

Recent changes in the Dutch Heteroptera fauna (Insecta: Hemiptera)

Berend Aukema

Abstract

At present 610 species of Heteroptera are recorded from the Netherlands. The database of the Dutch bureau of the European Invertebrate Survey currently includes about 130 000 Dutch records (combinations of locality and species). The records, however, are strongly biased towards aquatic and semi-aquatic species (72 761 records of 64 species = 1137 records/species) in comparison with terrestrial species (55 375 records of 545 species = 101 records/species). Although since about 1850 there have always been Dutch heteropterists, collecting efforts show large differences in time and place and it is for instance easy to locate both residences and favourite holiday resorts of heteropterists from the distribution maps.

Local faunas are not static but dynamic and changes in the Dutch Heteroptera fauna were analysed for the period since 1960 and especially before and since 1980. A number of 571 species (93.6% of the Dutch species listed) have been recorded since 1960 and 510 of these (83.6%) have been recorded regularly since 1960 and are considered 'resident species'. The changes documented for the period 1980-2002 concern 61 species: 27 new arrivals, 27 species rediscovered after not having been recorded in the period 1960-1980, and 7 species not recorded since 1980.

From these data it is concluded that the turnover of species since 1980 (61 of 571 species) has been 10.7%. New arrivals (27) outnumber the extinctions (seven). Turnover of species of local faunas is considered a natural process (species come and go continuously), but it is also clear that habitat changes, international trade and global warming have contributed largely to the observed changes in the Dutch fauna. At least four of the 27 new arrivals are linked to international transport of plant material and the majority of the new arrivals are supposed to benefit from global warming.

Keywords: Heteroptera, Dutch fauna, turnover, extinctions, new arrivals, range changes, global warming.

Introduction

Knowledge about the Dutch Heteroptera fauna has been compiled since 1853 when De Graaf & Snellen van Vollenhoven published the first checklist of this group for the Netherlands, including 119 species. Updates were published by De Graaf et al. (1860, 1862), Snellen van Vollenhoven (1868-1879), Fokker (1883-1900), Reclaire (1932-1951) and Aukema (1989), respectively (table 1). The last list included 588 species. At present, with 22 additional species discovered since 1989 (table 1), 610 Heteroptera species are known from the Netherlands.

Data on Dutch Heteroptera records are compiled in the database of the working group Heteroptera of the Dutch bureau of the European Invertebrate Survey at the National Museum of Natural History, Leiden. Altogether nearly 130 000 records (combinations of locality and species) are included

at present (fig. 1), showing a strong increase since the 1950s. The data, however, are strongly

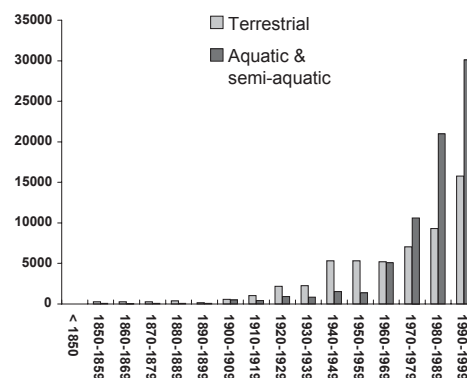


Figure 1
Number of records of Heteroptera per decade.

Table 1

Heteroptera known from The Netherlands: checklists and additional data. +: overlooked species.

Source	
1. De Graaf & Snellen van Vollenhoven (1853):	119 species
2. De Graaf, Six & Snellen van Vollenhoven (1860, 1862):	200 species
3. Snellen van Vollenhoven (1868-1878a, 1878b, 1879):	283 species
4. Fokker (1883-1900):	410 species
5. Reclaire (1932-1951):	488 species
6. Aukema (1989):	588 species
7. species added since 1989	reference
<i>Brachynotocoris puncticornis</i> Reuter, 1880	Aukema 1990a
+ <i>Megalonotus emarginatus</i> (Rey, 1888)	Aukema & Woudstra 1990
<i>Dichroscytus gustavi</i> Josifov, 1981	Aukema 1990b
<i>Psallus punctulatus</i> Puton, 1874	Aukema 1990b
<i>Phoenicocoris modestus</i> (Meyer-Dür, 1843)	Aukema 1990b
<i>Coriomeris scabricornis</i> (Panzer, 1809)	Aukema & Hermes 1992
<i>Nysius graminicola</i> (Kolenati, 1845)	Aukema 1992
<i>Rhopalus tigrinus</i> Schilling, 1829	Aukema 1993a
<i>Eurydema ornata</i> (Linnaeus, 1758)	Aukema 1993a
<i>Cymatia rogenhoferi</i> (Fieber, 1864)	Jansson 1995
<i>Stephanitis takeyai</i> Drake & Maa, 1955	Aukema 1996a
<i>Emblethis denticollis</i> Horváth, 1878	Aukema 1996b
+ <i>Nysius cymoides</i> (Spinola, 1837)	Aukema et al. 1997
+ <i>Rhyparochromus vulgaris</i> (Schilling, 1829)	Aukema et al. 1997
<i>Closterotomus trivialis</i> (A. Costa, 1853)	Aukema 1999
<i>Micronecta griseola</i> Horváth, 1899	Aukema et al. 2000
+ <i>Copium clavicornis</i> (Linnaeus, 1758)	Werner 2001
<i>Horvathiolus superbus</i> (Pollich, 1781)	unpublished 2000
<i>Stagonomus pusillus</i> (Herrich-Schaeffer, 1833)	unpublished 2000
<i>Rhaphigaster nebulosa</i> (Poda, 1761)	Aukema & Steeghs 2002
<i>Holcocranum saturejae</i> (Kolenati, 1845)	unpublished 2002
<i>Tritomegas sexmaculatus</i> (Rambur, 1839)	unpublished 2002
Total number of species (2002):	610

