Urban Biodiversity: Successes and Challenges: Glasgow's water beetles

Garth N. Foster

The Aquatic Coleoptera Conservation Trust, 3 Eglinton Terrace, Ayr KA7 1JJ

E-mail: latissimus@btinternet.com

INTRODUCTION

Water beetles are a well-recorded freshwater group in Britain despite lacking the charisma of dragonflies and the angling interest of mayflies and the like. The conference on urban biodiversity held by the Glasgow Natural History Society in October 2010 provided the stimulus to assess their status in the area.

Water beetles cannot be precisely excised from beetles as a whole. Coleoptera are divided into two major groups, the Adephaga and the Polyphaga. Within the Adephaga the name "Hydradephaga" has been coined to distinguish diving beetles and related species from the ground beetles in the Carabidae. This works fairly well so long as one ignores the fact that many ground beetles are confined to aquatic emergent vegetation or to the water's edge. The Polyphaga are more difficult, with even the major family the Hydrophilidae including some species mainly living in dung, often a wet habitat but not one usually worked with the pond net! The problem is acute for the leaf beetles (Chrysomelidae) and weevils (Curculionidae and Erirhinidae) that live on wetland plants, as sometimes the host range is quite diverse and may even include trees! The acid test applied here is whether the beetles are more likely to be encountered in the pond net wielded by an aquatic coleopterist than in a sweep net swung by a dry-shod coleopterist.

This paper is in two parts, an assessment of the records available from the national recording scheme and a description of a survey of sites in and around Glasgow in 2010.

RECORDING AROUND GLASGOW UP TO 2010

Information was extracted from the national recording data-base for the twenty 10 km squares NS44 in the south-west corner to NS87 in the north-east. This generated 1,644 records of 141 species, the majority from the vice-county of Lanarkshire, with small contributions from the vice-counties of Ayrshire, Renfrewshire, Dunbartonshire, and Stirlingshire. These beetles belong to fifteen families, dominated by the diving beetles in the Dytiscidae (Table 1).

Although 24 species have not been recorded in the area since 1979, 16 were last recorded in the 1980s. Eleven of the latter are typically associated with running water, leaving only another eleven running water species in the list of 101 species recorded from 1990 onwards. However several water beetles specialising in pond habitats have become established in the Glasgow area over a similar period.

The following examples of some species in decline and some on the increase serve to illustrate the range of habitats that can be occupied.

***Noterus clavicornis* (De Geer)** This species is usually referred to as "The Large *Noterus*" because the name *clavicornis* has also been applied to the smaller, flightless *N. crassicornis* (Müller), which is very rare in Scotland. The earliest Scottish record is a little uncertain but by 1946 *N. clavicornis* was in the garden of the greatest proponent of water beetles, Frank Balfour-Browne, in Dumfriesshire and it was first found in Kirkcudbrightshire in 1949. Roy Crowson (1987) reported it in the Glasgow area in Possil Loch in 1985, the same year that the author found it for the first time in Ayrshire. Subsequently it has spread over more of western mainland Scotland (an early record from Raasay was spurious) and was in 2010 found for the first time in the Borders in a well-recorded site in Roxburghshire. The noterine diving beetles differ from the dytiscid ones mainly in that their wireworm-like larvae live attached to roots and rhizomes of flote-grasses and bogbean, renewing their air supply through their posterior spiracles from aerenchymatous plant tissue, whereas the dytiscids live freely. Consequently noterids are typical of vegetation rafts though *N. clavicornis* can be common among vegetation in ordinary ponds, including in 2010 Durrockstock, Gartcosh, one of the M77 balancing lagoons at the Mearns Box, the Phoenix Industrial Estate, and Robroyston.

***Agabus congener* (Thunberg)** This is a scarce dytiscid diving beetle typically found in small hard-bottomed pools on peat. It persists in the Glasgow area on Lenzie Moss having first been reported in the Glasgow area in Robroyston Bog by the Reverend Hislop (1854).

***Rhantus suturalis* (Macleay)** The name "supertramp" has been used for this species (Balke *et al*. 2009) respecting its remarkable range, from Ireland to New Zealand. Its ancestry, based on mitochondrial DNA, indicates that about 1.5 million years ago it was an endemic of New Guinea mountains. Now it can be found in a great range of still water habitats north to Caithness. One specimen was found in a newly created pond at Cardowan in 2010: the only earlier record, and

there is potential confusion over the names it has received, is from the 19th Century (Young 1856).

