the Forth Naturalist and Historian

Volume 39 2016

Published by the Forth Naturalist and Historian, University of Stirling – charity SCO 13270.

ISSN 0309-7560

ISBN 978-1-898008-74-3

Cover: front– Puffin (*Fratercula arctica*) by Roger Stewart
back– Mountain aven (*Dryas octopetala*) by John Holland

Printed by Meigle Colour Printers Ltd., Tweedbank Industrial Estate, Galashiels.
Set in Zapf Calligraphic on 115 gsm Silk and cover 300 gsm Silk.

THE FORTH NATURALIST AND HISTORIAN

The Forth Naturalist and Historian was set up in 1975 as an informal enterprise of Stirling University. At that time it was administered by staff from the University and Central Regional Council, with the purpose of providing a focus for interests, activities and publications on environmental, historical, heritage and related topics. The coverage is across the Forth area, now generally comprising the Stirling, Falkirk and Clackmannan Council areas.

The annual *Forth Naturalist and Historian* journal has appeared yearly since 1976 and an annual conference has been held at the University since 1975; more recently, wildlife and heritage fairs have been held across the area.

The journal has published numerous important papers; together the volumes now form a significant body of local information, complementing the earlier *Transactions of the Stirling Field and Archaeological Society* series (1878-1939). The journal includes some regular items such as meteorological and bird reports.

In addition, two books have been published. *The Stirling Region* (edited by Timms, 1974) and *Central Scotland; Land, Wildlife, People* (edited, by Corbett et al. 1993). These, along with most back issues of the journal, are available, free, online via the website, which also has an Index to the papers in the Journal; website http://www.fnh.stir.ac.uk/journal/

Copies of recent volumes of the Journal can be purchased through local outlets or via the Secretary (address below).

Forth Naturalist and Historian is now an independent, membership organisation, retaining close links with the University. It is a registered charity (SCO 13270).

We are pleased to discuss ideas for future conferences (including partnerships and sponsorship) or for papers in the journal (contact the Secretary, address below). Detailed guidance and support on preparation of papers can be given, if required. Outline Instructions for Authors are at http://www.fnh.stir.ac.uk/journal/jnl_instructions_to_authors.pdf

Honorary Secretary Marilyn Scott,
Stirling
Email: fnh@stir.ac.uk
Web: http://www.fnh.stir.ac.uk

CHANGE AND CRISIS IN UPLAND FARMING FROM POLLEN ANALYSES ON BEN LAWERS *c.*AD1200 TO *c.*AD1700

Richard Tipping, Robert McCulloch and Eileen Tisdall

Summary

This paper describes the principal events impacting on the upland landscape, above 18th century head dykes, of the south-facing slopes of the Ben Lawers mountain range above Loch Tay. The interpretations come from pollen analysis, a rarely used source for medieval and post-medieval landscape change. The interpretations from four pollen sites are merged to give a narrative of change from the high medieval period c.AD1200 until the beginning of the 18th century. The analyses show an open woodland to have existed alongside the transhumant shieling economy in the hills until the mid-16th century when an intensification of the practice of shieling led to rapid woodland demise. Factors in this intensification may have been economic or climatic. The analyses from one key site also describe an early, remarkable but short-lived attempt at agricultural 'improvement' in the growing of buckwheat, possibly a response to very intense climatic deterioration in the later 17th century.

Introduction

Writing a detailed environmental history of the upland landscapes of central Scotland is difficult because very few documentary sources consider in depth the hills themselves. It is the lowlands and valley floors that interested contemporaries (Dodgshon 2004). One alternative approach is to use pollen analysis to describe changes in the flora. This paper reports on some major findings from new pollen analyses in the south-facing uplands of Ben Lawers, owned in perpetuity by the National Trust for Scotland (NTS). They have high scenic value and are of international ecological conservation significance. The present landscape is, however, almost entirely cultural, changed by millennia of human settlement.

The north shore of Loch Tay is dominated by the two mountain ranges of Ben Lawers and Tarmachan, separated by the north-south through-valley of the Lochan na Lairige. Ben Lawers is the higher at 1214 m OD and is the highest in the Breadalbane district, with Meall nan Tarmachan rising to 1044 m OD. Both ranges are made of an east-west trending series of metamorphosed Dalradian rocks. Slopes lower than 400 m OD are mantled by variable thicknesses of glacial till and, more commonly, glacifluvial sand and gravel.

The Ben Lawers Historic Landscape Project was a partnership between Scottish Natural Heritage, the National Trust for Scotland, the Carnegie Trust for

the Universities of Scotland and Historic Scotland. Pollen analysis was a key technique, and in the course of the project, seven different sites were sampled, analysed with high temporal resolution and dated by ^{14}C (radiocarbon), ^{210}Pb (lead-210) and other markers. This paper focuses on the data spanning the periods from the 'high' Middle Ages to the beginning of the 19th century from four upland pollen sites, all above the head dykes of 19th century farms. These are:

1. a narrow peat-filled basin at NGR NN 62528 37755, at 320 m OD, the T16 Gully, named from a complex multi-period archaeological site excavated in the project by Guard Archaeology (Figure 1)

2. Leacann Ghlasa is the name of the broad, smooth, steep south-facing hillside of Beinn Ghlas between the Burn of Edramucky and Coire a' Chommaidh. It is also the name given here to a small peat accumulation on the lower slopes of this hillside at NN 6270 3775, around 300m OD

3. Allt a' Mhoirneas, a small mire at 456 m OD between bedrock mounds at NGR NN 6054 3821, a few hundred metres south of the dam that now impounds the Lochan na Lairige (Figure 2)

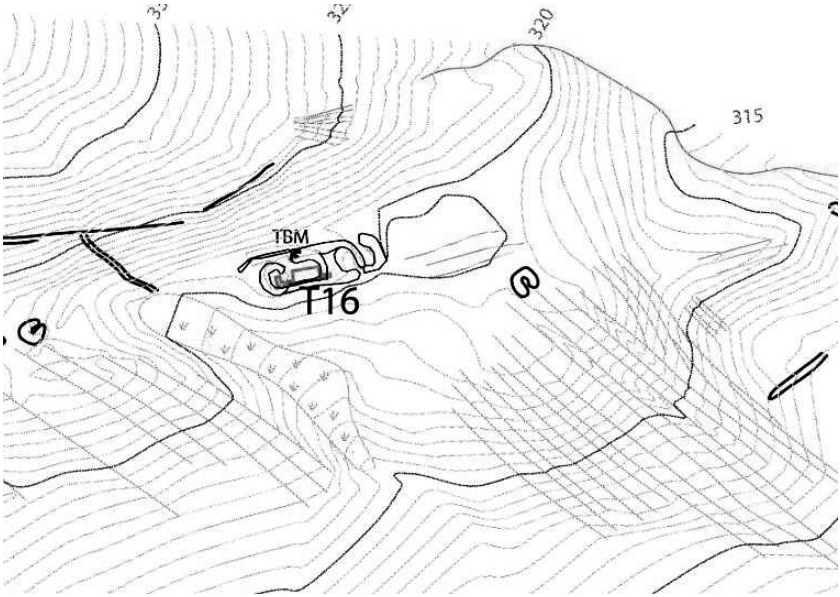


Figure 1. A map of the medieval and post-medieval archaeological structures at T16 and the peat-filled marsh to their south west. The length of the baseline is around 150m. The contour interval is 0.5m. At T16 itself is a high medieval 'long-house', overlain by two later, 15th-16th century AD shieling huts. The horse-shoe shapes are other shieling huts. The parallel lines crossing the contours south east of T16 are cultivation traces, of unknown age.

4. Tarmachan, a very small peat accumulating on the surface of a stabilised debris cone at the base of the imposing cliffs of the Tarmachan range (Figure 3), just above the Lochan na Lairige at 540 m OD (NGR NN 59265 40847).

Upland land use in the Medieval period

Agriculture was well-established by the Medieval period on Loch Tayside. Atkinson (2000) emphasises the survival along the northern side of the loch of a relict archaeological landscape on upper slopes above the head dyke boundaries of 18th century farms. These upper slopes have also preserved small huts interpreted as shielings. These were huts used when tending livestock that were moved uphill from early May until late summer to take advantage of slower growing grassland at high altitudes, to ease the pressure on lowland meadow and to avoid damage to growing crops (Bil 1990; Atkinson 2000; Boyle 2003). Livestock on the hill were principally cattle (dairy cows were the core of the shieling stock) but included sheep and horses (Dodgshon 2004). Shielings are recorded from the early 16th century AD (Bil 1990) but may have had prehistoric origins (Miller 2002).

Figure 2. This photograph looks west across the Meall nan Tarmachan range from the Loch Tay-Loch Lyon road (foreground), showing a fenced exclosure to protect young native trees from sheep grazing. Inside this exclosure is the pollen site of Allt a' Mhoirneas.

Figure 3. The forbidding cliffs of Tarmachan above the waters of the Lochan na Lairige reservoir. The lower slope is the location of the pollen site of Tarmachan, and close by is a group of shieling huts.

Upland woods in the Medieval period

Beneath Tarmachan, away from the intermittently unstable talus cones and slopes, birch grew in some abundance in a rather scrubby open wood in the 13th century AD, accompanied by some hazel, rowan and hawthorn. Willow was rare but perhaps grew on the gentler slopes rather than confined as it is today to rock ledges (Mardon 1990). There were no oaks or elms in the woodland around Tarmachan by the 13th century AD, though by comparison with the sequence at Allt a' Mhoirneas, oak trees may have been lost only a century or so before this, almost certainly through low-intensity grazing pressures. Woodland persisted on the lower slopes around Leacann Ghlasa. These analyses describe open, secondary, scrubby birch or birch-hazel-alder woods with grassy ground floras. They may well be depicting the high Medieval development of wood pasture throughout the region (Smout *et al* 2005, 165). Pollen diagrams from the region have not demonstrated this before, though few are sufficiently detailed in the historic period, but these new data support, firstly, Smout *et al*'s (2005, 43) speculation that much semi-natural woodland remained in upland Scotland in the Middle Ages, and secondly, the contrasts between lowland and highland noted by Sylvius in *c*.AD1430 (in Smout *et al* 2005, 39), "the one cultivated, the other covered with forests". The extensive open woods draping the shoulders of Ben Lawers were certainly more akin to montane scrub than "forests of original splendour" (Smout *et al* 2005, 52).

This upland landscape of open, lightly grazed woodland was probably that in which the shieling economy was situated. Hamilton & Davies (2007) imply that shieling-related grazing led to woodland loss at Leadour but this was not the case on Ben Lawers. The palaeoecological evidence suggests that there was no 12-13th century AD "high water mark" of upland settlement on Ben Lawers that may be seen in southern Scotland (cf. Parry 1978; Tipping 1999) and no high Medieval penetration of the uplands seen in northern England (Dunsford & Harris 2003).

The probable absence of permanent Medieval settlement in the uplands of Ben Lawers made easier the development of shieling grounds. Low stocking densities may also have been important in conserving woodland, or perhaps in this period shieling grounds were not so pressured as to require regulation, such that animals could be moved over the hillside with less concern for territorial constraint than shown later in the 18th century AD (Bil 1990). Dodgshon (1983) identified the 14th century AD as one when common upland grazings were made more exclusive by estates, and this control might have prevented grazing pressures. Attentive herding of animals may also have allowed trees and animals to co-exist on the hill.

There were considerable advantages in maintaining woods near shielings. Grasses not sheltered by woodland were either impoverished in nutrients or physically sparser. Shelter from summer storms for people and animals may have been valued (Smout & Watson 1997). But it is probably to their use as a fuel source or for supplying constructional timbers that we might look to understand the maintenance of these woods (Bil 1990, 242). There may, nevertheless, have been an increased attention to woodland conservation in the 13th century AD. Birch trees were probably selectively removed around Leacann Ghlasa after *c*.AD1250 but they had become re-established by AD1500. Woodland regeneration within an agrarian landscape must have required the management of this resource, a response by the estate or individual tenant farmers to local shortages of, in particular, birch trees by protecting seedlings or planting, an activity in which legislation encouraged conservation and planting (Crone & Watson 2003).

Calluna heath on the slopes of Ben Lawers

Together with birch, *Calluna* (ling) heath also expanded at Leacann Ghlasa after *c*.AD1450 to cover within a century around 10 % of the hill. *Calluna* populations did not expand from beneath tree canopies: grassland is on Ben Lawers the vegetation cover that benefitted from woodland loss. Seed sources for *Calluna* already existed on Ben Lawers, on the highest slopes where some blanket peat had been established from *c*.2000 BC (Donner 1962).

The recognition that heathland is not simply a product of woodland loss means that its expansion needs to be explained. One explanation has been the

use of fire. Fire and the deliberate burning of vegetation (muirburn) is a commonly cited cause of heath development but many analyses (Tipping 2000) have pointed out the 'chicken-&-egg' problem, that this is a way of improving an unwanted vegetation type only when it is established. Fire cannot be an explanation on Ben Lawers because there is no evidence from the charcoal record at Leacann Ghlasa and other sites in this period for burning. Grazing pressures were slight through a multitude of factors including the seasonality of the shieling routine, low stocking densities and herds being more-or-less constantly moved by herders). In similar settings on the Cheviot Hills (Tipping 2000) the appearance of *Calluna* heath was linked to long-term soil acidification coincident with increased grazing pressures. Lageras (2006, 136-8) saw the same combination of factors in the 18th century AD expansion of *Calluna* heath in southern Scandinavia.

Intensification of the upland agrarian economy in the later 16th century

There is abundant and quite striking palaeoecological evidence that the upland woods on Ben Lawers were sharply cut back in the decades after *c*.AD1550.

On stable slopes beneath Meall nan Tarmachan an open scrub woodland was rapidly cleared at *c.* AD1530. There is evidence for increased burning but this may be related to microscopic charcoal being transferred more easily to the pollen site as a consequence of woodland loss, and trees were probably cut rather than burnt down. Grazing pressures may also have increased. The open woodland around Leacann Ghlasa was lost at around AD1560. Land around the T16 gully was probably treeless at *c*.AD1550 when pollen analyses commence. At Leadour on the south side of Loch Tay the birch woodland was cut down at *c*.AD1614, the documentary records making it clear that unapproved destruction by local tenants was causal (Hamilton & Davies 2007).

It is likely that trees were cleared around Tarmachan to create more grazed grassland. Some grassland herbs that had survived protected beneath the open woodland canopy were lost as the sward was trimmed to a short, clipped turf, perhaps retreating then to rock ledges inaccessible to animals where they survive today. Grazing pressures appear to have intensified between *c*.AD1580 and *c*.AD1630, and led after *c*.AD1630 to substantial losses in herb diversity and of ribwort plantain. But species-rich grass communities dominated the landscape around the T16 gully, maintained not just by the natural high base-status of the soils but also by the constant replenishment of minerals as soils were eroded. Grazing pressures in gullies and wet areas were sufficiently intense, however, to have effectively eliminated patches of tall herbs.

This major transformation was almost certainly related to the shieling economy. Bil (1990, 256) identified an increasing demand by tenant farmers in upland Perthshire for new shielings after AD1600. He also argued that the developing long-distance droving trade may have led to the need for more

grazing land to feed larger cattle herds, but woodland clearance on Ben Lawers in the mid-16th century AD appears too early to relate to the expansion of the droving trade (Haldane 1997, 14). Stocking densities on shieling grounds may have increased: overstocking was certainly a problem in north Lochtayside in the early 17th century, with 'soumsters' expected to inspect and count stock before they went to the shielings (Harrison pers. comm.). Population expansion in townships may have led to new pressures, or more townships may have gained access to existing shieling grounds, forcing division of shielings and tree loss on increasingly smaller shieling grounds. The more frequent warm summers of the mid 16th century AD, before *c*.AD1560, may also have encouraged townships to increase herd sizes. The chronology of landscape change on Ben Lawers is not sufficiently precise in this period to identify the decades this intensification of shieling activities occurred, and it may equally have been a response to the earliest phase of a climatic extreme from *c*.AD1570 to *c*.AD1630 (Dodgshon 2006). Parry (1978) argued for abandonment by farmers of hills in south east Scotland between AD1300 and AD1530, although a strong degree of social cohesion may have prevented such a disaster (Outhwaite 1985; Whyte 2008, 129-31). Abandonment is a last-resort strategy. On Ben Lawers there seems to have been no permanent settlement and no crop growing on the higher slopes of Ben Lawers and so in some senses nothing to be abandoned. But shieling grounds could be made to provide more income as the weather of the later 16th century deteriorated, as Bil (1990, 256) argued. This may be the context in which upland trees on Ben Lawers were cut down, the extent of grazing increased, or more ground given over to hay production as the productivity of fodder for over-wintering livestock declined.

Buckwheat, agricultural innovation and human responses to the Maunder Minimum

The ground around the T16 gully carried, certainly within the 17th century AD, a significant new crop, buckwheat (*Fagopyrum*), estimated from our dating controls to be in the period *c*.AD1630 to *c*.AD1670. Buckwheat has never been a staple crop in the British Isles (Thirsk 1997), its pollen is exceptionally rare in British pollen diagrams (Greig 1988) and the plant is absent from descriptions of historic crops or garden plants in Scotland).

The local archaeological setting of its cultivation at T16 is of shieling huts, two of which were built after the 15th century AD (Atkinson submitted). Buckwheat is a summer-sown crop, and its sowing might have coincided with the move in late spring to the shieling ground. The local economic context was one of grazing at low intensities, sufficient to have removed trees by *c*.AD1550 but not yet enough to have led to the loss of tall and grassland herbs, leaving a species-rich grassland promoted by soils of high nutrient status and their frequent erosion (above). Associated with buckwheat at the T16 gully are unusually high proportions of the pollen of the perennial herb, *Rumex acetosella* (sheep's sorrel). This grows in moderately grazed, short-turf dry grassland,

most abundantly on disturbed ground. Sheep's sorrel responds favourably to nitrate deposition, on heavily manured soils, and it seems likely that around the T16 gully buckwheat and sheep's sorrel grew together on patches of ground akin to outfield, that may not have been cultivated every year, but where nutrients were added from animal dung in the process of tathing as described by an early 18th century 'improver' (Bil 1992, 39). *Hordeum* type pollen grains (barley type) are recorded in the same samples as those of buckwheat: they may represent barley grown in the same nutrient-enriched soils as buckwheat.

How the farming communities of Lochtayside came to understand the value of buckwheat is unknown. Buckwheat originated in eastern Europe and was taken up by farmers on the continent in the 14th century AD: Thirsk (1997, note 35) reports one Medieval reference to it from Wales in AD1326. Its use in England increased after *c*.AD1650 when stagnating prices for conventional crops encouraged experimentation, and when information on new crops was more widely disseminated (Thirsk 1997, 43). Thus it may have been that the estate encouraged this endeavour: Macinnes (1996, 147-8) argued that agricultural expansion in Breadalbane after AD1660 was directed by the first Earl. Other Perthshire estates took a very active role in the colonisation process in the hope of increased rentals (Bil 1992; Macinnes 1996, 147-8). On the other hand, Bil (1990, 259-263) argued that tenants were themselves pioneers. By the mid-17th century AD the distinction between shieling grounds and outfield was being purposefully blurred by tenants. Shieling grounds were becoming synonymous with outfield, because since outfield was cropped, albeit infrequently, so might shieling grounds without this change in land use resulting in increased rents.

What buckwheat was used for around the T16 Gully can only be guessed. Lord Ernle (1919, 95) recorded one 17th century AD recommendation for buckwheat, a "miserable" one, he thought, whereby the crop should be sown and grown on, to be then ploughed into the soil as a fertiliser. The practice proved sufficiently common for Kerridge (1967) to record it in eastern and southern England, particularly on nutrient-poor sandy soils, where buckwheat was sown and ploughed under when in flower, with inputs also from farmyard manure and marl, to improve pasture for sheep (pp. 77, 241), or as a fallow crop in arable fields, succeeding wheat or barley, or preceding barley, and grown to be fed to poultry (p. 85). The fertilising quality of buckwheat, whether true or perceived (Ernle 1919), provides one interpretation for its use on the shieling grounds of Ben Lawers, one that accords in chronology with evidence from the 1650's AD for shielings in Perthshire to have been converted to cultivated farmland (Bil 1990, 259-263; Bil 1992). North of Ben Lawers, some shielings in Glen Lyon were described as 'home shielings' in documents of AD1670, AD1681 and AD1710, argued to be the initial stage in permanent colonisation, though Bil's (1992) map of new settlements (his figure 2: p. 43) shows no such colonisation along Loch Tayside. The T16 gully venture, if that is what it was, is unrecorded, perhaps because it failed. In this interpretation it is buckwheat's

fertilising quality that was valued, in enabling cereal crops to be established, such as barley at the T16 gully.

Another interpretation focuses on the value of buckwheat as a famine crop. Although buckwheat is not a cereal, on the continent it was commonly cultivated from the high Medieval period for human consumption as a supplement to grain (Braudel 1981, 112), either as a flour substitute in bread or as gruel. With the failure of the principal bread grains in 'little ice age' climatic extremes, as in the later 16th century crises, buckwheat was integrated into peoples' diets (Pfister 2005). Late 17th century AD population stresses were probably driven by bad weather, such as the 'resting' of rentals in Glen Orchy, west of Ben Lawers (Figure 3.1) in most years between AD1668 and AD1708, and tenant farmers being permitted to withhold meal payments in the 1690s AD on Rannoch Moor, north and west of Ben Lawers (Dodgshon 2006). The Breadalbane estate itself supported tenants in the years after AD1683 by supplying meal in times of scarcity (Harrison pers. comm.). The financial effect of this and very high rent arrears (Cullen 2010, 51-52) was thought by Cullen, Whatley & Young (2006, 264) "to have been little less than catastrophic" to the estate. Whyte (1979, 1981) argued that the major economic impacts were not on lowland crop production but on hill farms, which experienced difficulties from the mid-1670's AD, more sharply after AD1695, though this is not supported by Cullen's (2010) analysis. The repeated famines of the 'seven ill years' led to increased emigration to Ulster (Cullen 2010), where famine was, extraordinarily, almost absent (Crawford 1989). Upland farms as low as 250 m OD in the Lammermuir Hills were predicted by Parry (1978) to have failed through bad weather in AD1674-1675 and again in AD1694-95. From this association it might be that cultivation of buckwheat was as a famine food, and possibly grown slightly later in the 17th century AD than defined from our dating controls, after *c*.AD1675. In this context the association of buckwheat with sheep's sorrel might be telling: Sir Robert Sibbald's (1699) list of famine foods included on page 10 of that pamphlet "all sorts of Sorrell", but buckwheat itself was not mentioned in his otherwise exhaustive list of wild and garden plants recommended to alleviate severe famine.

Conclusions

Shieling, the summer movement of domestic animals to the uplands, went through a number of critical changes on the south-facing slopes of Ben Lawers between *c*.AD1200 and *c*.AD1700. Crises in the management of these hills occurred, most notably within the 16th century, when the birch-hazel woodland resource was first stretched and eventually lost, through an intensification of what had been a system in delicate balance. This crisis may have been economic in origin, through the perceived need for greater profits, or social as rural populations increased, or climatic as extremes of the 'little ice age' caused people to 'dig deep'. Climatic stresses may also have been behind a novel innovation in upland agriculture, the introduction with sheep's sorrel of buckwheat, a continental import.

References

Atkinson JA. 2000. Rural settlement on north Lochtayside: understanding the landscapes of change. In: Atkinson JA, Banks I, MacGregor G eds. *Townships to Farmsteads: Rural Settlement Studies in Scotland, England and Wales*. Oxford: British Archaeological Reports 293, 150-160.

Bil A. 1990. *The Shieling 1600-1840: The Case of the Central Scottish Highlands*. Edinburgh: John Donald.

Bil A. 1992. The formation of new settlements in the Perthshire highlands, 1660-1780. *Northern Scotland* **12**, 35-63.

Boyle S. 2003. Ben Lawers: An Improvement Period Landscape on Lochtayside,

Perthshire. In: Govan S. ed, *Medieval or Later Rural Settlement in Scotland: 10 Years On*. Edinburgh: Historic Scotland, 17-30.

Braudel F. (trans Reynolds S.) 1981. *The Structures of Everyday Life*. London: Collins.

Crone A., Watson F. 2003. Sufficiency to scarcity: medieval Scotland, 500-1600. In: Smout TC ed, *People and Woods in Scotland*. Edinburgh: Edinburgh University Press, 60-81.

Cullen KJ. 2010. *Famine in Scotland: The 'ill years' of the 1690's*. Edinburgh: Edinburgh University Press.

Cullen KJ, Whatley CA, Young M. 2006. King William's Ill Years: new evidence on the impact of scarcity and harvest failure during the crisis of the 1690s on Tayside. *Scottish Historical Review* **85**(2), 250-276.

Dodgshon RA. 1983. Medieval rural Scotland. In: Whittington G, Whyte ID. eds, *An Historical Geography of Scotland*. London: Academic Press, 47-71.

Dodgshon RA. 2004. The Scottish highlands before and after the Clearances: an ecological perspective. In: Whyte I, Winchester AJL. eds, *Society, Landcape, Environment in Upland Britain*. Birmingham: The Society for Landscape Studies, 67-78.

Dodgshon RA. 2006. The Little Ice Age in the Scottish highlands: documenting its human impact. *Scottish Geographical Journal* **121**, 321-337.

Donner JJ. 1962. On the post-glacial history of the Grampian Highlands of Scotland. *Commentatore Biologiske* **24**, 5-29.

Dunsford HM, Harris SJ. 2003. Colonisation of the wasteland in County Durham, 11-1400. *Economic History Review* **56**, 34-56.

Ernle Lord. 1919. *English Farming Past and Present*. London: Longman, Green & Co.

Haldane ARB. 1997. *The Drove Roads of Scotland*. Edinburgh: Birlinn.

Hamilton A, Davies A. 2007. 'Written in the Hills': an environmental history project in the Scottish uplands. *History Scotland* **7**(3), 25-32.

Kerridge E. 1967. *The Agricultural Revolution*. London: Allen & Unwin.

Lagerås P. 2006. *The Ecology of Expansion and Abandonment. Medieval and Post-Medieval*

Land-use and Settlement Dynamics in a Landscape Perspective. Stockholm: National Heritage Board.

Macinnes AI. 1996. *Clanship, Commerce and the House of Stuart, 1603-1788*. East Linton: Tuckwell Press.

Mardon DK. 1990. Conservation of montane willow scrub in Scotland. *Transactions of the Botanical Society of Edinburgh* **45**, 427-436.

Miller J. 2002. The Oakbank crannog: building a house of plants. In: Ballin Smith B., Banks I. eds, *In the Shadow of the Brochs – The Iron Age in Scotland*. Stroud: Tempus Publishing, 35-43.

Outhwaite RB. 1985. Dearth, the English Crown and the 'crisis of the 1590s'. In Clark P. ed, *The European Crisis of the 1590s. Essays in Comparative History*. London: George Allen & Unwin, 23-43.

Parry ML. 1978. *Climate Change, Agriculture and Settlement*. Folkestone: Dawson & Sons.

Pfister C. 2005. Weeping in the snow. The second period of Little Ice Age-type impacts, 1570-1630. In: Behringer W, Lehmann H, Pfister C. eds, *Kulturelle Konsequenzen der "Kleinen Eiszeit"*. Göttingen: Vandenhoeck & Ruprecht, 31-86.

Sibbald Sir R. 1699. *Provision for the Poor in Time of Dearth & Scarcity*. Edinburgh: James Watson.

Smout TC, MacDonald AR, Watson F. 2005. *A History of the Native Woodlands of Scotland, 1500-1920*. Edinburgh: Edinburgh University Press.

Smout TC, Watson F. 1997. Exploiting semi-natural woods, 1600-1800. In: Smout TC. ed, *Scottish Woodland History*. Edinburgh: Scottish Cultural Press, 86-100.

Thirsk J. 1997. *Alternative Agriculture. A history from the Black Death to the present day*. Oxford: Oxford University Press.

Tipping R. 1999. Towards an environmental history of the Bowmont Valley and the northern Cheviot Hills. *Landscape History* **20**, 41-50.

Tipping R. 2000. Palaeoecological approaches to historic problems: a comparison of sheep-grazing intensities in the Cheviot Hills in the Medieval and later periods. In: Atkinson J, Banks I, MacGregor G. eds, *Townships to Farmsteads. Rural Settlement Studies in Scotland, England and Wales*. Oxford: British Archaeological Reports 293, 30-43.

Whyte I. 1979. *Agriculture and Society in Seventeenth Century Scotland*. Edinburgh: John Donald.

Whyte I. 1981. Human response to short- and long-term climatic fluctuations: the example of early Scotland. In: Delano Smith C, Parry ML eds, *Consequences of Climatic Change*. Nottingham: Nottingham University Press, 17-29.

Whyte I. 2008. *World Without End? Environmental Disaster and the Collapse of Empires*. London: IB Tauris.

MOUNTAINS AND PEOPLE IN THE LOCH LOMOND & THE TROSSACHS NATIONAL PARK

Bridget Jones

Introduction

Loch Lomond & The Trossachs National Park was Scotland's first National Park, designated in 2002 under the National Parks (Scotland) Act 2000. The National Park covers 720 square miles of mountains, lochs, woods, rivers, villages and farmland all just one hour from the majority of Scotland's population.

One of the reasons for the designation was the recognition that the Loch Lomond and The Trossachs area not only has outstanding natural heritage and landscape qualities but is also within close proximity of the main areas of population, making it accessible to millions of people for recreational enjoyment.

The National Park has four statutory aims:

- To conserve and enhance the natural and cultural heritage of the area;
- To promote sustainable use of the natural resources of the area;
- To promote understanding and enjoyment (including enjoyment in the form of recreation) of the special qualities of the area by the public;
- To promote sustainable economic and social development of the areas communities.

A key principle in achieving these aims, particularly when they come in to conflict, is that conservation should always be the priority. This is of particular relevance when the conservation of the Park's landscapes and habitats comes into contact with the public's recreational enjoyment of the special qualities that we are seeking to protect and look after.

The National Parks Mountains

The mountain landscapes of the National Park are characterised geologically by the Highland Boundary Fault cutting through the southern area of the Park from Callander and across the southern edge of Loch Lomond to near Balloch. This geological feature clearly divides the upland areas to the north from the lowlands to the south.

The National Park has 21 Munro height summits of over 3000 feet and 20 Corbetts over 2500 feet, which includes the recent addition of Cnoc Coinnich

in July 2016 as the improved accuracy of height recording brought this hill onto the list, and potentially a rush of walkers to "bag it".

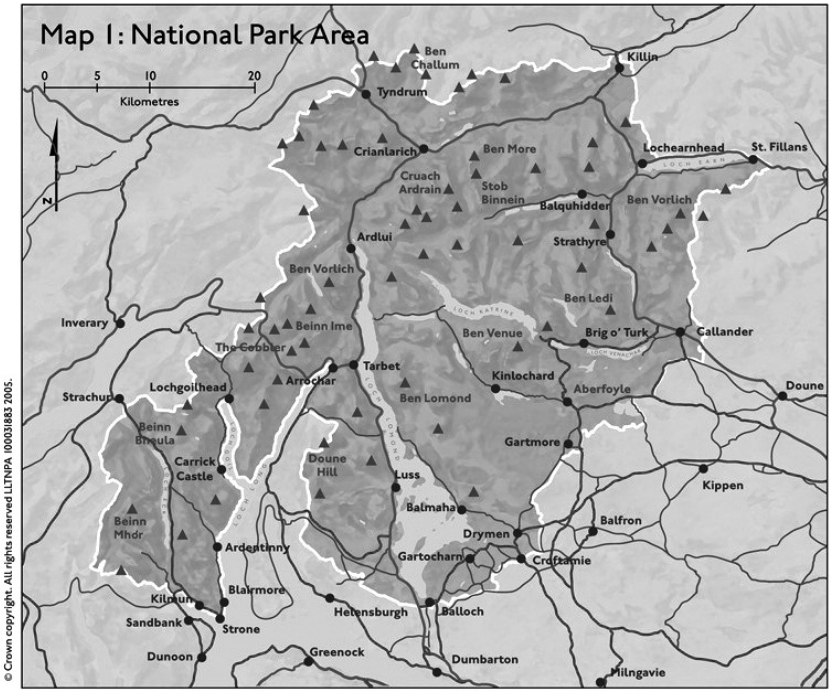


Figure 1. The major summits within the boundary of the National Park.

The mountains of the National Park are amongst the most accessible in Scotland and as a result the most popular. The likes of The Cobbler and Ben Lomond are often first time mountains for many people, and for some perhaps their only mountain climbing experience. Smaller summits such as Ben A'an and Conic Hill provide stunning views from their summits and a real mountain experience with less time and effort required to reach the tops. Again these "mini-mountains" are as popular as their higher reaching neighbours, which arguably offer a wider appeal to visitors of all ages and ability.

The mountains and hills are one of the main attractions for visitors coming to the National Park, not only to climb them but to simply take in the views and enjoy the scenery. Mountains form the backdrop to the National Parks' many lochs and provide a great recreational resource for hill-walking, rock climbing, ice climbing and winter mountaineering and, lower down the glens, for cyclists and paddlers to cross below or between them on journeys through the National Park.

Figure 2. Approaching the summit of Ben Lomond.

Mountains and Recreation

Recreational use of the countryside and the mountains increased significantly during the 1960s, 70's and 80's as people had more leisure time and car ownership increased and became more affordable. During this same period a number of hill-

walking and mountain guide books where published and television programmes like *Weirs Way* inspired people to take to the countryside and hills. The Munro's tables, originally published in 1892, led to detailed guidebooks showing the route options for every Munro summit and top in Scotland (the total number of summits is 282). The activity of "Munro-bagging" took off and has continued to be popular with the number of people who complete the challenge rising significantly each year, the current figures recorded by the Munro Society on behalf of the Scottish Mountaineering Council exceeding 5000 people per annum. But it should be noted that not all Munroists register with the Society.

Access to the countryside has improved, not only in terms of road networks and cars, but more recently in terms of mountain equipment becoming more readily available and affordable. Improvements in mapping and navigational aids such as GPS all indicate a continued demand for equipment to support mountain based recreation. The publication of inspirational books and television programmes such as *Mountain* featuring Griff Rhys Jones continue to showcase Scotland's mountains at their best.

The various guide books promote specific routes to the summits including the best start point, typically where parking is available. The routes promoted vary from utilising existing stalkers tracks to previously non-existent path-lines which have subsequently evolved as the pressure of feet following a more or less specified route from car or roadside to summit. This, combined with walkers' making decisions on the ground whilst walking, create desire lines as most direct or easier routes are chosen. These are often different depending on whether the walker is ascending or descending, and has resulted in the network of mountain paths or lines that are now visible up to, in between and on most summits in Scotland.

Mountain Path Erosion

The numbers of walkers going up our most popular mountains annually can be counted in the hundreds of thousands. Figures taken in 2015 for Ben Ledi showed in excess of 40,000 and figures for a new automatic counter installed on the main Ben Lomond path has counted 20,559 passes (ascending and descending) between 1 April and 30 June 2016. This is likely to mean that the main Ben Lomond path has in excess of 45,000 pairs of feet walking along its length over a year, with lower sections of path experiencing significantly more as the counter is located higher up the path.

The upland ecology is often a fragile habitat with thin soils at higher levels, areas of peat and mountain bog, open moorland heath and bed rock. The harsh upland climate experiences seasonal variations with unpredictable winter freeze-thaw conditions and in the west of Scotland particularly high levels of rain fall, in excess of 4.5 metres in a year. There are also other factors to consider such as gradients and slope stability, as well as land use such as forestry, grazing livestock or deer management activity.

However it is largely the combined impacts of weather and feet that lead to the inevitable visual and physical impacts on the landscape in the form of path erosion on our mountains. The erosion itself manifests itself in many forms.

Figure 3. Ben Lomond summit.

Thin soils and exposed bedrock and continued pressure of foot traffic have worn through the thin vegetated layer and quickly expose loose and thin mineral soils. These get washed out with rain and further footfall, exposing bedrock. The exposed hard surface is steep, with little grip, and not attractive for walkers, who then choose an adjacent vegetated area to walk over and begin the process of erosion again, resulting in an ever widening scar.

Peaty and wet low points in the terrain (Figure 4) are where water drains from adjacent slopes and then lies, the deep soft peaty ground becoming saturated. As walkers attempt to cross over they churn up the peat. Walkers then spread to the sides and create a wider scar. Often the direct line is not that bad to walk on, but the visual impression of deep soggy peat puts walkers off even attempting to cross by the most direct route. Scoured cross drainage occurs as water scours a path, resulting in a deep eroded channel across the path-line. Other typical erosion scenarios are where new path lines or desire lines emerge, often as the result of a significant change on the original route (e.g. a landslip, bridge washout or even long-lasting snow patches). In soft vegetation a new line can quickly appear as trampled vegetation, and once visible and if a good option for walkers it will get "adopted" as part of the path.

Figure 4. The lower slopes of Ben A'an prior to 2016 repairs.

The start of the erosion process is the trampling of vegetation. Once broken through, this exposes soils or peat, and 'pigeon-holing' starts as small pockets or steps appear which are then subject to further erosion by feet and water, creating a gully and a deepening of the path-line and a roughening of the path-line or a soggy wet area. All three factors then contribute to walkers moving to the side and onto vegetated areas to re-start the process and widen the scars.

Walkers tend not to like the following on the path-line: areas of soggy peat bog or standing water; loose rough block stone; large stones or rocks; stone pitching on descents; steep loose gravel and excessive zig-zags on descent. Walkers will walk to the side, short-cut and seek an alternative easier and dryer surface as illustrated on the summit area of Ben A'an prior to recent repair works in 2016 (Figure 5).

Erosion repair and management

The solutions to the erosion problems have evolved over many years, learning from historical construction techniques used in the building of stalkers paths , constructed by estates for getting ponies and stalkers on and off the hill for deer stalking, and also military road construction. In the 1980s and 1990s much was learnt in upland path construction with techniques tried, tested and improved, best practice developed, skills developed through training and path

Figure 5. The many paths towards the summit of Ben A'an.

contractors established. This work has formed the basis for mountain path repairs, not only in Scotland but internationally, and along with it a small highly skilled path industry.

More recently techniques have been further developed using small plant machinery such as tracked excavators and synthetic materials such as geo-synthetic grids and mesh, and the continued use of helicopters, remote working accommodation systems, more advanced surveying kits with access to GPS and the potential for further technological advances perhaps even the likes of drone base surveying and monitoring.

Materials for repairs are largely sourced locally, from the immediate area, with an emphasis on making any repairs and construction fit with the local environment. Ideally the walker is not aware that any path work has taken place, with minimal interventions where possible. Most path work is of a stone construction with great care taken in choosing the right stone and placing it in as natural a looking form as possible.

The main issues to address include keeping walkers on a defined line, making sure any water that comes on to the path either direct from rain or indirectly from adjacent ground is removed quickly before doing any damage and the restoration of damaged ground.

The types of features that are typically used include those for water control and drainage, such as stone water bars, stone cross drains, piped culverts with stone collars, stone letts, cross-falls and cambers, ditching and soakaways and stepping stones and cobbled fords. Good path-lines and surfaces are constructed by stone pitching, turfing, bunding and seeding defining of path edges, stone revetments and retaining walls and anchor bars and modern methods frequently use aggregate, gravel and fines or geo-synthetics to float paths on peat, and these provide erosion control and conservation.

Figure 6. Best practice footpath construction, drainage and conservation on Ben Lomond.

The construction methods used are hand-made and machine-built with most stone work being done by hand. Drainage and path trays and infill often use small tracked excavators and power barrows. Much depends on the accessibility of a site as to what is possible. The availability of material is another key factor with the excavation of small borrow pits, like mini-quarries, used for path sub-bases and surfacing. In cases where "as-dug" path construction can be used the machine will be used to excavate stone sub-base materials from along the path-line, mainly during ditching work, and carefully replacing soils and turfs afterwards to edge paths and re-line ditching. Stone for hand-built features such as pitching and water-bars is found close to the path, often winched in using hand winches, manually rolled or brought over in a power barrow. Where there is little or no local stone available material can be brought in from a local quarry, this is often then helicoptered onto the hill.

Actual construction can be very time-consuming and involves careful consideration of the surrounding land form and vegetation cover to ensure a good fit, avoiding harsh lines, using weathered rock surfaces or moss/lichen coverings appropriately, varying width and any straight lengths of path to create as natural a feel as possible. Path alignment is very important as walkers will look for direct routes towards or from the summit or view points along the way. Zigzags are often short cuts on descent, and any traversing that goes too wide will be similarly cut across. Desire lines quickly appear as summit areas come in to view or the car park at the end is in sight.

Pathworks are carefully surveyed and specified prior to construction; however unforeseen obstacles often appear once work starts such as bed-rock or springs which impact on pathline and drainage solutions. The following illustration is taken from the *Upland Path Construction Manual* shows a cross-section of a typical path.

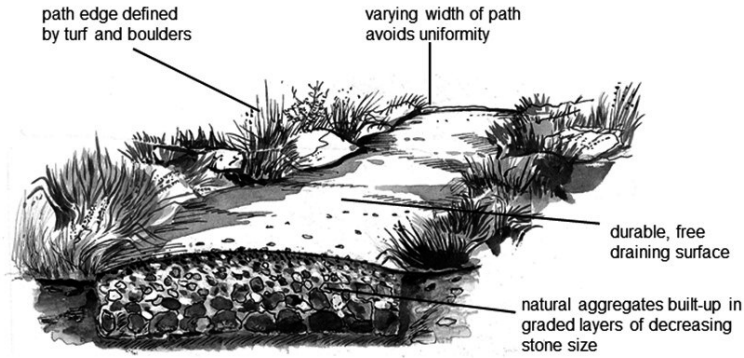


Figure 7. Best practice path construction.

Who does the fixing?

Over the last 30 years significant progress has been made in tackling mountain path erosion in Scotland. The start of this work began with the then Countryside Commission for Scotland who established a mountain paths team and began experimenting with hand-built construction techniques. The Scottish Conservation Projects Trust developed a trading wing and Pathcraft Ltd became the first mountain path contractors, working for Highland Regional Council on the West Highland Way Devils Staircase in Glencoe and for the National Trust in Torridon amongst others.

Skills training became a priority as larger more ambitious multi-million pound repair projects required more skilled contractors to do the work. The Ross & Cromarty Footpath Trust was established in the early 1990's and

Figure 8. Path repair by skilled contractors is usual.

developed a model, which was to be repeated many times over the following decades. The model combines mountain conservation and path repairs with a skills training course aimed at job and business creation, with the main funding in this case from the European Social Fund, Regional Development Funds, the local enterprise company and, more recently, Heritage Lottery Funds. Since then a number of projects have been developed and successfully delivered, largely led by the third sector including National Trust for Scotland, The Footpath Trust, Cairngorms Outdoor Access Trust and John Muir Trust. The public bodies such as Scottish Natural Heritage, the National Park Authorities, and Forestry Commission provide support often through funding which is then matched by European funds, the National Lottery and a variety of smaller Trusts and private sector contributions.

The focus has been on the most popular mountains such as the Cairngorms, Torridon, Skye, Ben Nevis, Glencoe, Arran, The Cobbler, Ben Lomond, Ben Lawers and Schehallion. The projects currently under way in Scotland include the John Muir Trust's repair project on Ben Nevis and just recently started the Mountains & The People project in Loch Lomond & The Trossachs National Park.

The Mountains & The People Project

This project is being led by the Cairngorms Outdoor Access Trust (COAT) and has just completed its first of five years of delivery. The focus of the project

is on conserving the landscape heritage of Scotland's two National Parks, Cairngorms and Loch Lomond & The Trossachs, whilst offering the people of Scotland and beyond the chance to play an active part in the conservation of these iconic mountains. Funding for the project has come from the Heritage Lottery Fund (£3.1 million), Loch Lomond & The Trossachs National Park Authority (£0.5 million),Forestry Commission Scotland (£0.5 million), Scottish Natural Heritage (£250K) and the Cairngorm National Park Authority (£250K), the remainder coming from other trust contributions, car park income, donations and COAT's own funds.

The project has six main work streams:

Path restoration: the upgrade, enhance and repair of 125 km of path across both National Parks, using both intensive and light touch path repair and restoration techniques. The routes have been prioritised from a list of paths generated through consultation and path audits. These include some of the worst path erosion problems in Scotland such as Ben A'an, The Cobbler and Ben Ledi.

Training and skills development: delivering Scottish Vocational Qualification skills training courses to provide trainees with the skills necessary to take up employment opportunities generated through the project and elsewhere. The programme will look to provide 36 paid trainee placements on 7 month long courses including work placements.

Conservation volunteering: engagement with volunteers in caring for the mountains by carrying out practical conservation tasks that support the mountain path restoration programme, including basic path construction, maintenance and helping conserve mountain habitats.

Adopt a path: seeks volunteers to help monitor the mountain paths across both National Parks and help provide on the ground information on path condition. This will help with programming the aftercare of the mountains and identify any emerging damage before it becomes a major problem.

Education and learning resources: working with young people from schools, colleges and universities in learning about our mountains and the importance of looking after them and developing resources to support learning. There will be opportunities to learn about the reasons behind erosion, the interaction between habitat, land use, people and climate, changing patterns of recreation and the challenges in managing these in Scotland's National Parks.

Visitor engagement: will ensure that visitors and the wider public have opportunities to find out about the mountains and the upland path networks in both National Parks, and be inspired by these special places. Learning about how important it is to care for them and how to minimise impacts and encourage responsible use. This will be done through the development of health walks, events, films, leaflets and interpretation.

Further information about this project can be found at:
www.themountainsandthepeople.org.uk
Twitter: @MountainsPeople
Facebook: The Mountains and The People

Conclusions

Our mountains endure extremes of climate and climate changes, varying land uses and pressures including intensive sheep grazing, forest plantations around the base of many hills, hydro-electric schemes, deer and grouse moor management and often have pylons, roads and railways passing through their midst. Recreational pressure is one more factor which is a cumulative pressure which is not going away. Once erosion begins it very rarely gets a chance to self-repair, due to the use and fragile nature of the upland habitats. It is essential that work continues to address the erosion problems through physical repairs and interventions, and that the people who enjoy climbing the mountains are aware of their impacts and help to look after these special places.

The challenges for the mountains are not surprisingly resource related. Skilled path builders are needed to look after the paths themselves, carry out preventative interventions, repairs, address any new and emerging erosion problems and upgrade and restore as appropriate. Significant progress has been made in this work but there are still mountain paths that have had little or no attention.

Strategic path management is essential to prioritise, nationally, where efforts should be focused, monitoring use, impacts and repair techniques as well as supporting new initiatives, and at a local level where care and management of the path networks is needed to ensure opportunities to experience the hills are maximised whilst minimising the environmental impacts, taking into account local conditions and putting in place local plans.

The mountains have been enjoyed by people for recreation and enjoyment, particularly over the last 50 years. For this to continue for another 50 years and beyond we need to keep looking after the network of Scotland's mountain paths to ensure they do not wash away and become visible and widening scars that not only detract from the walkers experiences of the mountains but spoil the mountain views enjoyed by millions of people visiting Scotland and its National Parks every year. The last 30 years have seen significant progress in tackling the issues, but the cycle of capital monies on a short term funding basis is not a sustainable or progressive model.

Our mountains should be valued and cared for as an important part of our National Parks and Scotland, contributing to the success of our tourism based economy, and to our nation's health and well-being.

THE CLACKMANNAN WAGGONWAY

Murray Dickie

The Clackmannanshire Field Studies Society obtained a Heritage Lottery Fund grant through the Inner Forth Landscape Initiative to undertake a four year research project on aspects of the development of the Two Estates of Alloa and Clackmannan, with particular emphasis on the 18th and 19th centuries. The grant enabled local volunteers to be trained and supported to research a number of topics. It was decided to concentrate the first year's work on researching the rise and decline of these waggonways and recording their remains. Twenty local volunteers were involved in undertaking the desk and field based research into these waggonways from May 2014 to June 2015. This article follows on from an account of the Alloa Waggonway published in Volume 38 of the Forth Naturalist and Historian, 2015.

The Clackmannanshire Estates: At the close of the 17th century the area covered by research was divided into six principal estates. While estate boundaries were complex and subject to change through time, these estates were: the Clackmannan Estate, owned by David Bruce of Clackmannan; the Alloa Estate, John, 6th Earl of Mar; the Alva Estate, Sir John Erskine; the Sauchie Estate, Lady Schaw; the Tillicoultry Estate, owned by Lady Tillicoultry and the Kennet Estate, owned by David Bruce of Kennet. At this time there were extensive salt flats along the edges of the inner estuary of the river Forth, bringing the coastline much further inland than is the case today. The modern coastline is the result of successive land reclamation projects in the mid to late 18th and early 19th centuries.

The Clackmannan waggonway was a challenging network to research. This was due to the complex, shifting ownership of the various sections, the amalgamation of two separate waggonways (the Sauchie waggonway and the Clackmannan waggonway), its relationship in its middle period with the development and decline of the Devon Iron Company and the complex co-partnership and partner relationships between the Clackmannan Coal Company, the Devon Iron Company and the Alloa Coal Company.

Early Mining at Clackmannan: There is evidence of a salt panning industry in the Clackmannan area in 1672 when Charles, Earl of Mar, with the consent of Alexander Mylne [or Milne], merchant burgess of Linlithgow, makes over to Sir Henry Bruce of Clackmannan "*a meadow or saltgrass at the west end of the Pannis at Craigton* (later Kennetpans)". There is also a reference to saltpans at Clackmannan and Alloa. At the same time, the Clackmannan estate was working coals and when Henry Bruce of Clackmannan died in 1674, his estate included 3,500 chalders (5,334 metric tons) of coal. Sir Henry Bruce's son David spent considerable sums of money improving coal mines on his estate at

Clackmannan and Sauchie. By 1699 it is recorded that the pits in the vicinity of Clackmannan were drained by a water engine, which was supplied by a lade from the river Black Devon.

Unfortunately, in 1704, David Bruce was made bankrupt and sought protection from his debtors, declaring his state of insolvency was due to liabilities which he had incurred as heir to his father and subsequent expenditure in improving the coal mines at Clackmannan and Sauchie. In 1708 the estate was purchased by Colonel William Dalrymple of Glenmuir, who was one of David Bruce's principal creditors. In 1711 he established with Sir John Erskine, 6th Ear of Mar, the right to use the harbour and Pow of Clackmannan. A rough sketch of 1713 shows the town of Clackmannan, a water engine draining the coal pits and the small settlement of Powsyde (Powside) on the tidal reaches of the river Black Devon where the coals were embarked. A plan of the Estate of Alloa circa 1704 shows the location of coal pits and a water engine in an area immediately to the South of the Parkmill, between the river Black Devon and the base of King's Seat Hill. These pits would have been mining the Nine Foot coal at a shallow depth. The pits were abandoned by 1745 but this water engine and a second one slightly to the North continued to drain the Clackmannan pits for at least another 50 years. Once the Nine Foot coal had been abandoned, workings moved further south towards the Pow into another faulted block of coal seams where the Alloa Cherry coal and the Alloa Splint coal were mined.

The first direct evidence of a waggonway at Clackmannan is a painting of Clackmannan Tower, by John Clerk in 1775. This shows Clackmannan Tower, a coal pit with stairs, women bearers, an overseer, a tally clerk and mine drainage waterwheel. It also shows a small section of waggonway with a single waggon. While it is difficult to be precise about measurements, the waggonway has two rails, laid on rows of sleepers made from small rounded logs, grouped in threes and spaced about the same distance apart as the rails are spaced from each other. The waggon is shown as being as high as it is broad and the length is shown as some three times the breadth. The waggon wheels are shown as having four circular holes and slightly smaller in diameter than the waggon is broad. The background detail of the picture suggests that the coal pit was close to the original tidal harbour of Clackmannan Pow at Powside.

Much of the land to the South of Powside is below the level of high tides and was originally an extensive area of tidal mud flats and saltmarsh. There are records of an early embankment built by Sir Charles Erskine sometime in the mid-17th century. Its location is shown on Roy's map of 1747. During the period 1772 to 1830 the estates of Alloa and Clackmannan built further, more extensive, sea walls to reclaim much of the land for agriculture. Each of these embankments followed along the banks of the river Black Devon and turned eastwards, running parallel to the shore of the river Forth. Each successive embankment enabled the waggonway to be taken closer to the North shore of the river Forth. At Powside, the base of the river Black Devon has been lined

with squared sandstone blocks and the eastern embankment paved with similar sandstone blocks supported at the base by a wooden plank held back by wooden piling (NS 902909). The embankment is divided into sections separated by wooden planks (Plate 1a). The depth of water here at high tide is 10 feet (3 metres), while the depth of water at the junction with the river Forth is 20 feet (6 metres). In 1772 Sir Lawrence Dundas, now owner of the Clackmannan estate straightened and deepened the mouth of the river Black Devon at its junction with the Forth (NS 895904).

As the size of ships increased during the 18th century, some were no longer able to travel up to the harbour at Powside and the Clackmannan waggonway was extended in 1776 from the usual landing place at Powside along the top of a new embankment on the bank of the Black Devon to a point closer to the mouth of the river. A later plan confirms the location of two waggonway piers ("*shipping births*") with small embankments running off the main embankment (NS 898904) onto wooden piers (Plate 1b). By 1796 the First Statistical Account of Clackmannan noted that the Clackmannan waggonway served several pits working the Alloa Cherry, Alloa Splint and Coal Mosie seams and that the average distance from the pits to the shore was three quarters of a mile (1.2 kilometres). Waggons were transporting one and a half tons of coal to Clackmannan harbour and about 7,000 tons were annually exported to Leith, Dunbar, Perth, Dundee, Montrose and other places.

Aerial cover in the National Library of Scotland County Map series shows a distinct crop mark and physical link connecting the site of the Old Carse pit (NS 8976891509) to the main waggonway route along the embankment at Powside (NS 9024790967). This crop mark is aligned with the remains of an embankment running NE from Powside. The RAF 1945 aerial cover, in Google Earth, shows another embankment leading from Powside to the site of the Old Mill pit at Heatherhouse and then on to the Watermill pit.

