

## Conservation of Britain's biodiversity: *Cyperus fuscus* L. (Cyperaceae), Brown Galingale

T. C. G. RICH\*

*Plantlife, 21 Elizabeth Street, London SW1W 9RP*

### ABSTRACT

*Cyperus fuscus* is a rare plant in Britain and probably always has been. It has been recorded in a total of 13 sites in England and two in Jersey, but is currently known from six sites and one site respectively (c. 50% decline). It is an annual of bare, seasonally exposed, nutrient-rich, base-rich mud on the edges of ponds and ditches. It is at its northern limit of distribution and is probably limited by climate. Population counts for extant sites are given for the period 1993–1996. The numbers of plants vary from year to year and site to site, with many observers noting it is most abundant in hot, drought years. Four sites have numbers below the minimum required to conserve all polymorphic genes with a frequency of 0.05 in the population. Most sites are grazed by stock, but in some, scrub has been removed to improve the habitat. Only one site is not protected.

KEYWORDS: Rare species, conservation.

### INTRODUCTION

*Cyperus fuscus* L. (Cyperaceae), Brown Galingale, is a rare plant in Britain. In 1992, the wild-plant conservation charity Plantlife became concerned that it was amongst the most threatened plants in Britain. It was therefore included in their "Back from the brink" project, which aims to conserve critically endangered plant species through research and management work. About 20 rare plant species have been included in this project between 1992 and 1996, which represents a significant contribution to the conservation of biodiversity in Britain by the voluntary sector. The aim of this paper is to summarize the conservation work carried out on *C. fuscus* to 1996; full details can be found in Rich (1993a, 1993b, 1994, 1995) and Rich *et al.* (1996). Further details about the "Back from the brink" project can be obtained from Plantlife.

### DISTRIBUTION

#### DISTRIBUTION IN BRITAIN

The distribution of *C. fuscus* is mapped in Fig. 1. It has been recorded from 13 native sites in England (some of which have or have had more than one population) and two in Jersey, in a total of eleven 10 km squares. The English sites are concentrated along parts of the valleys of the River Thames and River Avon with outlying sites in Somerset, Dorset and the Weald. It was also introduced to Fulham Common from Swiss material by A. H. Haworth in c. 1819 and was reported regularly until 1865 when the meadow was drained and built on (Gray 1871); this site is not discussed further. A record for Guernsey probably refers to Jersey (McClintock 1975).

The dates of first and last records are summarised in Table 1. It has only been recorded in six sites in England and one site in Jersey since 1990 (c. 50% decline). The reasons for its decline are not always clear, but loss of ponds, drainage, gravel extraction, land reclamation or natural in-filling are possible reasons for loss. Most of the decline took place by the 1920s, and only one site has been lost in the last 50 years.

\*Address for correspondence: Department of Biodiversity and Systematic Biology, National Museum and Gallery of Wales, Cardiff CF1 3NP

