1965a)

Otiorhynchus sp.
Plant recs.: Carduus personatus (Europe)
Remarks: Occasional visitor
Sources: Zwölf er (1965a)

Pseudocleonus grammicus Panzer
Plant recs.: Centaurea (Yugoslavia, France); Carlina (Europe); Carduus personatus, Cirsium, Silybum, Onopordum, Arctium, Carthusianum, Echinops, Tanacetum, Chrysanthemum, Inula (in lab. tests only)
Remarks: Field recs. on Centaurea are of larvae found in the roots; recs. on Carlina are of adults on foliage

Results of lab. tests (Delémont) for Cirsium: Adults (from Carlina) fed regularly on Carduus personatus (but not on 3 other spp. of Carduus), Centaurea, Cirsium, Silybum, Onopordum, Arc-
Rhinocyllus conicus (Froelich)

**Plant recs.**: Carduus nutans, C. acanthoides, C. personatus, C. pycnocephalus, C. nigrescens, C. crispus, C. ligiosus, C. tenuiflorus, Cirsium, Silymbum, Onopordum, Centaurea, Cnicus, Galactites, Xeranthemum, Carlina, Tagetes, Carthamus, Helianthus, Cichorium, Cynara, Lactuca, rye, mangel, apple, radish (Europe and/or in lab. tests - see remarks)

**Remarks**: Adults gnaw peripheral tissue of stems, peduncles, and leaves; feeding is usually of little importance, less pronounced than that of Larinus spp.; eggs laid externally on flower bud; larvae (1-16 per flower (200 larvae per flower in Mont.)) mine receptacle, 3-4 larvae prevent seed formation; host range Carduus-Cirsium-Silymbum (occasionally Onopordum) is believed to be highly stable, i.e., no tendency of R. conicus to form "races" attacking other plants

**Field recs.**: Adults and larvae from Carduus nutans (Switzerland, Austria, Italy, Europe), rarely C. acanthoides (France), C. personatus (Austria, Switzerland), C. pycnocephalus (France, Spain, Italy), C. nigrescens (France), C. crispus (Switzerland, France), mainly in large flowered species of Carduus and Cirsium (France, Switzerland, Germany, Austria), Silymbum (France, Italy), Onopordum (France), and Galactites; adults (only) from Carduus ligiosus (France), Xeranthemum, Centaurea, Cnicus, and Carlina (Europe)

**Other distrib.**: N. Africa, S. England, E. Europe (Hungary, Poland, Czechoslovakia, Romania), and USSR (Ukraine, Caucasus, Kazakhstan, Altai)

**Recorded European parasites**: Tetrastichus sp., Bracon urinator F., Aritranis (=Holocryptus) nigripes (Gravenhorst), and an egg parasite

**Results of lab. screening tests** (all tests at
Delémont except a few at Belleville (B): Adults fed heavily or regularly on Carduus nutans, C. crispus, C. personatus, C. acanthoides (also B), Cirsium (also B), Silybum, Centaurea, and C. tenuiflorus (last 3 in 1 test only, “occasionally” in 2d test), and occasionally Tugetes, Xeranthemum, Onopordum, Carthamus, Cnicus, Helianthus, Cichorium, Cynara, Lactuca, and (at B only) rye, mangel, apple, and radish; normal (4.5 eggs per female) oviposition obtained only on Carduus nutans, C. personatus, and Cirsium; atypical oviposition occasionally (0.3 egg per female) obtained on other (unpalatable) test plants (Carthamus, Helianthus, Cnicus, and Cynara); successful larval development only in Cirsium, Carduus nutans, and C. personatus (successful larval transference only into last one); in lab., prefers Silybum to Cirsium for oviposition (Albany Rpt., 1970)

History: First studied in 1962 by CIBC lab., Delémont; tested at Delémont and Belleville, 1962–68; U.S. Working Group on Biological Control of Weeds approved release in Canada, July 1968, and in U.S., Feb. 1969; adults collected and shipped by CIBC, Delémont, to Canada in 1964 (390), 1967–68 (2,500+), 1969–70 (many thousand), and to VPI, Blacksburg, Va., and SEA-AR lab., Albany, Calif., in 1969–73 (several thousand); adults also collected and shipped by SEA-AR lab., Rome, Italy, to Albany in 1969, 1971–75 (many thousand) and to VPI in 1971 (1,400)

Releases: First released by Canada Ag., in Carduus nutans in Sask. (400) and C. acanthoides in Ont. (370) in 1968; additional Canadian releases on C. nutans in Sask. (3,795) and in Ont. at 3 sites (4,952) in 1969; on C. acanthoides in Ont. at 3 sites (5,275) and C. nutans in Ont. at 2 sites (450) and on both spp. in Ont. (700) in 1970; released on C. nutans in Ont. (10,100), Sask. (120), and Man. at 2 sites (4,500) in 1974; and in Ont. at 2 sites (2,185) in 1975 (it was also released in New Zealand in 1975)
First released in U.S. by VPI on *C. nutans*, *C. thoermeri*, and *C. acanthoides* in Va. at 14 sites (2,000) and by SEA-AR, Albany, on *C. nutans* in Nebr. (60), Mo., Calif. (12), and Mont. (1,805) in 1969; addit. U.S. releases on *C. nutans*, *C. thoermeri*, and *C. acanthoides* in Va. at 9 sites (5,950) in 1970; on *Silybum marianum* in Calif. (1,141) and on *C. nutans* in Mont. (667) in 1971; on *S. marianum* in Calif. at 5 sites (2,062) and on *C. nutans* in Nebr. at 2 sites (663), Mont. (492), and Idaho (800) in 1972; on *C. nutans* in Nebr. at 2 sites (750), S. Dak. (1,000), Kans. (725), and Mont. (425); on *S. marianum* in Calif. at 4 sites (1,143) in 1973; on *C. nutans* in Calif. (440), Nebr. (440), Idaho (440), Colo. (440), and Nev.; on *S. marianum* in Calif. (370) in 1974; and on *C. pycnocephalus* in Calif. at 6 sites (3,069) in 1975.

Recoveries and establishments: Well established in Sask. by 1974, seed production reduced by 63 percent at 1969 site, and recolonization begun in 1974; by 1976, 85 percent of seeds destroyed at 1 site in Sask.; also reported established in Ont.; in Va., *R. conicus* is well established at several sites on *Carduus nutans* and *C. thoermeri*, but it is less effective against *C. acanthoides*; at 1 Va. site, *C. nutans* was reduced by 95 percent 6 yrs. after initial release of 100 adults; dispersal was 1.6 km each year and 32 km 6 yrs. after release recolonization begun in 1972; at a 1971 *Silybum* release site in Calif., 67 percent of flower heads were infested by 1972, later increasing to 94 percent in 1973; it became established at 5 of 10 release sites in S. Calif. (Goeden and Ricker, 1977); it also attacks *C. pycnocephalus* in Calif.; in Mont., beetles at 5 1969-73 release sites had spread over an area of 1,280 km² by 1974, attacking *C. nutans* and *Cirsium arvense*; established in Colo. in 1976.

Recolonizations: Over 20,000 adults collected from Va. establishments for recolonization in Va., W. Va., and Tenn. in 1972; reported established, infesting 70-80 percent of flower heads of *Carduus crispus* 3 yrs. after release in
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W. Va.; further recolonization on C. crispus and C. nutans in W. Va. made in 1975; 20,000 adults collected annually in 1973-75 for redistribution against C. nutans and C. acanthoides in Va.; additional beetles collected in Va. for release in Md. (757), N.J. (600), and Pa. (70) against C. nutans and C. thoermeri in 1975, and Md. (416) against C. nutans and Pa. (297) against C. nutans, C. thoermeri, and C. acanthoides in 1976; established in Md. and Pa. in 1978. In Canada, collections for recolonization were made in Sask., Que. (10,100), and Man. (4,500) in 1974; establishments reported in both Que. and Man. in 1975; in Calif., beetles were collected at Silybum establishments for recolonization on S. marianum at new Calif. sites in 1974 (2,016 at 4 sites) and 1975 (365); in 1975, collections were made at establishments in Mont. for release on C. nutans in Calif. (500), Colo. (500), Idaho (1,000), Iowa (500), Minn. (500), N. Dak. (500), S. Dak. (500), Utah (1,000), Wash. (500), and Wyo. (600); collections also made in Va. in 1975 for releases in Kans. (375), Ky. (430), La. (350), Mo. (500 established and spread 2 mi by 1976), Okla. (388 established in 1977), and Tenn. (500).

