

Assessing the presence of vendace in Loch Earn, 2016





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. 976

Assessing the presence of vendace in Loch Earn, 2016

For further information on this report please contact:

Professor Colin Bean
Scottish Natural Heritage
Clydebank Business Park
CLYDEBANK
G81 2NR
Telephone: 0141 9514488
E-mail: colin.bean@snh.gov.uk

This report should be quoted as:

Lyle, A.A. & Adams, C.E. 2017. Assessing the presence of vendace in Loch Earn, 2016.
Scottish Natural Heritage Commissioned Report No. 976.

This report, or any part of it, should not be reproduced without the permission of Scottish Natural Heritage. This permission will not be withheld unreasonably. The views expressed by the author(s) of this report should not be taken as the views and policies of Scottish Natural Heritage.

© Scottish Natural Heritage 2017.



COMMISSIONED REPORT

Summary

Assessing the presence of vendace in Loch Earn, 2016

Commissioned Report No. 976

Project No: 015774

Contractor: Alex Lyle Projects & University of Glasgow

Year of publication: 2017

Keywords

Vendace; Scotland; Loch Earn, netting survey.

Background

Vendace (*Coregonus albula* L.) fry from Bassenthwaite Lake, Cumbria, were introduced to Loch Earn, Perthshire, in spring 1989. There was no subsequent evidence of vendace having established a population in Loch Earn until a single specimen was caught by an angler in 2005. In 2007 an extensive netting and echosounding survey was undertaken for SNH as part of the Species Action Framework programme but no vendace were found. However, another vendace was taken by an angler in 2012. Further investigation into the presence of vendace was required by SNH to verify the presence of vendace at Loch Earn, in order to inform the Habitats Directive Article 17 reporting process, and it is the results of this survey that are presented here.

Main findings

- A single vendace was collected during a netting survey in late November 2016. This result confirms the presence of a self-sustaining vendace population in Loch Earn, albeit that the population is likely to be small.

For further information on this project contact:

Professor Colin Bean, Scottish Natural Heritage, Clydebank Business Park, Clydebank, G81 2NR.

Tel: 0141 9514488 or colin.bean@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 |
|---|-------------|
| 1. LOCH EARN SURVEY | 1 |
| 1.1 Introduction | 1 |
| 1.1.1 Vendace | 1 |
| 1.1.2 Vendace in Loch Earn | 1 |
| 1.1.3 Environmental DNA (eDNA) monitoring | 3 |
| 1.2 Objective | 3 |
| 1.3 Methods | 3 |
| 1.4 Results | 4 |
| 1.4.1 Gill netting | 4 |
| 1.4.2 Environmental DNA (eDNA) monitoring | 4 |
| 1.5 Conclusions | 4 |
| 2. REFERENCES | 6 |
| 3. FIGURES | 7 |
| 4. TABLES | 10 |

Acknowledgements

We thank riparian owners Drummond Estates and Ardvorlich Estates for their consent to carry out the netting survey.

Mr Alex Murray (Drummond Estates) gave invaluable advice and help before and during the survey.

Thanks to Danielle Orrell for field assistance throughout the survey.

We thank Prof Colin Bean of SNH for his advice and assistance throughout the project.

Gill netting for this survey was carried out under licence from Marine Scotland and a licence to collect vendace was issued by Scottish Natural Heritage.

1. LOCH EARN SURVEY

1.1 Introduction

1.1.1 Vendace

In the British Isles the freshwater fish species vendace (*Coregonus albula* L.) has been known to occur in only four lakes. Two of these are in Scotland, the Castle and Mill Lochs in Dumfriesshire and two are in England, Bassenthwaite Lake and Derwent Water in Cumbria.

In Castle Loch vendace became extinct early in the 20th century shortly after a new sewage works was opened in 1911. In Mill Loch the presence of vendace was confirmed in the 1960s by Maitland (1966) but by the late 1970s they could not be found and are extinct there now, most probably due to increasing eutrophication and the introduction of other, locally non-native, fish species.

The vendace populations in Bassenthwaite Lake and Derwent Water have been monitored by gill netting and hydroacoustics since 1995 and 1998 respectively (Winfield *et al.*, 2016). Vendace numbers had declined significantly in Bassenthwaite Lake in recent decades and between 2000 and 2012 no vendace were recorded in any of the surveys carried out at that site. The probable reasons for their apparent loss were considered to be eutrophication, sedimentation and introductions of coarse fish species. However, in 2013 a single vendace was captured during routine survey and, in 2014, two more were recorded. The origin of the vendace captured since 2013 fish is uncertain, as is the present status of vendace at that site (Winfield *et al.*, 2017). Vendace in Derwent Water have been recorded consistently each year and their status there is considered to be favourable (Winfield *et al.*, 2016). It is thought that Derwent Water may be the only remaining indigenous vendace population in Great Britain.