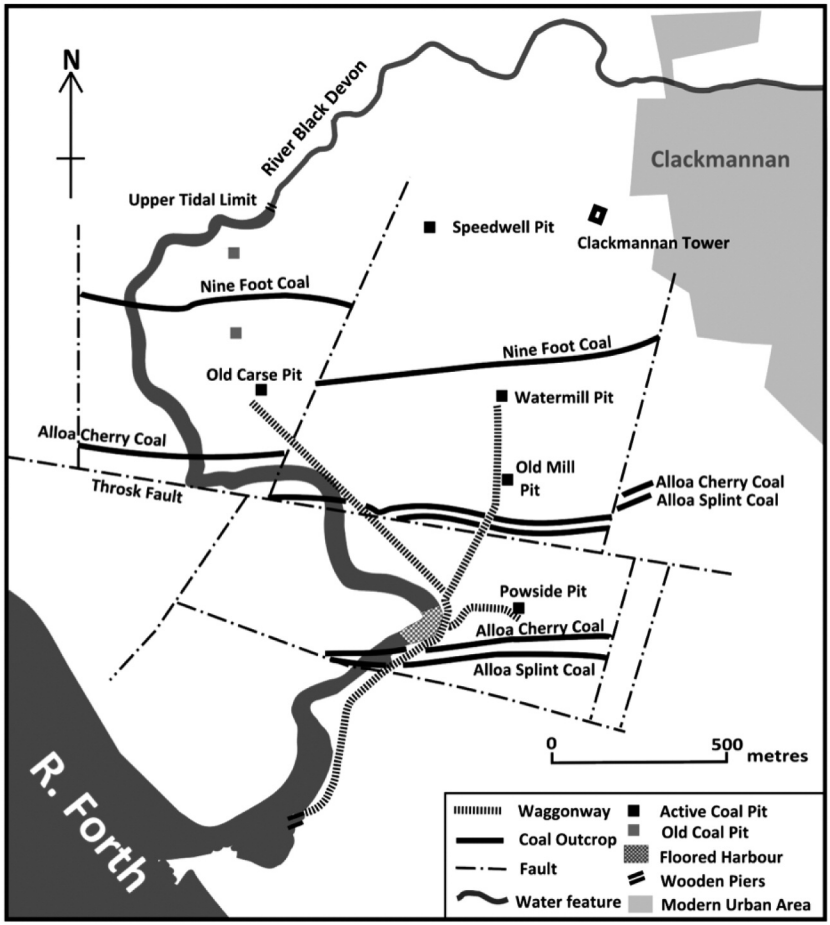
A Change of Management to the Clackmannan Coal Company: At the beginning of the 19th century, the Clackmannan pits were directly managed on behalf of the estate owner, Sir Lawrence Dundas. There are two historical references to the Clackmannan waggonway being extended from the Devon Iron Works to Clackmannan Pow circa 1806. However, the first of these references refers to the "Clackmannan waggonway" being owned by the Earl of Mansfield, who owned the Sauchie estate, while the second reference in 1807 refers to "*a wagon-way of recent and singular construction*" serving the Devon Iron Works. These two references appear to confuse the extension of the Alloa waggonway to the South Sauchie colliery in 1806 and the construction of the Sauchie waggonway, a small line built on the Sauchie estate to connect the Devon Iron Works to the Alloa waggonway at the South Sauchie Engine pit in 1837.

The line of the Sauchie waggonway is shown on a plan of 1839. Together, these references suggest that the Devon Iron Works had some degree of access

to the Alloa waggonway from 1806 and that this was improved in 1837 by the construction of a branch on the Sauchie estate to connect directly with the Alloa waggonway.

By 1810 the owner of the Clackmannan Estate, Thomas Dundas, 1st Baron Dundas, had leased the Clackmannan collieries to the Clackmannan Coal Company, a partnership between George Taylor and John Brown. In 1814, the Clackmannan Coal Company sought relief from the rental for the lease of the Clackmannan colliery, suggesting that the collieries were not proving to be a commercial success. In 1830, pits in the vicinity of the village of Westfield,

Figure 1. The Clackmannan Waggonway, circa 1796.



Based upon information from the National Library of Scotland and OS Opendata.

which had been working the Nine Foot, Five Foot, Alloa Cherry and Alloa Splint coals, were abandoned but new pits were soon opened in the Southfield coalfield at Craigrie (NS 904915) (241) and the Northfield coalfield at Hillend (NS 912929) where there is a record of 143 inhabitants living there in 1831, along with 16 pigs, 60 hens and 50 pigeons. There is no direct historical evidence to accurately date the extension of the waggonway from Powside to these two pits, but a later contract in 1841 between the Clackmannan Coal Company and Lawrence Dundas, 2nd Baron Dundas, for the Northfield and Southfield collieries of Clackmannan refers to access to a waggonway and Clackmannan harbour, suggesting that by 1831 the Clackmannan waggonway had been extended as far north as Hillend Pit (NS 910930). This waggonway was carried southwards from Hillend past Fauld (modern day Helensfield) and across the valley of the river Black Devon on a substantial embankment and a bridge supported on two sandstone built side walls and a central pier (NS 912922). When the Alloa to Kincardine railway line was built, it was carried over the waggonway on a stone bridge, which was removed when the line was recently reconstructed to take coal to Longannet power station.

The waggonway continued along the south side of the valley of the river Black Devon and then swung around the side of King's Seat hill in a series of cuttings, embankments and composite cuttings (Plate 2a). The use of composite cuttings was a very common and efficient method of creating a level track when running along a slope. Material was cut away on the upslope side of the line and then used to build an embankment on the downslope side.

By 1832, the river Black Devon had reverted to its pre-1772 course and was undermining the Alloa estate's (Erskine's) embankment on the West side of the river. Proposals were drawn up to change the course of the Black Devon, construct a new embankment to the shore of the Forth and build a new harbour there. The plan was implemented in 1832 and the Clackmannan waggonway was extended along the top of the new embankment. The waggonway now had three embarkation points: Powside, the two shipping berths close to the mouth of the Black Devon and a substantial harbour on the shore of the river Forth (NS 895903). There is very little left of this harbour, other than a few stumps of the wooden piers earth mounds which connected the waggonway on the embankment to the piers and a few bricks from the harbourmaster's office.

A New Partnership with the Devon Iron Company: The development of the Clackmannan waggonway was to change with the involvement of the Devon Iron Company, which had been founded in 1792. In 1834, the Clackmannan Coal Company was in financial difficulties and the two partners surrendered the lease of the Clackmannan collieries to the Devon Iron Company, along with two thirds of their shares. The iron works had initially utilised coal and ironstone from pits in the immediate locality of the iron works and used Alloa harbour and the Erskine's Coal Road to bring limestone from Charleston for the furnaces and to export cast iron bars and iron goods. Coal, originally

Figure 2. The embankment across the valley of the river Black Devon.

The waggonway embankment is across the centre of the photograph, with the larger embankment of the later Alloa to Kincardine railway behind.

Figure 3. The remains of the central bridge pier.

supplied solely from the Devon Iron Company's own pits, was now being mined in association with the Clackmannan Coal Company on the Clackmannan estate.

In 1837 the Devon Iron Company had negotiated with the Sauchie (Mansfield) Estate, the Alloa Coal Company and the Ochil Turnpike trust to construct a short waggonway (the Sauchie waggonway) from the east side of the iron works, across the turnpike road and then south eastwards to join the Alloa waggonway. In 1839 they negotiated a series of wayleaves with the Sauchie (Mansfield), Alloa (Erskine) and Clackmannan (Dundas) estates to construct a waggonway to carry coal and ironstone from the Clackmannan collieries to the Devon Iron works. The Erskine estate owned an area of land at Jellyholm, which linked the land owned by the Mansfield's at Sauchie to

Dundas's Clackmannan estate. There was a period of discussion about a clause in the Erskine lease which stated that the waggonway could only be used to bring coals to the works and specifically stated "*and for no other purpose*". The contract made clear that this clause was inserted to protect the financial interests of the Alloa Coal Company's waggonway and the Erskine's financial interests in Alloa harbour. Following legal discussion, agreement was reached that this clause would be rewritten to "*the waggon road could be used to move coal to the iron works and transport equipment from the ironworks to the pits, but for no other purpose*".

It would appear that the original clause was deleted and the new clause was attached as a separate piece of paper. In transcribing the contract, this paper was misplaced, the clause was omitted and the two parties signed the lease without any restriction. The contract was agreed in 1839 with a yearly rental charge of £60 for access to the land and the wayleave to allow the Sauchie waggonway to be extended to link up with the Clackmannan waggonway. The Erskine family noticed the omission of the clause in 1843 and initiated legal proceedings in 1845, but no record has been found of the case going to court. The extension to the Sauchie waggonway linked up with the Clackmannan waggonway at a point North of Hillend pit (NS 909933).

By 1841 products from the Devon Iron Works were carried by the Alloa Coal Company and Clackmannan Coal Company colliery waggonways to the harbours at Alloa and Clackmannan. In the same year the Dundas estate leased the seams of coal, ironstone and fireclay under the North and South portions of the Dundas estate to the Clackmannan Coal Company and Devon Iron Works for 23 years. An annual rent of £150 covered the use of the waggonway and shipping place at Clackmannan shore. There was an annual rental for the minerals of £200 for the first year of the lease and then £400 per year thereafter plus:

a) *Coal: Inland coal – less than 5/5d, 1/7th and more than 5/5d, 1/8th. Shipped coal –then less than 6/-d, deduct 7d for carriage then 1/8th and more than 6/-d, deduct 7d for carriage then 1/7th.*

b) *Ironstone (per ton of 22 ½ cwts): from the nine foot waste, 1/-d per ton, other seams, 6d per ton.*

c) *Fireclay (per ton of 22 ½ cwts): 3d per ton.*

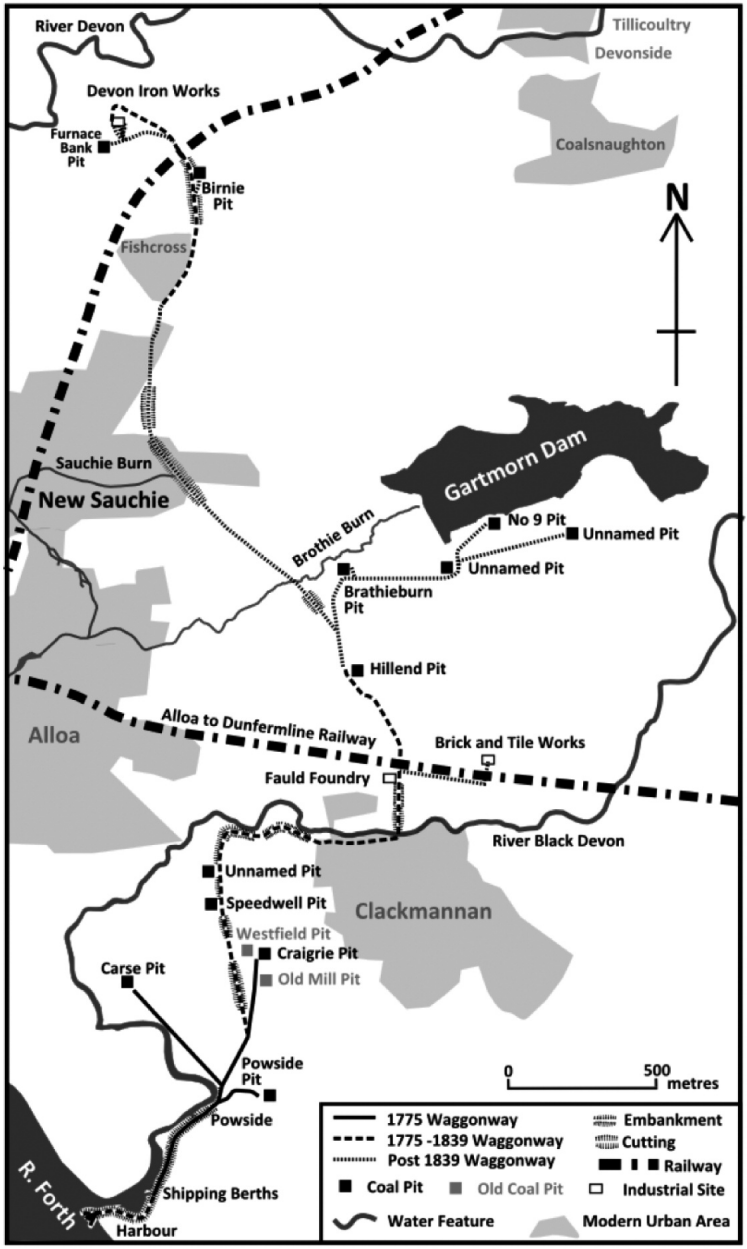
d) *All coals used for drainage, pit head fires, ventilation and workers heating to be free of burden.*

e) *North and South coalfield outputs to be recorded and reported separately. Separate records for sea coal and chaws to be kept.*

f) *All wood for new colliers housing to come from the estate's plantation.*

g) *No claims for damages resulting from breaching of the embankment.*

Figure 4. The Clackmannan Waggonway, circa 1845.



Based upon information from the National Library of Scotland, Russell Family Website, OS OpenData and Google Earth

This lease indicates that the two companies were working together to mine coal, ironstone and fireclay and were using the linked Sauchie and Clackmannan waggonways to supply the Devon Iron Works with raw materials, export goods from the iron works and ship coal from Clackmannan harbour. The New Statistical Account notes that in Clackmannan parish in 1841 "*Some 500 tons of coal are worked each day. 200 tons are consumed in the parish, mostly at the Devon Iron Works and the remainder is shipped to Scotland and beyond*" and that the iron works also had access to the Alloa waggonway and Alloa harbour.

Another New Partnership: Coal was by now the fuel in general domestic use and was for sale at about 6s (£0.30) per ton with collier families having a free supply. An extensive brick and tile works was in operation to the North of Clackmannan (NS 917925) and connected to the waggonway. Despite an annual output of some 60,000 tons, access to rail and port facilities linked by waggonways and an expanding market, the Clackmannan Coal Company was put up for sale in 1848. The lease was bought from the Devon Iron Company by Robert Moubray (a partner in the Alloa Coal Company) and the brothers, Andrew and Alexander Mitchell. The new partners reconstituted the Clackmannan Coal Company in 1849. Several pits were closed in the Southfield colliery and new pits opened in the Northfield colliery with a waggonway branch linking them to the main waggonway north of Hillend pit.

The first of four pits on this branch was the Brathieburn pit, which was associated with a small miners' row. There was no reference to the row in the 1841 census return, but it was included as a bustling miners' row in 1851. There is a borehole record showing that in 1850 the colliery owners were exploring the Alloa Cherry and the Alloa Splint seams to the East of the Brathieburn pit. This part of the Clackmannan Northfield coalfield is separated into a number of small wedges by a series of North to South and East to West faults and it is likely that the other pits to the East of Brathieburn represented the extension of workings eastwards into adjacent wedges of coal.

During the construction of the Alloa to Dunfermline railway in 1848 agreement had been reached for a diversion of the Clackmannan waggonway, with bridges to carry the railway across the waggonway at Fauld (modern day Helensfield) and at the entrance to the Clackmannan brick works. The diversion took the form of lowering the bed of the waggonway to minimise the height of bridges built to carry the railway across it.

Closure of the Devon Iron Company: In 1828 a fire was discovered in the North Sauchie colliery. It is thought to have started in a waste heap above an abandoned shaft sunk by the Devon Iron Company to rework the Blackband ironstone in the roof of the Nine Foot waste. The Devon Iron Company agreed that they would construct a barrier to encircle the fire to prevent it spreading and, hopefully, put it out. In 1839 the Devon Iron Company, by now having spent £15,000 attempting to control the fire, took legal action against the Sauchie (Mansfield) estate to recover their costs. The court decided in favour of

the Mansfield estate and the company's involvement in the fire placed a considerable financial strain on them.

While the barrier helped to contain the fire, it did not extinguish it and it burned for nearly 30 years, destroying a large area of coal and making the colliery almost impossible to work. It was finally extinguished in 1850 by a steam jet designed by Sir Goldsworthy Gurney, which forced a mixture of nitrogen and carbon dioxide into the mine.

By then, the Devon Iron Company were having to cart in ironstone from mines at Vicarsbridge and Mellochglen, to the south of Dollar and blackband ores from the Craigrie pit at Clackmannan and from Lethams, near Saline. They were initially using the Statute Labour roads and a report to the Commissioners of Roads indicated that they had been obliged to make a contribution of £30 per annum, or 2d. (£0.083) per cart, by allowing a portion of the road to get into such a bad condition that they were unable to drive their carts over it (the 2d against £30 represents equivalence to some 3,600 carts). The Company had a similar experience when shifting to the Turnpike road. In 1843 the Company surrendered their lease of the Sauchie Colliery to the Alloa Coal Company, agreeing to purchase 30,000 tons of coal annually from them.

While the quality of the ore they were using produced cast iron of a high quality, the output from their furnaces was quite small: 7,000 tons in 1846. In that year John Christie of the Devon Iron Works, bought the Crawford pit, near Dunfermline, perhaps as an additional source of raw materials. By 1850 the Company was facing financial difficulties and in 1854, the Devon colliery, one of their principal suppliers of coal, was flooded and then abandoned.

This perhaps represented the last straw for the partners and they decided to offer the iron works for sale. A notice in the Edinburgh Gazette indicated that "*We the Subscribers, the sole Parties representing the Concern carrying on Business as Ironmasters at Devon, near Alloa, under the name of The Devon Company, having sold the Devon Ironworks, alongst with the Leases and Ironstone Workings of Devon, Killarnie, and Alva, to Mr Andrew Christie, of Townhill Colliery, Dunfermline, with entry on 30th June last, ceased at that date to have any interest therein. July 10, 1854*".

Alexander Christie, who had been manager at the works from 1848-1854, bought the works in partnership with John Wilson of Dundyvan. The iron works closed in 1856 and the furnaces were drawn for the last time. Alexander Christie placed the works on the market later that year, but no buyer was found. In 1857 the Alva estate took legal action against the Devon Iron Company for the illegal extraction of coal, so coal mining operations were still on-going at that time.

In May 1858 there was a notice of a public sale, followed by another notice in November of a roup sale, with the upset price further reduced. The sale notice on 05/11/1858 indicated that there were three blast furnaces, blowing

engine, foundry, turning and boring machinery, private railways, lease of coal, ironstone, limestone and fireclay and houses, so at that time the line of the Clackmannan Waggonway was still in place. Finally, in 1861, the proprietors of Devon Iron Works resolved to break up and clear away the extensive iron works. The machinery, utensils and material were sold to Messrs Watters and Murdoch, Glasgow. Beyond that time, the section of the Clackmannan waggonway to the north of the Hillend junction with the Brathieburn branch would have been abandoned.

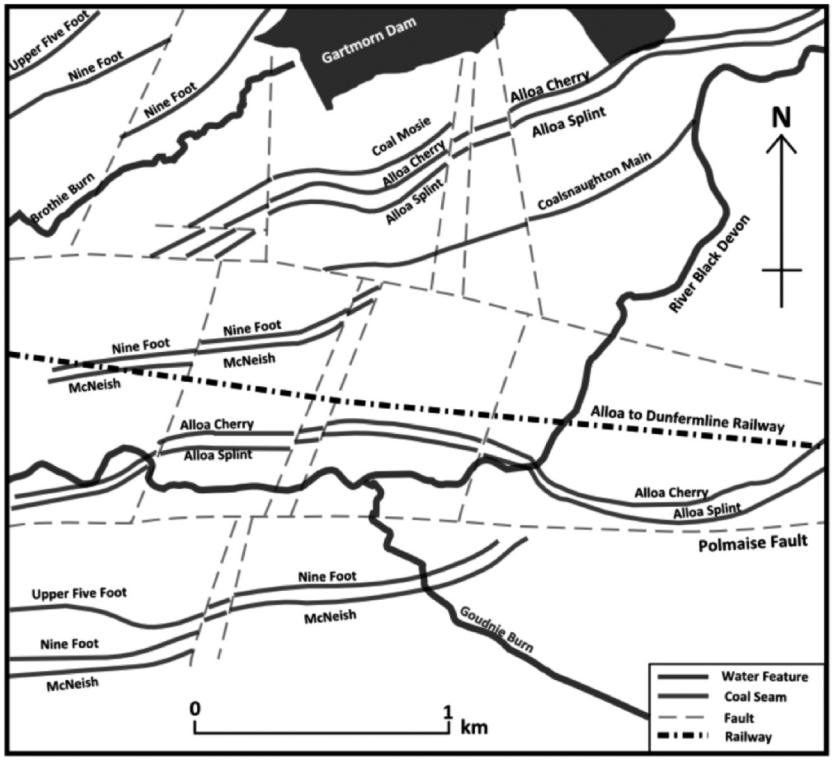
The Extended Clackmannan Branches, 1860-1898: The 1898 Six inch Second Edition Ordnance Survey map of Clackmannan records a number of sections of "*abandoned tramways*", the remains of embankments and shows the Alloa and Kincardine branch of the North British Railway bridging across the route of the Clackmannan waggonway with a second bridge close to the site of Clackmannan Station (NS 912922). None of these are shown on the First Edition Six Inch O.S. map of 1861. In addition, there are substantial changes between the two maps in terms of field boundaries in areas where the lines of abandoned tramways and embankments are indicated on the Second Edition Six Inch O.S. map of 1898. This evidence points to the construction of a number of additional sections of waggonway post 1861 and the Clackmannan waggonway still being active in this area at the time the Alloa to Kincardine branch railway was constructed in 1892.

Records of land sales of the Clackmannan Coal Company indicate that during the period 1863 to 1873 coal was being sold at Fauld (modern Helensfield) to be delivered by carrier and also sold on through the Alloa to Dunfermline railway siding. Records of sales at Clackmannan Pier covering the same time period show the bulk of seaborne sales went to other inner Forth estuary ports (principally Leith and Grangemouth), with other sales to ports on the east coast of Britain and across the North Sea and into the Baltic.

The geology of the area to the South of Gartmorn Dam shows a number of small, faulted wedges. Each wedge had to be mined separately by small shallow workings with separate waggonway branches. Three waggonway branches have been identified as being active at this time: the Goudnie Burn branch, a branch along the South Gartmorn shore and the Grassmainston branch. Evidence of the pit numbers show that the Goudnie Burn branch served pits 6 and 7, the South Gartmorn Dam branch served two unnamed pits and pits 12 and 13 and the Grassmainston branch served pits 14 and 15. The pit numbering suggests that the branches were built first at Goudnie Burn, then at South Gartmorn and finally at Grassmainston.

The Goudnie Burn branch was tracked using a combination of maps, aerial photographs and field work. The Second Edition Six Inch OS map of 1898 showed that the railway line was bridged over a small, dead-end roadway. A small section of abandoned embankment was shown near to the small hamlet of Riccarton, along the edge of the Goudnie burn. Beyond this point changes

Figure 5. The Geology of the Clackmannan Branches.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

to the field boundaries between the 1861 and 1898 maps indicated a route connecting to two abandoned pits (Numbers 6 and 7, NS 925918). The 1945 RAF aerial photograph clearly shows the line of the Goudnie Burn branch.

The branch along the South shore of Gartmorn Dam was the subject of field training run by A.O.C. Archaeology on behalf of the Inner Forth Landscape Initiative in May 2015. Historical evidence came from the Second Edition 25 inch OS map of 1898, which showed the existence of the remains of an embankment and abandoned pit sites. The line of the waggonway extension shows up clearly on the 1945 RAF coverage in Google Earth, where the entire route is clearly visible. A team of volunteers supported by AOC Archaeology staff surveyed the line of the waggonway extension in May 2015. The waggonway was followed from the site of the Number 13 pit, where it started at ground level at an elevation of 62 metres heading northwards. It is then gradually lifted upwards on an embankment which increases in height to some two metres. It reaches the site of the Number 12 pit where it curves round to

head west south westwards on a lengthy embankment (Plate 2b) towards an unnamed pit and then joined the original Brathieburn branch.

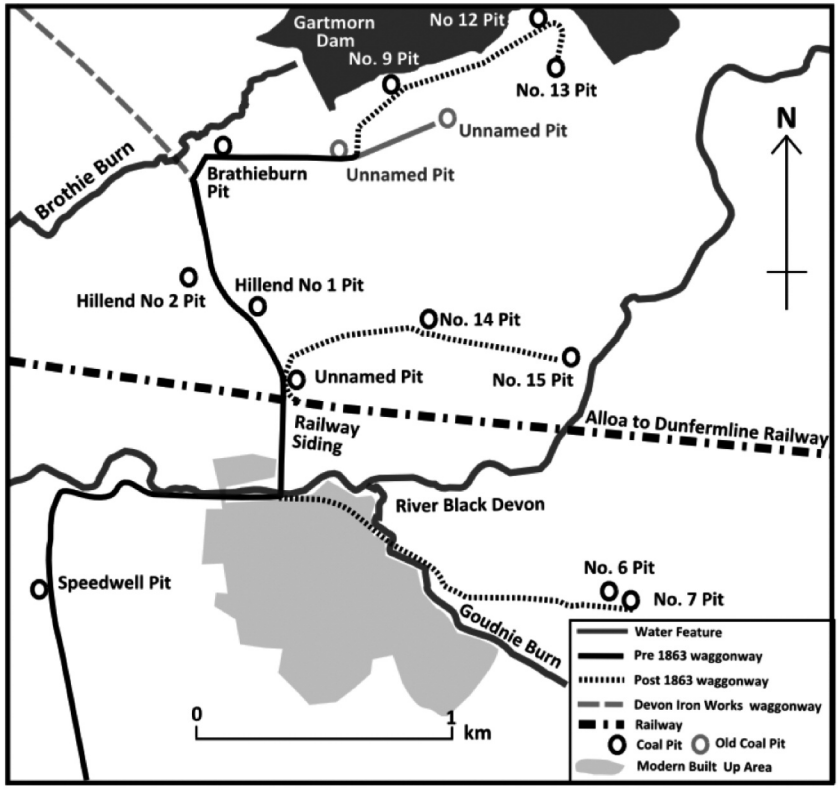
The waggonway was excavated by A.O.C. Archaeology staff and volunteers close to the Number 12 pit (NS 9236794087). It was found to be composed of a mixture of small pieces of white sandstone, cream sandstone and a soft dark blue blaes (Plate 3a). The embankment also contained a number of larger, flattish pieces of sandstone and a layer of these had been laid on the surface of the embankment close to its base. A borehole record from the area indicates that the shaft would have been sunk through white and cream sandstone and dark coloured blaes to the Alloa Splint coal. Furnace ash was present in layers in the embankment and a large mass was found in the centre of the embankment (Plate 3b). A newspaper report of 1868 records a fire at this colliery, which had been working the Alloa Cherry and Alloa Splint coals. The fire started in the Number 12 pit (the one adjacent to the excavation of the embankment). This was a combined access and ventilation shaft, with a wooden separator up the middle. There was a firebrick box some distance up from the bottom of the shaft which was fired with coal, to provide ventilation.

It was thought that the fire was started when this box was overloaded at the end of a Saturday shift, the heat setting an adjacent thin seam of "*foul coal*" on fire. By the time the fire was spotted the following morning the shaft timbers were well ablaze, eventually destroying the pit head gear. Efforts to put out the fire with streams of water failed, as did attempts to reach the bottom from the connecting Number 13 pit. The burning shaft was then filled in and Number 13 pit sealed off, putting 100 miners out of work. The use of this shaft with a firebox for ventilation might explain the presence of large amounts of ash in the embankment.

An end section of a cast iron plate rail was uncovered just beneath the soil cover, with two hand-made, wrought iron nails.

The reconstruction above is based on the standard length of plate rail known to be in common use. Being of cast iron, the length had to be kept short to prevent breakage. The use of a combination of a hole and a hook at each end allowed the rails to be arranged along a curve. Plate rails were introduced in England as early as 1756 and became widespread. However, the waggonways of north-east England saw an almost total conversion from wooden to iron edge-rail although the use of plate-rail underground was popular even in areas which used edge-rails overground. Unfortunately, there are no historical records of the type of rails used on the Clackmannan waggonway and this single piece of plate rail is the only evidence so far. The Ordnance Survey name books for Clackmannan records a small foundry at Fauld in 1863, owned by Thomas Dundas, 1st Earl of Zetland, which was noted as only casting rails for the Clackmannan waggonway (NS 911925). There is also a record of a small smithy at Fauld on the First Edition OS map of 1861. These two small industrial sites, together with the section of rail and

Figure 6. Clackmannan Branches, circa 1870.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

nails uncovered in the excavation suggest that the track used by the Clackmannan waggonway when the Brathieburn extension was built might have been a plateway. Alternatively, the fragment might have been part of an underground system of haulage in use in the Brathieburn pits. More evidence would be required to confirm this.

The line of the Grassmainston branch is clearly marked on the Second Edition Six Inch OS map of 1898 as an "*abandoned tramway,*" with a farm track and field boundaries showing the route of the former waggonway. The 1945 RAF aerial coverage shows the branch extremely clearly and the 1920 Geology Survey map names the pits as Number 14 and Number 15. These pits are listed on the Scottish Mining Website as being active in in 1873 with the Alloa Cherry and Alloa Splint coals being worked by the Clackmannan Coal Company and possibly represent a response to the closure of the South Gartmorn pits following the fire of 1868.

Figure 7. Reconstruction of plate rail fragment.

These Clackmannan branches of Goudnie Burn, South Gartmorn Dam and Grassmainston were built to support a series of small scale pits in an area where the geological faults have created a number of small wedges of coal seams. The pits stopped working the Alloa Cherry coal seam in 1894 and were finally abandoned in when they stopped working the Alloa Splint coal.

This was the last brief period of life for the Clackmannan waggonway as a coal transport system. The evidence for its end is sparse. Census returns for the area close to Clackmannan harbour show that there was a harbourmaster living at Heatherhouse, in 1841: John A Lange, aged 50, Harbourmaster and weigher, born in Fredrikstad, Norway. In 1861, also living at Heatherhouse, William Houston, Harbourmaster, born in Fossaway, Perthshire and in 1871 at Heatherhouse, Mr. Hunter, shoremaster. In 1881 the census returns do not record a local harbourmaster in this area. However, there is still a connection with the harbour as John Braun was recorded as a Pilot in the Forth and living at Powside.

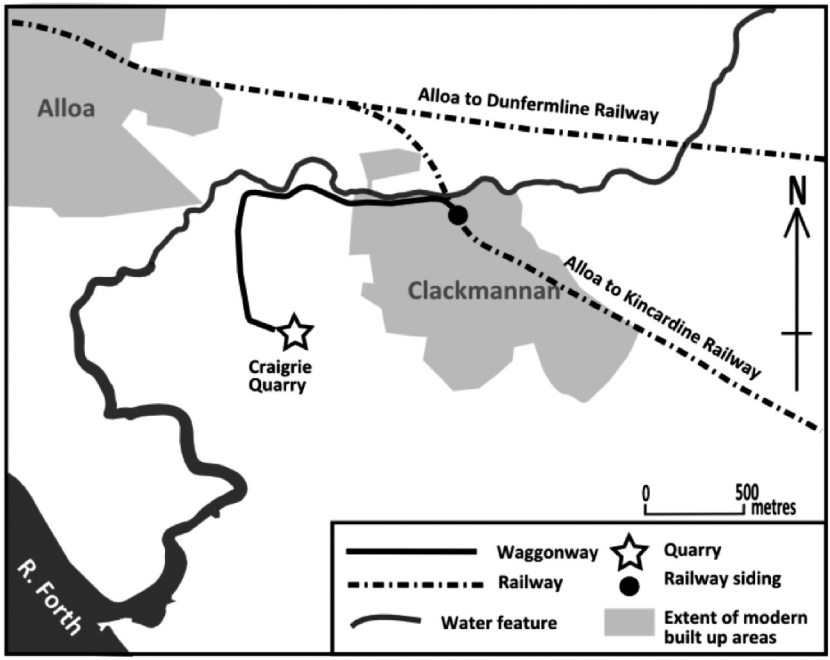
A Board of Trade inquiry was held in Dundee Sherriff court in 1890 regarding the loss of the steamship Newport. The evidence given at this inquiry indicated that the Clackmannan Coal Company had spent £3,000 in 1889 to dredge mud from the area off the pier and establish new buoys. It also noted that coal at Clackmannan pier was loaded on board ships using a steam crane to lift waggons and metal chutes to pour coal into the holds.

Evidence was given by Just Anker Lange, harbourmaster at Clackmannan; William Marshal, pilot at Alloa and Henry Ferris, manager of the Clackmannan Coal Company. Mr Ferris stated that the Company shipped a large quantity of coal and Clackmannan had always been considered a safe tidal harbour. Both the harbour master and the pilot stated that there were no hard objects on the bed of the anchorage, but that vessels were partly or wholly aground at low tide. The finding of the court regarding the loss of the vessel Newport indicated that she left port in "a good and seaworthy condition, except that in all probability she had been strained while loading. The Sherriff stated that "*the qualification was an important one and ought to be taken note of by those interested in the future of Clackmannan as a coal port, as well as owners and masters frequenting the Firth of Forth for coal cargoes."* A similar finding from the court several months later regarding the loss of the steamship "Swallow" must have raised serious questions about the future of Clackmannan pier.

At the turn of the century the OS maps of the area show a number of contradictions. The Third Edition of the OS One Inch Map (1904) shows a line from the Goudnie Burn pits to Clackmannan pier, with a branch to Fauld (modern day Helensfield). The Second Edition of the OS 25 Inch map (1898) shows only a line from the Craigrie Quarry to the railway near Clackmannan Station on the Alloa to Kincardine line. Although there is no direct evidence for the closure of the pier, the last pits on the Clackmannan branches stopped working the Alloa Cherry coal seam in 1894 and were finally abandoned in 1900 when they stopped working the Alloa Splint coal. It is likely that the last section of waggonway and the pier were abandoned at or soon after 1900.

The Westfield Quarry Mineral Railway: The Clackmannan waggonway route had been carefully graded with cuttings and embankments to ensure a gentle, steady gradient. Once the route was no longer used to take coals to the harbour, part of it was reused as the route of a "*Tramway*" connecting the Westfield quarry (NS 903916) to the Alloa to Kincardine railway line near to Clackmannan station (NS 912922).

Figure 8. The Westfield Quarry Tramway, circa 1898.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

This line is shown on the Ordnance Survey second edition Six Inch map of 1898 starting from a spur north of the quarry to the point where it once crossed

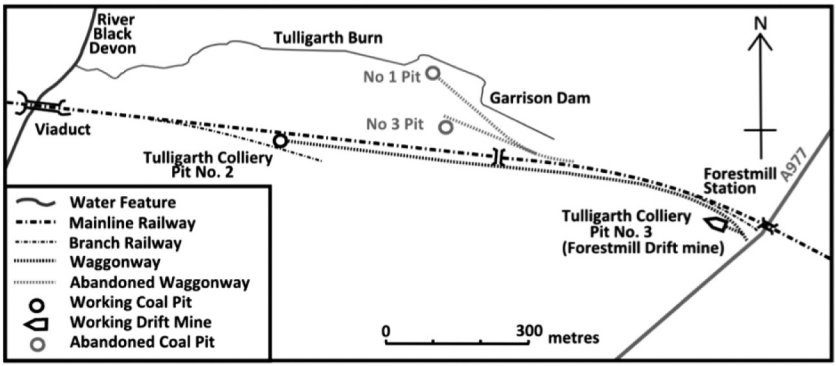
the river Black Devon. Two small sections were added to the route of the original waggonway: a 135 metre spur at the quarry and a small 170 metre curve to link directly with the mainline railway. This direct link suggests that the gauge of the line was the same as that of the railway. A retired miner in Clackmannan indicated that he once had a booklet with a picture of a steam train on the line of the waggonway near to the Craigrie quarry, hauling waggons loaded with sandstone.

This section of waggonway is one of the best preserved and most accessible in Clackmannanshire. It has a number of cuttings and embankments to carry it down the side of the river Black Devon and out on to the Carse. These cuttings and embankments, taking the route of the waggonway around the side of Kings Seat hill, are complex and demonstrate the high level of engineering used to keep the bed of the waggonway at a level, with the minimum amount of construction. Two sections in the Back Wood show the ways in which cuttings, embankments and composite cuttings/embankment have been used. The Revised Second Edition Six Inch O.S. map, published in 1921, shows the Craigrie Quarry line still in operation while the next edition, published in 1924, shows the whole system had been abandoned.

The Tulligarth colliery (and Pretoria pit) Tramways: There were two last tramways built in the Clackmannan area associated with the Tulligarth Colliery. This colliery started working in the area of the Tulligarth (or Garrison Dam) in the 1860's. The First Edition Twenty Five Inch O.S. map of 1861 shows the Tulligarth Number 1 pit connected directly to the Alloa to Dunfermline railway line by a "*Tramway*". A site survey revealed that this was carried across the bed of the old Garrison Dam on a very broad embankment (Plate 3c), suggesting that the tramway may have been a branch of the railway, connected directly to the Alloa to Dunfermline line. The Second Edition Six Inch O.S. map show that these workings had been abandoned by 1898. The Second Edition Twenty Five Inch O.S. map, revised in 1920, shows two workings to the South of the Alloa to Dunfermline railway line. The Tulligarth Colliery Number 2 (Pretoria Pit), had a branch line connecting it to the Alloa to Dunfermline railway. A tramway had been constructed to join this pit to Pit Number 3, which lay directly to the South of the Forestmill Station. The O.S. map shows the tramway running alongside the Alloa to Dunfermline railway line, but with no connection to it. The tramway was a single track with a passing place at Pit Number 3. This was a drift mine and the tramway branches off from a track leading from the mine entrance to a waste tip. The map shows the tramway to be of a narrower gauge than the mainline railway.

While neither of these pits is shown on the Second Edition Ordnance Survey Twenty Five Inch map, revised in 1898, there was an accident recorded at the Pretoria pit in 1906, when five miners were trapped by floodwater when they broke into old workings. Fortunately, the men were able to reach a higher level in the mine and were sustained with air and supplies lowered into a borehole sunk into the workings. They were eventually rescued after being entombed for 90 hours.

Figure 9. The Tulligarth Tramways, circa 1920.



Based upon information from the National Library of Scotland, OS OpenData and Google Earth

The Pretoria pit was still in operation in June 1915, when the Scotsman newspaper reported the death of Robert Fyfe, partner in the firm of Messrs J Fyfe and Company, owners of the pit. The Third Edition of the One Inch map (revised in 1923-26) shows the Pretoria pits abandoned, although the Tulligarth colliery continued to operate into the late 1930's.

Conclusion: The Clackmannan waggonway was constructed to assist with the movement of bulk materials, mainly coal and ironstone and were all horse-drawn, single line waggonways with passing places. Most of the routes had a very gentle downward slope or very little gradient at all. Part of the Sauchie waggonway had slight climb up to the ridge at Fishcross as the Devon Iron Works was situated lower down in the valley of the river Devon. The waggonway appears to have been constructed after the local estate owners had decided to lease the coals, rather than work them. Initial costs seem to have been burdensome, but the substantial increase in the amount of coals being handled covered costs quickly and the waggonways were responsible for moving very large quantities of coal quickly and easily and supported increased coal output.

It is clear that the most profitable aspect of the early coal trade was exporting by sea and the Clackmannan waggonway was specifically built with this in mind. Being of a smaller scale than mainline railways, waggonways were ideally suited for the pattern of mining in the Clackmannan area in the 18th and early 19th centuries where the geology of the coalfields led to a scatter of small pits, working their way across several faulted areas. New branches could be laid fairly quickly and cheaply and then abandoned as seams were worked out. The success of the waggonways is seen not only in the considerable increases in the volume of coal being transported, it is also underlined by their lengthy operation and the fact that they ran for a considerable period after the main line railways were introduced, acting as a means of taking coal from pits to the railway.

Acknowledgements

The volunteers who undertook the desk-based and field-based survey work, argued the case for competing theories and supported the project: Jack Archibald, Sadie Archibald, Donald Balsillie, Alan Blue, David Byetheway, Murray Dickie, Margaret Epp, Fiona Graham, Irene Hamilton, James Horne, Robert Horne, John Hutchison, Jeremy Lavender, Robert Lindsay, Janette McArthur, William McLaren, Bill Middleton, Kate Middleton, Susan Mills, Isobel Pearson, Gary Quinn, Ian Russell, Marilyn Scott, David Seaton, David Sinclair, Liz Sinclair, Anne Smith, Eddie Stewart, Jacqueline Stewart Jenni Stewart, Irene Taylor and Tom Wilkie; AOC Archaeology; Inkscape; Local landowners and residents who have supported survey work and provided local information; The Clackmannanshire Development Trust; The Clackmannanshire Field Studies Society Executive and Members; The Inner Forth Landscape Initiative; The Heritage Lottery Fund; The National Library of Scotland; The National Records of Scotland and the many families, organisations and individuals who had safeguarded and made their material available; ScotlandsPeople; ScotlandsPlaces; The Royal Commission on the Ancient and Historic Monuments of Scotland; The Universities of Edinburgh, Glasgow and St Andrews; Google, Google Books and Google Earth; Microsoft and with special thanks to Eddie Stewart and Susan Mills for their constant support, David Seaton for his stalwart research and my wife for her amazing patience and consideration.

References

Notes – Entries in **bold type** were accessed using the internet and entries in **underlined bold type** were accessed on the internet through Google Books.

Adamson, J. 1980. Sauchie and Alloa, A People's History, Alloa, Clackmannan District Libraries, pages 7 and 8.

Aerofilms, Canmore collection (image SC 1256200, Edinburgh, RCAHMS.

Alloa and Hillfoots Advertiser, 1856, Article on Devon Iron Works, Alloa, Alloa Library, page 3.

Bald, R. 1812. A General View of the Coal Trade, Internet, Google Books, page 84.

Bald, R. 1828. The Edinburgh New Philosophical Journal, Edinburgh, Adam Black, page 112.

Balfour, P. 1837-41. New Statistical Account, Volume 8, Clackmannan, Edinburgh, Church of Scotland, pages 124, 125, 129 and 137.

Baxter, B. 1966. Stone Blocks and Iron Rails, Newton Abbot, David & Charles, pages 47, 229 and 230.

Bing Maps. 2015. Aerial Coverage, Internet, HERE, Microsoft Corporation.

Borehole Records. 2015. British Geological Survey, Interactive Viewer, Borehole Records.

British Geological Survey. Borehole Records, Internet, 2015.

Campbell, J. A Wee Keek Back, Internet, page 309.

Carvel, JL. 1944. 100 Years in Coal, Edinburgh, T and A Constable, pages 6, 48, 49, 57 and 82.

Census Returns of Scotland. 1841, 1851 and 1861, Clackmannan Parish, Brathieburn, 1851, Edinburgh, Scotlandspeople.

Chalmers, G. 1807. Caledonia, an Account, Historical and Topographical of North Britain, Volume 7, Paisley, Alexander Gardner, page 95.

Clerk, J. 1775. Painting of Clackmannan Tower, Edinburgh, National Museums of Scotland.
Court of Session. 1840. Reports of Cases Decided in the Supreme Courts of Scotland, Volume 12, Edinburgh, Anderson & Co, pages 77-84 and 251.
Court of Session. 1840. Reports of Cases Decided in the Supreme Courts of Scotland, Volume 14, Edinburgh, Anderson & Co, page 524.
Dawson, J. 1861-1873. Clackmannan Coal Company, Land Sale Records at Fauld, Dawson Family Papers (In private ownership).
Edinburgh Gazette. 1854. Edinburgh, The Gazette, page 3.
Geological Survey of Scotland. 1901. Clackmannanshire, Sheets 140, NW and CXL NW, Edinburgh, National Library of Scotland.
Glasgow Herald. 1858. Glasgow Herald, Glasgow, Glasgow Herald, page 3.
Gomersal, H and Guy, A. 2015. A Research agenda for the Early British Railways http://www.rchs.org.uk/trial/Research%20agenda.pdf, Internet, rchs.org.uk, pages 5 to 7.
Google Earth. 1945 Aerial Coverage, Internet.
Gordon, TC. 1936. The History of Clackmannan, Glasgow, Civic Press, page 98 and 171.
Graham, W. 2015. Oral History Interview, Clackmannan, Clackmannanshire Field Studies Society.
Grange Papers. 1850. Grange Papers acc 5381 Box 17, Bo'ness, National Library of Scotland.
HMSO. 1859. Report of the Commissioners for Inquiring into Matters relating to Public Roads in Scotland, 1859, Edinburgh, Google Books.
Johnstone, J. 1839. The Mechanics Magazine, Museum, Register, Journal and Gazette, Volume XXVIII, London, W.A. Robertson.
Lists of Mines. 1873. Scottish Mining Website, Collieries in Clackmannanshire, 1873, Scottish Mining Website (www.scottishmining.co.uk) .
Mayer, J. 1872. Iron and Steel Institute, Volume II, 1872, Iron Industry and Trade, The Iron Manufactury in Scotland, London, FN Spon, page 36.
McGregor, M. 1920. Memoirs of the Geological Survey, Scotland, Special Report on the Mineral Resources of Great Britain, Volume XI, Iron Ores, Tanfield, Morrison and Gibb, page 5.
Mines Department. 1931. Catalogue of Abandoned Mine Plans, Vol 5, London, HMSO, pages 3 and 6.
Moodie, R. 1791-99. Old Statistical Account, Volume 15, Clackmannan, Edinburgh, Sir John Sinclair of Ulbster, pages 611-613, 622, 623.
National Library of Scotland. Mapbox Aerial Coverage, Internet, National Library of Scotland.
National Records of Scotland. Edinburgh: 1672, GD/124/771; 1711, GD124/15/1024/7; 1711, GD124/17/259; 1713, GD18/1042; 1814, GD173/26; 1831, GD173/26; 1832, RHP13272; 1833, RHP80659; 1838, GD124/6/346; 1839, RHP3561; 1841, GD173/26 and 1848, RHP43694.
Notes. 1846. The Mechanics Magazine, Museum, Register, Journal and Gazette, Volume XXV, London, WA Robertson.
Ordnance Survey. 1861. Ordnance Survey Name Book – OS1/8/3/26, Edinburgh, Scotlandsplaces.
Ordnance Survey. Southampton, National Library of Scotland:
1866, First Edition Twenty Five Inch, Clackmannanshire, Sheet CXL.5 (Combined);
1866, First Edition Six Inch Perthshire, Sheet CXL.NW;
1895, Second Edition, One Inch, Sheet 39 – Stirling;
1898, Second Edition 25 Inch OS Map, Clackmannanshire, Sheet 140.05;
1900, Second Edition Six Inch Perthshire, Sheet CXL.NW;
1901, First Edition Six Inch, Perth and Clackmannan Sheet CXL.NW;
1901, Third Edition One Inch map, Sheet 39;

1913, Revised Second Edition, Twenty Five Inch, Fife and Kinross Sheet XXXII.SW;
1913, Second Edition (Revised), Twenty Five Inch, Stirlingshire Sheet XVIII.
1920, Second Edition (Revised), Inch, Perth and Clackmannan Sheet 140.06; and
1922, Second Edition (Revised), Inch, Perth and Clackmannan Sheet 140.05.

Paisley Herald and Renfrew Advertiser, page 3, 1868, Paisley, British Newspaper Archive, 2015.

Porter, DH. 1998. The Life and Times of Goldsworthy Gurney, Cranbuy, NJ, USA, Associated University Presses Inc..

RAF 1945 Aerial Cover. 2015. Google Earth.

Railscot – A history of Britain's Railways, Internet, 2015.

Roy, Sir W. 1747-55. The Roy Military Survey of Scotland (Highland area), Internet, British Library.

The Geoinformation Group. Google Earth, Internet, Google Earth.

The Scotsman – Thursday 10 June 1915, page 7.

Wallace, J. 1890. The Sherrifdom of Clackmannan, Edinburgh, James Thin, pages 52 and 54.

Wikipedia. 2015. https://en.wikipedia.org/wiki/Wagonway, Internet, Wikipedia.

OPPORTUNITIES AND LIMITATIONS FOR WHINCHATS *Saxicola rubetra* IN THE UPLANDS OF CENTRAL SCOTLAND

John Calladine

Summary

Most breeding whinchats in Scotland are found in the upland margins where they are restricted at lower altitudes by more intensive agriculture and at upper altitudes by environmental constraints which likely operate on their breeding biology. Within this attitudinally restricted zone, habitat associations operate at different scales. At the landscape scale, tall vegetation (e.g. bracken, tall grasses and shrubs) appears to be required for nesting and other purposes. However, within a breeding territory (typically <1 ha) short swards are required for efficient foraging. Within grazed landscapes, the occurrence of suitable areas of tall vegetation maintained by lower grazing intensities appears to be a limiting factor. Within ungrazed or lightly grazed landscapes, the occurrences of short swards appear to be limiting.

A case study of former upland pasture undergoing re-afforestation confirmed a predicted upwards shift (a mean of 30 m over 4 years) in territory locations to more exposed areas where slower rates of vegetation development will have retained some areas with shorter swards. Sites where young successfully fledged tended to be at higher altitudes which contrasted with a nearby site where grazing was retained and successful territories tended to be at lower altitudes. An upward redistribution to potentially less favourable environments is inferred. Dispersal and recruitment mechanisms deserve further attention to see if abandoned hill pastures (which are readily colonised and used by breeding whinchats) could prove ultimately to be ecological traps.

The opportunities and limitations for whinchats breeding in upland Scotland differ under different land uses. A better understanding of how dynamic grazing and other land use changes have contributed to create and maintain whinchat habitats could inform future conservation strategies for the species.

Introduction

Across Britain, there has been a 40 % contraction in the breeding range of whinchat *Saxicola rubetra* between 1970 and 2010, estimated from the occupancy of 10-km squares (Balmer *et al* 2013) and an estimated decline in breeding abundance of 55 % between 1995 and 2012 (Harris *et al* 2014). The species is now largely restricted to the 'uplands' where extensive semi-natural habitats persist, including grassland, moorland, bracken and scrub (Fuller & Glue 1977, Stillman & Brown 1994, Gillings *et al* 2000, Fuller *et al* 2006, Grant & Pearce-Higgins 2012). A less marked range contraction of 26 % between 1970

and 2010 in Scotland probably reflects the relatively high proportion of moorland and other 'upland' within the country, though declines have also occurred within the species' remaining core upland range (Henderson *et al* 2014).

Declining populations across much of western and central Europe have been attributed to intensification of agriculture (Müller *et al* 2005, Britschgi *et al* 2006, Fischer *et al* 2013). The difficult terrain, harsh climates, poor soils and relative remoteness all of upland areas all contribute towards lower commercial returns and therefore agricultural practices here tend to be less intensive than on lower ground. These areas of low intensity agriculture have become refuges for some species that were formerly more widespread in lowlands, including whinchats (Archaux 2007, Calladine & Bray 2012). However, at increasing altitudes, there is a reduced likelihood of (a) potentially suitable habitat being occupied and (b) increasing territory size (which could be inversely related to habitat quality), suggesting an upper altitudinal limit defined by the species' ecological requirements. Whinchats appear to be impacted by 'altitudinal squeezing', being apparently limited at lower altitudes by intensive agriculture and at higher altitudes by environmental constraints on their breeding biology. Consequently, land management decisions within the restricted zone where suitable conditions persist will impact on whinchats.

The zone where most whinchats occur is perhaps best termed as 'marginal upland' as it is largely at the lower limits of altitude and exposure where extensive tracts of semi-natural vegetation occur. Land uses include grazing (principally by sheep but also cattle), sport shooting (principally of deer and red grouse *Lagopus lagopus scotica* and also other gamebirds which can be reared and released for that purpose) and forestry (including commercially productive plantations and other amenity and landscape woodlands). Changing economics of livestock production, forestry and environmental policies have also impacted on the marginal uplands. Current conditions have contributed to lower stocking rates by grazing animals and for those to be more extensively managed (Thomson 2011) and the replacement of pasture with woodland and scrub (Fuller *et al* 1999, Scottish Executive 2006).

This paper will, first, present a brief review of studies of breeding whinchats in Scotland (and more widely in upland Britain) and their habitat associations at multiple spatial scales before presenting a case study of how changing land use (abandonment of upland pasture for re-afforestation) has influenced the distribution and breeding success of whinchats. The opportunities and limitations for whinchats breeding in the marginal uplands and how these are likely to be influenced by changing land uses are discussed.

Habitat associations at multiple scales

Extensive multi-species surveys of birds on British moorland show whinchats to be frequently associated with bracken *Pteridium aquilinum*, often

on slopes and tending towards the lower altitudes covered by those surveys (Brown & Stillman 1993, Stillman & Brown 1994, Pearce-Higgin & Grant 2006, Grant & Pearce-Higgin 2012). They are also found in young growth-stage plantations (Calladine & Bray 2012, Calladine *et al* 2013) and in young naturally regenerating upland scrub woodland (Gillings *et al* 2000).

Studies at the scale of the breeding territory suggest the importance of bracken, as part of a mosaic that includes low vegetation (Conway & Fuller 2010). However, in the presence of taller vegetation such as young trees and ungrazed grasses, bracken appears less important (Calladine & Bray 2012). On open moorland and hill pastures, bracken can be the only vegetation type that exceeds one or two metres in height. Whinchats often use taller plants as perching and song posts (Fischer *et al* 2013), important in facilitating effective foraging (Opperman 1990) and for nesting (Fuller & Glue 1977). The apparent association with bracken is likely driven by the need for a diversity of vegetation structures within a territory.

Within a breeding territory, whinchats tend to forage, feed themselves and provision their young on short swards relative to that available within the wider territory (Murray *et al* in press). Selected foraging areas are typically short, often close cropped grasses and short herbs such as bedstraw *Galium saxatile* and tormentil *Potentilla erecta*, contrasting with the taller bracken, grasses and shrubs that comprise other parts of territories. The juxtaposition of tall shrubs and bracken with short ericaceous vegetation for breeding whinchats has also been noted by other studies in upland margins (Bastian & Bastian 1996, Conway & Fuller 2010). Relatively tall vegetation is required for nesting and perhaps other requirements such as perching to view feeding opportunities or for vigilance for predators. However, short swards are also required for foraging. Both features are required within the relatively limited area of a Whinchat breeding territory which, in most cases in the Scottish uplands, is likely to be less than one hectare in extent (Calladine & Bray 2012).

Increasing altitude and more exposed aspects can be negatively related to the likelihood of otherwise apparently suitable habitats being occupied by breeding whinchats (Calladine & Bray 2012). Abandonment of grazing can create suitable habitats for breeding Whinchats (Frankiewicz 2008, Orlowski 2010, Shitikov *et al* 2015). However, where forest regeneration or planting replaces former pasture, the seral development towards wooded habitats ultimately makes those areas unsuitable (Gillings *et al* 2000). Seral progressions are slower in more exposed environments and therefore it might be expected that the rate of them becoming unsuitable for whinchats would be slower at increasing altitude. It might be expected, therefore, that on a site of former pasture and current developing woodland, the lower areas, most favoured by whinchats soon after agricultural abandonment would become less suitable in terms of habitat structure more rapidly than higher areas experiencing the same change. This paper reports observations separated by four years comparing changes in the altitudinal distribution and breeding success of

Whinchats between two sites, (one afforested former pasture, the other managed as pasture) to test the hypothesis that seral progression in plant communities to shrub woodland would drive whinchats to more exposed and potentially less favourable areas.