***Hydroporus ferrugineus* Stephens** A major centre of biodiversity for water beetles is part of the Australian outback where each isolated pocket of subterranean water has it own endemic diving beetle species (e.g. Watts & Humphreys 2009). The northern European fauna is more restricted with only *H. ferrugineus* being truly subterranean though, unlike many subterranean species, it retains eyes. The larva, which is unusually pale, was described from the Speedwell Cavern by Alarie *et al*. (2001). *H. ferrugineus* is often found in wells and can occasionally be pumped to the surface (Young 1980). Professor Crowson's collection, in the Hunterian Museum, has a specimen of *H. ferrugineus* found by Mr H.D. Slack at 384, West George Street, Glasgow in December 1957. This address no longer exists, most likely lost beneath the motorway, but the possibility remains that this species survives in spring systems among the Glaswegian drumlins.

***Hygrotus nigrolineatus* (von Steven)** This beetle was first found in Britain in a pit used for gravel extraction in East Kent in 1983 by Ron Carr (1984). It subsequently spread through England as far north as Northumberland by 2004. A single specimen was taken by Craig Macadam in his Glasgow pond survey in May 2010 in a recently excavated pond at Robroyston (NS629683) (Macadam & Foster 2010). This beetle lives on an exposed substratum and cannot tolerate the presence of vegetation.

***Helophorus tuberculatus* Gyllenhal** This rare species is 3 mm and black, resembling a fragment of charcoal (Angus 1992). It lives on wet moorland that has been burnt, its principal population in Britain being on the North Yorkshire Moors, where the heather is managed by burning. Specimens dated from 1910 to 1915, from Drumpellier, Coatbridge, can be found in many entomological collections throughout Britain. These were mainly supplied by W.J. M'Leod, who, according to Balfour-Browne (1958), visited the site along with the original discoverer, G.A. Brown, and Anderson Fergusson in 1911. The near extinction of this species might be related to the loss of steam power, which would have ensured frequent burning of moorland neighbouring railways.

***Macroplea appendiculata* (Panzer)** Most reed beetles have showy adults living above the water on emergent vegetation, in particular reeds and bur-reeds: their larvae, like those of the Noterus, depend on aerenchyma of aquatic plants for their air supply. Members of the genus *Macroplea* are amongst the most aquatic of all beetles, living below the water in all stages of the life-cycle unlike the majority of beetles, which pupate out of the water. The sole record of *M. appendiculata* stems from another specimen in Professor Crowson's collection, taken by his wife Betty in Loch Libo, Renfrewshire on 29 April 1967. *M. appendiculata* has as its host plants alternate water-milfoil (*Myriophyllum alterniflorum*) and fennel pondweed (*Potamogeton pectinatus*). According to Monahan and Caffrey (1996), working in Irish canals, this species prefers fennel pondweed when both potential hosts are available. Further attempts to find the *Macroplea* in Loch Libo have been unsuccessful, and the fennel pondweed, which was plentiful up to 2004, could not be found in 2008, possibly because of eutrophication. *Macroplea* appears to have been lost from Milton Loch, Kirkcudbrightshire, where it was abundant in 1996, and Loch Leven, Fife, where it was found in 1933: these lochs have suffered from algal blooms that would have destroyed suitable host plants.

***Erirhinus aethiops* (Fab.)** This is a relatively large (5-7 mm long) black and shining weevil that looks as if it may have fallen in the water by accident when caught in the pond net. It lives on bur-reed (*Sparganium erectum*) and some sedges. Morris (2002) noted that it is usually rare and found north from north-east Yorkshire, though not in northern Scotland or on any of the islands. Pitfall trapping on exposed riverine sediment has established its presence in Wester Ross, Morayshire and East Inverness-shire (Eyre *et al*. 2000). Crowson (1971) recorded it from Loch Libo, where the author found it again on 31 May 2008.