Within its European distribution, vendace can occur in lakes of varying sizes. A water depth is required which is sufficient to give freedom from summer heat stress (which will vary with location) and refuge from competition and predation from other fish species such as pike *Esox lucius* (L.), perch *Perca fluviatilis* (L.), roach *Rutilus rutilus* (L.) and ruffe *Gymnocephalus cernuus* (L.). The size of vendace populations can show significant inter-annual variability and are known to fluctuate greatly over time, the reasons for which are uncertain.

1.1.2 Vendace in Loch Earn

By the 1980s, the vendace was the rarest freshwater fish in Great Britain with breeding populations in only Bassenthwaite Lake and Derwent Water. Concern over the future status of the vendace in Bassenthwaite Lake arose due to pressures from increasing eutrophication and introductions of coarse fish species. In response to these concerns, a vendace conservation and restoration programme was initiated by the Nature Conservancy Council in 1986 as part of a more general programme on the conservation of threatened native fish in Great Britain (Maitland & Lyle, 1990, 1991, 1992; Lyle & Maitland, 1992).

The first conservation action taken for vendace was to establish a conservation refuge site for the Bassenthwaite Lake population, whilst at the same time re-establish this species in Scotland. In December 1988 fertilised vendace eggs were collected from Bassenthwaite Lake and incubated in custom-made hatcheries in Scotland with the intention of introducing this species to suitable receptor sites (Maitland & Lyle, 1990). There was no formal provision at that time for an introduction site selection process and in the spring of 1989 8,379 unfed fry hatched from these eggs were introduced to Loch Earn in Perthshire. Loch Earn is one of the larger Scottish lochs with a surface area of 1,013 ha, a maximum depth of 87.5 m and a mean depth of 42.0 m (Murray & Pullar, 1910). It has a length of 10.4 km and

an average width of about 1 km (see Figures 1 & 2). While no specific surveys were initiated for vendace in Loch Earn subsequent to their introduction, other netting surveys for unrelated projects (e.g. Alexander & Adams, 2000; A. Walker, personal communication; S. Wallace, personal communication) did not record vendace and it was assumed that this species had not established there. However, in 2005 a single vendace was reported to have been captured by an angler at Loch Earn. An account of this episode is given by Maitland *et al.* (2011) and is reproduced below:

*“In October 2006 Alisdair MacDonald and Stuart Wallace of the Fisheries Research Services Fish Health Inspectorate [FRSFHI], Aberdeen, were carrying out a disease survey of wild fish from Loch Earn. Alex Murray from the Drummond Estates Fishery there passed on a frozen fish that had been reportedly caught by an angler on the loch the previous year. That the fish had been caught on Loch Earn was felt to be reliable and at the time it was thought the fish might be a powan *Coregonus lavaretus*. The fish was kept frozen at the FRS Freshwater Laboratory, Pitlochry, until it was examined by Ross Gardiner in April 2007 after which it was passed to Peter Maitland who confirmed its identification as a vendace.*

The fish was 234 mm fork length (264 mm total length) and 129.8 g in weight. There was a separate note with the fish which says “John Nicol, Canon Bryne Glebe, Kirkcaldy 01592 261828. Powan? Caught Mid-July 2005 on Loch Earn near to the south Loch Earn Caravan Park. Fish took in about 10 feet of water on a Kate McLaren fly.”

Almost certainly this fish is a descendent of fry from Bassenthwaite Vendace fry put there in the spring of 1989, as reported by Maitland & Lyle (1990).

The specimen was aged from scales as being 5+ which meant that it could not be one of the original fry, indicating that the original stock had bred and indeed probably gone through several generations. Thus it seemed likely that there may be an established population in Loch Earn.”

