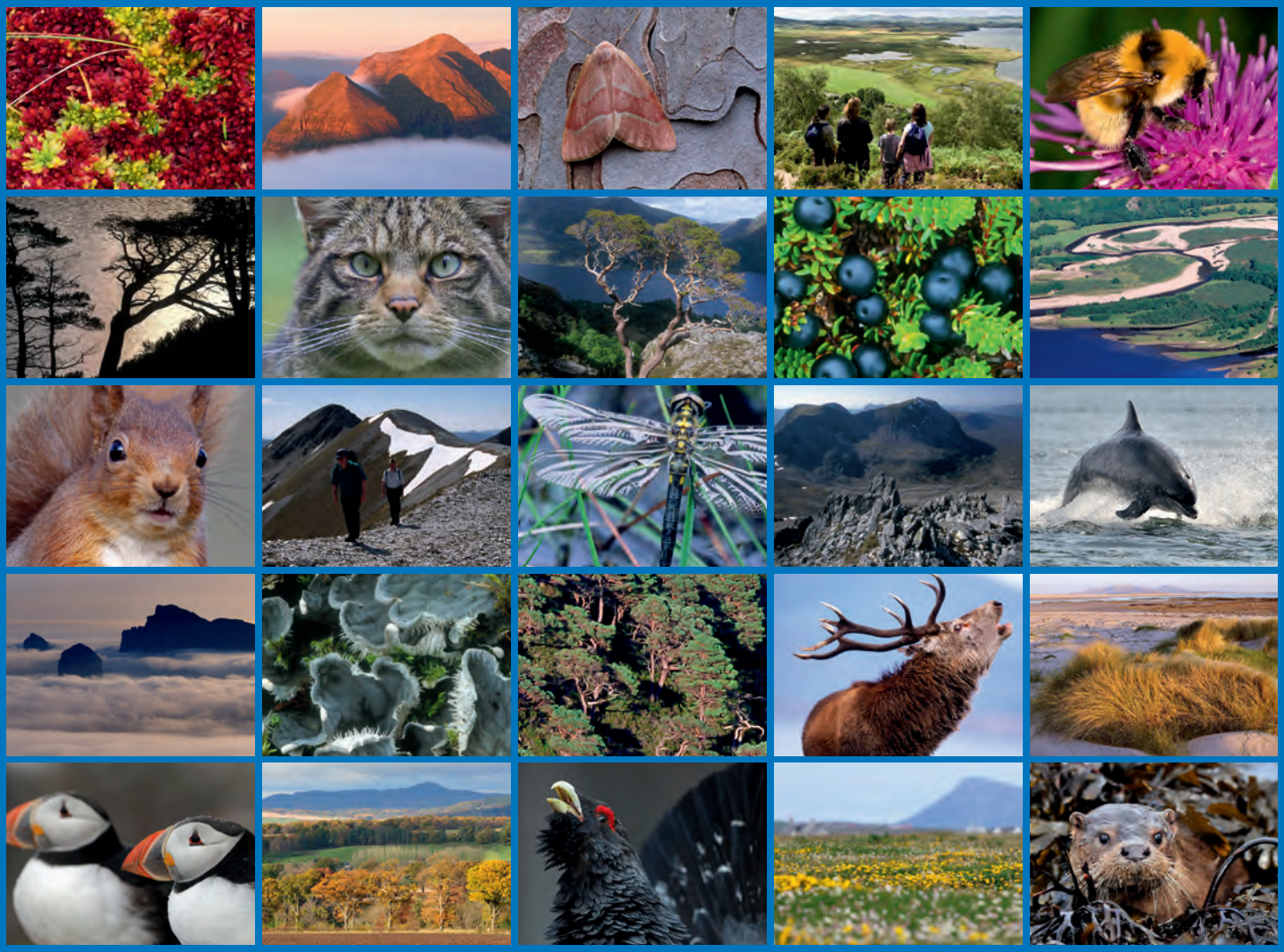
Scottish Natural Heritage
Commissioned Report No. 677

CSM monitoring of designated aquatic invertebrate features at Woodhall Loch, Buckstruther Moss, Firth of Forth, Lochs of Harray & Stenness and Rannoch Moor SSSIs



Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad

COMMISSIONED REPORT

Commissioned Report No. 677

CSM monitoring of designated aquatic invertebrate features at Woodhall Loch, Buckstruther Moss, Firth of Forth, Lochs of Harray & Stenness and Rannoch Moor SSSIs

For further information on this report please contact:

Athayde Tonhasca
Scottish Natural Heritage
Redgorton
PERTH
PH1 3EW
Telephone: 01738 458671
E-mail: athayde.tonhasca@snh.gov.uk

This report should be quoted as:

Knight, L.R.F.D. 2014. CSM monitoring of designated aquatic invertebrate features at Woodhall Loch, Buckstruther Moss, Firth of Forth, Lochs of Harray & Stenness and Rannoch Moor SSSIs. *Scottish Natural Heritage Commissioned Report No. 677.*

COMMISSIONED REPORT

Summary

CSM monitoring of designated aquatic invertebrate features at Woodhall Loch, Buckstruther Moss, Firth of Forth, Lochs of Harray & Stenness and Rannoch Moor SSSIs

Commissioned Report No.: 677
Project no: 1576
Contractor: L.R.F.D. Knight
Year of publication: 2014

Background

This survey was carried out from late May to early June 2013 to assess the following aquatic invertebrate features: Woodhall Loch: the caddisfly *Anabolia brevipennis;* Buckstruther Moss: the aquatic beetle assemblage, especially *Donacia aquatica* and *Acilius canaliculatus*; Firth of Forth: aquatic beetle assemblage, especially *Hydraena pulchella* and *Dryops nitidulus*; Lochs of Harray and Stenness: the caddisfly *Ylodes reuteri* and the freshwater nerite snail (*Theodoxus fluviatilis*); Rannoch Moor: the aquatic beetle assemblage.

Each SSSI was visited for a single day with sampling conducted at a minimum of four locations. In addition to the targeted features other aquatic invertebrate taxa incidentally captured during the surveys were also recorded.

Main findings

Woodhall Loch: A single *A. brevipennis* larva was recorded at a site within the fen complex at the southern end of the loch where suitable habitat was present in abundance. Assessment: **favourable-maintained**.

Buckstruther Moss: *A. canaliculatus* was recorded at two sites. *Donacia aquatica* was not recorded and may no longer be present. Overall the aquatic beetle assemblage was considered in **favourable-maintained** condition.

Firth of Forth: *D. nitidulus* and *H. pulchella* were not recorded but overall the aquatic beetle assemblage was in **favourable-maintained** condition.

Lochs of Harray and Stenness: *Theodoxus* was found and this feature was thus in **favourable-maintained** condition. *Ylodes reuteri* larvae were not recorded. It is difficult to assess whether the species is no longer present on the basis of a single survey but it would appear that this feature is now in **unfavourable-declining** condition. *Nebrioporus depressus* and *Hygrotus novemlineatus* were recorded.

Rannoch Moor: The diversity and condition of the water beetle habitats visited appeared to be in good condition, suggesting that the assemblage is in **favourable-maintained** condition.

For further information on this project contact:
Athayde Tonhasca, Scottish Natural Heritage, Battleby, Perth, PH1 3EW.
Tel: 01738 458671 or athayde.tonhasca@snh.gov.uk
For further information on the SNH Research & Technical Support Programme contact:
Knowledge & Information Unit, Scottish Natural Heritage, Great Glen House, Inverness, IV3 8NW.
Tel: 01463 725000 or research@snh.gov.uk

Table of Contents **Page**

Acknowledgements

Thanks are due Athayde Tonhasca and Brian Eardley for setting up the contract and enabling the contractor to work at some beautiful locations. Thanks to the various SNH regional staff that negotiated access to the SSSIs with local landowners and who provided data from previous surveys. These include: Denise Exton, Carol Jones, Elspeth Christie, Kate Thompson and Martin Faulkner. Thanks also to John Harrison the warden at Aberlady Bay Local Nature Reserve and to Katty Baird a local volunteer for supplying the map of the reserve and records of *Dryops* respectively.

Thanks to Ian Wallace (Trichoptera recording scheme) and to Garth Foster (aquatic Coleoptera recording scheme) for supplying details of historic records and many useful comments and advice.

1. INTRODUCTION

As part of its remit, Scottish Natural Heritage (SNH) is required to carry out a programme of Site Condition Monitoring (SCM) on the Sites of Special Scientific Interest (SSSIs) and Special Areas of Conservation (SACs). These sites are designated on the basis of notified features such as particular geological formations, habitats, vegetation types or species. CSM is a six year rolling programme of assessment, against quality standards, of the state of notified features.

This project was undertaken to monitor the condition of specific invertebrate features at five SSSIs across Scotland, summarised below:

1. Woodhall Loch: the caddisfly *Anabolia brevipennis* (formerly *Phacopteryx brevipennis*).
2. Buckstruther Moss: the aquatic beetle assemblage, especially *Donacia aquatica* and *Acilius canaliculatus.*
3. Firth of Forth: the aquatic beetle assemblage, especially *Hydraena pulchella* and *Dryops nitidulus.*
4. Lochs of Harray and Stenness: the caddisfly *Ylodes reuteri* and the freshwater nerite snail (*Theodoxus fluviatilis*).
5. Rannoch Moor: the aquatic beetle assemblage.

The aim of the project was to evaluate the condition of the invertebrate features, provide data to SNH to enable it to report on the features and provide site management recommendations, especially for any sites and features that may be found to be in unfavourable condition.

2. METHODS

The various aquatic invertebrate features and assemblages were sampled according to the pond netting protocol (Drake *et al.,* 2007). This involves three 1-min periods of net sampling at a site, followed by 30 min of sorting in the field.

The netting was carried out with a FBA pattern pond net, fitted with a 1 mm mesh collecting bag. The method involved a combination of kick sampling on hard substrates, sweeping through marginal and submerged vegetation and under overhanging (undercut) banks, and 'puddling' of soft sediments then sweeping through the resultant plume. After each 1 min session of net sampling, the contents of the net were emptied into a white tray and sorted in the field for 10 min. Net sampling was accompanied by manual investigation of submerged coarse woody debris and larger stones for Trichoptera cases and other attached organisms (e.g. *T. fluviatilis*) and searches for surface-dwelling animals (e.g. water cricket *Velia caprai*), for 1 min at each site. Thus sampling at each site involved 3 min of net sampling, 1 min search and 30 min of field sorting.

Manual searching during the sampling is not detailed by Drake *et al.* (2007), but is widely used in various other freshwater methodologies. It is also comparable with the standard sampling protocol used by the Environment Agency (EA) (Murray-Bligh, 1999) and Scottish Environment Protection Agency (SEPA) for sampling lotic watercourses.

Site locations and methods particular to each SSSI are detailed in the individual SSSI dossiers in the report. Acidity and conductivity were recorded at each site with a Hanna Instruments 9812-5 portable device.

During the field sorting, representative specimens of each aquatic taxa were picked out with entomological forceps and placed in a vial containing 90% industrial methylated spirits (IMS or denatured ethanol B), 5% water and 5% glycerol. Those taxa not easily identifiable in the field were later identified under a stereo microscope. In addition to the targeted aquatic invertebrate assemblages and species specific to each SSSI, all other aquatic macro-invertebrate taxa collected were identified to the lowest possible level, with the exception of the taxonomically difficult groups Oligochaeta (segmented worms), Hydracarina (water mites), Ostracoda (seed shrimps), and Chironomidae (non-biting midge larvae).

3. RESULTS

Taxa lists are provided in the dossiers for each SSSI, which also contain descriptions of the sampling sites and summarise the importance and condition of the aquatic invertebrates recorded. Notes on the ecology and distribution of species of conservation value recorded during the survey but not detailed in the main text are provided in the Annex. These are generally considered to be 'Local' species, although this designation can be a bit nondescript and there are often conflicting sources regarding the 'Local' status of many aquatic species, particularly amongst the Coleoptera. This should be borne in mind and will explain the omission of some species that are common in Scotland yet may be described as having a 'Local' distribution throughout the whole of Britain. There may also be outdated or unverified information for some species.

The condition of each of the invertebrate features for the specific SSSIs is summarised below:

Woodhall Loch (the caddisfly *A. brevipennis*): **favourable-maintained**. A single larva was recorded in the fen complex at the southern end of the loch where suitable habitat was present in abundance.

Buckstruther Moss (the aquatic beetle assemblage, especially *D. aquatica* and *A. canaliculatus*): overall the aquatic beetle assemblage was **favourable-maintained**. *Acilius canaliculatus* was recorded at two sites; *D. aquatica* was not recorded and may no longer be present. The SSSI has been the subject of much survey targeting the aquatic beetle assemblage over the years but *D. aquatica* has not been recorded since 1981.

Firth of Forth (the aquatic beetle assemblage, especially *H. pulchella* and *D. nitidulus*): a large SSSI encompassing the whole of the Firth of Forth and generally featuring areas of marine habitat. The aquatic beetle assemblage interest appeared to be concentrated on records from a survey of the Yellow Mires Marsh at the Aberlady Bay Local Nature Reserve during the 1980s, the area from which *D. nitidulus* was recorded in 1866 and two old records for *H. pulchella* from the Culross area, the latter from 1908. Overall the aquatic beetle assemblage at Aberlady Bay was in **favourable-maintained** condition, although *D. nitidulus* was not recorded. The museum material on which the 19th century record was based was erroneously identified and it appears that *D. nitidulus* was never recorded from the SSSI and should be removed from the citation. Suitable habitat for *H. pulchella* at Culross no longer appears to exist and the beetle was not found in the Blair Burn, the only extant freshwater habitat in the area. The village has undoubtedly changed significantly since 1908. The SSSI boundary at Culross follows the top of the shore line and thus the historical records for *H. pulchella* would have been outside the SSSI, thus *H. pulchella* should also be removed from the citation.

Lochs of Harray and Stenness (the caddisfly *Y. reuteri* and the freshwater nerite snail *T. fluviatilis*): *T. fluviatilis* was found at all four sampling sites around the Loch of Harray and the population was widespread, in healthy condition and thus categorised as **favourable-maintained**. *Ylodes reuteri* larvae were not found at its last known site at the Ring of Brodgar, where adult males were collected from amongst the marginal vegetation in 2003. It is difficult to assess if the species is no longer present on the basis of a single survey but it appears that this feature is now in **unfavourable-declining** condition.

Rannoch Moor (the aquatic beetle assemblage): due to the size of the SSSI and its difficult topography, sampling was limited to habitats along the western side of the moor, bordering the A82. It was thus hard to make a judgement on the condition of the aquatic Coleoptera assemblage based on rather limited information. The diversity and condition of water beetle habitats visited appeared to be in good condition and the species collected during the single

sampling event were indicative of the low-nutrient, acidic habitat, suggesting that the assemblage is in **favourable** condition. This feature has not previously been monitored at Rannoch Moor and it is recommended that further work validate the conclusions of this first survey.

4. WOODHALL LOCH

4.1 Introduction

Woodhall Loch is a long, narrow water body some 4.5 km in length, in a valley between Mossdale and Laurieston. It is the best example in the Stewatry of an oligotrophic loch, transitional between a peaty upland and a richer lowland loch. A variety of important habitats are present around its shores, including fen, mire and species-rich neutral grassland, as well as areas of wet willow, birch and alder carr. A commercial forestry plantation is present along the western shore of the loch, whilst the eastern side is a mixture of pasture, wetland and broadleaved woodland. Some recreational boating takes place on the loch, along with angling and shooting, for both game and wildfowl.

Water flows into the southern end of the loch via the Kenick Burn and a series of marshy drains. Most of the carr and fen habitat is concentrated in this area. Various small streams on the west and east banks also feed into the loch, which outflows to the north along Crae Lane. Crae Lane then joins the River Dee (Black Water of Dee) which flows into Loch Ken.

The SSSI was designated for the following features: fen meadow (favourable maintained, August 2010); lowland neutral grassland (not yet monitored); oligotrophic loch (unfavourable, July 2004); open water transition fen (favourable, August 2010); beetles (favourable, July 2010); and the caddisfly *A. brevipennis* (favourable, December 2004).

The water beetle fauna is unusually rich, with over 70 species recorded, including many on the edge of their range (Entomological Monitoring Services, 2003). The last monitoring of the oligotrophic loch feature suggested increased nutrient levels, above oligotrophic loch status. The current survey was undertaken to assess the status of *A. brevipennis*, which has not been recorded from the loch since 1985.

4.1.1 Distribution and Ecology of Anabolia brevipennis

Anabolia brevipennis is a limnephilid caddis species, formerly known as *Phacopteryx brevipennis*. The larvae occur in pools with a slight water flow in dense reed-fen or wet carr (Wallace, 1991). The pools are generally shallow, usually beneath deciduous tress and often dry up in summer (Wallace *et al*., 2003). The larvae have a mostly dark brown head, sometimes with a pale tip to the fronto-clypeal apotome, and they construct a case from disks of material cut from dead leaves. The case is straight and distinctly triangular in cross-section, unlike the cases of *Glyphotaelius pellucidus* larvae, which also make a straight case of dead leaf fragments and can be found in the same habitat (Wallace *et al*., 2003). The adult is very secretive and does not appear to stray far, being both difficult to capture with a net and only being light-trapped close to its breeding sites (Wallace, 1991).

The species is very localised and has been recorded from: Redgrave Fen, Foulden Common, Catfield fen and Ranworth in East Anglia; from Scarborough and Askham Bog in Yorkshire; Combe Abbey in Warwickshire; Hawes Water, Silverdale in north Lancashire; Blelham Fen and 'Congo' Carr', Windermere, in Cumbria; Hatch Mere, Wybunbury Moss and Hale Moss in Cheshire and from Wem Moss in Shropshire. Woodhall Loch in Galloway is the only Scottish location for this species (Wallace, 1991). Originally given RDB3 (Red Data Book 3: Rare) status, the 1991 confirmation of the Warwickshire specimen suggests that although there are few records, the species is more widespread than previously thought and, therefore, is better designated as Nationally Scarce (Wallace, 1991).

Examination of the Trichoptera Recording Scheme records showed that *A. brevipennis* has only been recorded once from the SSSI on 24 June 1985 when a pupal case was collected in the fen at the southern end of the loch (NX 677 663) (I. Wallace, pers. comm.). On 17

September and 19 December 2004, SNH carried out two visits to assess the SSSI for the *A. brevipennis* feature. The method followed was the simple recording of pools in suitable habitat, with 9 h spent over a winter/spring survey (when standing water was present) and a summer/autumn survey when the pools were dry. There does not appear to have been any concerted effort to locate the caddis itself, the survey being limited to an assessment of the habitat from which it was known. The habitat was judged to be in favourable-maintained condition, with a broad range of seasonal pools in the extensive area of fen and carr at the south end of the loch and on the floodplain beside Crae Lane. Large pools, some of which may be permanent, were most frequent in the carr. In the more open fen, the pools were mostly confined to networks of narrow hollows and channels between tussocks, although there were also marginal reed-beds which were covered by water to varying depths. By extension, the results of this survey also judged the *A. brevipennis* feature of the SSSI to be in favourable-maintained condition.

4.2 Methods

Sampling methods were described in section 2. As the aim of the survey was to search for and assess the status of *A. brevipennis*, sampling was limited to areas of suitable habitat where the species may occur: temporary pools and runnels amongst the extensive carr and fen at the southern side of the loch and any suitable pools that were present along the banks of Crae Lane. Other aquatic invertebrates collected during the search for *A. brevipennis* were also recorded. Figure 1 illustrates the locations of the sampling sites. Sampling took place on 29 May 2013.