biased towards the aquatic and semiaquatic species (72 761 records of 64 species, i.e. 1137 records/species) in comparison to the terrestrial ones (55 375 records of 546 species, i.e. 101 records/species). This is mainly due to the fact that data on aquatic and semiaquatic species have been systematically collected for water quality assessment by different organisations/institutes involved in water management during the last decades. This means that although since about 1850 there have always been Dutch heteropterists, collecting efforts show large differences in time and place and especially the terrestrial species have not been sampled in a representative way, showing clusters of records (fig. 2) and numbers of species recorded (fig. 3) around residences of collectors and favoured holiday destinations like the coastal dune area, the West

Frisian islands and the southern part of the province of Limburg. Therefore a general quantitative analysis of the data is not possible and a more or less qualitative approach had to be followed.

Faunal changes

Local faunas are not static, but dynamic: there are changes in time and space with respect to both species composition and species distribution. The following changes are considered:

- extinctions: species not longer recorded after a certain year (the pivot year);
- new arrivals: species not recorded before a certain year (the pivot year);
- range changes of resident species (species recorded both in the past and at present, showing increasing or decreasing ranges).

The pivot year selected here is 1980, because the



Figure 2
Number of records of terrestrial Heteroptera per 10 km square.



Figure 3
Number of species of terrestrial Heteroptera per 10 km square.

number of records of terrestrial species before and from this year onwards are more or less equal. Starting point is 1960.

Extinctions

Since 1960, 39 of the 610 species listed for the Dutch fauna have not been recorded anymore (table 2). Most of the species have been recorded only once or twice and 31 species have not been collected for at least 50 years or more. Of those *Arenocoris waltlii*, *Eurydema ventralis*, *Galeatus maculatus*, *Geocoris ater*, *Phymata crassipes* and *Spilostethus saxatilis* were not found for a century or more and probably have to be excluded from the list as truly extinct. The disappearance of some of the other species is clearly connected with the deterioration or disappearance of their habitat: *Salda morio* Zetterstedt, 1838 once lived in peat bogs, which largely disappeared, and *Brachycoleus pilicornis*, *Copium clavicorne* and *Cydnus aterrimus* disappeared together with the only locality where they once were found. *Brachycoleus pilicornis* and *C. aterrimus* are associated with *Euphorbia* species and the only

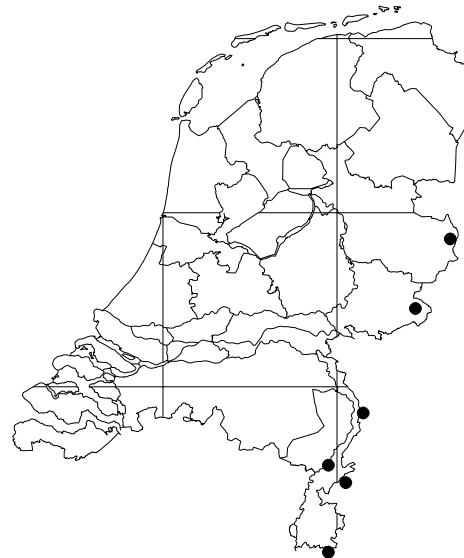


Figure 4
Dutch distribution of *Polymerus holosericeus* (not recorded since 1955).

Table 2

Heteroptera not recorded from The Netherlands since 1960 (see Aukema 1989): year of last record and number of 10 km squares occupied (N).