Mortality factors: In Va., larval and egg mortality of 68 percent was caused by weather, crowding, and parasitism by Aliolis curculionis (Fitch), Bracon mellitor Say, and a parasite of Lepidoptera, Campoplex polychrisidis Viereck; in Calif., R. conicus was destroyed by Hippodamia sp., Raphidia adnixa Hagan, spiders, pyemotid mites, rodents, and cattle grazing thistles (Goeden and Ricker, 1977).

Sources:
Kok (1974, 1975b); P. Harris in litt. (1975); Kok and Surles (1975); Surles and Kok (1975, 1976, 1977); Surles (1975); Surles et al. (1975); Hacker (1975); Batra in litt. (1975–76); Surles (1975); M. G. Maw in litt. (1976); Letendre et al. (1976); Hodgson and Rees (1976)

**Rhodobaenus tredecimpunctatus** (Illiger)

Plant recs.: Carduus sp. (Va.)
Remarks: Feeding
Sources: L. T. Kok in litt. (1976)

**Sitona callosus** Gyllenhall

Plant recs.: Carduus edelbergii, Cnicus (Pakistan); alfalfa (USSR)
Remarks: Adults feeding on leaves; “a known pest”
Sources: Alimdzhanov (1941); A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

**Tanymecus palliatus** F.

Plant recs.: Carduus acanthoides (Austria); Cirsium (France, Austria, Europe); Vitis, Chrysanthemum (also in lab. test); Beta, cereals (in literature); Solidago, Erigeron, Aster, Helianthus, Zinnia, Achillea, Tussilago, Calendula, Xeranthemum, Carthamus, Arctium, Cynara, Onopordum, Silybum, Centaurea, Taraxacum, Lactuca (all in lab. tests only)
Remarks: These field recs. are of adults only; adults feed on foliage; occasionally found listed in literature as pest of Vitis, Chrysanthemum, Beta, and cereals

In lab. tests (Delémont): Adults fed on all these plants except Carduus (Vitis, Beta, and cereals not incl. in tests); of no interest in biological control; broad feeding range
Sources: Delémont Rpts. (1962–63); Zwölfer (1965b)

**Trichosiocoleus horridus** (Panzer) (= *Ceuthorrhynchidius horridus* (Panzer))

Plant recs.: Carduus nutans, C. pycnocephalus (Italy); C. tenuiflorus, C. nutans, C. acanthoides, C. crispus (Europe); Galactites, Cirsium (Italy); Onopordum (Europe); Cynara, other plants (lab. tests only)
Remarks: Adults in lab. feed at base of leaves, ovipositing on tips of new growth; larvae mine and bore to base of growing leaves, then feed
on crowns (12–18 larvae per crown not uncommon); reared from *Carduus nutans*, *C. pycnocephalus*, *Galactites*, and *Cirsium*; adults and larvae found on *Carduus aeanthoides* and *Onopordum*; adults rare on new stands of *C. nutans* in Europe

Screening tests conducted at Delémont, 1964, and Rome (preliminary, 1964): *Hexamermis brevis* (nematode) reared from *C. horridus* larvae from crowns of *Carduus nutans* (Italy)

Culture and studies conducted at Rome lab., 1968–70: Adults fed on *Carduus nutans*, *C. aeanthoides*, *Cirsium*, *Galactites*, *Cynara*, and other plants; oviposited on these plants, *Carduus pycnocephalus*, and other plants

Adults (6,800+) collected in Italy and sent for final testing in quarantine at VPI, 1970–75; host-specificity tests at VPI: 1st instar larvae tested on 35 plant species; larvae were able to complete development in *Carduus nutans*, *C. aeanthoides*, and *Cirsium vulgare*, not in *Cynara* and *Carthamus*; adults and larvae fed on these and other plants to lesser degree (Ward et al., 1974; Kok, 1975a); biology studies (Kok et al., 1975); European distrib. (Zwolfer and Harris, 1966); U.S. Working Group on Biological Control approved release in U.S. in 1974; released in Va. in 1975, established by 1978 (L. T. Kok, pers. comm., 1976, 1979); adults (490+) sent to Canada by CIBC-Delemont in 1975; released in Sask. (87 in 2 sites) in 1975; bred successfully (Harris, 1975); testing begun at SEA-AR lab., Albany, Calif., in 1974–78, confirmed safety to *Cynara* (release in Kans., N. Dak., S. Dak., Mo., Wyo., Nebr., Mont. planned for 1978–79)

**Sources:**

Rome Rpts. (1964–66, 1968–73); Zwölfer (1965a); K. E. Frick in litt. (1966); Zwölfer and Harris (1966); Frick (1969); Ward et al. (1974); Kok (1975a); Kok et al. (1975); Harris (1975); CIBC Ann. Rpt. (1975); L. T. Kok, pers. comm. (1976)
COLEOPTERA—Continued

Buprestidae
Unidentified buprestid sp.
Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Rare; endophagous larva
Sources: Morihara and Baisbaugh (1976)

Tenebrionidae
Unident. tenebrionid sp.
Plant recs.: *Carduus pycnocephalus* (S. Calif.)
Remarks: Rare; adults feeding on leaves
Sources: Goeden (1974)

Lathridiidae
*Macrophthalmus* sp.
Plant recs.: *Carduus pycnocephalus* (S. Europe)
Remarks: Rare; adults endophagous in flowers; oligophagous
Sources: Goeden (1974)

LEPIDOPTERA

Unident. microlepidoptera
Plant recs.: *Carduus crassifolius* (Austria)
Remarks: Larvae found in 0.7 percent of flower heads in area
Sources: Delémont Rpt. (1963)

Arctiidae
Unident. arctiid sp.
Plant recs.: *Carduus pycnocephalus* (S. Europe)
Remarks: Rare; larvae on leaves
Sources: Goeden (1974)

*Estigmene acrea* (Drury)
Plant recs.: *Carduus pycnocephalus* (Calif.)
Remarks: Rare; larvae on leaves; economic pest
Sources: Goeden (1974)

Nymphalidae
*Cynthia cardui* (L.) (= *Vanessa cardui*)
Plant recs.: *Carduus edelbergii* (Pakistan); *C. nutans* (Austria, Canada); *C. acanthoides* (France); *C. pycnocephalus* (Egypt, Calif.); *C. pycnocephalus* and/or *C. tenuiflorus* (Calif.); *Carduus* spp. (U.S., Canada); *Cynara* (Italy); *Centaurea* (Pakistan, Egypt); *Carlina*, *Cnicus*, *Astragalus*, *Silybum*, *Urtica* (Pakistan); *Cirsium* (Switzerland, France, Canada); *Onopordum* (France, Austria); *Carlina* (Europe); many other hosts
Remarks: Larvae feed externally on foliage; polyphagous; a pest of *Cynara* in France; pest of sunflower, soybean, and other crops; recorded parasites: *Apanteles* spp. (Pakistan, Switzerland)

Sources: Huffaker (1956); A17-ENT-9 Rpts. (1961, 1965); Delémont Rpts. (1962–63); CIBC Spec. Rpt. (1962); Rome Rpt. (1963); Albany Rpt. (1963); Zwölfer (1965a); F4-ENT-5 Rpts. (1966–67); Harris and Zwölfer (1971); Baloch et al. (1971); Goeden (1974); L. T. Kok in litt. (1976); Maw (1976); Morihara and Balsbaugh (1976)

**Noctuidae**

Unident. noctuid sp.