THE 2010 SURVEY

The author's 2010 survey of ponds and similar habitats covered 37 sites generating 426 records of 76 species (Table 2), adding six species to the overall list. In Table 1 the other two species recorded in 2010 were from Craig Macadam's survey, *Hygrotus nigrolineatus*, described above, and *Haliplus fulvus*.

Apart from the *Hygrotus nigrolineatus* two other species are rated as Nationally Scarce on a GB-wide basis in a recent analysis (Foster 2010). *Rhantus frontalis*, represented by one specimen at Cardowan, is known in Scotland elsewhere from Angus in 1933, Ayrshire, most recently in 1911, Fife, most recently in 1961, Stirling and West Perthshire in the 19th Century, West Lothian in 1985, and since 2005 along the Solway coast. Earlier records for the vice-county of Lanarkshire are by Magnus Sinclair and the author from Carstairs Kames (NS957472) on 8 April 1977 and by the author from Coalburn (NS8035) on 25 May 1981. The Kames provided a more typical habitat for this species, sparsely vegetated water over sand, than the new Glasgow site in a shaded tussock fen. This species overwinters out of the water (Galewski 1963) and probably flies to seek ponds suitable for breeding in the spring. The other Nationally Scarce species, *Helophorus granularis*, was common in the marsh where *R. frontalis* occurred. This is a species of "vernal swamps" (see Balfour-Browne 1958) and occurs, scattered across the British Isles, in the micropterous form *ytenensis* Sharp, the wings of which are reduced in size but possibly not entirely incapable of flight.

On the basis of these GB-nationally Scarce species the marsh at Cardowan rates as the site with the greatest conservation status in the survey. A system that assesses conservation quality of the basis of all species present was developed by Foster & Eyre (1992). It was based on counts of ten km square records converted to

scores in a geometric series from1 for the commonest species, then 2, 4, 8…etc. up to the rarest species. The scores for southern Scotland used by Foster & Eyre (1992) are out-of-date, being based on considerably less records than are currently available and on a more limited suite of species than is currently recorded. New scores were developed (Table 2) based on counts of each species in the twenty 10 km squares of the search area used for Glasgow as available in the national recording scheme data-base, supplemented by records from the Chrysomelidae atlas (Cox 2007). These counts were used to assign each species a score from 1 to 5 on an arithmetic scale (1, 2, 4, 8, 16 if geometric) that then could be used to produce an aggregate quality score and a mean quality score for each site. The mean score should be more reliable than the aggregate score or the total number of species as it reduces the impact of variable recording effort.

Sites in Table 2 are ranked in order of the mean quality score. Bingham's Pond, beside the Pond Hotel on the Great Western Road, scores highest. This site, a typical Victorian Park pond with hard edges and many water fowl, has been improved by planting vegetation from Frankfield Loch and other Glaswegian sites (pers. comm. Sheila Russell). These plantings may have contributed the reed beetles that have raised the site's score. The second highest site is one of the few areas of seepage encountered, in this case the outflow of a balancing lagoon of the M77 at St. Martin's. The site with the greatest number of species, a pool behind the Phoenix Industrial Estate near to Glasgow Airport, scored third highest. This pool would appear to man-made in that it is formed by subsidence. Even the lowest scoring site, a peat ditch on Lenzie Moss, has one species of interest, *Hydroporus tristis*, but this and the other species present are characteristic of acid water that is still common around Glasgow.

DISCUSSION

There are many species of water beetle in and around Glasgow, their habitat range is diverse, and some species are in decline if not locally extinct whilst others are increasing. Declining species are associated mainly with peat, with running water and with exposed lake shores.

Pond species are generally doing well and do not require further conservation activity except that pond creation generates public interest and stewardship. The instant gratification of building a new pond cannot be denied! However, conservation activists are urged to avoid damage to existing temporary marsh systems in this process as many beetles require both vegetation cover and the periodic drought to eliminate predatory fish. Moving vegetation locally to soften the hard edge of a typical park pond has proved effective at Bingham's Pond, introducing host plants for showy beetles and providing marginal refugia for others.

Peatlands still exist in quantity around Glasgow despite the industrialisation and urbanisation of the area. The species dependent on a peat substratum will be the next to disappear unless the loss of peat is halted, preferably by flooding - so there is still scope for large scale pond creation. Land developments such as out-of-town shopping malls and golf courses, and the tidying up of brownfield sites just for the sake of tidying up could cause more damage than the industries from which the city grew.