Family/species	last record	N
Saldidae (2)		
<i>Chartoscirta elegantula</i> (Fallén, 1807)	1958	3
<i>Salda morio</i> Zetterstedt, 1838	1918	2
Tingidae (4)		
<i>Acalypta musci</i> (Schrank, 1781)	<1943	1
<i>Copium clavicorne</i> (Linnaeus, 1758)	1913	1
<i>Galeatus maculatus</i> (Herrich-Schaeffer, 1838)	<1884	1
<i>Physatocheila costata</i> (Fabricius, 1794)	1951	3
Miridae (9)		
<i>Brachycoleus pilicornis</i> (Panzer, 1805)	1953	1
<i>Capsodes gothicus</i> (Linnaeus, 1758)	1911	1
<i>Closterotomus biclavatus</i> (Herrich-Schaeffer, 1835)	1948	1
<i>Dicyphus constrictus</i> (Boheman, 1852)	1910	1
<i>Globiceps sphaegiformis</i> (Rossi, 1790)	1924	2
<i>Hadrodemus m-flavum</i> (Goeze, 1778)	1949	6
<i>Halticus saltator</i> (Geoffroy, 1785)	1948	5
<i>Pinalitus atomarius</i> (Meyer-Dür, 1843)	1953	1
<i>Polymerus holosericeus</i> (Hahn, 1838)	1955	6
Anthocoridae (1)		
<i>Dysepicritus rufescens</i> (A. Costa, 1847)	1937	1
Cimicidae (2)		
<i>Cimex columbarius</i> Jenyns, 1839	1938	5
<i>Cimex dissimilis</i> (Horváth, 1910)	1940	5
Reduviidae (2)		
<i>Phymata crassipes</i> (Fabricius, 1775)	1890	1
<i>Pygolampis bidentata</i> (Goeze, 1778)	1958	6
Aradidae (1)		
<i>Aradus corticalis</i> (Linnaeus, 1758)	1910	2
Lygaeidae (10)		
<i>Drymus pilicornis</i> (Mulsant & Rey, 1852)	1942	2
<i>Emblethis verbasci</i> (Fabricius, 1803)	1944	2
<i>Geocoris ater</i> (Fabricius, 1787)	<1878	1
<i>Geocoris megacephalus</i> (Rossi, 1790)	1902	3
<i>Lasiosomus enervis</i> (Herrich-Schaeffer, 1835)	1956	3
<i>Megalonotus emarginatus</i> (Rey, 1888)	1951	4
<i>Lygaeus equestris</i> (Linnaeus, 1758)	1935	2
<i>Raglius alboacuminatus</i> (Goeze, 1778)	1951	2
<i>Spilostethus saxatilis</i> (Scopoli, 1763)	<1884	1
<i>Tropidophlebia costalis</i> (Herrich-Schaeffer, 1850)	1943	2
Stenocephalidae (1)		
<i>Dicranocephalus agilis</i> (Scopoli, 1763)	1955	4
Coreidae (2)		
<i>Arenocoris waltlii</i> (Herrich-Schaeffer, 1834)	1892	3
<i>Gonocerus juniperi</i> Herrich-Schaeffer, 1839	1951	7
Cydnidae (1)		
<i>Cydnus aterrimus</i> (Forster, 1771)	1951	1
Scutelleridae (2)		
<i>Eurygaster austriaca</i> (Schrank, 1776)	1935	9
<i>Phimodera humeralis</i> (Dalman, 1823)	1941	5
Pentatomidae (2)		
<i>Eurydema ventralis</i> Kolenati, 1846	1893	1
<i>Palomena viridissima</i> (Poda, 1761)	1952	26

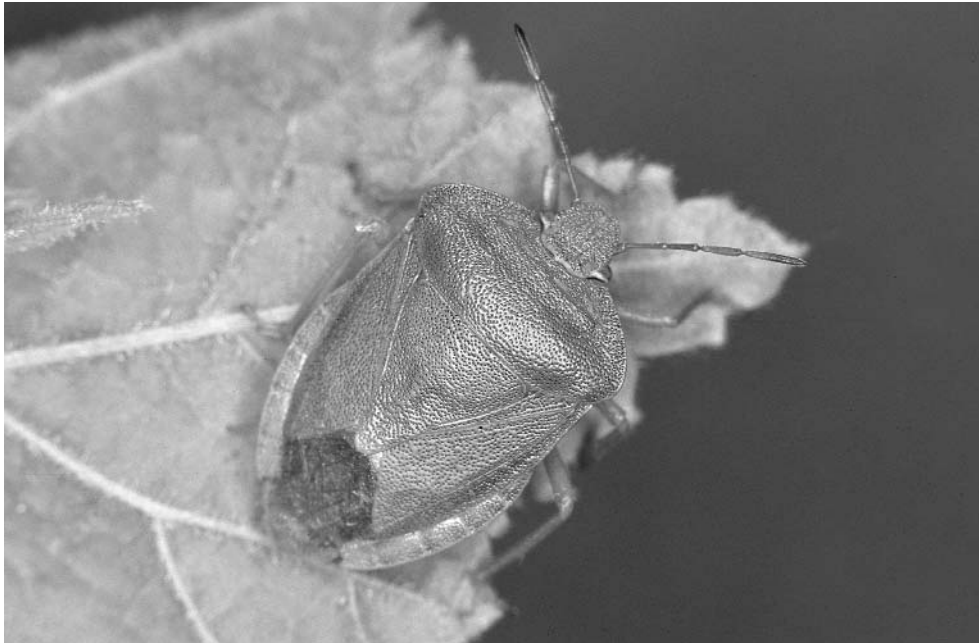


Figure 5
Palomena viridissima. Photo E. Wachmann, Berlin.

locality along the river Maas where they were found was destroyed by gravel winning activities (Aukema 1994). *Copium clavicornis* is only known from herbarium material of its foodplant *Teucrium chamaedrys* collected in 1913 on the former St. Pietersberg, dug down for cement production (Werner 2001). Many of the species

Table 3
Heteroptera not recorded since 1980. N: number of 10 km squares (see Aukema 1989).