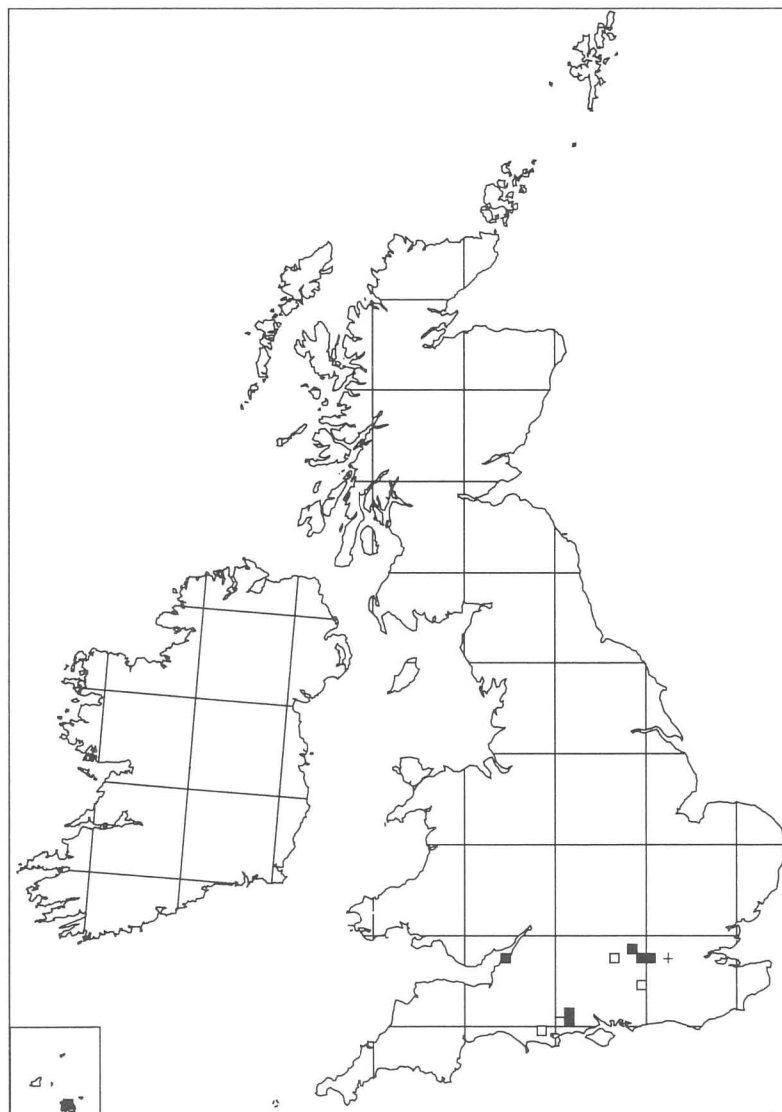


FIGURE 1. Distribution of *Cyperus fuscus* in the British Isles. ■ 1990–1996; □ pre-1990; + introduced.

#### WORLD DISTRIBUTION

*Cyperus fuscus* is widespread in Europe, adjacent parts of Africa and large parts of Asia (the eastern limits are insufficiently known; Hultén and Fries 1986). It is rare and declining in northern Europe (e.g. extinct in Sweden; Lindberg 1977) but is quite common in parts of central Europe. For instance it is quite frequent along the Rhine in Germany (Haeupler and Schonfelder 1989); in the Czech Republic, it is a characteristic plant of fish ponds in the south of the country (e.g. Husák 1953).

It is rare in the eastern United States of America, occurring westwards to Nebraska and South Dakota (Weedon and Stephens 1969). It was found in Canada in 1970 as an adventive at the edge of a pond in Ontario Province (Gillett 1971).

TABLE 1. DATES OF FIRST AND LAST RECORDS OF SITES OF *CYPERUS FUSCUS* IN THE BRITISH ISLES. EXTANT SITES ARE ONLY LOCALISED TO COUNTY

Site	No. of populations	First record	Last record	Reason for loss
Berkshire 1.	1	c. 1982	1996	-
Berkshire 2. Pangbourne	1	1911	1911	Exact site not known, possibly reclaimed for agriculture
Buckinghamshire 1.	2	1906	1996	-
Buckinghamshire 2. Huntercombe	1	1906	1906	Exact site not known, possibly reclaimed for agriculture
Dorset 1. Bere Regis	1	1893	1893	Site still suitable
Dorset 2. 1–2 miles from Bere Regis	1	1893	1893	Exact site not known, possibly reclaimed for agriculture
Dorset 3. Wimborne	1	1929	1929	Exact site not known
Hampshire 1.	1	1934	1996	-
Hampshire 2.	2	1983	1996	-
Hampshire 3. Blashford	1	1893	1893	Probably lost to gravel extraction
Middlesex 1.	1	1957	1996	-
Somerset 1.	3+	1899	1996	1 population still extant; others possibly lost through succession to fen/swamp vegetation
Surrey 1. Shalford	1	1846	1960s	Seedbank possibly still present, pond rarely dries out
Jersey 1. St Peter's Marsh	1	1842	1842	Site drained
Jersey 2.	1	1989	1996	-

## ECOLOGY

## LIFE CYCLE

*C. fuscus* is an annual. It probably germinates from early summer onwards when the seedbank in the mud becomes exposed by seasonal drops in water level. Some germination has been noted as late as August at sites in Hampshire and Buckinghamshire. Plants were seen in flower in early June in the Czech Republic (pers. obs., 1993), but in Britain it flowers later, from about July to September. Plants are wind-pollinated; the anthers are tiny and yellow, and are exerted after the styles.

Plants vary in size markedly. Plants collected at Somerset 1 (see Table 1) last century were often lush and up to 30 cm tall, whilst those seen more recently there and elsewhere have often been only a few centimetres high, although flowering and fruiting freely. It can grow and complete its life cycle within four months, as shown by its persistence in ditches at Somerset 1 over a period of many years where the ditches were cleared out on a four monthly cycle (White 1912). It is possible to obtain two generations in cultivation in one year (R. S. Cropper, pers. comm., 1995).