Methods

Breeding whinchats were surveyed in two study areas in central Scotland, Menstrie Glen (56°09′ N, 3° 51′ W; altitude range 100-550 m asl) and Glen Quey (56° 13′ N, 3° 39′ W; altitude 220-600 m asl; Figure 1) which were areas of, respectively, current and former semi-natural pasture in the marginal uplands. The vegetation of both areas was dominated by grasses with distinct areas of bracken, rush *Juncus* spp., herbaceous plants such as common nettle *Urtica dioica*, and thistle *Asteraceae* spp. and limited ericaceous cover primarily heather *Calluna vulgaris* and blaeberry *Vaccinium myrtillus*. Domestic grazing animals had been excluded from Glen Quey since 2002 and 2003 and subsequently planted with a mix of native broad-leaf tree species which by 2014 had grown to a height of approximately 5-10 m. Menstrie Glen remained extensively grazed by domestic sheep until early 2015.

Surveys were undertaken in 2010 and 2014. Although only a partial survey of Menstrie Glen was undertaken in 2010, this did include territories across the full altitudinal range in which whinchats occurred at that site. Territories were identified by the presence of singing males on at least two dates that were separated by a minimum of seven days or of alarming birds indicative of a nearby nest or young. Details of statistical analyses are published elsewhere (Calladine 2015).

Results

Within the 410 ha surveyed at Glen Quey, 36 whinchat territories were located in 2010 of which 19 successfully fledged young. In 2014, 30 territories were located of which 12 were successful. At Glen Quey, the mean altitude of whinchat territories in 2014 was 343 m (SE ±10) above mean sea level compared to 311 m (±9) in 2010. Successful breeding territories tended to be higher (355 m ±10) than were ones that failed to fledge young (299 m ±9).

Within the 650 ha at Menstrie Glen, 17 territories were located during an incomplete survey in 2010 of which 8 successfully fledged young. In 2014, 30 territories were located in a complete survey of which 13 were successful (Murray 2014). At Menstrie Glen, there was no significant difference in territory altitudes between years but successful territories (at 191 m ±8) tended to be lower than unsuccessful ones (223 m ± 8).

Discussion

The remaining stronghold for breeding whinchats in Scotland is in the

upland margins, but here there are limited opportunities for expansion to higher altitudes because of climatic constraints, and to lower altitudes because of unsuitable intensive agricultural management. Within this zone of suitable conditions, mosaics of vegetation structure that includes both tall and short swards are provided by bracken and regenerating (and remnant) scrub woodland on moorland and upland pasture. It can also be created by exclusion of grazing, for example where management objectives include forest expansion.

Bracken is widely considered a pest species that encroaches upon habitats such as grassland and heath that are perceived as more valuable, and is subject to widespread control (Pakeman *et al* 2000, Marrs *et al* 2000). Although there is anecdotal evidence for some individual Whinchat territories to have been abandoned following removal of bracken, there is no firm evidence to suggest such an impact at a national scale in Scotland. Arguably, there is also no firm evidence against such an impact. Because the extent of bracken cover is estimated to have increased by 27 % between 1998 and 2007 in areas that include the marginal uplands of Scotland (Norton *et al* 2009), a period coincident with Whinchat declines (Henderson *et al* 2014), the removal of bracken is unlikely to have been a major driver of those declines: however it deserves further attention as does the potential use of small-scale management to add diversity to extensive bracken stands to benefit whinchats.

In the absence of grazing, natural succession and woodland development will limit the suitable habitats for whinchats. For example at four sites across the central and eastern Highlands of Scotland where woodland regeneration on former moorland is being encouraged, the number of whinchat territories declined from 26 in 1998 to one in 2013 (unpublished data). The change was coincident with more widespread declines (Henderson *et al* 2014) and so a causal relationship cannot be confirmed. However, the trend for an upward drift of whinchat territories towards more exposed areas, and for higher breeding success at higher altitudes, reported here for Glen Quey, does suggest that developing vegetation in the absence of grazing may be causing a shift of whinchats to more marginally suitable areas. An opposing relationship at the grazed site in Menstrie Glen, where whinchats tended to breed more successfully at lower altitudes supports this interpretation.

Within grazed areas, opportunities for breeding whinchats are created by the presence of taller vegetation, for example bracken. Within areas that are not grazed, however, the extensive tall vegetation that develops ultimately becomes a limitation. Sites in the upland margins of Scotland where grazing is excluded (usually for the purposes of forest re-creation and expansion) appear to be readily colonised and used by breeding whinchats. However, as such sites develop and become increasingly unsuitable, there is the question as to whether they could ultimately become ecological traps for the species. A similar situation might be also apparent in other areas. For example, high levels of site occupancy of abandoned fields in Russia were not necessarily associated

with high breeding success (Shitikov *et al* 2015). Further work on rates and mechanisms of dispersal and recruitment could help inform what cues lead whinchats to occupy particular sites.

Whinchats require areas of tall vegetation (achieved with low grazing intensity), but within a breeding territory that is typically less than one hectare, patches of short swards (achieved with higher levels of grazing) are required for efficient feeding and provisioning of young. Suitable mosaics of vegetation structures can be maintained through extensive and low intensity grazing as has and continues to be practiced in the marginal uplands of Scotland where whinchats persist. Agricultural management of the upland margins has varied over centuries and has included marked fluctuations in human occupancy, inclusion of arable and intensities of grazing (e.g. RCAHMS 2001). The dynamics of relationships between grazing types and intensities and the structure and composition of vegetation mosaics is an area of research that needs more attention (Fuller & Gough 1999, Evans *et al* 2006) and would be relevant to the development of a conservation strategy for whinchats.

Grazing abandonment and reforestation can create habitats that are readily colonized by whinchats. However, development of the ground flora will make such areas increasingly unsuitable over a number of years. Spatially non-random changes in whinchat abundance in Scotland over recent decades suggest that some habitats and areas are being colonised or increasingly occupied while others are being abandoned or supporting declining populations (Henderson *et al* 2014). It is unclear whether the scale of pasture conversion to woodland is sufficient to explain at least some of those changes. However, targets for reforestation (with their associated benefits for biological diversity) need not necessarily be incompatible with the conservation of whinchats. Forest planning could include open areas and their maintenance, potentially including the reintroduction of grazing once trees are sufficiently established, that could support whinchats in the long term. For whinchats, and potentially other species that are now largely restricted towards their upper altitudinal limits (Archaux 2007, Calladine & Bray 2012), any prescribed 'whinchat clearings' should preferably be at lower altitudes and more sheltered aspects. As for open pasture, a dynamic management regime that includes variable levels of grazing with periodic development of scrub and bracken, and its clearance is a deserving area of research. Of critical importance is that any management for whinchats to provide suitable or even optimal breeding conditions should be able to mitigate against restrictions that may be operating outside the breeding season: however many of these remain unknown.

Acknowledgements

Work by the British Trust for Ornithology on Whinchats in Scotland has been supported by Forest Research, the Perth and Kinross Quality of Life Trust, the J & JR Wilson Trust, the AEB Charitable Trust and the Sound Approach. The Woodland Trust and Tillhill Forestry Ltd granted access to study areas.

This paper was first published in Bastian, H-V & Feulner, J (eds) *Living on the Edge of Extinction in Europe. Proceedings of the First European Whinchat Symposium*. LBV Hof: Helmbrechts, pp 219-226 (Calladine 2015). It is presented here in slightly altered form by kind permission of the editors.

References

Archaux F. 2007. Are mountains refuges for farmland bird species? A case study in the northern French Alps. *Bird Study* **54**, 73-79.

Balmer D, Gillings S, Caffrey B, Swann B, Downie I, Fuller RJ. 2013. *Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland*. British Trust for Ornithology, Thetford.

Britschgi A, Spaar R, Arlettaz R. 2006. Impact of grassland farming intensification on the breeding ecology of an indicator insectivorous passerine, the whinchat (*Saxicola rubetra*): Lessons for overall alpine meadowland management. *Biological Conservation* **130**, 193-205.

Brown AF, Stillman RA. 1993. Bird-habitat associations in the eastern Highlands of Scotland. *Journal of Applied Ecology* **30**, 31-40.

Broyer J, Sukhanova O, Mischenka A. 2014: Mowing management and density dependence in meadow passerine hatching success. *Bird Study* **61**, 394-403.

Calladine J. 2015. Multi-scale associations with habitat, land-use and change: Opportunities and limitations for Whinchats *Saxicola rubetra* in the uplands of Scotland *In* Bastian H-V, Feulner J. *Living on the Edge of Extinction in Europe. Proc. 1st European Whinchat Symposium*, 219-226. LBV Hof: Helmbrechts.

Calladine J, Bray J. 2012. The importance of altitude and aspect for breeding whinchats (*Saxicola rubetra*) in the uplands: Limitations of the uplands as a refuge for a declining, formerly widespread species? *Bird Study* **59**, 43-51.

Calladine J, Bielinski A, Shaw G. 2013. Effect on bird abundance and species richness of edge restructuring to include shrubs at the interface between conifer plantations and open moorland. *Bird Study* **60**, 345-356.

Conway GJ, Fuller RJ. 2010. Multi-scale relationships between vegetation pattern and breeding birds in the upland margins (ffridd) of north Wales. BTO Research Report No. 56, British Trust for Ornithology, Thetford.

Evans DM, Redpath SM, Evans SA, Elston DA, Gardner CJ, Dennis P, Pakeman RJ. 2006. Low intensity, mixed livestock grazing improves the breeding abundance of a common insectivorous passerine. *Biological Letters* **2**, 636-638.

Fischer K, Busch R, Fahl G, Kunz M, Knopf M. 2013. Habitat preferences and breeding success of whinchats (*Saxicola rubetra*) in the Westerwald mountain range. *Journal of Ornithology* **154**, 339-349.

Frankiewicz J. 2008. Breeding biology and ecology of whinchat *Saxicola rubetra* on abandoned farmland of Opole Province (SW Poland). *Acta Zoologia Cracovia* **51A**, 35-47.

Fuller RJ, Glue D. 1977. Breeding biology of Stonechat and Whinchat. *Bird Study* **24**, 215-228.

Fuller RJ, Gough SJ. 1999. Changes in sheep numbers in Britain: implications for bird populations. *Biological Conservation* **91**, 73-89.

Fuller RJ, Atkinson PW, Garnett MC, Conway GJ, Bibby CJ, Johnstone IG. 2006. Breeding bird communities in the upland margins (ffridd) of Wales in the mid-1980s. *Bird Study* **53**, 177-186.

Fuller RJ, Gillings S, Whitfield DP. 1999. Responses of breeding birds to expansion of

scrub in the eastern Scottish Highlands: preliminary implications for conservation strategies. *Vogelwelt* **120**, 53-62.

Gillings S, Fuller RJ, Balmer DE. 2000. Breeding birds in scrub in the Scottish highlands: variation in community composition between scrub type and successional stage. *Scottish Forestry* **54**, 73-85.

Grant MC, Pearce-Higgins JW. 2012. Spatial variation and habitat relationships in moorland bird assemblages: a British perspective. *In* Fuller RJ. (ed) *Birds and Habitat: Relationships in changing landscapes*, pp 207-236. Cambridge University Press, Cambridge.

Harris SJ, Risely K, Massimino D, Newson SE, Eaton MA, Musgrove AJ, Noble DG, Procter D, Baillie SR. 2014.*The Breeding Bird Survey 2013. BTO Research Report 638*. British Trust for Ornithology, Thetford.

Henderson I, Calladine J, Massimino D, Taylor J, Gillings S. 2014. Evidence for contrasting causes of population change in two closely related, sympatric breeding species the Whinchat *Saxicola rubetra* and Stonechat *Saxicola torquata* in Britain. *Bird Study* **61**, 553-565.

Marrs RH, Le Duc MG, Mitchell RJ, Goddard D, Patterson S, Pakeman RJ. 2000. The ecology of bracken: Its role in succession and implications for control. *Annals of Botany* **85**, 3-15.

Müller M, Spaar R, Schifferli L, Jenni L. 2005. Effects of changes in farming of subalpine meadows on a grassland bird, the whinchat (*Saxicola rubetra*). *Journal of Ornithology* **146**, 14-23.

Murray C. 2014. *The influence of vegetation structure on territory occupancy, provisioning rate and nesting success in whinchats (saxicola rubetra) breeding in a marginal upland area*. Unpublish MSc Thesis, University of Stirling.

Murray C, Minderman J, Allison J, Calladine J. in press. Vegetation structure influences foraging decisions in a declining grassland bird: the importance of fine scale habitat and grazing regime. *Bird Study*.

Norton LR, Murphy J, Reynolds B, Marks S, Mackey EC. 2009. *Countryside Survey: Scotland Results from 2007*. Centre for Ecology & Hydrology, Scottish Government, Scottish Natural Heritage.

Oppermann R. 1990. Suitability of different vegetation structure types as habitat for the whinchat (*Saxicola rubetra*). *Vegetatio* **90**: 109-116.

Orłowski G. 2010. Effect of boundary vegetation and landscape features on diversity and abundance of breeding birds communities of abandoned crop fields in southwest Poland. *Bird Study* **57**, 175-182.

Pakeman RJ, Le Duc MG, Marrs RH. 2000. Bracken distribution in Great Britain: Strategies for its control and the sustainable management of marginal land. *Annals of Botany* **85**, 37-46.

Pearce-Higgins JW, Grant MC. 2006. Relationships between bird abundance and the composition and structure of moorland vegetation. *Bird Study* **53**, 112-125.

RCAHMS 2001. *'Well sheltered and watered': Menstrie Glen, a farming landscape near Stirling*. Royal Commission on the Ancient and Historical Monuments of Scotland, Edinburgh.

Scottish Executive 2006. *The Scottish forestry strategy*. The Scottish Executive, Edinburgh.

Shitikov D, Vaytina TM, Gagieva VA, Fedchuk DV. 2015. Breeding success affects site fidelity in a Whinchat *Saxicola rubetra* population in abandoned fields. *Bird Study* **62**, 96-105.

Stillman RA, Brown AF. 1994. Population sizes and habitat associations of upland breeding birds in the south Pennines, England. *Biological Conservation* **69**, 307-314.

Thomson S. 2011. *Response from the hills: Business as usual or a turning point?* Scottish Agricultural College, Edinburgh.

Figure 1. (a) Upland pasture in central Scotland (Menstrie Glen) where mosaics of bracken and short swards of grass and herbs support breeding whinchats; (b) Former upland pasture in central Scotland (Glen Quey) where the abandonment of grazing for forest expansion has created conditions for breeding whinchats that may not remain suitable in the long term.

SCOTLAND'S RURAL COLLEGE (SRUC) KIRKTON AND AUCHTERTYRE FARMS – IMPROVING THE ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY OF HILL FARMING

John P. Holland

Summary

The SRUC hill farms of Kirkton and Auchtertyre, between Tyndrum and Crianlarich, have a rich and varied biodiversity that includes a number of nationally rare and scarce species and habitats, related primarily to geological, topographic, edaphic and altitudinal variation, together with past and present management practices. The flora are described in the first part of the paper, in relation to natural and agrarian habitats, from low-lying inbye fields and wetlands, the 300 ha of woodland and scrub, herb communities on the lower and mid-slopes, climbing to the upper hill ground, cliffs and mountain summits. The species-rich calcareous grasslands and flushes that occur at high altitude on Cam Chreag have particular conservation value and are of national importance. The estate is also important for its historical and archaeological heritage, in particular its links with St. Fillan.

The second part of the paper describes the ways in which SRUC are improving both the economic and environmental sustainability of the estate, essential for it to survive as a working farm and research centre. This has been achieved through the implementation of a range of applied research, the use of new technology, changes in the management of both the land and livestock and through diversification.

Introduction

Kirkton and Auchtertyre farms are situated between the villages of Tyndrum and Crianlarich in west Perthshire (NN 360 283), some 56 km north-west of Stirling. The farms are at the western end of the Breadalbane Mountains and are in the north-west corner of the Loch Lomond and the Trossachs National Park. The estate is managed by Scotland's Rural College (SRUC), Scotland's leading provider of education, research and consultancy in the rural environment. The estate is a centre for research and demonstration into sustainable land management in hill and mountain areas, and is the location for the SRUC Hill and Mountain Research Centre.

The farms cover some 2225 hectares of land, rising from 170 m above sea level (OD) on the floodplain of the River Fillan to 1025 m OD at the summit of Ben Challum. The main livestock enterprise is hill sheep production. In 2015 there were 1230 breeding ewes (900 Scottish Blackface and 330 Lleyn), plus a small herd of 20 suckler cows (Aberdeen Angus cross). The farms are made up

of 74 ha of improved pasture, 153 ha of semi-improved pasture, 1677 ha of unimproved hill grassland and wet heath, and 307 ha of woodland and scrub (Figure 1).

The estate has one 'Munro' (Ben Challum) and three 'Corbetts' (Beinn Chaorach, Beinn Odhar and Cam Chreag). The West Highland Way long distance footpath goes through the farms. The River Fillan that flows along the south-western boundary of the estate forms part of the River Tay System Special Area of Conservation (SAC). Cam Chreag ('Crooked Ridge'), which is at the northern boundary of the estate, forms part of the Beinn Heasgarnich SAC.

The work of the researchers at the Hill and Mountain Research Centre aims to seek economically, environmentally and socially sustainable land management systems in the context of international, national and local land use policies, with an emphasis on improving efficiency, reducing greenhouse

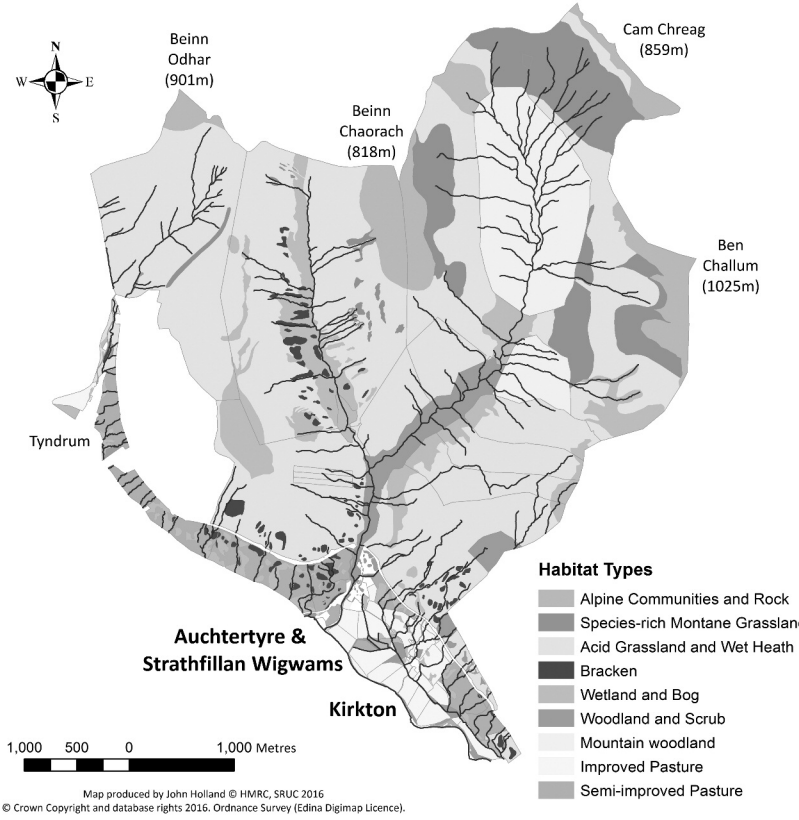


Figure 1. Habitat map of Kirkton and Auchtertyre farms.

gas emissions and enhancing biodiversity, while maintaining or enhancing productivity.

This paper gives an overview of the environment, biodiversity and historical importance of the estate, before looking at the ways in which research and farm management techniques have been implemented to improve the economic and environmental sustainability of the farms.

Environment, Biodiversity and Archaeological Heritage

Geology and Soils

The solid geology of the farms is mainly metamorphic quartzose mica-schist from the Dalradian series (late Pre-Cambrian in age, approximately 600 million years old). There are two Geological Conservation Review sites on the estate, one on the Crom Allt above Tyndrum and the other at Auchtertyre above the Strathfillan Wigwam site. At the Crom Allt site mineralised veins containing lead- and zinc-sulphides (galena and sphalerite) and barium sulphate (baryte) are well exposed in the river gorge. The section of river below this area has become popular with gold panners due to the presence of small quantities of native gold within the mineral veins. The remains of a disused lead mine that was in operation during the 18th Century, are still evident high up on the flank of Beinn Odhar above Tyndrum (Moreton 2015).

Soil types across the estate include alluvial brown earths on the flood plain, podsols on the moraine hummocks and peaty podsols, peaty mineral soils, deep peats, and shallow poorly developed soils on the hill ground. Soil pH values range from less than 4.0 in the peatlands to above 7.0 where there are outcrops of base-rich rock on the mountains.

Climate

The area has an oceanic climate, with cool, moist summers (mean maximum July temperature of 18.3°C) and relatively mild, wet and windy winters (mean maximum January temperature of 6.0°C; mean minimum January temperature of –0.2°C). Between 1991 and 2015 the mean annual rainfall measured at the Met Office station at Kirkton (which is at 170 m OD) was 2614 mm. This is more than three and a half times the average rainfall of Edinburgh. There is an average of 280 rain days a year.

Vegetation

A mosaic of plant communities has developed on the estate, related primarily to geological, topographic, edaphic and altitudinal variation, together with past and present management practices. Over 330 species of vascular plant have been identified including 16 nationally scarce species and three nationally rare, red data book species.

Inbye Fields, Wetlands and River Bank

The improved inbye grasslands on the alluvial plain of the River Fillan, used

for pasture and silage production, are relatively species poor, dominated by Yorkshire fog (*Holcus lanatus*), marsh foxtail (*Alopecurus geniculatus*), smooth meadow-grass (*Poa pratensis*), creeping bent (*Agrostis stolonifera*) and meadow buttercup (*Ranunculus acris*). A programme of reseeding some of these fields with a mix of perennial rye-grass varieties (*Lolium perenne*), timothy (*Phleum pratense*), cock's-foot (*Dactylis glomerata*) and white clover varieties (*Trifolium repens*) was started in 2012. This followed a period of 25 years when no reseeding had been carried out. The ploughing of these grasslands has resulted in a magnificent though temporary display of arable weeds, the seeds of which must have lain dormant for decades waiting for this disturbance and the rare opportunity to germinate. One of the most abundant and showiest of the weed species is the large-flowered hemp-nettle (*Galeopsis speciosa*) a species that is declining in the UK. Other arable weeds that have appeared in the ploughed fields include common hemp-nettle (*Galeopsis tetrahit*), redshank (*Persicaria maculosa*), corn spurrey (*Spergula arvensis*), scentless mayweed (*Tripleurospermum inodorum*), marsh cudweed (*Gnaphalium uliginosum*) and wild radish (*Raphanus raphanistrum* ssp. *Raphanistrum*) (Holland 2015a). Many of these weeds are valuable as nectar sources for insects such as bumblebees, hoverflies and soldier flies.

Along the wooded banks of the River Fillan there are patches of largely ungrazed, unimproved, neutral grassland and tall herb vegetation, with abundant wood crane's-bill (*Geranium sylvaticum*), melancholy thistle (*Cirsium heterophyllum*), pignut (*Conopodium majus*), meadowsweet (*Filipendula ulmaria*) and occasional globeflower (*Trollius europaeus*). The main tree species along the river bank is alder (*Alnus glutinosa*). The river shingle has an interesting flora with species such as ox-eye daisy (*Leucanthemum vulgare*), wild thyme (*Thymus polytrichus*), sea plantain (*Plantago maritima*), northern bedstraw (*Galium boreale*), goldenrod (*Solidago virgaurea*) and coltsfoot (*Tussilago farfara*). There are also some patches of vegetated sand beside the river with kidney-vetch (*Anthyllis vulneraria*) and common bird's-foot trefoil (*Lotus corniculatus*). In recent years the river embankment at the south-eastern end of the estate, which was constructed in the 1970s, has had a population of up to 160 greater butterfly orchids (*Platanthera chlorantha*). This embankment, which is covered in mouse-ear hawkweed (*Pilosella officinarum*), also has some large patches of stag's-horn clubmoss (*Lycopodium clavatum*), which is rather scarce elsewhere on the estate.

The principal stream that runs through the inbye fields at Kirkton was fenced off in the mid-1990s as part of an agri-environment scheme, and this water margin is now rich in tall herb species such as common valerian (*Valeriana officinalis*), meadowsweet, wild angelica (*Angelica sylvestris*), marsh ragwort (*Senecio aquaticus*) and water figwort (*Scrophularia auriculata*). This last species is at the northern edge of its range and is a rare plant in Perthshire. Other species within these flower-rich water margins include ragged robin (*Lychnis flos-cuculi*), greater bird's-foot trefoil (*Lotus pedunculatus*), meadow vetchling (*Lathyrus pratensis*), marsh marigold (*Caltha palustris*) and sneezewort

(*Achillea ptarmica*). Along the stream edge there are patches of hybrid monkey-flower (*Mimulus guttatus* x *luteus*), and in the slower sections, branched bur-reed (*Sparganium erectum*), water-cress (*Rorippa nasturtium-aquaticum*) and floating sweet-grass (*Glyceria fluitans*) can be found.

The inbye wetlands, which are mainly dominated by sharp-flowered rush (*Juncus acutiflorus*), also contain abundant marsh thistle (*Cirsium palustre*), marsh violet (*Viola palustris*), marsh willow-herb (*Epilobium palustre*), marsh bedstraw (*Galium palustre*), cuckoo-flower (*Cardamine pratensis*) and devil's-bit scabious (*Succisa pratensis*). Marsh cinquefoil (*Potentilla palustris*) and bog-bean (*Menyanthes trifoliata*) can also be found in some of the wetland areas. Whorled caraway (*Carum verticilatum*), a western species at the eastern edge of its main range in Scotland, occurs in some of the lowland wetland areas at Auchtertyre and above Tyndrum.

The vegetation on the glacially-derived hummocky moraine, below the West Highland Railway line, is a mosaic of semi-improved grassland, bracken, mire, flush, scrub and rush pasture. On the better drained and more accessible ground, lime and compound fertilisers have been spread, modifying the composition and productivity of the sward. In the flushes there are still some species of interest including round-leaved sundew (*Drosera rotundifolia*), common butterwort (*Pinguicula vulgaris*), marsh arrow-grass (*Triglochin palustris*) and marsh lousewort (*Pedicularis palustris*). White beak-sedge (*Rhynchospora alba*) occurs in a couple of the flushes and in a small basin mire near the Auchtertyre steading. This is close to the eastern edge of its range. On some of the steep sided moraine hummocks, where the grassland hasn't been improved, there are scattered heath fragrant orchids (*Gymnadenia borealis*) and abundant heath spotted orchids (*Dactyllorhiza maculata*).

Woodlands

The farms have more than 300 ha of woodland and scrub. This includes areas of semi-natural broad-leaved woodland, recently planted native woodland, mixed woodland shelterbelts, planted conifer blocks (of sitka spruce, Norway spruce and Scots pine), and gorse and broom scrub. Along the lower gorges of the Allt Auchtertyre and Crom Allt there are some remnants of semi-natural ancient woodland. The main tree species is downy birch (*Betula pubescens*), but there are scattered rowan (*Sorbus aucuparia*), ash (*Fraxinus excelsior*), aspen (*Populus tremula*) and hazel (*Corylus avellana*). There is also an old sessile oak (*Quercus petraea*) growing out of the rock face above the waterfall at Auchtertyre. Ground flora species include bugle (*Ajuga reptans*), wood anemone (*Anemone nemorosa*), wood sorrel (*Oxalis acetosella*), opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*), water avens (*Geum rivale*), primrose (*Primula vulgaris*), globeflower, common cow-wheat (*Melampyrum pratense*), wood sanicle (*Sanicula europaea*) and wood sage (*Teucrium scorodonia*). There are also a number of fern species including oak fern (*Gymnocarpium dryopteris*) and beech fern (*Phegopteris connectilis*).

Lower and Middle Hill Ground

Mat grass (*Nardus stricta*) and heath rush (*Juncus squarrosus*) dominate the vegetation on the open hill, while fescues (*Festuca ovina*, *Festuca vivipara*) and bent grasses (*Agrostis capillaris*, *Agrostis vinealis*) occur between the tussocks of mat grass, becoming more abundant on the better-drained and more fertile patches of land. Sweet vernal grass (*Anthoxanthum odoratum*), tormentil (*Potentilla erecta*), heath bedstraw (*Galium saxatile*), green-ribbed sedge (*Carex binervis*) and pill sedge (*Carex pilulifera*) are frequent throughout. Blaeberry (*Vaccinium myrtillus*) is common within the sward; however it rarely reaches more than a few centimetres in height. Although this grassland is relatively species-poor there are a few isolated patches of dwarf cornel (*Cornus suecica*) and chickweed wintergreen (*Trientalis europaea*), and scattered clumps of pale sedge (*Carex palescens*). In the wetter areas, purple moor-grass (*Molinia caerulea*), deer grass (*Trichophorum germanicum*), common cotton-grass (*Eriophorum angustifolium*), star sedge (*Carex echinata*) and common sedge (*Carex nigra*) are abundant.

There are numerous flushes and springs scattered across the hill slopes, some acidic while others are more base-rich. Carnation sedge (*Carex panicea*) and common yellow sedge (*Carex demissa*) are very common throughout, whereas glaucous sedge (*Carex flacca*) is restricted to the more base-rich flushes. Great sundew (*Drosera anglica*) occurs in two flushes, one above Kirkton on the lower slopes of Ben Challum and one in Gleann a'Chlachain, while broad-leaved cotton-grass (*Eriophorum latifolium*), tawny sedge (*Carex hostiana*), few-flowered spike rush (*Eleocharis quinqueflora*), yellow mountain saxifrage (*Saxifraga aizoides*) and grass-of-parnassus (*Parnassia palustris*) are more widespread. Bog orchid (*Hammarbya paludosa*) occurs in a flushed area just above the West Highland Railway line at Kirkton. Many of the bryophyte-dominated spring-heads contain starry saxifrage (*Saxifraga stellaris*) and blinks (*Montia fontana*). Bog myrtle (*Myrica gale*) forms extensive patches on the poorly drained lower slopes of the hills, below about 350 m OD. There are also some large patches of bracken (*Pteridium aquilinum*) on the lower slopes, but only where the soils are well drained and relatively deep. Along the sides of the mountain streams there are patches of lemon-scented fern (*Oreopteris limbosperma*) and hard fern (*Blechnum spicant*). Areas of blanket mire occur on Meall Buidhe, the southern slopes of Ben Challum and at the head of Gleann a'Chlachain. The main species growing on the deep peat are deer grass, common cotton-grass, hare's-tail cotton-grass (*Eriophorum vaginatum*), heather (*Calluna vulgaris*), cross-leaved heath (*Erica tetralix*), bog asphodel (*Narthecium ossifragum*) and star sedge. Bottle sedge (*Carex rostrata*) occurs in the wettest areas and there are also a few patches of few-flowered sedge (*Carex pauciflora*), some mats of cranberry (*Vaccinium oxycoccos*), and occasional bog blaeberry (*Vaccinium uliginosum*) and cloudberry (*Rubus chamaemorus*).

Upper Hill Ground, Cliffs and Mountain Summits

Above about 600 m OD the hill slopes are covered in a mosaic of acid grassland, calcareous grassland, base-rich flushes, springs, cliff ledge

communities and summit vegetation. Where there is outcropping of base-rich mica-schists at high altitude, particularly on Cam Chreag, there are extensive areas of species-rich mat grass and calcareous grassland dominated by sheep's fescue (*Festuca ovina*), common bent (*Agrostis capillaris*) and alpine lady's-mantle (*Alchemilla alpina*). These species-rich grasslands can have up to thirty species of vascular plant per metre square. Some of the many species present include wild thyme, alpine meadow-rue (*Thalictrum alpinum*), alpine bistort (*Persicaria vivipara*), mountain everlasting (*Antennaria dioica*) and hair sedge (*Carex capillaris*). Pink cushions of moss campion (*Silene acaulis*) adorn these grasslands in summer. Sheathed sedge (*Carex vaginata*) is frequent within the sward on Cam Chreag and there are a few scattered patches of mountain pansy (*Viola lutea*) and mossy saxifrage (*Saxifraga hypnoides*). Other species of interest found within these montane grasslands include moonwort (*Botrychium lunaria*), sibbaldia (*Sibbaldia procumbens*), cyphel (*Minuartia sedoides*), field gentian (*Gentianella campestris*) and the nationally rare false sedge (*Kobresia simpliciuscula*).

On the Glas Leathad (the south west shoulder of Cam Chreag), above 750 m OD, a species-rich grass-heath community has developed with mountain avens (*Dryas octopetala*) (Figure 2), mountain willow (*Salix arbuscula*), bog blaeberry, cowberry (*Vaccinium vitis-idaea*) and alpine cinquefoil (*Potentilla crantzii*), occurring within a viviparous fescue (*Festuca vivipara*) dominated sward.

Figure 2. Mountain Avens (*Dryas octopetala*) on Cam Chreag.

The slopes of Cam Chreag, Beinn Chaorach and Ben Challum are characterised by the presence of numerous base-rich springs and flushes, containing species such as yellow mountain saxifrage, thrift (*Armeria maritima*), Scottish asphodel (*Tofieldia pusilla*), three-flowered rush (*Juncus triglumis*), alpine willow-herb (*Epilobium anagallidifolium*), dioecious sedge (*Carex dioica*) and lesser clubmoss (*Selaginella selaginoides*), together with the occasional rarer species such as two-flowered rush (*Juncus biglumis*), chestnut rush (*Juncus castaneus*) and mountain scurvy-grass (*Cochlearia micacea*).

There is an area of cliff and associated boulder talus on the south west facing slope of Cam Chreag at an altitude of 720 m OD that supports a small population of the nationally rare alpine bartsia (*Bartsia alpina*), together with mountain willow (*Salix arbuscula*), and the tall-herb species globeflower, alpine saw-wort (*Saussurea alpina*) (Figure 3) and wood crane's-bill. Approximately 600 m to the west there is a smaller section of cliff at an altitude of 815 m OD that has a small population of alpine saxifrage (*Saxifraga nivalis*) growing in rock crevices on the cliff face, as well as alpine mouse-ear (*Cerastium alpinum*), alpine cinquefoil and hoary whitlow-grass (*Draba incana*).

The line of cliffs on Meall Buidhe above Tyndrum, at an altitude of about 550 m OD, also supports populations of alpine bartsia and mountain willow, as well as other cliff ledge species such as roseroot (*Sedum rosea*), purple saxifrage

Figure 3. Alpine Saw-wort (*Saussurea alpina*) on Cam Chreag cliff ledge.

(*Saxifraga oppositifolia*), alpine saw-wort, green spleenwort (*Asplenium viride*), holly fern (*Polystichum lonchitis*), stone bramble (*Rubus saxatilis*) and mountain sorrel (*Oxyria digyna*). There are also some cliffs along the Crom Allt gorge, below the Meall Buidhe cliffs, which have a mix of alpine, tall-herb and woodland species including wood vetch (*Vicia sylvatica*). The cliffs on the east side of Beinn Chaorach are also quite species-rich with scattered mountain willow (*Salix arbuscula*) and a single plant of downy willow (*Salix lapponum*). In contrast, the cliffs on Ben Challum tend to be more acidic and relatively species-poor.

The vegetation on the mountain summits is mainly grass-heath and moss-heath, dominated by mat grass, stiff sedge (*Carex bigelowii*), viviparous fescue, alpine lady's mantle, mountain crowberry (*Empetrum nigrum* subsp. *hermaphroditum*) and woolly-fringe moss (*Racomitrium lanuginosum*). On some of the more exposed ridges there are carpets of least willow (*Salix herbacea*), with alpine clubmoss (*Diphasiastrum alpinum*), fir clubmoss (*Huperzia selago*) and spiked woodrush (*Luzula spicata*). Near the summits of Beinn Odhar and Beinn Chaorach there are also scattered mats of trailing azalea (*Kalmia procumbens*).

On the north western ridge of Ben Challum there are some rock slabs where three-leaved rush (*Juncus trifidus*) grows. Another more acid loving species, the parsley fern (*Cryptogramma crispa*), grows within the boulder talus below the summit of Beinn Odhar and in a gully near the south top of Ben Challum.

Animals

One hundred and fourteen species of bird have been recorded on the farms, of which around half are probable or definite breeders. Seventeen species on the Birds of Conservation Concern 4 red list breed on the farms including cuckoo, skylark, lesser redpoll, spotted flycatcher, twite, tree pipit, grey wagtail, whinchat, black grouse and ring ouzel.

Nineteen species of mammal have been recorded including brown hare, mountain hare, pygmy shrew, stoat, weasel, pine marten, pipistrelle bat, roe deer and red deer. There are at least five badger setts on the estate, with two of them on the hill ground above 450 m OD. The stream that flows through the inbye fields at Kirkton has a population of "black" water voles, a rare species in the National Park. This stream also has water shrews, and is frequently used by otters. The common frog is abundant in wetlands on both the low and high ground, while the common toad and palmate newt are restricted to the lower ground. Common lizards can be found throughout the estate, from the grasslands around the Kirkton steading to high up on Cam Chreag. The River Fillan and its tributaries are important spawning grounds for Atlantic salmon, brown trout and brook lampreys.

The farms are also rich in invertebrates, including 14 species of butterfly. The most important butterfly species is the mountain ringlet (*Erebia epiphron*), a

rare montane species and Britain's only alpine butterfly. A number of populations occur above about 600 m OD on Beinn Odhar, Beinn Chaorach, Cam Chreag and Ben Challum. The Mountain Ringlet caterpillars feed on mat grass. In August large numbers of the scotch argus butterfly (*Erebia aethiops*) can be seen in the gorge woodland above Auchtertyre. Small pearl-bordered fritillaries (*Boloria selene*) can also be seen in this area; the caterpillars of this species feed on the abundant marsh violet. On the lower and middle hill ground there are small heath butterflies (*Coenonympha pamphilus*). On the low ground other butterflies include the green-veined white (*Pieris napi*), small tortoiseshell (*Aglais urticae*), orange tip (*Anthocharis cardamines*), red admiral (*Vanessa atalanta*), peacock (*Inachis io*) and ringlet (*Aphantopus hyperantus*). The latter four species have only recently spread into the area, only appearing in the last ten to fifteen years.

The golden-ringed dragonfly (*Cordulegaster boltonii*), a large black and yellow dragonfly often seen hunting over rush pastures and bog myrtle mires, is the commonest dragonfly on the farms. Common hawkers (*Aeshna juncea*) are frequently seen hunting along ditches and marshes on both the low and middle ground. The four-spotted chaser (*Libellula quadrimaculata*) can be seen hunting over upland boggy pools, while the black darter (*Sympetrum danae*) is occasionally seen in the wetlands above Tyndrum.

History and Archaeology

The farms have a rich archaeological and historical heritage, with Saint Fillan, the patron saint of the Strath, being a central character in the history and folklore of the farms and the local area, with many legends and stories associated with him and the healing powers of the Holy Pool at Auchtertyre. There are over 200 archaeological sites on the estate. Most of these are the remains of stone enclosures or shielings which are scattered throughout the estate, but are particularly concentrated in Gleann a'Chlachain ('glen of the village'). Adjacent to the Kirkton steading are the ruins of St. Fillan's Priory, a 14th century Augustinian priory. The Priory and the adjacent old graveyard are both Scheduled Ancient Monuments. The old graveyard occupies a circular mound set within a square enclosure. Among the grave stones, which mostly range from the 18th to the early 20th century, are four Early Medieval cross slabs which may date from the 7th or 8th century. One of the grave slabs bears an incised cross within a circle, decorated with a circular depression in each quadrant. This stone also bears a unique motif - the incised outline of a forearm and hand, perhaps a representation of St. Fillan's miraculous "luminous arm" (Gillies 1938). This slab is covered with a protective layer of turf. There are three other interesting grave slabs within the graveyard each one having three carved crosses. Two of the slabs are covered with turf to protect them, but one has been left exposed and can be seen on the slope down to the south east wall of the graveyard. On one of the covered slabs, in addition to the three carved crosses, there are four small cup shaped impressions carved into the stone, possibly of Bronze Age origin. Near the entrance to Auchtertyre the River Fillan deepens and broadens into what is known as the Holy Pool. The pool was

associated with an ancient healing ritual that was performed for many centuries (Macmillan 1901).

Improving the Economic Sustainability of the Farms

Genetic Improvement of the Hill Sheep Flock

The Scottish Blackface sheep within the Kirkton flock have been selected over a period of more than 20 years, based on a selection index incorporating ewe and lamb traits that is designed to improve the economic sustainability and profitability of the flock. Compared to a control line of sheep kept at average performance, sheep selected on this high selection index have shown increased overall profitability, with more lambs, heavier lambs and more productive ewes, resulting in improved income and better flock efficiency (Conington et al. 2001; 2004; 2006; Lambe et al. 2008).

As well as the Scottish Blackface the farm also has a flock of Lleyn ewes, a prolific upland breed from Wales. SRUC is both trying to improve the Scottish Blackface and evaluate the potential for alternative breeds like the Lleyn. Preliminary results show that the Lleyns at Kirkton can perform as well as or better than the Scottish Blackface in terms of number and weight of lambs reared.

Precision Livestock Farming

Research is being carried out on the farms testing the use of precision livestock farming (PLF) to improve efficiency, in particular the use of electronic identification tags (EID). The EID technology is being used in combination with an automated weighing crate that can record and sort up to 500 animals per hour, which over a year can lead to labour savings of 30-40 %. The research has shown that the EID and other PLF technology can help improve efficiency, animal welfare and economic margins (Morgan-Davies et al. 2014; 2015; Umstätter et al. 2013).

Work being carried out in collaboration with the Moredun Research Institute has shown that taking a targeted approach to worming lambs, based on individual lamb weight change, as recorded by the EID based technology, has led to significant savings in wormer costs and labour costs without compromising lamb growth (McBean et al. 2016; Morgan-Davies et al. 2016).

Grassland Management

Well managed inbye grasslands are crucial to the sustainability of the hill sheep system. They are the driver of the system and poor management of these grasslands can have a major impact on grass productivity and the availability of forage, particularly at tupping and lambing. The productivity and nutritional value of the inbye grasslands at Kirkton and Auchtertyre had been declining steadily since the 1980s with most of the perennial rye-grass and white clover having been lost. However, beginning in 2012 a programme of reseeding, together with improved grazing management and rush control, was

implemented to improve the grassland resource. Detailed soil pH and nutrient mapping has been used to help deliver more targeted lime and fertiliser application. Research linked to the reseeding work has looked at what impact different reseeding techniques (ploughing versus direct drilling) have on soil greenhouse gas emissions, weed diversity, grass productivity and farm economics. The low soil pH and high rainfall of the area makes it difficult to establish white clover within the grassland sward, so we have also been conducting some small scale plot trials looking at alternative nitrogen-fixing legume species, which may be more suited to the local environment.

In addition to the experimental work we have also been working in partnership with colleagues from SAC Consulting who organised a farmers' grassland group. This has led to a number of meetings at the farm over the last two years. These meetings allow active knowledge exchange with the farmers, allowing information about the reseeding demonstration work and research to be disseminated as well as getting feedback from the farmers that can be incorporated into future grassland management.

Diversification

Diversification is vital to the farms' economic sustainability, with tourism being the main enterprise. Auchtertyre is home to Strathfillan Wigwams, a tourism business with wooden wigwam accommodation, campsite and shop. Strathfillan Wigwams has been operating for more than twenty years and has grown from a simple demonstration site of two wigwams into a business welcoming over 22,000 guests a year. The site now holds 23 wigwams and five lodges, and has become a very important part of the estates income.

There is also a micro hydro-electric plant at Auchtertyre, although this is not owned by SRUC. This produces more than 2.2 million kilowatt-hours of electricity per annum, enough to supply 500 homes. The renewable energy produced on the estate has a mitigation potential of over 1000 tonnes of CO_2 per year.

Improving the Environmental Sustainability of the Farms

Peatland Restoration

In 2015 and 2016 some peatland restoration work, funded by Scottish Natural Heritage (SNH) under the Peatland ACTION Programme and managed by the Loch Lomond and the Trossachs National Park, was carried out on an area of degraded blanket bog on Meall Buidhe above Auchtertyre. The restoration work involved the re-profiling of peat erosion features, known as peat hags; the installation of peat, wood and stone dams to slow down and trap water in eroded gullies; and the fencing-off, re-wetting and re-seeding of an area of bare peat in order to encourage re-growth of the vegetation and stabilisation of the peat. The restored area covered more than 100 ha, with approximately 28,000 m of hags and gullies re-profiled. The restoration prevents the peat from drying out, thus reducing the amount of carbon

released into the atmosphere; it also reduces the impacts of flooding by slowing down water flow, improves water quality by reducing the amount of particulates and dissolved organic carbon and improves the quality of the peatland habitat.

Mountain Woodland

Three blocks of native woodland covering 260 ha of hill ground were planted in Gleann a'Chlachain in the late 1990s. The first phase of planting was along the Allt Gleann a'Chlachain gorge (43 ha; 220-380 m OD). The main purpose of this gorge woodland was to act as a wildlife corridor linking an area of existing semi-natural woodland in the lower part of the gorge with the main woodland planting in the upper bowl of Gleann a'Chlachain. More than 93,000 trees were planted in the gorge woodland between 1998 and 2009. The main species were downy birch, silver birch, grey willow, alder, Scots pine, sessile oak, goat willow, rowan and ash (Table 1).

Table 1. Tree species and total number of each species planted in the Allt Gleann a'Chlachain Gorge woodland (43 ha) and the two main Gleann a'Chlachain woodland blocks (217 ha) between 1998 and 2009.

Latin Name	English Name	Number of Trees Planted		Percentage
		Gorge Woodland	Gleann a'Chlachain Blocks	
Betula pubescens	Downy Birch	22,100	197,610	45.4%
Betula pendula	Silver Birch	20,000	43,505	13.1%
Pinus sylvestris	Scot's Pine	7550	41,750	10.2%
Alnus glutinosa	Common Alder	8500	35,265	9.0%
Sorbus aucuparia	Rowan	6100	32,010	7.9%
Salix cinerea	Grey Willow	9000	14,250	4.8%
Salix caprea	Goat Willow	7500	10,005	3.6%
Quercus petraea	Sessile Oak	7550	1300	1.8%
Salix aurita	Eared Willow	250	6000	1.3%
Salix mysinifolia	Dark-leaved Willow	0	5010	1.0%
Fraxinus excelsior	Ash	3550	510	0.8%
Corylus avellana	Hazel	0	3300	0.7%
Populus tremula	Aspen	500	610	0.2%
Salix lapponum	Downy Willow	750	0	0.2%
Total Number of Trees Planted		**93,350**	**391,125**	

The main phase of planting, which started in 1999, involved a large fenced area in the bowl of Gleann a'Chlachain (181 ha; 390-600 m OD) and a smaller block on the north-west facing flank of Ben Challum (36 ha; 360-610 m OD). Over 390,000 trees were planted in the two blocks between 1999 and 2009. More than half the trees planted were downy birch, with the other main species being silver birch, Scots pine, alder, rowan, grey willow, goat willow and eared willow (Table 1) (Holland 2009). Although many of the trees have been slow to establish and remain short in stature, their low, prostrate, bushy growth form, which has developed in response to the environmental and biological conditions, is entirely appropriate and expected at the altitudes involved. A mountain woodland of low growing trees and shrubs with extensive open areas will develop over the coming decades, creating a diverse and species-rich habitat that will enhance the landscape (Holland 2015b). In addition to the biodiversity, landscape and recreational benefits, the woodland will also become an important carbon store.

Agri-environment Schemes

The estate has entered into a number of agri-environment scheme agreements over the past 20 years, and has recently entered into a new agreement under the Scottish Government's Agri-environment Climate Scheme. Under this new agreement we will increase the number of fenced water margins, establish two shelterbelts, improve our management of inbye wetlands, create two wader scrapes, and manage our hill ground to benefit biodiversity through the use of summer grazing cattle and predator control.

Conclusions

Kirkton and Auchtertyre farms have a rich and varied biodiversity that includes a number of nationally rare and scarce species and habitats. The species-rich calcareous grasslands and flushes that occur at high altitude on Cam Chreag have particular conservation value and are of national importance. The estate is also important for its historical and archaeological heritage, in particular its links with St. Fillan.

Improving the economic and environmental sustainability of the estate is essential for it to survive as a working farm and research centre. This has been achieved through the implementation of a range of applied research, the use of new technology, changes in the management of both the land and livestock, and through diversification. We believe that this model, where there is a combination of income sources and an integrated approach to land management, should be used by hill farmers and crofters throughout Scotland to help them survive into the future.

Acknowledgements

The author wishes to acknowledge all of the staff at Kirkton and Auchtertyre who have been involved in the research and management of the

farms over the past 20 years, in particular Davy McCracken, Tony Waterhouse, Nicola Lambe, Claire Morgan-Davies, Ann McLaren, Meg Pollock, Harriet Wishart, Ewen Campbell and Jenna Kyle. SRUC receives financial support from the Scottish Government's Rural and Environment Science and Analytical Services Division (RESAS).

References

Conington J, Bishop SC, Grundy B, Waterhouse A, Simm G. 2001. Multi-trait selection indexes for sustainable UK hill sheep production. *Animal Science*, **73**, 413-423.

Conington J, Bishop SC, Waterhouse A, Simm G. 2004. A bio-economic approach to derive economic values for pasture-based sheep genetic improvement programmes: application to hill sheep farms in the UK. *Journal of Animal Science*, **82**, 1290-1304.

Conington J, Bishop SC, Lambe NR, Bunger L, Simm G. 2006. Testing selection indices for sustainable hill sheep production – lamb growth and carcass traits. *Animal Science*, **82**, 445-453.

Gillies WA. 1938. *In Famed Breadalbane*. Munro Press, Perth. 439pp.

Holland JP. 2009. The hill sheep and native woodland project – An update on the mountain woodland. *Scrubbers' Bulletin*, **8**, 13-26.

Holland JP. 2015a. Biodiversity benefits of reseeding inbye pastures in the uplands. In: *Grassland Biodiversity* – A summary of research outputs supported or facilitated by the Environmental Change Programme of the Scottish Government's Portfolio of Strategic Research 2011-2016. James Hutton Institute, Aberdeen. pp 12-13.

Holland JP. 2015b. The Gleann a'Chlachain mountain woodland. *Scrubbers' Bulletin*, **11**, 28-33.

Lambe NR, Bunger L, Bishop SC, Simm G, Conington J. 2008. The effects of selection indices for sustainable hill sheep production on carcass composition and muscularity of lambs, measured using X-ray computed tomography. *Animal*, **2**, 27-35.

Macmillan H. 1901. *The Highland Tay: From Tyndrum to Dunkeld*. H. Virtue and Company, London. 170pp.

McBean D, Nath M, Lambe N, Morgan-Davies C, Kenyon F. 2016. Viability of the Happy Factor™ targeted selective treatment approach on several sheep farms in Scotland. *Veterinary Parasitology*, **218**, 22-30.

Moreton S. 2015. *The Lead Mines of Tyndrum*, British Mining No. 99. Northern Mine Research Society, Nelson. 136pp.

Morgan-Davies C, Wishart H, Lambe N, McLaren A, Kenyon F, McBean D, Waterhouse A, Umstätter C. 2014. Improving efficiency in hill ewes for a better climate. In: McCracken K, ed. *Agriculture and the Environment X – Delivering Multiple Benefits from our Land: Sustainable Development in Practice*. Proceedings of the SRUC and SEPA Biennial Conference, 15-16 April 2014, Edinburgh. pp 241-244.

Morgan-Davies C, Wishart H, Lambe NR, Kenyon F, McBean D, Waterhouse A, McCracken D. 2015. EID and other technological advances in small ruminant research. *International Animal Health Journal*, **2**(4), 64-67.

Morgan-Davies C, Lambe NR, Kenyon F, McCracken D. 2016. Introducing a targeted selective treatment worming approach on a hill farm using electronic identification of lambs. *BSAS Annual Conference 2016 - Animal Science for Sustainable Production*, Chester, UK, 6-7 April 2016.

Umstätter C, Morgan-Davies C, Stevens H, Kenyon F, McBean D, Lambe N, Waterhouse A. 2013. Integrating electronic identification into hill sheep management. In: Berckmans D, Vandermeulen J, eds. *Precision Livestock Farming 2013*. Proceedings of the 6th European Conference on Precision Livestock Farming, 10-12 September 2013, Leuven, Belgium. pp 412-420.

THE OCHIL HILLS – THE CHANGING FACE OF THE UPLANDS

Drew Jamieson

"... five square feet of Scottish hillside would take a man a lifetime to describe, and even then how lame, how empty ...,"

Robert Louis Stevenson (in Stott. 1994)

SUMMARY

The Ochil Hills are a familiar and much-loved landscape and ecosystem, widely enjoyed by the communities of the Forth Valley. It is a landscape and ecosystem which has suffered from legacy land uses and neglect. It is now under pressure from accelerating changes in climate, hill-farming, EU and national regulation and subsidies and the changing priorities of economics, landscape, biodiversity and healthy outdoor recreation.

The Ochil Hills are divided between the jurisdictions of three local authorities – Clackmannanshire Council, Stirling Council and Perth and Kinross Council – and are subject to a number of different plans and strategies of different agencies and stakeholders. Until now there has been no conscious attempt to plan and manage the Ochil Hills in an integrated manner as a distinct geographical unit. This has resulted in variable planning policies, conflicting planning decisions and difficulties in achieving consensus across the landscape.

This paper analyses the changes which are affecting the Ochil Hills and the reasons for them. It describes the current fragmented planning and management processes and proposes a solution based on a Regional Land Use Partnership and Framework, associated with a vision for the uplands, as proposed by the Scottish Government in the second Scottish Land Use Strategy published in April 2016. These initiatives could provide a basis for cooperative working across the Ochil Hills and help to develop a vision which could, at last, see a coherent plan for this iconic landscape.

INTRODUCTION

A number of upland hill ranges create familiar horizons and popular recreation areas for the people of Central Scotland. The Pentland Hills in Lothian, the Lomond Hills in Fife, the Ochil Hills, the Campsie Fells and the Renfrew Heights are all familiar and much-loved landscapes which provide recreational "lungs" for the adjacent urban populations. These uplands also provide a range of ecosystem services. They form watersheds for collecting rainfall and regulating runoff to several flood-prone rivers. They are important

economic resources for hill farming, forestry and renewable energy. They are wildlife habitats and are important elements of Scotland's culture and history. All of them, in one way or another, might qualify for Robert Louis Stevenson's (1895) description of the *"Hills of Home"*. These uplands have always been subject to change but in recent years these changes have accelerated as new policies and initiatives affect, and will continue to affect, their landscape, ecosystem and enjoyment.

The Ochil Hills (Plate 4a), between Stirling and Perth, form a distinct upland area, highly visible from a large part of the Forth Valley. They form the northern horizon of the Central Belt and provide a "gateway" into Perthshire. A notional boundary and associated communities is shown in Figure 1.

Jamieson (2016) describes this distinctive landscape, ecosystem and popular recreation area in more detail. This present paper provides specific examples of the changes, in climate, land use, planning and enjoyment, taking place in the Ochil Hills, and the drivers behind them. Many of these changes affect the other familiar upland landscapes around Central Scotland – the "Hills of Home".