As a result of this positive identification, Scottish Natural Heritage commissioned a netting and hydroacoustic survey in 2007 specifically to search for vendace in Loch Earn (Maitland *et al.*, 2011). This survey was carried out between 3-7 September 2007 and included netting at some 20 sites and 10 day-time plus 10 night-time hydroacoustic transects throughout the loch. Despite the high coverage of this survey no vendace were detected. This survey is fully reported by Maitland *et al.* (2011) and concludes with the following statements:

“ no Vendace were caught during this study. However, one of the main objectives of the project was to determine the status of Vendace in Loch Earn, and it is reasonable to assume – from the results of both hydroacoustics and extensive gill netting – that the population, if indeed present at all (see below), is small.

The 1989 introduction was carried out near the start of a 5-year Nature Conservancy Council contract to work on freshwater fish conservation. This was the first time that any proper attention had been paid to the status and conservation needs of this group of vertebrates in Britain. It became clear very quickly that the stock of Vendace in Bassenthwaite Lake was declining (and is probably now extinct) and so, with the availability of a successful hatch of Bassenthwaite eggs, a decision was taken to introduce fry to Loch Earn as a suitable habitat whose outflow leads to no other standing water. Guidelines for fish translocations (Maitland & Lyle 1992) had not yet been developed; these would now rule out Loch Earn. Similarly, past introductions by others elsewhere in Scotland (DAFS 1975, 1978) would now be unacceptable”.

In 2012 Alex Murray (Drummond Estates) reported (personal communication) that another vendace had been taken by an angler on 23rd May that year. This fish had been foul hooked

at the east end of the loch (the 2005 vendace was reported to have been caught at the western end). Scottish Natural Heritage therefore commissioned a further, netting only survey, for vendace in Loch Earn to be carried out in 2016 and that survey is the subject of this report.

1.1.3 Environmental DNA (eDNA) monitoring

The fish sampling programme was also able to support an SNH-funded PhD project which is attempting to develop novel eDNA survey techniques to detect rare fish in large water bodies. This work was conducted at Loch Earn by Bernd Haenfling, Cristina Di Muri and Lynsey Harper from the University of Hull. The sampling for fish conducted at Loch Earn will provide an opportunity to test the efficacy of eDNA as a monitoring tool for vendace (and Arctic charr *Salvelinus alpinus* (L.)) against more traditional sampling techniques.

1.2 Objective

The objective of the netting survey at Loch Earn was simply to try and establish if vendace are present within Loch Earn.

1.3 Methods

The earlier survey for vendace in September 2007 (Maitland *et al.*, 2011) failed to find vendace but, because it was conducted during the summer months, it was necessary to sample the full range of inshore and offshore habitats of Loch Earn. The present netting survey adopted an alternative approach and was carried out between the 27th and 29th November 2016. This is slightly earlier than the expected vendace spawning period (early December) but coincides with the period when vendace would be congregating at or lying off potential spawning grounds. This approach should, therefore, greatly reduce the area of the loch and volume of water to be searched and increase the probability of vendace capture. Further to this, the temporal netting approach presumed that, at this late time of year, other fish species (such as brown trout *Salmo trutta* (L.)) should have begun their upstream migrations to spawn and been virtually absent from the survey area. Similarly, by this time Arctic charr were expected to have spawned and returned to deep water in the loch. Loch Earn is a busy tourist area for water sports and shoreline activities, so winter time near-shore netting would also be less at risk from interference at this time.

The gill nets used were single mesh monofilament benthic nets set onto the loch bed and comprised of a range of net mesh sizes specifically for catching vendace. The mesh sizes were knot-to-knot 18.5mm, 22mm and 25mm and these configurations have been used successfully to catch vendace in Derwent Water and elsewhere. Two sets of three nets, one of each mesh, were used throughout the survey. Both sets were 30m long, with one set being 1.5m deep, and the other 3m deep.

The nets were set from a powered boat, the dates and times of setting and lifting were noted, the water depths at each end of the net are recorded (using a Plastimo Ecotest II hand-held sonar) and the National Grid References of the net ends recorded (using a Garmin 60Sx GPS). These data are presented in Table 1. The identification of potential netting locations were informed by the vendace spawning substrate methodology developed by Coyle & Adams (2011). Nets were set in late afternoon and lifted the next morning and fish catches recorded by numbers and species. All nets were set at off-shore locations in areas where likely vendace spawning habitat was present.

Weather forecasts predicted calm conditions but with a west wind starting on the 30th November. Consequently, netting sites at the east end of the loch were sampled first. The loch level was low and the majority of potential spawning gravels were exposed leaving a relatively narrow band submerged. The first nets deployed at each site were set from the

lower edge of this gravel band, extending out into deeper water. An option of deeper net settings was available for use later, if required.

