Institution: Edge Hill University

Unit of Assessment: 17 - Geography, Environmental Studies and Archaeology

Title of case study: Discovery of two rare plant species leads to sympathetic conservation and observation.

1. Summary of the impact

Identification of rare plant species on nature reserves at Malham (Yorks.) and Morvich (W. Scotland) led to site managers developing sympathetic management approaches to ensure the species' conservation. These are detailed in management plans and include reduction in grazing and introduction of population census to assess management success. In addition, incorporation of the discoveries into plant guides has led to increased awareness of the two species which in turn has drawn naturalists to view and photograph them. Thus the research at Edge Hill has led to the conservation of and increased awareness of a rare component of the UK flora.

2. Underpinning research

The sedges (Cyperaceae) are a large, ecologically important plant family. *Carex* is the largest genus within the family. Certain groups within *Carex* present the opportunity to investigate taxonomic and evolutionary questions which includes the yellow sedges and the *Phacocystis* section of maritime species. Studies on these groups were undertaken by Dr Paul Ashton who joined EHU in 1994 as a Senior Lecturer, became Reader in 2009 and is currently Head of Department.

The complexity of the yellow sedges (*Carex flava* L. agg.) across Europe and North America has long attracted systematists, both to elucidate the number and location of taxon boundaries and to identify the position of taxa in the taxonomic hierarchy. Within the UK, research has focussed upon a problematic population at Malham Tarn (Yorks.) which has variously been identified as a hybrid, rare subspecies or true *C. flava*. This problem became a key component of a PhD undertaken by Nigel Blackstock and supervised by Ashton. Thus the work was wholly undertaken at Edge Hill with support from reserve managers at Malham Tarn National Trust Nature Reserve (NT) and at the site of the other UK population, Roudsea Wood NNR (Natural England). The work was undertaken between 1998 and 2002.

Taking the novel approach of considering the Malham population in the context of the variation within the species across the whole of its range and using a combination of genetic and morphometric approaches, Blackstock and Ashton demonstrated that the population consisted of *C. flava sensu stricto* (Outputs 1 and 2). Hence it is one of only two such populations in the UK; that at Malham with around 20 individuals being much smaller than the Cumbrian population with over 2000 individuals.

The initial findings, based upon morphometric analysis, were described in Blackstock and Ashton (2001, Output 1) with results discussed with local botanists and the wider academic community. This was developed further in Blackstock and Ashton (2010, Output2) which presented additional morphometric work and genetic analysis.

A similar problem emerged with the discovery of an unknown sedge species at Morvich, West Highlands. This was recognised to be a member of *Carex* section *Phacocystis* but the precise identification was unknown, the initial view considering it to be possibly *C. recta*, a rare Scottish species but confined to the east coast. The taxonomy of these plants was the subject of Dean's part time PhD undertaken at Edge Hill (1999-2004). Due to the knowledge amongst the botanical community of this work the specimen was sent to EHU where it was identified as *C. salina* (Saltmarsh sedge). This is a previously unrecorded species in the UK, being restricted to the coasts of Scandinavia and the eastern seaboard of North America. It is thus an extremely rare example of a species spreading by long distance dispersal.

The initial confirmation was outlined in the newsletter of the Botanical Society of the British Isles (Dean *et al*., 2005, Output 3). This was followed by a full justification of the finding plus a

description of the potential origins, the species' characteristics, ecology and key allowing distinction from closely related species in Dean *et al* (2008, Output 4).

3. References to the research

All outputs available on request. Outputs 2 and 4 are included in REF 2.

1) Journal Article: Blackstock, N. D. and Ashton, P. A. (2001) A reassessment of the putative hybrids of *Carex flava* at Malham Tarn (v. c. 64): A morphometric analysis. *Watsonia* **23(4):** 505-516 http://archive.bsbi.org.uk/Wats23p505.pdf

Watsonia was the peer reviewed journal of the Botanical Society of Britain and Ireland (BSBI) from 1949 to 2010. It has since been replaced by the *New Journal of Botany.* It is the journal to which stakeholders are most likely to have access.

2) Journal Article: Blackstock, N., Ashton, P. A. (2010) Genetic markers and morphometric analysis reveal contrasting population identification in putative *Carex flava* L. s.s (Cyperaceae) hybrid populations. *Plant Systematics and Evolution*, 287: 37-47 DOI: **10.1007/s00606-010-0287-0**

Journal: Plant Systematics and Evolution is a peer reviewed journal with a five year impact factor of 1.506 and ten year article half-life, ranked 96/197 for plant sciences.

3) Journal Article: Dean, M., Hutcheon, K., Jermy A. C., Cayouette, J. and Ashton, P. A. (2005) *Carex salina* – A New Species of Sedge for Britain. *BSBI News* **99:** 17-19 http://archive.bsbi.org.uk/BSBINews99.pdf

BSBI News is the members' newsletter of the BSBI. As such it is the principal medium for identifying new UK plant discoveries.

4) Journal Article: Dean, M., Ashton, P. A., Hutcheon, K., Jermy, A. C. and Cayouette, J. (2008) Description, ecology and establishment of *Carex salina* Wahlenb. (Saltmarsh sedge) – A New British Species. *Watsonia* **27** 51-57 http://archive.bsbi.org.uk/Wats27p51.pdf

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4. Details of the impact

The research underpinned the impact by detailing the addition of a new species to the British flora (*C. salina*) and the confirmation of a second population of a very rare UK species (*C. flava* at Malham). In addition to the peer reviewed journal output (listed above) dissemination of the findings were also achieved by conference presentations commencing in 2004 and continuing through to 2009. Some of this conference work was to non-academic audiences (Dean et al, 2004, Other Source 4; Blackstock, 2008, Other Source 3; Dean and Ashton, 2009, Other Source 5). This preliminary work, much ahead of the REF period has led to impact typically across three areas in the period 1 Jan 2008 to 31 July 2013.