Some recent events in the Ochil Hills provide evidence of the changes affecting these uplands. (Figure 1).

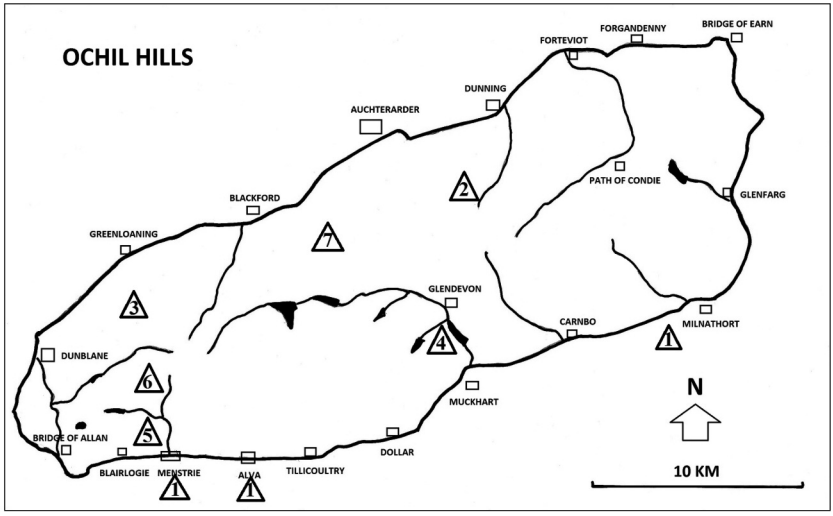


Figure 1: Some recent events changing the face of the Ochil Hills:

1. *2009-2012 – Flooding in the Hillfoots villages and Milnathort;*
2. *2014 – A 9-turbine windfarm application at Knowes Farm, Dunning, was refused by Perth and Kinross Council;*
3. *2015 – The Beauly-Denny power line, from Logie to Greenloaning, was completed;*

4. *2014 – A planning application for a sand and gravel quarry at Glenquey Moss, near Glendevon, was refused for reasons which included peat conservation, landscape and recreation;*
5. *2013 – Changing patterns of grazing were observed in Menstrie Glen;*
6. *2015 – Scotland's largest modern new forest was planted at Jerah;*
7. *2015 – The largest part of the Ochil Hills (and an eastern extension) was designated as a Special Landscape Area by Perth and Kinross Council*

In the Ochils, the changes to the landscape and ecosystem are currently being addressed by a number of different agencies, often working to different plans and strategies. The hills are divided between three local authorities – Stirling (SC), Clackmannanshire (CC) and Perth and Kinross (PKC) – and seventeen Community Councils have an interest in the hills. Among national agencies, the Ochils fall between two regional offices of Scottish Natural Heritage (SNH); Forestry Commission Scotland (FCS) and the Scottish Government Rural Payments Directorate which administers the Scottish Rural Development Programme (SRDP). The Scottish Environment Protection Agency (SEPA) is organised on river catchments with responsibilities divided in the Ochils between the Forth and the Tay. (Figure 2).

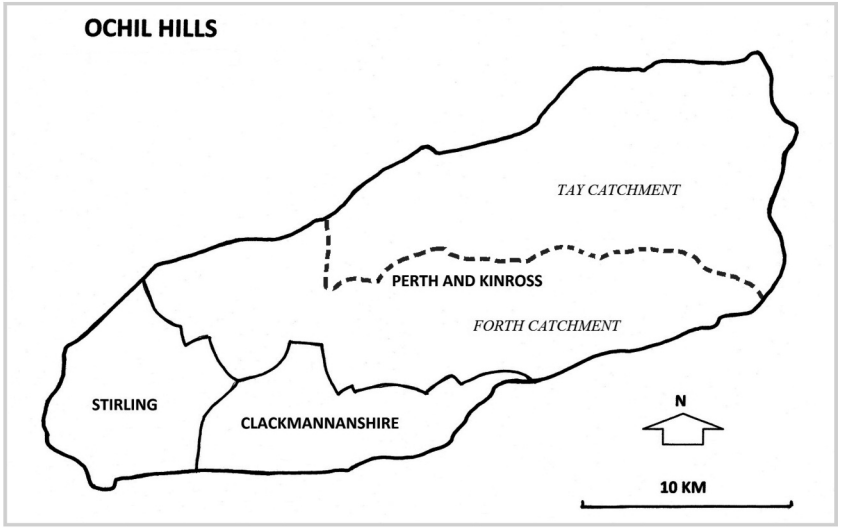


Figure 2: The 3 local authorities and the 2 major river catchments which divide the Ochil Hills.

This paper raises questions as to whether the existing fragmented planning and management arrangements are adequate to manage the changing face of this particular iconic upland area in a transparent and inclusive manner and to create some coherent "vision" for the future. In March, the Scottish Government (SG) published its second Land Use Strategy for Scotland 2016-

2021 (LUS2). (2016) This includes a number of policies and proposals, such as Regional Land Use Partnerships, Regional Land Use Frameworks and a "vision for the uplands", which could prove beneficial to the future planning and management of the Ochil Hills.

THE DRIVERS OF CHANGE

A number of environmental, legislative, economic and societal pressures are driving the changes that can be observed in the Ochil Hills. Changes in climate lead to responses about flood risk, renewable energy, peatland conservation and woodland and forest creation. These result in new networks of EU and national legislation and regulation. Changes in global and national economies affect hill farming and the economics of livestock rearing and woodland creation. These are managed through EU subsidies and the Scottish Rural Development Programme (SRDP). Changes in personal lifestyle and mobility increase recreational pressures with different expectations and attitudes to the countryside and landscapes. These societal changes are reflected in the decisions taken by the relevant planning authorities.

CHANGING CLIMATE

> *"The pressing challenge of climate change means that our action on the environment must continue to evolve, strengthening our longer-term resilience. A planned approach to development helps to strike the right balance between safeguarding assets which are irreplaceable, and facilitating change in a sustainable way. We must work with, not against, our environment to maintain and further strengthen its contribution to society."*
>
> *Scottish Planning Framework 3 (2014)*

The threats from climate change are well documented and the SG (2010) aims to reduce greenhouse gas emissions by at least 80 % by 2050. SEPA (2014) describes Scotland's climate changing as temperatures rise, the growing season increases, rainfall intensity and winter rainfall both increase. Winter 2015/2016 was the wettest on record. Four issues related to climate change have particular relevance to the Ochil Hills – flood risk, renewable energy, peatland conservation and woodland and forest creation.

• **Flood Risk.** The Ochil Hills have a history of intermittent flood events. There are records from 1785, 1846 and a significant event in Tillicoultry in 1877. There have been a number of more recent landslip events, including one at Myreton Hill, Menstrie, in 1984 and a major landslip in Kippenrait Glen in 1999.

> ***Event 1: Flooding.*** *In recent years floods from the Ochils have affected the Hillfoots villages of Menstrie, Alva, Tillicoultry Dollar and Milnathort. The flood at Menstrie on 29 August 2012, correlated with a high-intensity rain storm in the Bridge of Allan area which deposited 64 mm of rain in a 2 hour period – a rainfall pattern which had an estimated return period of more than 1,000 years. On the current*

understanding of climate change the current 200-year return period flow would reduce to 100-year return flow by 2080 (CC 2013). With the forecast of wetter winters and more intensive rainfall events, further flooding is an increasing risk.

The Ochil Hills act as a major watershed for the Earn, Devon, Allan and Leven river systems and have a significant role to play in flood-risk reduction. Under the Flood Risk Management (Scotland) Act 2009 (2009.1), SEPA has produced Flood Risk Management Strategies (2011.2) which identify areas of the Devon, Allan, Earn and Leven catchments within the Ochil Hills as Potentially Vulnerable Areas for flooding. (2015.3, 2015.4).

The benefits and techniques of natural flood management are well-documented by WWF (undated) and SEPA (2011.1, 2015.1). This would involve the whole Ochils ecosystem, from the blanket bogs of the watersheds to the bottoms of the glens. Changes in land management and the restoration of natural habitats, such as wetlands and woodlands could create more space for water and help reduce the flow of flood waters to areas downstream. SEPA (2015. 2) has produced maps of Opportunity Areas for Runoff Reduction, including the Ochil Hills.

It is likely that the Ochil Hills will experience further flooding, landslips and erosion and there are opportunities for coordinating landscape-scale mitigation across all three local authority areas through natural flood management techniques.

• **Renewable Energy.** The expansion of renewable energy is seen as a way of reducing greenhouse gas emissions and mitigating climate change. The potential for wind energy in the Ochils Hills has already been identified and has been exploited with four windfarms currently operational at Lochelbank (12 turbines), Greenknowes (18 turbines), Rhodders (6 turbines) and Burnfoot Hill (15 turbines). Other proposals have been refused. Further opportunities may exist for hydro, biomass, biofuels and solar in the Ochils subject to the constraints of local development plans and relevant supplementary guidance.

Event 2: Windfarm at Knowes Farm. *In December 2014, Perth and Kinross Council (2014) refused an application for a 9 turbine windfarm at Knowes Farm, above Dunning, subsequently confirmed by a Local Review Board hearing. One of the reasons given for the refusal was the "cumulative landscape and visual impacts", of the proposal - a recognition of the limited capacity of the Ochil Hills to absorb more windfarms.*

Wind farms and individual large wind turbines have been, and still are, some of the most controversial developments in the Ochils and there is a considerable concern to avoid the cumulative impact which might turn the Ochils from the present "landscape with wind farms" into a "wind farm landscape". Particular considerations for the Ochils include landscape, recreation, carbon-rich soils, separation from local communities and potential

cumulative impact with existing wind farms. Two of the planning authorities - Clackmannanshire (2015), and Stirling (2016) – have already adopted Supplementary Guidance, including Spatial Frameworks, for wind energy developments. Clackmannanshire classifies most of its part of the Ochil Hills as an "Area of Significant Protection" for turbines in excess of 50 m, while Stirling concludes that the western Ochil Hills have *"no capacity"* for wind energy developments. Perth and Kinross Supplementary Guidance is in preparation. The Ochil Hills are therefore subject to three different sets of policies and guidance on wind energy developments with no coherent overall vision for this iconic landscape.

Recently, the UK Government (2015) announced that the Renewable Obligation for new onshore wind would be terminated from 1st April 2016, which may reduce future demand for wind farms in the Ochils. However, in February, Perth and Kinross Council (2016) approved the installation of a photovoltaic solar panel farm and ancillary works covering 35 ha at Shire End Solar Farm, Path of Condie – the first solar energy project approved in the Ochil Hills.

Two high-voltage power lines cross the Ochils, one across Sheriffmuir and one near Glen Farg. After much controversy and a Public Inquiry, the existing power line on the western end of the hills, across Sheriffmuir, was replaced by the Beauly-Denny powerline, using much taller pylons, to carry renewable energy from the north of Scotland to the consumers in the south of the UK.

Event 3: Beauly-Denny Powerline. *This new power line was commissioned in 2015 and has a significant impact on the landscape and sky-scape of the western end of the Ochil Hills.*

The construction has been serviced by temporary new access roads creating an additional prominent industrial feature in the landscape. A sum of money has been set aside, the Beauly-Denny Visual Mitigation Scheme (BDVMS), to reduce some of the negative impacts of the power line on the landscape and amenity of this part of the Ochils.

• **Peatland Conservation.** Peatlands – blanket bogs, raised bogs and carbon-rich soils – are recognised as "carbon-sinks", storing carbon dioxide and other greenhouse gases. Peatlands are also important habitats and have a role in flood management.

Event 4: Glenquey Moss. (Plate 4b) *When Perth and Kinross Council (2014.1) refused the extension of a planning application for sand and gravel extraction at Glenquey Moss in 2014, the committee cited; "the likely damage to the moss which will be removed, the peat which will be removed and the change and scarring of landscape, notwithstanding the proposed remediation works …" - among its reasons for refusal. This decision was upheld by the DPEA Reporter on appeal (2015).*

The Scottish Government is committed to conserving peatlands. (2011.2) Scottish Natural Heritage published Scotland's first *National Peatland Plan* (2014) and was allocated £5 million from the Green Stimulus Package to spend on peatland restoration in the period 2012-2015. This was increased by a further £3 million in 2015 and an additional £10 million is included within the SRDP. At least one option – "Moorland Management" – would be available within the Ochil Hills.

Some of the peatlands on the high plateau are already at risk, with deep gullying evident in areas of the Menstrie Moss, Alva Moss and Maddy Moss. There are opportunities for landscape-scale peatland conservation across all three local authority areas which could have benefits for carbon storage, biodiversity, flood management and drinking water.

• **Woodland and Forest Creation.** Trees absorb carbon dioxide and therefore have a mitigating effect on climate change. Renewable energy can also be generated from bio-mass from forests and bio-fuels such as willow coppice may be grown in less productive agricultural land. The economic and other roles of woodlands and forests are described in the following section.

CHANGING LAND USE

The first Scottish Land Use Strategy set out the Scottish Government's integrated approach to land use (2011). It sets out key principles for sustainable land use to deliver multiple benefits, – the "Ecosystem Services Approach" – and encourages making best use of assets to support primary activities, including carbon storage. Of particular relevance to the changing face of the Ochils are the economics of upland farming and the role of forest and woodland. The SRDP provides funding for land-managers to tackle environmental priorities in the countryside, including biodiversity, landscape, climate change, water and soil quality and public access. It is delivered by the Scottish Government in partnership with other public bodies including SNH and FCS. The 2014-20 SRDP (2015) includes the Agri-Environment Climate Scheme (AECS) and the Forestry Grant Scheme (FGS), which includes objectives for mitigating climate change.

• **Upland Farming**. The EU Common Agricultural Policy (CAP) has been progressively changed over recent years with a higher proportion of farm subsidies being directed toward environmental management, habitat creation and biodiversity.

Event 5: Grazing change in Menstrie Glen (Plate 5a). *In 2015 the west side of Menstrie Glen illustrated the difference in grazing regimes between sheep and cattle and its effect on landscape and biodiversity. Where the glen is fenced off, the contrast between the close-cropped sheep sward and the longer, irregular pasture torn by the Highland cattle is marked. One impact on biodiversity is seen in the well-marked "buzzard-posts" where the longer grass of the cattle sward encourages small mammals.*

Across Scotland, both cattle and sheep have declined in numbers since the EU "headage" payment system was discontinued in 2003. This has encouraged reductions to stocking levels in upland areas with consequent effects on the nature of the grassland and associated biodiversity. The Royal Society for the Protection of Birds (2013) notes that, in the uplands, *"Too much or too little grazing, or grazing by the wrong type of livestock, or at the wrong time of year, and these areas can begin to lose their special character."* This can also have wider effects on moorland birds.

In response to EU subsidies and market forces, hill-farming in the Ochils is likely to face more economic challenges. Further changes are likely in the management of grazing and the character of grassland. There may be opportunities in a coordinated programme of SRDP funding across the Ochils to promote agreed objectives for flood resilience and biodiversity.

• **Woodland and Forestry.** In the Ochil Hills, the remains of the original native woodlands are mainly restricted to small fragments with two larger areas – Kippenrait Glen and Kincardine Castle Wood – designated as Sites of Special Scientific Interest (SSSI). Kippenrait Glen is also recognised as a Special Area of Conservation (SAC). Since 2000, the Woodland Trust (Scotland) (WTS) has been *"Re-wilding Glen Devon"* by planting around 1.5 million native trees, across the boundary between Clackmannanshire and Perth and Kinross, to restore native woodland, on a non-commercial basis. The first large-scale Forestry Commission plantation was started in 1930 and much of the upland landscape of the eastern Ochils is dominated by extensive coniferous forests. There are now changes in the purpose, nature and design of forests. The Scottish Forestry Strategy (2000) sets out the long-term vision of a multi-functional role for forestry in Scotland, including its value as a mechanism for sequestering CO_2. This strategy is due to be reviewed under LUS2. The UK Forestry Standard (2011) published by the UK Forestry Commission, defines sustainable forestry and provide guidance on delivering multiple objectives for biodiversity, climate change, the historic environment, landscape, people, soil and water.

> ***Event 6: Jerah Forest (Plate 5b)*** *was planted in 2015 on a 1,000 ha former sheep farm on the borders of Clackmannanshire and Stirling, using 1.3 million trees of 16 different species. The new forest is designed not only to produce a productive timber crop but also to create amenity woodland and to tackle climate change. Tilhill Forestry (2015) expects to sequester 183,000 tonnes of* CO_2 *in its 40-year rotation.*

To implement these policies, the local authorities have published Forest and Woodland Strategies which set out strategic frameworks for the development of forestry in their areas, including the Ochil Hills. (PKC 2014.2) (SC/CC 2014). Land is defined as Preferred, Potential, Sensitive or Unlikely/Unsuitable for forestry. Clackmannanshire Council is also preparing Supplementary Guidance 8 – Woodlands and Forestry (2016). The Ochil Hills are therefore subject to three sets of strategy and guidance for woodlands and forests, which do not always match across local authority boundaries.

The Scottish Government (2011.1) is committed to creating 100,000 hectares of new woodland and forest by 2022 and the reduced profitability of grazing will further encourage the expansion of woodland and forestry in the Ochil Hills. There will be opportunities to enhance and expand areas of existing native woodland and to create other small-scale deciduous woodlands while some of the old-established conifer plantations are being re-designed and re-structured to conform to current design standards. There is also a need to retain and replant existing specimen trees and shelter-belts, in those key locations where they contribute significantly to the landscape and cultural history of the hills.

CHANGING PLANNING OBJECTIVES

The Scottish Planning Framework 3 (op. cit.) and Scottish Planning Policy (2014.1) provide the current statutory planning framework upon which local authorities base their separate Local Development Plans. (SC 2014.1), (PKC 2014.3), (CC 2015.1) Recent emphasis has focused on issues such as sustainable development, the mitigation of climate change, creating a healthy physical and social environment including landscape, biodiversity and healthy recreation.

• **Local Landscape Designations.** SNH and Historic Scotland (2006) describes the concept of Local Landscape Designations (LLD) as a recognition of locally-valued landscapes, replacing and expanding on the roles of the previous Area of Great Landscape Value (AGLV). The purposes of a Local Landscape Designation – Local Landscape Area (LLA) or Special Landscape Area (SLA) – are to:

- *safeguard and enhance the character and quality of landscapes, which are important or particularly valued regionally or locally;*
- *promote understanding and awareness of the distinctive character and special qualities of local landscapes;*
- *safeguard and promote important settings for outdoor recreation and tourism locally.*

Local landscape designation should encourage local authorities to develop policy priorities and objectives for landscape, agriculture, forestry and tourism and to provide a focus for involving communities in policy-making. These objectives are very relevant to the Ochil Hills. Stirling and Clackmannanshire had previously designated their parts of the Ochil Hills as Local/Special Landscape Areas but, in 2014, Perth and Kinross Council followed suit.

Event 7: Local Landscape Designation. *In 2014, Perth and Kinross Council (2015) designated its large part of the Ochil Hills as a Special Landscape Area, extending eastwards to the council boundary with Fife.*

For the first time in its history the Ochil Hills, apart from a small part of the Stirling area, now have a consistent protective landscape designation and are recognised by all three local authorities as a Local or Special Landscape Area.

However, each planning authority still has slightly different policies and priorities for managing development within their own Local/Special Landscape Areas which could still lead to confusion. There is now an opportunity for the planning authorities to consider how to create a more coordinated vision for the landscape of the whole hill range.

• **Biodiversity and Geodiversity.** There are 9 Sites of Special Scientific Interest (SSSI) within the Ochil Hills, two of which are also designated as EU Special Areas of Conservation (SAC) under the EU Habitats and Species Directive. There are also 3 Geological Conservation Review Sites and a new site at Glenquey Moss, designated because of its geodiversity interest. While the management of designated sites protects examples of special habitats there is an increasing focus on identifying and enhancing the connectivity of habitats and networks. A number of strategy documents have developed the biodiversity agenda, including the Scottish Government (2004) and SNH (2010). The current Scottish Government's strategy *"2020 Challenge for Scotland's Biodiversity"*, (2013) reflects new international and EU commitments and focusses on desired outcomes for 2020.

In response to earlier initiatives, the three local authorities prepared Local Biodiversity Action Plans (LBAP). The Clackmannanshire BAP 2012-2017 (2012) has policies and actions for those habitats which are represented in the Ochil Hills ecosystem – blanket bog, upland grassland, heathland, woodland and water. Stirling Council published a Biodiversity Duty Report (2014.1) with a commitment to launch a revised Stirling BAP within three years. Tayside Biodiversity Partnership is revising its Local Biodiversity Partnership AP. (2015). The Ochil Hills are therefore subject to three separate Biodiversity Action Plans.

SNH describes habitat networks (2011) and maps of integrated habitat networks within the Ochil Hills have been prepared for: broadleaved woodland; wetland; grassland and heathland. The current SRDP offers significant potential benefits for the biodiversity of the Ochils. Financial support is available to protect and enhance peatlands, moorland, species-rich grassland, woodland and for other habitat and species conservation.

The planning of the aquatic ecosystem is also changing. The EU Water Framework Directive (2000) introduced the requirement to achieve *"good ecological status"* for water bodies by 2027. This may require improvements to water quality, aquatic biodiversity and fisheries. The major river catchments - Forth and Tay - each have their own River Basin Management Plan (RBMP) developed to meet this EU requirement. In 2015 the second River Basin Management Plans (2015.5) were published taking climate change into consideration. Some of the catchments in the Ochil Hills are already of "good" ecological status. The Loch Leven catchment is programmed to meet this standard by 2021 and the Devon and Allan catchments by 2027. The Water of May is expected to meet all criteria in 2027.

Several habitats of the Ochil Hills are likely to be affected by changes in climate and land use. Recent policies and initiatives provide the opportunity for positive and beneficial effects on the ecosystem of the Ochil Hills. They could be more effective if there was a cross-border approach to specific Ochils issues, such as the restoration of peatlands and native woodlands.

CHANGING ENJOYMENT

The Land Reform Act gives a right of responsible, non-motorised access to most land and inland water in Scotland. (2003). All three local authorities have adopted Core Paths Plans and the Ochils are well-endowed with agreed paths giving the public reasonable footpath access throughout its area. Recent initiatives by SNH, SportScotland and VisitScotland have encouraged increased active outdoor recreation in many forms.

> ***Event 4: Glenquey Moss.*** *In 2014, as part of its refusal for quarrying sand and gravel from Glenquey Moss, Perth and Kinross Council decided that a sand and gravel quarry "would adversely affect both current use and future development potential of the locality as an increasingly popular area for outdoor recreational use, particularly walking and cycling, and undermine the development of tourism within the area."*

In the Ochil Hills traditional activities such as walking, trout fishing, horse-riding, hill-running and orienteering are still popular, while mountain biking has expanded rapidly and sponsored challenges and more adventurous activities are likely to increase. Recreational pressure within the Ochil Hills tends to concentrate on particular "honeypots" with good access and/or longer routes. Popular places include the Dumyat/Cocksburn Reservoir area above Logie and much of Glendevon. Alva and Tillicoultry give access to the highest point – Ben Cleuch, while areas close to villages are popular with local residents.

Visitor numbers are difficult to estimate. No formal visitor survey of the whole Ochil Hills has been carried out. However, Friends of the Ochils (2007) reports on the survey carried out by the Dumyat Action Group which estimated that some 36,000 visits were made annually to Dumyat hill and the Cocksburn Reservoir areas, on the Sheriffmuir road. In Glen Devon, it is estimated that in excess of 9,000 visits are made along the old drove road between Glen Devon and Dollar each year. *Scotland's People and Nature Survey* (2014.1), estimated the total volume of adult visits to the outdoors in 2013/14 was the highest annual figure recorded since 2006 – some 395.8 million – with half taken in countryside locations.

The changing nature and intensity of recreation and tourism has significant effects on the landscape, ecosystems and enjoyment of the hills. Increased visitor numbers are creating landscape issues of informal roadside parking, footpath and verge erosion and litter.

There is a need to provide well-designed, small-scale car-parking; repair and maintain popular hill paths, manage litter and provide adequate visitor information. In the Ochil Hills three particular initiatives are addressing these issues. In Glen Devon, the Woodland Trust has created the 14-km *Reservoirs Trail,* linking Muckhart to Glen Devon Reservoirs. This includes well-designed car parking, well-signposted paths and visitor information panels interpreting the landscape, biodiversity and cultural heritage of the area.

Along the south of the Ochil Hills, the Ochils Landscape Partnership has created a 21-km *Hillfoots Diamond Jubilee Way,* linking Blairlogie with Muckhart in a continuous walk and cycle way supported by small-scale car parking, visitor information and sign posts. Above Logie, the *Beauly-Denny Visual Mitigation Scheme* is planned to deal with landscape and recreational issues arising from the new power line. This includes tree planting, the improvement of existing footpaths at Dumyat and at Cocksburn Reservoir, the restoration of areas of eroded verge and drystone dykes and the installation of stopping areas.

Planning authorities recognise the importance of recreation and tourism. It is likely that visitor numbers in the Ochil Hills will increase. Visitor provision and management is split between the three local authorities, Scottish Water and landowners such as WTS, with variable priorities. There should be further opportunities to coordinate visitor services, footpath maintenance, litter management and visitor information and to create a distinct and professional "Ochils" brand of visitor services.

MANAGING CHANGE – PRESENT AND FUTURE

Present Multiple Agencies

The only single organisation that looks at the conservation and management of the Ochil Hills as a single entity is the charitable and voluntary organisation – *Friends of the Ochils.* Otherwise, across the Ochil Hills, responsibilities for planning and management are currently divided between a large number of statutory and non-statutory organisations, each operating under different legislation, strategies and plans as indicated in the previous section.

The Ochils are divided between three local authorities each with its own Local Development Plans with variable policies for landscape and wildlife conservation, forest and woodlands and wind-energy or renewables development. There are three Local Biodiversity Action Plans and seventeen Community Councils with an interest in the hills. Among national agencies, Scottish Natural Heritage has two offices with interests in the Ochils, Forestry Commission Scotland has two Districts and the Scottish Rural Payments Directorate operates two regions – Forth and Tayside. The Central Scotland Green Network (CSGN) operates only in the Stirling and Clackmannanshire

parts of the Ochils. SEPA is organised on river catchments with two River Basin Management Plans –Tay and Forth and three Flood Risk Local Plan Districts – Tay, Forth and Forth Estuary. A large number of individual landowners, tenants and land managers all manage their own particular properties. While there is already a significant degree of inter-authority consultation on specific issues, such as flood-risk management, in a time of significant change, it would be beneficial if they worked more closely together for the economy, landscape and ambience of the Ochil Hills as a geographical, cultural and historical entity.

There are already several partnership groups operating for specific purposes within the Ochil Hills. Until 2015 the *Ochils Landscape Partnership* (OLP) comprised about 20 different organisations, including Clackmannanshire Council, Stirling Council, the University of Stirling, six community councils, Scottish Land & Estates, and various local community groups and organisations, to improve the amenity and access in the Hillfoots.

SEPA's River Basin Management Plan for the Forth catchment has an Area Advisory Group (AAG) of 26 members, but only 12 would have any locus in the Ochil Hills. Similarly, SEPA's Local Advisory Group for the Tay Flood Risk Management Plan has 27 members but only 15 have a direct interest in the Ochils. Since the Ochil Hills act as a major watershed for the Earn, Devon, Allan and Leven river systems they have a significant role to play in downstream flood risk reduction and perhaps should be managed as a single "watershed", rather than as two separate catchments.

It could be argued that there are enough groups already involved in planning and managing aspects of the Ochil Hills and there are adequate opportunities for consultation and involvement at many levels. This argument comes up against the evidence of the protracted histories of Glenquey Moss and Jerah Forest:

> ***Glenquey Moss:*** *The planning application to PKC, to extend the time limit for extracting sand and gravel from Glendevon Quarry (Glenquey Moss) took 5 years to resolve (2010-2015), required two meetings of the PKC Development Management Committee and an Appeal to the Scottish Government. Among the objectors were the adjacent planning authority, all four affected community councils, three national wildlife organisations and Friends of the Ochils – in all, over 180 objectors and a vigorous local campaign to "Stop the Quarry: Save Glenquey Moss". While statutory consultation can be adequate in many cases, the adversarial nature of the process does not always achieve the right consensus result, without considerable costs in staff time, delay for the applicant and uncertainty for the objectors.*

and

> ***Jerah Forest.*** *It can take three years for a new forest to be granted approval for planting with substantial costs associated with the environmental impact assessment process. The new Jerah Forest took 2 years and many meetings to*

complete all the consultations and environmental assessments and required 19 iterations of the planting plan. Parties involved included Forestry Commission Scotland, Tilhill UPM, two local authorities, two community councils, Friends of the Ochils and input from many others, including C'n'Do Scotland Ltd, Ochils Mountain Rescue Team, Ochil Hill Runners, Ochils Mountaineering Club and Ochils Paragliding Club. There is concern on one side that the needs of established recreational users were not adequately recognised at an earlier stage nor that the historical significance of Menstrie Glen was sufficiently taken into account. On the other hand, there is a concern at the lack of knowledge within the community about national forestry policy and design guidelines.

There has to be a better way to assess how changes in land use and land management may impact on a broad range of ecosystem services, bring stakeholders together and build understanding about competing interests.

Future Options for Coordination.

Existing Powers. Planning authorities currently have the necessary powers to enable co-ordinated working on matters which they consider to be of common interest. Options include, for example, ad-hoc informal meetings of local authority planning officers; a Technical Working Group of officers or a Joint Committee of elected members, supported by officers. Some areas – e.g. Tweed, Forth Estuary – have opted for a stakeholder forum. Other upland areas – e.g. Pentland Hills, have developed as Regional Parks. The extension of the Central Scotland Green Network to cover the whole Ochil Hills area has been suggested, while the Environmental Co-operation Action Fund (ECAF) within the SRDP has £10 million available between 2015 and 2020 to fund co-operative projects.

Local Landscape Designations. Now that the majority of the Ochil Hills is designated as a Local or Special Landscape Area, there is potential to: *".. integrate better the objectives of local landscape designations within wider policy and funding frameworks for agriculture, forestry, biodiversity, historic environment, recreation and tourism, both locally and nationally"* (SNH 2006). Perth and Kinross Council (2015) has already published its ambitions, or medium to long-term objectives, for its Special Landscape Areas, including its part of the Ochil Hills. These ambitions are based on the three themes of "Conserving and Enhancing", "Understanding and Enjoying" and "Living and Working" and will require a coordinated approach to planning, education, interpretation, promotion, facilitation, business support, marketing, branding, funding and management to achieve them.

Landscape and Land Use Partnerships. A number of areas of Scotland, e.g. Southern Uplands, Inner Forth, have already developed landscape partnerships - voluntary groupings of agencies and landowners working together to achieve common objectives and funding. However, the second Scottish Land Use Strategy (2016) contains three proposals and policies

relevant to the Ochil Hills - Regional Land Use Partnerships, Regional Land Use Frameworks and a Strategic Vision for the Uplands. These are new and developing areas and further work is required before rolling them out more widely but all three of these proposals could help to achieve better coordination in planning and management of the Ochil Hills.

• **An Ochil Hills Land Use Partnership** would progress better integration of land uses and better understanding of the issues of the Ochil Hills by bringing together local people, land users and managers into a regional partnership. It could also provide a vehicle for such landscape-scale projects as peatland restoration, natural flood management, native woodland creation and the re-design of legacy forests.

• **An Ochil Hills Land Use Framework** would:

  • Help in the assessment of how changes in land use and land management – e.g. forestry and renewable energy – may impact on a broad range of ecosystem services of the Ochil Hills;

  • Bring together the 17 communities and other stakeholders in the Ochil Hills to build understanding about competing interests in the use and management of the Ochil Hills;

  • Involve the 17 local communities and other stakeholders in decisions about the Ochil Hills;

  • Provide context and wider input to a range of local authority responsibilities such as development planning and flood risk planning in the Ochil Hills; and,

  • Assist in targeting the use of finite financial resources e.g. SRDP funding, to where they may have most impact in the Ochil Hills e.g. peatland conservation, natural flood management, native woodland expansion, forest re-design, across the whole Ochil Hills range.

• **A Strategic Vision for the Uplands.** LUS2 also includes a commitment to scope the potential to develop a "Strategic Vision for the Uplands", exploring the multiple benefits they deliver and how they can contribute to climate change targets. In this context, LUS2 also recognises the potential benefits of streamlining the array of sectoral strategies – flood risk, biodiversity, forest and woodland – into a single integrated strategic vision for an upland area. This would have significant benefit for the Ochil Hills.

CONCLUSION

The Ochil Hills form a distinct landscape unit and provide good examples of the challenges facing the uplands of Central Scotland. A number of recent

environmental laws and land use initiatives are driving change at an accelerated pace, affecting the landscape, biodiversity and enjoyment of the hills. At the same time, the Ochils are planned and managed by a large number of different organisations which communicate and cooperate to a greater or lesser degree – not always efficiently or effectively for the hills. Is this the best way to manage future change? Or is there a need for a more inclusive and focussed mechanism to develop and steer a more-coordinated "vision" for this iconic and much-loved upland. The concepts of Regional Land Use Frameworks and Regional Land Use Partnerships would appear to offer useful ways forward, while the concept of a "strategic vision for the uplands" could go some way to improving the planning and management of all the "Hills of Home".

ACKNOWLEDGEMENTS

The author acknowledges the help, information and encouragement, so freely given, by those who work, plan and manage the Ochil Hills. Particular thanks goes to the individuals and committee of *"Friends of the Ochils"*, who enjoy and love these hills and to the many other consultees who provided feedback on the drafts.

REFERENCES

Central Scotland Green Network.
http://www.centralscotlandgreennetwork.org

Clackmannanshire Council. 2012. *Biodiversity Action Plan 2012-2017.* Alloa
www.clacksweb.org.uk/document/4519.pdf

Clackmannanshire Council. 2013. *Menstrie Burn Post Flood Study. Summary Report.* 2013. Alloa.
www.clacksweb.org.uk/document/4198.pdf

Clackmannanshire Council. 2015. *Supplementary Guidance SG2 – Onshore Wind Energy.* Alloa.
http://gis.clacksweb.org.uk/dataset/e0a14ab6-c461-436a-a7e0-ec9ff4c899e9/resource/8e20cd05-4f8a-4ecfb2764d9585f4e357/download/supplementaryguidance2onshorewindenergy.pdf

Clackmannanshire Council. 2015.1 *Local Development Plan, 2015.* Alloa.
http://gis.clacksweb.org.uk/dataset/clackmannanshire-adopted-local-development-plan-2015/resource/aaa5ccb2-136a-48e5-b349-848d2ca27abc

Directorate for Planning and Environmental Appeals. 2015. *Appeal Decision Notice Planning appeal reference: PPA-340-2094.* Edinburgh.
http://www.dpea.scotland.gov.uk/CaseDetails.aspx?id=115666

European Union. 1992. *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).* Brussels.
http://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

European Union. 2000. *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy*. (*Water Framework Directive).*
http://ec.europa.eu/environment/water/water-framework/index_en.html

Forestry Commission (Scotland). 2000. *Scottish Forestry Strategy.* Edinburgh. http://scotland.forestry.gov.uk/supporting/strategy-policy-guidance/forestry-strategy

Forestry Commission. 2011. *UK Forestry Standard*. London. http://www.forestry.gov.uk/ukfs

Forth Estuary Forum http://www.forthestuaryforum.co.uk

Friends of the Ochils. 2007. Dumyat Action Group. *Levels of Use of the Dumyat Area and the Attitudes of Users to the Power Line Proposals in 2004.* Written evidence to the Beauly-Denny Public Inquiry. Stirling. 2007.

Jamieson, D. 2016. *The Ochil Hills – The Geography of a Special Place*. Third Edition. 2016. Unpublished.

Ochils Landscape Partnership 2015. *Diamond Jubilee Path*. Alloa. http://www.ochils.org.uk/hillfoots-way

Perth and Kinross Council. 2014. Planning Application 4/00837/FLL. *Erection of 9 no, turbines and associated infrastructure Knowes Farm, Dunning, Perth PH2 0RB for Knowes Renewables LLP.* Perth http://planningapps.pkc.gov.uk/online-applications/simpleSearchResults.do?action=firstPage

Perth and Kinross Council. 2014.1 Planning Application 10/02181/FLM *Variation of Condition (3) of Planning Permission 84/956/MW to enable the winning and working of minerals to continue to 2035 at Glendevon Quarry, Glenquey.* Perth http://planningapps.pkc.gov.uk/online-applications/files/E2F6448888F02A244FC7ECBD4F654F54/10_02181_FLM-DECISION_NOTICE-678821.docx

Perth and Kinross Council. 2014.2 *Forest and Woodland Strategy*. Perth http://www.pkc.gov.uk/CHttpHandler.ashx?id=28220&p=0

Perth and Kinross Council. 2014.3 *Local Development Plan.* Perth. http://www.pkc.gov.uk/CHttpHandler.ashx?id=23633&p=0

Perth and Kinross Council. 2015. *Landscape – Supplementary Guidance.* Perth http://www.pkc.gov.uk/CHttpHandler.ashx?id=31507&p=0

Perth and Kinross Council. 2015.1 *Statutory Biodiversity Duty, Report on Delivery: 1st January 2012 to 31st December 2014.* Perth http://www.pkc.gov.uk/CHttpHandler.ashx?id=28918&p=0

Perth and Kinross Council. 2016. *Supplementary Guidance – Renewable and Low Carbon Energy.* Perth. (in preparation) http://www.pkc.gov.uk/article/2691/Renewable-and-Low-Carbon-Energy-Supplementary-Guidance

Perth and Kinross Council. 2016.1 Planning Application 14/02077/FLL. *Installation of photovoltaic solar panel farm and ancillary works. Shire End Solar Farm, Path of Condie.* Perth. http://planningapps.pkc.gov.uk/online-applications/simpleSearchResults.do?action=firstPage

Royal Society for the Protection of Birds. 2013. *Livestock Farming Essential To Preserving Wildlife And Character Of Iconic Landscapes.* http://www.rspb.org.uk/news/341488-livestock-farming-essential-to-preserving-wildlife-and-character-of-iconic-landscapes

Scottish Environment Protection Agency. 2011.1. *Allan Water Natural Flood Management Techniques and Scoping Study. 2011. Stirling.*

Scottish Environment Protection Agency. 2011.2. *Flood Risk Management Strategies and Local Flood Risk Management.* http://www.sepa.org.uk/flooding/flood_risk_management/national_flood_risk_assessment.aspx

Scottish Environment Protection Agency. 2013. *Identifying Opportunities for Natural Flood Management.* Stirling.
https://www.sepa.org.uk/media/163412/natural_flood_management_guidance.pdf

Scottish Environment Protection Agency. 2014. *Our climate challenge*
Helping to deliver a resilient, low carbon Scotland SEPA's 2014-2018 Climate Change Plan.
Stirling.
http://www.sepa.org.uk/media/40789/our_climate_challenge-2014_2015.pdf

Scottish Environment Protection Agency. 2015.1. *Natural Flood Management Handbook.*
Stirling.
http://www.sepa.org.uk/media/163560/sepa-natural-flood-management-handbook1.pdf

Scottish Environment Protection Agency. 2015.2. *Opportunity Areas for Runoff Reduction.*
Stirling.
http://map.sepa.org.uk/floodmap/map.htm

Scottish Environment Protection Agency. 2015.3. *Flood Risk Management Strategy – Forth.*
Stirling.
http://apps.sepa.org.uk/FRMStrategies/pdf/lpd/LPD_09_Full.pdf

Scottish Environment Protection Agency. 2015.4. *Flood Risk Management Strategy – Tay.*
Stirling.
http://apps.sepa.org.uk/FRMStrategies/pdf/lpd/LPD_08_Full.pdf

Scottish Environment Protection Agency. *2015.*5 *The River Basin Management Plan for the Scotland River Basin District 2015–2020 Summary.* Stirling. (URL to be confirmed)

Scottish Government. 2003. *The Land Reform Act.* Edinburgh.
http://www.legislation.gov.uk/asp/2003/2/contents

Scottish Government. 2004. *Scotland's Biodiversity: It's in Your Hands. A strategy for the conservation and enhancement of biodiversity in Scotland. Edinburgh.*
http://www.gov.scot/Publications/2004/05/19366/37239

Scottish Government. 2009. *Climate Change (Scotland) Act.* Edinburgh.
http://www.legislation.gov.uk/asp/2009/12/contents

Scottish Government.2009.1 *Flood Risk Management (Scotland) Act.* Edinburgh.
http://www.legislation.gov.uk/asp/2009/6/pdfs/asp_20090006_en.pdf

Scottish Government. 2010. *Low Carbon Scotland: Meeting the Emissions Reduction Targets 2010-2022 (RPP1).*
http://www.gov.scot/Publications/2011/03/21114235/0

Scottish Government. 2011.2 *Delivering Sustainable Flood Risk Management.* Edinburgh.
http://www.gov.scot/Resource/Doc/351427/0117868.pdf

Scottish Government. 2011. *Getting the best from our land, Scottish Land Use Strategy.*
Edinburgh.
http://www.gov.scot/Publications/2011/03/17091927/0

Scottish Government. 2011.1 *Report on Proposals and Policies (RPP2).* Edinburgh
http://www.gov.scot/Publications/2013/06/6387

Scottish Government. 2013. *2020 Challenge for Scotland's Biodiversity – A Strategy for the conservation and enhancement of biodiversity in Scotland.* Edinburgh.
http://www.gov.scot/Publications/2013/06/5538

Scottish Government. 2014. *Ambition, Opportunity, Place – Scotland's Third National Planning Framework.* Edinburgh.
http://www.gov.scot/Resource/0045/00453683.pdf

Scottish Government. 2014.1 *Scottish Planning Policy 2014;* Edinburgh.
http://www.gov.scot/Resource/0045/00453827.pdf

Scottish Government.2015. *Scottish Rural Development Programme 2014-2020.* Edinburgh. http://www.gov.scot/Topics/farmingrural/SRDP

Scottish Government. 2016 *Getting the best from our land a Land Use Strategy for Scotland 2016-2021.*Edinburgh.
http://www.gov.scot/Resource/0049/00497086.pdf

Scottish Natural Heritage and Historic Scotland. 2006. *Guidance on Local Landscape Designations.* Perth.
http://www.snh.org.uk/pdfs/publications/heritagemanagement/GuidanceonLocalLandscapeDesignations.pdf

Scottish Natural Heritage. 2010. *Sustaining Nature's Services. Adopting an Ecosystem Approach.* Inverness
http://www.snh.gov.uk/docs/C334569.pdf

Scottish Natural Heritage. 2011. *An Essential Guide to Habitat Networks.* Inverness.
http://www.snh.gov.uk/land-and-sea/managing-the-land/spatial-ecology/

Scottish Natural Heritage. 2014. *Scotland's National Peatland Plan,* Inverness.
http://www.snh.gov.uk/docs/A1697542.pdf

Scottish Natural Heritage. TNS. 2014.1 *Scotland's People and Nature Survey 2013/14.* Commissioned Report No. 679. Inverness.
http://www.snh.gov.uk/docs/A1471713.pdf

The Southern Uplands Partnership. http://www.sup.org.uk/index.asp

Stevenson RL. 1895. *To S R Crockett* in *Songs of Travel.* Included in the *Collected Poems of Robert Louis Stevenson* (Edinburgh University Press, 2003)
http://www.scottishpoetrylibrary.org.uk/poetry/poems/s-r-crockett

Stirling and Clackmannanshire Council. 2014. *Forest and Woodland Strategy. Supplementary Guidance.* Stirling.
http://www.stirling.gov.uk/__documents/temporary-uploads/economy,-planning-_and_-regulation/sg-august-2014/sg30-forestry-and-woodland-strategy-august-2014.pdf

Stirling Council. 2014. *Supplementary Guidance SG27–Protecting Special Landscapes.* Stirling.
http://www.stirling.gov.uk/__documents/temporary-uploads/economy,-planning-_and_-regulation/approved-ldp/sg-teith-house-jan-2015/sg27-protecting-special-landscapes_feb-2015-red-1.pdf

Stirling Council. 2014.1 *Local Development Plan 2014.* Stirling.
http://my.stirling.gov.uk/services/housing/planning-and-building-standards/local-and-statutory-development-plans/local-development-plan

Stirling Council. 2014.2 *Stirling Council's Biodiversity Duty Report 2014.* Stirling.
http://www.stirling.gov.uk/__documents/stirling-council-biodiversity-duty-report.pdf

Stirling Council. 2015. *Stirling Landscape Sensitivity and Capacity Study for Wind Energy Developments. Update January 2015.(horner + maclennan).* Stirling.
http://www.stirling.gov.uk/__documents/planning-and-the-environment/approved-ldp/wind-energy-developments/landscape-capacity-study/stirling-capacity-for-windfarms-2015-text.pdf

Stirling Council. 2016. *Supplementary Guidance SG33 – Wind Energy Development.* Stirling.
http://www.stirling.gov.uk/__documents/temporary-uploads/economy,-planning-_and_-regulation/approved-ldp/sg-teith-house-jan-2015/sg33-windenergydevelopments-feb2016.pdf

Stott, Louis. 1994. New Light on Stevenson. *Forth Naturalist and Historian*, **17**: 70-75.

Tayside Biodiversity Partnership. 2015. *Tayside Local Biodiversity Action Plan (2nd Edition)(in preparation).* Perth
http://www.taysidebiodiversity.co.uk/action-plan/action-plan-new-lbap-2015/

Tilhill Forestry. 2015. *Latest Woodland Design Thinking Shapes Planting Of More Than A Million Trees In Menstrie Glen, Scotland.* Online.

http://www.tilhill.com/tilhill-forestry-news/news-article-985.php
Tweed Forum http://www.tweedforum.org/

UK Government. 2015. Statement by Secretary of State Amber Rudd on ending new subsidies for onshore wind.
https://www.gov.uk/government/speeches/ending-new-subsidies-for-onshore-wind

United Nations. 1993. *Convention on Biological Diversity.* New York.
https://www.cbd.int/sp/

Woodland Trust Scotland. 2015. *Glen Devon Woodlands.* (leaflet) Perth.
https://www.woodlandtrust.org.uk/visiting-woods/wood/5476/glen-quey/

Woodland Trust Scotland. 2015. *Glen Devon – Recreation.* (leaflet) Perth
https://www.woodlandtrust.org.uk/visiting-woods/things-to-do/walking/

World Wide Fund for Nature (WWF). Undated. *The River Devon Project "Slowing the Flow", (Leaflet)* Aberfeldy.
http://www.wwf.org.uk/filelibrary/pdf/slowingflow_web.pdf

World Wide Fund for Nature (WWF). Undated. *Flood Planner. A Manual for the Natural Management of River Floods.* Dunkeld.
http://assets.wwf.org.uk/downloads/floodplanner_web.pdf?_ga=1.155480059.1368200443.1455699796

ORCHARDS OF THE FORTH VALLEY: A PROGRAMME FOR REVIVAL

Dr. Crispin W. Hayes and Diane Alerdice

Introduction

"Even if I knew that tomorrow the world would go to pieces, I would still plant my apple tree", Martin Luther.

This paper gives a concise history of the planting of apple and other orchard trees in the Forth Valley by those who might have shared Martin Luther's sentiments, from monastic times to the present. It describes the role of Stirling-based environmental charity, Forth Environment Link (FEL), in facilitating survey work, feasibility studies, training, outreach and funding programmes, all to further the aim of reviving the orchards of the Forth Valley

Background: the germ of an idea

Forth Valley Food Links (FVFL, which merged with FEL in 2008) had a mission to promote *"Local food for local people"* (FVFL 2002). It recognised as far back as 2004, that Forth Valley's heritage of orchards could offer an opportunity to contribute to this end. At that time, the Scottish Executive was beginning to encourage Public Sector agencies to increase the supply of local produce into catering and food service contracts – including Free Fruit in Schools (Scottish Executive 2003) and the healthy vending programme (Scottish Executive 2002), so FVFL embarked on discussions on the feasibility of using and enhancing Forth Valley's collective orchard resource to supply whole fruit and fruit juice for healthy vending machines in schools.

Firstly it considered the supply of whole table fruit. However as a later report confirmed, the Forth Valley does not have the terrain, soil or climate to make production economically viable. *The Economic Potential of Forth Valley's Orchard Resource* (Tourism and Environment Consultancy in association with Talk Associates 2012), reported that the Forth Valley typically has 150-200 fewer hours of sunlight, higher rainfall, especially in the west of the area, over the growing season than the main fruit growing areas of England. The carselands around Stirling, Falkirk and Clackmannanshire have more potential, as evidenced by the historic growing of orchards there, though the wet, poorly drained soils here are also another limiting factor.

Secondly, the feasibility of using the existing crop for juicing was explored in the context of a healthy option for the school dinner hall. However, the regulatory hurdles made this hard to implement. According to interpretation of the regulations (Scottish Executive 2002. Section 3), only one whole portion of fruit could be offered with a meal. A decision was therefore taken not to

pursue the project further, though the desire to tackle the issue of Forth Valley's orchard degeneration never lay dormant.

Surveying the scene

In the early years of the millennium, interest was also growing elsewhere in Scotland. Orchard surveys were carried out in the Clyde Valley (Ironside & Farrar 2004), in Newburgh, Fife (Hayes 2004) and the Carse of Gowrie (Hayes 2007). Inspired by the workshops held by the Historic Orchard Forum on the Carse of Gowrie, FEL gained funding from Forth Valley & Lomond LEADER Programme to map the number and extent of orchards, and establish the current and potential contribution of orchards to the economic, and natural heritage value for communities in Forth Valley.

Three pieces of research were commissioned for a programme of landowner and community engagement to identify the location of orchards and fruit trees, and raise awareness about future orchard development possibilities.

Greenmapping

Clackmannanshire-based *Action for Change* held a series of participative 'Greenmapping' workshops in communities around Forth Valley. Each workshop yielded contacts for, and information on the location of 50 orchards and trees to be added to the orchard database. A full report is available (Action for Change 2009).

School Orchards

The mapping of the existence of fruit trees and orchards in nursery, primary and high schools of Forth Valley was undertaken by Mrs Margaret Miller, retired Head Teacher of Gartmore Primary School, and founder of the Gartmore Pomologists. Margaret has an indirect family connection to James Grieve, the former manager of Dickson's Nursery, Edinburgh after whom the dual-purpose and well kent apple was named in 1893. Thirty-four schools were surveyed. It found (Miller 2010) varying levels of management of the trees within the schools, depending on the resources given to maintenance, and the value of the resource for the curriculum. With the exception of nurseries, it was interesting to find that the trees had not been used for a resource beyond eating the crop. Nurseries had used their orchards to show the changing of the seasons, and had used the crop in enterprising ways, such as, for example, Newton Nursery in Dunblane making plum stone instruments.

Orchard Survey

The third piece of research was the commissioning of an orchard survey of the Forth Valley from the first author of this paper. The brief was to find and record fifty of the most significant orchards in the Falkirk, Clackmannanshire and Stirlingshire region. The outcome of the survey (Hayes 2010) is summarised in the following four sections, and in the report is couched in the context of the history of Forth Valley's orchards from monastic times to the present.

The Early History of Orchard and Monastic Connections

The establishment of orchards in the Forth Valley, as in much of Scotland , was closely related to the establishment of abbeys and other religious houses (Hayes 2008). The religious houses were places of 'knowledge transfer' and acted to introduce new cultural traits. One of these was pomoculture, the culture and techniques of growing orchard fruit.

In the Forth Valley, Cambuskenneth Abbey appears to have been the primary centre. The Abbey is located on a loop of the River Forth, just north of the river from, but adjacent to, Stirling. Cambuskenneth Abbey was established in 1147 by King David, and was subsequently an Augustine Order (anon 1872). Along the River Forth, other nearby religious houses existed: Culross Abbey (Fife), Inchcolm Abbey on Inchcolm Island, and the Isle of May Priory. There also appears to have been a strong connection with Holyrood Abbey; it held lands in the Falkirk area.

In an article in a 1913 edition of the *Stirling Journal*, there was some discussion of the history of orchards at Cambuskenneth Abbey (Chapman 1913) and indeed the history of orchards in general. There are specific historical instances cited, for example: *"In Instrument of Sasine in favour of Sir John Erskine, dated 2nd November 1696, the lands of Cambuskenneth are described as including gardens and orchards."* However, later in the piece, it is stated that *"In 1709, when Cambuskenneth was conveyed there was no mention of gardens or orchards . . ."* This perhaps merely highlights the inconsistency of the historical record. It may also indicate the relatively low importance attributed to orchards at that time.

The *Stirling Journal* article also mentions the current existence (in 1913) of the Brig Orchard beside the old bridge in Stirling. It is mentioned in the context of a reported dispute about rights to fruit in 1520, indicating that the Brig Orchard may have existed for at least 400 years.

Apart from the early references to orchards at Stirling and Cambuskenneth, there are also reports of orchards on the carselands of the Forth. Reid (1993) cites older sources in stating that *"Orchardland at Halls of Airth is on record in 1489"* and *"The presence of orchards is recorded in place names on the carse such as Orchardhead [1526], Orchard of Bothkennar [1630] and Crawfords Orchard [1669]."* Sibbald (1707, 47-48) describes the property of Stonehouse in the Parish of Bothkennar *". .with a fine orchard of very good fruit trees belonging to it"*.

During the 1790s, the first *Statistical Account* (Sinclair (ed.) 1799) was created by the Ministers of the respective parishes. Within the region (pp. 135, 185) orchards seem not to have featured as a key part of parish life in the Forth Valley – at least as far as the Ministers were concerned. The only parishes to mention orchards were:

- Bothkennar. 12 orchards totalling 3 acres
- Airth. 9 orchards

The *General View of the Agriculture of Stirlingshire* (Graham, 1812) provides a number of useful insights in a chapter on orchards. It states that many sorts of orchard fruit are grown on account of the mildness of climate. It also asserts where orchards were chiefly to be found:

"It is well ascertained that, in ancient times, orchards were cultivated, on an extensive scale, in the carses of Bothkennar and Airth."

"Whilst the monks of Cambuskenneth had orchards in the rich plains of Bothkennar, which produced pears and rennets of France, ... These luxurious clergymen passed winter in the Abbey, whilst they spent the summer in Airth and Bothkennar, where the reliques of these orchards may still be traced. "

Some interesting observations regarding cultivation practices are made. An example of the revival of an old orchard at Westerton in Bothkennar Parish was carried out by the addition of dung and quicklime. The trees responded by new growth and giving large quantities of fruit. Another interesting practice was reported:

"To prevent the roots from shooting down perpendicular into the cold soil, to which the influence of the solar heat never reaches, and to direct the roots to seek their food in a horizontal direction, they placed large flags under every fruit tree. These flags are still to be found in all their orchards"

The author is somewhat effusive in his enthusiasm:

"Indeed, no soil seems to be more favourable for fruit trees than the Carses of Stirlingshire."