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	Last record	No. 10 km squares	Quality score
Suborder Adephaga			
GYRINIDAE			
Gyrinus aeratus Stephens	2008	1	5
Gyrinus caspius Ménétriés	1913	2	4
Gyrinus marinus Gyllenhal	1915	3	4
Gyrinus minutus Fab.	1976	3	4
Gyrinus substriatus Stephens	2010	13	2
Orectochilus villosus (Müller)	1987	3	4
HALIPLIDAE			
Brychius elevatus (Panzer)	1910	3	4
Haliplus confinis Stephens	2010	7	3
Haliplus flavicollis Sturm	2010	7	3
Haliplus fluviatilis Aubé	1983	6	3
Haliplus fulvus (Fab.)	2010	11	2
Haliplus immaculatus Gerhardt	2010	6	3
Haliplus lineatocollis (Marsham)	2010	13	2
Haliplus lineolatus Mannerheim	2004	9	2
Haliplus obliquus (Fab.)	2010	1	5
Haliplus ruficollis (De Geer)	2010	14	2
Haliplus sibiricus Motschulsky	2010	14	2
NOTERIDAE			
Noterus clavicornis (De Geer)	2010	6	3
DYTISCIDAE			
Agabus affinis (Paykull)	2010	7	3
Agabus arcticus (Paykull)	1976	6	3
Agabus biguttatus (Olivier)	1932	5	3
Agabus bipustulatus (L.)	2010	19	1
Agabus congener (Thunberg)	2010	6	3
Agabus guttatus (Paykull)	1989	8	2
Agabus labiatus (Brahm)	1910	3	4
Agabus nebulosus (Forster)	2010	7	3
Agabus paludosus (Fab.)	2010	8	2
Agabus sturmii (Gyllenhal)	2010	15	2
Agabus unguicularis (Thomson)	2010	6	3
Ilybius aenescens Thomson	1974	2	4
Ilybius ater (De Geer)	2010	9	2
Ilybius fuliginosus (Fab.)	2010	15	2
Ilybius guttiger (Gyllenhal)	2010	5	3
Ilybius montanus (Stephens)	2010	6	3
Platambus maculatus (L.)	2008	9	2
Colymbetes fuscus (L.)	2010	13	2
Rhantus exsoletus (Forster)	2010	12	2
Rhantus frontalis (Marsham)	2010	2	4
Rhantus suturalis (Macleay)	2010	2	4
Rhantus suturellus (Harris)	1976	4	3
Acilius canaliculatus (Nicolai)	1992	5	3
Acilius sulcatus (L.)	2010	6	3
Dytiscus marginalis L.	2010	10	2
Dytiscus semisulcatus Müller	2000	8	2
Graptodytes pictus (Fab.)	1980	3	4
Hydroporus angustatus Sturm	2010	11	2
Hydroporus discretus Fairmaire	2010	7	3
Hydroporus erythrocephalus (L.)	2010	12	2
Hydroporus ferrugineus Stephens	1957	4	3
Hydroporus gyllenhalii Schiödte	2010	18	1
Hydroporus incognitus Sharp	2010	13	2
Hydroporus longicornis Sharp	1990	4	3
Hydroporus melanarius Sturm	1998	5	3
Hydroporus memnonius Nicolai	2010	13	2
Hydroporus morio Aubé	1989	7	3

