

Predictable risk to native plants in biological control of weeds

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Rhinocyllus conicus



Musk Thistle
(*Carduus nutans* complex)



Snowy thistle (*Cirsium pastorus*)



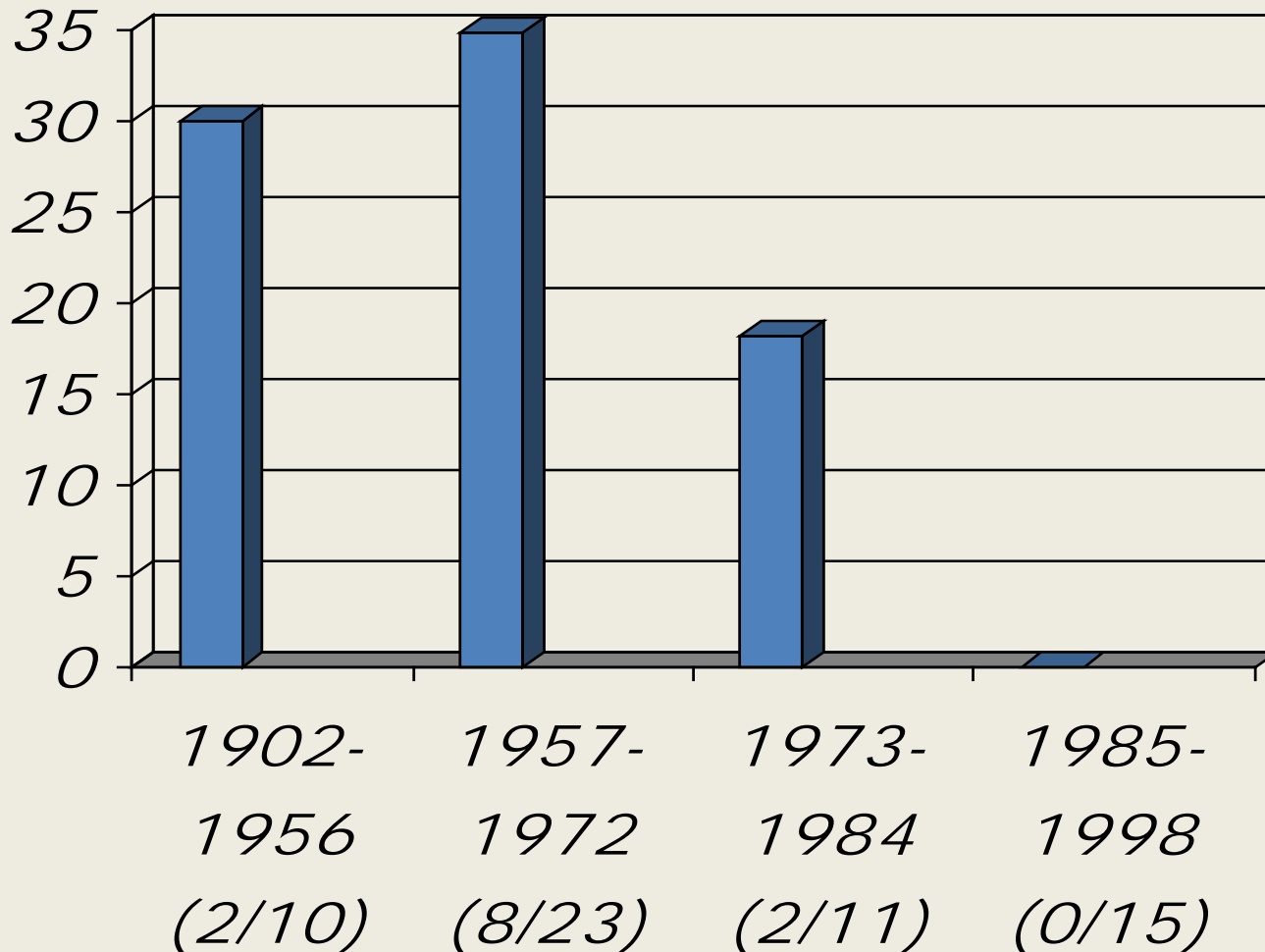
Biological control agents adopting non-target native host plants

Agent	Release	Weed	Non-target hosts
<i>Telenomia scrupulosa</i>	1902	<i>Lantana camara</i>	<i>Myoporum sandwicense</i>
<i>Athesapeuta cyperi</i>	1925	<i>Cyperus rotundus</i>	<i>Cyperus polyschyos</i>
<i>Chrysolina quadrigemina</i>	1946	<i>Hypericum perforatum</i>	<i>Hypericum concinnum</i>
<i>Agrilus hyperici</i>	1950	<i>Hypericum perforatum</i>	<i>Hypericum concinnum</i>
<i>Zeuxidiplosis giardi</i>	1950	<i>Hypericum perforatum</i>	<i>Hypericum concinnum</i>