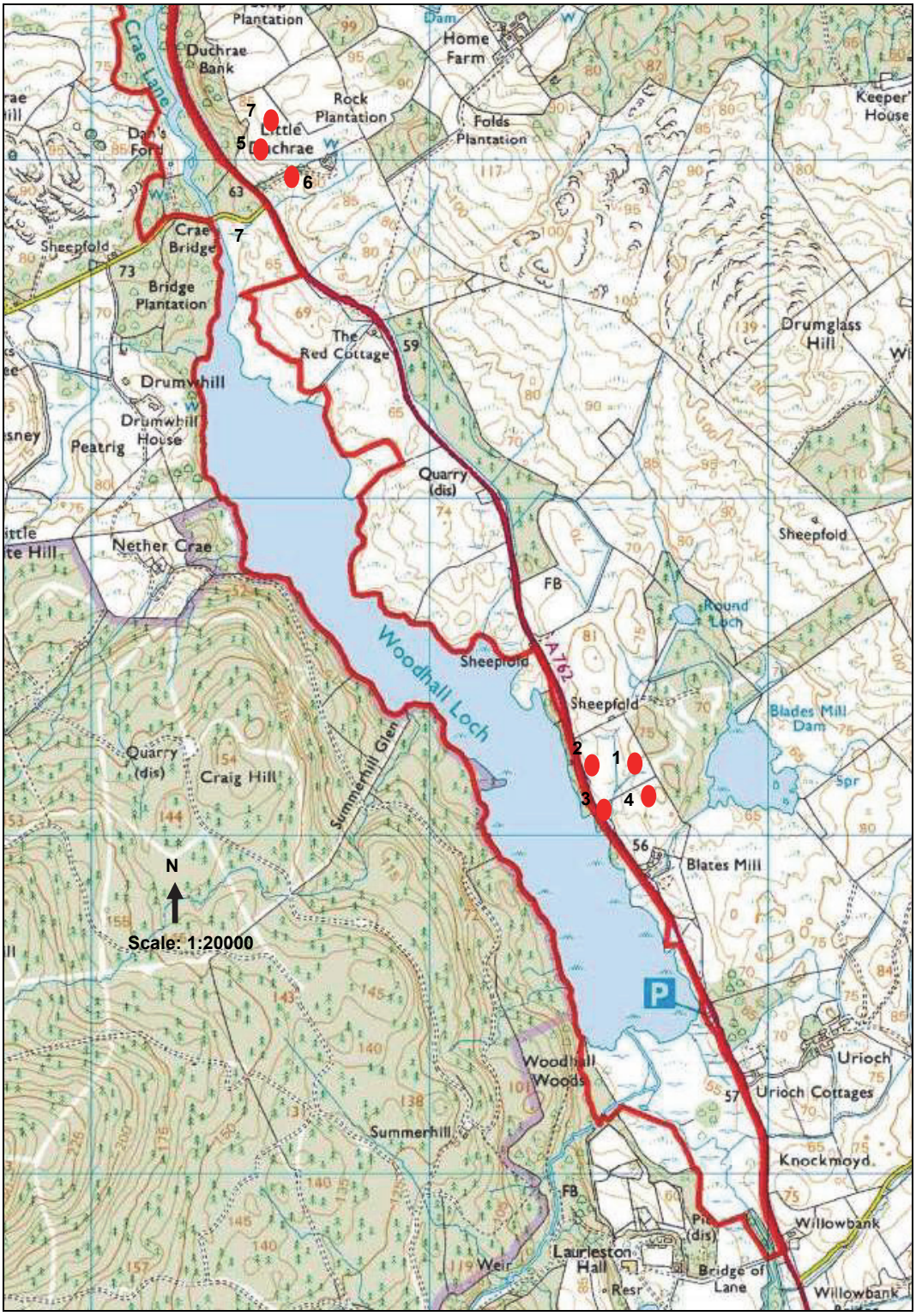


Figure 1. The location of sampling sites at Woodhall Loch SSSI (© Crown copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100017908).

4.3 Results

Sixty-one aquatic invertebrate taxa were recorded, including a single larva of *A. brevipennis* collected at site 4 (Table 1).

Table 1 - The taxa lists for the seven sampling sites along with incidental field sightings of amphibians.

SITE	**1**	**2**	**3**	**4**	**5**	**6**	**7**
NGR	NX 6778 6646	NX 6758 6642	NX 6767 6622	NX 6784 6625	NX 6630 6882	NX 6636 6880	NX 6632 6896
CONDUCTIVITY (µScm$^{-1)}$	170	130	160	160	100	80	190
pH	6.0	6.4	6.2	6	8.3	6.4	6.6
AQUATIC INVERTEBRATE TAXA							
OLIGOCHAETA							
Oligochaeta spp.	X	X		X	X	X	X
HIRUDINEA							
ERPOBDELLIDAE							
Trocheta bykoswkii	X			X			
GASTROPODA							
LYMNAEIDAE							
Stagnicola palustris gp.		X	X	X		X	
PLANORBIDAE							
Anisus leucostoma			X	X			
SUCCINEIDAE							
Oxyloma pfeifferi						X	X
BIVALVIA							
SPHAERIIDAE							
Sphaerium corneum					X		
Pisidium casertanum	X		X	X		X	X
Pisiidum hibernicum						X	
Pisidium nitidum			X			X	
CRUSTACEA							
ASELLIDAE							
Asellus aquaticus	X	X	X	X	X	X	X
Proasellus meridianus			X				
GAMMARIDAE							
Gammarus pulex		X	X		X	X	
CRANGONYCTIDAE							
Crangonyx pseudogracilis	X		X	X			X

HYDRACARINA							
Hydracarina spp.						X	
PLECOPTERA							
PERLODIDAE							
Isoperla grammatica			X				
NEMOURIDAE							
Nemoura erratica	X		X			X	X
Nemoura cinerea			X	X			X
Nemurella picteti	X						X
EPHEMEROPTERA							
SIPHLONURIDAE							
Siphlonurus lacustris		X	X				
LEPTOPHLEBIIDAE							
Leptophlebia vespertina					X		
TRICHOPTERA							
POLYCENTROPODIDAE							
Plectrocnemia conspersa	X						X
LEPTOCERIDAE							
Athripsodes aterrimus						X	
LIMNEPHILIDAE							
Limnephilus lunatus				X	X	X	X
Limnephilus marmoratus						X	
Chaetopteryx villosa					X		
Halesus radiatus	X					X	
Glyphotaelius pellucidus			X				
Anabolia nervosa						X	
Anabolia brevipennis				X			
BERAEIDAE							
Beraea pullata				X			
Beraea sp. (pupa)					X		
PHRYGANEIDAE							
Trichostegia minor		X					
HEMIPTERA							
CORIXIDAE							
Hesperocorixa sahlbergi			X	X		X	

Sigara semistriata						X	
GERRIDAE							
Gerris lacustris			X		X	X	
Aquarius najas						X	
NEPIDAE							
Nepa cinerea						X	
VELIIDAE							
Velia caprai	X		X	X	X	X	X
MEGALOPTERA							
Sialis lutaria	X	X			X	X	
DIPTERA							
CHIRONOMIDAE							
Chironomidae sp.	X	X	X	X	X	X	X
PSYCHODIDAE							
Psychodidae sp. (pupa)			X				
PEDICIIDAE							
Pedicia sp.							X
CERATOPOGONIDAE							
Palpomyia / Bezzia gp.			X	X			X
COLEOPTERA							
HYDROPHILIDAE							
Anacaena lutescens							X
HELOPHORIDAE							
Helophorus obscurus						X	
HYDREANIDAE							
Hydreana riparia			X			X	
Limnebius truncatellus						X	
HALIPLIDAE							
Haliplus ruficollis gp.			X				
GYRINIDAE							
Gyrinus substriatus			X		X	X	
DYTISCIDAE							
Dytiscus sp. (larvae)				X			
Agabus paludosus							X
Agabus bipustulatus	X					X	X

Agabus sturmii		X	X	X		X	
Ilybius guttiger	X			X			
Hydroporus palustris				X			
Hydroporus pubescens						X	
Hydroporus incognitus				X		X	
Hydroporus nigrita							X
SCIRTIDAE							
Elodes sp. (larvae)				X			
DRYOPIDAE							
Dryops luridus						X	
CHRYSOMELIDAE							
Prasocuris phellandrii						X	
STAPHYLINIDAE							
Stenus sp.		X	X	X		X	
FIELD OBSERVATIONS							
AMPHIBIA							
Bufo bufo		X					
Rana temporaria (tadpoles)	X			X		X	

4.4 Site Descriptions

4.4.1 Site 1

This was a small runnel, with a slight flow, in fen under willow trees on the south side of the loch. Vegetation in the channel and along the margins consisted of *Phalaris arundinacea*, *Caltha palustris, Filipendula ulmaria, Veronica beccabunga, Cardamine pratense, Oenanthe crocoata, Juncus acutiflorus, Valeriana officinalis, Fontinalis antipyretica, Deschampsia cespitosa* and *Carex* species (mostly *C. sylvatica, C. demissa* and *C. nigra*) with an underlying carpet of *Calliergonella cuspidata* and *Climacium dendroides*.

The aquatic invertebrate assemblage was dominated by large numbers of the naturalised shrimp species *Crangonyx pseudogracilis* and the freshwater hog louse *Asellus aquaticus*, with quite a few *Plectrocnemia conspersa* larvae and the pea mussel *Pisidium casertanum*. The presence of nymphs of the 'Local' stonefly *Nemoura erratica* and a single specimen of the diving beetle *Ilybius guttiger* were worthy of note. The latter species has been recorded several times from the SSSI between 1980 and 2002 (Entomological Monitoring Services, 2003). *Nemoura erratica* was also recorded at sites 3, 6 and 7.

4.4.2 Site 2

This was a series of pools under willow carr on the east bank of the Kenick Burn, close to its mouth on the southern side of the loch. The pools mostly extended under *Salix cinerea*, with a fringing bed of *Phalaris* and *Phragmites australis* between the edge of the pools and the loch shore. There was a channel providing some connection between the pools and the Kenick Burn during high flows but there appeared to be no water movement discernible in the pools themselves. Dense *Phalaris* grew around the northern edge of the site, with patches of *V. beccabunga, Mentha aquatica, F. ulmaria, Solanum dulcamara* and *Urtica dioica* under the trees.

A fairly low diversity of aquatic invertebrates was recorded at this location and the pools were generally thought to be too open to make a good habitat for *A. brevipennis*. A single specimen of the phryganeid caddis *Trichostegia minor* was recorded. This species is known from only one other location in Scotland: Caerlaverock on the northern side of the Solway Firth, to the south at Dumfries (Wallace, 1991). It can be regarded as Notable in Scotland.

4.4.3 Site 3

The Kenick Burn initially flows north-eastwards before turning north-westwards just before it flows into Woodhall Loch. Site 3 was located adjacent to this sharp bed and consisted of a series of small flowing channels and pools under *Salix cinerea*. This area is probably the result of overspill from the drain that flows northwards from the Bridge of Lane and joins the Kenick Burn close to the sharp bend. Flora in the area included: *V. beccabunga, O. crocoata, M. aquatica, D. cespitosa, C. palustris, P. arundinacea, U. dioica, Callitriche stagnalis, Galium palustre* and the mosses *F. antipyretica, Dichodontium palustre* and *Plagiomnium* sp.

The aquatic invertebrate fauna was quite diverse and dominated by *Asellus aquaticus* and *C. pseudogracilis*. A large number of empty *Glyphotaelius pellucidus* cases were also present on the surface of the silt in most of the pools.

4.4.4 Site 4

Site 4 consisted of a flooded area of fen under a mixed canopy of willow and birch. The main feature was a shallow silty drain that flowed into the fen from the direction of Urioch

and which had overflowed onto the adjacent habitat to produce a series of small runnels and pools. Although the drain carries water from the slopes above Urioch, there was no discernible flow in either the main drain or the pools and channels in the surrounding habitat.

Vegetation consisted of *Filipendula, Caltha, O. crocoata, G. palustre, V. officinalis, M. aquatica*, *Carex* species and occasional *Equisetum fluviatile*, above a mixed bryophyte carpet, in which *Sphagnum* sp. *Thuidium tamariscinum* and *Calliergonella cuspidata* were the most abundant species.

The aquatic invertebrate community was quite diverse for such an ephemeral habitat and was dominated by chironomid midge larvae, *A. aquaticus* and *C. pseudogracilis*. Noteworthy species included single specimens of the diving beetles *I. guttiger* and *A. brevipennis*.

4.4.5 Site 5

Site 5 was located on the west bank of Crae Lane, just downstream of Crae Bridge. A small channel off the main watercourse diverted water into a series of flooded hollows at the edge of the riparian woodland. Most of the pools were sparsely vegetated, although occasional stands of *Phalaris, Caltha* and *O. crocoata* were present along with a few scattered clumps of *F. antipyretica*.

Some work at the banks had recently been carried out in the vicinity of the bridge, including the construction of a new road drain that discharged into the large pool where sampling took place. Road run-off and drainage from the new block work are likely to explain the elevated pH measured at this site, compared to all others in the survey. This was not an ideal site but was one of the few easily accessible sampling areas on the west bank of Crae Lane. The assemblage was not particularly diverse, representative of the habitat, contained no species of note and was dominated by Oligochaeta, Chironomidae and nymphs of the alderfly *Sialis lutaria*.

4.4.6 Site 6

On the east bank upstream of Crae Bridge was a low-lying area beneath birch and willow that appeared to be periodically flooded by the adjacent Crae Lane, forming a mosaic of pools and runnels. The area was vegetated with scattered stands of *Caltha, Carex, Ranunculus flammula, J. effusus, J. acutiflorus, Filipendula, O. crocoata, D. cespitosa, M. aquatica, G. palustre, Agrostis stolonifera* and *Phalaris* above a carpet of *Calliergonella*.

The varied vegetation and shallow pools provided a refuge for a diverse community of aquatic invertebrates, the richest recorded during the survey, including the ‘Local’ water bugs *Aquarius najas* and *Sigara semistriata* and nine species of aquatic beetle, of which *Helophorus obscurus* was a new record for the SSSI.

4.4.7 Site 7

The best of the fen and carr habitat within the SSSI was mostly limited to the southern end of the loch. Much of the west bank was not investigated upstream of Crae Bridge as the riparian woodland was quite dense and there appeared to be limited wetland development due to the fairly steep wooded slope restricting the amount of suitable ephemeral wetland habitat. On the east bank the woods were more open and access was easier. There was also a more extensive lateral fringe of wet woodland, especially along the base of Duchrae Bank. Much of this wet woodland was ‘damp’ at the time of the survey with very few open pools and runnels suitable for sampling.

Site 7 was located in an area of open fen and wet woodland opposite the small island just upstream of Dan's Ford. A small runnel rose as a marshy seepage at the bottom of a wooded slope then flowed across more open fen into Crae Lane opposite the island. The runnel was sparsely vegetated and much of its lower course was overhung by bank side vegetation, although there were occasional stands of *J. acutiflorus, Caltha, Filipendula, O. crocoata, Carex* and *Phalaris.* The invertebrate community was not particularly diverse and contained species of limited conservation value, typical of the habitat.

4.5 Conclusions

Suitable habitat for *A. brevipennis*, including ephemeral fen and carr pools and runnels, were found at both the northern and southern end of Woodhall Loch. To the north the habitat was rather limited and restricted to a thin marginal band along the banks of Crae Lane. At the southern end of the loch the habitat was much more extensive occupying the flat valley bottom area between the southern loch shore and the Bridge of Lane. This area of mixed willow, birch and alder carr, with scattered plots of more open fen, was criss-crossed by several small drains and springs flowing into the loch,and the Kenick Burn. In wet weather these various watercourses overflow into the surrounding fen to create extensive ephemeral aquatic habitat.

Anabolia brevipennis was recorded once in 1985 from the fen at the southern end of the loch, close to sites 3 and 4. During the current survey a single larval specimen was collected from site 4 (NX 6784 6625) and it is likely that the species is present elsewhere in suitable habitat within the fen. The recording of the species for the first time since 1985 proved that the population is still present, which coupled with the presence of extensive areas of suitable habitat would indicate that this designated feature is in **favourable-maintained** condition.

The aquatic invertebrate communities recorded were generally of fairly low diversity and representative of the habitat. Other invertebrate species of note recorded included the uncommon diving beetle *I. guttiger*, a former Nationally Scarce species that has since been downgraded but which is nevertheless an indicator of good quality habitat (Foster, 2010); the 'Local' species *N. erratica*, *A. najas* and *S. semistriata*; and a single larva of the caddis *T. minor.* This latter species (recorded at site 2) is only known from one other site in Scotland, south of Dumfries, and has possibly been overlooked in the borders area.

4.6 Management recommendations

- *Anabolia brevipennis* was recorded at site 4, in the small drain that carries water into the fen at the southern end of the loch from the slopes behind Urioch. Although the actual water chemistry requirements of *A. brevipennis* are poorly known, it would be prudent to assume that good water quality is preferred and that no polluting discharges are permitted to enter the watercourse in the vicinity of Urioch Farm or Cottages or from the fields on the slopes behind.

- Current water levels at the SSSI should be maintained as it is clearly evident that the current regime provides plenty of suitable habitat for *A. brevipennis*. Lowering the water level, especially at the southern end of the loch, is likely to result in habitat loss and also liable to affect other species of aquatic invertebrates.

- Although *A. brevipennis* generally occurs in ephemeral habitats beneath trees, for aquatic invertebrates in general it is important to maintain some areas of open fen within the wetland mosaic at the southern end of the loch. This can be done by controlling scrub and trees in certain areas and cutting back fen vegetation where

required. The maintenance of such open areas will provide suitable habitat for taxa such as water beetles and aquatic Hemiptera.

- It is recommended that some consideration is given to placing the caddis *T. minor* on the SSSI citation. This species is known from only one other location in Scotland and can certainly be considered Regionally Scarce in the country. It prefers similar habitats to *A. brevipennis*, thus the management recommendations above will also benefit this species.

4.7 Site photographs

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

5. BUCKSTRUTHER MOSS

5.1 Introduction

Buckstruther Moss is the most extensive, intact example of 'schwingmoor' (floating poor fen) in the Borders. The SSSI is located 5 km south-east of Hawick, close to Adderstonelee Moss SSSI, and has developed in a glacial hollow which originally contained a lake. Over thousands of years the lake has in-filled as plants growing around the margins have died and the accumulated organic matter formed peat which has eventually filled in parts of the basin. Over time the peat was colonised by more plants, which in turn produced more organic matter such that a nutrient-poor basin mire was eventually formed.

Today the site consists of two open water-bodies, the larger lochan Birnie Loch in the south and a smaller pond in the north, with the floating mire occupying the area in-between. The open mire is punctuated by numerous small pools which possibly interconnect beneath the carpet of floating vegetation. Two small springs on moorland south of the fen feed into the SSSI, which then drains to the north along a small north-eastwards flowing stream. An embankment along the southern edge of the SSSI helps to maintain the high water levels essential for the habitat and was probably constructed in the 19th century, possibly to hold back water and aid in the extraction of marl or tile clay in the area.

There is some trout fishing on Birnie Loch and some limited rough shooting, but otherwise the site is relatively undisturbed.

The SSSI was originally notified in 1972 on the basis of its basin fen – schwingmoor type feature.This is of interest botanically and for the mosaic of meso-habitats it can provide for aquatic and wetland invertebrates, including its remarkable assemblage of aquatic beetles. The fen feature was surveyed and found to be in favourable-maintained condition in September 2003. The aquatic beetle assemblage was assessed in August 2002 and also found to be in favourable condition (section 5.1.1).

5.1.1 The aquatic beetle assemblage at Buckstruther Moss and previous survey data

Research and survey of the aquatic beetle assemblage at Buckstruther Moss has been carried out for some time by various individuals and organisations, thus there is a fairly comprehensive species list for the site. Fifty-nine species of aquatic beetle (including five species that are aquatic in their larval stage only) and an additional three species closely associated with damp habitats, but not truly aquatic, were recorded. This is an exceptional species list in comparison to similar peatland sites, where the average number of aquatic beetle species is 24. The Buckstruther species are listed in Table 3 and include several uncommon beetles, the most noticeable of which are *D. aquatica, A. canaliculatus, A. sulcatus, Cyphon kongbergensis, Cercyon ustulatus, Enochrus ochropterus* and *E. coarctatus.*

Donacia aquatica is a UK Biodiversity Action Plan (BAP) species. It that was not evaluated under the assessment of British water beetle species (Foster, 2010), thus its current status is still Red Data Book Rare (RDB 3). Foster *et al*. (2007) did note, however, that it should be the equivalent to IUCN Vulnerable. It is a scarce and much declined reed beetle that is associated with sedges, reed sweet-grass (*Glyceria maxima*) and bur-reeds with the aquatic larvae living inside the stems of the host plant and the adults found on the flowers (Foster, 2001). It was recorded at Buckstruther from 1976 to 1981, with no sightings since.