Hydroporus nigrita (Fab.)	2010	12	2
Hydroporus obscurus Sturm	2010	6	3
Hydroporus obsoletus Aubé	1968	1	5
Hydroporus palustris (L.)	2010	17	1
Hydroporus planus (Fab.)	2010	13	2
Hydroporus pubescens (Gyllenhal)	2010	19	1
Hydroporus rufifrons (Müller)	1853	1	5
Hydroporus striola (Gyllenhal)	2010	13	2
Hydroporus tessellatus Drapiez	2000	1	5
Hydroporus tristis (Paykull)	2010	11	2
Hydroporus umbrosus (Gyllenhal)	2010	12	2
Nebrioporus assimilis (Paykull)	2004	11	2
Nebrioporus elegans (Panzer)	2004	12	2
Oreodytes davisii (Curtis)	1974	4	3
Oreodytes sanmarkii (Sahlberg)	2008	9	2
Oreodytes septentrionalis (Gyllenhal)	1987	9	2
Stictonectes lepidus (Olivier)	1910	2	4
Stictotarsus duodecimpustulatus (Fab.)	1984	10	2
Hygrotus confluens (Fab.)	1999	4	3
Hygrotus impressopunctatus (Schaller)	2010	4	3
Hygrotus inaequalis (Fab.)	2010	14	2
Hygrotus nigrolineatus (von Steven)	2010	1	5
Hygrotus novemlineatus (Stephens)	1911	2	4
Hyphydrus ovatus (L.)	2010	6	3
Laccophilus minutus (L.)	2010	5	3
Suborder Polyphaga			
HELOPHORIDAE			
Helophorus aequalis Thomson	2010	13	2
Helophorus arvernicus Mulsant	2008	4	3
Helophorus brevipalpis Bedel	2010	16	1
Helophorus flavipes Fab.	2010	13	2
Helophorus grandis Illiger	2010	11	2
Helophorus granularis (L.)	2010	3	4
Helophorus griseus Herbst	2010	1	5
Helophorus minutus Fab.	2010	9	2
Helophorus obscurus Mulsant	2010	8	2
Helophorus tuberculatus Gyllenhal	1915	1	5
HYDROCHIDAE			
Hydrochus brevis (Herbst)	1853	1	5
HYDROPHILIDAE			
Hydrophilinae			
Anacaena globulus (Paykull)	2010	19	1
Anacaena lutescens (Stephens)	2010	7	3
Chaetarthria seminulum s. lat.	1987	2	4
Enochrus coarctatus (Gredler)	2010	2	4
Hydrobius fuscipes (L.)	2010	15	2
Laccobius bipunctatus (Fab.)	2010	13	2
Laccobius colon (Stephens)	2010	3	4
Laccobius minutus (L.)	2010	4	3
Laccobius striatulus (Fab.)	1983	2	4
Sphaeridiinae			
Coelostoma orbiculare (Fab.)	1989	5	3
Cercyon marinus Thomson	2010	3	4
Cercyon ustulatus (Preyssler)	1985	1	5
HYDRAENIDAE			
Hydraena britteni Joy	2000	3	4
Hydraena gracilis Germar	2008	2	4
Hydraena nigrita Germar	1983	1	5
Hydraena riparia Kugelann	2010	13	2
Limnebius nitidus (Marsham)	1919	1	5
Limnebius truncatellus (Thunberg)	2010	14	2
Enicocerus exsculptus (Germar)	1987	3	4

Ochthebius dilatatus Stephens	2010	2	4
Ochthebius minimus (Fab.)	2010	2	4
SCIRTIDAE			
Microcara testacea (L.)	1999	1	5
Cyphon hilaris Nyholm	1999	1	5
Cyphon padi (L.)	2000	1	5
Cyphon variabilis (Thunberg)	2010	4	3
ELMIDAE			
Elmis aenea (Müller)	2008	5	3
Esolus parallelepipedus (Müller)	1987	2	4
Limnius volckmari (Panzer)	1990	5	3
Oulimnius tuberculatus (Müller)	1987	4	3
Riolus cupreus (Müller)	1987	2	4
Riolus subviolaceus (Müller)	2008	1	5
HETEROCERIDAE			
Heterocerus marginatus (Fab.)	1853	1	5
COCCINELLIDAE			
Coccidula rufa (Herbst)	2010	2	4
CHRYSOMELIDAE			
Plateumaris discolor (Panzer)	2010	4	3
Plateumaris sericea (L.)	2010	2	4
Donacia obscura Gyllenhal	1979	1	5
Donacia simplex Fab.	2010	1	5
Donacia versicolorea (Brahm).	1992	2	4
Donacia vulgaris Zschach	2010	2	4
Macroplea appendiculata (Panzer)	1967	1	5
Galerucella nymphaeae (L.)	2010	4	3
Hydrothassa marginella (L.)	2010	2	4
Phaedon armoraciae (L.)	2010	2	4
Phaedon cochleariae (Fab.)	2010	1	5
Prasocuris phellandrii (L.)	2010	5	3
CURCULIONIDAE			
Phytobius leucogaster (Marsham)	1994	2	4
Bagous alismatis (Marsham)	1900	2	4
ERIRHINIDAE			
Erirhinus aethiops (Fab.)	2008	2	4
*Notaris acridulus (*L.)	1901	4	3
Grypus equiseti (Fab.)	1901	1	5

Table 1. Water beetles recorded in and around Glasgow.