On pears, Graham states *"The pear tree particularly thrives in this soil. The 'golden knap', or 'gouden nap', as it is here called, seems peculiar to this part of Scotland. This trees bear astonishing crops. The produce of many single trees of this kind has been known to sell for ten guineas. It is equal in beauty to any fruit tree whatever; it is never known to canker"*

In contrast to this, a later report (Tait 1883) on Clackmannanshire has no mention of orchards and their produce. There is also no mention of apples, pears or plums in the Board of Trade Returns (1881) for these counties. In respect of the Grangemouth area, that adjoins Bothkennar parish, there is also little early evidence of orchards, despite lands in the area being owned by the Abbey of Holyrood. Rental lists (Porteous 1967) are detailed, even recording, for instance, *'2 wild geese'*, but no mention of orchards or their produce is made.

Later Evidence on Extent and Scale of Orchards

While we have seen that the larger and well known ancient orchards appear to have been restricted to the carselands of the Forth, it is likely that smaller non-commercial orchards were to be found throughout Stirlingshire and

Clackmannanshire; in private gardens, walled gardens and small farm orchards. These orchards are probably well characterised as being primarily for the use of the owner's household together with some local sales. As the Victorian era progressed, country seats were improved or built anew. The new works often included new walled gardens and elaborate facilities to grow exotic fruit. Perhaps a slightly competitive culture of fruit growing emerged between wealthy gentry – as they vied with one another to produce exotic status symbols. However, their interest and finance was not restricted to exotic fruit. The breeding of indigenous species was a focus of attention and fine private orchards were established or improved.

A report of the Exhibition of Agricultural Production at Stirling (anon 1833) demonstrates this renewed interest. From Dunmore Gardens came exhibits of 76 named varieties of apples, *"including the best and most approved new sorts"* and 38 best new varieties of pears. Local apple exhibits also came from Kennet and Alloa in Clackmannanshire, and in Stirlingshire from Corntoun, Buchanan, Coldoch and Stirling. Local pear exhibits came from Kennet, Westertown, Corntoun and Culross Abbey gardens.

The new *Statistical Account* (Parishes 1840) is a rich work and gives an valuable insight into life at that time. All the parishes within Stirling and Falkirk Districts, and Clackmannanshire have been consulted for information of relevance to this study. The Account gives the following details in regard to these parishes:

St Ninians (*ibid* p314)

" We have very little natural wood in this district and though there are numerous fruit trees scattered through the parish as well as in the gardens there is hardly in it any thing that deserves the name of an orchard "

Clackmannan (*ibid* p127)

"The reverend and venerable Thomas Boston of Ettrick whose memory and writings are embalmed in the hearts of so many of the Scottish people did in his youth officiate for a time at Kennet in the capacity of tutor. Under the shadow of a particular pear tree in the retired orchard, he was in the habit of engaging in those exercises and of enjoying that communion by which he might be fitted and prepared for working that work which his Heavenly Father might give him to do. By those individuals about the place who sympathised with the spirit which animated Boston, the pear tree was long viewed with a peculiar interest."

It is interesting to note the use of the term 'retired orchard'.

Polmont (*ibid* p194)

"An attempt has been made to introduce some of the varieties of the Canadian apple, viz. the Pomme grise and the fumeuse, by Mr Logan of Clarkstone, but not with much success, in consequence of our summers being generally too cold to bring the fruit to maturity."

Alloa (*ibid* p15)

Discussions regarding the fruit tree pest *Coccus,* and its remedy.

Bothkennar (*ibid* p202)

"Agriculture. In no part of Scotland is agriculture better understood or pursued with more eagerness and success than in this small parish."

"There are fourteen orchards in the parish and the first of them appear to have been planted by the monks of Cambuskenneth who understood gardening better than any other part of the community at the period in which they lived. The soil is particularly adapted to pear trees which bear more abundant crops than in any part of Great Britain. The golden nap which appears to be indigenous, grows with all the luxuriance of a forest tree and never cankers. Its value is so great that single trees have in some particular years brought from L 10 10s to L 12 12s and a single acre has in some years given L 100."

Airth (*ibid* p285)

"Produce: The average produce of grain of all kinds may be estimated at about 6 bolls per imperial acre. The culture of potatoes turnips cabbages &c in the fields is exceedingly limited. …. Produce of gardens and orchards is in general very abundant "

Logie (*ibid* p214-233)

Cambuskenneth is vaguely mentioned. Otherwise, no orchard or fruit produce mentioned in whole parish account. This must be a reflection of the author, for it is clear from other sources such as the OS 1st Edition map that many large orchards existed in the area: Tower Orchard, St James Orchard, Ferry Orchard, and Lady's Neuk Orchard at Cambuskenneth alone.

The first edition of the Ordnance Survey map (Ordnance Survey, various dates) was compiled from 1843 to 1882. It provides an excellent and detailed resource, including evidence for orchards, usually given as distinctive style of rows of deciduous trees. This period is generally seen as the zenith for larger orchards (Hayes 2008). Elsewhere in the literature, Mains of Bothkennar and Dunmore Park are mentioned in terms of apple breeding and David Trotter of Alva reports on peaches and nectarines being grown on heated walls (Robertson, 2008). The latter practice became quite widespread across Scotland.

Survey of Contemporary Situation

A field survey was carried out in the autumn of 2009. During the survey, visits were made to 45 sites and a further 21 sites were assessed but not visited. A full report is available (Hayes 2010), from which this material is drawn.

The survey found that 25 sites have an orchard to some extent:

- 27 orchards have apple trees
- 15 orchards have pear trees
- 26 orchards have plum trees

- 7 orchards have fruit trees of other species; such as greengage or cherry

Where appropriate, the orchard keeper was asked if the fruit from the orchard was used. Of the respondents:

- 2 orchard keepers said they used 'a lot' of their fruit.
- 8 orchard keepers said they used 'some' of their fruit.
- 4 orchard keepers said they used none of their fruit.

These figures give some indication of the level of engagement and enthusiasm of the orchard keepers surveyed.

The Best Remaining Orchards

To provide a focus on the orchards with the finest remains, the visited orchards were further scored. The criteria for the best remaining orchards were:

- size & age of orchard
- number of mature trees remaining
- historical significance
- pomological significance – unusual varieties or forms of growth

Condition of orchard or trees was excluded as a criterion, as were biodiversity indicators.

There were 9 orchards considered as '5 star', and a further 3 orchards considered '4 star'.

A selected number of the best remaining orchards are described below.

Ferry Orchard, Cambuskenneth

The orchards of Cambuskenneth are deservedly well known – especially given the apparent role of the Abbey in developing pomoculture in the area. There were formerly four orchards of Cambuskenneth; Tower Orchard, St James Orchard, Ferry Orchard, and Ladysneuk Orchard, the last around 0.5 km north of the village. Today only part of one of those orchards remains, and that is Ferry Orchard.

The relevant part of the OS 1st Edition map is shown below. It is annotated with the orchard names. Tower Orchard is now grazing with a small area of recently planted fruit trees. St James Orchards is a small housing estate. Ladyneuk Orchard is now grazing. The eastern half of Ferry Orchard is now housing. Only the part of the orchard demarcated by the heavy dashed box remains as traditional orchard. This is now the private garden orchard of Ferry Orchard House.

Ferry Orchard House dates from 1746. Ferry Orchard originally extended some seven acres. It is now much diminished to something like a quarter of that

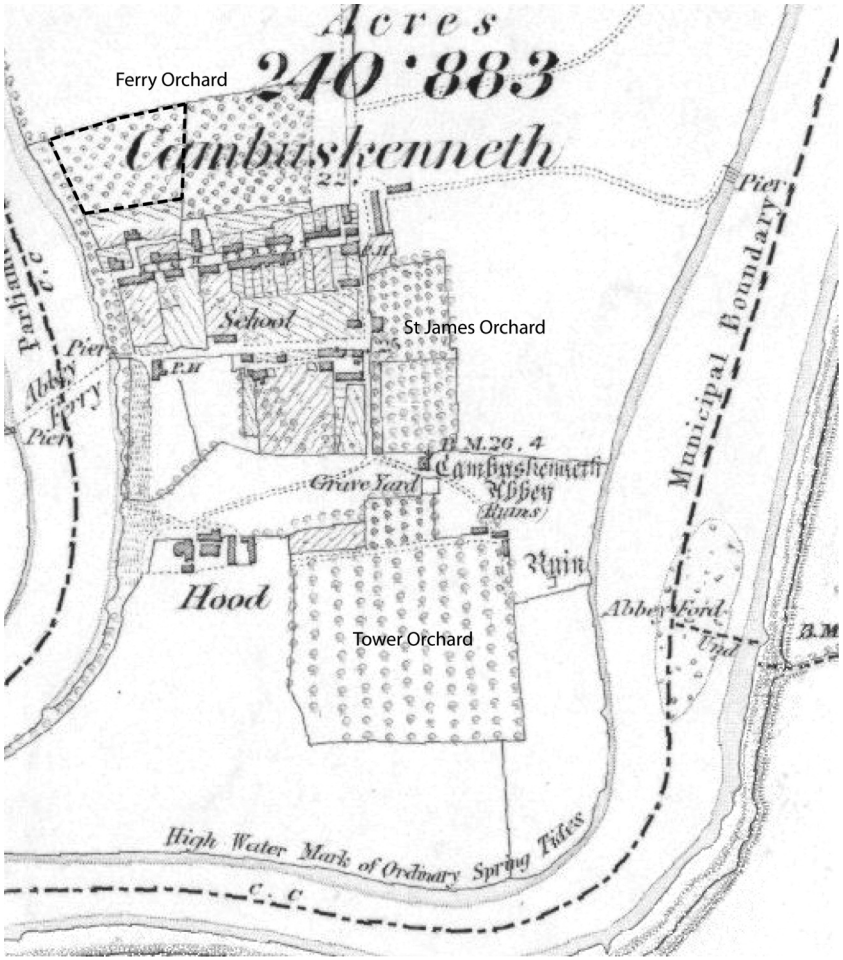


Figure 1. Map showing the orchards of Cambuskenneth in the later 19th century (Map source note: Author's surveyed, non-derived boundaries on a base map of the OS 1st Edition Map of the 1860s (out of copyright)).

size. Cambuskenneth was an 'artist's colony' with local anecdotal evidence that artist William Kennedy, one of the 'Glasgow Boys', painted and was painted in Ferry Orchard. The orchard is situated on a flat field set back from the bank of the river Forth. When the current owner came in 1957, the orchard was very overgrown - " a jungle". The orchard had been tenanted before they bought it. Formerly there were also gooseberries, strawberries, raspberries, red and black currants growing in the understorey, a common practice in orchards. Cambuskenneth itself was famous for its berry or 'Groset Fair' that came when the gooseberries were ripe.

Figure 2. A view of Ferry Orchard in 2009.

Howkerse, Bothkennar

There are two substantial orchards at Howkerse Farm, which is situated just north of Skinflats. The property has been tenanted to the same family for several generations, by the same owners. The owner takes an active interest in the orchards. They are shown in Figure 3, together with the neighbouring Teindsyard orchard.

The North Orchard is a fine old pear orchard. The orchard is on flat, heavy carseland and is somewhat wet underfoot. With the exception of the central section, which is fenced off, the orchard is grazed by cattle. It contains 26 old pear trees up to an estimated age of 200 years, and three apple trees of a century or so in age. The new central section has 25 young pear trees, grafts of the older unusual varieties, carried out in 1992 by John Geddes of Central Scotland Countryside Trust, and the young trees were grown on for a year at Lanark prior to being planted out. The work was grant aided, an excellent example of orchard replenishment.

Orchards at Drumdruills Farm

There are two orchards at Drumdruills Farm, on the Glen Road, the ancient route between Bridge of Allan and Dunblane. To the south-west of the farm steading and beside it, is the West Orchard. Several hundred metres to the east, and to the east of the Glen Road, is the East Orchard. The OS 1st Edition (Figure

Figure 3. Map showing Howkerse and Teindsyard Orchards in the later 19th century (Map source note: Author's surveyed, non-derived boundaries on a base map of the OS 1st Edition Map of the 1860s (out of copyright)).

5) shows neither of these orchards in existence in the 1860s. The 3rd Edition map of 1912 shows that the West Orchard appears to be in existence, but not the East Orchard. Approximate boundaries for the orchards as they exist today are shown on the map above.

Drumdruills was in the ownership of the Bishops of Dunblane from 1442 to 1690. Local amateur historian and descendant of former owner, Robert Scott, states (Gordon 2010):

'So for at least 250 years life at Drumdruills, its tenants, and productivity were dictated by the Bishop from his splendid palace in Dunblane. It is the writer's belief that it was during this "reign" that Drumdruills was first planted as an orchard - the distant and

Figure 4. Howkerse Orchard in 2009.

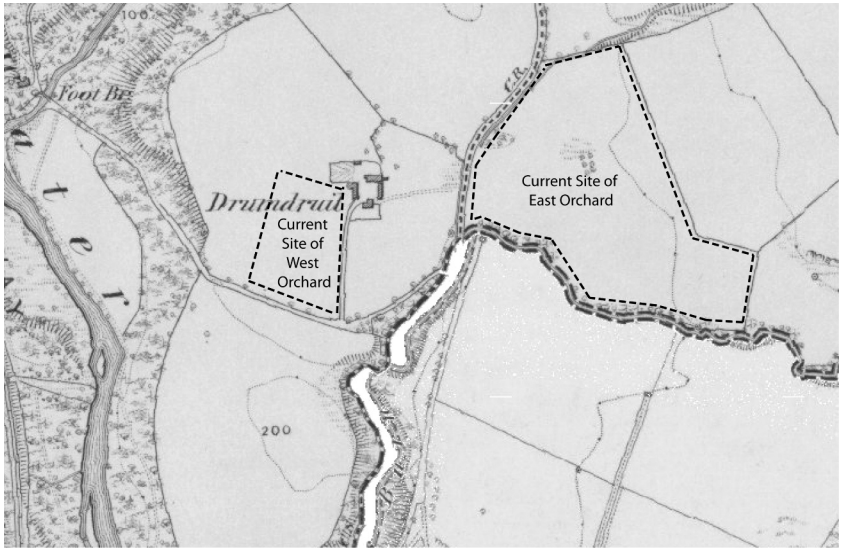


Figure 5. Map showing the orchards of Drumdruills in the later 19th century (Map source note: Author's surveyed, non-derived boundaries on a base map of the OS 1st Edition Map of the 1860s (out of copyright)).

long since forgotten predecessor to the Scott Orchard of 1892! There is documentary proof that this orchard survived up until the early 18th century, indeed in 1723 Sir James Campbell's son and brother jointly urged him to purchase the property of 'Drumdroulls' on the ground that it had: "One of the best fruit orchards in the shire, both as to kinds and quantities, and also contained a lime quarry of as good lime as ever they had seen." '

In 1894 and subsequently, orchards were planted by Robert Scott of Carluke, who was a jam manufacturer. He bought the property in 1892. He also had Kennetpans Orchard (discussed in Hayes 2010), and the now extirpated Cornton orchard. Prior to Scott there appears to have been an intermission when orchards did not exist at Drumdruills, or were very small. It is likely that the trees that remain today were predominantly planted by Scott. Both orchards are currently in state of naturalisation, with undergrowth that is thick in parts. However they both still contain large number of trees – predominantly plum, though the fruit is not much used.

The Orchard Initiative takes root

Together with Margaret Miller's report on school orchards, the orchard survey report and its recommendations represented a major step forward in developing an evidence base for future action on orchards in our area.

Using the researched evidence, FEL received two rounds of funding from the Central Scotland Green Network (CSGN) Development Fund between 2011 and 2015, for a programme of works to develop the Forth Valley Orchards' Initiative (FVOI). FVOI was a 6-year programme (2009-2015) whose vision is to, *"Increase orchards in the landscape that contribute to the economy and that are used, maintained and loved by the community throughout the year"* (FEL, 2012).

The FVOI delivered five projects with this funding:

- CSGN Orchard Grant Scheme - to facilitate orchard expansion
- Economic Development - supporting the ability of landowners and businesses to develop orchard-related enterprise
- Network development - encouraging the sharing of skills, knowledge and experiences of individuals and groups within Forth Valley, and the wider CSGN area.
- Targeted Capacity-building - delivering formal and informal training and workshops to build up an orchard management expertise for sustaining the initiative in the longer-term
- Orchard Promotion & Engagement - involving people in orchards through events and activities that inspire and enthuse

The Orchard Initiative bears fruit

One of the most significant and successful mechanisms for achieving an expansion of orchards has been the CSGN Orchard Grant Scheme, for

landowners and communities to plant and maintain fruit and nut trees. The grant scheme covers all 19 Unitary Authority areas of the CSGN area, except the Loch Lomond & Trossachs National Park area and north-east Fife, these areas being subject to separate funding regimes. Since 2010 the scheme has disbursed £40,000 to 161 applicants across central Scotland. In total, more that 2000 fruit trees have been planted as a result.

In Forth Valley, there have been 22 orchards planted in schools, seven on private land, and 18 community orchards on public land. Training events in particular have become very popular, especially in Stirling. By 2014, there were five new community orchards in and around the city: Cornton; Gowan Hill (Top of the Town); Torbrex Community Orchard (Beechwood Park); Kings Park Community Orchard, and Riverside Community Orchard, and possibly two others in 2014. Residents have great pride in them, one resident commenting on completing the Riverside Community Orchard in March 2012, that the orchard was Riverside Community Council's greatest ever achievement (Graham 2012). The majority of species planted has been apples, followed by pear, plum and cherry. But other species were planted too, including bullace, chestnut, crab apple, damson, greengage, hazelnut, medlar, mulberry, quince and walnut. It is significant that grant applicants think of orchards more as collections of fruit than nut trees.

Orchard-related Business

In fulfilment of the priority to encourage the growth of the orchard economy, FEL commissioned two studies which interviewed over 50 key players in the orchard market place, *The Economic Potential of Forth Valley's Orchard Resource* (Tourism and Environment Consultancy 2012) and *The Future of Forth Valley Orchards* (SKS Scotland CIC 2013).

Both studies reached similar conclusions, advising against focusing on traditional orchards, as these did not produce much fruit. They stated that newer plantings in older orchards would also not be very productive either, modern, more efficient production methods being required. Their opinion was that there would be limited viability in developing orchards for large commercial gain, once labour costs were considered, large orchard growers, who have themselves invested in their businesses without external support, saw orchards and other added value products from the orchards as a form of diversification within larger food-related business.

In 2013, two businesses were supported by the CSGN Orchards Futures Fund, both being excellent examples of sustainable local food chains, having their respective production, processing, retailing, and waste management processing all within a radius of less than a mile of each other. Knockraich Farm Orchards, by Fintry, received funding to install juicing and bottling equipment for supplying its own farm shop, local and multiple retailers with juice from its

700 trees, and also offer a 'single variety' juicing service for other tree owners. Fordhead Farm Orchard, by Kippen Station, received a grant to plant a new orchard of 200 trees in winter 2014, with view to working with neighbour, Fallen Brewery, to produce cider.

Long term outcomes

To provide a legacy and sustain the actions for orchards in the longer term, great emphasis has been placed on skill development, knowledge acquisition and networking. The main elements of this have been:

- A programme of free, public Forth Valley Orchard Workshops, which were hugely popular.
- An orchard photography workshop. Local orchard owners kindly allowed the use of their orchards as training venues, with surprises such as the discovery of Mistletoe (*Viscum album*), rare in Scotland, in an old orchard in Blairlogie.
- *Certificate in Orchard Care & Maintenance*, a highly successful course run with Elmwood College, Cupar in 2012.
- School's Orchard Project, including a grant to support for their practical outdoor and class-based orchard programme, and Continuing Professional Development sessions for their staff. 11 schools have taken up this offer.
- *'How to manage your orchard'* leaflet,
- '*School Orchard Teachers' Pack*' and resource boxes for loan to schools and community groups are available.
- Annual networking conference for participating schools

Finally, we have also been contributing to our national orchard revival. In September 2014, FEL ran workshops for training volunteers in field survey of orchards in collaboration with a larger SNH-funded project to create a *National Orchard Inventory for Scotland*. The latter project will need up to 350 volunteers in order to achieve national coverage of what will be a landmark survey.

Propagating Success – Thoughts about the future

To conclude, we are now able to recognise the rich cultural heritage that Forth Valley enjoys in terms of its orchards. From the monastic introduction to this important contemporary initiative aimed at revival. The Orchard Initiative has achieved much: a renewed passion for orchards has been ignited, many new orchards created, old ones enhanced, the cultural heritage identified, new skills and knowledge learned, and economic developments set in motion. Mechanisms are being put in place to continue the most successful elements of the Initiative, in particular, skills development and orchard creation and management, whilst ensuring continuing stakeholder engagement and wider networking (see www.orchardrevival.org.uk/network). Only in working together with our collective strengths and capacities can we continue to reap the fruits of this rich history in Forth Valley, and honour our orchard heritage.

References

Acta Dominorum Auditorium, i, p137 cited in Reid, J. 1993. The Carselands of the Firth of Forth. *Calatria*, **4** (Spring): 1-31.

Action for Change 2009. *Report on Mapping Workshop*. December 2009.

anon. 1833. *Report on the Exhibition of Agricultural Production at Stirling From November 16th 1832 till 16 March 1833*. W Drummond & Sons, Nursery & Seedsmen, Stirling: 76-77. PD155/1

anon. 1872. *The Cartulary of Cambuskenneth*. Grampian Club, Edinburgh.

Chapman, M. 1913. The Early History of Apple, Pear and Plum. *Stirling Journal*, 20th February 1913: 9.

Forth Environment Link. 2012. *FVO 2012 – 2015 workplan outcomes - FINAL.*

Forth Valley Food Links. 2003. *FVFL Strategic* Objectives. 2003.

Gordon, Peter. 2010. *Personal communications via email with Crispin W Hayes. January 2010*. (Peter is grandson of Robert Scott)

Graham, P. 1812. *General View of the Agriculture of Stirlingshire*. Board of Agriculture and Internal Improvement,

Graham. 2012. *Personal communications via email with Diane Alderdice. March 2012.*

Hayes, CW. 2004. *Taking Stock: Newburgh's Orchard Heritage. Report on a Mapping and Stock Survey of Orchard Trees in Newburgh in 2003*. Report to Newburgh Orchard Group. Available www.crispinwhayes.com/projects

Hayes, CW. 2007. *Historic Orchards of the Carse of Gowrie. Phase 1 Survey: An Investigative Study on their Location, Extent and Condition*. Report to Perth and Kinross Countryside Trust. Available www.crispinwhayes.com/projects,

Hayes, CW. 2008. Ancient Orchards on the Banks of the River Tay. *Landscape Archaeology and Ecology*, **7:** 63-75.

Hayes, CW. 2010. *Survey of Traditional Orchards in the Forth Valley 2009*. Report to Forth Environment Link. Available www.crispinwhayes.com/projects.

Ironside Farrar. 2004. *A Clyde Valley orchards survey. Scottish Natural Heritage Commissioned Report No.023 (ROAME No. F02LI21)*.

Miller, M. 2010. *FVORI Schools' Report – Final*.

National Orchard Inventory for Scotland. http://www.scotlandthefruit.org.uk

Ordnance Survey 1843-1882. *Six Inch 1st Edition Scotland*.

Parishes, The Ministers of. 1845. *The New Statistical Account of Scotland. Dunbarton, Stirling and Clackmannan*. Society for the Benefit of the Sons and Daughters of the Clergy,

Porteous, R. 1967. *Grangemouth's Ancient History*. Burgh of Grangemouth.

Robertson, FW. 2008. Orchards, Fruits and Gardens of Early Nineteenth-Century Scotland. *Review of Scottish Culture*, 20: 45-56.

Scottish Executive. 2002. *Hungry for Success: A Whole School Approach to School Meals in Scotland.* http://www.scotland.gov.uk/Publications/2003/02/16273/17566

Scottish Executive. 2003. *Free Fruit in Schools Initiative, 2003-2006*, http://www.scotland.gov.uk/Resource/Doc/1038/0004051.pdf

Sibbald, R. 1707. *History and Description of Stirling-shire*.

Sinclair, SJ. (Ed.) 1799. *The Statistical Account of Scotland 1791-1799. Vol IX. Dunbartonshire, Stirlingshire, Clackmannanshire.*

SKS Scotland CIC. 2013. *The Future of Forth Valley Orchards.* Report to Forth Environment Link.

Tait, J. 1883. The Agriculture of the Counties of Clackmannan and Kinross. In *Transactions of the Highland and Agricultural Society of Scotland.* 4th Series, Vol. XV: 50-64.

Tourism and Environment Consultancy in association with Talk Associates. 2012. *The Economic Potential of Forth Valley's Orchard Resource.* Final Report to Forth Environment Link.

Table 1: The Best Remaining Orchards in 2009

Location ID	Orchard	Location	Area	Star Rating
FV057	Blairlogie Lower Orchard	Blairlogie	Stirling	5
FV058	Blairlogie Upper Orchard	Blairlogie	Stirling	5
FV019	Bowtrees	by Airth	Stirling	5
FV001	East Orchard at Drumdruills Farm	Bridge of Allan	Stirling	5
FV002	West Orchard of Drumdruills Farm	Bridge of Allan	Stirling	5
FV007	Ferry Orchard	Ferry Orchard House	Stirling	5
FV014	Howkerse	Bothkennar	Falkirk	5
FV013	Teindsyard	by Skinflats	Falkirk	5
FV052	Kennetpans Orchard	Kennetpans	Clackmannanshire	5
FV043	The Pineapple at Dunmore Estate	Airth	Falkirk	4
FV047	Wester Spittalton	by Thornhill	Stirlingshire	4
FV056	Harvieston House Walled Garden	Harvieston	Clackmannanshire	4
FV053	3 Alexandra Drive	Alloa	Clackmannanshire	3
FV054	Cambus Orchard	Cambus	Clackmannanshire	3
FV028	Cardross House	Port of Mentieth	Stirling	3
FV049	Parks of Garden	Kippen	Stirling	3
FV033	The Roman Camp Hotel	Callendar	Stirling	3
FV034	Touch House	Touch Estate	Stirling	3

Report of the *Forth Naturalist and Historian* Man and the Landscape Conference Saturday November 14th 2015

THE MOUNTAINS OF CENTRAL SCOTLAND PAST, PRESENT AND FUTURE

Our region's mountains provide dramatic scenery rising from the lowlands, are havens for wildlife and rare plant communities and have sheltered and served as homes to people for millennia. They are constantly changing, adapting to new demands as visitors have flocked to them, and will continue to change into the 21st century. This conference sought to celebrate our mountains and uplands, presenting overviews and new research on our natural environment and its conservation, and the emergence of a lived landscape.

David Anderson (Forestry Commission, Aberfoyle) is the conservation manager for Cowal & Trossachs Forest District, roughly 80,000 hectares, of which >40 % of this is open, mainly montane habitats. His role as Conservation Manager allowed many insights into the management of montane habitats. David argued that our largely treeless uplands are now degraded from centuries of over-grazing from both sheep and deer, and muirburn taken to excesses. The landscape is depleted of small herbivores, with mountain hare, filed vole, stoat and weasel populations in significant decline over at least the last 30 years. Wild cat populations have suffered from disease spread by feral, once domestic animals. In Cowal and the Trossachs, native woodland planting has coincided with the removal of sheep and the culling of deer (4000 a year) in a 199-year management plan which has seen, among other trends, increases in the numbers of black grouse, from 12 to 80 males, and in pine marten, now very common from being absent in the 1980s.

This improvement has had little effect on predators like the peregrine falcon, and numbers remain in significant decline, but populations of hen harriers and golden eagles have increased. The monitoring of nests by remote-controlled cameras has shown the range of prey caught by eagles, including grows, foxes, badgers and gannets (!), but this wide variety introduces threats also in the passing up the food chain of environmental pollutants. Winter food 'dumps' of culled deer, shot with lead-free bullets, have done much to maintain populations of top predators.

John Calladine is Senior Research Ecologist with the British Trust for Ornithology. His recent research has included work on the Ochil Hills above Stirling and recent changes there in populations of whinchat. These small birds have been declining in their ranges (40 % in the last *c.*40 years) and abundance, by 55 %, contracting in lowland areas. Upland Scotland still has strong populations, and they thrive in open, semi-natural habitats like moorland and sheep pasture, as in the Ochils, where mosaics of grasses, tall herbs and plants

like bracken occur. Future management for whinchats might include reductions in trends such as the monotonous spread of plants like bracken. We might mimic the dynamics of former land uses. Whinchats have also benefitted from the establishment in recent decades of new native woodlands, or rather as these are now, still small and open-canopy, offering a niche for nesting, perching and singing. Monitoring in the Ochils has demonstrated that as tall shrubs and trees reclaim the higher ground, with reduced grazing pressure, whinchats follow them up. They are increasingly rare, however, in montane habitats above 300 m above sea level.

Helen Cole discussed what the National Trust for Scotland has undertaken with regard to protection and conservation of the internationally rare arctic-alpine plant communities on the base-rich metamorphic rocks of their Ben Lawers estate. Once a zoologist and a neuro-biologist, Helen discovered Scotland in her first post as ranger for the NTS at Brodick Country Park and Goatfell on Arran, reaching Ben Lawers as full time Ranger Naturalist in 1991, latterly as property Manager/Senior Ranger/Naturalist. Ben Lawers contains 16 nationally rare plant species, including alpine fleabane, alpine forget-me-not and alpine gentian. Habitats such as alpine calcareous grassland are of major importance and the site is also renowned, for lichens and bryophytes. The numbers of surviving plants are carefully monitored, working from a baseline survey in -1981. By the 1990's Highland saxifrage was represented by only one plant: it has been rescued now. The numbers of alpine fleabane are, for example, stable whilst other species are in decline, some as a consequence of grazing. Both red and roe deer are found on the hills, and sheep populations. Habitat restoration of the very small population of high-altitude willow species has resulted in fenced exclosures to remove grazing pressures, and the planting of willow stock grown from local seed in our nursery Colonies now thrive and their establishment has led to a rapid expansion of invertebrate and bird populations. More recently work has begun on restoring degrading peat bogs by re-profiling existing hags and stabilising with local heather brash. The work continues.

After lunch our attention turned to the impacts of people on our hills in the past, present and future. **John Atkinson**, Managing Director of GUARD Archaeology, led a few years ago a detailed campaign of archaeological survey and excavation with the NTS on their Ben Lawers estate, the Ben Lawers Historic Landscape Project. Though the focus was on medieval and post-medieval landscapes, it is characteristic of upland landscapes that evidence for prehistoric activity often lay just under historic period sites. In total, John's team excavated a total of 15 sites in three years. At altitudes above the head-dykes of 'traditional' medieval 'fermetouns' lie several turf-built square-shaped houses dated to the 12th and 14th centuries AD which may well have been occupied all-year-round. The site called T16 is typical of these, but here a large, possibly permanent house was overlain by two later shielings. This represents a pattern across the hillside where upland settlement changed, perhaps in the 15th century, from permanent to seasonal. Some huts suggested to be shielings

nevertheless represent substantial investments, while others are much more poorly constructed. Lordly residences of the 13th-14th centuries lie by the shore of Loch Tay at its head and exit. Taymouth Castle grew from in the 15th and 16th centuries from one of these. In the late 19th century, the landscape changed once more with the issuing of long leases for new single-tenancy farms above the old 'fermetouns'. One with late 17th century origins was Balnasuim whereas Kiltyrie was leased to one Donald Campbell a century or so later. The new farms had standard 'long-house' plans with byres and accommodation. But these barely lasted into the 19th century.

Also involved in the Ben Lawers Historic Landscape Project was **Richard Tipping** (University of Stirling) and he followed John Atkinson with a presentation that looked at the same Ben Lawers landscape but from pollen analyses. The high medieval upland shieling landscape was wooded, contrary to many assumptions, not dense or wild, but managed, conserved open-canopy woods of birch, hazel, rowan ad hawthorn, and used as wood pasture for cattle, providing shelter and more nutritious grassland for them as well as wood for fuel and construction. The pollen record shows that the shieling system on Ben Lawers intensified from the mid-16th century, when the wood pasture was lost, as it was elsewhere along Loch Tay. Grassland diversity was also reduced after *c.*1630, perhaps through larger herd sizes or stocking densities, through more people on the land or because of increasing stress to the shieling system from climate change in the Maunder Minimum, the most intense phase of the 'little ice age'. Close to the shielings of T16, 320 m above sea level, farmers tried to grow new crops around the shieling, possibly interpreted as an attempt to re-establish permanent farms despite the vagaries of the climate. They tried to grow buckwheat, and sheep's sorrel colonised mature-rich soils. Expansion is one interpretation: another is that people were growing both as famine food, to survive the 'little ice age'. Their attempt did not succeed. Neither, eventually, did the 'fermetoun'-shieling system, replaced in the late 18th century by the new farms. These failed, and clearance followed, around 1830. As people left, some seem to have memorialised this by the planting of single larch trees, not native to Scotland, but a symbol of a new world.

Bridget Jones has worked in outdoor access, recreation and visitor management for about 25 years, with the Loch Lomond & Trossachs National Park Authority for the last 13 years, with mountain paths as her area of expertise, as surveyor, trainer and co-author of the Upland Path Construction Manual. The Park was established in 2002, covers 1865 sq. km, and is home to more than 15,000 people. The Park has an astonishing 7 million visitor days a year, with >50 % of Scotland's population within an hours' travel time. There are more than 40,000 walkers on the big, 'frontline' hills, impacting on thin soils or peat in a very wet climate. The 'frontline' hills include The Cobbler and Ben's Lomond, Lui, Vorlich, Ledi and A'an. The effect of this pressure is clear, including the 'braiding' or widening of paths as walkers avoid quagmires and 'pigeon-holing' as walkers literally follow earlier steps, accelerating erosion. But there are ways to minimise this impact, by designing repairs utilising local

materials including boulders and turf to define path edges, varying its width to avoid uniformity and using graded stones to establish a good surface. Paths can be built by hand or with small diggers or power barrows using techniques to reinstate path surfaces, incorporating drainage and re-instatement of eroded ground. This can include stone water-bars diverting water off the path, stone cross-drains taking running water across rather than along paths and use of stone pitching to create a hard wearing surface on steeper gradients. The aims are to have paths that look natural, are attractive to walkers and low maintenance. The work is costly, but the two National Parks have been awarded £3.2 million from the National Lottery which has been matched by the two National Park Authorities, the Forestry Commission, Scottish Natural Heritage and others. This 5-year project will include path construction contracts which will provide opportunities for local employment, provide skills training for the unemployed, volunteering, education and learning for schools and visitors and improve the public's understanding of our mountains.

Also looking to the future is the SRUC Hill & Mountain Research Centre at Kirkton & Auchtertyre, near Crianlarich in the north of the National Park. **John Holland** talked about these developments. John is an upland ecologist, joining the Scottish Agricultural College (the former name of SRUC) in 1994. The farm is around 2225 ha, from 180 m to 1025 m above sea level at Ben Challum, with 74 ha of improved pasture, 153 ha of semi-improved pasture and 1677 ha of rough pasture, for 1230 breeding ewes and 21 breeding cows. Hill farms will need to pay their way in the coming years, and research is aimed at genetic improvements and increasing efficiencies. The first has led to more and heavier Scottish Blackface lambs, and more prolific Lleyn ewes are being trialled. Efficiencies come with automated monitoring of animals through their electronic tagging, now compulsory in Scotland and in minimising unnecessary work such as worming all lambs. Soils are carefully managed, grassland re-seeded with different mixes and with alternative legumes like Alsike Clover and Bird's-foot Trefoil. Economic diversification includes tourist accommodation and a farm shop.

There are also conservation measures, including cattle, introduced in 2013 to improve diversity of moorland and acid grassland habitats. Over 260 ha of mountain woodland have been planted in the last 20 years with a range of native tree and shrub species including downy willow. Much of this woodland was originally planted as part of a silvo-pastoral project, however due to the slow rate of growth of the trees it has not yet been possible to introduce sheep into the woodland. Herb species now flourish in the un-grazed woodland enclosure, including Northern Bedstraw and Melancholy Thistle. The spread of Purple-moor Grass has resulted in a substantial rise in the population of Scotch Argus butterflies. Bird species that have increased in response to woodland enclosure include species of conservation concern such as the Black Grouse, Tree Pipit, Cuckoo and Lesser Redpoll.

Richard Tipping

Plant Report 2016

STICKY CATCHFLY *SILENE VISCARIA*

Stuart Bence and Lorna M. Blackmore

Other contributors:
Michael Christie, Joanne Gibb, William Purdie, Roy Sexton, Melissa Shaw.

Introduction

Sticky catchfly *Silene viscaria* is a member of the *Caryophyllaceae;* the plant family that includes pinks, campions, chickweeds, carnations and stitchworts. This beautiful plant is grown in gardens and cultivars are available in most garden centres. At a distance it appears very similar to its common relative the red campion (*Silene dioica*). While both have showy pink flowers (Plate 6 and 7) they are easily distinguished by their leaves: sticky catchfly leaves are narrow and strap-shaped, while those of red campion are broader and oval. Another difference between the two plants is that the flower stalks of *S. viscaria* have sticky dark red patches beneath the apical nodes while *S. dioica* does not. These patches trap insects and when the stems die back (Plate 7) in the autumn it is thought that the insect remains contribute nutrients to the surrounding soil thereby acting as a fertilizer.

Sticky catchfly has a long recorded history in Scotland and is said to have been admired by James VI on the crags of Arthur's Seat. Sadly the plant has declined or disappeared from many of its former locations making it one of Scotland's rare plants. The cliffs and screes along the Hillfoots remain its national stronghold and, as a result, it has featured in a number of previous Forth Naturalist articles (Blake 1976, Blake et al. 1976, Stewart 1988, Sexton 2010). The main threat to the plant is over grazing particularly by rabbits and sheep. The introduction of sheep breeds that are more suited to steep slopes has pushed the surviving colonies onto inaccessible cliff faces and crags. Sadly these habitats are also under threat from gorse (*Ulex europaeus)* encroachment which not only out-competes the sticky catchfly but increases the risk of fire. These often impact on sticky catchfly colonies, even when the fire is at a distance, by scorching cliff faces far above the actual blaze. As a result of these factors each study in the Forth Naturalist has recorded a steady decline in numbers of sticky catchfly.

As part of the '2013 The Year of Natural Scotland' the Forth Naturalist and Historian was awarded a grant by Scottish Natural Heritage entitled 'What's Changed'. The purpose was to follow up some of the earliest surveys published in the journal during the 1970's. As the first edition carried an article on sticky catchfly it was chosen as a research topic and the Stirling University Nature Society (SUNS), led by Stuart Bence and Lorna Blackmore,

undertook a complete survey of all the cliff faces along the south scarp of the Ochils.

Methodology

Because the plants are largely restricted to inaccessible rock faces potential observation points were initially identified using Google Earth satellite images. Between June 10-20th (2013), the peak flowering time for the plant, the authors, together with groups of volunteers, headed out to these points and, after sketching an outline of the cliffs, split them into sections for surveying. Each section was then scanned from the closest accessible location using high magnification spotter's scopes and a count made of the number of flower spikes of sticky catchfly present. This method differs from the previous 2004 study of Tom MacDonald (Sexton, 2010) who abseiled down the slopes. The current method had the advantage of allowing a much greater area to be surveyed during the plant's short flowering period. However it had the disadvantage that the non-flowering plants were difficult to see and therefore could not be recorded. Where the plants could be reached it was established that there were approximately three flower spikes per clump and, for each flowering clump recorded, there were often between two and three unrecorded non-flowering plants.

Results and Discussion

The survey moved in an easterly direction starting on the cliffs of Abbey Craig. The plant was first recorded here in 1831 by William Forest who described it as abundant (Stewart 1989). Blake et al. (1976) also found it there, but Stewart (1989) only reported one plant near Wallace's Pass[1] (NS 8106 9534) in 1983, followed by three plants in 1987. In the current study, after two days of searching, it was concluded that the species is now extinct in this area. It was concluded that one of the main factors for this disappearance was likely to be the shading effect of the large trees which have grown up in front of the cliffs from the scree at their base. There is also competition from gorse, bramble (*Rubus fruticosus)* and shrubs that have become established on the cliffs.

At the east end of Stirling University campus 360 flower spikes were found above Blair Logie cemetery on Yellow Craigs[1] (NS 8192 9716). This result compared very favourably with the 25 clumps of plants recorded there by Blake et al. in 1976. The local Scottish Wildlife Trust group has been monitoring this cliff-side site (Table 1) and found a dramatic increase in flowering plants in the last few years. This was probably due to the restriction of sheep grazing in the area. However the site is still at some risk from scrub encroachment from the scree at the base of the cliffs. No plants were found at the top of Yellow Craigs, probably because of human pressure and extensive scrub and bracken growth. Above the caravan park just to the east on Witches Craig (NS 822 971), and in Craig Gullies, there were no plants, which in this case was a result of heavy grazing.

Table 1 illustrates counts of the flowering plants of *Silene viscaria* on Yellow Craig courtesy of Roy Sexton, Scottish Wildlife Trust (Approximately four flower spikes per plant).

Year	**1976**	**2006**	**2008**	**2010**	**2012**	**2013**	**2014**	**2015**
Plants	25	60	90	55	90	108	260	240

Sticky catchfly has largely disappeared from Ewes Lairs above Blairlogie village where Tom MacDonald recorded approximately 100 plants, although a small patch of 12 flowering spikes remained (NS 82897 97260). The cliffs of Castle Law above Ewes Lairs were found to have 20 flowering spikes on the west side (NS 82989 97275) and 30 on the east side (NS 83073 97186) similar to MacDonald's findings. This area had many young non-flowering plants restricted to the cliffs above a height where they could be grazed by sheep.

No sticky catchfly plants were found on the upper cliff areas running up to and including the summit of Dumyat. The flora of this area has dramatically changed since Blake's report in 1976. Not only has sticky catchfly been lost but areas once covered with Rockrose *Helianthemum nummularium* and Stone Crop *Sedum sp.* have been reduced to small patches out of the reach of cattle and sheep.

On the cliffs above the Blairlogie car park (NS 8312 9682) 50 flower spikes of sticky catchfly were identified in a band above the upper limit of the gorse. They were hard to spot amongst spectacular displays of similarly coloured red campion (*Silene dioica*), herb robert (*Geranium robertianum*) and foxgloves (*Digitalis purpurea)*. The prevalence of gorse in the area meant that there is a high risk of the plants being destroyed by fire. .

The cliffs to the east of Blairlogie car park were accessed through the dense thicket of gorse by climbing up along the Burnwarroch Glen (Plate 8). From a vantage point at NS 8356 9721 100 flowering spikes were seen on the west side of the burn and 116 on the east. The upper reaches of this burn were also surveyed by walking down from the summit of Dumyat, and in one vertical fissure, not visible from below, 361 flower spikes were recorded (NS 83787 97403) (Plate 8). The cliffs 300m to the SE of the summit of Dumyat and 150m west of the Burnwarroch Burn are known as The Kips[1] (Plate 8). MacDonald found this to be the main stronghold of sticky catchfly with 642 flowering clumps (Sexton 2010). Significantly more plants, were spotted with 1262 flowering spikes on the west side (NS 83701 97326) and 1276 spikes (NS 83966 97380) on the east side (Plate 8). Although there was high grazing pressure in this area, the steep ridges of rock that form the Kips prevent livestock entering the small strips of grassland where sticky catchfly flourishes. As the Kips level out to the east, two further ledges were found with a total of 126 flowering spikes (NS 8409 9734). At the east end of the Kips there are two small outcrops below the main cliffs (NS 84124 97345) with 65 sticky catchfly spikes present (Plate 8). The vulnerability of these colonies was illustrated during the summer

of 2014 when a gorse fire on the lower slopes was spread by embers to the grassland higher up the Kips. This caused the destruction of two colonies of sticky catchfly but thankfully stopped short of the main sites.

In the review by Sexton (2010) a single plant was recorded in Menstrie Glen, however there have been a number of landslides in the area and many cliffs have become covered in loose soil and spoil. The remaining stable cliffs are covered in gorse and, as a result, there is no area left for the sticky catchfly to grow. No plants were found on Myreton Hill above Menstrie Glen, the lower slopes of which are very heavily grazed, covered with bracken and are subjected to frequent fires.

The next area surveyed to the east was Craig Leith which is designated as an SSSI with sticky catchfly as a qualifying species. The area is grazed and the lowest cliffs are covered in dense gorse, however sticky catchfly remains in the upper areas (NS 8743 9795) where 124 spikes were found – less than was reported in MacDonald's 2004 report (Sexton 2010). These plants grow in areas inaccessible to sheep and are protected from fires by a large buffer between them and the gorse. The species is absent from a number of sites that would appear to be suitable for it, especially around the centre of the upper craigs. These are covered in rockrose (see Bence & Blackmore 2014) suggesting grazing pressure is not responsible and their absence might be due to competition with rockrose itself. There is one lower craig isolated from the rest near the Carnaughton Burn (NS 87583 97775) which has one clump of sticky catchfly with seven flower spikes. Records indicate a larger colony was once found in this area, with further plants along the edge of the burn which is now overgrown by gorse. Across the burn on Torry Hill (NS 8802 9811) there were similar colonies but these are no longer present as the area has suffered a number of gorse fires.

In the current study Craig Leith was the furthest east *Silene viscaria* was found on the south side of the Ochils. It was hoped that Alva Glen (NS 8857 9769) would be a stronghold since historic pictures indicated that the steep slopes may have been suitable, and the area has been fenced to avoid grazing. However the slopes are now over-grown with scrub and woodland. Upper Alva Glen and cliffs to the east were also surveyed without success, although records show the plant was once present. Similarly no plants were found on the cliffs in the Ochil Hills Woodland Park (NS 8956 9778) which have become overgrown and shaded by trees. Tillicoultry Craigs, Dollar Glen and the cliffs round King's Seat were also searched but no sign of sticky catchfly was found.

At the furthest eastern end of the Ochils near the A912 road at Glenfarg there were records from the Botanical Society of Britain and Ireland of another sticky catchfly site. Roy Sexton searched the area of the old railway cutting and tunnel entrance where the plant used to be found without success. However 205 flowering spikes were found on the cliffs on the roadside 200 m up the track from the A912 to the Binn's Recycling Plant (NO 1634 1322). There were a few scattered single plants nearby, suggesting the colony might be spreading.

Conclusion

To summarise, this study recorded 3,900 flowering spikes of sticky catchfly along the Hillfoots Scarp. As the accompanying article shows this is by far the biggest population of this rare plant in the UK. The threats that sticky catchfly face in Scotland include overgrazing, fire, encroaching gorse and, to a lesser extent landslides. Although along the Hillfoot Craigs some colonies still support good numbers of plants the species has all but disappeared from the rest of Scotland. These marginal sites do not provide the ideal conditions for its growth but exist because they are areas inaccessible to sheep. There is also a high risk from gorse fires which are perhaps the main cause of current colony loss. Gorse is part of the natural succession of vegetation on these slopes and by permanently fencing out sheep gorse is encouraged to grow. This therefore does not provide an answer. To further protect the species it is important to survey the remaining sites regularly and to look for ways of expanding the size and number of populations. It is relatively easy to collect seed and grow these plants so it might be possible to re-establish populations on fenced sites like Myreton Hill. However there would need to be effective site management to prevent gorse encroachment. An area, which is already fenced, that could be suitable after scrub clearance is the upper area of Alva Glen.

Sticky catchfly could be brought to extinction in Scotland by a few relatively minor incidents. To ensure the future of this beautiful plant further monitoring and a local management plan are needed.

References

Bence S, and Blackmore ML. 2014. A Survey of Large Heath, Purple Hairstreak and Northern Brown Argus Butterfly Populations in the Forth Valley. *Forth Naturalist and Historian* **37**, 139-152.

Blake EA. 1976. Ecological Aspects of Some of the More Local Flowering Plants of the Western Ochil Hills. *Forth Naturalist and Historian* **1**, 107-116.

Blake EA, Wallis PR, and Proctor J. 1976. The Red German Catchfly in the Western Ochil Hills. *Forth Naturalist and Historian* **1**, 117-121.

Sexton R. 2010. Plant Records 2009-10. *Forth Naturalist and Historian* **33**, 96-98.

Stewart NF. 1989. The Sticky Catchfly (*Lychnis viscaria* L.) on Abbey Craig. *Forth Naturalist and Historian* **11**, 83-84.

[1] *The place names in this account are found on OS Pathfinder Map 383*

Associate editors: Dr Neville Dix and RoySexton

Plant Report 2016 Part 2

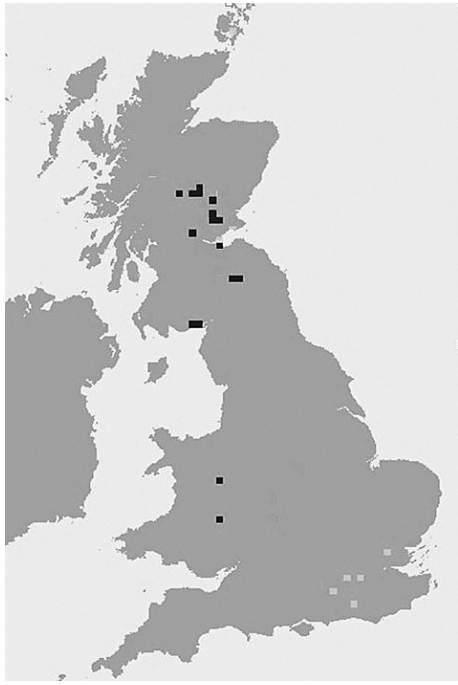
HOW IMPORTANT ARE THE HILLFOOTS' POPULATIONS OF STICKY CATCHFLY (*SILENE VISCARIA*) IN A UK CONTEXT?

Roy Sexton
(Stirling and Clackmannanshire SWT)

Introduction

Sticky Catchfly (*Silene viscaria; synonym Lychnis viscaria*) is a Red Data listed plant classified as 'Near Threatened' by the International Union for Conservation of Nature (Cheffings and Farrell, 2005). As the sister article by Bence and Blackmore (2016) relates nearly 4,000 flowering spikes were found in 2013 on the south facing cliffs and crags beneath Dumyat and Craig Leith in Clackmannanshire. To judge how important these local populations are in a UK context the Botanical Society of Britain and Ireland's (BSBI) data base has been consulted to obtain details of where sticky catchfly has been found. The BSBI Vice County (VC) recorders for these sites were contacted and all provided helpful information about the current state of their colonies.

Figure 1. *Silene viscari* sites in 2002. Modified from the New Atlas of the British and Irish Flora.



There are a number of sticky catchfly sites where the BSBI records extend back to the 1700s. The earliest is attributed to the famous botanist John Ray who in his *Catalogue Plantarum Angliae*, 1670 described *S. viscaria's* location as *in rupibus in vivario Edinburgeni*, *on rocks in Edinburgh (Holyrood Park*). Apparently it was not Ray who originally found sticky catchfly but Thomas Willisel the plant collector for the Royal Society of London two years earlier (Lusby and Wright, 1996). It is remarkable that this nationally rare plant has survived in a city for 300

years and it is perhaps in recognition of this long association that it was elected Edinburgh and Midlothian's 'County Plant'. Although it is still found in the area of Arthur's Seat known as Sampson's Ribs the BSBI records show that by 1980 it had been lost from a lot of its other historical locations in Edinburgh. These include Edinburgh Castle Rock, Duddingston Craigs, Blackford Hill, Corstorphine Hill and Braid Hermitage. The Royal Botanic Gardens Edinburgh (RBGE) is involved in trying to re-establish it at some of these locations, indeed the Sampson's Ribs population is now a mix of original and re-introduced plants.

S.viscaria is restricted to the crevices and ledges on south facing cliff faces mainly on basic igneous rocks. Apart from two locations on the Welsh border all the other genuinely wild populations are in Scotland (Figure 1). There are scattered sites in England but they are considered non-native garden escapes or introductions.

Survey Results

Since 1852 botanical recording has been based on regions derived from old county boundaries (or divisions of them) which are known as Vice Counties (VCs). The review uses this system and the botanists who have kindly provided updated information are shown in parenthesis.

Welsh records in VC 43 Radnorshire and VC 47 Montgomeryshire: It was the Woolhope Naturalists who first found sticky catchfly on Stanner Rocks NNR, Radnorshire (SO 262584) in 1893. A modern count in 2013 showed the site still had just over 100 flowering spikes located on 13 different crags. The second Welsh location on Breidden Hill SSSI in Montgomeryshire (SJ 288137) dates from 1687. This colony has been reduced by quarrying and although 73 plants were reported in 1986 there are currently only 4 small clumps. (Updates: Rhys Jenkins and Kate Thorne).

VC 73 Kirkcudbrightshire: The most southerly group of sites in Scotland are on the coastal cliffs of Kirkcudbrightshire. The Port O' Warren SSSI (NX 877533) near Portling had 545 plants in 1996, 60 in 2006 but no flowering spikes were seen at this map reference in late May 2016. Since 1995 periodic attempts have been mounted to maintain the species on Scottish Wildlife Trust's Southwick Coast Reserve (NX 910558) near Sandyhills Bay 2.5 kilometres to the east. This has involved collecting seed and planting out the resultant seedlings. By 2014 only three clumps remained but a programme to remove competing vegetation in 2015 together with further plantings will hopefully secure their survival. Five flowering spikes were reported in late May 2016. (Updates: Steven Blow, David Hawker, Roy Sexton)

VC 79 Selkirkshire: The cliffs at Corby Linn waterfall in Selkirkshire (NT 447295) supported a small population of 20 flowering plants. They became extinct in 1992 as a consequence of the cessation of gorse management.

Although a reintroduction programme was mounted by the RBGE the plants declined and were last seen in 2004. They were not re-found in 2012. (Updates: Rod Corner and Jeff Waddell)

Figure 2. A sticky catchfly flower spike on Yellow Craigs VC 87 24th May 2014.

VC 80 Roxburghshire: A colony on the Minto Craigs SSSI (NT 582207) 7 km north-west of Hawick was first reported in 1832. The last record was 19 flowering stems in 2005. (Update: Rod Corner)

VC 83 Midlothian: The Midlothian populations on Sampson's Ribs (NT 274726) mentioned above were recently surveyed by Mcintosh, Cole and McCabe. Numbers had increased from 5 plants in 2012 to 49 clumps in 2014. In early June 2016 some of these plants had 10-20 flower spikes making them easily visible on the crags beside the roads that cross Sampson's Ribs. Re-introductions were attempted on the Blackford Hills in 2002 but rabbits soon ate them. Very recently plantings have also been carried out on the Braid Hills and plans are in place to recolonise other Edinburgh sites including the Castle Crags. (Updates: Heather McHaffie and Barbara Sumner)

VC 85 Fife: There was a Fife colony on Glenduckie Hill east of Newburgh (NO 281194) which in 1996 was reported to consist of 9 clumps of 68 flowering spikes. Since then two recent searches proved unsuccessful. (Updates: George Ballantyne and Sandy Edwards)

VC 87 West Perthshire: The historic county of Perthshire was massive stretching from Loch Lomond to Dundee and as a result it is divided into 3 recording vice counties. West Perthshire includes part of Stirling District and Clackmannanshire. The position of the ancient Stirlingshire/Perthshire

boundary is marked by three stones in the middle of Stirling University golf course. As a result all the *S. viscaria* colonies along the Hillfoots are in VC 87 West Perthshire including a site on Abbey Craig which supports the Wallace Monument (NS 810954). This population was reported as 'flourishing' in 1908 however the last record was in 1983 when only 3 small plants were found by N.F. Stewart. In the sister paper Bence and Backmore (2016) reported being unable to find any plants at this location in 2013. Just to the east of Stirling University above Blairlogie church is Yellow Craigs (NS 819972) which supports a thriving population (Figure 2). SWT annual counts show this colony has prospered from 25 clumps in 1972 to 240 clumps with approximately 1000 flowering spikes in 2015 (Plate 6). This increase is largely attributed to the reduction of grazing pressure.