Acilius canaliculatus was formerly classified as RDB 3 but has since been found to be more common and hence was downgraded to Nationally Scarce status in Foster (2010). It is one of the larger diving beetles, known colloquially as the scarce lesser diving beetle, and is

usually found in shaded peaty waters in fens and bogs, and has a preference for peat cuttings and small shaded pools, particularly those created by the displaced roots of fallen trees (Sutton, 2008; Foster & Friday, 2011). It has a patchy distribution in England, and has been recorded on the Kent and Sussex levels and associated woodland, Berkshire, the Cheshire Plain, Thorne Wastes and surrounding lowlands in Yorkshire and North Lincolnshire, the Lake District and Shropshire. It is known from two sites in Wales but is much more common in Scotland, including the Borders, Ayrshire and Glasgow and in eastern Scotland north to Speyside and the Black Isle (Foster & Friday, 2011). It has been recorded at Buckstruther from 1974 to 1989.

The lesser diving beetle (*Acilius sulcatus*), although nationally fairly common and widespread, is rather rare in southern Scotland. It occurs in a variety of habitats, including silt ponds and peat pools (Sutton, 2008) which are often steep-sided and ranging out into deep clear water in the absence of fish (Foster & Friday, 2011). In England it is mostly known from lowland locations, whilst in Scotland it is more typical of isolated, fishless lochans (Foster & Friday, 2011), where it occurs as a melanic form. In the Borders it is present as the paler form more typical of its English locations. Its virtual absence in southern Scotland is hard to decipher and is not due to competition with *A. canaliculatus* as the two occur together in the north (Sutton, 2008) as well as at Buckstruther Moss, where *A. sulcatus* was recorded for the first time in 2002.

Table 2 - Aquatic beetle species recorded at Buckstruther Moss (data from Entomological Monitoring Services, 2003)

HALIPLIDAE			
Haliplus confinis	*Haliplus fulvus*	*Haliplus lineatocoliis*	*Haliplus ruficollis*
GYRINIDAE			
Gyrinus substriatus			
DYTSICIDAE			
Hydroporus angustatus	*Hydroporus discretus*	*Hydroporus erythrocephalus*	*Hydroporus gyllenhalii*
Hydroporus incognitus	*Hydroporus memnonius*	*Hydroporus nigrita*	*Hydroporus obscurus*
Hydroporus palustris	*Hydroporus planus*	*Hydroporus pubescens*	*Hydroporus striola*
Hydroporus tristis	*Hydroporus umbrosus*	*Hyygrotus impressopunctatus*	*Hygrotus inaequalis*
Agabus affinis	*Agabus bipustulatus*	*Agabus congener*	*Agabus nebulosus*
Agabus paludosus	*Agabus sturmii*	*Ilybius ater*	*Ilybius fuliginosus*
Ilybius montanus	*Rhantus exsoletus*	*Rhantus suturellus*	*Colymbetes fuscus*
Acilius canaliculatus	*Acilius sulcatus*	*Dytiscus marginalis*	*Dytiscus semisulcatus*
HYDROPHILIDAE			
Coelostoma orbiculare	*Cercyon marinus*	*Cercyon ustulatus*	*Anacaena globulus*
Anacaena lutescens	*Enochrus coarctatus*	*Enochrus ochropterus*	*Hydrobius fuscipes*
Laccobius bipunctatus	*Laccobius minutus*	*Laccobius striatulus*	
HELOPHORIDAE			
Helophorus aequalis	*Helophorus brevipalpis*	*Helophorus flavipes*	*Helophorus grandis*
Helophorus minutus	*Helophorus obscurus*		
HYDRAENIDAE			
Hydraena britteni	*Ochthebius minimus*	*Limnebius truncatellus*	
SCIRTIDAE			
Cyphon hilaris	*Cyphon kongsbergensis*	*Cyphon padi*	
CHRYSOMELIDAE			
Donacia aquatica	*Plateumaris sericea*	*Galerucella* sp.	
COCINELLIDAE			
Coccidula rufa			
STAPHYLINIDAE			
Stenus melanarius			

The Kongsberg marsh beetle (*C. kongsbergensis*) is a Nationally Scarce species first recorded in Britain in 1981 from Skidmore in Scotland and thereafter from other sites in Scotland and Wales. It is likely to be much more common in Scotland than previously recorded (Foster, 2001). All its known sites are acid mires, with a high proportion of records being from bog pools in raised and blanket mires. It has also been found in association with acid flushes at some sites (Boyce, 2004). The species was first recorded from Buckstruther in 2002.

Cercyon ustulatus is a small scavenger water beetle found amongst wet plant litter and marshy vegetation at the edge of still water. It is widespread but local and has recently been downgraded from Nationally Scarce status (Foster, 2010). At Buckstruther it has been recorded several times between 1976 and 2002.

Enochrus ochropterus and *E. coarctatus* are former Nationally Scarce species (Foster, 2010). The former occurs in fens mostly in the south of Scotland whilst the latter is more usually found in base-rich habitats but will occur with *Enochrus affinis*, a species of large intact bogs (Foster, 2001). Both *E. ochropterus* and *E. coarctatus* have been widely recorded at Buckstruther.

Various other uncommon species recorded as 'Local' are also included in the species list for Buckstruther Moss. The last SCM survey of the aquatic beetle assemblage was carried out at six sites during August 2002. It recorded 31 species, a good diversity for a single sampling event, including *Hydroporus incognitus, Helophorus minutus, Cercyon marinus* and the Nationally Scarce *C. kongbergensis*, which were new records for the SSSI. The status of the assemblage was considered to be favourable-maintained (Entomological Monitoring Services, 2003).

5.2 Methods

In order to obtain as diverse a list of aquatic beetle species as possible, a variety of different habitats were surveyed. This ranged from marginal vegetation at the edge of Birnie Loch (site 1) and the large pool in the north (site 6), to dense marshy vegetation (site 3) and more open bog pools across the Moss (sites 2, 4 and 5).

The sampling method described in section 2 was supplemented by sampling of mossy hollows with a tea strainer. In addition to net sampling in the open water, the *Sphagnum* carpet was sampled by pushing down into the moss, thereby creating a depression that was allowed to fill with water inflowing from the surrounding saturated vegetation; the resulting hollow was then swept through with a tea strainer. This is a particularly good method for collecting small hydrophilid and hydraenid beetles that live within the saturated moss carpets of bogs.

In addition to the aquatic Coleoptera, other aquatic invertebrates collected during the survey were identified and recorded. Figure 2 illustrates the locations of the sampling sites. Sampling took place on 30 May 2013.

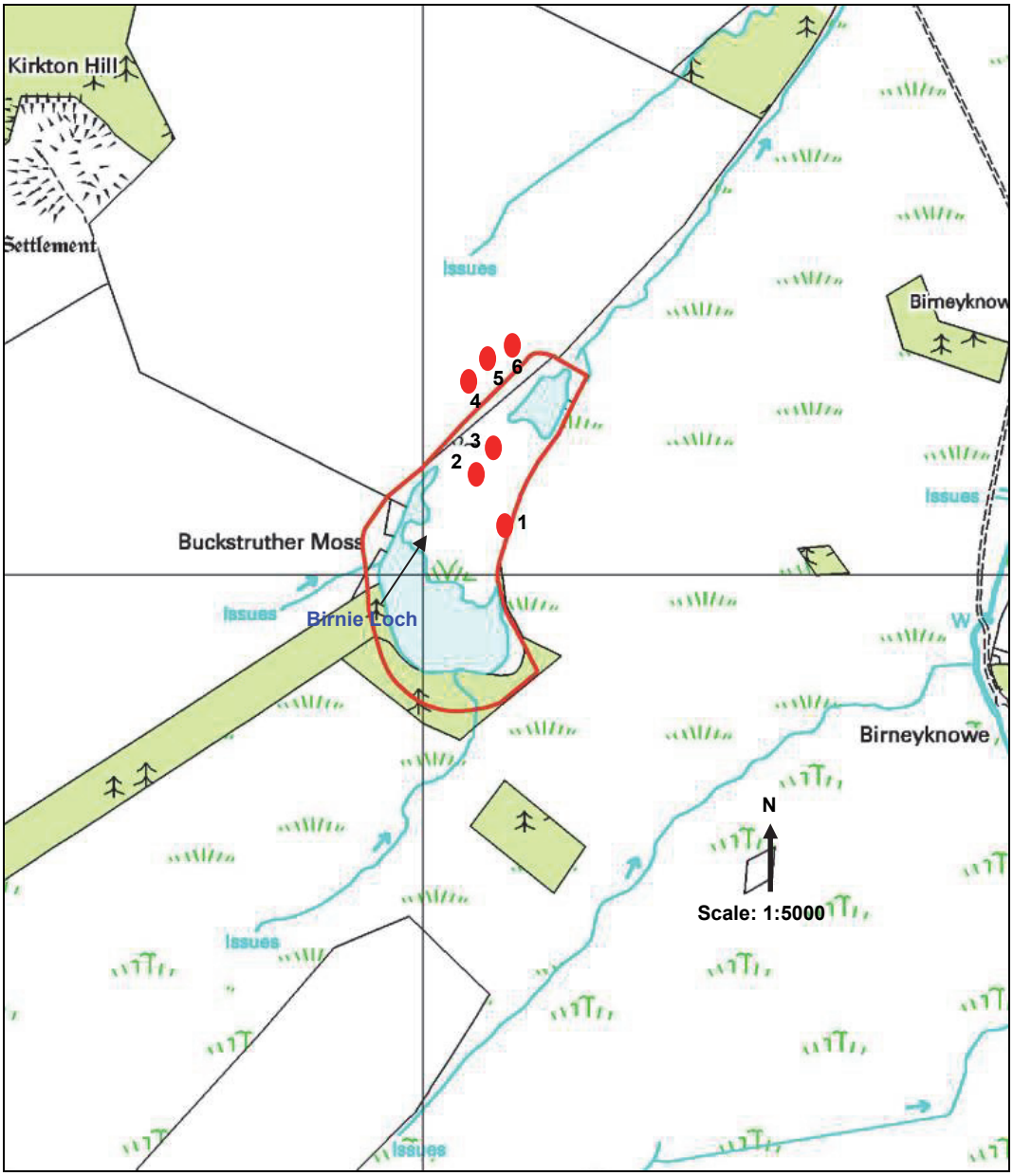


Figure 2. Locations of sampling sites at Buckstruther Moss SSSI (© Crown copyright and database right 2011. All rights reserved. Ordnance Survey Licence number 100017908).

5.3 Results

Eighty five invertebrate taxa were recorded across the six sites, including 28 species of aquatic beetle and *Cyphon* larvae (Table 3). *Acilius canaliculatus* was collected at sites 3 and 4 but there were no sightings of *D. aquatica.* A single specimen of the Nationally Scarce *Hydraena rufipes* was recorded at site 2 and *Rhantus suturalis* was recorded at site 3, both first records from the SSSI (Table 3).

Table 3 - The taxa lists for the six sampling sites along with incidental field sightings of amphibians.

SITE	**1**	**2**	**3**	**4**	**5**	**6**
NGR	NT 5407 1196	NT 5405 1199	NT 5405 1201	NT 5404 1209	NT 5403 1214	NT 5408 1213
CONDUCTIVITY (µScm$^{-1)}$	140	130	70	120	120	60
pH	6.4	6.3	5.8	6.4	6.2	5.5
AQUATIC INVERTEBRATE TAXA						
TRICLADIDA						
PLANARIIDAE						
Polycelis tenuis	X	X	X		X	
Polycelis nigra					X	
OLIGOCHAETA						
Oligochaeta spp.	X	X	X	X		X
HIRUDINEA						
GLOSSIPHONIIDAE						
Glossiphonia complanata			X			X
Alboglossiphonia heteroclita					X	
ERPOBDELLIDAE						
Erpobdella octoculata	X	X	X	X	X	X
GASTROPODA						
LYMNAEIDAE						
Radix balthica		X		X	X	
Stagnicola palustris gp.	X	X	X		X	
VALVATIDAE						
Valvata cristata	X	X	X	X	X	
PHYSIDAE						
Physa fontinalis	X	X	X	X	X	
PLANORBIDAE						
Gyraulus albus		X	X	X	X	
Hippeutis complanatus						X
Bathyomphalus contortus	X		X		X	X
SUCCINEIDAE						
Oxyloma pfeifferi				X		
BIVALVIA						

SPHAERIIDAE						
Sphaerium corneum	X		X	X	X	X
Pisidium pulchellum	X					
Pisidium hibernicum				X		
Pisidium nitidum		X				
CRUSTACEA						
GAMMARIDAE						
Gammarus pulex	X	X		X	X	
CLADOCERA						
DAPHNIIDAE						
Simocephalus vetulus	X		X		X	X
CHYDORIDAE						
Eurycercus lamellatus					X	
COPEPODA						
Cyclops sp.			X			
HYDRACARINA						
Hydracarina spp.	X				X	
ARACHNIDA						
Argyronecta aquatica	X				X	
ZYGOPTERA						
COENAGRIONIDAE						
Ischnura elegans	X	X				
Pyrrhosoma nymphula	X			X	X	X
ANISOPTERA						
AESHNIDAE						
Aeshna juncea			X	X		
Aeshna sp. (early instar)		X				
PLECOPTERA						
NEMOURIDAE						
Nemoura cinerea	X	X	X	X		
Nemoura cambrica	X		X	X	X	X
EPHEMEROPTERA						
LEPTOPHLEBIIDAE						
Leptophlebia vespertina	X	X	X	X	X	
BAETIDAE						

Cloeon dipterum					X	
TRICHOPTERA						
POLYCENTROPODIDAE						
Holocentropus dubius	X					
Holocentropus picicornis						X
LIMNEPHILIDAE						
Limnephilus lunatus	X	X		X		
Limnephilus marmoratus	X	X	X	X	X	
Limnephilus flavicornis					X	
Limnephilus stigma		X	X	X	X	
PHRYGANEIDAE						
Agrypnia varia				X		
HEMIPTERA						
CORIXIDAE						
Hesperocorixa linnaei				X		
Hesperocorixa sahlbergi		X	X	X	X	X
Hesperocorixa castanea				X	X	
Sigara semistriata		X				
VELIIDAE						
Velia sp. (nymphs)	X	X				X
Microvelia reticulata		X				
GERRIDAE						
Gerris odontogaster	X			X		
Gerris lateralis			X	X	X	
NOTONECTIDAE						
Notonecta glauca				X	X	
MEGALOPTERA						
Sialis lutaria	X			X		
DIPTERA						
CHIRONOMIDAE						
Chironomidae sp.	X	X	X	X	X	
CERATOPOGONIDAE						
Palpomyia / Bezzia gp.						X
CULICIDAE						
Anopheles sp.	X					

CHAOBORIDAE						
Chaoborus crystallinus		X		X		
PEDICIIDAE						
Pedicia sp.		X				
CYLINDROTOMIDAE						
Phlacrocera replicata				X		
DIXIDAE						
Dixella aestivalis	X	X	X	X	X	
COLEOPTERA						
HYDROPHILIDAE						
Anacaena globulus	X	X	X	X	X	X
Anacaena lutescens	X	X	X	X	X	X
Hydrobius fuscipes	X	X			X	X
Laccobius bipunctatus	X					
Enochrus coarctatus	X	X	X	X	X	X
Enochrus ochropterus			X		X	X
Coelostoma orbiculare		X				X
HYDRAENIDAE						
Hydreana rufipes		X				
HALIPLIDAE						
Haliplus ruficollis					X	
GYRINIDAE						
Gyrinus substriatus				X		
DYTISCIDAE						
Dytiscus marginalis			X			
Dytiscus sp. (larvae)	X	X			X	
Agabus bipustulatus	X		X		X	
Agabus affinis		X	X	X	X	
Ilybius ater			X		X	
Rhantus exsoletus	X		X	X		
Rhantus suturalis			X			
Acilius canaliculatus			X	X		
Hydroporus palustris	X		X	X	X	
Hydroporus striola	X				X	
Hydroporus planus		X	X	X		X

Hydroporus pubescens		X	X		X	X
Hydroporus gyllenhalii		X		X		X
Hydroporus nigrita		X	X	X	X	X
Hydroporus obscurus		X	X		X	X
Hydroporus memnonius			X			
Hydroporus erythrocephalus			X	X	X	X
Hydroporus umbrosus				X		
Hydroporus angustatus						X
SCIRTIDAE						
Cyphon sp. (larvae)	X	X	X	X	X	X
STAPHYLINIDAE						
Stenus sp.	X	X	X	X	X	X
FIELD OBSERVATIONS						
AMPHIBIA						
Lissotriton helveticus				X	X	
Rana temporaria (tadpoles & adults)	X	X	X	X	X	X

5.4 Site Descriptions

5.4.1 Site 1

Site 1 was an area of fringing vegetation along the eastern side of Birnie Loch, adjacent to the boat house. The vegetation consisted of *Menyanthes trifoliata, C. palustris* and *Carex rostrata* with occasional birch saplings, *Mentha aquatica* and *Equisetum fluviatile.* A carpet of the moss *C. cuspidata*, with occasional patches of the liverwort *Marchantia polymorpha* was present in the very shallow water at the edge of the shore.

The aquatic invertebrate assemblage was dominated by a mixture of *Sialis lutaria* nymphs, chironomid larvae, *Leptophlebia vespertina* nymphs, sphaeriid mussels (including the 'Local' *Pisidium pulchellum*) and the shrimp *Gammarus pulex*. Nine species of aquatic beetles, including *E. coarctatus* and the 'Local' *Rhantus exsoletus,* were recorded as well as *Dytiscus* and *Cyphon* larvae. *Rhantus exsoletus* has been recorded at Buckstruther from 1974 to 2002.

Gammarus pulex is a ubiquitous species but is not generally associated with lentic habitats, in which it is usually replaced by *G.lacustris* in northern Britain. The presence of *G. pulex* at most of the Buckstruther sites is possibly due to feeding by springs to the south, where the shrimp originated. The occurrence of this species might also indicate a sub-surface flow, and support the hypothesis that many of the pools on the floating bog are inter-connected beneath the raft of floating vegetation.

5.4.2 Site 2

Sampling at site 2 was concentrated in the marginal vegetation and amongst the moss carpet of three pools in the floating fen just to the north of Birnie Loch. Two of the pools were fairly open, whilst the third was shallower and more overgrown. Vegetation was dominated by *M. trifoliata, C. rostrata, Eriophorum, Caltha* and dense *Sphagnum*. Large numbers of bottles, and even a television, had been dumped in several of the pools along the north-eastern side of the lochan.

Leptophlebia vespertina, pea mussels (*Pisidium* sp.), limnephilid caddis larvae and aquatic beetles were the most abundant taxa. *Dytiscus* and *Cyphon* larvae were recorded in addition to 12 other species of water beetle, including *E. coarctatus* and a single specimen of the Nationally Scarce *H. rufipes*. This record for *H. rufipes* was a first for the SSSI and was also highly unusual. The species is normally associated with mossy rocks and clean shingle in fast streams and rivers and thus its occurrence in a floating fen is rather strange. It is known from quarry ponds in Scotland (Foster, 2001) but it may be that its presence could represent a specimen washed into the system from the springs feeding Buckstruther (c.f. *G. pulex*) to the south.

5.4.3 Site 3

This was an area of flooded dense vegetation close to site 2, with mostly *E. fluviatile, Eriophorum* and *M. trifoliata* above a carpet of *Sphagnum*, and occasional patches of *Lemna minor* and *Potamogeton polygonifolius* in the more open sections.

The fauna was dominated by large numbers of limnephilid caddis larvae, the horny orb mussel (*Sphaerium corneum*), *L. vespertina* and aquatic beetles of which 18 species were recorded, including *A. canaliculatus, E. ochropterus, E. coarctatus, R. exsoletus* and *R. suturalis*. This latter record was a first from the SSSI, a recently occurring species in southern Scotland that is still in the process of expanding its range northwards (Foster & Friday, 2011).

5.4.4 Site 4

Site 4 encompassed the vegetated margins of an open pool in the northern section of the schwingmoor. *Eriophorum, Caltha, Menyanthes, E. fluviatile*, bog-rush (*Schoenus* sp.), *C. rostrata* and *Juncus conglomeratus* made up the marginal emergent vegetation with a few patches of *Lemna minor, Dicranella rufescens*, some large clumps of willow moss (*F. antipyretica*) and dense *Sphagnum* in the deeper water.