Fish processing took place in the field. These included the taking of specimen photographs, scale samples (taken for aging) and tissue samples (for genetic study). All of the fish captured during the study have been stored, frozen, for further analysis if necessary.

Six nets were set out on the 27th November and lifted on the 28th, four of these nets were set out again on the 28th and lifted on the 29th. Details of the nets used are also given in Table 1 and their locations are shown in Figure 2.

1.4 Results

1.4.1 Gill netting

The total catch from the gill netting programme was 186 brown trout, 21 Arctic charr and 1 vendace. Catch details for each net are given in Table 1. The high number of brown trout taken was unexpected since many were pre-spawning adults and it was assumed that by the end of November they would have left the loch and entered their spawning streams. However local anglers informed us that the water flow in the loch tributaries had been too low to enable the trout to run upstream and that spawning had been delayed. Subsequent reports indicate that the trout spawning migration did not start until the 9th December following the first significant rainfall. Similarly, the Arctic charr caught during the survey were almost ripe adults. Arctic charr spawn in similar habitats to vendace. This was unexpected since most (but not all) Scottish Arctic charr populations spawn in October and this suggests that, either their spawning had been delayed, or that the Loch Earn Arctic charr normally spawn at this later date. Surface water temperature at the time of netting was 7.6°C.

A single vendace was caught by net E2 (Table 1). This fish was a ripe male and confirms that a vendace population does exist in Loch Earn. It also confirms that their spawning period is similar to that of the Cumbrian vendace populations. The fact that no other vendace were caught in the other nine nets set in similar habitats may be because they were congregating further off shore and the main spawning period was yet to occur. The vendace captured during the survey had a fork length of 209mm (Figure 3) and scale reading indicated that the fish was 5+ years old.

No further netting was undertaken since the presence of vendace was verified, and the cessation of gill netting effort also reduced the potential by-catch of pre-spawning adult brown trout and Arctic charr.

1.4.2 Environmental DNA (eDNA) monitoring

At the time of writing there are as yet no results from the eDNA work by the University of Hull. This will be presented as part of a larger PhD submission.

1.5 Conclusions

Although only a single vendace specimen was collected by the short netting programme at Loch Earn this result does show that: 1) a population of vendace has established there; and 2) this has been sustained over several generations since 1989. Although this survey does not provide for a robust analysis of vendace population size, the very low catch rate compared with brown trout and Arctic charr, the absence of any record in the 2007 survey and the low number of reports from other sources suggests that the population of vendace in Loch Earn is not large.

This study, whilst not quantitative, did not find evidence that vendace were seriously impacting upon the Arctic charr in Loch Earn. Arctic charr in spawning condition were captured at seven of the ten sites netted suggesting that the population is healthy and robust. However, a regular (possibly five-year) survey programme should be established to monitor the status of vendace in Loch Earn and inform possible interactions with other fish species. Innovative approaches, such as the stable isotope methodology used by Harrod (2011) to identify trophic interactions in Loch Earn during the 2007 survey may be usefully repeated in future years if vendace numbers increase.

As it is unlikely that vendace can be removed from Loch Earn, consideration should be given to the provision of a robust assessment of the genetic status of Arctic charr in Loch Earn in relation to neighbouring populations, and in a wider national context. Consideration should also be given to identifying suitable receptor sites which may act as a conservation refuge of Arctic charr. However, site selection must be informed by the requirements set out in The Scottish Code for Conservation Translocations (NSRF, 2014a) and Best Practice Guidelines for Conservation Translocations in Scotland (NSRF, 2014b). These are, themselves, informed by the current IUCN guidelines for reintroductions and other conservation translocations (IUCN/SSC, 2013).