Details of the colonies along the Hillfoots' cliff faces have been dealt with in Bence and Blackmore's accompanying account. By comparison with the majority of other sites in this review they support large numbers of plants Approximately 3,500 flowering spikes were reported spread over the south side of Dumyat of which about 2,500 were found in the area of cliffs below the summit known as the Kips (NS 842973). Rather confusingly these VC 87 West Perthshire populations are all just within the current boundary of Stirlingshire i.e. west of Menstrie Burn and as a result should be covered by Stirling's Biodiversity Action Plan.

Two kilometres further east 131 plants were found below Craig Leith (NS 877979) in Clackmannanshire. However even though the Southern Ochils support large populations in UK terms there have been dramatic reductions in previous colonies like those on the cliffs round the summit of Dumyat and on Myreton Hill (Updates: Stuart Bence and Jane Jones)

VC 88 Mid Perthshire: Mid Perthshire also has some healthy colonies. Sticky catchfly has been known in the area around Glen Farg south of Perth since 1821. The traditional site on the rocks around the southerly entrance to the old railway tunnel (NO 156132) has probably been lost as a result of shading by trees. No flowering plants were found there in 2015. This is sad since there were 267 plants with 433 flowers in 1997. However there are other colonies in the neighbourhood one of which had 205 flowering spikes in 2015 on the road side cliffs on the track up to Binns Farm recycling works (NO 163132). The Weem Woods colony near Aberfeldy (NN 845502) had 173 flowering spikes in 2000 but recent searches have been unsuccessful. Craig Varr on the Ben a'Chuallaich SSSI near Kinloch Rannoch (NN 671590) seems another important current colony where 359 flower spikes were counted on the rock faces and ledges in 2010. The first records in the Pass of Killiecrankie date from 1890 however since 1968 the site has been more specifically described as Craig Fonvuick at the eastern end of Tulach Hill SSSI (NN 907620). The last record here was 50 clumps in 1995. (Update: Alistair Godfrey)

VC 89 East Perthshire: The best current site in East Perthshire is in Craighall

Gorge SSSI on the River Ericht just north of Blairgowrie (NO 176485). Site condition monitoring here in 2015 revealed 286 clumps at nine separate sites. VC 89 also had a *S. viscaria* colony on Glencarse Hill 6 km west of Perth (NO 182227) where the last record was 15 plants in 1992. Just northwest of Pitlochry on Creag Glunaid (NN 932598) there is another record of 176 plants in 1996 though there have been no reports since. (Update: Martin Robinson)

VC 90 Angus: There have been historic records in Angus since the 1850s. In 1989 plants were found near Kirriemuir in the Den of Airlie NNR (NO 293520) but unfortunately recent surveys have failed to re-find the colony. (Update: Robin Payne).

Summary

The survey above shows that there are apparently only 10 surviving sticky catchfly populations and some of these have very few plants. *Silene viscaria* is thought to have become extinct at a further 11 sites since the 1990s though in one or two of these locations further searches might prove rewarding. This brings the species very close to the 'Vulnerable' classification in the Red Data List which requires less than 10 locations as well as a continuing decline in numbers.

The various reasons for the losses given by the recorders are gorse and shrub overgrowth, tree shading, rabbit and sheep grazing, gorse and bracken fires, rockfalls and droughts. Conservationists will feel that much more could be done to protect the remaining vulnerable colonies from some of these factors.

The main healthy self-sustaining populations are Stanner Cliffs in Radnorshire, Breidden Hill SSSI in Montgomeryshire, the Hillfoots Cliff colonies in Stirling and Clackmannanshire, Glen Farg south of Perth, Craig Varr at Kinloch Rannoch and in the Craighall Gorge north of Blairgowrie. In addition the Arthur's Seat population in Edinburgh and the Southwick Coast population in Kircudbrightshire are surviving with the help of reintroductions. There may also be some potentially good sites which have not been surveyed for 15-20 years, these include Craig Fonvuick, Minto Craigs and Creag Glunaid.

Judging the size of these sticky catchfly populations is difficult. Some recorders count flowering stems, others plants and yet more clumps including non-flowering plants. Where more than one method is used you can get a rough idea of the inter-relationships. There are on average about 3-5 flower spikes per plant and from 1-5 plants per clump.

This study makes clear that the Hillfoots' colonies in Stirling and Clackmannanshire are the most important interbreeding meta-population of *S. viscaria* in Britain. There is not only a number of separate colonies over a 6 km stretch of cliffs but there are large numbers in some of them too. The Craig

Leith population has some statutory protection as *S.viscaria* is a qualifying species in the Craigleith and Myreton Hill SSSI citation. The last site condition monitoring of this species was carried out in 2008 and was found to be 'favourable' but the management plan does not include any specific protective measures. Worryingly Bence and Backmore in 2013 only found 131 spikes in this area, a reduction from MacDonald's records of 350 in 2004 (Sexton, 2012). Both these groups of surveyors found far more plants on the area known as the Kips beneath Dumyat with 643 plants in 2003 and 2,400 flower spikes in 2013; yet these areas have no statutory protection. Virtually all the plants are now growing in sites that are inaccessible to sheep having been grazed out on the more gentle slopes where they used to grow. The main remaining threat seems to be the forests of bracken and gorse (visible across the cliffs in Plate 8) and the potential for huge fires.

References

Bence, S. and Blackmore LM. 2016. A Survey of Sticky Catchfly (*Silene viscari)* Populations on the Hillfoots Craigs *Forth Naturalist and Historian* **39**, 117-121.

Cheffings, C. and Farrell, L. 2005. *The Vascular Plant Red Data List for Great Britain*, http://jncc.defra.gov.uk/page-3354

Lusby, P. and Wright, J. 1996. *Scottish Wild Plants. Their History, Ecology and Conservation.* The Stationery Office Ltd. Edinburgh

Sexton R. 2012. Plant Records 2009-10. *Forth Naturalist and Historian* **33**, 96-98.

Associate Editor Dr Neville Dix

DUNBLANE WEATHER REPORT 2015

Neil Bielby and Dr. John Holland

The weather station is my suburban back garden in Ochiltree, Dunblane. This is situated 50 m. to the east of the Dunblane Hydro ridge, 100 m a.s.l., in a shallow, sheltered valley. (G.R. NN 78990143).

I have been recording the weather since 1995 and all averages etc. refer to the last 21 years. (Note: because there is much variation from year to year in Britain in the parameters used to define climate, climatological averages are usually taken over periods of 30 years for temperature and 35 years for rainfall. Therefore, all averages in this report should be viewed with some caution). I am indebted to Dr. John P. Holland for providing Met. Office and additional weather records from Kirkton Farm, Strathfillan (NN 359283; 170 m a.s.l.) and Killin (NN 571326; 130 m a.s.l.). Weather recording began in 1991 at Kirkton Farm and means etc. for this site date from that year. Killin means date from 2002. The data from Kirkton allows for some interesting meteorological comparisons between the far north-west and central areas of our region.

Daily rainfall (> 0.2 mm); maximum and minimum temperatures; barometric pressure; cloud cover; wind direction and speed (Beaufort scale) are recorded. All except the maximum daily temperature are recorded at 09.00 hours. A brief description of the day's weather is also noted along with exceptional and unusual weather phenomena across the UK. Unless indicated otherwise, daily (24 hour) rainfall amounts are measured from 09.00 hours on the date mentioned until 09.00 hours the following morning.

2015 in **Dunblane** was slightly cooler but with more precipitation than normal (Figure 1). The mean temperature of 8.35°C was 0.13°C below the norm whereas precipitation of 1326.1 mm was 199.3 mm above the mean making this the 2nd wettest year after 1423.5 mm in 2002 (Plate 9). There was a maximum temperature of 24.4°C (1st July) and a low of –7.04°C (3rd Feb.). There were 213 'rain days' (mean 209) and the highest 24 hour total was 39.6 mm measured at 09.00 hours on 17th July. There were 61 air-frosts (mean 70) while snow lay on the ground at 09.00 hours on 25 occasions (mean 21). The average barometric pressure was 1012 mb (mean 1011 mb) with a high of 1040 mb (8th Feb.) and a low of 974 mb (23rd Feb.). Turning to the seasons: winter (Dec. 2014-Feb. 2015) was colder (–0.23°C) and quite a bit wetter (+59 %) than average. Spring (March-May) was slightly cooler (–0.47°C) and wetter (+23 %) then the norm. Summer (June-July) was noticeably cooler (–1.04°C) and wetter (+30 %) whereas autumn was warmer and a little drier with temperatures 0.34°C above the norm and with 12 % less rainfall.

At **Kirkton** 2015 was a very wet year. The main features of the weather were a wet January; a dry first half of February, followed by a wet second half; a wet

March; a relatively dry, sunny and at times warm April; a cool, wet May; a wet June, July and August, followed by a dry and relatively warm September and early October; and a very wet November and December.

The total rainfall recorded at the Met Office automatic station at Kirkton in 2015 was 3585.8 mm (141 inches) which was 972.0 mm more than the 1991-2015 twenty-five year average (2613.8 mm). This was the highest annual rainfall total since recording began in 1991, exceeding the previous record of 3453.6 mm set in 2011. The wettest month was December when a total of 738.4 mm (29.07 inches) of rainfall was recorded, making it the wettest December and the wettest calendar month since records began in 1991. The rainfall was above average in all months apart from April, September and October. The July rainfall of 249.2 mm was the highest July rainfall recorded since records began in 1991. During June, July and August a total of 624.2 mm of rainfall was recorded making it the wettest summer since records began in 1991. The driest month was September with a total of 63.8 mm of rainfall (only 33 % of the average September rainfall). The highest rainfall over a calendar week (Monday to Sunday) was 228.4 mm between the 5th and the 11th January. The highest rainfall in a single 24 hour period (09:00 GMT to 09:00 GMT) was 95.4 mm on the 4th December. The highest rainfall in a single half-day 12 hour period (21:00 GMT to 09:00 GMT) was 69.6 mm on the 29th December. The total number of rain days was 292 (80 %). There were 46 days when there was more than 25 mm of rainfall recorded, including 6 days when more than 50 mm of rainfall was recorded and 2 days when more than 75 mm of rainfall was recorded.

The lowest temperature recorded during 2015 was on the 19th January when the temperature fell to –8.8°C. This is the fourth year in a row that the temperature has not fallen below –10.0°C. The lowest maximum daily temperature was also recorded on the 19th January (–0.1°C). This was the only day during 2015 when the temperature failed to get above freezing. Air-frosts were recorded on a total of 73 days. The highest temperature recorded was on the 1st July (24.0°C). August was the warmest month with a mean temperature of 13.02°C. Temperatures of 20°C or above were recorded on 15 days: one day in April, 4 days in June, 3 days in July, four days in August, two days in September and one day in October. The 1st October 2015 was the warmest October day on record (20.0°C). The highest temperature recorded in May was only 15.4°C, which is the lowest maximum temperature for May since records began in 1991.

Sleet or snow was recorded falling at the weather station on 42 days during 2015 and lying snow was noted on 43 days. A depth of 20 cm of lying snow was recorded on the 14th January and 18 cm on the 3rd March. As in the previous winter, snow on the mountains above 600 m lasted well into spring, with a few patches on some of the surrounding Munros not melting until August.

There were 9 days when sustained gale force winds were recorded (9th, 10th, 11th, 12th and 15th January; 9th March; 12th and 20th November; and

23rd December) and 6 days when thunder and lightning were recorded (9th and 12th January; 31st March; 5th June; 4th July; and 10th August).

The total rainfall recorded in **Killin** in 2015 (2479.5 mm [97.62 inches]) was significantly higher than the 2002-2011 ten year average (1837.1 mm). 2015 was the second wettest year since recording began in 2002 (2011 was 1.0 mm wetter). September was the driest month with only 45.0 mm of rain, while December was the wettest month with 542.0 mm and the wettest calendar month since recording began in 2002. Nine months of the year were wetter than average, only April, September and October were drier. During 2015 Killin received approximately 69 % of the rainfall recorded at Kirkton (i.e. some 1106.3 mm less). The rainfall was higher at Kirkton in all months.

The Dunblane Year.

January was colder and wetter than normal. The mean temperature of 1.81°C was 0.49°C below the norm with a mean high of 4.0°C and a mean low of –0.39°C. Precipitation of 158.3 mm (507.8 mm Kirkton) was 28 % above the January average. Measurable amounts fell on 18 days (average 20) with a high of 20.2 mm (11th). There were 14 air-frosts (average 14) with snow lying at 09.00 hours on 12 occasions. Across Scotland rainfall was 42 % above the average but whereas in the east of the country it was around the norm, Lerwick (Shetland) had its wettest January in 100 years with almost double the usual amount.

The 1st was a wet and windy day followed by sunny spells and sharp showers, some of hail, on the 2nd. Heavy rain that night resulted in a 48 hour total of 29.6 mm. The 3rd was cloudless and calm – a complete contrast and the perfect mid-winter's day. A rapidly deepening low pressure passing just to the north of Scotland during the night of the 8th/9th brought storm force winds to the northern half of the country. A gust of 113 mph was recorded in Stornaway (equaling the previous record set in 1962) while wind speeds reached 140 mph on Cairngorm summit. There were gusts of up to 61 mph in the Central Belt and all the major road bridges crossing forths were closed until dawn. These winds wreaked the expected damage and disruption with all train services suspended and those north of Dunblane not being recommenced until late on the 9th. C.120,000 homes were without power by dawn on the 9th and as well as all schools in the Western and Northern Isles, 150 were also closed in the Highlands that day. It rained during most of the 9th but the winds quickly moderated only to strengthen again as another vigorous low passed above the north of Scotland. Storm force winds again hit the northern half of the country reaching hurricane force in Shetland. Gusts of 52 mph were recorded in the Central Belt. These winds slowly eased during the 10th as it turned colder with sunny spells interspersed with snow flurries. These became more prolonged during the night with a centimetre of wet snow lying at 09.00 hours the following morning. C.13,000 homes in the north and west of Scotland were still without power on the 11th as snow and strong winds (47 mph Central Belt; 80 mph Shetland) hampered repair work.

The 11th was also a day of heavy rain with 20.2 mm recorded (70.8 mm Kirkton).

Steady snowfall during the evening and night of the 14th/15th resulted in an accumulation of 15 cm (6 inches) by 09.00 hours on the 15th (30 cm Aviemore). Drifting snow on gale force winds during this period blocked the A9 between Pitlochry and Inverness with many motorists being stranded overnight. The strong winds continued throughout the 15th causing even further travel chaos: the major bridges were closed to high-sided vehicles with the Tay Road Bridge being closed to all traffic. The snow gates were closed on the A93, A939 & B974 while there were no trains between Perth and Inverness; Inverness and Kyle of Lochalsh and north of Arrochar on the West Highland lines. Many ferries were also cancelled as winds reached 70 mph through the Central Belt (a gust of 80 mph was recorded on Blackford Hill, Edinburgh). Barometric pressure fell to 963 mb as the depression passed close to the north of Scotland.

The weather then became quieter and colder as pressure rose and northerly winds developed. This Arctic air-stream brought snow flurries and sharp frosts (–7.0°C 18th; –8.8°C Kirkton; –13.7°C Glascarnoch, 19th) but virtually cloudless days on the 18th and 19th. The calm, cold spell lasted until the 23rd when a warm front crossed south-eastwards across Scotland bringing with it a milder, damper spell. This ended on the 28th which was a raw day with frequent snow showers. Both barometric pressure (976 mb, 29th) and the temperature (–5.5°C, –8.5°C Kirkton 30th) fell. Strong, bitterly cold northerly winds were drawn down from the Arctic as the low pressure system drifted into the North Sea. The last 3 days of the month were sunny with very clear air.

February was colder and drier than usual with the mean temperature of 2.70°C being 0.36°C below the norm. The mean high was 5.76°C while the mean low was –0.37°C. Precipitation of 79.2 mm (261.4 mm Kirkton) was 82 % of the norm with measurable amounts on 13 days (mean = 17). There were 17 air-frosts while snow lay on the ground at 09.00 hours on nine occasions. Scotlandwide, the mean temperature was 0.2°C above the 1981-2010 average with a high of 15.6°C at Fyvie Castle (18th) while precipitation was 4 % below it.

The first 12 days of the month were dry and mostly sunny as a high pressure system (1040 mb, 8th) built to the west of Scotland. Light rain during the morning of the 13th ended a run of 13 consecutive days without precipitation which equalled the 4th longest such spell here. There was a cold, northerly airstream on the 1st but it was mostly calm thereafter with 13 nightly frosts (min –7.4°C, –10.8°C Dalwhinnie 3rd). Patches of snow which had fallen on 28th January persisted until 8th February. After the 13th, the weather became more unsettled with days of sunshine and rain – the latter often in the form of showers. The last week of the month was mostly wet and windy as alternative cold and warm fronts raced across Scotland from the west with Kirkton receiving 42.6 mm of rain (23rd) and 49.8 mm (28th) when a gust of

wind reached 70 mph in Edinburgh. Some of the precipitation fell as snow and although amounts were heavy in the hills very little settled in lower areas.

The mean temperature in **March** of 4.91°C was only 0.1°C above the average but precipitation of 111.9 mm (367.2 mm Kirkton) was 45 % above the norm. There were 11 air-frosts (average 11) while there was lying snow at 09.00 hours on 2 days. Similarly, across Scotland, the mean temperature was 0.2°C above the 1981-2010 average with precipitation 22 % above the norm. The latter ranged from 50 % above the average in some western localities to only 50 % of the norm in parts of Aberdeenshire.

Snow during the night of the 2nd/3rd produced 7 cm (2.75″) by 09.00 on the 3rd (18 cm Kirkton). There were further wintery showers that morning before they turned to light rain in the afternoon. The 4th was sunny but overcast conditions prevailed for the next 3 days as a mild south-westerly airstream raised daytime temperatures to a year high of 11.1°C (17.4°C Santon Downham, Suffolk, 7th). 122.2 mm of rain fell at Altdearg House, Skye in the 24 hours ending at 09.00 hours on the 7th (60.0 mm Kirkton with a further 45.8 mm the following day). Unsettled weather continued until the 13th with the night of the 9th/10th being particularly wet and windy as a vigorous low crossed the Western and Northern Isles. Gusts of 83 mph and 89 mph were recorded on Skye and Lewis respectively leaving c.4,500 homes without power. A high pressure system developed over Scandinavia from the 11th (1038 mb 15th) with the associated, light easterly airflow bringing in largely overcast conditions to all but the north-west of the UK. Largely calm conditions with some sunshine from the 18th saw a rise in temperatures to a year high of 12.0°C on the 20th when an almost full solar eclipse (91 %) took place at 09.35 hours and, although there were varying amounts of cloud, at times this thinned to just the correct density to allow the phenomena to be observed without eye protection. The following day was one of glorious unbroken sunshine. A succession of Atlantic lows and associated fronts brought very unsettled and rapidly changing weather from the 25th until the month end. Between the spells of wind and rain brighter periods were often accompanied by cold northerly winds with occasional sleet showers at low levels and blizzard conditions on the hills. A gust of 97 mph was recorded at Capel Curig, N. Wales while 44.6 mm of rain was recorded at Kirkton (30th).

April was slightly cooler and noticeably drier than average. The mean temperature of 7.64°C was 0.21°C below the average while in contrast, the 20.8°C recorded on the 22nd and 23rd was the highest temperature for this month since 21.8°C in 2003. There were eight air-frosts (mean five). Precipitation of 43.9 mm (114.6 mm Kirkton) was 70 % of the norm with measurable amounts on 13 days (mean 15). The maximum 24 hour total (daily high) of 6.2 mm was the lowest ever for this month. UK wide, the mean temperature was 0.5°C above the 1981-2010 average while rainfall was 64 % of the norm. A maximum temperature of 25.6°C was recorded at Faversham, Kent (15th) with a minimum of –8.0°C in Co Down (27th). Across Scotland the mean

temperature was 0.2°C above the norm with rainfall 87 % of the average. It was the sunniest April since 1942 being 44 % above the norm. Six cm of snow lay in Aviemore on the 1st.

The first three days of the month were mixed but a high pressure system (1035 mb 8th) moving up from the south brought a dry, settled spell with above average temperatures (17.5°C; 20.7°C Aboyne, 5th) and much sunshine. There was no precipitation from the 4th-10th but an Atlantic front produced a little rain during the night of the 10th/11th. This was followed by a typical April mixture of squally showers (some of hail) and sunshine the next day which was distinctly colder and fresher. A high pressure system developed over the UK from the 15th (1035 mb 21st) bringing settled conditions with virtually unbroken sunshine from the 15th-24th and nine consecutive dry days. A light easterly airflow depressed temperatures down the east coast with the highest values being in NW Scotland (20.6°C Dunblane, 22nd & 23rd; 22.6°C Aberfeldy 22nd). A marked change in the weather from the 24th brought much colder conditions with some night frosts (–3.2°C, 27th) and sleet/snow showers to low levels. The 30th was sunny but with a cold northerly airflow.

May was colder and wetter than usual with the mean temperature of 9.43°C being 1.46°C below the norm making this the 2nd coldest May at this station after 8.27°C in 1996. Scotland wide, the mean temperature was 1.2°C below the norm with rainfall 77 % above average making this the 4th wettest May dating back to 1910. There were two air-frosts with a low of –2.2°C (1st). Precipitation of 97.6 mm (298.2 mm Kirkton) was 39 % above average with measurable amounts on 17 days.

The first 3 weeks of May were unsettled with the 3rd (19.0 mm; 30.6 mm Kirkton; 36.2 mm Durris, Aberdeenshire), 5th (13.0 mm; 35.0 mm Kirkton) and 10th (13.4 mm; 36.2 mm Kirkton) being particularly wet days. Winds were mostly from the south-west with temperatures below the norm. A ridge of high pressure built on the 19th/20th bringing some much welcome sun and warmth (19.6°C, 23rd). From the 24th the weather was cooler, but mostly sunny and breezy with winds from a westerly quarter and just two spells of rain until the month end.

June was cooler than normal with the mean temperature of 12.9°C being 1.07°C below the average. Rainfall of 70.2 mm (181.0 mm Kirkton) was just below the monthly norm. Across Scotland the mean temperature was 0.7°C below the long-term average with rainfall just 3 % above it.

The cold, unsettled weather which characterised May continued into June with 18.8 mm of rain on the 1st (45.6 mm Kirkton). It was often windy with gusts of 65 and 63 mph recorded on Blackford Hill, Edinburgh (2nd & 6th) A high pressure system (1037 mb, 8th) brought a relieving spell of dry, warm weather from the 9th-12th (24.4°C 11th; 23.8°C Aboyne). Cold conditions returned with a vengeance on the 13th with a maximum temperature of only

11.3°C. Cool conditions continued with only the odd, brief warm day (18.6°C 20th). Temperatures were closer to the seasonal norm from the 21st until the month end but with occasional rain culminating in 16.5 mm during the early hours of the 28th. The temperature on the final day of the month reached 22.6°C (26.9°C Carterhouse, Borders).

July was much cooler and wetter than normal with the mean temperature of 14.31°C being 1.56°C below the average making it the coldest July at this station replacing the 14.47°C in 2007. Rainfall of 177.5 mm (249.2 mm Kirkton) was 103 % above the average which also set a new July record high here (supplanting the 156.3 mm in 2002). Rainfall across Scotland was 53 % above average with central and eastern areas receiving double the normal amount for July. Measurable rainfall occurred on 25 days (average 16). A maximum of 36.7°C was recorded at Heathrow Airport (1st) which set a new UK high for July.

A spell of warm, humid weather (23.6°C 3rd; 29.4°C Kinloss, 1st) culminated in a prolonged electrical storm during the early hours of the 4th which produced 24.0 mm of rain in 6 hours. Another electrical storm delivered 18.8 mm in 1½ hours from 17.00 hours on the 5th. These storms were widespread across the UK and two people were unfortunately killed by lightning in the Brecon Beacons. The weather continued to be very unsettled with rain most days. It was particularly wet from the 17th to the 20th when 71.0 mm fell (85.6 mm Kirkton), severely affecting the Open Golf Championship at St Andrews which couldn't be completed until the Monday.

August was a little cooler and drier than average. The mean temperature of 14.77°C was 0.4°C below the norm while rainfall of 73.9 mm (194.0 mm Kirkton) was 84 % of the average. Across Scotland the mean temperature was 0.1°C below the L.T.A. while rainfall totals equalled it. A monthly high of 25.8°C was recorded at Prestwick Airport (23rd) while the 35.4 mm accumulated at Achnagart (10th) was the wettest day.

Repeated low pressure systems and their associated fronts passing eastwards to the north-west of Scotland meant that the weather continued to be unsettled and mostly damp with only the occasional short sunny period. High pressure finally built on the 12th (1025 mb) producing unbroken sunshine the following day and a high of 22.4°C. It continued mostly sunny and warm until the late afternoon of the 19th when a spell of rain heralded a return to more unsettled weather although rainfall amounts were low until the 26th/27th when regular heavy downpours provided a 24 hour total of 28.3 mm. Sunshine and showers on a south-westerly airflow continued to be the theme until the month end.

September was cooler but much drier than the norm. The mean temperature of 11.64°C was 0.57°C below the average with a day high of 20.1°C (6th) and a night low of 1.7°C (30th). Rainfall of 28.0 mm (63.8 mm Kirkton) was

only 34 % of the average making this the 2nd driest September after 20.5 mm in 2014 and the 6th driest across Scotland in a series dating back to 1910. There were measurable amounts on only 8 days with a 24 hour high of 13.6 mm (12th). Barometric pressure averaged 1017 mb with a high of 1037 mb and a low of 993 mb.

Low pressure to the east of the UK combined with high pressure in the Atlantic produced a cool northerly airflow for the first 4 days of the month. Thereafter high pressure built over Scotland producing a welcome 'Indian Summer'. There were several cloudless and calm days with temperatures peaking at 20.1°C (6th and 7th; 21.4°C Kinlochewe 9th). A spell of 10 consecutive days without rain ended on the 12th as a vigorous depression crossed Scotland from the west producing 13.6 mm of rain on strong easterly winds. Despite low pressure (993 mb 15th) the sunny and largely dry weather returned allowing farmers to continue with the cereal harvest apace. During this period temperatures peaked at 18.5°C (18th) and with clear night skies fell to 2.0°C (15th). The weather was mixed from the 20th to the 25th but settled again as the barometer rose to 1037 mb (30th). This resulted in four cloudless days from the 27th until the month end. A maximum temperature of 17.9°C was recorded on the 29th compared to a high of 24.0°C in Braemar the following day.

October was a little warmer and much drier than the norm. The mean temperature of 8.96°C was 0.41°C above the average with a high of 17.0°C (1st) and a low of –0.6°C (17th). Rainfall of 73.6 mm (173.0 mm Kirkton) was only 56 % of the norm making this the driest October since 2007. The mean barometric pressure was 1017 mb compared to the average of 1009 mb. Across Scotland it was the driest and sunniest October since 2003 with 50 % of average rainfall and 121 % of average sunshine. The mean temperature was 0.8°C above the norm.

The settled spell, which included a run of 10 dry days ended on the 5th although early morning fog sometimes took until mid-morning to clear. The maximum temperature of 22.7°C recorded at Braemar (1st) was the highest for the month in the UK.

The rest of the month was more unsettled with rain from 16.00 on the 23rd until midday the following day produced 15.0 mm (43.0 mm Kirkton) while 29.3 mm fell between 04.00 on the 28th and 11.00 the next day. It was also windy with gusts of up to 60 mph in the north and west on the 21st and 70 mph the following day although it remained unseasonally mild with temperatures reaching 21°C east of the Grampians.

November was milder and wetter than usual with the mean temperature of 5.86°C being 1.04°C above the norm. A monthly high of 13.4°C was recorded (1st & 9th) and low of –1.1°C (30th) and there were four air-frosts and one ground frost. Precipitation of 189.9 mm (437.2 mm Kirkton) was 64 % above the

average with measurable amounts on 23 days. A new UK maximum temperature of 22.4°C for November was recorded near Aberystwyth on the 1st. Scotland wide the mean temperature was 1.3°C above the average while the south of the country had 147 % of the normal rainfall making this the 2nd equal wettest November. Across the UK the mean temperature of 8.2°C made it the third warmest in a series dating back to 1910 (after 1994 and 2011). In the 24 hours ending at 09.00 on the 10th, 96.8 mm of rain fell at Capel Curig (N. Wales). A wind gust of 97 mph was recorded at High Bradfield (S. Yorks) on the 29th while snow lay at a depth of 9 cm at Aviemore on the 30th.

After a perfect sunny, mild autumn day on the 1st overcast conditions with an increasing 'Atlantic' influence pertained although rainfall amounts were initially low. However, autumn storms 'Abigail', 'Barney' and 'Clodagh' brought very wet and windy weather for most of the second half of the month. Rain from 10.30 on the 8th had produced 23.6 mm by 09.00 the following day (48.0 mm Kirkton (+40.4 mm Kirkton 9th); 78.4 mm Alldearg Ho, Skye). Storm 'Abigail' tracked across the north-west of Scotland on the 12th with gust speeds widely in excess of 55-70 mph peaking at 84 mph on S. Uist and Sella Ness (Shetland). Kirkton received 47.0 mm of rain on the 15th and 38.6 mm on the 18th.

The weekend of the 21st/22nd brought a welcome respite from the wind and gales with largely clear skies and calm, dry conditions. Rainfall amounts remained low until the 27th after which it turned colder with snow falling on the hills and occasionally at lower levels, notably in Dunblane during the morning of the 29th.

December was much milder and wetter than normal. The mean temperature of 5.32°C was 2.49°C above the average for the month and the highest at this station (replacing the 4.32°C in December 2013). The average low of 3.08°C and the average high of 7.56°C were also the highest here. The lowest temperature during the month was –6.4°C (13th) and the highest was 13.0°C (19th). There were four air-frosts (mean 14) and one ground frost. Total precipitation of 222.1 mm (738.4 mm Kirkton) was 90 % above the average making this the 2nd wettest December here (supplanting the 225.5 in 2013) with measurable amounts on 26 days (mean 20). Despite the regular Atlantic depressions barometric pressure remained within the fairly narrow range of 990 mb-1017 mb.

For Scotland as a whole, the mean temperature was 2.7°C above the long-term average while precipitation was a massive 115 % above the norm. UK wide, the mean temperature of 7.9°C was 4.1°C above the 1981-2010 long-term average and 1.0°C above the previous warmest December dating back to 1910. The southern half of England was exceptionally mild with Central England recording its warmest December in a series starting in 1659 (Plate 10). Provisionally, it was not only the wettest December, but also the wettest ever calendar month ever recorded across the UK with rainfall 91 % above the average. (Plate 11)

The procession of Atlantic depressions continued throughout the month with the heavy rain and gales accompanying storm 'Desmond' causing extensive flooding in southern Scotland and north-west England from noon on the 4th to late evening on the 5th. Several main roads in the Stirling area were impassable on the morning of the 5th including the southbound carriageway of the M9 between the Keir roundabout and Bannockburn; the M876 and the A821 through Aberfoyle. Bus passengers on the A 81 had to be rescued by the Trossachs Search and Rescue Team. The 48 hour total at this station was 53.6 mm (141.0 mm Kirkton; 114 mm Glasgow; 139 mm Eskdalemuir). Further afield parts of Hawick were under water with 600 houses being evacuated as the R. Teviot topped its banks. The east and west rail lines between Scotland and England were cut while the Perth to Inverness line had already been closed due to flooding at Kingussie for a few days. A gust of 78 mph was recorded at Inverbervie and the gales blew a bus off the road into a field in Fife. In the 24 hours ending at 09.00 on the 5th, 341.4 mm (13.4 inches) of rain fell at Honister Pass (Lake District) – the highest 24 hour total ever recorded in the UK. A further 264.4 mm (10.4 inches) fell at Thirlmere (Lake District) in the following 24 hours causing extensive flooding with many roads closed. Carlisle was particularly badly affected with a number of areas under water and numerous homes evacuated. Even Carlisle United's football ground – Brunton Park – was under several feet of water. The town centres of Cockermouth, Kendall and Keswick also experienced severe flooding.

The south-westerly airstream continued to feed in moist air with rain every day until the 12th. However, the weather turned colder on the 10th with the heavy showers turning to snow around noon – even at low levels. These showers continued through the night to reveal the hills plastered with snow above 1,500 feet the following day (14 cm at Aviemore). After the coldest night of the year on the 12th/13th (–6.4 °C; –8.7°C Dalwhinnie) and a calm, sunny day to follow when the temperature remained below freezing (max. –1.1°C), the weather became increasing mild reaching an unseasonal 13.0°C on the 19th (17.2°C Achnagart and Plockton, Highland; 16th). Unfortunately this was accompanied by mostly damp, dreich conditions made even gloomier by the proximity of the approaching winter solstice.

A belt of heavy rain crossed the Central Belt from west to east during the morning of the 21st depositing 16.8 mm in only 4 hours (38.8 mm Kirkton). This was quickly followed by storm 'Eva' which brought the 3 day total to 59.8 mm (111.2 mm Kirkton). The north of England suffered the most from this storm with parts of Ribchester and Whalley (Lancashire) along with parts of Leeds, Knarseborough, Hebdon Bridge and Tadcaster (Yorkshire) being flooded while c.3,500 properties in York were inundated by the R. Foss. There was a single flash of lightning and accompanying clap of thunder directly overhead at 19.30 on the 24th. Xmas Day was dry and overcast but 'normal' service resumed on Boxing Day with unrelenting rain on a raw north-easterly airflow. The 27th was a rare sunny & calm day.

'Frank', the third named storm of the month hit the northern half of the UK during the night of the 29th/30th. By late afternoon on the 30th, 37.4 mm of rain had fallen (80.0 mm Kirkton). The accompanying gales reached 85 mph in South Uist. The A84 was closed for most of the day between Callander and Lochearnhead due to flooding as was the M74 at Abington. Inevitably, heavy rain (76.0 mm in 20 hours) washed c.250 tonnes of earth onto the A83 just below the summit of the 'Rest and Be Thankful' closing the road to all traffic for several days. Part of the A93 between Ballater and Braemar was washed away by the River Dee producing the unforgettable broadcast image of large static caravans from a site at the former village floating down the river. Six thousand homes across Scotland were without power and many homes had to be evacuated with Dumfries, Newton Stewart, Hawick, Moffat, Peebles and Ballater the worst affected. Twelve passengers had to be airlifted from a bus stuck in floodwater in S. Ayrshire. A gust of 98 mph was recorded at the Needles (Isle of Wight, 31st). The Association of British Insurers estimated that the total cost for the flood damage caused by the three December storms would be £1.3 billion.

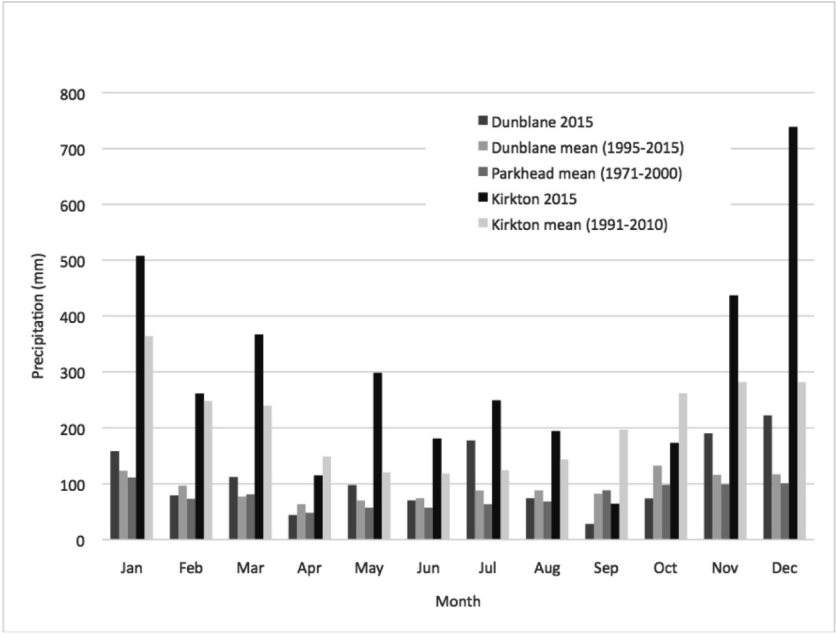


Figure 1. Rainfall 2015

FORTH AREA BIRD REPORT 2015

N. Bielby

This is the 42nd bird report for the Upper Forth SOC (Scottish Ornithologists Club) recording area. The area covered by the report comprises the council areas of Falkirk, Clackmannanshire and Stirling but excludes parts of the Clyde drainage basin such as Loch Lomondside and the Endrick Water area (including Fintry and Balfron) all of which are covered by the Clyde bird report. The report consists of a summary of the main bird news from 2015 followed by detailed species accounts.

Chris Pendlebury, the current SOC recorder, can be contacted by e-mail at chris@upperforthbirds.co.uk; by leaving a message on 07798 711134; or by mail to 3 Sinclair Street, Dunblane FK15 0AH. Records can be provided through the BTO BirdTrack system or by an Excel spreadsheet that can be sourced from Chris. Details of what type of records are required for each species along with advice on writing descriptions and submitting records can be obtained from the deputy recorder, Neil Bielby, at n64b68@gmail.com or by phoning 01786 823830.

In this report a coded summary of general distribution is included after the species name. The codes used in this report are:

B	Breeding status: widespread (present in more than five 10 km squares)
b	Breeding status: local, scarce (present in fewer than five 10 km squares)
W	Winter status: widespread or often in groups of more than ten
w	Winter status: local, scarce or usually fewer than ten in a group
P or p	Passage (used for species usually absent in winter); P and p used for widespread and local/scarce, respectively, as in winter status above.
S or s	Summer visitor (used for species present in summer but which do not normally breed); S and s used for widespread and local/scarce, respectively, as in winter status above.

Rarer species for which a full list of records are provided are highlighted with the use of an asterix (*). Records of rare species are subject to acceptance by the BBRC, SBRC or the local rarities panel. The latter currently consists of Graeme Garner, Cliff Henty, Mark Lewis, Duncan Orr-Ewing, Chris Pendlebury and Andre Thiel. A list of local rarities is available from Chris Pendlebury.

Thanks are due to the organisers (M.V. Bell - Forth Estuary & N. Bielby - Inland) of the Winter Waterbirds Counts (WeBS) for providing the results from these surveys (the estuary counts are downstream from Cambus). Thanks also

to the surveyors involved in both this scheme and the Breeding Bird Survey scheme who provide all the data and records.

HIGHLIGHTS OF THE YEAR

January

The only Waxwing of the year was feeding on 'Joseph Rock' rowan berries in a Dunblane garden on the 2nd. This was followed by a Mediterranean Gull at Kinneil on the 4th & 12th. A ♂ Smew at Blairdrummond Ponds on the 8th was probably the red-head from the previous winter returning, it was then seen intermittently here until the 15th of April and also on the Blackdub Floods (12th) and around the Forth/Teith confluence on several occasions during the month. A White-tailed Eagle was at L. Katrine on the 19th. There was a ♀ Long-tailed Duck on the Lake of Menteith on the 14th with 2 ♀ there on the 21st when three Common Scoters were on the Forth Estuary at Kinneil.

February

A *sinensis* Cormorant was at Gartmorn Dam on the 1st followed by a 2nd winter Ring-billed Gull at Skinflats on the 6th. A Red-throated Diver was off Kinneil on the 7th while two 'blue morph' Snow Geese were with a flock of c.1,000 Pink-footed Geese at Slamannan on the 10th. Three Common Scoters were off Bo'ness on the 11th with possibly the same birds off Carriden 5 days later.

March

The only Fulmar of the year was over the Forth at Skinflats on the 2nd. Two imm/♀ Long-tailed Ducks were observed on the Lake of Menteith on the 13th with a Ptarmigan being encountered on Ben Lui the following day. A White-fronted Goose was at Skinflats on the 20th. A White-tailed Eagle was in Finglen (L. Tay) on the 22nd while a Snow Goose was at Cambus Village Pools the next day.

April

A 1st summer Little Gull was at Kinneil on the 11th and a White-tailed Eagle was noted at Auchtertyre (Strath Fillan) on the 16th.

May

An Arctic Tern was at Kinneil on the 6th when a singing Lesser Whitethroat there was the only record for the year as was a ♂ Garganey at Cambus Village Pool on the 9th &10th. An immature Goshawk was seen over Earlsburn Moor on the 20th.

June

A Little Gull was at Skinflats Pools on the 12th with one to two 2nd summer birds present until the last record on the 11th August. A Little Gull also visited the Blackdevon Wetlands on the 13th when the only Guillemot of the year was seen off Blackness. The only reported Quail was from Flanders Moss on the 14th.

July

An adult Mediterranean Gull visited Kinneil Lagoon on the 3rd with a 1st summer bird there on the 9th and a 2nd summer bird on the 14th. Three Mediterranean Gulls were on a flooded field at Westfield (Falkirk) on the 17th & 18th. An adult Little Gull was at Kinneil on the 30th and again on the 6th August.

August

A Goshawk was seen over Callendar Park (Falkirk) on the 1st with a Kittiwake at Kinneil the following day. An adult Sabine's Gull at Kinneil on the 6th was only the 5th record for the Upper Forth. An Arctic Tern was seen at Blackness on the 6th with between one and two recorded at Kinneil from the 9th-11th. A Sanderling was at Skinflats Pools on the 8th & 9th with one still in summer plumage at the head of L. Tay on the 14th. A 2nd summer Mediterranean Gull was at Kinneil on the 12th. A Marsh Harrier was at the confluence of the R. Forth and the Bannock Burn on the 20th with an imm/♀ visiting both Skinflats Pools and Powfoulis on the 22nd. A Wood Sandpiper was noted at Skinflats Pools on the 22nd.

September

A juvenile Little Stint was at Skinflats Pools on the 5th and the 15th-17th. A Marsh Harrier was at both Skinflats Pools and Powfoulis on the 8th with a juvenile over the Alloa and Tullibody Inches on the 12th and again at the latter site on the 20th. Single Curlew and Wood Sandpipers, three Turnstones and a Gannet were at Kinneil Lagoon on the 12th where a Bittern from the 12th-14th was only the 4th record for the Upper Forth. A juvenile Pomarine Skua was off Blackness on the 13th. Two Sanderlings and a Curlew Sandpiper were at Skinflats Pools from the 28th to 30th.

October

A White-tailed Eagle was seen over Bo'ness on the 4th with a Kittiwake at Kinneil the following day. A Slavonian Grebe was on the Forth at Blackness on the 19th and 26th while a ♀ Goshawk was reported form Arnprior on the 23rd. Three light-bellied Brent Geese at Blackness on the 26th were the only record this year. A Sanderling was at Kinneil on the 23rd followed by a Hen Harrier at L. Mahaick the next day. The month ended with seven Ptarmigan encountered on Ben Ledi on the 30th.

November

A Slavonian Grebe was off Grangepans on the 8th. A Snow Goose was with Pink-footed Geese at Skinflats on the 14th. Two Mediterranean Gulls were at Skinflats Pools from the 8th-27th with single birds also putting in an appearance at Higgin's Neuk and Powfoulis on the 21st. Also on the 21st, a Common Scoter was off Bo'ness along with the only Shag of the year. A Long-tailed Duck was in residence at Gartmorn Dam from the 22nd-26th.

December

A Merlin was by the R. Carron (Denny-Larbert) on the 12th and a Red-

throated Diver was off Blackness on the 29th.

CONTRIBUTORS

This report has been compiled from records submitted by the contributors listed below. Where initials are given, the contributors are listed in species entries of birds that are rare, uncommon or otherwise noteworthy. The editors are grateful to all the contributors for submitting their records. Apologies to anyone who has been inadvertently missed out.

C. Adams, D. Anderson (DA), A. Ayre, A. Baird (ABa), S. Bayne (SB), D. Beattie, J. Bell (JB), M. Bell (MVB), D. Bennie, N. Bielby (NB), Birdguides (BG s), P. Blackburn (PB), A. Blair (AB), M. Blamire (MGB), D. Boggon (DB), R. Broad, D. Bryant (DMB), T. Burkinshaw, R. Calder, J. Calladine (JRC), P Callaghan (PC), E Campbell (EC), J. Carolan, P. Carroll (PCa), E. Champness (ECh), AP. Chick (AC), JA Clarke, F. Clements (FC), A. Combe, A. Cotton (ACC), J. Coyle (JC), N. Crowther (NC), J. Daisley, R. Dalziel, B. Darvill (BD), S. Dewey, LA du Feu, K. Duffy (KJD), D. Edwards (DE), R. Elliot (RE), C. Everett (CE), A. Everingham (AE), T. Findlay (TF), G. Garner (GG), R. Goater, T. Goater (TG), R. Gooch (RG), JD Gordon, SG Gough (SG), A. Hamilton (AH), M. Harding (MDH), J. Hatcher (JJH), M. Hawkins, I. Henderson, C. Henty (CJH), L. Hesp, D. Hill (DHi), D. Hodgson (DH), J. Holland (JPH), K. Houston, D. Irving (JDI), D. Jarrett, R. Jenkins (RJ), D. Jones, AG. Kennedy (AK), D. Kerr (DK), G. Kett (GK), I. Laird, L. Lamont (LL), G&E Leisk, P. Kerrison, R. Mair (RM), F. Martin, L. McBrien, M. McDonald (McD), S. McGeachie (SMcG), H. McLaren, E. McLellan (EMcL), E. McLoughlin (EJM), A. McNab, G. McNeill, T. Messer, N. Metcalfe, SP. Milligan (SM), M. Mitchell (MM), A. Morgan (AM), J. Morgan-Davies, A. Murphy (AMu), F. Murray, J. Neil (JN), J. Nugent, L. Oldershaw, D. Oliver (DO), S. Orr (SO), D. Orr-Ewing (DOE), S. Paterson (SP), W Paterson (WP), C. Pendlebury (CJP), D. Phillips, D. Pickett (DAP), L. Reid (LR), M. Reid (MR), A. Renwick, E. Reynolds, J. Robertson (JGR), S. Roos, A. Ross (A. Ro), C. Ross (CR), D. Scobie, R. Shand (RS), K. Shaw, EM Shilland (ES), J. Short (JS), M. Smillie, B. Smith, R. Smith, C. Spray (CS), R. Stewart (RJS), P. Stockil (PS), D. Taylor (DTy), P. Taylor, A. Taylor-Pigott (ATP), W. Thomson (WT), D. Thorogood (DT), J. Towill, J. Waddell, K. Walshaw (KW), T. Wells, H. Weir, C. Wernham (CW), A. Whyte (AW), Rory Whytock (RTW), L. Willocks (LW), G. Wilkinson (GW), K&T Wilkinson, J. Wilson, V. Wilson, S. Weatherston, S. Wotherspoon (SW) and P. Wright.

SYSTEMATIC LIST

Codes – F, C and S refer to Falkirk, Clackmannanshire and Stirling Council Areas.

Names and species order: both the common and scientific names, along with the species order, have been in an ever increasing state of flux over recent years. To maintain some semblance of continuity (in order to make locating a species in the report a little easier) the same order as last year has been retained. As with the species order, there appear to be several different sets of common English names by different authorities, but for this report the British Birds 2016 list has been used with any additions to the vernacular English names preceding the latter in brackets.

Note that only c.50 % of inland WeBS sites were counted in Oct / Nov and where this has notably affected the total of a species recorded these months have been omitted. Additionally, the Lake of Menteith, a major site for some species, wasn't counted in Dec. so totals for these species haven't been included for that month either. Where totals for these months have been included the aforementioned should be borne in mind.

Spring and autumn arrival and departure dates in this report have not usually been recorded systematically so that changes between years should only be seen as indicative and not interpreted as reflecting true phenological variation.

Abbreviations: ad (adult), AON (apparently occupied nest (s)), AOT (apparently occupied territories), br (bridge), BoA (Bridge of Allan), BoD (Braes of Doune), cemy (cemetery), conf (confluence), CP (country park), Cres (crescent), CVR (Carron Valley Reservoir), Est (estuary), Ex (exchange), Fm (farm), gdn (garden), Garg (Gargunnock), G (glen), GP (gravel pit), Hosp (hospital), Ho (house), imm (immature), juv (juvenile), Kinc. (Kincardine), L (loch), NE (nest with eggs), NR (nature reserve), NNR (national nature reserve), ne (near), NY (nest with young), occ (occasional), Pl (Place), Pr (s) (Pair (s), QEFP (Queen Elizabeth Forest Park), res (reserve), St (Stirling), temp (temporary), Tilly (Tillicoultry), Uni (University), Y (young).

MUTE SWAN *Cygnus olor* (B, W)
Inland WeBS: 283 in Jan, 267 in Feb, 232 in Mar, 125 in Sep, 214 in Oct, 191 in Nov and 238 in Dec.
Forth Est. WeBS: 27 in Jan, 18 in Feb, 13 in Mar, 9 in Sep, 4 in Oct, 42 in Nov and 76 in Dec.

F Breeding: Callendar Park (7Y); Forth/Clyde Canal, Camelon (4Y); Larbert House Loch (2Y); R. Carron, S. Broomridge (NE). Site max: 76 Skinflats Pools 6 Dec; 14 Helix Park 25 Oct and 11 Millhall Resr. 8 Mar.

C Breeding: Delph Pond, Tullibody (4Y); R. Devon: Dollar – Tillicoultry (3Y) & A907 - Cambus Weir (5Y). Site max: 114 (91 ad) R. Devon, Tullibody Br - A907 26 Jan; 103 Gartmorn Dam 25 Oct; 36 R. Devon, Alva - Tullibody Br 19 Dec; 21 R. Forth at Cambus 2 Apr and 20 R. Forth, Cambus – Alloa 17 Jan.

S Breeding: Airthrey L, BoA (pr + Y) 6 Jun; Cambusmore / Gart GP, Callander (5Y); Cromlix Ho L (4Y) and Ochlochy Pond (6Y). Site max: 17 Airthrey L, BoA 8 Oct; 11 Lake of Menteith 21 Jan; R. Forth: 14 W. Carse Fm – Teith conf. 18 Oct; 11 Teith – Allan conf's 18 Oct and 16 Stirling Br. – A91 on 20 Jan.

WHOOPER SWAN *Cygnus cygnus* (W)
Inland WeBS: 40 in Jan, 46 in Feb, 46 in Mar, 0 in Sep, 2 in Oct, 29 in Nov and 15 in Dec.
Forth Est. WeBS: 3 in Jan, 2 in Feb, 0 in Mar, 0 in Sep, 7 in Oct, 2 in Nov and 5 in Dec.
Spring departure: last 30 Mar S. Alloa. Autumn arrival: first 3 Oct L. Dochart. Single over-summering bird Drip Moss 14 Jun.

F Winter/spring site max: 13 S. Alloa 30 Mar. Autumn/winter site max: 39 Skinflats Pools 16 Nov.

C Winter/spring site max: 20 Longcarse 14 Mar. Autumn/winter site max: 23 Longcarse 15 Nov.

S Winter/spring site max: 31 L. Dochart / Iubhair 25 Feb; 24 Argaty Mill, Dunblane 1 Feb and 22 L. Venachar 12 Feb. Autumn/winter site max: 118 Dykehead, Kippen 16

Nov; 38 >S Dunblane 20 Nov; 28 Drumloist & L. Mahaick 28 Dec (same birds?) and 21 L. Dochart 21 Nov.

BEAN GOOSE *Anser fabalis* (W)

F Regular wintering flock of Taiga race birds in the vicinity of the Slamannan Plateau. Autumn/winter max: 165 Slamannan 2 Nov.

PINK-FOOTED GOOSE *Anser brachyrhynchus* (W)

Spring departure: last 160 Longcarse 13 May. Autumn arrival: first 20 Bannockburn 5 Sep. Presumed summering single birds were at Skinflats Pools (F) 30 Jun; Longcarse (C) 23 Aug and Higgin's Neuk (F) 3 Sep.

Forth Est. WeBS: 1,595 in Jan, 754 in Feb, 2154 in Mar, 5 in Sep, 4,931 in Oct, 5,975 in Nov and 1,377 in Dec. (virtually all (if not all) these birds are in fields above the high water mark. Although this species is recorded on inland WeBS counts many flocks spend the day grazing in non-wetland locations making the WeBS counts unrepresentative).

F Winter/spring site max: 2,525 Skinflats 8 Feb and 255 St Helen's Loch 17 Jan. Autumn/winter site max: 5,750 Skinflats 8 Nov; 3,160 S. Alloa 20 Oct; c.1,000 Powfoulis 7 Nov and 374 St Helen's Loch, Bonnybridge.

C Winter/spring site max: c.3,200 Longcarse 21 Mar; 3,125 Alloa Inch 13 Apr; c.1,800 Cambus 7 Feb & c.500 Blackgrange 1 Feb & 15 Mar. Autumn/winter site max: c.3,700 Longcarse 17 Oct and c.1,600 Ditch/Gogar 28 Dec.

S Winter/spring site max: c.1,250 Carse of Lecropt 12 Jan; c.1,200 Flanders Moss NR 2 Apr; c.1,100 >N Ashfield 9 Apr; c.1,100 R. Teith, W. Row-Forth conf. 8 Mar; c.1,000 Drip Moss 8 Mar and c.950 Ochtertyre Carse 12 Jan. Autumn/winter site max: c.1,500 Carse of Lecropt 29 Dec; c.800 Flanders Moss NR 26 Oct; c.750 R. Forth at Kippen 29 Nov and c.500 R. Forth at Gargunnock 15 Mar.

*WHITE-FRONTED GOOSE (Greenland race) *Anser albifrons* (w)

F One Skinflats 20 Mar (RS).

GREYLAG GOOSE *Anser anser* (b, W)

Spring departure and autumn arrival are muddied by the presence of an ever increasing number of resident feral birds.

Forth Est. WeBS: 27 in Jan, 25 in Feb, 46 in Mar, 281 in Sep, 498 in Oct, 8 in Nov and 95 in Dec (virtually all (if not all) these birds are in fields above the high water mark). Although this species is recorded on inland WeBS counts many flocks spend the day grazing in non-wetland locations making the WeBS counts unrepresentative).