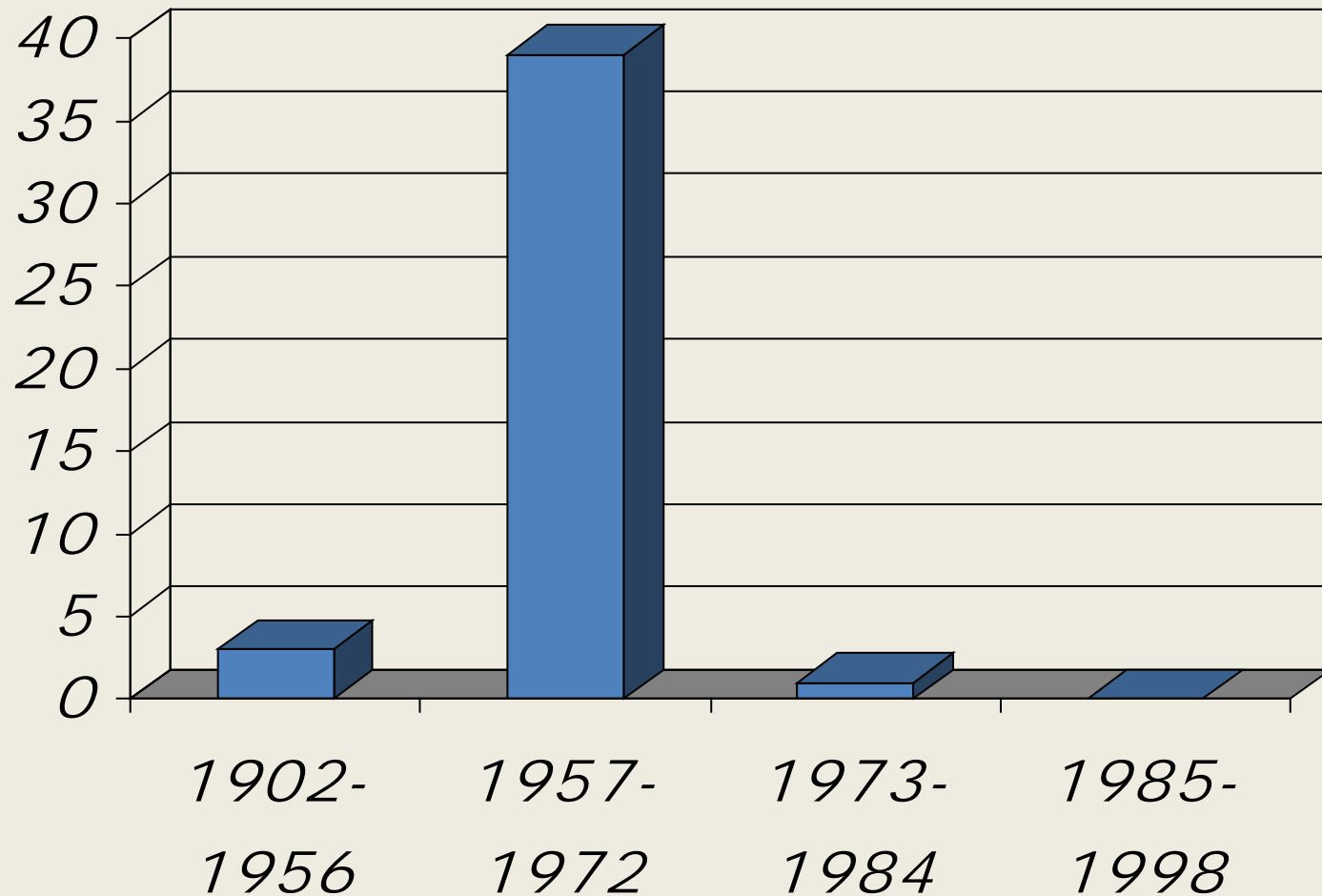
Cactoblastis cactorum	1957	Opuntia species	6 Opuntia
Tyria jacobaea	1959	Senecio jacob.	3 Senecio
Microlarinus lareynii	1962	Tribulus terrestris	2 Kallstroemia
Microlarinus lypriformis	1963	Tribulus terrestris	2 Kallstroemia
Schreckensteinia festaliella	1963	Rubus argutus	2 Rubus
Croesia zimmermani	1964	Rubus argutus	2 Rubus
Priophorus morio	1966	Rubus argutus	2 Rubus