Plant recs.: *Carduus pycnocephalus* (S. Europe)

Remarks: Rare; larvae ectophagous on leaves

Sources: Goeden (1974)

**Autographa gamma** (L.) (= *Phytometra gamma*)

Plant recs.: *Carduus pycnocephalus, Centaurea* (Egypt, S. Europe)

Remarks: Rare; larvae on leaves; polyphagous crop pest


**Eublemma parva** (Hübner) (= *Porphyria parva*)

Plant recs.: *Carduus edelbergii* (Pakistan); *Xanthium* (Bangladesh, Pakistan); *Carthamus, Blumea, Inula* (Pakistan); *Centaurea* (Pakistan, Egypt); *Ziziphus* (China); *Tagetes, Conyza* (in lab. tests only)

Remarks: Larvae bore into burs of *Xanthium*, feed on seeds, flowers, and tender shoots; larvae feeding in flowers and fruits of *C. edelbergii*; larvae infesting drying heads of *Centaurea* in Egypt; in 1960, 12 shipments (3,285 larvae) of *E. parva* sent from CIBC Pakistan lab. to Queensland, Australia, as breeding stock for release vs. *Xanthium*; *E. parva* found to damage *Carthamus* in Pakistan (1961–62); *E. parva* found to be previously established in Australia

Results of lab. tests (Rawalpindi): Larvae fed to pupation on *Tagetes, Conyza*, and *Carthamus*; oviposition obtained on *Carthamus*

Recorded parasites (Pakistan): *Brachymeria* sp. nr. *aegyptiaca* Masi, *Apanteles* sp. nr. *stanton*
(Ashmead), *Eurytoma* sp., *Netelia* sp., and *Paraholaspis* sp.

**Sources:**

**Eublemma purpurina** (Denis and Schiffermüller) (= *Thalpochares purpurina*)

**Plant recs.:** *Carduus nutans* (Italy); *Cynara* (lab.); *Cirsium* (Europe)

**Remarks:** Larvae in petioles, crown, and buds

**Sources:** Mellini (1951a); Zwölfer (1965a); Rome Rpt. (1975)

**Euxoa spp.** (= *Agrotis* spp.)

**Plant recs.:** *Carduus pycnocephalus* (Egypt, Calif.); *Carduus* sp. (Va.)

**Remarks:** Common feeder on foliage; larvae on leaves in Calif. “prob. *E. tesselata* (Harris)”

**Sources:** F4-ENT-5 Rpts. (1967, 1969); Goeden (1974); L. T. Kok in litt. (1976)

**Euxoa segetum** Schiffermüller

**Plant recs.:** *Carduus edelbergii* (Pakistan)

**Remarks:** Larvae feeding in flowers; exophytic on stems and leaves; polyphagous crop pest

**Sources:** A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

**Heliothis armigera** (Hubner)

**Plant recs.:** *Carduus edelbergii*, *Xanthium*, *Cardthamus*, *Datura*, *Chrozophora*, *Loranthus*, *Trichodesma*, *Hypericum* (Pakistan); many others

**Remarks:** Larvae destroy flowers of *Carduus nutans* and *Cardthamus*; feed on fruits of *Xanthium* and on leaves of *Loranthus*; polyphagous; an economic pest

**Sources:** CIBC Ann. Rpts. (1959, 1961); A17-ENT-9 Rpts. (1960–61, 1964–65); Baloch et al. (1968, 1971)

**Lycanades purpurea** (Grote)

**Plant recs.:** *Carduus pycnocephalus* (Calif.)

**Remarks:** Larvae occasionally feeding on leaves

**Sources:** Goeden (1974)

**Papaipema arctivorans** Hampson

**Plant recs.:** *Carduus* sp. (Va.)

**Remarks:** Common feeder

**Sources:** L. T. Kok in litt. (1976)
**Papaipema nebris** (Guenée)

**Plant recs.**: *Carduus nutans* (S. Dak.)

**Remarks**: Larvae in stems; polyphagous crop pest

**Sources**: Morihara and Balsbaugh (1976)

**Peridroma saucia** (Hübner)

**Plant recs.**: *Carduus pycnocephalus* (Calif.)

**Remarks**: Larvae found rarely feeding on leaves; economic sp.

**Sources**: Goeden (1974)

**Geometridae**

**Unident. geometrid spp.**

**Plant recs.**: *Carduus acanthoides* (Austria); *C. defloratus* (Switzerland); *C. pycnocephalus* (S. Europe); *C. nutans* (S. Dak.)

**Remarks**: Larvae in flower heads; on leaves

**Sources**: Delémont Rpts. (1962–63); Goeden (1974); Morihara and Balsbaugh (1976)

**Eupithecia** sp.

**Plant recs.**: *Carduus* sp. (Va.)

**Remarks**: Common feeder

**Sources**: L. T. Kok in litt. (1976)

**Pyralidae**

**Unident. phycitine sp.**

**Plant recs.**: *Carduus personatus* (centr. Europe)

**Remarks**: Larvae endophytic in flower heads

**Sources**: Zwölfer (1965a)

**Unident. pyralid spp.**

**Plant recs.**: *Carduus pycnocephalus* and/or *C. tenuiflorum* (Europe, Calif.)

**Remarks**: Larvae boring into stems and leaf axils in Calif.; locally common in Europe; ectophagous on leaves; another sp. "probably Mycopsis sp." endophagous in flowers of *C. pycnocephalus* in Calif.

**Sources**: Albany Rpt. (1963); Goeden (1974)

**Homoeosoma** sp. (= *Phycitodes* sp.)

**Plant recs.**: *Carduus acanthoides* (France); *C. nutans* (Switzerland)

**Remarks**: Larvae attacking flower heads

**Sources**: Delémont Rpt. (1963); CIBC Ann Rpt. (1971)

**Homoeosoma binaevella** (Hübner) (= *Phycitodes binaevella*)

**Plant recs.**: *Carduus nutans* (Europe); *C. edelbergii* (Pakistan); *C. acanthoides*, *C. personatus* (Europe);
Cnicus, Echinops (Pakistan); Cirsium (France, Europe); Centaurea, Anthemis, Senecio (Europe)

Remarks: Larvae endophytic in capitula; 3 generations per year; low incidence of attack generally in lab.; fed on Carduus and Cirsium spp. only, and not the 5 other Compositae tested; considered of possible use in control of Carduus nutans


Homoeosoma electellum (Hulst)

Plant recs.: Carduus nutans (Sask., S. Dak.)
Remarks: Larvae in flowers; pest of sunflowers
Sources: M. G. Maw in litt. (1975); Morihara and Balsbaugh (1976)

Homoeosoma nebulellum (Denis and Schiffermüller)

Plant recs.: Carduus acanthoides (Austria); C. crispus (Rhine Valley); C. nutans (Europe); Cirsium, Silybum, Centaurea (Europe)
Remarks: Larvae endophytic in flower heads
Sources: Delémont Rpt. (1963); Zwölfer (1965a)

Myelois sp.

Plant recs.: Carduus nutans (Rhine Valley)
Remarks: Larvae in flower heads
Sources: Delémont Rpt. (1963)

Myelois cribrumella Hübner (= M. "cribrella")

Plant recs.: Carduus nutans (Rhine Valley, Europe); C. acanthoides (Europe); Cirsium (Germany, France, England, Switzerland, Austria); Onopordum (Austria); Centaurea, Arctium, Carthamus (Europe); Jurinea, Echium (literature); Aster, Helianthus, Senecio, Silybum, Chrysanthemum (in lab. oviposition tests only)
Remarks: Larvae endophytic in stems; also in flower heads of Cirsium.