F Winter/spring site max: 183 St Helen's Loch, Bonnybridge 17 Jan. Autumn/winter site max: 73 Skinflats Pools 12 Dec.

C Winter/spring site max: c.300 Alva Floods 28 Feb; c.300 Longcarse 21 Mar; 238 Gogar/Ditch, Tullibody 23 Jan and 153 Gartmorn Dam 15 Feb. Summer: 794 Longcarse 23 Aug. Autumn/winter site max: 430 Longcarse 17 Oct.

S Winter/spring site max: 152 R. Teith, W. Row-Forth conf. 8 Mar; 108 Kinbuck 20 Mar and 104 Blairdrummond 25 Jan. Autumn/winter site max: c.150 R. Forth, Kippen 29 Nov.

*SNOW GOOSE *Anser caerulescens*

The Snow Goose is commonly kept in captivity and escapes from there make it difficult to prove the provenance of suspected genuinely wild birds.

F One Larbert Hosp Pond 17 Jan (AB); 2 'blue morph' birds Slamannan 10 Feb (TF) and 1 Skinflats Pools 14 Nov (SW).

C One Cambus Village Pool 23 Mar (DH).

S One Airthrey L (BoA) 15 Jan.

CANADA GOOSE *Branta canadensis* (b W)

Numbers continue to increase steadily.

Inland WeBS: 606 in Jan, 538 in Feb, 602 in Mar, 429 in Sep, 562 in Oct and 527 in Dec.

Forth Est. WeBS: 0 in Jan, 0 in Feb, 0 in Mar, 77 in Sep, 21 in Oct, 26 in Nov and 31 in Dec.

BBS: recorded at 0.24 b/lkm (1997-2014 average: 0.1 b/lkm).

F Site max: c.280 Skinflats Pools 21 Sep; c.200 Skinflats Tidal Ex. 20 Sep; c.130 Larbert 12 Sep; 113 St Helen's Loch, Bonnybridge 12 Dec and 68 Little Denny Resr 3 Oct.

C Breeding: FL Y Gartmorn Dam 9 May; pr + 2Y Aberdona Ponds 25 May. Site max: 932 Longcarse 23 Aug (new high for the Upper Forth) and 291 Gartmorn Dam 18 Oct.

S Breeding: 14Y Cambusmore/Gart GP 17 May. Site max: c.250 Drip Moss 4 Sep; c.200 R. Forth at Gargunnock 4 Jan; c.170 L. Venachar 25 Sep; 162 L. Rusky 1 Sep; 132 Lake of Menteith 21 Feb; c.120 Carse of Lecropt 15 Nov; c.100 Flanders Moss NR 26 Oct; 91 L. Coulter 13 Dec; 87 Cambusmore/Gart GP 16 Aug; 87 R. Forth at Kippen 29 Nov; 72 L. Voil 27 Dec; 69 Killin Marshes 17 Jan; 64 R. Forth, Teith-Allan conf's 11 Sep and 49 L's Dochart/Iubhair 27 Feb.

BARNACLE GOOSE *Branta leucopsis* (w)

In our area it can be difficult distinguishing between wild migrants and feral birds resident in Britain but most records from Feb - Mar & Sep – Nov will be of wild birds on migration between Svalbard and the Inner Solway Firth.

F 10>SW Bo'ness 7 Feb; 1 Blackness 11 Oct; 39 Skinflats Pools 2 Oct; 7 Higgin's Neuk 26 Oct and 1 Powfoulis 21 Nov.

C 1 Tullibody 23 Mar; 13 Longcarse 10 Oct and 3 Longcarse 17 Oct.

S 6 Blairdrummond 1 Jan; 1 N. Third Resr 18 Mar (probable a feral bird – with Canada Geese); 2 head of L. Tay 24 May; 6 Blairdrummond 1 Nov and 2 Flanders Moss E 27 Dec.

*BRENT GOOSE (light-bellied) *Branta bernicla* (w)

F Three Blackness 26 Oct (DOE).

(Common) SHELDUCK *Tadorna tadorna* (b, W)

Inland WeBS: 0 in Jan, 0 in Feb, 32 in Mar, 0 in Sep, 0 in Oct, 0 in Nov and 10

Forth Est WeBS: 423 in Jan, 638 in Feb, 556 in Mar, 2,752 in Sep, 3,091 in Oct, 1,589 in Nov and 556 in Dec.

F Breeding: broods of 8 & 4 Kinneil 7 Jun. Moult flock max count of Kinneil / Skinflats 5,173 on 11 Aug (MVB). Site max: 4,590 Kinneil 11 Aug; 1,650 Skinflats 10 Sep; 337 Blackness 19 Oct; c.150 Skinflats Tidal Ex. 21 Sep and 109 S. Alloa 15 Aug.

C Site max. 21 Cambus Village Pools 1 May and 125 Tullibody Inch 13 May.

S Site max: 15 Blackdub Floods 8 Mar; 2 Blairdrummond Ponds 1 Apr; 2 Carse of Lecropt 1 Mar & 19 Dec; 2 Kinbuck 23 Feb; 2 R. Forth at Gargunnock 15 Mar and 1 Head of L. Tay (Killin) 10 Jan.

*MANDARIN DUCK *Aix galericulata* (b, w)

It is unknown whether the following records relate to a bird(s) bred in the wild or escapees.

C Single ♂'s at Gartmorn Dam 9 May (SMcG) and R. Devon (Alva-Tullibody Br.) 12 Sep (JRC).

S A single ♂ was reported from the R. Teith, The Meadows, Callander from 24 Jan-28 Mar (DOE, SO *et al*). Probably the same bird was then reported from the R. Teith at the Carse of Lecropt 9 Jun (DT) with again, probably the same bird, recorded at Doune Ponds from 8 Aug-24 Dec (DOE).

(Eurasian) WIGEON *Anas penelope* (s, W)

Inland WeBS: 284 in Jan, 174 in Feb, 339 in Mar, 10 in Sep, 108 in Oct, 162 in Nov and 239 in Dec.

Forth Est. WeBS: 689 in Jan, 431 in Feb, 714 in Mar, 8 in Sep, 207 in Oct, 639 in Nov and 1,014 in Dec.

F Winter/spring site max: 575 S. Alloa 5 Feb; 460 R. Forth, Alloa-Kincardine Br. 18 Jan; 117 Skinflats 8 Mar and c.80 Higgin's Neuk 4 Jan. Summer site max: c.200 Blackness 13 Jun. Autumn/winter site max: c.250 Blackness 21 Nov; 204 Skinflats 12 Dec; c.70 Kinneil 21 Nov; c.50 Powfoulis 12 Sep and c.50 Higgin's Neuk 29 Dec.

C Winter/spring site max: c.300 R. Forth, S. Alloa-Cambus 8 Mar; 92 Alva Floods 8 Mar and 50 Cambus Village Pools 11 Feb. Autumn/winter site max: 568 R. Forth, S. Alloa-Cambus and 53 Gartmorn Dam 13 Dec.

S Winter/spring site max: 78 L. Dochart 7 Feb; c.60 L. Iubhair 12 Feb; 59 Blackdub Floods 12 Jan; c.50 R. Forth (Gargunnock) 4 Jan and c.50 Cambusmore/Gart GP 14 Mar. Autumn/winter site max: c.200 Lecropt 27 Dec; 85 R. Forth, the Frews 22 Nov; 50 L. Dochart 13 Oct; c.50 R. Teith, W. Row-Teith conf. 25 Nov and 45 Killin Marshes 6 Dec.

GADWALL *Anas strepera* (s, w)

F Skinflats Pools: monthly max of 2 in Mar; 2 in Aug; 1 in Sep; 10 in Nov & 13 in Dec; ♂ Little Denny Resr 12 Feb (1st record here) and 3 R. Forth, Alloa-Kincardine Br 12 Jan.

C Blackdevon Wetlands: 2 on 11 Mar; 3 on 10 May & 6 on 24 Nov. Cambus Village Pools: monthly max of 2 in Mar; 8 in Apr & 2 in Aug; 6 Gartmorn Dam 25 Oct and 4 R. Forth, Cambus-Alloa 14 Mar.

(Eurasian) TEAL *Anas crecca* (b, W)

Inland WeBS: 1,150 in Jan, 1,374 in Feb, 1,466 in Mar, 502 in Sep, 980 in Oct, 872 in Nov and 1,052 in Dec.

Forth Est. WeBS: 1,912 in Jan, 1,285 in Feb, 895 in Mar, 453 in Sep, 685 in Oct, 2,237 in Nov and 3,332 in Dec.

F Winter/spring site max: 1,147 Kinneil 18 Jan; 420 Skinflats (WeBS area) 18 Jan; c.200 Higgin's Neuk 11 Feb; 177 R. Carron, Carron Ho.-A905 7 Feb; c.100 Skinflats Pools 11 Feb and 53 St Helen's Loch 19 Mar. Autumn/winter site max: 1,370 Kinneil 12 Dec; c.480 Skinflats (WeBS area) 12 Dec and 92 R. Carron, Carron Ho.-A905 19 Oct.

C R. Forth, Cambus-Alloa monthly max: c.300 on 25 Jan; c.120 on 28 Feb; c.210 on 8 Mar; 108 on 23 Aug; 303 on 9 Sep; 786 on 8 Nov and 1,241 on 12 Dec. Other site max: c.250 Devonmouth Pool 20 Nov; c170 Alva Floods 16 Dec and c.100 Cambus Village Pool 19 Nov.

S Site max: 283 R. Forth, St. Br.-A91; 14 Feb; 224 R. Forth, A91-Fallin 12 Nov; 188 Cambusmore/Gart GP 1 Feb; 148 Allan Water, Cambushinnie-Ashfield 7 Nov; 139 L. Dochart 3 Oct; 133 R. Forth, Fallin-Cambus 17 Jan; 112 Blackdub Floods, R. Teith 12 Jan; c.100 R. Forth, the Frews 22 Nov; 76 Killin Marshes 6 Dec; 75 L. Coulter 13 Dec; 67 R. Forth, W. Carse Fm-Teith conf.) 8 Mar; 65 L. Watston 14 Feb; 61 Balvag Marshes, Balquhidder 24 Feb and 52 Flanders Moss NNR 2 Oct.

MALLARD *Anas platyrhynchos* (B, W)

Inland WeBS: 2,573 in Jan, 2,218 in Feb, 1,476 in Mar, 1,691 in Sep, 1,425 in Oct and 1,645 in Dec.

Forth Est. WeBS: 372 in Jan, 326 in Feb, 182 in Mar, 143 in Sep, 124 in Oct, 221 in Nov and 324 in Dec.

BBS: recorded at 0.61 b/lkm (1997-2014 average: 0.62 b/lkm).

F Breeding: R. Carron, S. Broomage; Larbert Hosp. Pond and Falkirk (NS8779). Site max: 90 Larbert Hosp Ponds 12 Dec.

C Breeding: Devonmouth Pool and Cambus Village Pool. Site max: 239 Gartmorn Dam 18 Jan.

S Breeding: Ochlochy Pond. Site max: 175 R. Forth, W. Carse Fm-Teith conf. 18 Oct; 144 Cambusmore/Gart GP 1 Feb; 133 Blairdrummond Ponds 15 Sep; 113 L. Lubnaig 12 Jan; 109 Lake of Menteith 21 Jan; 100 L. Dochart 6 Feb; 94 Doune Ponds; 87 Balquidder Glen 30 Jan; 84 Airthrey L. 8 Oct; 80 R. Teith, Callander 9 Feb; 75 L. Coulter 25 Feb; 70 Cambushinnie 2 Feb and 70 Killin Marshes 7 Feb.

PINTAIL *Anas acuta* (W)

Forth Est. WeBS: 90 in Jan, 93 in Feb, 59 in Mar, 3 in Sep, 10 in Oct, 25 in Nov and 79 in Dec.

F Winter/spring site max: 92 Kinneil 4 Feb and 87 Skinflats 18 Jan. Autumn/winter site max: 21 Kinneil 12 Dec and 58 Skinflats 12 Dec.

*C Two Devonmouth Pool 9 Apr; 2 Cambus Village Pool 10 Apr; 3 R. Forth, Cambus-Alloa 9 Sep and 1 R. Forth, Cambus-Alloa 15 Nov.

*GARGANEY *Anas querquedula* (s)

C One ♂ Cambus Village Pool 9th -10th May (DH, DMB & JRC). This is the 25th record of this species in Upper Forth.

SHOVELER *Anas clypeata* (p)

F Skinflats Pools: 1 on 4 Jan; ♀ on 11 Apr; 3 on 25 Apr; 2 on 13 Jun; 3 on 20 Aug; 3 on 21 Sep; 2 on 2 & 11 Oct; 1 from 8 Nov – 31 Dec (AB, DOE, SW *et al*). 1 St Helen's Loch, Bonnybridge 19 Mar (NB). 2 Skinflats Tidal Ex 12 Apr (DOE). 1 Kinneil 25 Nov & 12 Dec (BMB, JRC) and a ♂ R. Carron, Carronshore) 13 Dec (AB).

C A ♂ Cambus Village Pools 2 Apr – 3 May (GG, DH *et al*). 1 Gartmorn Dam 4 Apr (RE). 2 R. Forth (Cambus-Alloa) 25-26 Apr (GG, JRC) and a ♂ Blackdevon Wetlands 10 May (DMB).

S 4 Flanders Moss 6 Nov (DP) and 2> BoA 11 Dec (FC).

*(Common) POCHARD *Aythya ferina* (W)

Numbers have reduced greatly over the past 15 years.

Inland WeBS: 3 in Jan, 7 in Feb, 2 in Mar, 0 in Sep, 0 in Oct, 8 in Nov and 7 in Dec.

F Skinflats Pools: 1 on 13 Jun; 4 from 9-12 Jul; 1 on 20 Aug; 1 from 18-24 Dec & 3 on 31 Dec (AB, NB, DOE & SW).

C Gartmorn Dam: 4 on 15 Feb; 2♂ on 14 Mar; 1 on 16 Jun; 18 on 31 Oct; 5 on 22 Nov & 11 on 1 Dec (WT, DMB, ACC, GG, SR, MVB).

S Cambusmore/Gart GP: single ♂ from 4 Jan – 21 Jun then 2 on 16 Aug (NB, DMB, DOE, DT). Killin Marshes / head of L. Tay (monthly max): 1 Jan; 4 Feb; 1 Mar; 1 Sep & 2 Nov (JPH). 1 L. Mahaick 7 Nov (DOE) and 7 CVR 13 Dec (JS/AM).

TUFTED DUCK *Aythya fuligula* (B, W)

Inland WeBS: 333 in Jan, 285 in Feb, 262 in Mar, 213 in Sep, 242 in Oct, 214 in Nov and 317 in Dec.

F Site max: 47 N. Pool Skinflats 9 Apr; 28 Callendar Park Loch 20 Jan and 27 L. Ellrig 4 Sep.

C Gartmorn Dam winter/spring max: 71 on 28 Feb. Autumn/winter site max: 125 on 25 Oct.

S Breeding: ♀ hatched 5 with only 1 fledging Ochlochy Pond. 2 ad + 8Y R. Forth, Drip Moss 16 Aug. Winter/spring site max: 75 Lake of Menteith 21 Jan; 45 Blairdrummond Ponds 3 Feb; 35 Cambusmore/Gart GP 14 Feb; 35 L. Watston 14 Feb and 21 L. Lubnaig 20 Jan. Summer site max: 243 Cambusmore/Gart GP 16 Aug (new high - moult flock) and 45 Blairdrummond Ponds 22 Aug. Autumn/winter site max: 49 Cambusmore/Gart GP 6 Sep and 47 Blairdrummond Ponds 7 Sep.

(Greater) SCAUP *Aythya marila* (s, w)

Forth Est. WeBS: 3 in Jan, 6 in Feb, 0 in Mar, 0 in Sep, 9 in Oct, 0 in Nov and 0 in Dec.

F Kinneil monthly max: 4 in Jan; 7 in Feb; 9 in Apr & 9 in Oct; ♂ N. pool Skinflats 14 Apr – 5 Sep; 2 Bo'ness 14 Feb; 1 Blackness Point 7 May and 1 R. Carron, Glensburgh 5 Jun.

S A ♂ Cambusmore/Gart GP 8 Mar – 19 Apr (NB, DMB, JRC) and a ♀ Killin Marshes 22 Nov (JPH).

(Common) EIDER *Somateria mollissima* (s, w)

Forth Est. WeBS: 9 in Jan, 6 in Feb, 4 in Mar, 0 in Sep, 3 in Oct, 2 in Nov & 3 in Dec.

F Blackness max: 1 in Jan, 2 in Feb, 7 in May, 45 in Jun, 52 in Sep & 6 in Dec; Bo'ness max: 12 in Feb & 6 in Dec; Kinneil max: 4 in Feb, 15 in Apr, 9 in Aug, 1 in Sep & 10 in Oct. Other: 4 Grangemouth 8 Mar; 5 Skinflats 30 Jul and 1 Higgin's Neuk 12 Apr.

*LONG-TAILED DUCK *Clangula hyemalis* (w)
C One Gartmorn Dam 22-26 Nov (JRC, AR).
S One Lake of Menteith 14 Jan, 2♀ on 21 Jan, 1 on 24 Jan & 2♀ on 13 Mar (CJP, NB).
*COMMON SCOTER *Melanitta nigra* (w)
F Bo'ness: 3 on 11 Feb & 1 on 21 Nov (DOE). 3 Carriden 16 Feb (DMB) and 3 Kinneil 21 Jan (JRC).
(Common) GOLDENEYE *Bucephala clangula* (W)
Inland WeBS: 422 in Jan, 383 in Feb, 401 in Mar and 0 in Sep.
Forth Est. WeBS: 33 in Jan, 25 in Feb, 19 in Mar, 0 in Sep, 0 in Oct, 1 in Nov and 91 in Dec.
F Site max: 54 R. Forth (S. Alloa) 5 Feb and 41 Kinneil 12 Dec.
C Site max: 78 (12♂) R. Devon (Tullibody Br.-A907) 26 Jan; c.70 Gartmorn Dam 14 Mar; 55 R. Forth at Cambus 29 Jan and 34 Alloa Inshes 12 Dec.
S Site max: 146 Lake of Menteith (13 Mar); 42 Head of L. Tay 29 Mar; 33 L. Venachar 17 Mar and 29 Blackdub Floods, R. Teith 12 Jan.
*SMEW *Mergellus albellus* (w)
What was probably the red-head from 2014 returned as an adult ♂.
S Blairdrummond Ponds: intermittently from 8 Jan-15 Apr (NB, DOE *et al*). Other sightings of the same bird: Blackdub floods 12 Jan (NB) and around the Forth/Teith conf. 18 Jan, 19 Jan, 25 Jan & 4 Feb (DK, DT, DOE, DMB).
RED-BREASTED MERGANSER *Mergus serrator* (B, W)
Inland WeBS: 0 in Jan, 1 in Feb, 4 in Mar, 0 in Sep, 6 in Oct, 0 in Nov and 1 in Dec.
Forth Est. WeBS: 31 in Jan, 36 in Feb, 13 in Mar, 27 in Sep, 79 in Oct, 64 in Nov and 93 in Dec.
F Kinneil monthly max: 6 in Jan, 21 in Feb, 60 in Aug, 36 in Sep, 43 in Oct, c.20 in Nov & 2 in Dec. Other site max: 14 Blackness 26 Oct; 39 Bo'ness 26 Jul (3 ad with crèche); 10 Skinflats Est 12 Dec; 3 Skinflats Pools 31 Jan; 4 Skinflats Tidal Ex. 26 Oct; 5 Higgin's Neuk 29 Dec; 2 Forth/Clyde Canal, Lock 16-R. Carron 10 Mar and a ♀ L. Ellrig 19 Mar.
C Three R. Forth (Cambus) 11 Feb & 18 Mar.
S Site max: Forth/Teith conf: 2 in Feb, 4 in Mar & 1 in Dec; 1 R. Forth, Allan conf-Stirling Br 22 Feb; 2 Head of L. Tay 22 May & 1 on 9 Jun; 2 L. Katrine 28 Apr with 1 on 4 May and 2 L. Arklet 30 Apr with 4 on 14 Jun.
GOOSANDER *Mergus merganser* (B, W)
Inland WeBS: 119 in Jan, 123 in Feb, 146 in Mar, 72 in Sep and 125 in Dec.
Forth Est. WeBS: 2 in Jan; 4 in Feb, 34 in Mar, 14 in Sep, 6 in Oct, 13 in Nov and 32 in Dec.
F Site max: 23 Kinneil 11 Aug; 16 Forth/Clyde Canal, Lock16-Bonnybridge 8 Mar; 16 R. Carron (Carron Br- Carronhouse) 13 Sep; 15 Forth/Clyde Canal, Kelpies-Falkirk Wheel 28 Dec; 14 (7♂) Black Loch, Limerigg 12 Feb; 13 mouth of the R. Carron 11 Aug; 13 Skinflats 13 Sep; 11 Union Canal, Glen Village-Polmont 17 Dec and 10 R. Carron, Larbert 8 Feb.
C Site max: 74 R. Forth, Cambus 13 Mar; 22 Gartmorn Dam 27 Nov and 13 (6♂) R. Devon, Tullibody Br-A907 24 Mar.
S Breeding: R. Fillan, Kirkton ♀ + 7 ducklings 10 Jun. Site max: 42 R. Forth, Stirling Br-A91 14 Feb; 23 R. Forth, Teith-Allan conf's 18 Oct; 19 (6♂) W Loch of Daldorn 13 Mar; 14 Head of L. Tay 13 Jul; 12 Allan Water, Ashfield 14 Sep; 12 Blairdrummond Ponds 15 Nov and 12 R. Forth, Drip Moss.
RED GROUSE *Lagopus lagopus* (B, W)
Present in small numbers in heather habitat
BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.1 b/lkm).
S Site max: 10 Sheriff Muir 20 Feb; 4 Burnfoot Moor (NS 6890) 6 Sep; present Ling Hill (NS6689) 28 Mar and Beinn Duhbchraig, Tyndrum 3 Feb.

*PTARMIGAN *Lagopus muta* (b, w)
S One Ben Lui 14 Mar (AK) and 7 Ben Ledi 30 Oct (AMu).
*BLACK GROUSE *Tetrao tetrix* (b, w)
S 13 L. Arklet 1 May (JC); 4 Bracklinn 9 May (JRC); 4 Gleann a' Chlaichain 24 Jan (JPH); 4 Leathan Dhail (NN 6510) 21 Nov (JN); 1 G. Finglas 10 Mar (RE); 1 Lendrick Hill (Brig o' Turk) 8 May (RE) then 21 Jul (JJH); present Finglen Burn (Ardeonaig) 22 Mar (MGB) and present Ling Hill (NS6689) 28 Mar (ATP).
*RED-LEGGED PARTRIDGE *Alectoris rufa* (b, w).
It is thought unlikely that the small feral population is self-sustaining.
F Present Skinflats 7 Jun (SB).
S One Cambushinnie 2 Feb (DOE); 1 Sheriff Muir 16 Apr (DOE) and 2 lower E slopes of Ben Ledi 30 May (AMu).
GREY PARTRIDGE *Perdix perdix* (b, w)
Has become quite scarce during the last 20 years. A small number of releases, including at Blairdrummond, helps sustain numbers.
F Site max: 7 Skinflats Pools 4 Jan.
C Site max: 15 Blackdevon Wetlands 18 Jan; 2 Cambus 28 Jul and 1 Gartmorn Dam 25 Feb.
S Site max: 16 Blairdrummond Ponds 25 Jan and 8 Hilton, Flanders Moss 15 Nov.
*(Common) QUAIL *Coturnix coturnix* (b)
S One calling Flanders Moss NNR 14 Jun (EMcL).
(Common) PHEASANT *Phasianus colchicus* (B, W)
Large numbers released on shooting estates, otherwise widespread but in small numbers.
BBS: recorded at 0.4 b/lkm (1997-2014 average: 0.5 b/lkm).
*RED-THROATED DIVER *Gavia stellata* (b, w)
F 1 Kinneil 7 Feb (DMB) and 1 Blackness 29 Dec (DOE).
S Successful breeding at one undisclosed location in the Trossachs 22 Aug (SW).
*BLACK-THROATED DIVER *Gavia arctica* (b)
S 1 Head of Loch Tay intermittently from 21 Apr-13 Jul (JPH). Also present at three undisclosed locations in Trossachs from 17 Mar-13 Aug (NB, RE, DOE, JC) and 2 at an undisclosed location in NW of area 2-4 Jun (JPH).
LITTLE GREBE *Tachybaptus ruficollis* (B, w)
Inland WeBS: 70 in Jan, 66 in Feb, 50 Mar, 89 in Sep, 79 in Oct and 40 in Dec.
F Breeding: 4Y Darnrigg Moss Pools 15 Sep; 1Y Braeface Pond 4 Sep and 1Y Little Denny Resr (4 Sep). Site max: 17 Little Denny Resr 4 Mar; 13 Drumbowie Resr 4 Mar; 9 Darnrigg Moss Pools 28 Sep and 7 N. Pool Skinflats 29 Jul.
C Site max: 6 R. Devon, Alva-Tullibody Br. 9 Feb.
S Breeding: 2Y Sheriffmuir Big Wood 1 Aug; 2 hatched (1 fledged) Ochlochy Pond (Dunblane) 1 Jun and 2Y Lochan Chip Dhuibh 17 Sep. Site max: 31 Cambusmore/Gart GP 16 Sep; 14 L. Dochart 18 Jan & 21 Nov; 11 L. Lubnaig 20 Jan & 11 Feb; 10 Blairdrummond Ponds 15 Sep; 7 L. Ard 19 Oct; 5 L. Voil 27 Dec and 5 Wester Cambushinnie Pond 22 Sep.
GREAT CRESTED GREBE *Podiceps cristatus* (b, W)
Inland WeBS: 4 in Jan, 23 in Feb, 36 in Mar and 51 in Sep.
Forth Est. WeBS: 2 in Jan, 16 in Feb, 3 in Mar, 7 in Sep, 51 in Oct, 8 in Nov and 10 in Dec.
F Monthly max: Blackness: 2 in Jan, 45 in Jun, 25 in Sep, 35 in Oct, 2 in Nov & 10 in Dec. Kinneil: 8 in Jan, 14 in Feb, 25 in Jul, 13 in Aug, 38 in Sep, 51 in Oct & 8 in Nov. N. Pool Skinflats: between 1-4 birds from Mar – Dec with nesting but no Y recorded. Other site max: 5 Forth Est, Bo'ness 21 Sep; ad + 2 juv L. Ellrig 4 Sep; 2 Darnrigg Moss Pools 16 Apr and 1 Skinflats Tidal Ex. 29 Dec.
C Monthly max Gartmorn Dam: 2 in Feb, 6 in Oct, 10 in Nov & 7 in Dec.

S Monthly max: Lake of Menteith: 4 in Jan, 23 in Feb, 27 in Mar, 47 in Sep (a new high which incl. 11 large Y) & 1 in Dec. Other sites summer: up to 6 at Cambusmore/Gart GP 14 Mar-21 Jun with one nest but no Y noted; 1-2 Blairdrummond Ponds 7 Mar-15 Apr. Other sites max: 2 CVR 8 Mar; 2 L. Venachar 26 Apr; 2 N. Third Resr 18 Mar; 2 L. Watston 22 Mar and 1 L. Coulter 18 Mar.

*SLAVONIAN GREBE *Podiceps auritus*

F 1 Blackness 19 & 26 Oct (DMB, DOE) and 1 Grangepans 8 Nov (JRC).

*FULMAR *Fulmaris glacialis* (s, p)

F One Forth at Skinflats 2 Mar (DMB).

(Northern) GANNET *Morus bassanus* (p)

Mostly juv's / imm's.

F 1-2 Kinneil 12-29 Sep (CJP, DMB, DOE, DT); 4 Kinneil 5 Oct (DT); 1 Skinflats 13 & 16 Sep (DOE, DMB); 2 Skinflats Tidal Ex 19 Sep (DOE); 3 Blackness 21 Sep (DOE) and 3 Higgin's Neuk 25 Sep (ACC).

S 1 > Causewayhead, Stirling 11 Sep & 22>W R. Forth (Meiklewood) 20 Sep (JDI).

(Great) CORMORANT *Phalacrocorax carbo* (S, W)

Inland WeBS: 88 in Jan, 88 in Feb, 83 in Mar, 38 in Sep and 120 in Dec.

Forth Est. WeBS: 59 in Jan, 60 in Feb, 47 in Mar, 87 in Sep, 125 in Oct, 104 in Nov and 51 in Dec.

F Site max: 24 Skinflats (WeBS area) 11 Oct; 12 Bo'ness 21 Sep; 12 Kinneil 21 Sep and 8 Higgin's Neuk 11 Feb.

C Monthly max R. Forth, Longcarse: 11 in Jan, 18 in Feb, 65 in Mar, 24 in Apr, 8 in May, 42 in Sep, 53 in Oct (viaduct roost) & 84 in Nov. Other site max: 24 R. Forth at Cambus 13 Mar. A *sinensis* bird was at Gartmorn Dam 1 Feb (DOE).

S Monthly site max: Lake of Menteith: 40 in Jan (new high), 29 in Feb, 31 in Mar & 40 in Oct. CVR: 19 in Mar, 12 in Sep, 11 in Oct & 30 in Dec. Other site max: 14 Head of L. Tay 4 Jan; 10 R. Forth, A91-Fallin 8 Mar; 8 L. Lubnaig 11 Feb; 8 R. Teith (Lecropt) 13 Sep; 7 Cambusmore/Gart GP 5 Apr; 7 L. Rusky 21 Feb; 7 R. Forth (Teith-Allan conf's) 9 Feb; 6 R. Forth (Drip Moss) 18 Oct and 5 N. Third Resr. 24 Jan.

*SHAG *Phalacrocorax aristotelis* (w)

F 1 Blackness 21 Nov (DOE).

* (Eurasion) BITTERN *Botaurus stellaris* (w)

F One Kinneil Lagoon 12-14 Sep (CS). This is only the 4th record for the area, the 1st being on the Goodie Water (S) on 30/10/1972.

LITTLE EGRET *Egretta garzetta* (w)

F Max 4 Higgin's Neuk / Kincardine Br area 1 Jan-6 Apr then 2 on 8 Aug, 4 on 22 Nov & 1 on 12 Dec. 1 Kinneil 6 Sep – 14 Oct. 1 Powfoulis 21 Jan & 3 on 10 Oct. Between 1 – 3 intermittently at Skinflats Pools throughout the year. 1 S. Broomage 23 Aug. 1 Skinflats Tidal Ex 29 Mar then 1-3 from 21 Aug-5 Dec. A bird at Higgin's Neuk 18 Mar was ringed as a juv in Nottinghamshire in 2014.

*C Two Kennetpans, 1 Longcarse and 1 Cambus 3 Jan; 1 Kennetpans 21 Feb and 1 Blackdevon Wetlands 21 Mar.

GREY HERON *Ardea cinerea* (B, W)

Inland WeBS: 120 in Jan, 97 in Feb, 58 in Mar, 88 in Sep and 62 in Dec.

Forth Est. WeBS: 35 in Jan, 10 in Feb, 2 in Mar, 33 in Sep, 53 in Oct, 27 in Nov and 36 in Dec.

BBS: recorded at 0.11 b/lkm (1997-2014 average: 0.12 b/lkm).

F Breeding: 24 AON Dunmore Woods. No nesting at Kinneil Wood (trees felled). Site max: 26 Skinflats (WeBS area) 11 Nov; 15 R. Forth, Alloa-Kincardine Br (WeBS) and 10 Kinneil 14 Oct.

C Site max: 9 R. Forth (Cambus-Alloa) 9 Sep; 9 Alloa Inch 10 Oct; 6 Alva Floods 18 Jan & 17 Oct.

S Breeding: 21 AON Nyadd. No nesting Cardross Wood. Site max: 12 R. Teith (Lecropt) 8 Feb; 11 Eas Gobhain, Callander 30 Jan (NH); 10 Netherton Marsh (BoA) 19 Jan; 10 Cambusmore/Gart GP 6 Sep and 9 Blairdrummond Ponds 24 Feb.

RED KITE *Milvus milvus* (b ,W)

*C 1 Menstrie Glen 7 Feb & 21 Mar (JRC, DMB).

S Breeding: of 32 pairs on territory 25 were known to lay eggs of which 19 hatched fledging at least 26 Y (DOE, MMcD, DA). Max of c.40 Argaty 1 Jan & 7 Nov. Regular in areas of BoD; Cromlix; Stirling; BoA; Dunblane and Callander. Occ. sightings in areas of CVR; Earlsburn Resr's; Flanders Moss and Gargunnock.

*WHITE-TAILED EAGLE *Haliaeetus albicilla* (s, w)

All likely to refer to birds from the Fife reintroduction scheme.

F 1 Bo'ness 4 Oct (RS).

S 1 L. Katrine 19 Jan (DOE); 1 Finglen, Ardeonaig 22 Mar and 1 Auchtertyre, Strath Fillan 16 Apr (EC).

*MARSH HARRIER *Circus aeruginosus* (p, s)

F One Skinflats Pools and Powfoulis 22 Aug (♀/imm) & 8 Sep (AB, RS, DB).

C One juv Alloa and Tullibody Inches 12 & 20 Sep (GG, DMB).

S One conf of the R. Forth and the Bannock Burn 20 Aug (ATP).

*HEN HARRIER *Circus cyaneus* (b, w)

S Flanders Moss: 1 on 24 & 27 Jan (CJP, DAP), ♂ 21 Feb (DMB), 1 on 3 Jun (DP), 1 on 3 Sep, ♀/imm on 16 Sep & ♂ 8 Oct (DAP). Other records: 2 Fintry Hills 11 Apr (ATP); 1 L. Venachar 3 Jan (RE); 1 carse N of Kippen 27 Feb & ♂ 7 Mar (RJS); 1 Drip Moss 17 May (GW) and 1 L. Mahaick 24 Oct & 7 Nov (DOE).

*(Northern) GOSHAWK *Accipiter gentilis* (b, w)

F 1 Callendar Park (Falkirk) 1 Aug (SW).

S Imm ♂ Earlsburn Moor 20 Apr (EJM) and ♀ Arnprior 23 Oct (JDI).

(Eurasion) SPARROWHAWK *Accipiter nisus* (B, W)

Inland WeBS counts: 6 in Jan, 4 in Feb, 0 in Mar, 6 in Sep, 2 in Oct, 7 in Nov and 4 in Dec. Recorded throughout the majority of the recording area. Contributors are encouraged to submit breeding records.

C Pr alarming Menstrie 3 Aug.

(Common) BUZZARD *Buteo buteo* (B, W)

Recorded throughout the majority of the recording area. Contributors are encouraged to submit breeding records.

Inland WeBS counts: 52 in Jan, 42 in Feb, 43 in Mar, 48 in Sep, 43 in Oct, 39 in Nov and 35 in Dec.

BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.3 b/lkm).

F Breeding: NY Callendar Park & Helix Park 3 Jun. Bird with white wing tags 'U6' on both wings Skinflats 11 Oct. Juv still giving begging food calls Kilbean Wood (Falkirk) 11 Oct. Max counts: 5 over central Falkirk 13 Aug and 5 Carronshore 27 Sep.

C Max count: 5 Gartmorn Dam 29 Mar.

S Bird mobbing a Golden Eagle Tyndrum 22 Apr. Max counts: 9 R. Teith, Lecropt 18 Jan; 7 G. Dochart 14 Mar; 6 R. Forth, Drip Moss 18 Oct and 5 R. Forth, Meiklewood 15 Nov.

*GOLDEN EAGLE *Aquila chrysaetos* (s, w)

C 1 Tarmangie Hill 14 Mar (JGR).

S Juv bird (mobbed by Hooded Crows) Gleann a' Chlachain, Ben Challum 6 Feb (JPH); 1 Ardeonaig, L. Tay 7 Feb (DOE); imm. Finglen, L. Tay 22 Mar (MGB); 1 Earlsburn Resr's 12 Apr (DOE); juv (mobbed by a Buzzard) nr Tyndrum 22 Apr (JPH); 1 L. Arklet 1 May (JC); 1 Lower Botaurnie, G. Lochay 1 May (GK); 1 Stob Breac 25 May (DHi); 1 Stronachlachar 13 Aug (JC); 1 L. Tinker 4 Sep (ES) and 1

Achmore Burn, Killin 23 Sep (PS).

OSPREY *Pandion haliaetus* (B)

Breeding: of 15 prs 13-14 laid clutches with 11 prs successfully raising 27 Y.

First records of the year: 1 Tillicoultry Golf Course 3 Mar (LW); 1 Kinlochard 16 Mar (DOE); 1 Stirling 20 Mar (BGs) and 1 Longcarse 21 Mar (JRC). Last record: 1 Lanrick (R. Teith) 9 Sep (DOE).

F 1 Skinflats Pools 5 Sep (SW).

S Summer: present throughout the district, particularly Callander, Doune, Lake of Menteith and L Tay areas.

(Common) KESTREL *Falco tinnunculus* (B, W)

Inland WeBS counts: 6 in Jan, 3 in Feb, 7 in Mar, 8 in Sep, 3 in Oct, 4 in Nov and 5 in Dec. Recorded throughout most of the recording area. Contributors are encouraged to submit breeding records.

S Max 3 L. Mahaick 14 Mar.

*MERLIN *Falco columbarius* (b?, w)

F Skinflats: 1 on 4 Jan, 11 & 14 Feb (AB, CJP); 1 (chasing a Tree Sparrow) 8 Feb (WT). 1 Kincardine Br 8 Mar (MVB); 1 Carronshore 1 Oct (AE); 1 Kinneil 22 Oct (DT); 1 Powfoulis 21 Nov (DOE) and 28 Nov (AB).

S 1 Biggins, SE Dunblane 11 Jan (SG); 1 Flanders Moss 24 Jan (CJP); 1 Carse of Lecropt 19 Mar (DT); 1 Hoish (NS 5292) 28 Apr (DOE) and 1 G. Breac-nic (NN5305) 2 May (CW).

PEREGRINE FALCON *Falco peregrinus* (B, W)

Widespread in small numbers outwith the breeding season, mostly in lowland areas and especially along the tidal R. Forth and estuary. Birds observed on wader kills at Kinneil & Skinflats.

WATER RAIL *Rallus aquaticus* (b, w)

F Site max: 4 Kinneil 23 Jan; 2 Skinflats Pools 21 Apr & 14 Nov and 1 Glen Marsh, Lionthorn, Falkirk 18 Oct.

C Site max: 11 Longcarse 21 Mar; 4 Cambus 12 Apr; 2 Blackdevon Wetlands 21 Mar & 10 May and 2 R. Forth, Blackgrange 7 Apr.

S Singles at Killin Marshes; Laighills, Dunblane; L. Watston and R. Forth, Drip Moss.

MOORHEN *Gallinula chloropus* (B,W)

Inland WeBS: 93 in Jan, 63 in Feb, 65 in Mar, 82 in Sep, 82 in Oct and 64 in Dec.

F Breeding; 1 chick St Helen's Loch 4 Sep. Skinflats Pools monthly max: 5 in Jan, 5 in Feb, 12 in Mar, 12 in Apr, 7 in May, 5 in Jul, 15 in Aug, 17 in Sep, 16 in Oct, 20 in Nov & 9 in Dec. Other site max: 10 Forth/Clyde Canal, Kelpies-Falkirk Wheel 28 Dec; 9 Callendar Park Loch 22 Nov; 7 Larbert Hosp Ponds 17 Jan; 7 R. Carron, S. Broomage 8 Feb; 6 Kinneil Ho. Curling Pond 20 Jan; 5 Glen Marsh, Lionthorn 18 Oct and 5 Darnrigg Moss Pools 5 Aug.

C Breeding: 1Y Delph Pond, Tullibody 9 Sep and 1Y R. Devon, A907-Cambus Weir 14 Sep. Site max: 11 R. Devon, Alva-Tullibody Br. 15 Nov; 10 R. Forth, Cambus-Alloa 15 Mar and 10 in a Cambus Village garden (25 Jan).

S Breeding: 4Y Ochlochy Pond, Dunblane 15 Jul. Site max: 20 Airthrey L. 16 Jan and 8 Cultenhove Dam 25 Feb.

(Common) COOT *Fulica atra* (B, W)

Inland WeBS: 210 in Jan, 105 in Feb, 105 in Mar, 53 in Sep, 139 in Oct, and 158 in Dec (wintering numbers have reduced greatly during the last decade).

F Breeding: 4 pr's with Y Larbert Hosp. Ponds 7 May; 2 pr's on nests R. Carron, S. Broomage 2 Jun; 1Y Darnrigg Moss Pools 14 Aug and 2 juv Braeface Pond, Banknock 4 Sep. Site max: 21 Skinflats Pools 9 Apr.

C Site max: 112 Gartmorn Dam 15 Feb.

S Site Max: 85 Airthrey L. 16 Jan and 36 Lake of Menteith 21 Jan.

OYSTERCATCHER *Haematopus ostralegus* (B, W)
Inland WeBS: 20 in Jan, 146 in Feb, 548 in Mar, 0 in Sep, 0 in Oct, 2 in Nov and 0 in Dec.
Forth Est. WeBS: 301 in Jan, 341 in Feb, 298 in Mar, 198 in Sep, 176 in Oct, 200 in Nov and 169 in Dec.
BBS: recorded at 0.44 b/lkm (1997-2014 average: 0.77 b/lkm).
Early inland spring return: 5 Longcarse 3 Jan; 1 Blairdrummond Ponds 8 Jan (bird appeared to overwinter here); 2 R. Forth, Teith-Allan conf's 19 Jan and 1 R. Forth, St. Br.-A91 20 Jan.

F Site max: 349 Kinneil 11 Aug; c.200 Skinflats Pools 8 Feb; c.60 Blackness 11 Feb and 60 Powfoulis 12 Sep.
C Site max: 42 Longcarse 28 Feb.
S Breeding: Pr with 1 chick St. Uni. 27 May. Site max: 168 Blairdrummond Ponds 10 Mar; 66 R. Forth, St. Br.-A91 8 Mar; 35 Cambusmore/Gart GP 14 Mar and 26 Head of L. Tay 13 Aug.

RINGED PLOVER *Charadrius hiaticula* (b, W)
Forth Est. WeBS: 5 in Jan, 81 in Feb, 4 in Mar, 0 in Sep, 4 in Oct, 0 in Nov and 5 in Dec.

F Monthly max: Kinneil: 26 in Jan, 81 in Feb, 7 in Aug, 71 in Sep, 80 in Oct & 5 in Nov. Blackness: c.30 in Feb, 31 in May, 10 in Jun, 20 in Sep, 8 in Oct & 6 in Nov. Other records: 13 Bo'ness 26 Jul; 2 Skinflats fields (temp pool) 20 May; 2 Skinflats Pools 12 Jul and 1 on 11 Aug.
C Spring passage of *tundrae* type birds: 28 Kennet Pans 9 May.
S Summer: monthly max Cambusmore/Gart GP: 9 on 8 Mar, 3 in Apr, 8 in May & calling ad + large Y 16 Aug. Head of L. Tay: 1 on 26 Mar, 1 in Apr & 6 on 12 Sep.

(European) GOLDEN PLOVER *Pluvialis apricaria* (B, W)
Forth Est. WeBS: 0 in Jan, 0 in Feb, 0 in Mar, 15 in Sep, 193 in Oct, 165 in Nov and 15 in Dec.

F Monthly max Kinneil: c.200 in Feb, 31 in Sep, 192 in Oct, 212 in Nov & c.100 in Dec. Other site max: 42 Blackness 21 Nov; c.30 Skinflats 26 Oct and 10 Skinflats Tidal Ex 21 Sep.
S 2 Kirkton Fm, Tyndrum 23 Mar; 1 Shieldbrae, Touch Hills 22 Apr; 1 Meall Buidhe, Tyndrum 24 Jun; 1 Beinn Challum, Tyndrum 25 Jul; 4 Stuc a'Chroin 30 Aug and 1 Flanders Moss NNR 16 Sep.

GREY PLOVER *Pluvialis squatarola* (p/w)

F Skinflats Pools monthly max: 2 on 4 Jan, 1 on 20 Aug, 5 on 28 Sep, 3 on 24 Oct & 1 on 13 Nov. Other site max: 1 Kinneil Lagoon 30 Jun and 5 Skinflats Tidal Ex 20 Sep.

(Northern) LAPWING *Vanellus vanellus* (B, W)
Inland WeBS: 191 in Jan, 149 in Feb, 206 in Mar, 441 in Sep, 365 in Oct, 227 in Nov and 116 in Dec.
Forth Est. WeBS: 594 in Jan, 78 in Feb, 300 in Mar, 509 in Sep, 1,673 in Oct, 1,580 in Nov and 1,131 in Dec.
BBS: recorded at 0.44 b/lkm (1997-2014 average: 0.78 b/lkm).

F Winter/spring site max: c.400 Kinneil 13 Jan; 225 R. Forth, Alloa- Kinc. Br. 18 Jan and 64 Braeface Pond, Banknock 12 Feb. Autumn/winter site max: 526 Kinneil (WeBS area) 8 Nov; c.490 Skinflats (WeBS area) 12 Dec; 70 Darnrigg Moss Pools 9 Aug and 58 Gardrum Moss 4 Oct.
C Winter/spring site max: 77 Alva Floods 8 Mar and 70 Gartmorn Dam 25 Feb. Autumn/winter site max: c.870 R. Forth, Cambus-Alloa 10 Oct; 165 R. Forth, Fallin-Cambus 24 Nov and 97 Alva Floods 13 Sep.
S Winter/spring site max: 159 Blairdrummond Ponds 22 Feb; 141 Cambusmore/Gart GP 4 Jan and 76 R. Forth N of Kippen 6 Mar. Autumn/winter site max: 148 Cambusmore/Gart GP 6 Sep and 91 R. Forth, Meiklewood 18 Oct.

(Red) KNOT *Calidris canutus* (W)
Forth Est. WeBS: 2,160 in Jan, 2,620 in Feb, 782 in Mar, 0 in Sep, 441 in Oct, 12 in Nov and

212 in Dec.

F Kinneil monthly max: 3,150 in Jan, 3,050 in Feb, 782 in Mar, 1 in May, 3 in Jul, 40 in Aug, 107 in Sep & 440 in Oct. Other sites: 55 Skinflats 25 Aug.

C 8 Cambus Pools (SWT res) 10 Apr and 3 Cambus Village Pool 13 May.

*SANDERLING *Calidris alba*

F One (moulting ad) Skinflats Pools 8-9 Aug (DMB, AB) and 2 from 28-30 Sep (AB, SW). 1 Kinneil 23 Oct (RS).

S One (summer plumage) Head of L. Tay 14 Aug (JPH).

*LITTLE STINT *Calidris minuta*

F One (juv) Skinflats Pools 5 & 15 - 17 Sep (DOE, DMB).

*CURLEW SANDPIPER *Calidris ferruginea* (p)

F One Kinneil 13-19 Sep (AB, SW). 1 Skinflats Pools 30 Aug, 15-18 & 30 Sep (DB, RS, SW).

DUNLIN *Calidris alpina* (b?, W)

Forth Est WeBS: 4,170 in Jan, 3,710 in Feb, 1,347 in Mar, 351 in Sep, 1,161 in Oct, 1,732 in Nov and 3,771 in Dec.

F Kinneil monthly max: 3,835 in Jan, 3106 in Feb, 978 in Mar, 10 in Apr, 2 in July, c.50 in Aug, 3 in Sep, c.1,500 in Oct, c.1,500 in Nov & c.2,000 in Dec. Skinflats WeBS: 326 in Jan, 570 in Feb, 315 in Mar, 325 in Sep, 367 in Oct, 119 in Nov & 495 in Dec. Skinflats Pools monthly max: 20 in May, 6 in Aug, 14 in Sep, 12 in Oct, 15 in Nov & 12 in Dec. 5 Skinflats Tidal Ex 23 Aug & 1 on 29 Dec. Blackness monthly max: 1 in Jan, 25 in Jun, c.40 in Sep, 3 in Oct, c.150 in Nov & 2 in Dec. Other sites: c.50 Bo'ness 29 Dec and 3 on temp pool in Skinflats fields 20 May.

C 9 Blackdevon Mouth 25 Feb.

S 1 Cambusmore/Gart GP 25 Apr. Head of L. Tay: 1 on 26 & 2 on 29 Apr, 1 on 14 May.

RUFF *Philomachus pugnax* (w, p)

F Skinflats Pools: 1 ('ruffed' ♂) 24 Apr, 2 on 30 July then present during Aug with max of 11 on 30th. 1-2 Kinneil 9 Aug-3 Oct & 1 on 12 Dec. Other site max: 8 Powfoulis 23 Aug; 1 Higgin's Neuk 2 Sep and 1 Gardrum Moss 9 Oct.

C One mouth of Black Devon 28 Feb and 2 Tullibody Inch 23 Aug.

JACK SNIPE *Lymnocryptes minimus* (w)

Inland WeBS: 4 in Jan, 2 in Feb, 3 in Mar, 0 in Sep, 0 in Oct, 0 in Nov and 4 in Dec.

F Four St Helen's Loch (Bonnybridge) 17 Jan with singles 12 Feb & 19 Mar (NB); 2 Higgins Neuk 21 Jan, 1 on 26 Oct & 6 on 10 Dec (DOE, RS); 2 Kinneil Lagoon 31 Jan (BGs); 1 Darnrigg Moss Pools 21 Feb (TF); 1 Skinflats Pools 7 Nov-29 Dec (DOE, SW) and 1 Skinflats fields (flood pool) 10 Dec (RS).

S Singles Wester Moss (Fallin) 8 Jan & 15 Oct (DH); 1 Carse of Lecropt 20 Jan, 2 on 3 Feb, 1 on 1 Mar & 1 on 19 Dec (DT, DOE); 2 Flanders Moss NNR 23 Jan, 1 on 4 Mar & 2 on 12 Dec (DAP); 2 Cambusmore/Gart GP 8 Feb, 2 on 8 Mar & 1 on 5 Apr (NB); 1 R. Forth, Drip Moss 8 Feb (GW) and 1 Ashfield Pools 12 Dec (DAP).

(Common) SNIPE *Gallinago gallinago* (B,W)

Inland WeBS: 126 in Jan, 89 in Feb, 96 in Mar, 16 in Sep, 61 in Oct, 73 in Nov and 47 in Dec.

Forth Est. WeBS: 3 in Jan, 12 in Feb, 0 in Mar, 3 in Sep, 2 in Oct, 8 in Nov and 35 in Dec.

BBS: recorded at 0.15 b/lkm (1997-2014 average: 0.08 b/lkm).

F Winter/spring site max: 28 St Helen's Loch (Bonnybridge) 17 Jan; 15 Higgin's Neuk 21 Jan and 7 S. Alloa 5 Feb. Autumn/winter site max: 17 Higgin's Neuk 10 Dec; 15 Gardrum Moss 3 Oct; 9 Skinflats 21 Nov and 6 L. Ellrig 4 Sep.

C 12 R. Devon, Tilly-Alva 8 Mar and 5 Cambus Pools (SWT Res) 18 Mar.

S Winter/spring site max: 47 Cambusmore/Gart GP 4 Jan; 25 R. Forth, St Br-A91 8 Mar; 12 R. Forth, E. Frew-Garg. Br. 15 Mar; 9 Carse of Lecropt 1 Dec; 8 Wester Moss 8 Jan and 7 Killin Marshes 17 Jan. Autumn/winter site max: 33 Netherton Marsh.

BoA 17 Nov; 22 R. Forth, St Br-A91 17 Oct; 22 Westley's, Carse of Lecropt 22 Nov; 10 Wester Moss 15 Oct; 9 Blairdrummond Ponds 22 Nov; 8 Flanders Moss NNR 21 Jul and 5 L. Mahaick 7 Nov.

(Eurasion) WOODCOCK *Scolopax rusticola* (B, W)

Inland WeBS: 2 in Jan, 3 in Feb, 0 in Mar, 0 in Sep, 0 in Oct, 2 in Nov and 1 in Dec

F 2 Darnrigg Moss Pools 10 Mar (TF); 2 R. Carron, M876-Larbert 14 Nov (AE); singles from Skinflats Pools 25 Nov (DOE) and Callendar Park 10 Dec (CE).

C Singles Blackdevon Wetlands 18 Jan & 11 Feb (RG, DOE).

S 2 R. Teith (Carse of Lecropt) 8 Feb (DK). Singles at Airthrey L., Ballat (NS5291), Gallow Hill, BoA, Craigforth, Doune, Flanders Moss NNR, G. Dochart, G. Finglas, Lanrick, Deanston, L. Achray, Plean, Sheriffmuir Great Wood and Wester Moss (BD, JN, CJP, DOE, DAP, CR, RJ, KD, DH).

BLACK-TAILED GODWIT *Limosa limosa* (W)

Forth Est. WeBS: 443 in Jan, 386 in Feb, 527 in Mar, 729 in Sep, 680 in Oct, 324 in Nov and 152 in Dec.

F Kinneil monthly max: 124 in Jan, 183 in May, 516 in Jul, 697 in Aug, 783 in Sep, c.200 in Oct & c.100 in Dec. Skinflats Pools monthly max: 458 in Apr, 49 in Jul, c.270 in Aug, 45 in Sep & 15 in Nov. Other sites max: 8 Higgin's Neuk 4 Jan; 8 Blackness 13 Jan; 3 S. Broomage 23 Aug and 2 Powfoulis 12 Sep.

C Cambus Village Pools monthly max: c.500 in Apr, 221 in May, 1 in Aug & 8 in Oct. 55 Longcarse 19 Sep.

S 2 Powdrake (NS 8686) 16 May.

BAR-TAILED GODWIT *Limosa lapponica* (W)

Forth Est. WeBS: 74 in Jan, 63 in Feb, 49 in Mar, 5 in Sep, 12 in Oct, 1 in Nov and 196 in Dec.

F Kinneil monthly max: 122 in Feb, 2 in Aug, c.80 in Nov & 190 in Dec. Skinflats Pools monthly max: 3 in Feb, 1 in Apr, 36 in Aug, 2 in Oct & 2 in Nov. Other site max: 55 Airth foreshore 20 Feb; 43 R. Forth, Alloa- Kinc Br 8 Mar; 10 S. Alloa 25 Feb; 8 Blackness 21 Nov and 6 Dunmore 2 Mar (1 bird in summer plumage).

C 2 Kennetpans 18 Jan and 4 Cambus 10 Apr.

WHIMBREL *Numenius phaeopus* (p)

F Spring/summer: 8 Strathavon Fm (Slamannan) 5 May (TF); 35 Skinflats 7 May with singles on the 9th & 13th May (DMB, DOE); 2 Blackness 7 May (ATP); singles Kinneil 13 May, 8 Jun & 29th (DT, RS); 1 Higgin's Neuk & Skinflats Tidal Ex 9 May (DOE). Autumn: singles Kinneil from 29 Aug to last on 5 Oct (TG, RS, DMB, DT); 1 Skinflats Tidal Ex 30 Jul (RS) and 1 Skinflats Pools 5 Sep (DOE).