Family/species	Year	N
Dipsocoridae (1)		
<i>Cryptostemma waltli</i> (Fieber, 1860)	<1967	6
Miridae (4)		
<i>Amblytulus brevicollis</i> Fieber, 1858	<1962	2
<i>Bothynotus pilosus</i> (Boheman, 1852)	<1966	5
<i>Deraeocoris punctulatus</i> (Fallén, 1807)	<1968	22
<i>Stenodema virens</i> (Linnaeus, 1767)	<1974	24
Anthocoridae (1)		
<i>Anthocoris visci</i> Douglas, 1889	<1973	4
Cimicidae (1)		
<i>Cimex pipistrelli</i> Jenyns, 1839	<1977	3

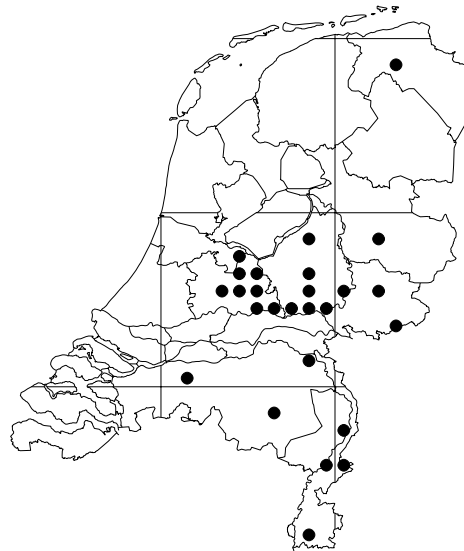


Figure 6
Dutch distribution of *Palomena viridissima* (not recorded since 1952).

Table 4
Heteroptera recorded in The Netherlands before 1960 and after 1980 only. N: number of 10 km squares.

Family/species	before 1960		after 1980		reference(s)
	Year	N	Year	N	
Saldidae (1)					
<i>Saldula c-album</i> (Fieber, 1859)	<1949	2	>1983	1	Aukema 1989
Tingidae (2)					
<i>Lasiacantha capucina</i> (Germar, 1837)	<1951	1	>1994	1	Aukema et al. 1997
<i>Oncochila simplex</i> (Herrich-Schaeffer, 1830)	<1955	2	>1981	3	Aukema 1989; unpubl.
Miridae (7)					
<i>Acetropis gimmerthalii</i> (Flor, 1860)	<1878	1	>1989	11	Aukema & Hermes 1990; unpubl.
<i>Conostethus roseus</i> (Fallén, 1807)	<1882	2	>1981	20	Aukema 1989; unpubl.
<i>Heterocordylus leptocerus</i> (Kirschbaum, 1856)	<1946	12	1985	1	Aukema 1989
<i>Heterocordylus tumidicornis</i> (Herrich-Schaeffer, 1835)	<1949	2	>2000	2	unpubl.
<i>Hoplomachus thunbergii</i> (Fallén, 1807)	<1951	19	>2001	2	unpubl.
<i>Miridius quadrivirgatus</i> (A. Costa, 1853)	<1956	2	>1992	3	Aukema 1993b; unpubl.
<i>Psallus mollis</i> (Mulsant & Rey, 1852)	1929	1	>1988	6	Aukema 1989; unpubl.
Microphysidae (1)					
<i>Myrmedobia distinguenda</i> Reuter, 1884	<1913	3	>1990	2	Aukema 1990c; unpubl.
Anthocoridae (1)					
<i>Temnostethus longirostris</i> (Horváth, 1909)	1951	1	>1987	11	Aukema 1989; unpubl.
Reduviidae (1)					
<i>Empicoris baerensprungi</i> (Dohrn, 1863)	<1926	2	>1987	4	Aukema 1989; unpubl.
Lygaeidae (6)					
<i>Drymus pumilio</i> Puton, 1877	<1960	3	2002	1	Aukema 1986; unpubl.
<i>Emblethis griseus</i> (Wolff, 1802)	<1951	1-2	>1983	1	Aukema 1989; unpubl.
<i>Metopoplax ditomoides</i> (A. Costa, 1847)	1948	1	>1994	27	Aukema et al. 1997; unpubl.
<i>Pachybrachius luridus</i> Hahn, 1826	<1951	8	>1983	7	Aukema 1989; unpubl.
<i>Peritrechus lundii</i> (Gmelin, 1790)	<1952	20	>1994	8	Hermes & Aukema 1998a; unpubl.
<i>Scolopostethus grandis</i> Horváth, 1880	1950	2	>1985	8	Aukema 2000
Berytidae (1)					
<i>Berytinus montivagus</i> (Meyer-Dür, 1841)	<1891	1	>1986	2	Aukema 1989; unpubl.
Coreidae (2)					
<i>Bathysolen nubilus</i> (Fallén, 1807)	<1953	7	>1982	4	Aukema 1989; unpubl.
<i>Gonocerus acuteangulatus</i> (Goeze, 1778)	<1950	3	>1998	6	unpubl.
Rhopalidae (1)					
<i>Liorhyssus hyalinus</i> (Fabricius, 1794)	1923	1	>1994	6	Aukema et al. 1997; unpubl.
Cydnidae (1)					
<i>Sehirus morio</i> (Linnaeus, 1761)	<1950	4	>1993	3	Hermes & Aukema 1998b; unpubl.
Pentatomidae (3)					
<i>Carpocoris fuscispinus</i> (Boheman, 1850)	<1951	5	>1996	2	Aukema et al. 1997; unpubl.
<i>Chlorochroa pinicola</i> (Mulsant & Rey, 1852)	<1953	13	>1983	17	Aukema 1989; unpubl.
<i>Holcostethus sphaelatus</i> (Fabricius, 1794)	<1909	2	1983	1	Aukema 1989