Rhinocyllus conicus	1969	Cardus and Cirsium spp.	22 Cirsium spp.
Acrola (Vogtia) malloi	1971	Alternanthera philoxeroides	Alternanthera & Blataparon spp
Neochetina eichhorniae	1972	Eichhornia crassipes	Pontederia cordata
Trichosirocalus horridus	1974	Carduus and Cirsium spp.	1 Cirsium
Aphthona nigroscutis	1991	Euphorbia esula	Euphorbia robusta

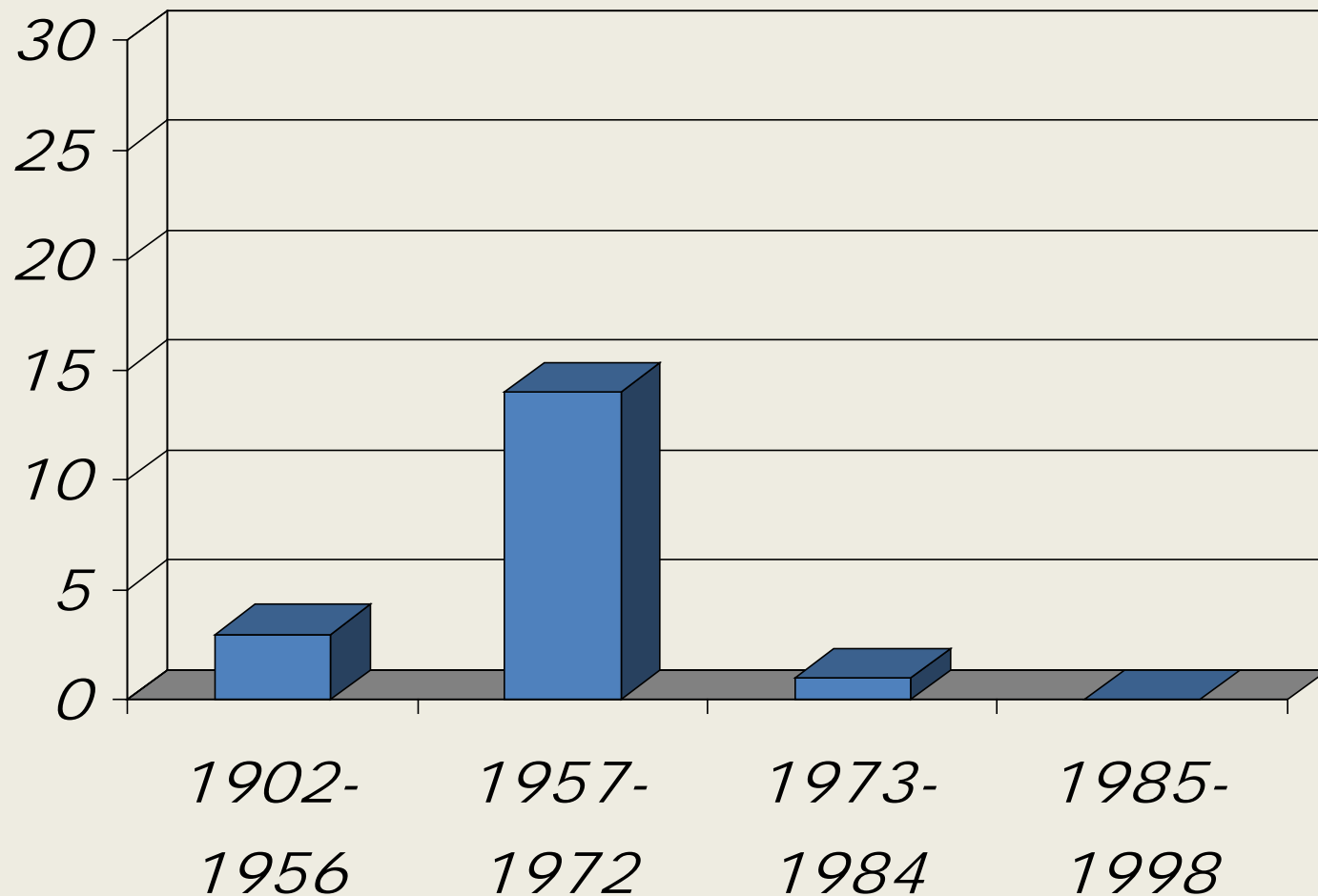
Percent of projects producing non-target use of native plants