The fauna was dominated by aquatic Coleoptera, of which 13 species were recorded including *A. canaliculatus, E. coarctatus* and *R. exsoletus*. Other uncommon species included a single pupa of the Nationally Scarce crane fly *Phalacrocera replicata* and the 'Local' pond skater species *Gerris lateralis*.

5.4.5 Site 5

Sampling at site 5 included an area of open *Equisetum fluviatile* swamp (fringed with marginal *Juncus acutiflorus* and *Eriophorum*) that graded into a denser bed of *Juncus effusus* with a fringe of *C. rostrata*, in the corner of a pool close to the open water body at the northern end of the Moss. Other vegetation present included *L. minor, M. trifoliata, Caltha* and *Myosotis* sp., along with a pervading carpet of *Sphagnum* and occasional clumps of *C. cuspidata* and *Bryum pseudotriquetrum*.

The most diverse aquatic invertebrate community was recorded at this site, including 47 taxa, of which limnephilid caddis larvae, sphaeriid mussels, large red damselfly (*Pyrrhosoma nymphula*) nymphs and water beetles made of the bulk of the population. Sixteen species of aquatic beetle were recorded, including *E. coarctatus* and *E. ochropterus*. The 'Local' pond skater *G. lateralis* was also present, along with a single larva of the caddis *Limnephilus flavicornis*, a fairly uncommon species in Scotland.

5.4.6 Site 6

Site 6 consisted of a transect through several different meso-habitats that form part of the marginal mosaic around the large open pool in the north of Buckstruther Moss. From dry land there was a water-soaked carpet of *Sphagnum*, which then graded into open *Equisetum fluviatile* swamp, with occasional *Myosotis* and *Eleocharis palustris* and a fringe of dense *C. rostrata* and *E. fluviatile* bordering the open water.

Surprisingly this was the least diverse of all the sites sampled with only 28 taxa recorded including 13 water beetle species of which *E. ochropterus* and *E. coarctatus* were of interest. The leech *Erpobdella octoculata*, *S. corneum* and water beetles made up the majority of the aquatic invertebrate community.

5.5 Conclusions

Twenty eight species of aquatic beetle were recorded across the six sites, not including *Cyphon* larvae which were present but were not identified further. This compares favourably with the 31 species recorded during the 2002 SCM survey and is above the average number of species recorded from comparable Borders Mosses.

Uncommon aquatic Coleoptera recorded included: the Nationally Scarce *A. canaliculatus* and *H. rufipes* (a new species record for the SSSI); *E. coarctatus, E. ochropterus* and *R. suturalis*, three species recently downgraded from Nationally Scarce status but which are nonetheless still relatively uncommon and indicators of good quality habitat; and the 'Local' *R. exsoletus*. *Rhantus suturalis* appears to have recently re-colonised Scotland and is slowly spreading northwards; the records at site 3 were the first from Buckstruther Moss. As

in 2002 the aquatic beetle assemblage was a mixture of fen and moss species. There were no records of *D. aquatica*, a rare species that has not been recorded at the SSSI since 1981.

Other uncommon aquatic invertebrate species included the water bugs *Sigara semistriata* and *G. lateralis*, the pea mussel *P. pulchellum* and the Nationally Scarce cranefly *P. replicata*, as well as a single larva of the caddis *Limnephilus flavicornis* which is common across most of Britain but is rather rare in the upland districts of the north.

In addition to the rich aquatic beetle community recorded, habitat appeared to be in good condition with a diverse mosaic of meso-habitats across the site, ranging from open water to saturated *Sphagnum*. There is little evidence of excessive scrub encroachment. The site can be considered to be in favourable-maintained condition for its aquatic beetle assemblage.

The presence of large numbers of bottles and a television set in pools along the northern shore of Birnie Loch is a cause for concern and indicates that the site, isolated as it may be, is not entirely free from vandalism.

5.6 Management recommendations

- Maintain the current water levels and water quality. The diverse assemblage of aquatic Coleoptera and other aquatic invertebrates demonstrates that both features are in good condition, thus management should be geared towards maintaining the *status quo*. Coniferous forestry borders the southern shore of Birnie Loch but does not appear to have been detrimental to the SSSI. Changes in farming practices on the surrounding moorland can adversely impact the water quality of the site itself and the two streams that drain the moorland catchment to the south of Birnie Loch, feeding into the SSSI via the lochan. Current agriculture management appears to be of low intensity and mostly involves upland grazing, which does not appear to have affected the ecological integrity of the site. Fields to the west of the Moss (on the slopes of Kirkton Hill) were being used for cultivation at the time of the 2013 survey and the maintenance of buffer strips along the eastern side of these two fields should reduce any run-off and the potential water quality impacts this could cause.

- Monitor scrub encroachment and remove any excessive cover. This will maintain the mosaic of saturated moss and open pools vital for beetles and other invertebrates.

- Work in conjunction with the landowner at Birneyknowe Farm and anglers who use Birnie Loch to identify and if possible prosecute those responsible for dumping refuse along the northern edge of the lochan.

- Banks Renewables are currently planning to construct a wind farm at Birneyknowe Farm and there has been a recent series of public meetings to discuss this. Buckstruther Moss will lie within the zone of influence of this development, although nearby Adderstonelee Moss will lay just outside this zone. Data from this survey and all previous surveys should be made available to the local planning officer to inform their decision on the proposed wind farm.

5.7 Site photographs

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

6. FIRTH OF FORTH

6.1 Introduction

The Firth of Forth SSSI encompasses a vast area covering the coastline from Alloa along the Fife coast to Crail and along the Falkirk and Lothian coast to Dunbar. It covers a variety of habitats including intertidal mud flats, salt marshes, reed beds and some saline lagoons, all of which are of vital importance for a diverse array of invertebrate and bird species. There are also areas of sand dunes and coastal grasslands encompassed within the SSSI which was notified for a variety of geological and biological features. Notable amongst the sand dunes is the Aberlady Bay Local Nature Reserve, a stretch of dunes in varying stages of succession along the eastern side of the bay to Gullane Point.

Large numbers of insects occur across the area, reflecting the range of habitats and one of the designated features for the SSSI is the beetle assemblage, including such rarities as *Cleonis pigra, Lebia chlorocephala, Microplontus rugulosus* and *Scymnus schmidti*. The terrestrial beetle assemblage was assessed in October 2000 and found to be in unfavourable-declining condition, primarily due to the fact that their habitats have been heavily impacted and are in poor condition. There has been no previous assessment of the aquatic beetle assemblage recorded from the SSSI although there are records of two rare species *D. nitidulus* and *H. pulchella*.

6.1.1 Distribution and ecology of Dryops nitidulus

This species is classified as IUCN Near Threatened. As with all *Dryops*, dissection of the genitalia is required to separate this species from others in the genus. It is recorded from two distinct habitats, both of which have loose sand or coarse soil. The first is from rivers and streams, often in mountainous areas, and the second is dune slack pools where the species has often been located only by pitfall trapping or by survey in the terrestrial habitat; sand by running water or in dune slacks appears to be its main habitat (Foster, 2010). Most modern Scottish records have come from the Northhouse Burn in Roxburghshire where it is found in the ablation zone, at the roots of plants in deep unstable beds of sand and shingle (Foster, 2001).

Throughout Britain it is known from Devon, Wiltshire, Norfolk, Glamorgan, Pembroke, Ceredigion, Anglesey, Yorkshire and Northumberland, with older records from Hampshire, Cambridgeshire, Lancashire and Westmorland (Foster, 2010). The fairly recent [2001] Northumberland records are from dune slack pools on Holy Island (Foster, pers. comm.) Aside from the Northhouse Burn the only other confirmed Scottish record is from Thornhill in Dumfriesshire in 1910 (Foster, pers. comm.). An 1866 record from Aberlady Bay is mentioned in Foster (1994), but subsequent examination of the material revealed it to be *Dryops ernesti*. *Dryops nitidulus* and *D. ernesti* can be confused without examination of the genitalia (Foster, per. comm.), thus many *D. nitidulus* records may be erroneous, although, on the list of species for the Firth of Forth SSSI, it would appear that this species has never occurred in the site. The only other records from Aberlady Bay reserve are for *Dryops luridus* and *D. ernesti*. Katty Baird has been carrying out extensive pitfall trapping of spiders across the reserve, and any beetles captured are sent to a coleopterist at Natural England for identification. She has collected *D. luridus* and *D. ernesti* from traps in dune slacks, but no *D. nitidulus* has turned out (K. Baird, pers. comm.)

The low number of sites from which *D. nitidulus* has been collected since 1980 shows an apparent decline over much of the species' range and this, coupled with the fragility of its habitats, led to it being given Near Threatened status. Its main threats are stream regulation and abstraction and the lowering of water tables in dune slack areas, such as by the construction of golf links and other coastal developments (Foster, 2010).

6.1.2 Distribution and ecology of Hydraena pulchella

Hydraena pulchella occurs in pockets of still water at the edges of streams and rivers. These are sometimes amongst tree roots but more usually amongst clean silt or mud (Foster, 2010) and often subject to continuous gentle wave action (Foster, 2001). It has also been recorded from drains leading onto coastal levels (Foster, 2010).

Modern records for the species include Sussex, Kent, Oxfordshire, Worcester, Yorkshire, Cumberland, Dumfries, Ayrshire and Lanark, with older records from Devon, Dorset, Hereford, Warwickshire, Kirkcudbright, West Lothian, West Perth and Moray. Three records are listed on the Firth of Forth citation although, based on labelled museum material, the most recent record is in fact 1908 (Foster, pers. comm.). At Culross, the SSSI boundary runs along the top of the shoreline thus these historic records are not actually within the boundary of the SSSI.

Due to its small area of occupancy, fragmented distribution and evidence of declines, it has been given an IUCN category Vulnerable. The main threat to *H. pulchella* is enrichment of watercourses that damages its habitat by the accumulation of algae and organic material (Foster, 2010).

6.1.3 Previous survey data

The only records for aquatic invertebrates from the Firth of Forth SSSI citation which are on the SNH Invertebrate Site Register are *H. pulchella* and aquatic invertebrate species from the Aberlady Bay area (NT 46 81). This latter group of records is based on comprehensive survey carried out throughout 1985 and 1986 of freshwater habitats in the Yellow Mires Marsh, most notably the many small pools created by the removal of concrete anti-tank blocks and from the Marl Loch (Jeffries, 1987). The exact methods and sampling sites were not described, although some water chemistry parameters were measured and a very comprehensive species list was generated (Table 4). The data suggest that the marsh is a base-rich, pH-neutral wetland, an important habitat in the local area.

The list includes several Local species as well as the Nationally Scarce crane fly *P. replicata*, the Nationally Scarce soldier fly *Stratiomys singularior*, the Nationally Scarce scavenger water beetle *Enochrus quadripunctatus* and the diving beetles *A. labiatus* and *A. unguicularis*. *Agabus labiatus* is a former Nationally Scarce species that was given an IUCN status of Near Threatened in Foster (2010). It is usually found in temporary pools and more permanent acid waters, probably to avoid fish predation; nationally it is known from Somerset to Inverness, with the distribution in Scotland including Fife, Angus, South Aberdeenshire, Moray, East Inverness and East Ross. *Agabus unguicularis* is a former Nationally Scarce species, subsequently downgraded in Foster (2010). It is generally found in peaty water amongst moss or dense vegetation.

The specimens of *Hydroporus memnonius* included a matt female, a more southerly form, and *Enochrus testaceus* (Jeffries, 1987), a rare species in Scotland that is known only from the Yellow Mires Marsh and richly vegetated ponds on the Solway coast (Foster, 2001). The suggestion is thus that the Yellow Mire Marsh supports a fauna common further south but unusual in Scotland (Jeffries, 1987). Note that there is some doubt over the identification of *Anacaena limbata* as the only confirmed record from Scotland is from Boyach Loch in Wigtownshire. Whilst common in England and Wales, in Scotland *A. limbata* is replaced by the dark parthenogentic form of *A. lutescens* (Foster, 2001).

In addition to the species listed in Table 4 there are also records for the 'Local' lesser water boatman species *Corixa panzeri* and *S. semistriata*.

Table 4 – List of aquatic invertebrates recorded form the Yellow Mires Marsh, Aberlady Bay by Jeffries during 1985 and 1986 (data from Jeffries, 1987).

COELENTRATA			
Hydra sp.			
PLATYHELMINTHES			
Dalyellia viridis	*Polycelis tenuis*	*Dugesia lugubris*	
GASTROPODA			
Stagnicola palustris gp.	*Planorbis planorbis*	*Planorbis carinatus*	*Gyraulus crista*
Bathyomphalus contortus	*Hippeutis complanatus*	*Oxyloma pfeifferi*	
BIVALVIA			
Pisidium casertanum			
OLIGOCHAETA			
Nais variabilis	*Lumbriculus variegatus*		
HIRUDINEA			
Theromyzon tessulatum	*Helobdella stagnalis*	*Erpobdella octoculata*	*Haemopis sanguisuga*
HYDRACARINA			
Rhabdohydrachna geographica	*Thyas venusta*	*Arrenurus* sp.	
ARANAEA			
Argyronecta aquatica			
CRUSTACEA			
Proasellus meridianus	*Daphnia curvirostris*	*Simocephalus vetulus*	*Candona candida*
Cypria ophthalmica	*Notodromas monacha*	*Diaptomus castor*	*Cyclops abyssorum*
Acanthocyclops gigas	Harpacticoidea sp.		
ODONATA			
Ischnura elegans	*Enallagma cyathigerum*	*Lestes sponsa*	
EPHEMEROPTERA			
Cloeon dipterum	*Habrophlebia fusca*	*Caenis horaria*	
TRICHOPTERA			
Holocentropus stagnalis	*Triaenodes bicolor*	*Oxyethira* sp.	*Limnephilus binotatus*
Limnephilus centralis	*Limnephilus rhombicus*	*Limnephilus vittatus*	
HEMIPTERA			
Nepa cinerea	*Notonecta glauca*	*Cymatia bondsdorffi*	*Callicorixa praeusta*
Corixa punctata	*Hesperocorixa linnaei*	*Hesperocorixa sahlbergi*	*Sigara fossarum*
Sigara nigrolineata			
DIPTERA			
Tipula luna	*Dicranomyia ventralis*	*Phalacrocera replicata*	Psychodidae sp.
Ptychoptera scutellaris	*Dixella autumnalis*	*Chaoborus crystallinus*	*Anopheles claviger*
Culiseta fumipennis	*Ceratopogonidae* sp.	*Holotanypus* sp.	*Abroblesmia* sp.
Meropelopia sp.	*Xenopelopia* sp.	*Acricotopus lucens*	*Eukiefferiella* sp.
Psectrocladius sp.	*Coryoneura scutellata*	*Chironomus dorsalis*	*Phaenospectra* sp.
Microspectra sp.	*Zavrelia pentatoma*	*Odontomyia viridula*	*Stratiomys singularior*
Empididae sp.	Dolichopodidae sp.	*Atherix ibis*	
COLEOPTERA			
Haliplus obliquus	*Haliplus ruficollis*	*Haliplus sibericus*	*Hygrotus inaequalis*
Hydroporus angustatus	*Hydroporus erythrocephalus*	*Hydroporus memnonius*	*Hydroporus palustris*
Hydroporus planus	*Hydroporus striola*	*Hydroporus umbrosus*	*Agabus bipustulatus*
Agabus labiatus	*Agabus nebulosus*	*Agabus unguicularis*	*Ilybius ater*
Rhantus exsoletus	*Colymbetes fuscus*	*Dytiscus marginalis*	*Helophorus aquaticus*
Helophorus brevipalpis	*Hydrobius fuscipes*	*Anacaena limbata*	*Laccobius biguttatus*
Enochrus quadripunctatus	*Enochrus testaceus*	*Ochthebius minimus*	*Cyphon* sp.

6.2 Methods

Due to the scale of the Firth of Forth SSSI, the distribution of habitats and the listed occurrence of freshwater taxa, it was decided to limit sampling for the aquatic beetle assemblages to Aberlady Bay and Culross specifically to try and locate *D. nitidulus* and *H. pulchella* respectively at each location.

At Aberlady Bay, the freshwater habitats Marl Loch and the pools on the Yellow Mires Marsh sampled by Jeffries (1987), as well as the Peffer Burn that flows into the bay from the direction of Gullane, were within the SSSI boundaries. The lower reaches of the burn were distinctly tidal but the upper section by Blackford Bridge was mostly freshwater; sampling was carried out here to ascertain if *D. nitidulus* may be collected from the eroded bank habitats. The Marl Loch and several of the pools were also sampled on the Yellow Mires Marsh.

The sampling method described in section 2 was supplemented by sampling with a tea strainer of mossy hollows around some of the pools on the Yellow Mires Marsh. In addition to net sampling in the open water, the surrounding bryophyte carpet was sampled by pushing down into the moss, thereby creating a depression that was allowed to fill with water from the surrounding saturated vegetation; the resulting hollow was then swept through with a tea strainer. This is a particularly good method for collecting small hydrophilid and hydraenid beetles that live within the saturated moss carpets of bogs and fens. Sampling at Aberlady Bay took place on 31 May 2013.

Culross was visited on 4 June, when the only possible habitat for *H. pulchella* was a small stream, the Blair Burn which flows into the estuary via a culvert underneath the shoreline car park on the western edge of the village of Culross. Sampling was carried out on the lower reaches of this watercourse.

In addition to the aquatic Coleoptera, other aquatic invertebrates collected were also identified and recorded. Figure 3 illustrates the locations of the sampling sites.

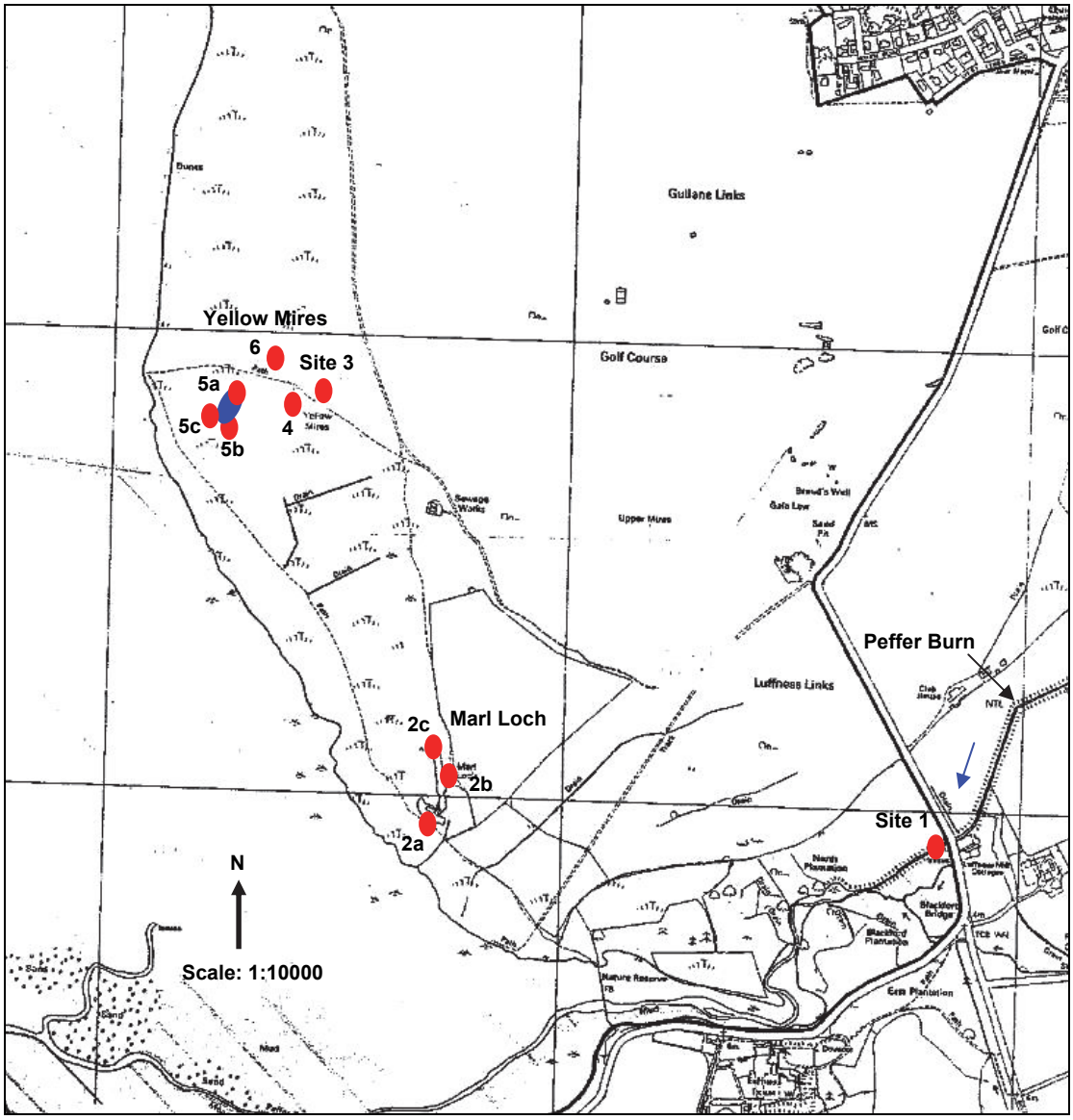


Figure 3. The locations of sampling sites on the Peffer Burn, Marl Loch and Yellow Mires Marsh at Aberlady Bay (© Crown copyright. Based upon Ordnance Survey data with the permission of the Controller of Her Majesty's Stationery Office. Licence number GD03135G0005.)