apparently reached the limits of their distribution, as for instance *Polymerus holosericeus* (fig. 4), a species only known from six squares along the eastern border. The number of 'resident species' in 1960 was 545. Of these, seven species have not been recorded

since 1980 (table 3), so altogether 46 species are not recorded since 1980. Some species of the lists probably are not extinct, but overlooked because they are very small (*Cryptostemma waltli*, living in wet moss), live in habitats that are sampled not frequently (*Anthocoris visci* on *Viscum album*) or



Figure 7
Deraeocoris flavilinea. Photo E. Wachmann, Berlin.

hardly ever (*Cimex columbarius* in dove-cotes, *C. dissimilis* and *C. pipistrelli* in bat roosts).

Most interesting are the three species that were once well established (recorded from more than 20 10 km squares) and disappeared without any obvious cause: the predatory mirid *Deraeocoris punctulatus*, the grass feeding mirid *Stenodema virens* and the polyphagous phytophagous pentatomid *Palomena viridissima* (figs. 5, 6).

On the other hand 27 species that were not recorded between 1960 and 1980 were rediscovered since 1980 (table 4). Most of these species remained rare, but five of them increased remarkably: *Acetropis gimmerthalii*, *Chlorochroa pini-cola*, *Conostethus roseus*, *Metopoplax ditomoides* and *Temnostethus longirostris*. Species that obviously suffered significant losses, are *Heterocordylus leptocerus* and *Hoplomachus thunbergii*, and to a lesser degree *Peritrechus lundii*.

New arrivals

Since 1980, 27 species were discovered for the first time in the Netherlands (table 5). They can be classified as overlooked species, successful

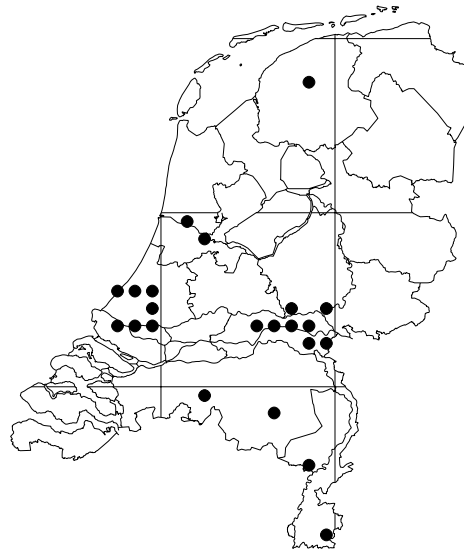


Figure 8
Dutch distribution of *Deraeocoris flavilinea* (recorded since 1985).



Figure 9
Metopoplax ditomoides. Photo E. Wachmann, Berlin.

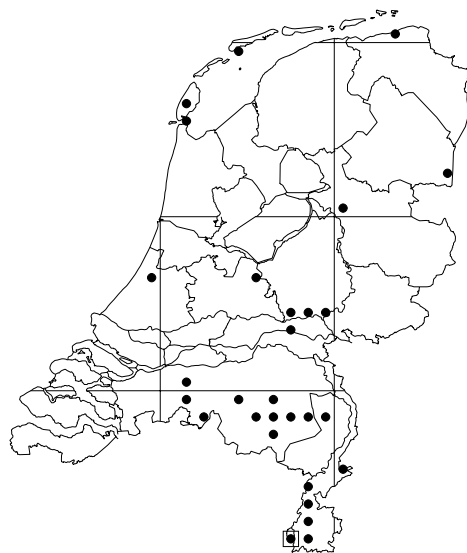


Figure 10
Dutch distribution of *Metopoplax ditomoides* before (squares) and since 1980 (dots).

incidental introductions related to international transport or trade in plant material (passive dispersal), or species extending their range in a natural way (active dispersal).

Kleidocerys privignis, *Phoenicocoris modestus*, *Psallus assimilis* and *P. pseudoplatani* represent clear cases of overlooked species. *Kleidocerys privignis* lives in wet biotopes and feeds on seeds of *Alnus glutinosa*, especially in the southern part of the country. *Phoenicocoris modestus* lives early in the season exclusively on *Pinus sylvestris* and may have been confused with the much more commoner *P. obscurellus* (Fallén, 1829). *Psallus assimilis* and *P. pseudoplatani* live monophagous on *Acer campestre* and *A. pseudoplatanus*, respectively. The first one is rare and only found in the southern part of the province of Limburg, but the second one is more common and found in a large part of the country, even in the north.