C Spring: 2 Longcarse 25 Apr with 4 on 26 Apr, 16 on 1 May & 21 on 13 May (GG, NB); 6 R. Forth, Cambus 10 May (GG) and 2 Kennetpans 9 May & 16 Jul (DMB).

(Eurasion) CURLEW *Numenius arquata* (B, W)

Inland WeBS: 115 in Jan, 85 in Feb, 428 in Mar, 17 in Sep, 190 in Oct and 262 in Dec.

Forth Est. WeBS: 1,003 in Jan, 708 in Feb, 753 in Mar, 455 in Sep, 716 in Oct, 784 in Nov and 999 in Dec.

BBS: recorded at 0.38 b/lkm (1997-2014 average: 0.64 b/lkm).

F Breeding: nest on Strathavon Fm, Slamannan 4 May. Winter/spring site max: 259 Kinneil (WeBS area) 8 Feb; 422 Skinflats (WeBS area) 18 Jan; c.150 Higgin's Neuk 11 Feb; c.100 Blackness 11 Feb and 48 L. Ellrig 19 Mar. Autumn/winter site max: c.370 Kinneil (WeBS area) 12 Dec; 304 Kinneil 11 Aug; 316 Skinflats (WeBS area) 8 Nov and c.70 Blackness 29 Dec.

C Winter/spring site max: 295 Kennetpans 18 Jan; 215 Longcarse 14 Mar; c.150 R. Forth, Cambus 3 Jan; 115 Cambus Fields 3 Jan and c.50 Haugh of Blackgrange 15 Mar. Autumn/winter site max: 374 Longcarse 28 Nov; c.250 Haugh of Blackgrange 21 Dec and 202 Longcarse 23 Aug.

S Breeding: nest with 2 eggs G. Dochart 30 May. Spring site max: 115 R. Forth, Teith-Allan conf's 8 Mar and 87 Blackdub Floods 10 Mar.

COMMON SANDPIPER *Tringa hypoleucos* (B)

BBS: recorded at 0.12 b/lkm (1997-2014 average: 0.07 b/lkm).

First of year: 1 Larbert Hosp Pond (F); 4 Longcarse (C); 1 R. Devon, Cambus (C) and 1 Blairdrummond Ponds (S) all 15 Apr (AB, NB, DH, DOE). Last of year: 3 Kinneil Lagoon 11 Sep (SW) and 1 Skinflats Tidal Ex 12 Sep (AB).

F An overwintering bird was at Higgin's Neuk from 25 Jan-11 Feb. Site max: 7 Kinneil 14 Jul; 5 Higgin's Neuk 9 Jul and 5 Skinflats Tidal Ex 22 Aug.

C Site max: 4 Tullibody Inch 26 Jul.

S Site max: 7 Cambusmore/Gart GP 17 May; 5 CVR 22 Apr; 5 Blairdrummond Ponds 4 May; 4 Dalzeil Wood, L. Ard 4 May; 4 Head of L. Tay 23 Jun & 13 Jul; 3 G. Lochay 24 Apr and 3 E end L. Katrine 4 May.

*GREEN SANDPIPER *Tringa ochropus* (w, p)

F 1 Skinflats Pools 9 Aug (AB); 1 Kinneil 12 Aug (RS); 1 Skinflats Tidal Ex 22-23 Aug (RS, DOE) and 1 L. Ellrig 4 Sep (NB).

C 1 Gartmorn Dam 1 Nov (LL).

S 2 Bolfornought, E of Stirling 20 Aug (ATP).

*SPOTTED REDSHANK *Tringa erythropus* (p)

F Single Kinneil 21 Jan – 11 Apr (MVB, BGs *et al*.) and 13 Aug- 12 Dec (DT, JRC *et al*.). Single Skinflats Pools 14 Feb, 16 Sep & 13 Nov (CJP, DMB, SW). Single Skinflats Tidal Ex. 23 Aug (DOE).

GREENSHANK *Tringa nebularia* (w, p)

F Present Kinneil 2 Jan-23 Apr & 3 Jul-29 Dec (JB, RS, JC, DOE *et al*). Kinneil monthly max: 2 in Jan, 2 in Feb, 3 in Mar, 2 in Apr, 3 in Jul, 5 in Aug, 5 in Sep, 4 in Oct, 6 in Nov & 4 in Dec. Single Skinflats Pools from 11 Feb-12 Apr & 12 Jul-23 Dec with 2 on 24 Oct (DOE, AB, SW). Single Skinflats Tidal Ex 4 Jan with max of 6 in Aug & 5 in Sep and last one 21 Sep (DOE, RS *et al*.). Other sites: singles Bo'ness Bay 21 & 25 Jan (MVB, RS); 1-2 Higgin's Neuk 17 Aug-7 Nov (ACC, DOE) and 3 L. Ellrig 4 Sep (NB).

S 1-2 Head of L. Tay 6-29 Apr (JPH).

*WOOD SANDPIPER *Tringa glareola* (p)

F One Skinflats Pools 22 Aug (RS) and 1 Kinneil Lagoon 12 Sep (BGs).

REDSHANK *Tringa totanus* (B, W)

Inland WeBS: 0 in Jan, 3 in Feb, 6 in Mar, 2 in Sep, 1 in Oct, 0 in Nov and 0 in Dec

Forth Est. WeBS: 1,828 in Jan, 1,806 in Feb, 932 in Mar, 2,210 in Sep, 3,178 in Oct, 2,394 in Nov and 2,298 in Dec.

F Kinneil monthly max: 804 in Jan, 451 in Feb, 537 in Mar, c.780 in Apr, 255 in Jul, 206 in Aug, 901 in Sep, 2014 in Oct, 783 in Nov & 1018 in Dec. Skinflats monthly max: 928, in Jan, 901 in Feb, 574 in Mar, 655 in Sep, 942 in Oct, 967 in Nov & 893 in Dec. Other site max: c.60 Higgin's Neuk 4 Jan; 56 Bo'ness 26 Jul; c.50 Skinflats Tidal Ex 4 Jan and 6 S. Alloa 25 Feb.

C Site max: 5 R. Forth, Cambus-Alloa 17 Jan; 3 R. Forth at Cambus 21 Jan and 3 Cambus Village Pools 15 Apr.

S Two Allan Water (Cambushinnie-Ashfield) 15 Mar; 1 Cambusmore Gart GP 8 Mar then 2 on 17 May; 1 L. Coulter 18 Mar; 2 N. Third Resr 18 Mar; 1 Flander's Moss NNR 24 Apr; 2 Head of L. Tay 26 Mar with 3 on 6 Apr & 8 on 25 Apr then 2 on 13 Jul.

TURNSTONE *Arenaria interpres* (W)

Forth Est .WeBS: 0 in Jan, 1 in Feb, 2 in Mar, 0 in Sep, 3 in Oct, 2 in Nov and 2 in Dec.

F Site max: 16 Bo'ness 8 Mar; 14 Carriden 16 Feb (DMB); 4 Kinneil 6 Aug (RS); 3 Skinflats 6 Jan (SP); 3 Blackness 11 Feb (DOE) and 1 Carronmouth 8 Feb (MVB).

*POMARINE SKUA *Stercorarius pomarinus* (p)
F A juv was off Blackness 13 Sep (EMcL).
* KITTIWAKE *Rissa tridactyla* (P, w)
F One ad Kinneil 2 Aug (RS) and present there 5 Oct (DT).
SABINE'S GULL *Xema sabini*
F One ad Kinneil 6 Aug (DT) was the 5th record for the Upper Forth.
BLACK-HEADED GULL *Chroicocephalus ridibundus* (B,W)
Inland WeBS: 2,303 in Jan, 598 in Feb, 974 in Mar, 315 in Sep, 685 in Oct, 733 in Nov and 908 in Dec.
Forth Est. WeBS: 386 in Jan, 500 in Feb, 311 in Mar, 608 in Sep, 338 in Oct, 288 in Nov and 296 in Dec.
F Breeding: 3 AON Darnrigg Moss Pools 23 Jun. Site max: 698 Kinneil Lagoon 21 Aug; c.400 Skinflats Pools 7 Jan & 7 Nov; c.250 Higgin's Neuk 21 Nov and c.200 Blackness 13 Jun.
C Site max: c.200 Cambus 26 Oct.
S Site max: c.250 Carse of Lecropt 27 Dec and 57 Head of L. Tay 12 Jun.
*LITTLE GULL *Hydrocoloeus minutus* (p)
F One Skinflats Pools 12 Jun then 1-2 2nd summer birds until last 1 on 11 Aug (RTW, DMB, NB *et al*.); 1st summer bird Kinneil 11 Apr (JB) with ad there 30 Jul & 6 Aug (RS, DT) and 1st summer bird at Blackness 18 Jul.
C One Blackdevon Wetlands 13 Jun (JRC).
*MEDITERRANEAN GULL *Larus melanocephalus* (w)
F Three Westfield (Falkirk) 17 & 18 Jul (LR); Kinneil Lagoon: 1 on 4 & 12 Jan (JB), an ad 3 Jul (DT, CJH), a 1st summer 9 Jul and a 2nd summer 14 Jul & 12 Aug; 1 Higgin's Neuk 21 Nov (DOE) and max of 2 Skinflats Pools 8-27 Nov (AB, SW).
C One Kennetpans 3 Jan and 1 Longcarse 28 Nov (JRC).
COMMON GULL *Larus canus* (B,W)
Inland WeBS: 238 in Jan, 443 in Feb, 588 in Mar, 590 in Sep, 231 in Oct, 411 in Nov and 384 in Dec.
Forth Est. WeBS: 319 in Jan, 577 in Feb, 99 in Mar, 42 in Sep, 142 in Oct, 23 in Nov and 25 in Dec.
F Site max: c.300 Blackness 21 Sep; c.300 Skinflats Tidal Ex 21 Nov; c.200 Kinneil and Skinflats Pools 21 Nov.
C Site max: 62 Gartmorn Dam 15 Feb.
S Site max: 222 Pendreich Pool 18 Mar; c.200 Bolquhan (Kippen) 13 Apr; c.200 Drip Moss 4 Sep; c.200 L. Watston 12 Dec; c.200 Flanders Moss (E) 27 Dec and 104 Head of L. Tay 13 Jul.
*RING-BILLED GULL *Larus delawarensis*
F Ad Skinflats 6 Feb (DMB).
LESSER BLACK-BACKED GULL *Larus fuscus* (b, S)
Inland WeBS: 22 in Jan, 19 in Feb, 483 in Mar, 210 in Sep, 139 in Oct, 184 in Nov and 13 in Dec.
Forth Est. WeBS: 1 in Jan, 1 in Feb, 40 in Mar, 81 in Sep, 26 in Oct, 7 in Nov and 6 in Dec.
1-2 birds were recorded throughout the area during the winter (Jan, Feb & Dec) with a max of 11 Forth/Clyde Canal, Lock16-R. Carron 19 Jan.
F Breeding: 2 chicks seen on Carron Works roof, Falkirk (PC). Site max: 79 Little Denny Resr 4 Sep; 52 Darnrigg Moss Pools 30 Jun and 43 Gardrum Moss 4 Sep.
C Max: 120 Longcarse 9 Sep.
S Max: 390 Gartartan, Aberfoyle 13 Mar (all ad apart from one 1st winter bird); 156 R. Forth (Cardross Br-Ladylands) 16 Nov and 65 Drip Moss 4 Sep.
HERRING GULL *Larus argentatus* (b, W)
Numbers much reduced in recent years following the closure of open refuse tips and

greater recycling of food waste.
Inland WeBS: 62 in Jan, 143 in Feb, 56 in Mar, 51 in Sep, 80 in Oct, 240 in Nov and 378 in Dec.
Forth Est. WeBS: 291 in Jan, 184 in Feb, 135 in Mar, 277 in Sep, 215 in Oct, 129 in Nov and 25 in Dec.

F Max: c.80 Kinneil 21 Sep.
C Max: c.350 Ditch, Tullibody 28 Dec.
S One head of L. Tay 23 Apr (rare here).

GREAT BLACK-BACKED GULL *Larus marinus* (S,W)
Inland WeBS: 6 in Jan, 5 in Feb, 9 in Mar, 6 in Sep, 4 in Oct, 4 in Nov and 3 in Dec.
Forth Est WeBS: 6 in Jan, 12 in Feb, 3 in Mar, 6 in Sep, 5 in Oct, 2 in Nov and 6 in Dec.

F Recorded in small numbers (1-2) from: Blackness (max 4 on 21 Nov); Bo'ness; Falkirk Wheel; Kinneil (max 4 on 21 Sep); Greyrigg, Avonbridge; Higgin's Neuk (max 4 on 11 Feb); Skinflats; 3 Little Denny Resr 12 Feb; Skinflats Tidal Ex (max 5 on 21 Aug); S. Alloa and St Helen's Loch, Bonnybridge.
C Recorded in small numbers (1-2) from: Cambus; R. Forth, Cambus-Alloa (max of 8 on 15 Mar) and Menstrie.
S Recorded in small numbers (1-2) from: Cambusmore/Gart GP; Carse of Lecropt (max of 3 on 15 Nov); Lake of Menteith (max of 4 on 21 Jan); R. Forth, Kippen and Raploch.

SANDWICH TERN *Sterna sandvicensis* (s, P)

F Site max: c.200 Blackness 21 Sep (DOE); 129 Carriden-Grangepans 13 Sep (JRC); c.60 Skinflats Tidal Ex 20 Sep (DOE); 25 Kinneil 23 Aug (DOE): 9 Skinflats 11 Aug (MVB); 8 Bo'ness 21 Sep (DOE) and 1 Kincardine Br 13 Sep (MVB). Last record: c.200 Blackness 21 Sep (DOE).
C 9 Kennetpans 11 Aug (MVB) and 2 R. Forth (Cambus-Alloa) 9 Sep (NB).

COMMON TERN *Sterna hirundo* (S)
First of year 3 Skinflats Pools 9 May (AB, DOE); last of year 2 Kinneil 23 Sep (DOE).

F Site max: 13 Skinflats Pools 9 Jul; 5 Blackness 21 Sep; c.100 Kinneil 6 May; 1 Higgin's Neuk 28 Jul and 1 Skinflats Tidal Ex 11 Aug.
C Two R. Forth at Cambus 29 May.

*ARCTIC TERN *Sterna paradisaea* (s)

F One Kinneil 6 May & 11 Aug with 2 on 9 Aug (DMB, DT, CJP) and 1 Blackness 6 Aug (ACC).

*(Common) GUILLEMOT *Uria aalge* (s, w)

F One Blackness 13 Jun (DOE).

FERAL PIGEON *Columba livia* (B,W)
BBS: recorded at 0.3 b/lkm (1997-2014 average: 1.1 b/lkm).

F Max: c.400 Grangemouth area 25 Oct; c.190 Skinflats 8 Nov and 100+ Falkirk Town Centre 3 Oct.
C Max: 78 Jellyholm (New Sauchie) 24 Jan and c.50 Longcarse 22 Aug.
S Max: c.40 Carse of Lecropt; c.30 Blairdrummond 2 Jan and c.30 Drip Moss 20 Dec.

STOCK DOVE *Columba oenas* (B, W)
Usually encountered in groups of <4.

F Site max: 32 Kinneil 27 Aug. Also recorded from: Carron, Darnrigg Moss, Helix Park, Larbert Hosp, Skinflats Pools, Skinflats Tidal Ex and S. Alloa.
C Site max: 12 Cambus 21 Mar. Also recorded from: Longcarse and R. Devon, Alva.
S Site max: 116 Greenyards, Dunblane; 25 Blairdrummond 2 Jan; 19 Dykedale, Dunblane and 10 Holmehill, Dunblane. Also recorded from: Argaty, Bannockburn, Buchany, Cambuskenneth, Carse of Lecropt, Cromlix, Doune, Flanders Moss NNR, Hill of Row, Lanrick, Deanston, Powdrake and Stirling Uni.

WOOD PIGEON *Columba palumbus* (B, W)
BBS: recorded at 3.2 b/lkm (1997-2014 average: 3.6 b/lkm).
F Site max: c.150 Skinflats Pools 26 Oct and c.150 Kinneil 14 Feb.
C Site max: c.40 Gartmorn Dam 15 Feb.
S Site max: c.1,400 Greenyards, Dunblane 2 Dec; c.1,100 Biggins Wood, Dunblane 23 Jan and c.400 Blairdrummond 19 Dec.
COLLARED DOVE *Streptopelia decaocto* (B, W)
BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.3 b/lkm).
Recorded throughout region. Max: 22 Blairdrummond 19 Sep (S); 10 Blackness and Skinflats Pools (F) 21 Nov.
(Common) CUCKOO *Cuculus canorus* (B)
BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm).
First spring records: CVR 16 Apr (MM) and 18 Apr Kirkton Fm, Tyndrum (JPH). (6 year range 15 to 27 April).
F Juv Kinneil 30 Jul & 2 Aug. Recorded singing at Carriden 6 May.
C One Tarmangie Hill 9 Jun and a juv nr Cambus 30 Jul.
S Site max: 5 Flanders Moss NNR 27 May and 5 Sheriff Muir 4 Jun. Also recorded from: Badivow, QEFP, Balquhidder, Bows, Dunblane, Bracklinn Falls, Callander, Brig O' Turk, Cambusmore/Gart GP, Cocksburn Resr, Cromlix, Daldorn, Gartmore, Flanders Moss W, Easter Glinns (NS6591), G. Breac-nic (NN 5320), G. Dochart, G. Finglas, G. Lochay, Killin, Kippen Muir, L. Arklet, L. Rusky, Lossburn Resr, Strath Fillan and Tyndrum.
BARN OWL *Tyto alba* (b, w)
F Breeding: one downy Y Glenbervie 20 Jul. Also recorded from: S. Broomage, Grougfoot Fm (Champany), New Carron, Falkirk and Skinflats (max 2).
C Recorded from: Forestmill.
S Recorded from: Cambuskenneth, Cowie, Craigforth and Kirkton Fm (Tyndrum).
TAWNY OWL *Strix aluco* (B, W)
Widespread but under-recorded.
F Recorded from: Bo'ness, Callendar Park and Carron (Falkirk).
C Recorded from: Dollar and Sauchie Tower (Fishcross).
S Recorded from: Balquhidder, BoA, Doune, G. Lochay, Killin, Killin Lodges (2), Kirkton Fm, Tyndrum, Lanrick, Deanston and around Dunblane.
*LONG-EARED OWL *Asio otus* (b, w)
F One Skinflats 23 Dec (SW) and 1 Kinneil 13 Dec (RS).
C Breeding: chick at Aberdona (DTy).
S Breeding: nest with 2Y (fledged later) Kinbuck 17 Jun (AH).
SHORT-EARED OWL *Asio flammeus* (b, W)
F Kinneil: 2 on 29 Aug (TG) then 1-3 present Oct-Dec (DT, RS et al). Skinflats: 1 on 30 Aug (DB) then 1 on 27 Nov & 13 Dec (SW). 1 Powfoulis area 22 Nov & 17 Dec (JN).
S One Ashfield 2 & 10 Jan (CJP); 1 Harperstone, Sheriff Muir 5 Feb (MVB); 2 Culligart, L. Katrine 28 Apr (DOE); 1 Flanders Moss NNR 9 Sep (DAP); 1 Black Hill, Sheriff Muir 30 Oct (KJD) and 1 L. Mahaick 15 Nov (DOE).
(Common) SWIFT *Apus apus* (B)
Recorded throughout the area. BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.5 b/lkm). Spring arrival: one Blairdrummond 4 May (NB). 9 year range (24 April to 4 May). Last: 1 Carronshore 22 Aug (AB).
F Max: c.50 Glensburgh 5 Jun and c.50 Skinflats Pools 7 Jun.
S Max: c.30 Bannockburn 9 Aug and c.30 BoA 14 Jul.
(Common) KINGFISHER *Alcedo atthis* (b, w)
Inland WeBS: 1 in Jan, 1 in Feb, 0 in Mar, 9 in Sep, 4 in Oct, 8 in Nov and 3 in Dec.
F Breeding: 2 nests on R. Carron, S. Broomage flooded out twice. Recorded from:

Helix Park, Kinneil, R. Carron (M876-Glensburgh), Skinflats Tidal Ex, Union Canal, Bantaskine and Polmont and West Mains Pond, Falkirk.
C Recorded from: Gartmorn Dam and R. Devon, Vicar's Br–Cambus Weir.
S Recorded from: Allan Water, BoA, Blairdrummond Ponds, Eas Gobhain (Callander), head of L. Tay (Killin), R. Forth (Cobleland and Teith conf-A91), R. Teith, (Callander and Lecropt) and Strath Fillan.

GREEN WOODPECKER *Picus viridis* (B, W)
F Recorded from: Larbert, Muiravonside, Skinflats Pools and Torwood.
C Recorded from: Menstrie (3) and Alva.
S Recorded from: Argaty, Balquhidder, Blackwater Marshes, BoA, Sheriff Muir, L. Achray (2), L. Ard and L Venachar.

GREAT SPOTTED WOODPECKER *Dendrocopos major* (B, W)
BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm).
Recorded in small numbers throughout the area and year.
Max: 4 Holmehill, Dunblane 28 Feb.

SKYLARK *Alauda arvensis* (B, W)
BBS: recorded at 1.6 b/lkm (1997-2014 average: 1.7 b/lkm).
F Max: c.550 Kincardine Br and c.350 Skinflats Pools 18 Jan (cold weather influx); c.250 Orchardhead, Skinflats 21 Jan.
C Max: 60 Forestmill 19 Nov (in a stubble field) and 36 Longcarse 17 Jan.
S Max: 75 Drip Moss 18 Oct; c.60 Carse of Lecropt 29 Jan and 50+ Strath Fillan 31 Mar.

SAND MARTIN *Riparia riparia* (B)
BBS: recorded at 0.4 b/lkm (1997-2014 average: 0.5 b/lkm).
First for year: 1 Dunblane 21 Mar (CJP) was in middle of 10 year range of 4 Mar to 11 Apr.
Last: 1 Skinflats Pools 13 Sep (DOE).
F Max: c.60 Skinflats Pools 14 Apr.
C Max: 110 Longcarse 30 Jul and c.60 Gartmorn Dam 27 Aug.
S Breeding: 954 AON Cowie Quarry 28 Jun (DMB); 56 AON Cambusmore/Gart GP 21 Jun (NB) and 15 AON Mid Cambushinnie 30 Apr (MVB). Max: c.80 Cambusmore/Gart GP 19 Jun.

(Barn) SWALLOW *Hirundo rustica* (B)
BBS: recorded at 1.7 b/lkm (1997-2014 average: 2.3 b/lkm).
First for year: 2 Dunblane-Ashfield 10 Apr (DO) was towards end of the 10 year range of 6 Mar to 13 Apr. Last: 1 Kincardine Br 11 Oct (MVB).
F Max: c.50 Skinflats Pools and Tidal Ex 16 & 20 Sep.
C Max: c.770 Tullibody Inch 19 Sep (dusk roost count).
S Max: c.60 Blairdrummond Ponds 22 Aug.

HOUSE MARTIN *Delichon urbicum* (B)
BBS: recorded at 0.7 b/lkm (1997-2014 average: 0.8 b/lkm).
First of year: 1 Alva 11 Apr (CE) is within 10 year range of 6-16 Apr. Last: 13 Lionthorn, Falkirk 4 Oct (CE).
F Breeding: 6 AON Lionthorn, Falkirk 5 Jun (RD)
S Breeding: 9 AON Hill Ho, Cromlix 28 Jun (MVB) and 8 AON Gartmore 17 Aug (RM). Max: c.70 BoA 3 May and c.50 Blairdrummond Ponds 22 Aug.

TREE PIPIT *Anthus trivialis* (B)
BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm).
First of year: 1 Avonbridge 8 Apr (ABa) is 4 days earlier than the 9 year range of 12-27 Apr.
C Recorded from Seamab Hill.
S Max: 19 Tyndrum 1 May. Widespread to N & W of Stirling.

MEADOW PIPIT *Anthus pratensis* (B, W)
BBS: recorded at 6.8 b/lkm (1997-2014 average: 4.7 b/lkm).

Recorded throughout the area being abundant in the hills.
Max: 200+ Malling, Lake of Menteith 28 Apr; c.100 Tullibody Inch 20 Sep and c.70 Kirkton Fm, Tyndrum 24 Mar.

*ROCK PIPIT *Anthus petrosus* (w)

F 1 Higgin's Neuk 2 Jan & 4 Jan with 2 on 5 Dec (CJP, DOE); 3 S. Alloa 27 Dec (DMB); present Blackness 6 Aug and 1 Kinneil 14 Nov (NC).

C 3 Kennetpans 21 Feb (JRC) and 1 R. Forth, Cambus-Alloa 15 Mar (GG).

GREY WAGTAIL *Motacilla cinerea* (B, w)

Recorded in small numbers in suitable habitat throughout the area.
Inland WeBS: 16 in Jan, 8 in Feb, 22 in Mar, 26 in Sep, 17 in Oct, 7 in Nov and 11 in Dec.

S Breeding: 2 juv Allan Water, Ashfield-Dunblane 27 May (MVB) and 2 juv Kilmahog 27 Jun (MR). Max: 6 Head of L. Tay 14 Mar.

PIED WAGTAIL *Motacilla alba yarrellii* (B, w)

BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.4 b/lkm). Recorded throughout the area.

F White Wagtail M.*a.alba*: 1 Skinflats Pools 25 Apr (AB) with 2 on 21 Sep (DOE).

C White Wagtail M.*a.alba*: 2 Longcarse 15 Apr (NB) and 1 Cambus 2 May (GG).

S Max: c.80 Stirling train station roost 5 Feb & c.60 on 23 Dec (DOE); 25 Kirkton Fm, Tyndrum 23 Mar and 24 Gartartan, Aberfoyle 13 Mar. White Wagtail M.*a.alba*: ♂ Springkerse (Stirling) 18 Sep (CJP).

*WAXWING *Bombycilla garrulus* (w)

S One Ochiltree, Dunblane 2 Jan feeding on Sorbus 'Joseph Rock' berries (NB).

DIPPER *Cinclus cinclus* (B, W)

Recorded in small numbers in suitable habitat throughout region.
Inland WeBS: 52 in Jan, 54 in Feb, 40 in Mar, 19 in Sep, 28 in Oct, 31 in Nov and 51 in Dec.

F Max: 7 R. Carron, M876-Larbert 14 Nov.

C R. Devon, Dollar-Tillicoultry monthly max: 17 in Jan, 12 in Feb, 11 in Mar, 14 in Sep, 10 in Nov & 21 in Dec. Other sites max: 12 R. Devon, Vicar's Br-Dollar 9 Feb and 14 on 13 Dec.

S Max: 5 R. Teith, Lanrick 4 Oct.

WREN *Troglodytes troglodytes* (B, W)

Widespread and common. BBS: recorded at 1.6 b/lkm (1997-2014 average: 1.9 b/lkm).

S Max: 22 Dalzell Wood, L. Ard Forest 4 May and 11 R. Teith, Doune-Blairdrummond 25 Jan.

DUNNOCK *Prunella modularis* (B, W)

Widespread and common. BBS: recorded at 0.5 b/lkm (1997-2014 average: 0.5 b/lkm).

ROBIN *Erithacus rubecula* (B,W)

Widespread and common. BBS: recorded at 1.1 b/lkm (1997-2014 average: 1.2 b/lkm).

F Max: 10 Forth & Clyde Canal, Kelpies-Falkirk Wheel 28 Dec.

C Max: 11 Gartmorn Dam 15 Feb.

S Site max: 22 Dalzell Wood, L. Ard Forest 4 May; 17 Ashfield-Dunblane 10 Apr and 12 Blairdrummond 24 Oct.

(Common) REDSTART *Phoenicurus phoenicurus* (B)

First spring record: 19 Apr (within 10 year range of 12 to 27 Apr) Killin Marshes (JPH).
Last: one Callendar Wood, Falkirk 1 Aug.

S Max: 13 Tyndrum 15 May. Also recorded from: Bracklinn, Callander, Brig o' Turk, Buchany, Doune, Daldorn, Flanders Moss NNR, Flanders Moss W, Lake of Menteith, Lanrick, Deanston, L Katrine, L. Rusky, Killin, G Dochart and G Lochay.

WHINCHAT *Saxicola rubetra* (B)

BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm).
First spring record 24 Apr Flanders Moss NNR (DAP) was at beginning of 10 year range of 24 April to 2 May. Last 21 Sep Kirkton Fm, Tyndrum (JPH).

F Max: 13 Kinneil 13 May. Also recorded from: Skinflats Pools and Strathavon Fm

(Slamannan).
C Recorded from Seamab Hill.
S Breeding: broods of 4 & 3Y G Finglas 15 Jul (RE) and 3 prs with Y Flanders Moss 21 Jul (DAP). Max: 12 Sheriff Muir 19 Aug. Also recorded from: Badivow (NS5193), Easter Glinns (NS6591), Kinbuck, L. Arklet, G. Dochart, G. Lochay, Strath Fillan, Strathyre and Wharry Burn Br (NN8201).

(European) STONECHAT *Saxicola rubicola* (b, w)
This species is still recovering from the cold winters of 2009 and 2010 with another increase of records in 2015.
F Recorded from: Kinneil, Skinflats Pools, Skinflats Tidal Ex and Slamannan.
C Recorded from: Blackdevon Wetland and Hillfoot Hill.
S Breeding: pr + 5Y Sheriffmuir Inn 16 Aug (RE). Max: 6 Sheriff Muir 3 Apr & 19 Aug and 5 Flanders Moss NNR 18 Mar. Also recorded (up to 4) from: Annet, BoD, Cocksburn Resr, CVR, Earls Hill, Easter Buckieburn, Easter Glinns (NS6591), Edra, L Katrine, G. Finglas, Harperstone and Lairhill (Sheriff Muir), Kippen Muir, Kirkton, L. Arklet, L Coulter, L. Mahaick, L. Venachar and Logie (BoA).

(Northern) WHEATEAR *Oenanthe oenanthe* (B)
BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.2 b/lkm).
First spring record: 2 Earl's Hill 19 Mar (RD) was 2 days earlier than 9 year range of 21 Mar to 8 Apr. Last: 1 Ben Cleuch 17 Oct (PB).
F 1-2 Skinflats Pools 4–9 May were probably 'Greenland' birds of the ssp O. *o. Leucorhoa*. Likewise 2 Higgin's Neuk and 1 Skinflats Tidal Ex 9 May.
C Eight, 3 & 5 Longcarse on 1, 3 & 10 May were also probably 'Greenland' birds of the ssp O. *o. Leucorhoa*.
S Max: 12 G. Lochay 24 Apr and 8 Sheriff Muir 22 Apr. 5+ Malling (Lake of Menteith) 28 Apr were also probably 'Greenland' birds of the ssp O. *o. Leucorhoa*.

*RING OUZEL *Turdus torquatus* (b)
S One Low Botaurnie, G. Lochay 1 May (GK); 2 Stuc a' Chroin 11 Jul (AW); 1 Ben Ledi 22 Jul (JJH) and 1 Ben Challum 25 Jul (AK).

(Common) BLACKBIRD *Turdus merula* (B, W)
Widespread and common. BBS: recorded at 1.6 b/lkm (1997-2014 average: 2.2 b/lkm).
F Max: 10 Blackness 11 Feb and 10 Skinflats Pools 21 Nov.
C Max: 20 Gartmorn Dam CP and 13 in a Cambus Village garden 25 Jan.
S Max: 15 Carse of Lecropt 22 Nov.

FIELDFARE *Turdus pilaris* (W)
Last spring record of 1 Skinflats Pools 12 Apr (DOE) was within 10 year range: 25 Mar to 14 May. First autumn record of 6 Skinflats Pools 26 Sep (WS) (was within the 10 year range of 3 Sep to 22 Oct).
F Max: 155 Bo'ness 21 Jan and c.120 Skinflats Pools 8 Nov.
C Max: c.190 Forest Mill 1 Feb and 115 Longcarse 3 Feb.
S Site max: c.500 Carse of Lecropt 17 Nov; c.440 Kinbuck 15 Nov; c.350 L. Mahaick 7 Nov; c.250 Kirkton, Tyndrum 30 Oct and c.240 Muirmailing (NS8185) 3 Feb.

SONG THRUSH *Turdus philomelos* (B, W)
Widespread. BBS: recorded at 0.7 b/lkm (1997-2014 average: 0.5 b/lkm).
S Max: 14 L. Mahaick 14 Mar and 12 Cromlix 24 Mar.

REDWING *Turdus iliacus* (W)
Last spring record at Kinneil 18 Apr (DE) is within the previous 10 year range: 7 Mar to 1 May. First autumn record of 1 Skinflats Pools 26 Sep (SW) is a day earlier than the previous 9 year range: 27 Sep to 12 Oct.
F Max: c.100 Skinflats Pools 21 Nov and c.80 Powfoulis 8 Mar.
C Max: c.70 Gartmorn CP 31 Oct and c.70 Forest Mill 1 Feb.
S Max: c.500 Lendrick Hill, Brig O'Turk 18 Oct; c.250 Kirkton, Tyndrum 30 Oct; c.120

Cambushinnie 13 Nov; c.100 Flanders Moss NNR 19 Oct; c.100 Blairdrummond 24 Oct and c.100 Carse of Lecropt 17 Nov.

MISTLE THRUSH *Turdus viscivorus* (B, W)

Widespread. BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.2 b/lkm).

F Max: 15 S. Alloa 25 Oct.

C Max: 23 Balhearty (NS9395) 5 Oct.

S Max: 16 Lanrick, R. Teith 4 Oct.

GRASSHOPPER WARBLER *Locustella naevia* (b)

First spring record of 1 at Cambus 23 Apr (GG) [within 10 year range of 17 to 27 Apr]. Last: 1 at Skinflats 2 Aug (RS).

F One Skinflats Pools 25 Apr. Also recorded from: Carron Dams, 3 Darnrigg Moss and R. Carron, S. Broomage.

C Two Blackdevon Wetlands 10 May. Also recorded from Longcarse and Pool of Muckhart.

S Recorded from: Aberfoyle, Auchtubh, Balquhidder, Blackwater Marshes, Callander and Flanders Moss.

SEDGE WARBLER *Acrocephalus schoenobaenus* (B)

Found throughout the area in suitable habitat. BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm). First spring record: 1 Cambus Village Pools 21 Apr (DH) [10 year range of 21-31 Apr]. Last: 1 Tullibody Inch 12 Sep (GG).

F Max: 10 Skinflats Pools 22 Jun.

C Max: 16 (♂'s singing) Tullibody Inch 10 May.

*REED WARBLER *Acrocephalus scirpaceus*

Breeding of the species in the Upper Forth area was first confirmed in 2011.

F Singles Skinflats Pools on 24 & 26 May, 1, 7 & 22 Jun, 30 Jul and 2 & 8 Aug with 2 on 12 Jun & 11 Aug (DOE, RD, RS, AB, DMB, RTW). One Kinneil 18 Apr.

C Three Cambus Pools 10 May (JRC); 1 Cambus Village Pools 11 May (GG) and singles Tullibody Inch 26 Apr, 19 Jun & 30 Jul (JRC, NB, GG).

BLACKCAP *Sylvia atricapilla* (B,w)

Found throughout the area. BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.2 b/lkm). First spring record: 1 Cambus 8 Apr (GG) [10 year range 23 Mar to 13 Apr].

C Winter records: ♀ overwintered in an Alva gdn (PCa).

S Winter records: ♀ in Broomridge gdn, Stirling 18 & 24 Jan and 2 Mar (DT); one Dunblane gdn 19 Jan and a ♂ in BoA 8 Feb (DMB). Max: 7 Blairdrummond and 6 Dalzell Wood, L. Ard 4 May with 6 singing ♂'s Laighills (Dunblane) 27 May.

GARDEN WARBLER *Sylvia borin* (B)

Recorded throughout the area in small numbers.

First spring record of 1 Brig o'Turk 28 Apr (RE) (10 year range 15 Apr to 2 May).

COMMON WHITETHROAT *Sylvia communis* (B)

BBS: recorded at 0.1b/lkm (1997-2014 average: 0.2 b/lkm).

First spring record of one Cambus 1 May (NB) [10 year range 9 Apr to 2 May]. Last: 1 Longcarse 12 Sep (GG).

F Max: 6 Kinneil and 6 Skinflats Pools 6 & 9 May.

*LESSER WHITETHROAT *Sylvia curruca* (b?)

F One (singing) Kinneil 6 May (DMB).

WOOD WARBLER *Phylloscopus sibilatrix* (B)

First spring record of 2 at Kilmahog on 22 Apr. (10 year range: 17 Apr to 5 May).

S Also recorded from: Big Wood, Sheriff Muir, Blackwater Marshes, Brig o' Turk, Callander, Drumchork, Dunblane, Killin, L. Katrine and 6 Pass of Leny 10 Jun.

(Common) CHIFFCHAFF *Phylloscopus collybita* (B)

BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.1 b/lkm). Numbers have increased over the past 20 years with a few birds overwintering. Now recorded throughout the region.

First spring record: 1 Cambus 18 Mar (GG) [10 year range 11 to 31 Mar].
F Winter records: 1 Kinneil 12 Jan (JB). Max: 4 Carribber Mill and 4 Wallace's Cave (both R. Avon) 8 Apr.
C Winter records: 1 Cambus 3 Jan (NB). Max: 4 Menstrie 12 Apr; 4 Wood Hill, Alva 5 Apr and 4 BoA 11 Apr.
S Max: 4 Dunblane 29 Mar; 4 Holmehill, Dunblane 17 Apr and 4 Blairdrummond 4 May.

WILLOW WARBLER *Phylloscopus trochilus* (B)
BBS: recorded at 1.6 b/lkm (1997-2014 average: 1.7 b/lkm). First of year 1 Cambus 7 Apr (NB). [10 year range 3-18 Apr]. Last: 1 Skinflats Pools 26 Sep (SW).
S Max: 48 Tyndrum 1 May; 16 Dalzeil Wood, L. Ard 4 May and 11 Flanders Moss NNR 27 May.

GOLDCREST *Regulus regulus* (B, W)
Widespread. BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.5 b/lkm).
F Breeding: 5 Y in nest Kingseat Pl, Falkirk fledged 11 Jun (WP).
S Max: 23 Dalzell Wood, L. Ard 4 May; 12 Drumloist 24 Apr and 10 Blairdrummond 4 Oct.

SPOTTED FLYCATCHER *Muscicapa striata* (B)
First spring record 1 Kirkton Fm (Tyndrum) 13 May (JPH). [10 year range: 2 to 20 May]. Last: 2 Blairdrummond 7 Sep (DOE).
F Recorded from Larbert Hosp Ponds.
S Breeding: pr with 2Y Coilhallan Woods, Callander 22 Jul (RE). Max: 8 G. Lochay 23 May and 5 Stronachlachar, L Katrine. Also recorded from: Ben Ledi, around Doune and Dunblane, Blairdrummond, around Callander, around BoA, G. Finglas, Lake of Menteith, Lochearnhead, N. Third Resr, L. Rusky, Sheriff Muir, Strath Fillan and Strathyre.

*PIED FLYCATCHER *Ficedula hypoleuca* (b)
S One Ruinn Dubh Aird, L. Katrine 4 May (SM); 2 G. Lochay 23 May (JPH) and 1 Lower Botaurnie, G Lochay 2 Jun (GK).

*BEARDED TIT *Panurus biarmicus*
C One pair bred at a confidential location for third consecutive year with max of 2Y fledged (DMB, JRC *et al*). Max of 6 at same location 3 Jan & 15 Nov (JRC).

LONG-TAILED TIT *Aegithalos caudatus* (B, W)
Widespread. BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.2 b/lkm).
F Breeding: nest predated by Magpies at New Carron, Falkirk 11 May (SW) and nest with ad feeding Y Kingseat Pl, Falkirk 14 May (WP). Max: 19 Falkirk Town Centre 3 Oct; 15 Carron, Falkirk 31 Oct and 14 L. Ellrig 3 Oct.
C Max: 14 Gartmorn Dam 1 Feb.
S Max: 24 Brig O Turk 1 Nov; 20 Killin 28 Sep; 18 Blairdrummond 15 Nov and 15 Lanrick, R. Teith 17 Jan.

BLUE TIT *Cyanistes caeruleus* (B, W)
Widespread. BBS: recorded at 1.1 b/lkm (1997-2014 average: 1.7 b/lkm).
F Max: 24 Carron, Falkirk 8 Feb.
C Max: 23 Jellyholm, Sauchie 24 Jan.
S Max: 81 R. Teith, Doune 25 Jan and 29 Holmehill, Dunblane 27 Dec.

GREAT TIT *Parus major* (B, W)
Widespread. BBS: recorded at 0.9 b/lkm (1997-2014 average: 0.9 b/lkm).
C Max: 17 Jellyholm, Sauchie 24 Jan.
S Max: 29 R. Teith, Doune 25 Jan and 16 Holmehill, Dunblane 31 Jan.

COAL TIT *Periparus ater* (B, W)
Widespread. BBS: recorded at 0.4 b/lkm (1997-2014 average: 0.5 b/lkm).
S Max: 27 R. Teith, Doune 25 Jan; 12 R. Teith, Lanrick 17 Jan and 12 Dalzell Wood, L. Ard 4 May.

(Eurasion) NUTHATCH *Sitta europaea*
After the first record in 1999 and first breeding recorded in 2009, the species is spreading, particularly in Stirlingshire.

F Recorded at: Blackness, Callendar Wood, Larbert Hosp Pond, Plean CP and R. Carron (Falkirk).
C Recorded at Dollar.
S Breeding: 8 territories Blairdrummond 19 Apr (CJP). Max: 6 Blairdrummond 4 Oct and 5 Holmehill, Dunblane 19 Sep. Also recorded at: Aberfoyle, Auchlyne (G. Dochart), BoA area, Brig o'Turk, Doune area, Dunblane area, Callander area, Killin, Lake of Menteith, L. Venachar and N Third Resr.

(Eurasion) TREECREEPER *Certhia familiaris* (B, W)
Widespread in small numbers.

F Max: 3 Larbert Hosp Pond 12 Sep.
S Max: 6 St Uni 15 Jan; 6 R. Teith, Doune 14 Mar and 4 Edra, L. Katrine 29 Aug.

*GREAT GREY SHRIKE *Lanius excubitor* (p, w)

S One L. Mahaick 10-17 Mar (NB, DOE, CJP, DMB *et al*) and 1 Craigforth (St) 22 Nov (DOE).

(Eurasion) JAY *Garrulus glandarius* (B, W)
Widespread in small numbers.

S Max: 7 R. Teith (Lanrick) 12 Dec & 6 on 17 Jan; 6 Blairdrummond 12 Dec; 5 Drumloist 9 Feb and 4 Holmehill (Dunblane) 19 Sep was first record here.

MAGPIE *Pica pica* (B, W)
Widespread in Falkirk and Clackmannan districts and Stirling area.
BBS: recorded at 0.5 b/lkm (1997-2014 average: 0.5 b/lkm).

F Max: 27 Forth & Clyde Canal, Kelpies-Falkirk Wheel 28 Dec; 17 Kinneil 14 Nov; 13 Larbert 6 Feb; 12 Carron, Falkirk 8 Feb; 10 Helix Park 8 Feb and 10 Bo'ness 29 Dec.
C Max: 15 Blackdevon Wetlands 11 Feb and 12 Jellyholm, Sauchie 1 Feb.
S Max: 19 Longleys, Lecropt 29 Jan; 14 The Crescent, Dunblane 4 Dec and 11 Holmehill, Dunblane 19 Sep.

JACKDAW *Corvus monedula* (B, W)
BBS: recorded at 2.3 b/lkm (1997-2014 average: 2.5 b/lkm).

F Site max: c.400 Skinflats Pools 4 Jan and c.200 Higgin's Neuk 4 Jan. A bird at Kinneil 12 Jan was probably of the nominate 'Nordic' race (*C. m. monedula*) (JB).
C Site max: c.300 Longcarse 3 Aug.
S Site max: c.300 Blairdrummond 2 Jan and c.300 Lanrick, R. Teith 8 Nov.

ROOK *Corvus frugilegus* (B, W)
BBS: recorded at 2.2 b/lkm (1997-2014 average: 3.6 b/lkm).

F Breeding 48 AON Avonbridge (NS9272), 24 AON Avonbridge and 19 AON Wallace's Cave, R. Avon 8 Apr (ABa). Site max: c.120 Kingseat Pl, Falkirk 15 Dec; c.100 Skinflats Pools 4 Jan and c.100 Kinneil 21 Nov.
S Breeding: 333 nests Dunblane in May - an increase of 31 compared to 2014 and up 37 compared to 2013 (MVB). Max of c.100 Flanders Moss NNR 19 Oct.

CARRION CROW *Corvus corone* (B, W)
Ubiquitous. BBS: recorded at 2.3 b/lkm (1997-2014 average: 3.3 b/lkm).

F Max of c.100 S Broomage, Falkirk 18 Oct.
C Max of 91 Gartmorn Dam 25 Oct (pre roost flock).
S Max of c.200 Kippen Carse 18 Oct.

HOODED CROW *Corvus cornix* (b, w)
Hybrids with Carrion Crow common in a fairly narrow transition band running E-W across the area just to the N of Callander.

S Widespread in northwestern part of the area. Max: 26 Kirkton Fm, Tyndrum 24 Jan and 9 G. Lochay 24 Apr.

(Common) RAVEN *Corvus corax* (B, W)
BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.1 b/lkm).
F Recorded in small numbers (max 6) from: Callendar Ho, Falkirk; Carron Valley; Darnrigg Moss; Higgin's Neuk; Kinneil; Powfoulis; S. Alloa; Skinflats Pools and Westerglen, Falkirk.
C Recorded in small numbers (max 4) from: Haugh of Blackgrange; Longcarse, Menstrie and the Ochils.
S Recorded in small numbers throughout. Max: 9 Caol Ghleann (Strath Fillan) 24 Jan; 7 Gleann a' Chlachain (Strath Fillan) 2 Feb and 6 Argaty 24 Oct.
(Common) STARLING *Sturnus vulgaris* (B, W)
BBS: recorded at 4.2 b/lkm (1997-2014 average: 5.2 b/lkm).
F Site max: c.400 Powfoulis 6 Dec; c.300 Higgin's Neuk 22 Aug and c.300 Skinflats Pools 7 Nov.
S Site max: c.600 Craigforth, St 6 Dec and c.500 Drip Moss 30 Dec.
HOUSE SPARROW *Passer domesticus* (B, W)
BBS: recorded at 1.5 b/lkm (1997-2014 average: 1.7 b/lkm).
F Site max: c.90 Skinflats Pools 20 Aug.
S Site max: 88 Laraben, Kippen 13 Sep and 37 Callander (W end) 9 Feb.
TREE SPARROW *Passer montanus* (B, W)
BBS: recorded at 0.2 b/lkm (1997-2014 average: 0.1 b/lkm).
Numbers and range continuing to increase.
F Site max: 98 Orchardhead, Skinflats 4 Feb and c.20 Higgin's Neuk 21 Nov.
C Max of 15 Alva 15 Oct.
S Breeding: bred in nest boxes in two Dunblane gdns with reports of broods visiting feeders from several others. Site max: c.100 Carse of Lecropt 15 Nov; 75 Greenyards, Dunblane 23 Nov; 72 Meiklewood 15 Nov; 41 Faraway, Kippen 23 Oct and c.20 L. Watston 31 Dec.
(Common) CHAFFINCH *Fringilla coelebs* (B, W)
BBS: recorded at 3.5 b/lkm (1997-2014 average: 4.0 b/lkm).
S Site max: c.600 Greenyards, Dunblane 6 Jan; c.400 Stonehill, Dunblane 21 Nov; c.330 Dykedale, Dunblane 21 Nov; c.200 Blairdrummond 12 Dec and 100+ Kinnell, Killin 10 Jan.
BRAMBLING *Fringilla montifringilla* (W)
Last spring record from Gartmore Ho 1 Apr (JN). First autumn record c.30 Alva 15 Oct (RE).
F Recorded from Kinneil and Polmont.
S Site max: c.30 Kinnell, Killin 18 Jan; c.20 Scouring Burn, Dunblane 25 Jan and 20+ Gartinstarry, Buchlyvie 20 Feb. Also recorded from Blairdrummond, Cambushinnie, Doune and Dunblane (several gdns).
GREENFINCH *Carduelis chloris* (B, W)
Still widespread but numbers have fallen markedly in the last decade largely due to the parasite *Trichomonosis gallinae*.
BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.5 b/lkm).
F Site max: 15 Blackness 21 Nov and 12 Skinflats Pools 21 Nov.
S Site max: c.60 Taylorton 11 Feb; c.60 Stirling 29 Dec and c.40 Carse of Lecropt 25 Oct.
GOLDFINCH *Carduelis carduelis* (B, W)
BBS: recorded at 0.4 b/lkm (1997-2014 average: 0.5 b/lkm).
F Site max: c.180 Kinneil 12 Nov; c.140 Skinflats Tidal Ex 19 Sep and c.50 Higgin's Neuk 21 Nov.
S Site max: 109 Newton Cres, Dunblane 16 Dec (feeding on ash seeds) and c.60 N Third Resr 20 Sep.

SISKIN *Spinus spinus* (B, W)
BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.3 b/lkm).
F Max of c.100 Kingseat Pl, Falkirk 5 Jan.
S Site max: 213 R. Teith, Doune 25 Jan; c.100 Dunblane 1 Mar; 96 Dunblane (cemy) 14 Jan; c.50 Carse of Lecropt 29 Jan; c.40 Cambusmore/Gart GP 12 Mar; 35 Edra, L. Katrine and c.30 Kinbuck 13 Sep.

LINNET *Linaria cannabina* (B, W)
BBS: recorded at 0.3 b/lkm (1997-2014 average: 0.3 b/lkm).
F Site max: c.150 Kinneil 3 Sep; 43 Standburn (NS9174) 13 Jan and 33 Skinflats (pools & shore) 23 Dec.
C Site max: c.80 Gartmorn Dam 1 Dec; 65 Haugh of Blackgrange 15 Mar and c.60 Cambus 21 Mar.
S Site max: c.700 Greenyards, Dunblane 6 Jan; c.120 Dykedale, Dunblane 2 Jan; 84 Drip Moss 18 Oct and 60 Carse of Lecropt 29 Jan.

TWITE *Linaria flavirostris* (b, W)
F Site max: 138 Higgin's Neuk 21 Jan & c.80 on 22 Nov; 70+ Powfoulis 21 Jan. Also recorded from: Airth, Larbert, Skinflats, Skinflats Pools and S. Alloa.
C Site max: c.60 Kennetpans 3 Jan. Also recorded from Menstrie Glen.
S Recorded from: Ashfield, G. Dochart, G. Lochay and Strath Fillan.

LESSER REDPOLL *Acanthis cabaret* (b, W)
BBS: recorded at 0.4 b/lkm (1997-2014 average: 0.1 b/lkm).
F Max: 31 Tamfourhill (Falkirk – feeding on meadowsweet seeds) 11 Oct and 16 Skinflats Pools 14 Nov.
C Max of c.60 Fishcross 10 Oct.
S Max: 15 Edra, L. Katrine 29 Aug; 15 Killin Marshes 22 Feb; 12 Cromlix 24 Mar and 10 Kippen Muir 6 Dec.

COMMON CROSSBILL *Loxia curvirostra* (b, W)
BBS: recorded at 0.1 b/lkm (1997-2014 average: 0.1 b/lkm).
F Max: Five Torwood 4 Oct; 1 Cleuch Plantation, Falkirk 4 Oct and 1 Glenrig, Falkirk) 11 Oct. Also present at CVR and Skinflats Pools.
*C Ten Hillfoot Hill, Dollar 1 Feb (GG).
S Max: c.20 L. Mahaick 15 Mar; 11 Kirkton Fm, Tyndrum 23 Nov; 10 Coilhallan Wood (Callander) 22 Jul and 10 Holmehill (Dunblane) 19 Sep.

BULLFINCH *Pyrrhula pyrrhula* (B, W)
F Breeding: ad feeding 2 fledged Y 9 Aug (AB). Max: 6 Kingseat Pl, Falkirk 16 Feb and 4 Oct and 6 Bo'ness 29 Dec.
C Max of 13 Forest Mill 1 Feb.
S Max of 8 Argaty 1 Jan.

*SNOW BUNTING *Plectrophenax nivalis* (W)
C 18 Commonedge Hill, Dollar 1 Feb (GG); 2 Menstrie Glen 4 Jan & 1 on 7 Feb (JRC) and 1 Myreton Hill, Menstrie 4 Mar (GG).
S 20 G. Gyle, L. Katrine 17 Mar (DOE); 6 Kirkton Fm, Tyndrum 24 Jan and 2 on 21 Jan (JPH); 8 Gleann a' Chlachain 2 Feb and 1 on 13 Mar (JPH); 6 Tyndrum 24 Jan (BGs); 2 Ben Ledi 9 Feb (DOE) and 1 Invertrossachs 7 Feb (BGs).

YELLOWHAMMER *Emberiza citrinella* (B, W)
BBS: recorded at 0.5 b/lkm (1997-2014 average: 0.5 b/lkm).
F Site max: c.50 Higgin's Neuk 4 Jan and 23 Skinflats Pools 18 Jan.
C Site max: 36 Jellyholm, Sauchie 24 Jan and c.30 Alloa Inches 12 Dec.
S Site max: 85 Steuarthall, Fallin 17 Feb; c.50 Carse of Lecropt 1 Jan & 25 Dec; 39 Greenyards (Dunblane) 6 Jan & 33 on 30 Dec (MVB) and c.20 L. Watston 31 Dec.

REED BUNTING *Emberiza schoeniclus* (B, W)
BBS: recorded at 0.2 b/lkm (2004-2014 average: 0.2 b/lkm).

F Site max: c.30 S. Alloa 25 Feb; 15 Higgin's Neuk 4 Jan and 12 Skinflats Pools 12 Apr.
C Site max: 24 Jellyholm, Sauchie 24 Jan and 14 R. Devon, Alva-Tullibody Br 18 Jan.
S Site max: 29 Netherton Marsh, BoA 19 Jan and 19 Blairdrummond 17 Jan.

ESCAPED SPECIES

*ROSS'S GOOSE *Anser rossii*
All the following records probably refer to the same bird.
F Present Bonnybridge 13 Dec (BGs).
C One Tullibody 11-24 Mar (BGs, DMB); 1 Longcarse 14-21 Mar (JRC) and 1 Cambus 21 Mar (DOE).
S 1 E. Gogar 20 Mar (ECh).
*WHITE-FACED WHISTLING DUCK *Dendrocygna viduata*
C One Cambus Village Pools 26 & 30 Jul and 23 Aug (NB, GG).