Results of lab. tests (Delémont, for Cirsium): Oviposition obtained on Aster, Helianthus, Chrysanthemum, Senecio, Silybum, Centaurea, Arctium, and especially on Onopordum and Cirsium (no Carduus incl. in tests); found to have a wide host range, dropped from further consideration in biological control
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Sources: Mellini (1951a); Delémont Rpts. (1962–63); Zwölfer; (1965a)

Noctuelia floralis (Hübner)
Plant recs.: Carduus pycnocephalus (Egypt)
Remarks: Rare
Sources: F4-ENT-5 Rpt. (1967)

Ostrinia kasmirica (Moore)
Plant recs.: Carduus edelbergii, Cnicus (Pakistan)
Remarks: In stems
Sources: Baloch et al. (1971)

Ostrinia nubilalis (Hübner) (= Pyrausta nubilalis)
Plant recs.: Carduus edelbergii (Pakistan); occasionally Cnicus (Pakistan)
Remarks: Larvae in stems; this “strain” (of O. nubilalis from Carduus nutans) was not observed on corn; Ephialtes sp. and Chlorocytus sp. parasites of O. nubilalis on Cnicus; this sp. is a common crop pest
Sources: A17-ENT-9 Rpts. (1960-63, 1965); Baloch et al. (1971)

Phycita sp.
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Larvae feeding on leaves
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Pyrausta silhetalis Guenée
Plant recs.: Carduus edelbergii (Pakistan)
Remarks: Larvae bore in stems; no other hosts known
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Olethreutidae (= Eucosmidae)

?Epiblemma sp.
Plant recs.: Carduus pycnocephalus (Europe)
Remarks: Larvae endophagous in stems
Sources: Goeden (1974)

Epiblemma sp. nr. E. scutulana (Denis and Schiffermüller)
Plant recs.: Carduus nutans, Cirsium (Italy)
Remarks: Larvae mine stems and flower heads; damage to capitula of C. nutans reported to be severe
Sources: P. H. Dunn in litt. (1966); Rome Rpt. (1975)

Epiblemma scutulana (Denis and Schiffermüller) (= E. pflugiana (Haworth))
Plant recs.: Carduus acanthoides (France); C. nutans (Europe); Cirsium (France as E. pflugiana and Europe as E. ?pflugiana); Carlina, Centaurea (Europe); other Compositae (in lab. tests)
LEPIDOPTERA—Continued
Olethreutidae—Continued

Remarks: Larvae rare; in stems of *Carduus nutans* and *C. acanthoides* (Europe)

Results of lab. tests (Delemont): Larvae developed successfully to live pupae only on *Cirsium*; fed to various degrees with some larval development (no live pupae) on *Centaurea* (fed heavily), *Aster, Echinops, Cynara, Onopordum, Silybum, Cnicus, Zinnia, and Lactuca* (no *Carduus* incl. in these tests)

This sp. was first discovered (first known as *E. pflugiana*) and tested for biological control of *Cirsium* at Delemont in 1961; small shipment of pupae (as *E. scutulana*) sent to Canada in 1962; recorded tachinid parasite: *Actia lamia* (Meigen)

Sources: Delemont Rpts. (1961–63); Zwölfer (1965a)

*Eucosma* sp. (?) = *cana* Haworth

Plant recs.: *Carduus personatus* (Austria); *Cirsium, Centaurea* (Europe)

Remarks: Larvae endophytic in flower heads of these hosts

Sources: Delémont Rpt. (1963); Zwölfer (1965a)

*?Grapholitha* sp.

Plant recs.: *Carduus acanthoides* (France)

Remarks: Larvae in stems

Sources: Delémont Rpt. (1963)

*Herpystes* sp. (= "*Acroclita* sp."")

Plant recs.: *Cuscuta* (Bangladesh, Pakistan); *Carduus, many other plants* (in lab. tests only)

Remarks: Main enemy of *Cuscuta* in Pakistan, attacking fruits and vines; *Carduus edelbergii* and other plants received slight feeding by larvae in lab. tests; larvae completed development on several economic plants; not likely of use in biological control of *Cuscuta*


Pterophoridae

*Platyptilia carduidactyla* (Riley)

Plant recs.: *Carduus nutans* (S. Dak.)
Remarks: Larvae in stems; attacks other Compositae, including *Cynara*
Sources: Morihara and Balsbaugh (1976)

**Tortricidae**

Unident. tortricid spp.
- Plant recs.: *Carduus acanthoides* (France); *C. nutans* (S. Dak.)
- Remarks: Larvae in flower heads
- Sources: Delémont Rpt. (1962); Morihara and Balsbaugh (1976)

Unident. cnephasiine sp.
- Plant recs.: *Carduus acanthoides* (Europe)
- Remarks: Occasional visitor
- Sources: Zwölfer (1965a)

Archips sp.
- Plant recs.: *Carduus edelbergii* (Pakistan)
- Remarks: Larvae exophytic on stems and leaves; polyphagous crop pest
- Sources: Baloch et al. (1971)

*Clepsis strigana* (Hübner)
- Plant recs.: *Carduus nutans* (Austria)
- Remarks: Larvae on leaves
- Sources: Delémont Rpt. (1963)

*Cnephasis* spp.
- Plant recs.: *Carduus acanthoides* (Austria); *C. defloratus* (France); *C. nutans* (Europe)
- Remarks: Larvae on *C. acanthoides* and *C. defloratus*; occasional visitor on *C. nutans*
- Sources: Delémont Rpt. (1962); Zwölfer (1965a)

*Cnephasiella incertana* (Treitschke)
- Plant recs.: *Carduus nutans, Cirsium* (Europe)
- Remarks: Listed as occasional visitor on *C. nutans*
- Sources: Zwölfer (1965a)

**Cochylidae** (= Phaloniidae)

Unident. cochylid sp.
- Plant recs.: *Carduus nutans* (Europe)
- Remarks: Larvae endophytic in flower heads and buds
- Sources: Zwölfer (1965a)

*Cochylis dubitana* (Hübner)
- Plant recs.: *Carduus nutans, C. acanthoides, Arctium* (Europe); *Cirsium, Centaurea*
- Remarks: Larvae endophytic in flower heads and buds
- Sources: Hannemann (1964); Zwölfer (1965a)

*Cochylis* sp. nr. *C. posterana* (Zeller) or *C. hybridella* (Hübner)
- Plant recs.: *Carduus edelbergii, Cnicus* (Pakistan)
LEPIDOPTERA—Continued

Cochylidae—Continued

Remarks: Larvae bore into flowers for feeding; no other hosts known; of possible interest as a biological control agent; efforts to study biology in lab. (Rawalpindi) unsuccessful; more study warranted


Cochylis posterana (Zeller) (= Phalonia posterana)

Plant recs.: Carduus nutans (Rhine Valley, Europe); C. acanthoides (France, Europe); C. personatus (Europe); C. crispus (Europe); C. pycnocephalus (S. Europe, France); Cirsium (Austria, France, Switzerland, Europe); Centaurea (Austria, Europe); Arctium, Onopordum, Serratula, Carlina (Europe)

Remarks: Larvae reared from flowers; endophytic


Euxanthoides straminea (Denis and Schiffermüller)

Plant recs.: Centaurea (S. Europe); Carduus nutans, C. crispus (lab. tests)

Remarks: Oviposited on Carduus nutans and other Compositae in lab. tests


Cosmopterigidae

Pyroderces argyrogrammos Zeller

Plant recs.: Carduus nutans (Upper Rhine Valley, Austria); C. pycnocephalus (S. Europe); C. crispus (Upper Rhine Valley); Centaurea (?France, Switzerland, Romania, Egypt); Silybum, Onopordum, Carlina (Europe); Silybum (Egypt)

Remarks: Larvae endophytic in flower heads


Gelechiidae

Scrobipalpa acuminatella Sircom (= Lita acuminatella)

Plant recs.: Carduus nutans, Cirsium, Onopordum, Serratula, Centaurea (literature recs., Europe)

Remarks: Larvae mining leaves

Sources: Schutze (1931); Zwölfer (1965a)
Oecophoridae

*Agonopteryx arenella* (Denis and Schiffermüller)

**Plant recs.**: *Carduus nutans, C. personatus, Cirsium* (Europe)

**Remarks**: Larvae reared externally on stems and leaves; reported mining shoots of *Cirsium* in Switzerland

**Sources**: Delémont Rpts. (1962–63); Zwölfer (1965a)

*Agonopteryx propinquella* (Treitschke)