Firstly the recognition of the significance of the species discovered and hence their need for suitable management to ensure sensitive conservation of the UK's rarest plant species. Hence impact is manifest in **management plans** written by the site managers. Secondly the incorporation of the **findings into published floras**. Finally a combination of the above two impacts is that it has contributed to the **'green tourism'** within the area of the two species as naturalists seek to see and photograph the species. Beneficiaries are the statutory national bodies responsible for conservation (Natural England, NE, and Scottish Natural Heritage, SNH) plus voluntary conservation bodies the National Trust (NT) and the National Trust for Scotland (NTS). Additional beneficiaries include individuals with an interest in biodiversity and areas surrounding the locations as individuals visit.

Prior to the Blackstock and Ashton work, the Malham population was viewed as little more than a curiosity (Jermy et al, 1983, Other Source 6). However, the significance of finding true *C. flava* at Malham Tarn National Nature Reserve was recognised by the NT, the owners of the site, who introduced sympathetic management accordingly, detailed in the most recent management plan (2010, Other Source 8) and written in agreement with NE. This included 'a change of management to carefully control grazing' (Factual Statement 1) and introduced an annual count of the population

to identify long term changes in abundance and hence assess the appropriateness of the management.

The *C. salina* work took a similar route to impact. The finding of these sedge raised the question of whether this was the only site where the species was found in the UK. This was partly addressed by a 'Citizen Science' appeal via the Edge Hill website. This in turn was picked up by the BBC and featured on the front page on its news website in February 2007. The discovery of the new species was then featured in other news sources. While many of the routes to dissemination predate the impact of the census return they raise awareness of the finding and prepare the ground for the impact within the census period, in the wider acceptance and dissemination of the work.

Two bodies were beneficiaries of the discovery: SNH, the government body responsible for conservation in Scotland and the NTS who own and manage the Kintail estate on which the species is found. The presence of the species informed management plans developed by NTS in 2008 in agreement with SNH and reduced grazing on the site (Other Source 9).

The initial academic work (Journal Articles 1 and 4) and attendant dissemination of findings has led to the wider impact within the census period. For instance, documentation of the Malham *C. flava* population in Abbott (2005, Other Source 1) and Jermy et al, (2007, Other Source 7) resulted in the incorporation of the work into the third edition of the *Flora of GB* (Stace, 2010, Other Source 11). This text has been the standard reference work for the British Flora since its first edition in 1991.

An outcome of these publications raising the profile of both of the species is that they have become a botanical attraction for visitors to the area interested in wildlife (see Other Source 12). *Carex flava* features on Field Studies Council courses at Malham Tarn field centre 'continues to attract interest from both locals and from individuals who visit the area from further afield' (Factual Statement 1) and is regularly photographed (e.g. Other Source 10). *C. salina* has been similarly featured on botanical excursions and has also been photographed as individuals seek to become familiar with it and then seek it at additional sites.

Without the sedge taxonomy work at Edge Hill it is likely that the population at Malham would have continued to be viewed as a hybrid population (as in the second edition of the BSBI sedge handbook). Without these changes, resulting from your work, this extremely important population of plants could have been seriously threatened with potential loss of an important part of UK biodiversity and a distinctly remote population of the species as a whole (see Factual Statement 1). Likewise the *C salina* population may have been misidentified and the opportunity to observe a new addition to the UK flora lost.

5. Sources to corroborate the impact

Factual Statements:

1) Ecologist and Wildlife Engagement Officer, National Trust – confirms that the c.flava population at Malham would have been seriously threatened without proper identification; change in site management plans and practices as a result of the underpinning research; visitor interest in the site as a result of proper identification of c. flava.

Other Sources:

1) Abbott, P. P. (2005) Plant Atlas of Mid-West Yorkshire. YNU Bradford.

2) BBC News website Feb 1, 2007 http://news.bbc.co.uk/1/hi/sci/tech/6317367.stm

3) Blackstock, N. (2009) Status of *Carex flava* in the British Isles. Malham Research Conference proceedings vol 6. FSC Shrewsbury.

4) Dean, M., Hutcheon, K., and Ashton P. A. (2004) November Scottish BSBI Exhibition Meeting. Poster display *A new species of sedge related to Carex recta Boott for Britain*.

5) Dean, M. and Ashton, P. A. (2009) Hybrid evolution in *Carex* section *Phacocystis*. Oral presentation: 52nd Ecological Genetics Group Annual conference. Sheffield.

6) Jermy, A. C. et al (1983) *Sedges of the British Isles* 2nd ed BSBI.

7) Jermy, A. C. et al (2007) *Sedges of the British Isles* 3rd ed BSBI.

8) National Trust (2010) Malham Tarn NNR site management plan.

9) National Trust Scotland (2010), Kintail estate management plan.

10) Panoramio website http://www.panoramio.com/photo/91470595 accessed 23.10.13 at 00.12

11) Stace, C. A. (2010) *Flora of Great Britain* 3rd ed Cambridge University Press.

12) Botanical Society of Britain and Ireland, Field Meetings Programme 2010. Available: http://www.bsbi.org.uk/FieldMeetings2010.pdf pg 14 Accessed 18.11.2013.