Closterotomus trivialis, *Dichroscytus gustavi*, *Orsillus depressus* and *Stephanitis takeyai* are examples of species introduced with plant material. The strictly Mediterranean *Closterotomus trivialis* only occurs on ornamental shrubs and trees in the city of The Hague. *Dichroscytus gustavi* thus far was only found on cultivated

Table 5

Heteroptera recorded from The Netherlands since 1980 only. A: natural pathway (active dispersal); O: overlooked; T: transport related pathway (passive dispersal). NN: number of 10 km squares, northern provinces (Friesland, Groningen and Drenthe); NW: ibid, western provinces (Noord-Holland, Zuid-Holland and Zeeland); NR: ibid, remaining 'continental' provinces.

Family/species	source	category	Year	NN	NW	NR
Corixidae (2)						
<i>Cymatia rogenhoferi</i> (Fieber, 1864)	Jansson 1995	A	>1991	-	-	3
<i>Micronecta griseola</i> Horváth, 1899	Aukema et al. 2000	A	>1999	3	-	4
Tingidae (1)						
<i>Stephanitis takeyai</i> Drake & Maa, 1955	Aukema 1996a	T	>1994	1	5	3
Miridae (11)						
<i>Brachyarthrum limitatum</i> Fieber, 1858	Aukema 1989	A	>1980	-	-	7
<i>Brachynotocoris puncticornis</i> Reuter, 1880	Aukema 1990a	A	>1989	-	1	7
<i>Closterotomus trivialis</i> (A. Costa, 1853)	Aukema 1999	T	>1998	-	1	-
<i>Conostethus venustus</i> (Fieber, 1858)	Aukema 1989	A	>1980	1	13	22
<i>Deraeocoris flavilinea</i> (A. Costa, 1862)	Aukema 1989	?	>1985	2	7	15
<i>Dichroscytus gustavi</i> Josifov, 1981	Aukema 1990b	T	>1990	-	1	4
<i>Phoenicocoris modestus</i> (Meyer-Dür, 1843)	Aukema 1990b	O	>1990	-	-	3
<i>Psallus assimilis</i> Stichel, 1956	Aukema 1989	O	>1985	-	-	3
<i>Psallus pseudoplatani</i> Reichling, 1984	Aukema 1989	O	>1985	2	4	6
<i>Psallus punctulatus</i> Puton, 1874	Aukema 1990b	A	>1990	-	-	2
<i>Reuteria marqueti</i> Puton, 1875	Aukema 1989	A	>1987	-	1	5
Aradidae (1)						
<i>Aradus signaticornis</i> R.F. Sahlberg, 1848	Aukema 1989	A	>1985	-	-	2
Lygaeidae (6)						
<i>Emblethis denticollis</i> Horváth, 1878	Aukema 1996b	A	>1992	-	4	3
<i>Holcocranum saturejae</i> (Kolenati, 1845)	unpublished 2002	?	2002	-	-	1
<i>Horvathiolus superbus</i> (Pollich, 1781)	unpublished 2000	A	2000	-	-	1
<i>Kleidocerys privignus</i> (Horváth, 1894)	Aukema 1989	O	>1982	-	3	16
<i>Nysius graminicola</i> (Kolenati, 1845)	Aukema 1992	A	>1990	-	1	-
<i>Orsillus depressus</i> (Mulsant & Rey, 1852)	Aukema 1989	T	>1986	1	3	6
Coreidae (1)						
<i>Cortiomeris scabricornis</i> (Panzer, 1809)	Aukema & Hermes 1992	A	>1987	-	-	7
Rhopalidae (1)						
<i>Rhopalus tigrinus</i> Schilling, 1829	Aukema 1993	A	>1992	5	2	10
Cydnidae (1)						
<i>Tritomegas sexmaculatus</i> (Rambur, 1839)	unpublished 2002	A	2002	-	1	-
Pentatomidae (3)						
<i>Eurydema ornata</i> (Linnaeus, 1758)	Aukema 1993	A	>1992	-	1	1
<i>Rhaphigaster nebulosa</i> (Poda, 1761)	unpublished 2001	A	>1997	-	-	1
<i>Stagonomus pusillus</i> (Herrich-Schaeffer, 1833)	unpublished 2000	A	>2000	-	-	3

Juniperus species in parks and gardens but not in natural *Juniperus* stands. *Orsillus depressus* is found mainly in parks and gardens on cultivated conifers like *Chamaecyparis* and *Thuja*, but since 2002 it was also found twice in natural *Juniperus* stands. *Stephanitis takeyai* was imported with its foodplant *Pieris japonica* from Japan and is spreading in private gardens.

Many of the other species have a more southern distribution in Europe and their arrival in the Netherlands is supposed to have resulted from

active dispersal, most likely stimulated by global warming. This assumption is supported by the fact that almost all recently arriving species (24 of 27) have been found in the 'continental' provinces (table 5). Besides, these provinces contain most of the total number of occupied squares by these species (135 of 198).