**Plant recs.**: *Carduus acanthoides* (Switzerland); *Cirsium, Onopordum, Serratula* (Europe)

**Remarks**: Larvae mine leaves; ident. of larvae from *C. acanthoides* not verified

**Sources**: Delémont Rpts. (1962–64); Zwölfer (1965a)

*Agonopteryx subpropinquella* Stainton

**Plant recs.**: *Carduus nutans, C. pyrocephalus, Cirsium, Centaurea, Cynara, Onopordum* (Europe)

**Remarks**: Locally common; larvae mining leaves

**Sources**: Schutze (1931); Delémont Rpt. (1964); Zwölfer (1965a); Goeden (1974)

*Endrosis sarcitrella* (L.) (= *E. lactaeella* Schiffermüller)

**Plant recs.**: *Carduus acanthoides* (Europe); *Cirsium* (Rhine Valley, France); *Centaurea* (Europe)

**Remarks**: Larvae feed in flower heads, destroy seeds; listed as occasional visitor on *C. acanthoides*; recorded in literature on mushrooms, fruits, flour, etc.; of no interest in biological control

**Sources**: Delémont Rpt. (1962); Zwölfer (1965a)

**Glyphipterygidae**

*Choreutis bjerkandrella* Thunberg

**Plant recs.**: *Carduus crispus, Carlina* (Europe)

**Remarks**: Larvae mining leaves of *C. crispus*; found externally on leaves of *Carlina*

**Sources**: Schutze (1931); Zwölfer (1965a)

**Coleophoridae**

*?Coleophora* sp.

**Plant recs.**: *Carduus defloratus* (Switzerland)

**Remarks**: Case (only) found on plant

**Sources**: Delémont Rpt. (1962)

*Coleophora ?aeripennis* Wocke

**Plant recs.**: *Carduus defloratus* (Europe)

**Remarks**: Larvae mine leaves; European literature recs. for *C. aeripennis* = *Arctium, Serratula*, and *Centaurea*

**Sources**: Zwölfer (1965a)
**LEPIDOPTERA—Continued**

 Coleophoridae—Continued

*Coleophora therinella* Tengström

Plant recs.: *Carduus nutans, Cirsium, Carlina* (Europe)

Remarks: Larvae mining leaves

Sources: Zwölfer (1965a)

**DIPTERA**

*Cecidomyiidae*

Unident. *cecidomyiid* spp.

Plant recs.: *Carduus nutans, C. defloratus, C. acanthoides, C. crispus* (Europe); *C. nutans* (S. Dak.); *C. pycnocephalus* (Egypt)

Remarks: Larvae endophytic in buds, galls, and flower heads

Sources: Ross and Hedicke (1927); Zwölfer (1965a); F4-ENT-5 Rpt. (1970); Morihara and Balsbaugh (1976)

*Jaapiella cirsiicola* Rubsaamen

Plant recs.: *Carduus crispus, Cirsium* (Europe)

Remarks: Larvae endophytic in (and deforming) flower heads

Sources: Buhr (1964); Zwölfer (1965)

*Syrphidae*

*Cheilosia* sp.

Plant recs.: *Carduus crispus* (Switzerland); *C. acanthoides, C. personatus, C. sp.* (Austria); *C. nutans* (Italy, France, Europe); *C. tenuiflorus, C. pycnocephalus, Cirsium* (Italy)

Remarks: Generic identity of some of these larval recs. originally questioned; larvae (usually solitary) mine stems, roots, and sometimes buds and crowns, damaging 10 percent of rosettes; rec. from *Carduus* sp. in Austria was as leaf miner; only specimen reared (from many larvae) in Italy was identified as *Cheilosia chrysocoma* (from *C. nutans*)

Sources: Delémont Rpts. (1962–63); Rome Rpts. (1965, 1974–75); Zwölfer (1965a); K. E. Frick in litt. (1966)

*Cheilosia chrysocoma* (Meigen)

Plant recs.: *Carduus nutans* (Italy); *C. crispus* (Europe)

Remarks: Larvae (usually solitary) in stems and crowns; only specimen reared to adult (from many syr-
Phid larvae found on Carduus spp. in Italy was identified as C. chrysocoma (from C. nutans); C. chrysocoma chosen for study for possible use in biological control of Carduus (Rome)

Sources: Brauer (1883); K. E. Frick in litt. (1966); Rome Rpt. (1975)

Cheilosia cynocephala Loew

Plant recs.: Carduus nutans (Europe)
Remarks: None
Sources: Brauer (1883); K. E. Frick in litt. (1966); Rome Rpt. (1975)

Cheilosia flavicornis (F.)

Plant recs.: Carduus crispus, ?Cnicus (Europe)
Remarks: None
Sources: Brauer (1883); K. E. Frick in litt. (1966)

Cheilosia grossa Fallén

Plant recs.: Carduus pycnocephalus, C. nutans, C. crispus, Cnicus (Europe)
Remarks: Adults feed on pollen in early spring
Sources: Mellini (1951a); Goeden (1974); Rome Rpt. (1975); F. C. Thompson in litt. (1976)

Cheilosia mutabilis (Fallén)

Plant recs.: Carduus acenthoides (Europe)
Remarks: None
Sources: F. C. Thompson in litt. (1976)

Cheilosia variabilis (Panzer)

Plant recs.: Carduus nutans (Italy); Cirsium, Scrophularia (Europe)
Remarks: Larvae in stems
Sources: Rome Rpt. (1975)

Platystomatidae

Platystoma sp.

Plant recs.: Carduus nutans (Europe)
Remarks: Occasional visitor
Sources: Zwölfer (1965a)

Platystoma seminationis F.

Plant recs.: Carduus crispus (Europe)
Remarks: Larvae endophytic in flower heads and buds; has been reared from mushrooms
Sources: Zwölfer (1965a)

Tanyderidae

Unident. tanyderid sp.

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Rare
Sources: Morihara and Balsbaugh (1976)
DIPTERA—Continued

Tephritidae (= Trypetidae)

Unident. tephritid spp.

Plant recs.: Carduus defloratus, C. acanthoides (Switzerland); C. nutans (Austria); C. tenuiflorus (France); C. pycnocephalus (S. Calif.)

Remarks: Larvae found in flower heads in all these recs.; addit. rec. of unident. adult on C. defloratus; larvae on C. acanthoides in 1 rec. said to be gregarious

Sources: Delemont Rpts. (1962–63); Goeden (1974)

Acanthiophilus eluta (Meigen) (= A. helianthi (Rossi))

Plant recs.: Carduus pycnocephalus (France, Italy); C. edelbergii (Pakistan); C. personatus (Austria); Cirsium (France, Europe); Centaurea (France, Pakistan, Italy, Romania, Bulgaria, USSR (Caucasus), Egypt, Syria, Lebanon); Carthamus (India, Pakistan); Carlina (Austria); Cynara, Onopordum (Italy); Serratula, Xeranthemum, Leuzea (Europe); Cnicus, Echinops (Pakistan); Silybum (Egypt, Pakistan, Lebanon)

Remarks: Larvae reared from flower heads, tend to be gregarious; viable seed production reduced; polyphagous within Cynareae; major pest of Carthamus in India and Pakistan; most important enemy of Centaurea in Europe and Egypt; some oviposition tests conducted on Centaurea (at Delémont)


Chaetostomella cylindrica (Robineau-Desvoidy) (= C. onotrophes Loew)

Plant recs.: Carduus nutans, C. crispus (Europe); Cirsium, Serratula (Austria, Europe); Centaurea, Microlonchus (Europe)

Remarks: Larvae reared from flower heads

Sources: Delémont Rpt. (1963); Zwölfer (1965a)

Euaresta bella (Loew)

Plant recs.: Carduus nutans (S. Dak.)
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Remarks: Endophagous in flowers; normally in *Ambrosia* seeds

Sources: Morihara and Balsbaugh (1976)

*Orellia winthemi* Meigen

Plant recs.: *Carduus crispus* (Britain, Rhine Valley); *C. crassifolius* (Austria); *C. acanthoides* (Europe)

Remarks: Larvae in flower heads; identity of larvae from *Carduus defloratus* and *C. acanthoides* not verified

Sources: Delémont Rpt. (1963); Zwölfer (1965a, 1974)

*Paracantha culta* (Wiedemann)

Plant recs.: *Carduus nutans* (S. Dak.)