6.3 Results

A total of 80 invertebrate taxa were recorded during the survey, 70 from the lentic (still water) sites and 17 from the lotic (running water) sites (Tables 5 & 6). These records included *D. luridus*, *D. ernesti*, *E. testaceus* and several other species of localised distribution. There were no records of *D. nitidulus*. Three species of water beetle were collected from the lotic sites with one species *Hydroporus tessellatus* not found in the lentic habitats; there was no record of *H. pulchella* from the Blair Burn at Culross.

Table 5 - Data for the still water habitats (sites 2 to 6), along with CCI values and incidental field sightings of fish, amphibians and adult damselflies

SITE	**2 (Marl Loch)**	**3**	**4**	**5**	**6**
NGR	NT 4670 8095; NT 4675 8103; NT 4673 8108	NT 4633 8192	NT 4633 8187	NT 4621 8184; NT 4623 8172; NT 4620 8173	NT 4615 8193
CONDUCTIVITY (µScm$^{-1)}$	460	600	810	870 7.1	630
pH	8.5	7.3	6.9	7.1	6.8
AQUATIC INVERTEBRATE TAXA					
TRICLADIDA					
PLANARIIDAE					
Polycelis nigra				X	
OLIGOCHAETA					
Oligochaeta spp.		X	X	X	X
HIRUDINEA					
GLOSSIPHONIIDAE					
Glossiphonia complanata	X				
HIRUDIDAE					
Haemopis sanguisuga	X		X	X	X
ERPOBDELLIDAE					
Erpobdella octoculata	X	X		X	
GASTROPODA					
LYMNAEIDAE					
Radix balthica				X	
Stagnicola palustris gp.			X	X	X
PHYSIDAE					
Physa fontinalis					X
PLANORBIDAE					
Planorbis carinatus	X			X	
Gyraulus albus					X
Hippeutis complanatus	X				
Anisus leucostoma		X	X	X	X
HYDROBIIDAE					
Potamopyrgus antipodarum				X	
SUCCINEIDAE					
Oxyloma pfeifferi	X	X	X		
BIVALVIA					
SPHAERIIDAE					
Sphaerium corneum	X				
Pisidium obtusale		X			X
Pisidium casertanum			X	X	
Pisidium milium				X	
Pisidium nitidum	X				
CRUSTACEA					
CRANGONYCTIDAE					
Crangonyx pseudogracilis	X	X	X	X	
ASELLIDAE					
Proasellus meridianus	X		X	X	
CLDOCERA					
DAPHNIIDAE					
Simocephalus vetulus				X	
ZYGOPTERA					
COENAGRIONIDAE					

Ischnura elegans	X			X	
Pyrrhosoma nymphula					
ANISOPTERA					
LIBELLULIDAE					
Libellula quadrimaculata	X				
EPHEMEROPTERA					
CAENIDAE					
Caenis robusta	X				
BAETIDAE					
Cloeon dipterum				X	
TRICHOPTERA					
LIMNEPHILIDAE					
Limnephilus marmoratus	X				
Anabolia nervosa	X				
LEPTOCERIDAE					
Athripsodes aterrimus	X				
PHRYGANEIDAE					
Agrypnia varia	X				
HEMIPTERA					
CORIXIDAE					
Hesperocorixa linnaei	X	X		X	
Hesperocorixa sahlbergi		X	X	X	
Sigara dorsalis	X			X	
VELIIDAE					
Microvelia reticulata				X	
GERRIDAE					
Gerris odontogaster			X		
Gerris sp. (nymphs)		X			
NOTONECTIDAE					
Notonecta glauca	X			X	
DIPTERA					
CHIRONOMIDAE					
Chironomidae sp.	X	X	X	X	X
CERATOPOGONIDAE					
Palpomyia / Bezzia gp.	X				
STRATIOMYIDAE					
Odontomyia angulata / larval species B?				X	
PTYCHOPTERIDAE					
Ptychoptera contaminata				X	
LIMONIIDAE					
Gonomyia sp.				X	
COLEOPTERA					
HYDROPHILIDAE					
Anacaena globulus	X	X			
Anacaena lutescens	X		X	X	
Hydrobius fuscipes		X	X	X	X
Laccobius minutus				X	
Enochrus testaceus	X				
Coelostoma orbiculare				X	
HELOPHORIDAE					
Helophorus brevipalpis			X		
HYDRAENIDAE					
Ochthebius minimus		X	X		
HALIPLIDAE					

Haliplus ruficollis				X	
NOTERIDAE					
Noterus clavicornis	X				
DYTISCIDAE					
Dytiscus sp. (larvae)	X	X			
Colymbetes fuscus		X	X	X	X
Agabus bipustulatus		X	X		
Agabus sturmii	X		X	X	X
Ilybius ater			X		
Rhantus exsoletus				X	
Hygrotus inaequalis				X	
Hydroporus palustris				X	
Hydroporus striola		X	X		X
Hydroporus planus		X	X		X
Hydroporus nigrita				X	
Hydroporus memnonius		X		X	
Hydroporus erythrocephalus		X	X	X	X
Hydroporus angustatus				X	
DRYOPIDAE					
Dryops luridus		X	X		
Dryops ernesti			X		
SCIRTIDAE					
Cyphon sp. (larvae)		X	X		
CHRYSOMELIDAE					
Galerucella sp.				X	
FIELD OBSERVATIONS					
ADULT ODONATA					
Ischnura elegans	X				
FISH					
Gasterosteus aculeatus				X	
AMPHIBIA					
Lissotriton helveticus		X			
Bufo bufo	X				

Table 6 - Data for the running water habitats (sites 1 and 7) on the Peffer and Blair burns, along with incidental field sightings of fish, amphibians and adult damselflies.

SITE	**1 (Peffer Burn)**	**7 (Blair Burn)**
NGR	NT 4784 8092	NS 9801 8590
CONDUCTIVITY (µScm^{-1})	940	
pH	7.7	
AQUATIC INVERTEBRATE TAXA		
OLIGOCHAETA		
Oligochaeta spp.	X	X
GASTROPODA		
LYMNAEIDAE		
Radix balthica	X	
HYDROBIIDAE		
Potamopyrgus antipodarum	X	
CRUSTACEA		
GAMMARIDAE		
Gammarus pulex	X	
Gammarus zaddachi	X	
ASELLIDAE		
Asellus aquaticus	X	
PLECOPTERA		
NEMOURIDAE		
Nemurella picteti		X
EPHEMEROPTERA		
BAETIDAE		
Baetis rhodani	X	X
TRICHOPTERA		
POLYCENTROPODIDAE		
Plectrocnemia conspersa		X
LIMNEPHILIDAE		
Micropterna sequax		X
Drusus annulatus		X
HEMIPTERA		
VELIIDAE		
Velia caprai		X
Velia sp. (nymphs)	X	
DIPTERA		
CHIRONOMIDAE		
Chironomidae sp.	X	X
CERATOPOGONIDAE		
Palpomyia / Bezzia gp.	X	
COLEOPTERA		
HELOPHORIDAE		
Helophorus brevipalpis		X
DYTISCIDAE		
Agabus bipustulatus		X
Hydroporus tessellatus		X
FIELD OBSERVATIONS		
FISH		
Platichtys flesus	X	
Gasterosteus aculeatus	X	

6.4 Site Descriptions

6.4.1 Site 1: Peffer Burn

Site 1 was located on the lower reaches of the Peffer Burn, above the marine transitional zone at Blackford Bridge. The site was a riffle just downstream of the bridge and, although it showed some signs of tidal influence, the fauna was predominately freshwater aside from the shrimp *Gammarus zaddachi*. The burn's channel was contained within abrading silt/sand banks, thickly vegetated with *Phragmites australis*. The substrate consisted of cobbles and pebbles, many of which were covered in green filamentous algae (*Cladophora* agg. and *Enteromorpha intestinalis*).

The aquatic invertebrate community was not particularly diverse and was dominated by large numbers of *Gammarus* shrimps and the isopod *A. aquaticus*. Although the marginal habitat could have been suitable, *D. nitidulus* was not recorded. The composition of the invertebrate community and the thick growth of algae indicated that the burn was heavily enriched.

6.4.2 Site 2: Marl Loch

Marl Loch is a large pond at the southern edge of Aberlady Bay reserve. Sampling was carried out at three locations around the shore, with 1 minute of pond-netting and 10 minutes of field sorting. At all three locations the invertebrate assemblage was dominated by large numbers of the shrimp *Crangonyx pseudogracilis* and planorbid snails. The first sampling spot (NT 4670 8095) was at the southern end of the loch, in an area of dense fringing *Glyceria maxima* swamp. The second (NT 4675 8103) was on the east bank of the northern end of the loch, where the fringing vegetation was more open and consisted of *G. maxima* with intermixed *Carex rostrata* and occasional *Menyanthes trifoliata* and a few stands of *Iris pseudoacorus* and *Equisetum palustre* at the base of the bank. The third area (NT 4673 8108) was in the shallow water at the north end of the loch, where there was a fringing *C.rostrata* swamp with intermixed *Equisetum fluviatile* and *Menyanthes*.

Uncommon species recorded included the 'Local' mayfly *Caenis robusta* and the beetles *E. testaceus* and *Noterus clavicornis,* both common species in southern Britain but expanding northwards. *Noterus clavicornis* is characteristic of well-vegetated still waters, especially those containing *Menyanthes*. It is a common species in the south; in Scotland it is frequent in Dumfries and Galloway (Foster, 1994) but relatively rare elsewhere, having expanded its range into Ayrshire and the central belt since the 1970s (Foster, 2001). The species was not previously recorded by Jeffries (1987) and has since colonised the area.

6.4.3 Site 3: Yellow Mires Marsh

The Yellow Mires Marsh occupies much of the western side of the reserve, encompassing the low ground between Marl Loch and the sand dunes in the north, most of which is usually flooded in winter. Several overgrown small field drains are present as well as numerous depressions, ranging from the 'tank trap ponds' surveyed by Jeffries to dune slack pools and scrapes constructed more recently by reserve volunteers for winter waders. At the time of survey (late May), many of these former flooded areas had dried out considerably, although the type and extent of the vegetation clearly delineated land that experienced regular inundation. Many of the depressions were still damp although there was no standing water to allow sampling for aquatic invertebrates.

Site 3 was the last remnant of a much larger area of flooded ground. Most of the vegetation consisted of *Carex, Equisetum palustre* and *Filipendula ulmaria*, with occasional *Caltha palustris, Ranunculus omiophyllus* and the moss *Calliergonella cuspidata*. The invertebrate assemblage was dominated by aquatic beetles, including several specimens of *D. luridus* and *C. pseudogracilis*.

6.4.4 Site 4: Yellow Mires Marsh

Site 4 was a small pool, the only open water remaining within a much larger damp area of low-lying ground. *Carex, E. palustre, Filipendula* and the moss *Drepanocladus aduncus* grow around the edges of the pool, whilst submerged in the water were *Drepanocladus, Hippuris vulgaris* and *Chara* sp. The aquatic invertebrate fauna was surprisingly diverse for such a small pool and was dominated by *Crangonyx* and beetles, including *D. luridus* and *D. ernesti.*

6.4.5 Site 5: Yellow Mires Marsh

This was a large, shallow pond on the western side of the marsh, sampled at three locations around its margins. *Crangonyx* and aquatic snails made up the bulk of the invertebrate community. The first sampling location (NT 4621 8184) at the northern end was in a swamp of *Schoenoplectus* with intermixed *Hippuris* and shallow water behind, in which grew stands of *Apium nodiflorum, M. aquatica, R. omiophyllus, Callitriche* sp*., L. minor* and a moss carpet including *Drepanocladus, Campyliadelphus* and *Calliergonella*. The second sampling location (NT 4623 8172) was a fringing band of *Typha latifolia* at the southern end of the pond, with shallow water behind in which grew *Hippuris, E. palustris, M. aquatica, R. omiophyllus* and mosses. The third location (NT 4620 8173) was a small flooded hollow at the south-west corner of the pond, in which *Filipendula, M. aquatica, Rorippa nasturtium-aquaticum* and *Myosotis* sp*.* grew with occasional clumps of terrestrial grass species and docks.

Three-spined sticklebacks (*Gasterosteus aculeatus*) were present indicating that this pond is probably a more permanent feature of the marsh than many of the other depressions.The. The most diverse assemblage in the survey was recorded here, including the 'Local' diving beetle *R. exsoletus*, larvae of the 'Local' phantom crane fly *Ptychoptera contaminata* and a single specimen of a soldier fly larva. This latter specimen keyed out as *Odontomyia angulata* or as 'larval species B' from Stubbs & Drake (2001) key. *Odontomyia angulata* is poorly known from Britain with only a few sites on the Somerset Levels and in East Anglia and Oxfordshire. 'Larval species B' was described from a single specimen collected from amongst moss in a trickle among seepages on marshy grassland sloping down to the sea shore near Whitehills on the north coast of Aberdeenshire, much further north than any other *Odontomyia* species (Stubbs & Drake, 2001). The related *O. viridula* has been recorded from the reserve but the dorsal pattern of the specimen collected lacked the distinct thistle-shaped marking of this species. Markings and colouration can be notoriously unreliable for identification, especially for specimens preserved in alcohol. A search for adult specimens is required to identify species at site 5 with any certainty.

6.4.6 Site 6: Yellow Mires Marsh

This was a low-lying area of flooded ground amongst small dunes on the northern edge of the Yellow Mires Marsh with hummocks of grass (mostly *A. stolonifera*) and moss protruding above the water. It had occasional *Hippuris* and *E. palustre* and dense filamentous green algae in the wet hollows. The assemblage was not particularly diverse, dominated by *Hydroporus* diving beetles and the planorbid snail *Anisus leucostoma*.

6.4.6 Site 7: Blair Burn

The Blair Burn was the only area of freshwater habitat available for sampling in the Culross area. The Burn flows down a steep wooded valley and between a terrace of houses at the edge of Culross village before entering a culvert and the estuary. Sampling took place along the open reach upstream of the culvert. On 4 June the stream was quite shallow with little flow, in essence consisting of a series of small pools in the bed linked by shallow tricking

water. The substrate was mostly cobbles, gravel and pebbles, with occasional boulders and overlying silt in the pools. A thick mat of the moss *D. palustre* grew in a pool at the top of the sampled reach.

The fauna was not very diverse and consisted of mostly larvae of the caddis *P. conspersa* and *Nemurella picteti* stonefly nymphs. No *H. pulchella* were recorded and although there were several areas of marginal slack water, the burn did not offer the best habitat for the species. The record for *H. tessellatus* is the only modern one for this species on the east coast north of Northumberland (G. Foster, pers. comm.). Although widespread in slow-running streams, pools, ditches and ponds at low altitude in England, in Scotland it is mostly limited to the west coast where the typical habitat is small pools on the landward side of salt marshes filled with rotting seaweed (Foster, 1994; Foster, 2001).

6.5 Conclusions

Twenty-six species of water beetle were collected as well as *Dytiscus* and *Cyphon* larvae; 25 from the Marl Loch and habitats on the Yellow Mires Marsh at Aberlady Bay Local Nature Reserve and an additional record for *H. tessellatus* from the Blair Burn at Culross. This compares favourably with the 27 species (plus *Cyphon* larvae) recorded by Jeffries. There are significant differences in the taxa list which could be due to sampling variability and the fact that Jeffries carried out his sampling encompassing differing water levels, although this is not actually detailed in Jeffries (1987). Several of the uncommon species, such as *A. labiatus, A. unguicularis* and *E. quadripunctatus,* were not recorded in 2013 although *E. testaceus*, a species with a more southern distribution, was recorded as well several other species not previously recorded. The presence of *N. clavicornis* in the Marl Loch illustrates the northwards increase in this species' range in Scotland.

Dryops luridus and *D. ernesti* were present in pools on the marsh. *Dryops nitidulus* was not recorded either on the Yellow Mires Marsh or by sampling in the abraded marginal habitats of the Peffer Burn. Examination of historic data and specimens has shown that *D. nitidulus* was never truly recorded from the area, with an old 19th century record actually representing misidentified *D. ernesti*.

Hydraena pulchella was not found in the Blair Burn, the only freshwater habitat at Culross, where this species was last recorded in 1908. A railway line runs along the coast here and behind it much of the coastline has been developed. The boundary for the Firth of Forth SSSI only extends to mean high water along the Culross shore thus the beetle was probably never recorded within the SSSI. A century of heavy industry along the Firth of Forth, including enrichment from agriculture as well as impacts from coal mining and naval activity during the wars is likely to have adversely affected much of the habitat along the estuary.

As most of the Firth of Forth SSSI is essentially marine habitat and the only freshwater aquatic invertebrate records for the SSSI are from the Yellow Mires Marsh, it would appear that this is the centre for aquatic beetles and consequently sampling was mostly limited to this area. Comparison of the 2013 records with Jeffries' 1985/86 survey indicated that a rich assemblage of beetles was still present and habitat appeared to be in good condition. On this basis the water beetle assemblage of the SSSI can be said to be in favourable-maintained condition. The SSSI encompasses areas around the Tyne Mouth near West Barna and sections of coastal grassland on the north and south coasts, including the dunes north of Gullane. The boundary also incorporates the lagoon and mud flats at Skinflats near Grangemouth, where the River Carron flows into the estuary and freshwater pools might occur on the river's flood plain. These areas should be investigated to identify any other potential freshwater habitats including ponds, marshes and dune slack pools.

As neither *D. nitidulus* nor *H. pulchella* were recorded, one could argue that the water beetle assemblage is in unfavourable condition. However it would appear that the 19th century record for *D. nitidulus* from the Aberlady Bay area was in fact incorrect and that *H. pulchella* was never actually recorded within the SSSI.

6.6 Management recommendations

- The freshwater habitat in the Yellow Mires Marsh and Marl Loch on the Aberlady Bay Local Nature Reserve appear to be in good condition. Much of this is no doubt due to the efforts of the reserve warden and a team of local volunteers. Maintenance of the habitats will involve preserving the current water levels and checking any scrub encroachment. Much of the marsh is managed for winter waders, including the creation of scrapes which is likely to have concomitant benefits for freshwater invertebrates.

- Both *D. nitidulus* and *H. pulchella* should be removed from the list of species on the Firth of Forth SSSI citation. The only record for *D. nitidulus* is based on erroneously identified *D. ernesti*. *Hydraena pulchella* was last recorded from the Culross area in 1908 and as the SSSI boundary runs along the mean high water level at this location, it would almost certainly have been recorded outside the SSSI. There does not appear to be any suitable habitat for the species remaining at Culross.

- Other areas within the SSSI boundary where freshwater habitats may occur should be investigated and identified for future survey effort for aquatic beetles and other invertebrates.

- SNH should maintain close links with volunteers working at the reserve. Katty Baird's pit-fall trapping for spiders is likely to produce some interesting results, including stray aquatic beetles. A Diptera survey may help identify the soldier-fly larva recorded at site 5 on the Yellow Mires Marsh, which potentially could simply be a misidentified *O. viridula* or something of much greater interest.