National grid reference	Site	VC	Date	No. spp.	AQS	MQS	Noteworthy spp.
NS55436811	Bingham's Pond	99	5 June	15	42	2.8	*Haliplus confinis, Donacia simple, D. vulgaris*
NS50495149	M77 Mearns box	76	12 May	5	13	2.6	*Hydrothassa marginella*
NS45286466	Phoenix Industrial Estate	76	24 April	24	61	2.5	*Phaedon cochleariae*
NS64857181	Lenzie Moss 2	99	10 April	10	24	2.4	*Agabus congener*
NS6720672	Gartloch Pool	77	5 June	17	40	2.4	*Haliplus confinis, Cercyon marinus*
NS707684	Gartcosh 4	77	20 March	15	35	2.3	*Acilius sulcatus, Agabus unguicularis*
NS651673	Cardowan 1	77	27 March	19	43	2.3	*Rhantus suturalis*
NS70576838	Gartcosh 6	77	5 April	15	34	2.3	*Haliplus confinis, H. obliquus*
NS4566160	Durrockstock pond	76	1 May	6	14	2.3	
NS654674	Cardowan 2	77	27 March	16	35	2.2	*Rhantus frontalis, Helophorus granularis*
NS55336220	Pollok Country Park, marsh	77	4 May	5	11	2.2	
NS62806838	Robroyston Park 2	77	17 July	17	38	2.2	*Phaedon armoraciae*
NS62776805	Robroyston Park 1	77	10 April	15	32	2.1	
NS50495147	M77 Mearns box	76	12 May	19	40	2.1	*Ilybius guttiger, Phaedon armoraciae*
NS707684	Gartcosh 3	77	20 March	12	24	2.0	*Hydroporus tristis*
NS653674	Cardowan 3	77	27 March	8	16	2.0	
NS52775930	Darnley Mill	76	1 May	12	24	2.0	
NS60576568	Cathkin Marsh 2	77	1 May	6	12	2.0	
NS60325791	Cathkin Marsh 3	77	1 May	16	32	2.0	
NS707685	Gartcosh 5	77	20 March	17	33	1.9	*Enochrus coarctatus*
NS43926568	Linwood Moss 2	76	24 April	14	27	1.9	*Ilybius guttiger*
NS51725274	M77 Mearns box	76	12 May	17	33	1.9	
NS705682	Gartcosh 1	77	20 March	13	24	1.8	
NS706687	Gartcosh 2	77	20 March	8	14	1.8	*Ochthebius dilatatus*
NS52195380	M77 Junction 5	76	12 May	14	25	1.8	
NS54795411	Titwood	76	12 May	12	21	1.8	
NS603722	Wilderness Plantation 1	99	5 April	3	5	1.7	
NS63466936	Robroyston Road	77	10 April	11	19	1.7	
NS55336220	Pollok Country Park, The Glade	77	4 May	3	5	1.7	
NS52225375	M77 Junction 5	76	12 May	11	19	1.7	
NS54565429	Titwood	76	12 May	7	12	1.7	
NS43656600	Linwood Moss 1	76	24 April	16	26	1.6	
NS55336220	Pollok Country Park, main pond	77	4 May	7	11	1.6	
NS601721	Wilderness Plantation 3	99	5 April	5	8	1.6	
NS60576568	Cathkin Marsh 1	77	1 May	4	6	1.5	
NS602721	Wilderness Plantation 2	99	5 April	2	3	1.5	
NS64787171	Lenzie Moss 1	99	10 April	6	8	1.3	*Hydroporus tristis*

Table 2. Summary of the 2010 survey. The vice-counties (vc) are 76 Renfrewshire, 77 Lanarkshire, and 99 Dunbartonshire. AQS is the aggregate quality score, i.e. the sum of all the species quality scores. MQS is the mean quality score, the average quality score value per species.

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