Remarks: Endophagous; polyphagous

Sources: Morihara and Balsbaugh (1976)

*Tephritis* sp.

Plant recs.: *Carduus edelbergii*, *Cirsium* (Pakistan)

Remarks: Six generations per year in unopened flower heads; did not attack other Compositae tested in lab.


*Tephritis cardialis* Hardy

Plant recs.: *Carduus edelbergii*, *Cirsium spp.* (Pakistan)

Remarks: Endophytic in flowers

Sources: Rawalpindi Rpt. (1968); Baloch et al. (1971)

*Tephritis heiseri* Frauenfeld

Plant recs.: *Carduus nutans* (Europe); *C. edelbergii* (Pakistan); *C. acanthoides* (Europe, ?Austria); *C. defloratus* (Europe); *Cirsium, Cnicus* (Pakistan)

Remarks: Larvae reared from flower heads; larvae of Austrian rec. from *C. acanthoides* not reared; biological studies conducted at Rawalpindi: Lab. oviposition obtained on *C. nutans* but not on 7 other spp. of Compositae; recorded parasites (Pakistan): *Paraholaspis* sp. and *Tetrastichus* sp.


*Tephritis hyoscyami* (L.)

Plant recs.: *Carduus personatus* (Austria, France); *C. uncinatus* (USSR); *C. nutans* (Europe); *C. crispus*
Remarks: Larvae reared from flower heads; larvae from
C. acanthoides not reared, may be Tephritis heiseri; formed galls in Carduus sp.

Sources: Séguy (1934); Delémont Rpt. (1963); Zwölfer (1965a, 1974); A17-ENT-9 Rpt. (1965)

*Terellia serratulae* (L.)

**Plant recs.:** Carduus nutans (Europe, Britain); C. defloratus (Switzerland, Europe); C. crassifolius (Austria); C. acanthoides (Europe); C. tenuiflorus (France); C. edelbergii (Pakistan); Cirsium (Europe, Pakistan); Onopordum, Galactites, Centaurea (Europe); Cnicus (Pakistan)

**Remarks:** Larvae attack seeds and tissue of flower heads of Carduus; found to reduce both seed production and seed viability of C. edelbergii (in Pakistan)

Field and lab. studies conducted at Rawalpindi: Regular oviposition and successful larval development obtained only on Carduus edelbergii and Cnicus; in early test, some oviposition obtained on following plants (in isolation): Cynara, Conyza, Centaurea, Cousinia, Acroclinum, Gerbera, Gaillardia, and in later test on Calendula; no larval feeding seen on these plants; recorded parasites (Pakistan): Paraholaspis cothurnata Masi and Tetrastichus sp.


*Urophora* sp. nr. *U. approximata* (Hering)

**Plant recs.:** Carduus defloratus (Switzerland)

**Remarks:** Larvae endophytic in flower heads and/or buds; true *U. approximata* rec. (Europe) only from Cirsium

**Sources:** Hering (1938); Zwölfer (1965a, 1974)

*Urophora cardui* (L.)

**Plant recs.:** Cirsium arvense only (Europe); Carduus nutans (in lab. tests)
Remarks: Larvae endophytic in stems

In lab. tests: Will oviposit on *Cirsium vulgare* and *Carduus acanthoides* if *Cirsium arvense* is absent; some larval development in *Carduus nutans*

Galls sent to Canada from Europe for *C. arvense* control: 1,400 (1969), 750 (1973), and 1,080 (1974); U.S. Working Group on Biological Control of Weeds approved release in Canada (1974) and in U.S. (1977); releases (against *C. arvense*): 274 in B.C. and 574 in Sask. (3 sites) in 1974; 96 in Que., 81 in Ont., 98 in B.C., and 374 in Sask. (3 sites) in 1975; 951 in Sask. (5 sites), 472 in Alta. (2 sites), 199 in B.C., 52 in Ont., 451 in Que. (4 sites), and 191 in N.B. (2 sites) in 1976

Sources: Delémont Rpts. (1961–67, 1970); Zwölfer (1965a); Peschken (1971); Peschken and Harris (1975); Harris (1975)

*Urophora ?eriolepidis* (Loew)

Plant recs.: *Carduus nutans* (Rhine Valley); *Cirsium, Centaurea* (Europe)

Remarks: Larvae doubtfully identified as *U. eriolepidis* found in flower heads of *C. nutans* in association with larvae of *Urophora solstitialis*; larvae definitely identified as *U.* (or *Euribia*) *eriolepidis* reared only from *Cirsium* (Germany, Europe)

Sources: Ross (1927); Delémont Rpts. (1963–64); Zwölfer (1965a)

*Urophora ?solstitialis* (L.)

Plant recs.: *Carduus nutans* (France, Italy, Rhine Valley); *C. acanthoides* (France); *C. pycnocephalus* (S. Europe); *C. crispus* (Rhine Valley); *C. defloratus* (Switzerland); *C. edelbergii* (Pakistan); *C. personatus* (Europe); ?*Arctium, ?Carthamus, Carlina, Centaurea* (Europe)

Remarks: Ident. often questioned; larvae from galls in flower receptacles; feed on seeds

Sources: Ross (1927); Séguy (1934); Mellini (1952); H. L. Parker in litt. (1957); Delémont Rpts. (1963–64); Zwölfer (1965a); L. A. Andres in litt. (1966); Rawalpindi Rpt. (1968); CIBC Ann. Rpt. (1971); Baloch et al. (1971); Goeden (1974)
DIPTERA—Continued
Tephritidae—Continued

*Urophora stylata* (F.)

**Plant recs.:** *Carduus acanthoides, C. personata, C. nutans* (Europe); *C. edelbergii, Cnicus* (Pakistan); *Cirsium, Senecio* (Europe)

**Remarks:** Larvae endophytic in flower heads and buds; European specimens mostly from *Cirsium*; Pakistan specimens from *Carduus edelbergii, Cnicus, and Cirsium*

Results of lab. oviposition tests (Delémont, 1966–68): Regular oviposition obtained only on *Cirsium*, occasionally on *Carduus acanthoides, Arctium, Onopordum*, and on *Centaurea* when artificially stimulated (Rawalpindi, 1966–68). Oviposition obtained only on *Carduus edelbergii* and *Cnicus*

Shipments of 750 galls containing *U. stylata* larvae made in 1964–67 from Delémont to Belleville, Ont., for testing as control agent of *Cirsium vulgare*; U.S. Working Group on Biological Control of Weeds approved release in Canada in 1973

Releases (against *Cirsium vulgare*): 1,227 adults released in B.C. (4 locs.) in 1973, established, and populations increasing by 1975; 123 larvae released in Que. in 1975; Pakistan population possible biological control agent for *Carduus nutans* and/or *Cnicus wallichii*

**Sources:** Séguy (1934); Delémont Rpts. (1961–68); A17-ENT-9 Rpts. (1963–65); CIBC Ann. Rpts. (1964–67, 1973–74); Zwölfer (1965a, 1974); Baloch et al. (1971); Williamson (1974); Harris (1975)

*Xyphosia miliaria* (Schrank)

**Plant recs.:** *Carduus nutans, Cirsium* (Europe)

**Remarks:** Larvae endophytic in flower heads and buds

**Sources:** Séguy (1934); Delémont Rpts. (1961–65); Zwölfer (1965a, 1974)

*Drosophilidae*

*Scaptomyza pallida* (Zetterstedt) (= *Parascaptomyza pallida*)

**Plant recs.:** *Carduus edelbergii* (Pakistan)

**Remarks:** Larvae mine leaves; no other host known
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Chloropidae

Oscinella spp.

Plant recs.: Carduus nutans (S. Dak.)
Remarks: Common; endophagous in stems
Sources: Morihara and Balsbaugh (1976)

Polydaspis sp.