2. REFERENCES

- Alexander, G.D. & Adams, C.E. 2000. The phenotypic diversity of Arctic Charr, *Salvelinus alpinus*, (Salmonidae) in Scotland and Ireland. *Aqua*, **4**, 77-88.
- Coyle, S. and Adams, C.E. 2011. Development of a methodology for the assessment of the quality of vendace spawning substrate and its application to sites in Scotland and northern England. *Scottish Natural Heritage Commissioned Report No. 308*.
- DAFS. 1975. Trial stocking with American Brook Trout (*Salvelinus fontinalis*). *Freshwater Fisheries Laboratory Pitlochry, Triennial Review of Research, 1973-75*, 32.
- DAFS. 1978. Field trials with the Shrimp *Lepidurus arcticus*. *Freshwater Fisheries Laboratory Pitlochry, Triennial Review of Research, 1976-78*, 36.
- Harrod, C. 2011. Characterising the trophic ecology and habitat use of vendace using stable isotope analysis. *Scottish Natural Heritage Commissioned Report No. 282*.
- IUCN/SSC 2013. Guidelines for Reintroductions and Other Conservation Translocations. Version 1.0. IUCN Species Survival Commission, Gland, Switzerland. pp 57.
- Lyle, A.A. & Maitland, P.S. 1992. Conservation of freshwater fish in the British Isles: the status of fish in National Nature Reserves. *Aquatic Conservation*, **2**, 19-34.
- Maitland, P.S. 1966. Present status of known populations of the Vendace *Coregonus vandesius* Richardson in Great Britain. *Nature, London*, **210**, 216-217.
- Maitland, P.S. & Lyle, A.A. 1990. Practical conservation of British fishes: current action on six declining species. *Journal of Fish Biology*, **37A**, 255-256.
- Maitland, P.S. & Lyle, A.A. 1991. Conservation of freshwater fish in the British Isles: the current status and biology of threatened species. *Aquatic Conservation*, **1**, 25-54.
- Maitland, P.S. & Lyle, A.A. 1992. Conservation of freshwater fish in the British Isles: proposals for management. *Aquatic Conservation*, **2**, 165-183.
- Maitland, P.S., Lyle, A.A., Winfield, I.J. & Fletcher, J.M. 2011. Vendace in Loch Earn. *Scottish Natural Heritage Commissioned Report No. 284*.
- Murray, J. & Pullar, L. 1910. *Bathymetrical survey of the Scottish fresh water lochs*. Edinburgh: Challenger Office.
- National Species Reintroduction Forum 2014a. The Scottish Code for Conservation Translocations. Scottish Natural Heritage.
- National Species Reintroduction Forum 2014b. Best Practice Guidelines for Conservation Translocations in Scotland Version 1.1. Scottish Natural Heritage.
- Winfield, I. J., Fletcher, J. M. & James, J. B. 2016. Monitoring the fish populations of Bassenthwaite Lake and Derwent Water, 2015. *Report to United Utilities*. LA/NEC05364/3. 56 pp.
- Winfield, I. J., Fletcher, J. M. & James, J. B. 2017. The 'reappearance' of vendace (*Coregonus albula*) in the face of multiple stressors in Bassenthwaite Lake, U.K. *Fundamental & Applied Limnology*, **189**, 227-233.