For some species, however, the pathway of their arrival is not clear at all. The predatory mirid *Deraeocoris flavilinea* (fig. 7), for instance, was considered an Italian endemic till the early 1980s,

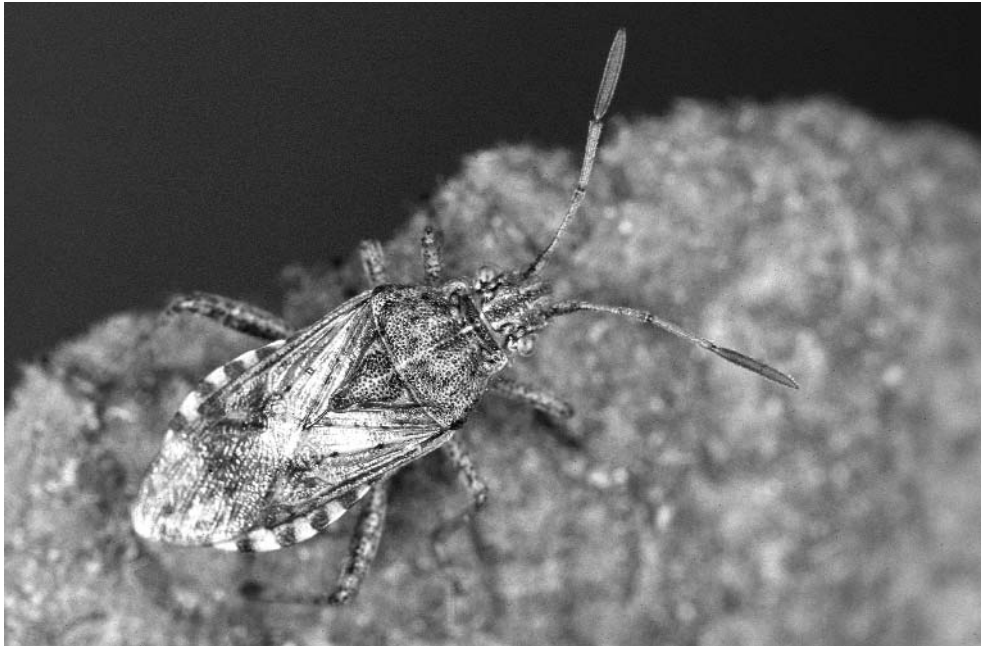


Figure 11
Stictopleurus punctatonervosus. Photo E. Wachmann, Berlin.

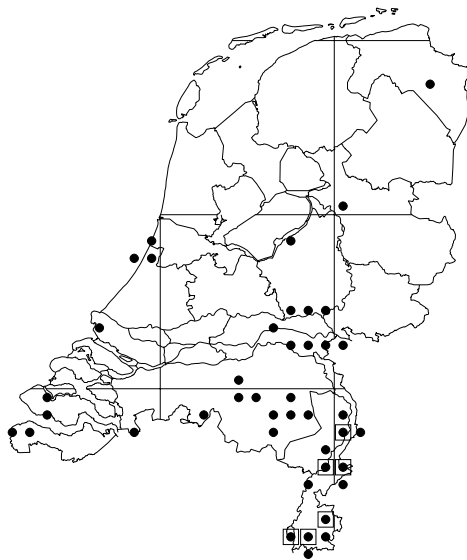


Figure 12
Dutch distribution of *Stictopleurus punctatonervosus*
before (squares) and since 1980 (dots).

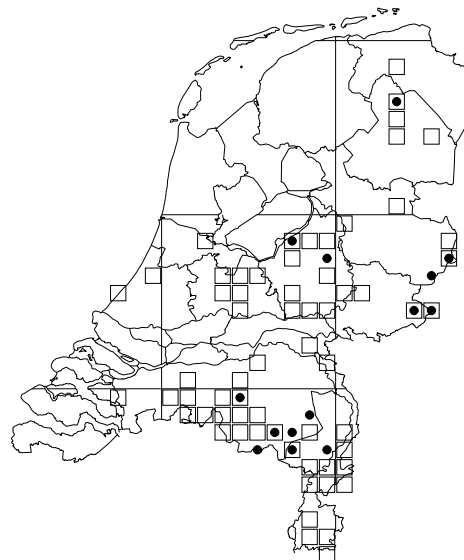


Figure 13
Dutch distribution of *Aquarius najas* before (squares)
and since 1980 (dots).

when it appeared in France and successively showed up in more West-European countries, including England. It may have spread by flight, but the possibility that it was transported at least partly as eggs inserted in plant tissue cannot be ruled out. In the Netherlands it was recorded for the first time in 1985 and now there are 62 records from 20 squares (fig. 8). The lygaeid *Holcocranum saturejae* has a South European/Mediterranean distribution and feeds on *Phragmites australis*. So it may have been transported with thatch imported for roofing of houses. The Mediterranean mirid *Conostethus venustus*, usually found on *Matricaria*, most likely arrived by active dispersal along the coasts of the Atlantic and the English Channel and colonised Central-Europe along the river valleys from the northwest (Aukema 1988). It was recorded for the first time in 1980 and at present it was recorded 98 times from 34 squares distributed over a large part of the country.