Plant recs.: Carduus edelbergii, Cnicus (Pakistan)
Remarks: Pupae found in flowers; status unknown
Sources: A17-ENT-9 Rpt. (1965); Baloch et al. (1971)

Agromyzidae

Unident. agromyzid spp.

Plant recs.: Carduus crispus (Rhine Valley); C. pycnocephalus (Egypt)
Remarks: Adults

Agromyza apfelbecki Strobl

Plant recs.: Carduus acanthoides (Hungary); Cynara (Europe)
Remarks: Leaf miner; pest of Cynara
Sources: Spencer (1973)

Cerodontha dorsalis (Loew)

Plant recs.: Carduus nutans (S. Dak.)
Remarks: In leaves; polyphagous
Sources: Morihara and Balsbaugh (1976)

Liriomyza sp. nr. L. eupatoriæ Kaltenbach

Plant recs.: Carduus pycnocephalus (S. Calif.)
Remarks: Rare; larvae endophytic in leaves
Sources: Goeden (1974)

Melanagromyza sp. (poss. M. aeneoventris (Fallén)

Plant recs.: Carduus crispus (Rhine Valley); C. acanthoides (Europe); Cirsium (Europe)
Remarks: Larvae found in stems of C. crispus
Sources: Séguy (1934); Delémont Rpt. (1963); Zwölfer (1965a)

Melanagromyza aeneoventris (Fallén) (= M. cirsii (Rondani))

Plant recs.: Carduus nutans, C. acanthoides (Europe); C. edelbergii (Pakistan); Carduus sp. (Argentina); Cirsium, Centaurea, Senecio, other Compositae (Europe)
Remarks: Larvae mine within the pith of stems; pupae parasitized by Tetrastichus sp.
Sources: Séguy (1934); Delémont Rpt. (1962); A17-ENT-19 (1962, 1965); A7-ENT-9 Rpts. (1964-65); Rome Rpt. (1965); Baloch et al. (1971)
DIPTERA—Continued
Agromyzidae—Continued

*Napomyza lateralis* (Fallén)

**Plant recs.:** *Carduus nutans, C. pycnocephalus* (Italy); *Centaurea, Calendula* (Europe)

**Remarks:** Common feeder on Compositae

**Sources:** Spencer (1973)

*Phytomyza* sp.

**Plant recs.:** *Carduus pycnocephalus* (S. Europe)

**Remarks:** Occasional larvae; endophagous in leaves

**Sources:** Goeden (1974)

*Phytomyza affinis* Fallén

**Plant recs.:** *Carduus acanthoides* (Finland); *Cirsium, Onopordum, Serratula* (Europe)

**Remarks:** Leaves mined

**Sources:** Seguy (1934); Delémont Rpt. (1962); Zwölfer (1965a)

*Phytomyza cardui* Hering

**Plant recs.:** *Carduus crispus, Cirsium* (France)

**Remarks:** Larvae in leaf galls

**Sources:** Buhr (1964); Zwölfer (1965a)

*Phytomyza cirsi* Hendel

**Plant recs.:** *Carduus* (Finland, Britain); *Cirsium, Serratula* (Europe)

**Remarks:** Leaves mined

**Sources:** Seguy (1934); Parmenter (1952)

*Phytomyza farfarella* Hendel (= *P. atricornis* Meigen)

**Plant recs.:** *Carduus personatus* (France); *C. crispus* (Czechoslovakia); *C. pycnocephalus* (U.S., Canada); *Cirsium, Onopordum, Silybum, Xeranthemum* (Europe); *Xanthium, Carthamus, Salvia, Centaurea, Cannabis, Conyza, Datura, Silybum, Trichodesma* (Pakistan); ?*Centaurea* (Egypt); many other hosts

**Remarks:** Larvae mine leaves; occasional visitor on these hosts in Europe

**Sources:** Frick (1969); A17-ENT-9 Rpts. (1961, 1965); Delémont Rpts. (1962–63); Zwölfer (1965a); F4-ENT-5 Rpts. (1966–68); Baloch et al. (1968)

*Phytomyza syngenesiae* (Hardy) (= *P. "atricornis"* Meigen" in part)

**Plant recs.:** *Carduus crispus* (Sweden); several other Compositae (rarely other plants) (Europe, N. Amer., Australia, New Zealand)
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Remarks: Leaf miner; pest of lettuce and chrysanthemum
Sources: Spencer (1973)

Anthomyiidae
Unident. dipterous larvae, prob. Pegomya terebrans (Rondani) (= P. nigricornis [Strobl])
Plant recs.: Carduus pycnocephalus, Cynara (Italy)
Remarks: Larvae mine leaves; larvae from Cynara ident. as P. terebrans
Sources: Rome Rpt. (1965); Goeden (1974)

Hylemya spp.
Plant recs.: Carduus nutans (S. Dak.)
Remarks: Endophagous
Sources: Morihara and Balsbaugh (1976)
Pegomya carduorum Huckett (= P. bicolor [Wiedemann])
Plant recs.: Carduus pycnocephalus, Cirsium (Calif.)
Remarks: Common; larvae mine leaves; reared
Sources: Albany Rpts. (1968–69); Goeden (1974); G. Steyskal in litt. (1977)
Pegomya fodiens (Hendel) (= Carduiphila fodiens)
Plant recs.: Carduus crassifolius (Europe)
Remarks: Mine leaves
Sources: G. Steyskal in litt. (1977)
Pegomya steini Hendel
Plant recs.: Carduus crispus (Britain)
Remarks: None
Sources: Niblett (1957)

FUNGI ASSOCIATED WITH CARDUUS THISTLES

The use of plant pathogens for weed control has been reviewed by Wilson (1969) and Hasan (1974). It would be desirable to introduce highly specific fungi to control Carduus thistles with no danger to other plants. Smuts and some rust strains are notably species, subspecies, variety, or even race specific. The successful establishment of an Italian strain of Puccinia chondrillina Bubak & Sydow to control the Eurasian skeletonweed (Chondrilla juncea L.) in Australia was discussed by Hasan (1971).

Carduus thistles are attacked by a variety of relatively nonspecific and specific fungi, according to information extracted from herbarium specimens and the host or fungus index in the National Fungus Collections, Plant Protection Institute, Beltsville.
Agricultural Research Center, Beltsville, Md. Recorded nonspecific fungi are as follows:

*Ascochyta phomoides* Saccardo
*Bremia lactucae* Regel
*B. tulasnei* (Hoffman) Sydow
*Cercosporella carduicola* P. Brunaud
*Cladosporium herbarum* Link ex Fries
*Erysiphe cichoracearum* DC. ex Merat
*Fusicladium aronici* Saccardo
*F. schnablianum* Allescher
*Heteropatella umbilicata* (Persoon) Saccardo
*Leptosphaeria carduina* Passerini
*L. clivensis* (Berkeley & Broome) Saccardo
*L. purpurea* Rehm
*Leveillula compositarum* Golovin forma *cardui* (Jaczewski) Golovin
*L. taurica* (Lévêle) Arnaud
*Macrosorium commune* Rabenhorst
*Oidium* spp.
*O. conspicua* Fautrey & Lambette
*Ophiobolus acuminatus* (Sowerby) Duby
*O. pellitus* (Fuckel) Saccardo
*Ovularia vossiana* Thümen
*Passalora schnabliana* (Allescher) Petrak
*Phoma albicans* Roberge & Desmazieres
*P. pycnocephali* Passerini
*Phragmidium personatae* Allescher
*Phyllosticta personatae* Allescher
*Pleospora albicans* Roberge & Desmazieres
*P. penicillus* (Schumacher) Fuckel
*Pseudohelotium micaceum* (Persoon) Saccardo
*Ramularia cardui* Karsten
*Rhabdospora cirsii* Karsten
*Sclerotinia sclerotiorum* (Libert) DeBary
*Scolecotrichum cardui* Schroeter
*Septoria associata* Bubak & Kabat
*S. cardui* Fossi
*Venturia pellita* Hazslinszky

In addition, *Carduus glaucus* on limestone is associated with a mycorrhizal fungus in Poland, according to records in the files of the National Fungus Collections. The obligate parasitic fungus *Albugo trogapogi* (Persoon) Schroeter is associated with and may be host specific on *Carduus crispus* in Denmark and the Netherlands.