6.7 Site Photographs

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

7. LOCHS OF HARRAY & STENNESS

7.1 Introduction

The two large lochs of Harray and Stenness are located on the Orkney west Mainland between Stenness and Dounby, to the north-east of Stromness. Together the two lochs make up the Lochs of Harray and Stenness SSSI which was notified due to its saline lagoon and eutrophic loch habitats, wintering populations of goldeneye, scaup, tufted duck and pochard and two freshwater invertebrate species *T. fluviatilis* and *Y. reuteri*.

Loch of Stenness is the second largest saline lagoon in Britain and is of great importance due to its size, stability, northern location and fluctuating salinity. The loch stretches from the Bridge of Waithe, where it is connected to the Bay of Ireland by a narrow channel known as the Bush, northwards to Voy and eastwards to the Bridge of Brodgar, where the loch connects with Loch of Harray. Due to its sea connection Loch of Stenness is brackish throughout, and its vegetation is dominated by seaweeds.

Loch of Harray is mostly eutrophic freshwater, although there is a transition zone to brackish water around the channel connecting the lochs at the Bridge of Brodgar. The extent of this zone depends on seasonal water levels and the tide cycle, although the brackish influence on the inner loch has declined significantly since one-way flaps were installed at Brodgar in the 1960s. The Loch's catchment encompasses a shallow basin covering the centre of west Mainland, with water draining into the loch from as far away as the flanks of the Kame of Corrigal. A variety of freshwater habitats and vegetation is present around Loch of Harray including several species of charophytes and nine species of pondweed, three of which (*Potamogeton filiformis, P. praelongus* and *P. friessi*) have restricted distributions. Both *Y. reuteri* and *T. fluviatilis* have been recorded from the loch, their only known Scottish locations.

The Loch of Harray has suffered from the effects of enrichment in the past and was classified as unfavourable-no change in August 2004. The catchment is almost entirely agricultural and used for grazing and silage. The sewage works of Dounby, the largest population centre, are discharged into the northern part of the loch at Decca Bay, and numerous other small farms and dwellings around the shore are linked to septic tanks that may have some seepage or discharge to the loch, especially during prolonged wet weather. Nutrient enrichment has led to algal blooms on the Loch of Harray and during the 1980s the effects of enrichment were exacerbated by the excessive growth of the invasive Canadian pondweed (*Elodea canadensis*).

The Loch of Stenness' catchment is similar in nature with the main population centre at Stenness having their sewage works discharged into the loch. However nutrient levels in the brackish loch have not been a problem and the saline lagoon habitat was assessed as favourable-maintained in September 1999.

7.1.1 Distribution and ecology of Ylodes reuteri

The larvae of this caddis species are found in brackish water, amongst vegetation and usually where there is slight water movement. Wallace (1991) expressed some concern over the Loch of Harry population due to the threats of enrichment of the loch and the tidal flaps altering the salinity regime. Aside from its only known Scottish location at Loch of Harray, *Y. reuteri* has been recorded from Spurn in Yorkshire, various sites in Suffolk and Norfolk and the Thames Estuary marshes in north-west Kent and Essex. Aside from Loch Harray and Spurn the breeding sites are unknown (Wallace, 1991). The species has been recorded from Loch of Harray in 1980 (under its former name *Triaenodes reuteri*), 1986 and 2003 (Godfrey, 2004).

7.1.2 Distribution and ecology of Theodoxus fluviatilis

The freshwater nerite is common in the south of Britain, living in well-oxygenated waters rich in lime, including fast and slow-flowing rivers, canals and the wash-zone of large calcareous lakes. It grazes on algae and favours hard surfaces including pebbles, rocks or the masonry of bridges. It is tolerant of brackish water and mild organic pollution, but has disappeared from highly polluted canals and rivers (Kerney, 1999). In Britain its range extends as far north as Lancashire and Yorkshire (Kerney, 1999) although on the website of the National Biodiversity Network there are several records (collected by the Environment Agency) north of this in the watercourses bordering the Lake District and a single 1900 record from Lanarkshire north of Lesmahagow. It would appear that Kerney considered this latter record to be invalid. Thus the records from Orkney are the only confirmed from Scotland. The species has been known from the Loch of Harray since 1931 (then *Neritina fluviatilis*) and from the Loch of Stenness (Boycott, 1936), where it was last recorded in 1938 (International Centre for Island Technology, 2004). It has been recorded many times from the Loch of Harray and the population there seems to be both stable and secure.

7.1.3 Previous survey data

Various invertebrate surveys have been carried out on the Lochs of Stenness and Harray, with the most relevant for freshwater aquatic invertebrates in 1938, 1978, 1980 and 1995. The results of these are summarised in a report commissioned by SNH (International Centre for Island Technology, 2004) which includes extensive species lists for algae, macrophytes and invertebrates in both lochs. *Theodoxus fluviatilis* was recorded at Loch of Harray and Loch of Stenness, but only in the Loch of Harray thereafter. *Ylodes reuteri* was recorded from the Loch of Harray in 1980 but not in the other surveys.

Table 7 – Aquatic invertebrates recorded during the 2003 CSM survey (Godfrey, 2004).

	Site 1	Site 2	Site 3	Site 4
TRICLADIDA				
Polycelis felina	X			
GASTROPODA				
Potamopyrgus antipodarum	X		X	X
Theodoxus fluviatilis	X			X
Bathyomphalus contortus		X		
Radix balthica		X		
CRUSTACEA				
Crangonyx pseudogracilis				X
TRICHOPTERA				
Polycentropus flavomaculatus	X			
Cyrnus trimaculatus				X
Tinodes waeneri	X	X	X	X
Agapetus fuscipes	X			
Athripsodes aterrimus			X	X
Athripsodes cinereus	X	X	X	
Ceraclea fulva	X			
Mystacides longicornis		X		
Mystacides azurea				X
Potamophylax latipennis	X			
Limnephilidae sp. (indet.)			X	X

On 9 August 2003 Andy Godfrey carried out a SCM survey for *Y. reuteri* in the Loch of Harray. This survey concentrated on sweep netting for adult caddis larvae at four locations around the loch, coupled with field observations of other species (Table 7). Note that all the

caddis records are for adults. He recorded five male *Y. reuteri* at site 1, the Ring of Brodgar, and observed *Theodoxus* at site 4, the picnic spot near Grimeston, both at the southern end of the loch.

7.2 Methods

The same four sites sampled by A. Godfrey in 2003 on Loch of Harray were selected for sampling, plus an additional site at the top end of Stenness Loch at the mouth of the Burn of Dale, close to Veron Point and The Ness (Figure 4). Methods were described in section 2. Sampling took place on 2 June 2013 at site 3, Merksiter hotel, and at the remaining sites on 3 June. Other aquatic invertebrates collected during the survey were also identified and recorded.

Figure 4. Locations of sampling sites on the Loch of Harray and Loch of Stenness (© Crown copyright and database right 2010. All rights reserved. Ordnance Survey Licence number 100017908).

7.3 Results

Sixty-four invertebrate taxa were recorded (Tables 8 & 9). The list from Loch of Harray included the Near Threatened diving beetles *Nebrioporus depressus* and *Hygrotus novemlineatus. Theodoxus* was present at all four sites on Loch Harray but *Y. reuteri* was not recorded.

Table 8 - Taxa for the four sampling sites on Loch of Harray along with incidental sightings of fish.

SITE	**1 (Ring of Brodgar)**	**2 (Mill of Rango)**	**3 (Merkister Hotel**	**4 (Longholm)**
NGR	HY 2981 1329	HY 2697 1790	HY 2981 1896	HY 3093 1398
CONDUCTIVITY (µScm$^{-1)}$	1330	830	720	1070
pH	8.5	8.5	8.5	8.3
AQUATIC INVERTEBRATE TAXA				
TRICLADIDA				
PLANARIIDAE				
Polycelis tenuis	X	X	X	X
OLIGOCHAETA				
Oligochaeta spp.	X	X	X	X
HIRUDINEA				
GLOSSIPHONIIDAE				
Glossiphonia complanata	X	X	X	X
Helobdella stagnalis	X			X
Theromyzon tessulatum	X	X	X	X
ERPOBDELLIDAE				
Dina lineata	X	X	X	X
GASTROPODA				
LYMNAEIDAE				
Radix balthica	X	X	X	X
PLANORBIDAE				
Bathyomphalus contortus	X	X	X	X
NERITIDAE				
Theodoxus fluviatilis	X	x	X	X
HYDROBIIDAE				
Potamopyrgus antipodarum	X	X	X	X
SUCCINEIDAE				
Oxyloma pfeifferi	X			X
BIVALVIA				
SPHAERIIDAE				
Sphaerium corneum	X	X	X	X
Pisidium hibernicum		X	X	X
Pisidium milium	X			X
Pisidium nitidum			X	
CRUSTACEA				
CRANGONYCTIDAE				
Crangonyx pseudogracilis		X		
GAMMARIDAE				
Gammarus duebeni	X	X	X	X
ASELLIDAE				
Asellus aquaticus	X	X	X	X
JANIRIDAE				
Jaera nordmanni	X			X
OSTRACODA				

Ostracoda spp.		X		
HYDRACARINA				
Hydracarina spp.		X		
PLECOPTERA				
CHLOROPERLIDAE				
Siphonoperla torrentium	X			
EPHEMEROPTERA				
CAENIDAE				
Caenis luctuosa		X	X	X
TRICHOPTERA				
POLYCENTROPODIDAE				
Polycentropus flavomaculatus	X	X	X	X
PSYCHOMYIIDAE				
Tinodes waeneri	X		X	X
GLOSSOSOMATIDAE				
Agapetus fuscipes	X			X
LEPIDOSTOMATIDAE				
Lepidostoma hirtum	X		X	
SERICOSTOMATIDAE				
Sericostoma personatum	X		X	X
LIMNEPHILIDAE				
Limnephilus lunatus	X	X	X	X
Limnephilus extricatus				X
Limnephilus marmoratus			X	
Chaetopteryx villosa	X		X	X
Potamophylax latipennis	X			
Anabolia nervosa			X	
HYDROPTILIDAE				
Agraylea multipunctata		X		
Hydroptila sp.		X	X	
LEPTOCERIDAE				
Athripsodes cinereus	X	X		
Athripsodes aterrimus		X	X	
MEGALOPTERA				
SIALIDAE				
Sialis lutaria			X	X
HEMIPTERA				
CORIXIDAE				
Callicorixa praeusta		X		
Sigara dorsalis	X	X	X	X
VELIIDAE				
Velia caprai	X			X
DIPTERA				
CHIRONOMIDAE				
Chironomidae sp.	X	X	X	X
COLEOPTERA				
HYDROPHILIDAE				
Anacaena lutescens				X
HELOPHORIDAE				
Helophorus brevipalpis				X
HYDRAENIDAE				
Hydraena riparia gp. (female)				X
Limnebius truncatellus				X
HALIPLIDAE				

Haliplus ruficollis		X		X
Haliplus lineatocollis		X		X
Haliplus confinis				X
Haliplus sp. (larvae)			X	
ELMIDAE				
Elmis aenea			X	
Oulimnius tuberculatus	X			
DYTISCIDAE				
Dytiscus sp. (larvae)				
Nebrioporus depressus	X			
Agabus sturmii		X		
Ilybius fuliginosus		X		
Hygrotus inaequalis		X		
Hygrotus novemlineatus				X
Hydroporus erythrocephalus		X		
DRYOPIDAE				
Dryops sp. (females)	X			
FIELD OBSERVATIONS				
FISH				
Anguilla anguilla		X		
Salmo trutta				X
Gasterosteus aculeatus	X	X	X	X

Table 9 - Taxa for the single site (site 5) on Loch of Stenness along with incidental sightings of fish.

SITE	**5 (Vernon Point)**
NGR	HY 2547 1498
CONDUCTIVITY (µScm$^{-1)}$	>1990
pH	8.3
AQUATIC INVERTEBRATE TAXA	
POLYCHAETA	
Nereis diversicolor	X
GASTROPODA	
HYDROBIIDAE	
Potamopyrgus antipodarum	X
CRUSTACEA	
GAMMARIDAE	
Gammarus zaddachi	X
MYSIDAE	
Neomysis integer	X
COLEOPTERA	
HELOPHORIDAE	
Helophorus grandis	X
FIELD OBSERVATIONS	
FISH	
Gasterosteus aculeatus	X

7.4 Site Descriptions

7.4.1 Site 1: Ring of Brodgar

This was a stony (mostly cobble and pebbles, with lesser amounts of gravel) wave-washed shore adjacent to the road, close to the Ring of Brodgar standing stones and not far from the link with Loch of Stenness. The high conductivity indicated a degree of brackish influence but the water tasted rather fresh. The fauna was predominately freshwater, with the exception of the brackish water isopod *Jaera nordmanni*. Both the hydrobiid snail *Potamopyrgus antipodarum* and the shrimp *Gammarus duebeni* can tolerate brackish conditions but cannot really be counted as indicators of such. *Potamopyrgus antipodarum* has long been adapted to freshwater habitats across Britain and occurs throughout the country, often far from the sea. *Gammarus duebeni* can tolerate brackish water but on islands and many peninsulas in the west of Britain (*e.g.* The Lizard in Cornwall) it replaces the ubiquitous *G. pulex* in freshwater habitats, forming stable populations in streams and still waters.

Vegetation along the shoreline was sparser than the other three sampling locations, possibly due to being exposed to greater wave action. *Caltha palustris, M. aquatica, Carex, Juncus articulatus, Litorella uniflora* and lesser amounts of *P. arundinacea* grew along the shoreline. Further out frequent clumps of *Chara* grew amongst the larger stones, many of which had patches of encrusting *Rivularia* and much rarer *Hildenbrandia*. A large clump of the moss *F. antipyretica* was also present and many of the stones had small sponge colonies attached (likely to be *Spongilla lacustris*). A few small balls of the green alga *Aegagropila linnaei* were noted along the shore line.

The fauna was dominated by large numbers of *G. duebeni* and the caddis *Agapetus fuscipes*. Many of the larger stones were covered in the cases of this species and a large hatch was going on at the time of sampling. Most stones along the shoreline also had at least some *T. fluviatilis* attached. Uncommon species recorded included the Near Threatened diving beetle *N. depressus* and the leech *Dina lineata,* the only erpobdelid usually recorded this far north. Godfrey had collected adult *Y. reuteri* along this shore line in 2003 but no larvae were observed during the current survey.

7.4.2 Site 2: Mill of Rango

Site 2 was located in a small bay at the north-western end of the loch, close to the bungalow at Scarrataing, with pasture coming almost down to the loch shore and separated from it by a fence and a marginal fringe of vegetation. A heavily-trampled embayment gave cattle access to the water and a small muddy stream flowed into the loch adjacent to the sampling site. The bay was quite sheltered and the substrate predominately consisted of pebbles and gravel covered with a thick layer of decaying *Cladophora* sp. algae and films of *Spirogyra* sp..The latter was especially concentrated around the embayment and the mouth of the small stream. The fringe of marginal vegetation included: *C. nigra, Caltha, Equisetum fluviatile, M. trifoliata, E. palustris, A. stolonifera, Iris pseudoacorus, P. arundinacea, Sparganium erectum* and *Epilobium hirsutum*, with occasional clumps of *F. antipyretica* and *Elodea canadensis* in the deeper water.

The invertebrate assemblage was dominated by large numbers of the hog louse *A. aquaticus* and the lesser water boatman species *Sigara dorsalis* and *Callicorixa praeusta*. *Gammarus duebeni* and the crawling water beetles *Haliplus lineatocollis* and *H. ruficollis* were also present in substantial numbers, along with the leech *Glossiphonia complanta* and the flatworm *Polycelis tenuis* which covered many of the larger stones. The two haliplid beetles feed on filamentous algae and the abundance of green algal films across the bay

explained their high numbers. *Theodoxus* was present on a few stones but in much lesser numbers than at the other three sites.
The overall impression was that the site was heavily enriched, probably due to run-off from the nearby pasture directly into the loch and also into the small stream. The sheltered nature of the bay would also allow organic matter to accumulate and reduce the flushing out of nutrient-rich sediment. In 2003 Godfrey also noted green algae covering the stones at the edge of the shore (Godfrey, 2004).

Shallow water extended some way out into the loch, and outside the bay there was significantly more wave action. Clumps of *Cladophora* still grew on many of the larger rocks but the substrate was not smothered beneath a film of algae. There was also a more diverse community of submerged plants, including *Chara* sp., *Myriophyllum alterniflorum* and a few patches of rather stunted *P. praelongus*. *Theodoxus* was present on most of the rocks, in much greater numbers than within the bay.

7.4.3 Site 3: Merkister Hotel

Sampling was carried out along a length of shoreline separated from the road to the Merksiter Hotel by a narrow belt of rank vegetation, mostly *U. dioica* and *F. ulmaria*. The site was located in the far north-eastern corner of the loch and the shoreline was quite wave-washed with a predominately gravel substrate, although substantial amounts of pebbles and cobbles were also present. Marginal vegetation included *Carex* sp*., E. palustre, M. aquatica, P. arundinacea, Filipendula, L. uniflora, Iris, Caltha, Sparganium erectum* and *J. articulatus*. *Elodea canadensis, M. alterniflorum and F. antipyretica.* Scattered patches of *Chara* and stunted *P. praelongus* were also present in the deeper water. Many of the larger stones had small colonies of *Spongilla lacustris* (?) attached, along with patches of *Hildenbrandia* and *Cladophora. Theodoxus* was present on most of the larger cobbles.

The invertebrate community was dominated by large numbers of *G. duebeni* with lesser numbers of *A. aquaticus* and limnephilid cased caddis larvae.

7.4.4 Site 4: Headland opposite Long Holm

Site 4 was located at the southern end of the loch on the east shore, virtually opposite site 1 at the Ring of Brodgar. Sampling was carried out within a small bay at the end of the western headland, due south of the easternmost point of Long Holm island. This headland was reached by a path from the picnic area near Grimeston and is the same location sampled by Godfrey in 2003, north of the small embayment ("lagoon") between the two headlands.

The site experienced some wave action but was much more sheltered than sites 1 and 3, with shallow water extending quite some way out into the loch. The substrate was predominately gravel, with areas of larger pebbles and cobbles. Marginal vegetation included *M. aquatica, Menyanthes, Caltha, R. omiophyllus, E. palustre, Filipendula* and rare *S. erectum* and *Litorella.* 'Cladophora balls' (*Aegagropila linnaei*) were abundant along the shore line and amongst the marginal vegetation. In the deeper water were clumps of *F. antipyretica*, *Chara* and a single stand of *M. alterniflorum*. Many of the larger cobbles had *Spongilla* colonies, *Theodoxus* and *A. fuscipes* cases attached to them, with occasional patches of attached *A. linnaei*.

The aquatic invertebrate community was dominated by large numbers of *G. duebeni* and nymphs of the angler's curse mayfly *Caenis luctuosa*. The Near Threatened diving beetle *H. novemlineatus* was recorded here. The high conductivity and the presence of the isopod *Jaera nordmanni* suggested some brackish influence.

Godfrey (2004) described the “lagoon” between the two headlands as being “covered with green algae-covered rocks” implying that this area was heavily enriched. During the current survey no such algal cover was noted and the fauna did not suggest any enrichment at the site.

7.4.5 Site 5: Loch of Stenness

After failing to find *Y. reuteri* at the ring of Brodgar, sampling was carried out at the northern end of Loch of Stenness in the small bay north of Veron Point on the Ness and close to the mouth of the Burn of Dale, where it was thought that less brackish conditions might exist and the area might potentially be suitable for *Y. reuteri* larvae. The site was, however, distinctly brackish with very little freshwater influence. The substrate was deep anoxic silt, covered in a layer of *Enteromorpha intestinalis* algae, with marginal vegetation including various seaweed (mostly *Fucus*) species and *Phragmites australis.* The invertebrate assemblage consisted of large numbers of the brackish water shrimp *G. zaddachi*, a few *P. antipodarum* and singletons of the remaining three species.

7.5 Conclusions

Theodoxus fluviatilis was recorded at all four sites around the Loch of Harray and the population remains stable, widespread and in favourable-maintained condition.

Ylodes reuteri larvae were not found at site 1, the Ring of Brodgar and were not present at any of the other sampling sites on the Loch of Harray or the single site sampled at the northern end of the Loch of Stenness. It is hard to judge from a single sampling event as to whether the species is no longer present in the loch. Although many adult caddis tend not to move far from their larval sites, it may be the case that the species is not actually breeding at the Ring of Brodgar site and larvae may be present closer to the Bridge of Brodgar. However on the basis of this survey alone the conclusion is that the *Y. reuteri* feature for the SSSI is in unfavourable-declining condition.