Collection material of *Copium clavicorne*, *Megalonatus emarginatus*, *Nysius cymoides* and *Rhyparochromus vulgaris*, although discovered after 1989 (table 1), has been overlooked, and consequently these species are not included as new arrivals.

Range changes of resident species

Since a quantitative approach of range changes was not appropriate because of differences in sampling intensity in time and place, only some illustrative examples are given.

Increasing ranges since 1980

Micronecta scholtzi (Fieber, 1860) was recorded 19 times before 1980 (ten squares) and 129 times since 1980 (93 squares) and spread to the north-east with new records in the provinces of Drenthe, Friesland and Overijssel and even reaching the West-Frisian island Ameland. One of the possible causes of the increase of both the number of records and its range may be the increase of suitable biotopes (larger water bodies) during the last decades as a result of sand or gravel extraction for construction purposes.

Metopoplax ditomoides (fig. 9) was recorded once in 1948 from the province of Limburg. It was rediscovered in the same province in 1994 and recorded 46 times (29 squares) since

(fig. 10). With the exception of Zeeland it reached all provinces and was even recorded from the West-Frisian islands Texel and Terschelling. *Stictopleurus abutilon* (Rossi, 1790) was recorded 45 times before 1980 (15 squares) in the central and southern part of the country. Since 1980 there are 82 records (35 squares) and the species extended its range towards the north with records in the provinces of Drenthe, Friesland and Groningen, also reaching the West-Frisian Islands Texel and Terschelling.

Stictopleurus punctatonervosus Goeze, 1778 (fig. 11) was known before 1980 only from the province of Limburg (24 records, seven squares). Since 1980 139 records (42 squares) were listed and a considerable extension of its range towards the west and the north was registered (fig. 12) with records in the provinces of Noord-Brabant, Zeeland, Zuid-Holland, Noord-Holland, Gelderland, Overijssel en Groningen.

Declining ranges since 1980

Aquarius najas (De Geer, 1773) was a rather common species of small rivers and springs before 1980 (fig. 13: 124 records, 64 squares). Since 1980 it decreased considerably with only 24 records (12 squares) remaining (fig. 13). It disappeared completely from the western and central part of the country and in the north one population remained. Water pollution and a low dispersal power (macropters are very rare in Dutch populations) are thought to be responsible for this drastic decline.

Discussion

The vast majority of the changes since 1980 in the Dutch Heteroptera fauna known to have occurred consists of new arrivals or increasing species. This picture does not stand alone since, interestingly, the same trend was observed in British Heteroptera by Kirby et al. (2001) and not surprisingly a fair number of the same species is involved. Examples of species showing similar patterns and listed by Kirby et al. as 'recently arrived, established and perhaps expanded in range' are *Deraeocoris flavilinea*, *Dichroscytus gustavi*, *Emblethis denticollis*, *Liorhyssus hyalinus*, *Metopoplax ditomoides*, *Nysius graminicola*, *Orsillus depressus*, *Stictopleurus abutilon* and *Stictopleurus punctatonervosus*. Not all Dutch

new arrivals have reached Great Britain yet, but some certainly will, and *Stephanitis takeyai* already has. As in the Netherlands in Great Britain the number of new arrivals associated with introduced plants is relatively small: apart from *S. takeyai* only three species are listed by Kirby et al. (2001), of which only *Orsillus depresses* was added to the Dutch fauna as well.

The number of 27 species 'rediscovered' since 1980 after having not been recorded between at least 1960 and 1980 is rather large and shows that one has to be very careful using terms like 'extinct' or 'new arrival'. In a group like Heteroptera, with only a few active collectors at a time, species may be overlooked and thus remain 'rare' or 'obscure', especially when their habitat or foodplants are not or badly known. Good examples are *Acetropis gimmerthalii* and *Conostethus roseus*. *A. gimmerthalii* was collected only once in or before 1878 till its rediscovery in 1989, when it became clear that it lives early in the season exclusively on *Anthoxanthum odoratum*. Since then the species was taken at many localities (table 5). *Conostethus roseus* was collected twice in 1882 or earlier before its rediscovery on *Corynephorus canescens* on blowing sands and other sandy habitats in 1981, where it appeared to be not rare early in the season (table 5).

Conclusions

Since 1960, 571 (93.6%) of the Dutch Heteroptera species were recorded and 517 of them were recorded between 1960 and 1980. Since 1980, seven species were not recorded, 27 species were rediscovered and 27 new species were recorded. Consequently, the turnover of the Dutch Heteroptera fauna since 1980 can be estimated as 10.7% (61 out of 571 species). Moreover, the new arrivals (27) outnumber the extinctions (seven) by far. The possible causes of this turnover are not clear in all cases, but habitat changes, international trade and global warming are considered to be major causes. Turnover on a local scale, however, has to be considered a natural process as well, resulting from local extinctions and (re)colonisations.

Concerning changes in occurrences of resident species there is a need for better methods eliminating the influence of differences in collecting effort in time and space.

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B. Aukema
Plantenziektenkundige Dienst, Sectie Entomologie
Postbus 9102
6700 HC Wageningen
The Netherlands
b.aukema@pd.agro.nl