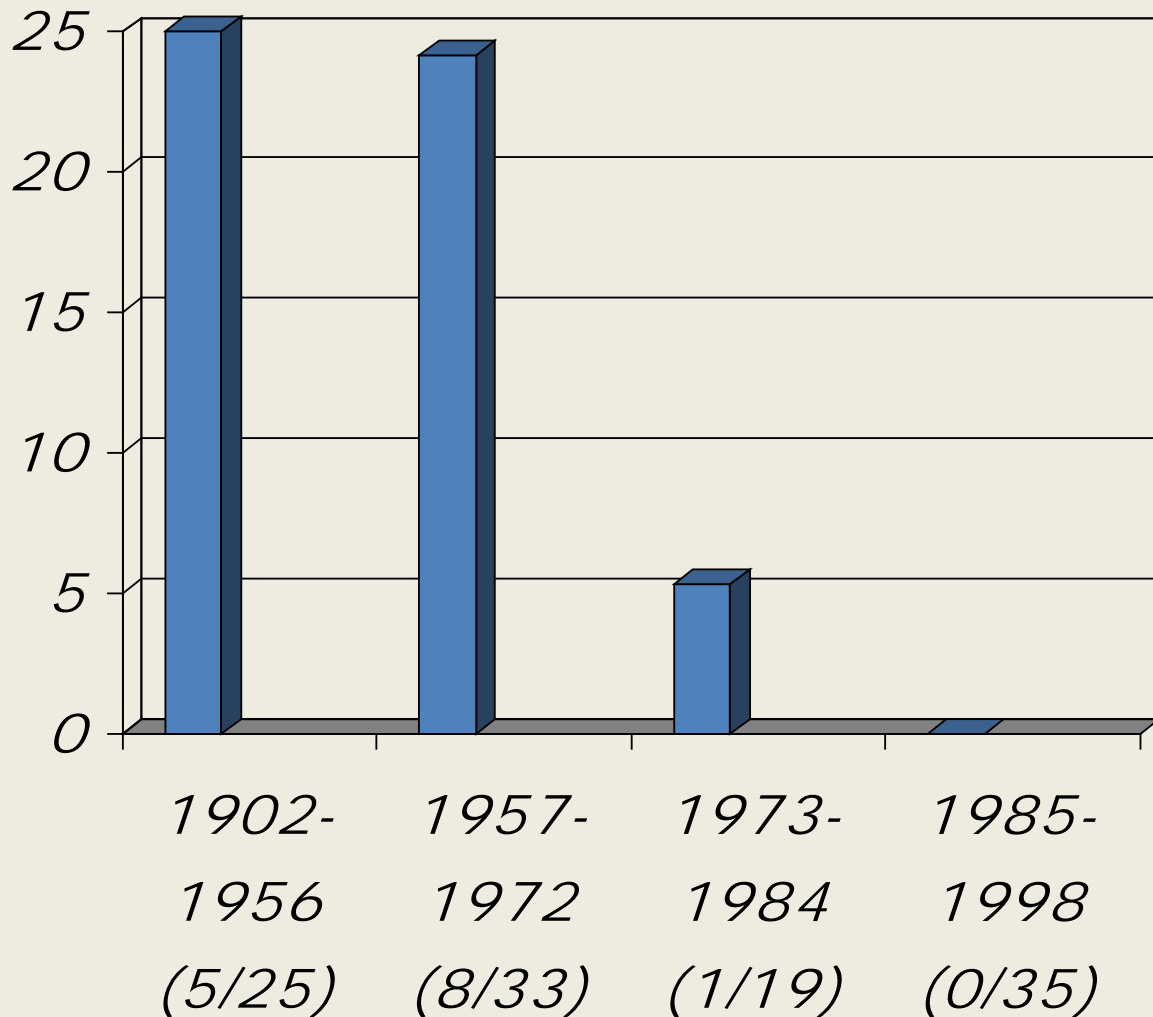
Number of native plants adopted as hosts by agents released in different eras



Number of native plants adopted in different eras excluding *Cirsium* adopted by *Rhinocyllus conicus*