Higher conductivity levels and the presence of the brackish water isopod *J. nordmanni* at sites 1 and 4 at the southern end of Loch of Harray indicated that there was still some brackish influence on the southern part of the loch from Loch of Stenness. Although little is known on the actual water chemistry requirements of *Y. reuteri* it may be that, over time, the brackish influence on Loch of Harray has decreased due to the one-way tidal flaps at the Bridge of Brodgar. Other potential impacts on the species could arise from enrichment of the loch which has caused water quality issues in the past. However, the only signs of enrichment appeared to be within the enclosed bay at site 3, the Mill of Rango at the far northern end of the loch, where *Theodoxus* was present but in much smaller numbers in comparison to the other sampling sites. Outside the bay the numbers of *Theodoxus* increased as the stronger wave action caused a concomitant decrease in the algal coverage. Godfrey (2004) noted signs of enrichment at site 4 during 2003 but these were not observed in 2013.

7.6 Management recommendations

- During an on-site meeting, Kate Thompson, the SNH Operations Officer for Orkney was familiarised with the appearance and habitat of *T. fluviatilis* and several reference specimens were collected. *Theodoxus* is a distinctive freshwater snail that cannot be confused with any other freshwater species. It is recommended that local SNH staff carry out future surveys for *Theodoxus* and monitor the status of the population, saving the expense of contractors. Specimens can be sent for verification to the current contractor if required.

- Control the usage of fertilisers on the surrounding catchment and the discharge of farm slurry and sewage into the Loch of Harray in order to prevent eutrophication that is liable to be detrimental to *Y. reuteri* and *T. fluviatilis*. Enrichment was certainly evident at site 3 and other small sheltered bays at the northern end of the loch may also be suffering from similar conditions. It is likely that the more exposed shorelines are not likely to be impacted due to wave action that disperses nutrients. Although currently still abundant around the loch, *Theodoxus* could be especially vulnerable to eutrophication as it promotes growth of filamentous algae, which can smother the substrate, including the larger rocks on which *Theodoxus* attaches itself to graze.

- SNH should liaise with officers from SEPA who carry out water quality monitoring on Loch of Harray as part of SEPA's commitment to the Water Framework Directive. Part of this monitoring programme should include the sampling of aquatic macro-invertebrates around the margins of the lake. If this includes sampling at the southern end of the lake then specimens of *Y. reuteri* may be collected in the future. SEPA officers should be trained and encouraged to look for this species during sampling or can send specimens on to the contractor for identification.

- Maintain the current water level management as it seem suitable for diverse aquatic invertebrate communities.

7.7 Site photographs

Site 1

Site 2

Site 3

Site 4

Site 5

8. RANNOCH MOOR

8.1 Introduction

Rannoch Moor SSSI encompasses a high-level basin approximately 10 km north of Bridge of Orchy.It contains an extensive mosaic of blanket bog and fen habitats as well as numerous streams, lochs and lochans. The various open water habitats range from small dystrophic bog pools and lochans to larger oligotrophic lochs such as Loch Ba, Loch Laidon and Lochan na h-Achlaise.

Notified features within the SSSI include the dystrophic and oligotrophic loch and blanket bog habitats, breeding bird assemblage, assemblages of Coleoptera, Diptera and moths, and communities of vascular plants. This includes several rare species such as *Lycopodiella inundata, Carex magellanica, Betula nana, Nuphar pumilla, Sparganium angustifolium* and the Rannoch-rush (*Scheuchzeria palustris*), for which the site is the only known location in Britain. The vascular plant assemblage was found to be in unfavourable condition in 2001, 2002 and 2004, due to over-grazing and burning on the moor, and the absence of two key species that make up the assemblage. Due to a lack of recent records, the invertebrate assemblages have not been assessed but the remaining four features have all been assessed as favourable.

Much of the SSSI is under management agreements with SNH, along with an area in the north-east, a former National Nature Reserve which is owned by SNH. The area is used for a variety of activities such as walking, canoeing, fishing and deer stalking.

8.1.1 The aquatic beetle assemblage at Rannoch Moor and previous survey data

Various surveys have been carried out over the years and Table 10 summarises the list of aquatic beetles recorded. The records incorporate data from both lentic and lotic habitats. The data on the NBN gateway is mostly derived from Balfour-Browne club water beetle surveys, records from SEPA's biological monitoring and data from the Highland Biological Recording Group. For such a large and diverse area, the list of beetles is quite small, probably reflecting the low nutrient status of many of the water bodies.It does, however, contain a high proportion of uncommon species adapted to the various habitats on the plateau.

Table 10 – Aquatic Coleoptera recorded at Rannoch Moor SSSI (data compiled from SNH data and the website of the National Biodiversity Network).

DYTSICIDAE			
Dytiscus lapponicus	*Dytiscus marginalis*	*Dytiscus semisulcatus*	*Agabus bipustulatus*
Agabus congener	*Agabus arcticus*	*Agabus sturmii*	*Agabus affinis*
Agabus guttatus	*Agabus paludosus*	*Ilybius aenescens*	*Rhantus exsoletus*
Acilius sulcatus	*Hydroporus longicornis*	*Hydroporus obscurus*	*Hygrotus novemlineatus*
Nebrioporus depressus	*Potamonectes griseostriatus*	*Oreodytes septentrionalis*	
HALPLIDAE			
Haliplus ruficollis	*Haliplus fulvus*	*Haliplus lineatocollis*	
GYRINIDAE			
Gyrinus opacus	*Gyrinus minutus*	*Gyrinus substriatus*	
HYDROPHILIDAE			
Enochrus affinis	*Enochrus fuscipennis*	*Anacaena globulus*	
SCIRTIDAE	**ELMIDAE**	**DRYOPIDAE**	
Cyphon padi	*Elmis aenea*	*Dryops luridus*	

The lesser diving beetle (*Acilius sulcatus*) is rather rare in southern Scotland but fairly common and widespread elsewhere. In the north of Scotland it is typical of isolated, fishless lochans (Foster & Friday, 2011). *Hygrotus novemlineatus* is an IUCN Near Threatened species typically found in open non-vegetated lochs and tarns. *Nebrioporus depressus* is another Near Threatened species typical of lochs but also found in running water in the north of Scotland where its much commoner relative *N. elegans* is absent. Other Near Threatened species include *Dytiscus lapponicus*, a species of lochs and lochans and *Hydroporus longicornis* (see Annex for further information on both species), a species of relict spring-fed bogs and fens. The 1972 record for *D. lapponicus* from the 'roadside lochan near Loch Ba' was based on fragments of a dead specimen, possibly spat out by a heron. *Dytiscus lapponicus* is very prone to be trapped (G. Foster, pers. comm.) but it can no longer be found on the Rannoch Moor plateau (Foster, 2010).

The Nationally Scarce whirligig beetles *Gyrinus opacus* and *G. minutus* have also been recorded; the former is a species of exposed lochans in the north of Scotland and the latter characteristic of still water, usually on peat in dubh lochan complexes and western lakes (Foster & Friday, 2011). The last record for *G. opacus* from the Rannoch plateau was in 1980 and the species is probably no longer present (G. Foster, pers. comm.)

Other uncommon species include *E. affinis*, a frequent species of large intact bogs (Foster, 1994); the diving beetle *Ilybius aenescens*, found in permanent, acidic, stagnant water, usually under loose masses of *Sphagnum;* and five 'Local' species of diving beetle: *H. obscurus*, *Oreodytes septentrionalis, Agabus arcticus*, *A. congener* and *R. exsoletus. Agabus affinis* is another rare species in the Highlands, despite its association with *Sphagnum* lawns (Foster, 2001).

8.2 Methods

In order to obtain as diverse a list of aquatic beetle species as possible, a variety of different habitats across the plateau were surveyed. This included the dubh lochan complex in the north-west (sites 1 and 2), bog pools (sites 3 and 5), loch margins (site 4 and 7), a stream (site 8) and a slow-flowing bog runnel (site 6). Initially the plan was to include sampling sites on the eastern side of Loch Ba and the north-western arm of Loch Laidon, however the nature of the terrain and the distances involved meant that a lot of time would have been spent traversing the moorland between sites and less time sampling. Sampling was thus restricted to sites that were relatively easy to access from the A82 along the western border of the SSSI.

The sampling method was described in section 2, supplemented by some sampling with a tea strainer of mossy hollows around the bog pools and runnel. In addition to net sampling in the open water, the surrounding *Sphagnum* carpet was sampled by pushing down into the moss, thereby creating a depression that was allowed to fill with water inflowing from the surrounding saturated vegetation; the resulting small water-filled hollow was then swept through with a tea strainer. This is a particularly good method for collecting small hydrophilid and hydraenid beetles that live within the saturated moss carpets of bogs.

In addition to the aquatic Coleoptera, other aquatic invertebrates collected were identified and recorded. Figure 5 illustrates the locations of the sampling sites. Sampling took place on 5 June 2013.

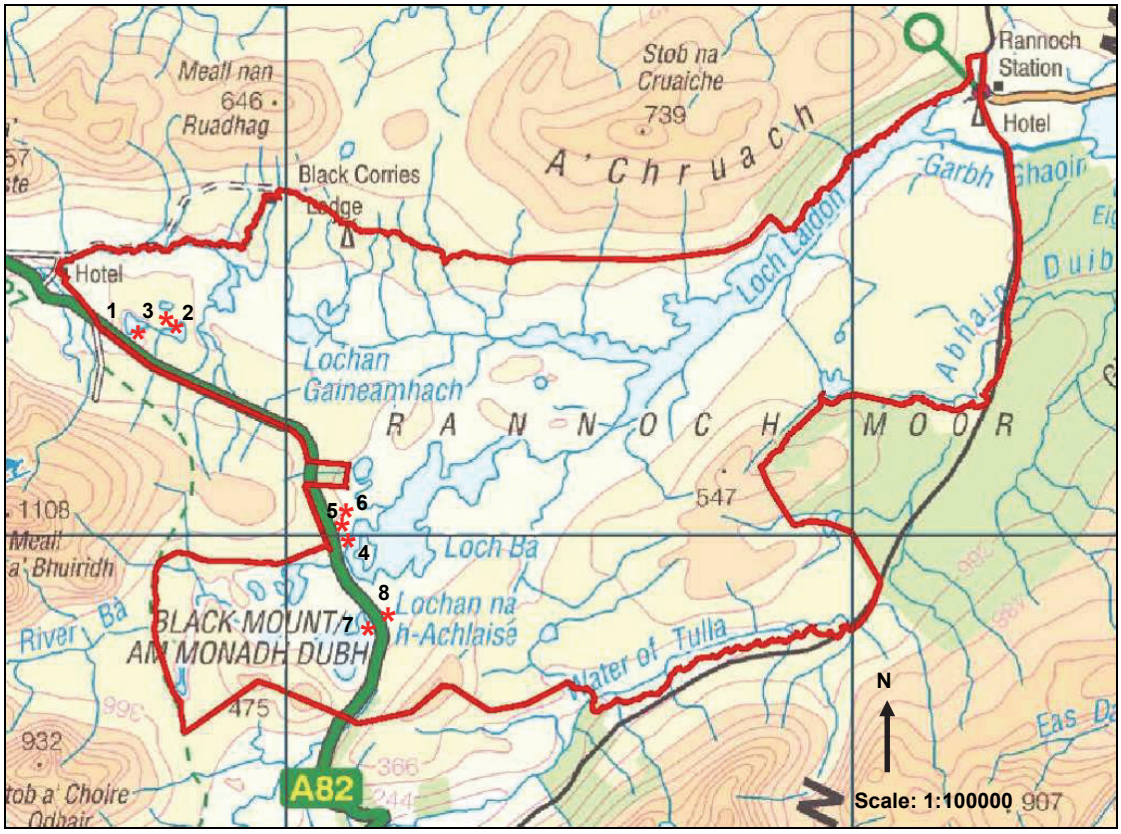


Figure 5. Locations of sampling sites on Rannoch Moor SSSI (© Crown copyright and database right 2007. All rights reserved. Ordnance Survey Licence number 100017908).

8.3 Results

Fifty four invertebrate taxa were recorded (Table 11). The beetles included the Nationally Scarce *G. minutus* recorded from the bog pool at site 5, *A. arcticus, A. congener*; *H. obscurus*, *H. tristis* and *Rhantus suturellus*. These last two species are new records for the SSSI. *Rhantus suturellus* is typically associated with upland peat pools and lochans, especially those thinly vegetated with *Eriophorum* species. It is frequent in Scotland, the more mountainous areas of western Wales and also in northern England and on heathland from Dorset to Berkshire (Foster & Friday, 2011). *Hydroporus tristis* is usually found in *Sphagnum* pools on peat bogs but has also been recorded in groundwater-fed fens (Foster & Friday, 2011) and is common across most of Scotland.

Other uncommon aquatic invertebrate taxa included larvae of the caddis *Polycentropus kingi*, the lesser water boatman *Sigara scotti* and Lilljeborg's pea mussel (*Pisidium lilljeborgii*).

Table 11 - Taxa lists for the eight sampling sites along with incidental field sightings of fish, amphibians and adult Odonata.

SITE	1 (Dubh Lochan)	2 (Dubh Lochan)	3 (bog pool)	4 (Loch Ba)	5 (bog pool)	6 (bog runnel)	7 (Lochan na h-Achlaise)	8 (Stream)
NGR	NN 2728 5368	NN 2811 5371	NN 2806 5364	NN 3105 4975	NN 3106 4978	NN 3104 4983	NN 3152 4859	NN 3158 4861
CONDUCTIVITY (µScm$^{-1)}$	130	40	130	40	30	40	190	40
pH	6.3	6	4.5	6.6	4.5	4.7	5.5	5.3
AQUATIC INVERTEBRATE TAXA								
OLIGOCHAETA								
Oligochaeta spp.	X		X	X			X	X
BIVALVIA								
SPHAERIIDAE								
Pisidium hibernicum								X
Pisidium lilljeborgii	X			X			X	X
Pisidium milium	X							
CRUSTACEA								
GAMMARIDAE								
Gammarus lacustris				X				
CHYDRORIDAE								
Eurycercus lamellatus		X						
HYDRACARINA								
Hydracarina spp.								X
ZYGOPTERA								
COENAGRIONIDAE								
Enallagma cyathigerum	X	X		X			X	
Pyrrhosoma nymphula						X	X	
ANISOPTERA								
CORDULEGASTRIDAE								
Cordulegaster boltonii		X						
LIBELLULIDAE								
Libellula quadrimaculata					X	X	X	
AESHNIDAE								
Aeshna juncea					X			

PLECOPTERA								
CHLOROPERLIDAE								
Siphonoperla torrentium							X	
PERLODIDAE								
Isoperla grammatica								X
NEMOURIDAE								
Nemoura cinerea							X	
EPHEMEROPTERA								
LEPTOPHLEBIIDAE								
Leptophlebia vespertina	X	X		X		X	X	X
SIPHLONURIDAE								
Siphlonurus lacustris				X				
TRICHOPTERA								
POLYCENTROPODIDAE								
Holocentropus dubius		X						X
Polycentropus kingi				X				X
Plectrocnemia conspersa							X	
Plectrocnemia geniculata								X
SERICOSTOMATIDAE								
Sericostoma personatum	X	X		X				
LEPTOCERIDAE								
Athripsiodes aterrimus	X							
Mystacides azurea				X				
LIMNEPHILIDAE								
Limnephilus lunatus	X							
Limnephilus rhombicus				X			X	
Anabolia nervosa				X				
Halesus radiatus				X				X
Halesus digitatus								X
PHRYGANEIDAE								
Agrypnia obsoleta		X		X	X		X	
HEMIPTERA								
CORIXIDAE								
Hesperocorixa castanea					X			
Sigara scotti	X	X		X			X	

VELIIDAE								
Velia caprai							X	X
GERRIDAE								
Gerris odontogaster			X			X		
Gerris sp. (nymphs)		X						
MEGALOPTERA								
Sialis lutaria	X	X			X	X	X	X
DIPTERA								
CHIRONOMIDAE								
Chironomidae sp.	X	X	X	X	X	X		X
CERATOPOGONIDAE								
Palpomyia / Bezzia gp.		X						X
RHAGIONIDAE								
Chrysopilus sp.								X
TIPULIDAE								
Tipula montium								X
COLEOPTERA								
HYDROPHILIDAE								
Anacaena globulus							X	X
Hydrobius fuscipes					X		X	
Enochrus fuscipennis					X			
GYRINIDAE								
Gyrinus substriatus		X			X		X	
Gyrinus minutus					X			
DYTISCIDAE								
Dytiscus sp. (larvae)					X			
Platambus maculatus								X
Agabus bipustulatus					X	X	X	
Agabus arcticus		X					X	
Agabus congener					X			
Ilybius fuliginosus							X	
Rhantus suturellus			X					
Acilius sp. (larvae)					X			
Hydroporus obscurus		X			X		X	
Hydroporus tristis					X			

FIELD OBSERVATIONS								
ADULT ODONATA								
Enallagma cyathigerum		X						
Libellula quadrimaculata					X			
Aeshna juncea		X						
FISH								
Gasterosteus aculeatus				X				
AMPHIBIA								
Lissotriton helveticus								
Rana temporaria (tadpoles)		X		X				X

8.4 Site descriptions

8.4.1 Site 1: Dubh Lochan

Site 1 was located on the westernmost waterbody of the dubh lochan complex in the north-west of the SSSI, close to the King's House Hotel. Sampling was carried out along the south shore, near the mouth of a small stream flowing into the lochan, an area dominated by *Menyanthes trifoliata*, with occasional *Equisetum fluviatile, Carex nigra* and a few stands of *Schoenus nigricans*. Submerged beneath the water were stands of *Myriophyllum alterniflorum* and *Juncus bulbosus*, with occasional patches of *Sphagnum* and *Utricularia*. The water was rather shallow throughout most of the lochan, with a substrate of peaty silt overlying more solid ground beneath.

Aquatic invertebrate diversity was very low with very few specimens and probably indicative of the low nutrient status of the waterbody. Noteworthy species included the boreal relict pea mussel *P. lilljeborgii* and *Sigara scotti*, a species that can be described as 'Local' nationally but which is common across most of Scotland and the Highlands.

8.4.2 Site 2: Dubh Lochan

This was the most eastern of the three larger waterbodies in the dubh lochan complex described above. Sampling took place on the west shore of the northern arm of this small lochan. The substrate was much stonier than site 1, consisting of mostly gravel with occasional cobbles and boulders overlying peat. There was a marginal fringe of *Carex*, with some *Eriophorum* intermixed and patches of submerged water lobelia (*Lobelia dortmanna*) forming a rather patchy turf. Other macrophytes included *Juncus bulbosus, Potamogeton polygonifolius, Sphagnum* and *Batrachospermum* algae, with a few patches of *Scapania* on some of the larger stones.

Although not a diverse community, many more specimens of aquatic invertebrates were collected in comparison to site 1, including *Sigara scotti*, *H. obscurus*, and *A. arcticus*. The community was dominated by large numbers of nymphs of the common blue damselfly (*Enallagma cyathigerum*) and *S. scotti*. Although not observed directly, fish were present in the lochan as many were heard rising during the sampling.

8.4.3 Site 3: Bog pool

This was a small bog pool on the moorland above site 2, covered with a very dense carpet of *Sphagnum*, with emergent *Carex* and *Eriophorum*. The dense *Sphagnum* made net sampling difficult and very few invertebrates were recorded: a few chironomid larvae and worms, a single *Rhantus suturellus* and several pond skaters (*Gerris odontogaster*) on the water surface.

8.4.4 Site 4: Loch Ba

Loch Ba was sampled in a small, shallow bay, close to the island at the western end of the loch. The substrate was gravel with the occasional boulder. There was little marginal cover, with scattered patches of water lobelia and *Juncus bulbosus*. Further out into the loch, where silt overlaid much of the gravel, there was a band of *Carex rostrata* swamp, with a few stands of intermixed *E. fluviatile*.

The shores along the western part of Loch Ba consisted of bare gravel shoals, mostly lacking in marginal vegetation. The loch is stocked with fish and used for angling, and the lack of suitable refuges from fish predation is likely to explain the complete absence of aquatic Coleoptera. The bulk of the population was dominated by chironomid larvae and the

shrimp *Gammarus lacustris*, a species that replaces the commoner, ubiquitous *Gammarus pulex* in the lakes of northern Britain.