3. FIGURES



Figure 1. Loch Earn looking east. Photo A. Lyle

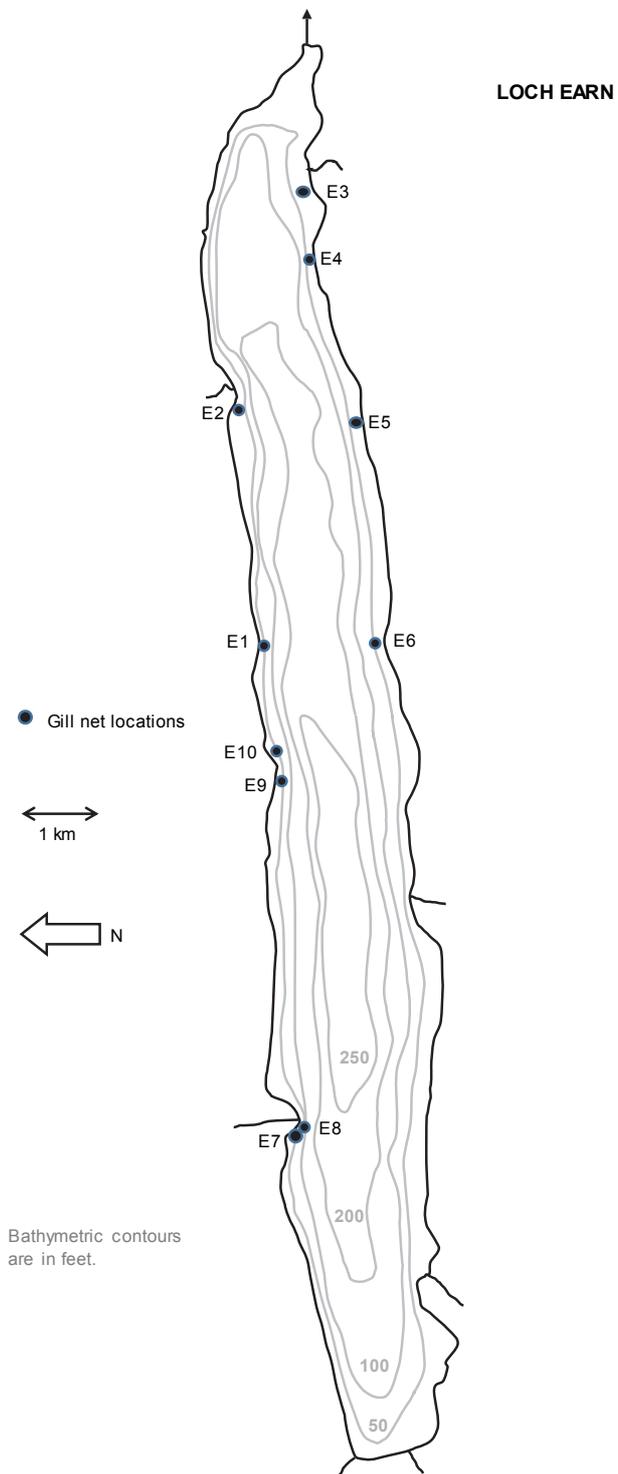


Figure 2. A map of Loch Earn showing depth contours in feet (Murray and Pullar 1910) and gill net locations (see also Table 1 for netting details).



Figure 3. The single vendace collected at Loch Earn. This fish is a male, 209 mm fork length, aged 5+ years.

4. TABLES

Table 1. Details of the netting programme and fish catches at Loch Earn on 27 – 29 November 2016.

| Net | Mesh size (mm) | Net size (m) | Depth (m) | Depth (m) | NGR1 | NGR2 | Date (IN) | Time (IN) | Date (OUT) | Time (OUT) | b.trout | A. charr | vendace |
|-----|----------------|--------------|-----------|-----------|--------------|--------------|-----------|-----------|------------|------------|---------|----------|---------|
| E1 | 25.0 | 30x1.5 | 1.9 | 7.2 | NN6512724334 | NN6512824334 | 27-Nov | 15.05 | 28-Nov | 11.10 | 15 | 7 | 0 |
| E2 | 25.0 | 30x3.0 | 5.8 | 5.0 | NN6696124487 | NN6693424496 | 27-Nov | 15.20 | 28-Nov | 10.20 | 19 | 1 | 1 |
| E3 | 18.5 | 30x1.5 | 2.3 | 5.2 | NN6849124034 | NN6850824046 | 27-Nov | 15.40 | 28-Nov | 10.30 | 33 | 1 | 0 |
| E4 | 22.0 | 30x3.0 | 3.1 | 9.1 | NN6801624006 | NN6804224019 | 27-Nov | 15.45 | 28-Nov | 10.40 | 39 | 1 | 0 |
| E5 | 18.5 | 30x3.0 | 7.0 | 12.0 | NN6657923612 | NN6660923627 | 27-Nov | 15.55 | 28-Nov | 10.50 | 8 | 5 | 0 |
| E6 | 22.0 | 30x1.5 | 2.5 | 5.5 | NN6518923469 | NN6521923474 | 27-Nov | 16.05 | 28-Nov | 11.00 | 8 | 5 | 0 |
| E7 | 18.5 | 30x1.5 | 2.1 | 2.9 | NN6162624062 | NN6164424039 | 28-Nov | 15.40 | 29-Nov | 9.30 | 22 | 0 | 0 |
| E8 | 22.0 | 30x1.5 | 3.2 | 7 | NN6169023988 | NN6165923998 | 28-Nov | 15.50 | 29-Nov | 9.40 | 18 | 0 | 0 |
| E9 | 25.0 | 30x3.0 | 5.0 | 5.5 | NN6424324163 | NN6420924163 | 28-Nov | 16.00 | 29-Nov | 10.00 | 12 | 0 | 0 |
| E10 | 18.5 | 30x1.5 | 3.2 | 7.6 | NN6428024201 | NN6425124167 | 28-Nov | 16.10 | 29-Nov | 9.55 | 12 | 1 | 0 |

www.snh.gov.uk

© Scottish Natural Heritage 2017
ISBN: 978-1-78391-449-4

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.



Scottish Natural Heritage
Dualchas Nàdair na h-Alba

All of nature for all of Scotland
Nàdar air fad airson Alba air fad