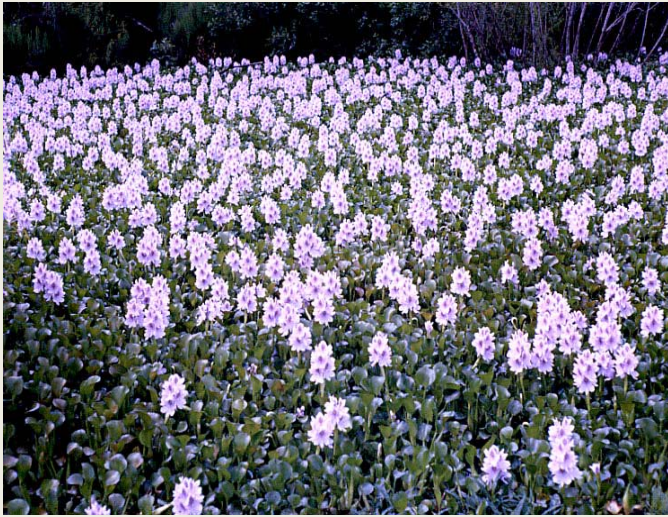


Percent of agents adopting non-target native plants as hosts



New or previously unrecognized
cases of native plant use after
2000

Neochetina eichhorniae on *Pontederia cordata*



Neochetina eichhorniae
Mottled water hyacinth weevil
Copyright 1997 USDA-ARS

Larinus planus on *Cirsium undulatum*



Aphthona nigriscutis on *Euphorbia robusta*



Risk is related to the number of closely related native plants in the area of introduction (1902-2009)

	with close relatives	without close relatives
% projects with non-target use	51.4 (18/35)	3.0 (1/31)
% agents adopting native hosts	25.8 (17/66)	5.9 (1/72)
number non-target plants used	42	1

Rhinoncomimus latipes on *Polygonum perfoliatum* (Hough-Goldstein et al.)



Sphenoraia rutilans and *Trachyaphthona* spp.
and *Paederia foetida*) (Pemberton et al. 2010, unpub.)

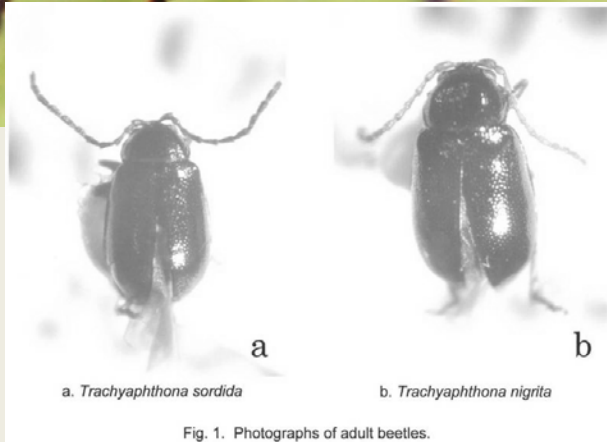


Fig. 1. Photographs of adult beetles.



Percentage of agents using native
plants 13.6% (18/133)

Percentage of agents with
unpredictable native plant use
.08% (1/133)

Impact studies

Rhinocyllus conicus on *Cirsium canescens*
(Rose, Louda et al. 2005)



Rhinocyllus conicus on *Cirsium
hyrdophyllum vaseyi* (Herr 2004, Herr pers.com.)



Tyria jacobaeae on *Senecio triangularis*
(Diehl & McEvoy 1990)



Aphthona nigriscutis on *Euphorbia robusta*
(Baker et. al. 2008)



Pemberton, R.W. 1986. Native plant considerations in the biological control of leafy spurge. In: Del Fosse, E.S. (ed.) Proc. VI Int. Symp. Biol. Contr. Weeds. Vancouver, 1984. Agric. Canada. pp. 57-71.

“Berkeley bird and bunny people”
environmentalist that would not
introduce any more leafy spurge
biological control agents

Biological control insects petitioned for
leafy spurge in the US
by Robert Pemberton

1984 *Bayeria capititgena*

1986 *Aphthona flava cyparissiae*

1986 *Aphthona cyparissiae*

1987 *Aphthona czwalinae*

1989 *Dasineura capsulae*

1989 *Aphthona nigriscutis*

Conclusions

- Native plant use is highly predictable
- The great majority of used native plants are close relatives of target weeds, mostly congeners.
- Half of the cases of native plant use are due to a single agent *Rhinocyllus conicus*.
- Native plant use by introduced agents has declined, largely due to decisions to employ specialists.
- Few impact studies have been undertaken; 1/4 studies has shown a decline of the non-target native plant.

Current biological control practice poses modest risks to native plants

The problem that weed biocontrol aims to solve-invasive plants- are mostly escaped ornamentals. This industry in the US and most of the world is essentially unregulated.

Pemberton, R.W. and H. Liu. 2009. Marketing time predicts naturalization of horticultural plants. *Ecology* 90: 69-80.