8.4.5 Site 5: Bog pool

Site 5 was a small open bog pool close to site 4. The pool was much more open in comparison to site 3, with a mixed *Menyanthes* and *Eriophorum* swamp with *Sphagnum* around the edges.

Invertebrate diversity was moderate, with beetles, the lesser waterboatman *Hesperocorixa castanea* and nymphs of the common hawker dragonfly (*Aeshna juncea*) the most numerous species. Amongst the aquatic Coleoptera, *H. obscurus*, *H. tristis* and *G. minutus* were of note. Two specimens of *A. congener* were collected from amongst the *Sphagnum* around the edge of the pool.

8.4.6 Site 6: Bog runnel

This was a small runnel that drained a flat area of bog and eventually flowed into Loch Ba.Most of the channel was fairly deep with a peat substrate and no in-channel vegetation, although *Eriophorum* and *Sphagnum* grew at the edges. Invertebrate diversity was low with chironomid larvae and alderfly nymphs (*Sialis lutaria*) being most numerous.

8.4.7 Site 7: Lochan na h-Achlaise

This site was chosen as the possible location of *Dytiscus lapponicus.* It is a small bay at the eastern side of Lochan na h-Achlaise, close to the A82. Unlike many of the larger waterbodies on the moorland, there was a good marginal fringe of vegetation with a strip of *Carex nigra*, giving way to *E. fluviatile, Lobelia, P. polygonifolius, M. alterniflorum* and *J. bulbosus* in the deeper water. The substrate was mostly gravel with occasional pebbles, cobbles and boulders. A small runnel overgrown with *Sphagnum* flowed into the bay and some sampling took place at the edge of this.

Probably due to the presence of a good marginal fringe providing cover, invertebrate diversity at this site was the highest recorded, with 21 taxa present, including *P. lilljeborgii, Sigara scotti, H. obscurus* and large numbers of *A. arcticus* amongst the *Carex*.

8.4.8 Site 8: Stream, outflow from Lochan na h-Achlaise

Site 8 was located on a large stream, approximately 5-6 m wide that drained Lochan na h-Achlaise, exiting the lochan close to site 7. The stream flowed in a north-easterly direction to eventually enter Loch Laidon. The substrate was mostly cobbles and boulders with occasional pebbles. Sampling incorporated a shallow riffle and the deeper slower-flowing sections to either side. Vegetation on the riffle was sparse and limited to patches of *Marsupella emarginata* on a few cobbles, although *P. polygonifolius*, *Lobelia, J. bulbous* and marginal *Carex nigra* grew in the deeper water. Most of the substrate was also covered in a film of dense filamentous green algae (*Ulothrix* sp.).

The invertebrate community was representative of the lotic habitat and included larvae of the caddis *Polycentropus kingi*, the most numerous species present, and *P. lilljeborgii*.

8.5 Conclusions

Thirty-one species of aquatic beetle have been recorded from all aquatic habitats across Rannoch Moor SSSI, including a high proportion of nationally uncommon species (four species of IUCN Near Threatened category, two Nationally Scarce and seven other species with localised distributions). Two of the near Threatened species, *D. lapponicus* and *G.*

opacus, probably no longer occur on the plateau. The current survey recorded only 13 species, along with *Dytiscus* and *Acilius* larvae, including the Nationally Scarce *G. minutus* and the Local species *H. obscurus, A. arcticus* and *A. congener*. The survey also added two new species to the list, *Rhantus suturellus* and *Hydroporus tristis*.

On the basis of a single survey conducted on a limited number of sites, it was hard to make firm judgements on the condition of the aquatic beetle assemblage across the whole of the SSSI. The relatively low number of aquatic beetle species probably reflected the nutrient status of most of the waterbodies present, many of which are dystrophic, coupled with the lack of refugia provided by the shallow stony margins, with little marginal plant cover along many of the lochans. Waterbodies like the more productive, oligotrophic Loch Laidon, the larger watercourses draining into this loch and Garbh Ghaoir in the east of the SSSI were not investigated. Nonetheless, almost a third of species (four) were uncommon and two were new records for the area. The habitat for aquatic beetles along the western edge of the SSSI appeared to be intact and undisturbed and the species collected were indicative of the upland habitat.

The presence of fish in several of the lochans is cause for concern as many of the shorelines offer little refugia from fish predation. This may be a contributing factor to the disappearance of *G. opacus* and *D. lapponicus* from the plateau.

Overall the abundance of suitable habitat and the species list suggest that the aquatic beetle assemblage is in favourable condition and that further surveys in other parts of the SSSI, most notably the eastern section, are liable to generate many more records. The aquatic beetle assemblage can be regarded as favourable.

8.6 Management recommendations

- Maintain the current high water levels across the plateau by making sure no drainage works are undertaken.

- Maintain the low nutrient status of the waterbodies across the SSSI. The moorland is currently used for grazing and thus agricultural impacts on both the moor and the waterbodies are low. However, every effort should be made to reduce any increase in fertiliser applications.

- Be aware of potential road run-off from the busy A82 into waterbodies on the western side of the plateau, in particular Lochan na h-Achlaise, Loch Ba and the streams in the area. There were no signs of pollution during the survey, apart from rubbish dumped by motorists along the edge of the road, but road run-off can contain potential pollutants including engine oil and de-icer. Diverting some of the road drainage into settlement lagoons or reed beds before it enters the waterbodies would be of benefit.

- Avoid introducing fish into any more lochans. Fish can be voracious predators of water beetles and their presence will often curtail the diversity and numbers of aquatic Coleoptera.

- Further survey on the more nutrient-rich areas in the eastern half of the SSSI is recommended, in particular Loch Laidon and the watercourses that feed into it. Further work here is liable to significantly increase the number of aquatic beetle species recorded and would enable a more accurate assessment of the condition of the assemblage.

8.7 Site photgraphs

Site 1

Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

9. REFERENCES

Boyce, D.C. 2004. A review of the invertebrate assemblage of acid mires. *English Nature research report No. 592. Peterborough: English Nature.*

Boycott, A.E. 1936. *Neritina fluviatilis* in Orkney. *Journal of the Conchological Society of London,* **20**, 199-200.

Drake, C.M., Lott, D.A., Alexander, K.N.A. & Webb, J. 2007. Surveying terrestrial and freshwater invertebrates for conservation evaluation. *Natural England Research Report NERR005.*

Entomological Monitoring Services. 2003. Survey of notified water beetle sites in southern Scotland for site condition monitoring. *Scottish Natural Heritage Commissioned report, Contract AB(AC322)020361.*

Falk, S. 1991. A review of the scarce and threatened flies of Great Britain (part 1). *Research and Survey in Nature Conservation, No. 39*. Peterborough: Nature Conservancy Council.

Foster, G.N. 1994. Biodiversity inventory for Scotland: aquatic Coleoptera*. Scottish Natural Heritage Review No. 26.*

Foster G. N. 2001. Atlas of Scottish water beetles. *Scottish Natural Heritage Commissioned Report F00AC337.*

Foster, G.N., Bratton, J.H., Ewing, A.W., Hodge, P.J. & Nobes, G. 2007. Current status of *Donacia aquatica* Linnaeus (Chrysomelidae) in Britain and Ireland. *The Coleopterist,* **16**, 25-34.

Foster, G.N. 2010. A review of the scarce and threatened Coleoptera of Great Britain Part (3): Water beetles of Great Britain. *Species Status 1*. Peterborough: Joint Nature Conservation Committee.

Foster, G.N. & Friday, L.E. 2011. Keys to adults of the water beetles of Britain and Ireland (Part 1). *Handbooks for the Identification of British Insects Vol. 4, Part 5*. St. Albans: Royal Entomological Society.

Godfrey, A. 2004. Site condition monitoring: true flies, caddisflies and sawflies on Sites of Special Scientific Interest. *Scottish Natural Heritage Commissioned Report No. FO3AC322.*

Huxley, T. 2003. *Provisional atlas of the British aquatic bugs (Hemiptera, Heteroptera).* Huntingdon: Biological Records Centre.

International Centre for Island Technology. 2004. Review of biological communities in the Lochs of Stenness and Harray, Orkney. *Scottish Natural Heritage Commissioned Report No.066 (Part 2 of 12) (ROAME F01LA02).*

Jeffries, M. 1987. The freshwater fauna from the Yellow Mires Marsh, Aberlady Bay, Longniddry, East Lothian. *The Glasgow Naturalist*, **21**, 3, 283-286.

Kerney, M.P. 1999. *Atlas of the land and freshwater molluscs of Britain and Ireland*. Colchester: Harley Books.

Killeen, I. Aldridge, D. & Oliver, G. 2004 *Freshwater bivalves of Britain and Ireland*. Shrewsbury: Field Studies Council, occasional publication No. 82

Macadam, C. & Bennett, C. 2010. *A pictorial guide to British Ephemeroptera*. Shrewsbury: Field Studies Council.

Murray-Bligh, J. 1999*. Procedures for collecting and analysing macro-invertebrate samples. Internal Environment Agency document BT 001*.

Smith, K.G.V. 1989. An introduction to the immature stages of British flies diptera larvae, with notes on eggs, puparia and pupae. *Handbooks for the identification of British insects, 10, Part 14*. London: Royal Entomological Society.

Stubbs, A.E. & Drake, M. 2001. *British soldierflies and their allies: an illustrated guide to their identification and ecology.* Reading: British Entomological and Natural History Society.

Sutton, P. 2008. *The larger water beetles of the British Isles*. Orpington: The Amateur Entomologists' Society.

Wallace, I.D. 1991. A review of the Trichoptera of Great Britain. *Research & Survey in Nature Conservation No. 32*. Peterborough: Nature Conservancy Council.

Wallace, I.D., Wallace, B. & Philipson, G.N. 2003. Keys to the case-bearing caddis larvae of Britain and Ireland. *Freshwater Biological Association, Scientific Publication No. 61*, Ambleside.

ANNEX A: INFORMATION ON SPECIES OF CONSERVATION INTEREST

***Aquarius najas* (the river skater)**
Aquarius najas has a rather disjunct distribution, common locally in southern England and Wales but absent from much of northern Britain. Populations in Wigtownshire and Kirkcudbrightshire represent its most northerly occurrence. The species is found in the slow reaches of rivers and streams, often forming huge flotillas beneath dappled tree shade. It has been recorded from the River Dee downstream of Woodhall Loch, where unusually the species has been recorded from swirling water between massive granite boulders where there are no trees (Huxley, 2003).

***Caenis robusta* (angler's curse mayfly)**
A widespread but rather localised species, with most records from the south-east of England, although it does extend as far north as Sutherland and the Western Isles. Nymphs are found in pools and the margins of rivers, on lake shores or in canals and ponds, living in deep silt and mud on the bottom (Macadam & Bennett, 2010).

***Dytiscus lapponicus* (the Highland diving beetle)**
Known almost exclusively from Scotland, with one isolated site in North Wales, this species is typical of fishless dubh lochans in tension pool complexes in the Flow Country, or in remote mountain lochs, either without fish or with sufficient vegetation to provide a refuge from predation. It occurs across the Highlands south to Kintyr but is absent from the Southern Uplands (Foster & Friday, 2011). Most sites are remote, thus it is not under threat from development but many sites have been lost due to the introduction of fish (Foster, 2010). *Dytiscus lapponicus* was accorded an IUCN status of Near Threatened in Foster (2010).

***Gerris lateralis* (a pond skater)**
A species more common in northern Britain, extending as far south as Berkshire, even so there are large parts of northern Scotland where it is absent. It is particularly associated with very shallow water amongst tall swamp vegetation such as bottle sedge (*Carex rostrata*) (Huxley, 2003).

***Gyrinus minutus* (a whirligig beetle)**
The smallest of the whirligig species, the Nationally Scarce *G. minutus* is found in still water, usually on peat in dubh lochan complexes and also in western lakes. In Scotland the typical habitat is small peat pools and upland lochs, but it can also occur in mesotrophic still water (Foster, 1994). The species is known from a few sites on remnant heathland in Dorset, the Lake District, Yorkshire and South Essex but has died out across much of England. In Wales it is confined to Snowdonia (Foster & Friday, 2011) but in Scotland is relatively common around peaty lochs and in dubh lochan complexes in the south-west, the Highlands and Islands, with some loss of range in central Scotland (Foster, 2010).

***Gyrinus opacus* (a whirligig beetle)**
A Nationally Scarce species known only from the north of Scotland (the Highlands, Flow Country and Harris), where it is typical of the edges of exposed lochans and dubh lochan complexes in the Flow Country (Foster, 1994), often under undercut banks above exposed peat (Foster & Friday, 2011).

***Hydraena rufipes* (a water scavenger beetle)**
This Nationally Scarce species is generally associated with mossy rocks and clean shingle in base-rich fast streams over most of it range, it is also known from quarry pools in Scotland. Unlike several other species within the *Hydraena rufipes* group that require confirmation by

examination of the genitalia, male *H. rufipes* are relatively easy to identify due to a distinct bulge on the tibia just above the joint with the tarsus.

***Hydroporus longicornis* (a diving beetle)**
An IUCN Near Threatened species found in slow flowing water in dense mossy vegetation, either in headwater seepages or in valley fens (Foster & Friday, 2011), usually associated with base-poor water on a peaty substratum. It has a widespread distribution from Cornwall to the Highlands. In western Scotland the habitat is probably fairly safe, unlike many of the English and Welsh sites which are at risk from drainage and modification particularly in association with pasture improvement and afforestation (Foster, 2010).

***Hygrotus novemlineatus* (a diving beetle)**
Associated with permanent water in exposed lakes, usually with light-coloured, finely particulate bottom substrata, either sand or silt, sometimes interspersed with peat and often base-poor (Foster & Friday, 2011). This IUCN Near Threatened species is probably commoner in Scotland than anywhere else, although still confined to the larger lochs (Foster, 2001). It has a widespread but patchy distribution in Scottish, mainly in lakes in the western-southern uplands, then from Loch Lomond north to the Orkneys (Foster & Friday, 2011).

***Ilybius guttiger* (a diving beetle)**
Formerly designated as Nationally Scarce byt downgraded in Foster (2010), this species is found amongst flooded vegetation, particularly mosses in fens and often in dense reedbeds. Generally associated with shaded mossy pools in relict fens, it is also occasionally found in old clay workings with established vegetation. It is widespread but very local, with the British distribution centred on areas from Dorset to Essex and up to the Scottish borders. There is a wholly separate population of the species in Cornwall (Foster & Friday, 2011). In Scotland it is frequent in lowland fen and carr south of the southern uplands, with other records from the Glasgow area, north Ayrshire and Stevenson Loch (Foster, 1994, 2001).

***Limnephilus flavicornis* (a caddis species)**
Limnephilus flavicornis is common and widespread throughout most of Britain, but as it prefers fairly rich waters, it is absent from much of the upland districts. Its Scottish distribution is rather localised (Wallace, 1991), with most records concentrated in the central lowlands. The larvae can be difficult to separate from the closely related *Limnephilus marmoratus*, which builds a similar case of tangentially arranged plant fragments. Its habitat includes ponds, lakes, canals, ditches and pools, including areas that considerably diminish in the summer (Wallace, 1991).

***Nebrioporus depressus* (a diving beetle)**
Nebrioporus depressus habitat is typically vegetation-free deep water in larger lakes, but it will also occur in rivers in the north of its range where *N. elegans* is generally absent (Foster & Friday, 2011). In England it is confined to the Lake District whilst in Scotland it is commoner in the north with some overlap with the distribution of *N. elegans* in the south (Foster, 2001). IUCN status of Near Threatened.

***Nemoura erratica* (a stonefly)**
A stonefly whose nymphs are found in small stony streams, often headwaters near their source. Adults are found from February to September and the nymphs can be difficult to separate from other species in the family Nemouridae. Can be abundant where found.

***Phalacrocera replicata* (a cranefly)**
The gilled larvae of this Nationally Notable cranefly species are quite well camouflaged for a life of living in and feeding on mosses such as *Sphagnum* and *Hypnum* in pools on both fen and bog. The species has a widely scattered distribution, with its stronghold in the north of

England and Scotland. There appears to have been a decline over recent years, especially within its core area (Falk, 1991).

***Pisiidum lilljeborgii* (Lilljeborg's pea mussel)**
Pisidium lilljeborgii is a boreal relict species found mostly in upland areas, from small tarns to large lakes and lochs, but also occasionally in the sheltered margins of swift-flowing rivers and streams (Killeen *et al*., 2004). It occurs in mountainous areas in north and west Wales, the north of England and across Scotland (Kerney, 1999). It lives in a wide range of sediment types and unlike most other *Pisidium,* it can be found in coarser sandy or gritty substrates. In lakes and tarns it is typically associated with *Pisidium hibernicum* (Killeen *et al*., 2004).

***Pisidium pulchellum* (the iridescent pea mussel)**
A species of clean still water, especially over muddy, sometimes organic substrates. It is found in slow streams, marsh drains, lakes and ponds and is rare in rivers and canals. It prefers hard water in mostly lowland, but can be found in oligotrophic lakes at moderate elevations. It has a rather scattered distribution, mostly concentrated in southern and south-eastern England with few records in the north and Scotland (Kerney, 1999).

***Polycentropus kingi* (a caddis fly)**
Larvae of this species build nets to trap prey in stony rivers and streams. It is far less common than *P. flavomaculatus,* and larvae of the two species can be easily confused. It is fairly common in Scotland, Wales northern England and the south-west where the fast flowing watercourses it prefers are distributed, but is scarce elsewhere (Wallace, 1991).

***Ptychoptera contaminata* (a phantom cranefly)**
Ptychoptera larvae are semi-aquatic and inhabit saturated mud, having long telescopic breathing tubes on their rear ends, similar to those of the rat-tailed maggots (*Eristalis* sp.). *Ptychoptera contaminata* prefers mud covered with water with a high organic content and thus is common around farm yard pools and similar habitats (Smith, 1989). It has a widespread but localised distribution with most records from central and south-eastern England. It is becoming much less common in the north, Wales and the south-west, and is known from few sites in Scotland.

***Rhantus exsoletus* (a diving beetle)**
A species usually found along lowland lake, reservoir and pond edges amongst vegetation, usually in acid or mesotrophic conditions. Frequent in large tracts of fenland and heathland. In England it is absent from most of the south-west and in Wales it is mostly known from the north. In Scotland it is mostly confined to the south (Foster & Friday, 2011).

***Rhantus suturalis* (The supertramp diving beetle)**
Formerly allocated Nationally Scarce status, it has been downgraded in Foster (2010). It is a strong-flying species, usually associated with ponds in southern England, often recently created and polluted. It occurs across England, southern Scotland and Wales. In Scotland it is a fairly recent re-coloniser and as recent as 2001 was thought to be absent from the country, with the last record in 1950 (Foster, 2001). It is still expanding its range, having reached Caithness in the east and Glasgow in the west (Foster & Friday, 2011).

***Sigara scotti* (a lesser water-boatman)**
A mainly northern species which is relatively common across Scotland but can be described as 'Local' nationally. It is typically found in upland acidic waters but also occurs in ponds on lowland heaths in the south of Britain (Huxley, 2003).

***Sigara semistriata* (a lesser water-boatman)**
Its distribution is rather localised nationally, with most records in the north of England and Scotland. It is particularly associated with small base-deficient ponds but is not confined to such habitats, with many records from ditches (Huxley, 2003).

***Trichostegia minor* (a cased caddis species)**
Larvae of this species occur in pools and ditches, in woods and fens which often dry up in the summer and choke with rotting leaves or reed. They construct cases of dead leaves arranged longitudinally. It is fairly widespread in England, although not particularly common. It is known from only a few sites in Wales and from just a single location, Caerlaverock, in Scotland. It can be considered Notable in Wales and Scotland but probably not in England, with the possible exception of the north-east and Yorkshire (Wallace, 1991). It is considered to be a good candidate species for spreading northwards in the future (I. Wallace, pers. comm.).

www.snh.gov.uk

ISBN: 978-1-78391-073-1

Policy and Advice Directorate, Great Glen House,
Leachkin Road, Inverness IV3 8NW
T: 01463 725000

You can download a copy of this publication from the SNH website.

recycle

Scottish Natural Heritage
Dualchas Nàdair na h-Alba
All of nature for all of Scotland
Nàdar air fad airson Alba air fad