*Carduus micropterus broteri* was attacked by the lettuce mosaic virus in Portugal, and a phloem necrosis virus infected *C. nutans* at Beltsville, Md.
The rusts and smuts in the following list are specific to *Carduus* thistles or contain specific races or biotypes attacking various species or varieties of *Carduus*. Because many rusts are highly specific to certain varieties or races of the host, these fungi seem most promising as potential biological control agents, particularly since they have not yet been reported from North America.

**LIST OF SPECIFIC FUNGI**

**UREDINALES**

*Puccinia cardui-pycnocephali* H. Sydow & P. Sydow

**Plant recs.:** *Carduus pycnocephalus* (Italy, Spain, Yugoslavia, Portugal, Britain, Turkey, Asia Minor, Iran, Cyprus, New Zealand, Azerbaidzhan SSR, Turkmen SSR, North Africa, Scotland, Palestine); *C. tenuiflorus* (Spain, Portugal, New Zealand, France, Morocco); *C. ammophilus* (as *C. reuterianus*) (Spain); *C. seminudus* (Caucasus – USSR); *C. spachianus var. duriae* Boiss. & Reut. (Morocco); *C. clavulatus* (Canary Is.); *C. fallii*, *C. myriacanthus* (Morocco)

**Remarks:** States II (uredia) and III (telia) on living leaves and stems; plants persisted but disease disappeared after several years (Switzerland); occurs in June (Portugal)

**Sources:** Sydow and Sydow (1904); Natl. Fungus Coll.

*Puccinia carduorum* Jacky (= *P. hieracii* (Roehling) Martius; = *Aecidium cardui* Sowerby; = *Uredo flosculosorum* Albertini & Schweinitz; = *P. flosculosorum* Winter; = *P. cardui-carlinoides* Petrak; = *P. compositarum* Schlechtendahl [in part])

**Plant recs.** *Carduus nutans* (France, USSR, Spain, Britain, Germany, Hungary, Lithuanian SSR, Pakistan, Kirghiz SSR, Switzerland, India, Romania); *C. crispus* (France, Switzerland, Romania, USSR, Spain, Siberia, Japan, Korea, Lithuanian SSR (as *Uredo flosculosorum*), Uruguay, Hungary, Finland (Lapland), Norway, Sweden, Germany, Altai Mts. – USSR, Czechoslovakia, Scotland, Europe (as *Puccinia hieracii*, *Uredo hieracii*); *C. cornius* (Greece (as *C. armatus*), Bulgaria); *C. kernerii* (Europe); *C. defloratus* (Switzerland, France, Austria (as *Aecidium cardui*), Europe (as *Puccinia*...
**Puccinia flosculosorum**); C. getulus (N. Africa); C. crassifolius (as C. glaucus) (Czechoslovakia); C. hamulosus (Hungary); C. leptoclados, C. myriacanthus, C. macrocephalus, C. meananthus (Morocco); C. candidans (Europe); C. personatus (France, Hungary, Germany, Bulgaria, Switzerland); C. ammophilus (as C. reuterianus) (Spain, Balearic Is.); C. tenuiflorus (Portugal, Spain, France); C. onopordoides (Bulgaria); C. ballii (Morocco); C. acaenhostides (Europe (as Puccinia flosculosorum), France, Germany, Czechoslovakia, Ukrainian SSR); C. pycnocephalus (Turkmen SSR (as P. hieraci), Europe, Cyprus, Spain, Iran, Turkey, Turkmen SSR, Uzbek SSR); C. gayanus (Spain (as C. carpetanus)); C. thoerneri (Africa (as C. leiophyllus)); C. chrysacanthus (France (as Puccinia carduicarlinoides)); C. collinus (Romania, Hungary); C. kerner (as C. scardicus) (Bulgaria); C. (Alfredia) acaenhostipes and C. (A.) nivea (Kirghiz SSR); C. (A.) curnua (Kirghiz SSR, Siberia); C. chevallieri (N. Africa); (?) *Silybum marianum* (L.) Gaertn. (Portugal)

**Remarks:**
States II and III on leaves and branches in July and Aug. (Europe, C. nutans); II and III common on stems and leaves in July-Oct. (Europe, C. crispus, C. personatus); June-Oct. (Switzerland, C. defloratus)

**Sources:**
Sydow and Sydow (1904); Savulescu (1955); Natl. Fungus Coll.

*Puccinia centaureae* DC. (= *P. centaureae* Fuckel; = *P. calcitrapae* DC.; = *P. scabiosae* P. Magnus; = *P. jaceae* Otth; = *P. inquinans* Wallroth; = *Epitea jaceae* Otth; = *Uredo flosculosorum* var. *centaureae* Wettstein)

**Plant recs.:**
*Carduus crispus* (Norway, Finland); C. clavulatus (Canary Is.); C. pycnocephalus (Iraq, Canary Is., as *Puccinia centaureae* forma *asperae* Cast. on C. pycnocephalus as C. tenuiflorus); also literature records from *Centaurea* spp.

**Remarks:**
States II and III on *C. clavulatus* (Canary Is.)

**Sources:**
Sydow and Sydow (1904); Natl. Fungus Coll.

*Puccinia cnici-oleracei* Persoon ex Desmazieres (= *P. cardui* Plowright; = *P. spectabilis* Otth)
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Plant recs.: Carduus (Afrocarduus) kikuyorum (Kenya); C. (Afrocarduus) sp. (Uganda); ? C. crispus (Germany); Cirsium spp. (Europe); Carthamus (France); Lupsia (Canary Is.); Artemisia (China)

Remarks: In living leaves; probably several spp.
Sources: Sydow and Sydow (1904); Natl. Fungus Coll.

Puccinia galactica Sydow
Plant recs.: Carduus pycnocephalus var. albidus (Asia Minor); C. arabicus marmoratus (Europe); C. nutans (Sinkiang, China)

Remarks: On living leaves
Sources: Sydow and Sydow (1904); Natl. Fungus Coll.

USTILAGINALES

Ustilago cardui F. de Waldheim (= U. reessiana Kühn)
Plant recs.: Carduus acanthoides (as U. reessiana), C. acanthoides, C. nutans (N. Europe); C. defloratus (Switzerland); C. personata (USSR, Europe); C. crispus (USSR – Altai Mts.); C. thoermeri (Europe)

Remarks: In flower heads; destroys capitulum
Sources: Savulescu (1955); Natl. Fungus Coll.

Ustilago violacea S. F. Gray (= U. violacea Persoon)
Plant recs.: Carduus acanthoides (Germany)

Remarks: None
Sources: Natl. Fungus Coll.

SUMMARY

Six Eurasian species of Carduus thistles have become established in North America, where they are troublesome weeds in pastures and rights-of-way. A search for biological control agents in Eurasia and North America has shown that Carduus spp. are attacked by about 340 species of phytophagous insects, including 71 that are oligophagous on Cynareae. The host range of 39 Eurasian species was determined by laboratory testing (30 Coleoptera, 5 Lepidoptera, and 4 Diptera). Five of them were sufficiently damaging and host specific to warrant their release in North America. The results are as follows:

(1) Altica carduorum Guérin-Méneville, repeatedly released against Canada thistle (Cirsium arvense (L.) Scop.) but not yet established in North America.
(2) *Ceutorhynchus litura* (F.), first released against *Cirsium arvense* and established in Sask., Ont., Idaho, Mont., and Calif., with some control of the host.


(5) *Urophora stylata* (F.), first released against *Cirsium vulgare* (Savi) Ten. in 1973 and established in B.C. In addition, *Cassida rubiginosa* Mueller, which had been laboratory tested, was found to have been adventively established on *Carduus* and *Cirsium* in northeastern North America since 1927.

*Carduus* thistles are also attacked by 42 species of fungi; of these, 7 species of *Puccinia* and *Ustilago* may be host specific and are worthy of further investigation.

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