Plants fruit soon after flowering. Most fruits probably do not disperse outside the pond or ditch system, but fruits have been found in mud attached to birds (Salisbury 1970) and its distribution along river valleys suggests that fruit is also dispersed by water during floods. Evidence from conservation work suggests that it has a persistent seed bank (see below).

## HABITAT

The plant occurs on the damp, open, seasonally exposed, muddy margins of small ponds and ditches. Most soils are nutrient-rich (e.g. Lousley 1976), and it may benefit from nutrients from wildfowl droppings. Soil samples measured from four sites ranged from pH 6.6–7.8. It will tolerate some salinity in Europe (pers. obs., 1993), but has not been recorded in saline habitats in Britain.

It is often associated with annuals of disturbed mud such as *Bidens cernua*, *B. tripartita*, *Gnaphalium uliginosum*, *Juncus bufonius*, *Persicaria maculosa*, *P. hydropiper*, *Ranunculus sceleratus*, *Rorippa nasturtium-aquaticum* and *R. palustris*, and perennials such as *Agrostis stolonifera*, *Alopecurus geniculatus*, *Glyceria fluitans* and *Mentha aquatica*. The vegetation is

TABLE 2. SUMMARY OF RECENT POPULATION COUNTS OF *CYPERUS FUSCUS*. NO PLANTS HAVE BEEN SEEN RECENTLY AT SURREY 1, BUT A SEED BANK MAY STILL BE PRESENT. \* NOT SURVEYED

SITE	1984–5	1993	1994	1995	1996
Berkshire 1	1,000	250	35–40	30	60
Buckinghamshire 1	0	41	188	96	7
Hampshire 1	1,500	1,000+	10,000	25,000	5,000
Hampshire 2	36,500	c. 500	200	1,061	1,682
Middlesex 1	50	0	200	100	320
Somerset 1	2	5	33	10	1
Surrey 1	0	0	0	0	0
Jersey 2	*	0	0	3	3,000+
Total	39,052	1,796+	10,656	26,300	10,070+

usually open, but *C. fuscus* can sometimes be found under the canopy of taller swamp species, though it will not tolerate deep shade. It is sometimes found with other uncommon wetland species such as *Hottonia palustris*, *Oenanthe aquatica*, *Persicaria minor* and *Rumex palustris*, and in central Europe such communities (*Cyperetalia fusci* and *Cypero Limoselletum*) are regarded as botanical gems (Ellenberg 1988).

#### CLIMATE

*Cyperus fuscus* is at the northern limit of its distribution in Britain, and seed production is probably limited by climate indirectly through habitat conditions, and directly through effects on growth and reproduction. Many observers (e.g. Druce 1926) note that it is most abundant in hot, drought years, and this has been confirmed in recent years (e.g. Table 2).

With a generally wet and cool climate in Britain compared to Europe, its wetland habitats are dependent on seasonal lowering of the water table through low rainfall and higher temperatures, thus exposing the mud to allow plants to germinate. Tutin (1953) noted that in cultivation at Leicester it required relatively high temperatures for germination, and set little or no seed in a cool summer. The high nutrient status of many of its sites may also enable rapid growth under suitably warm climatic conditions. It flowers from peak summer onwards in Britain and thus has a very short flowering season before the autumn rains begin and plants are flooded. Plants at Middlesex 1 have been observed to survive short periods of inundation by water, but not longer periods; plants collected in September 1994 after c. 1 week under water and transplanted to the Seed Bank at Wackhurst Place died and set no fruit.

*Cyperus fuscus* appears likely to benefit from global warming if the climate becomes warmer and drier, but probably not if it becomes warmer and wetter.

#### POPULATION SIZES

The population sizes at the seven extant sites in 1993–1996 are summarised in Table 2, with some earlier 1984–1985 data for comparison from surveys carried out for the Nature Conservancy Council (Everett 1987; L. Farrell, pers. comm., 1993). It was present in seven sites between 1993 and 1996, and a seed bank may be still present at Shalford Common.

The number of sites present each year depends on the weather and on disturbance. All recorders find that it varies in abundance within sites from year to year. For instance Lousley (1976) noted that *C. fuscus* fluctuated in abundance from year to year at Shalford “from great abundance in years like 1949, when the pond was almost dry, to complete absence when the water is high or the pond is overgrown with tall vegetation”.

#### CONSERVATION

##### SITE MANAGEMENT

Most sites are usually subject to light disturbance which helps to maintain them in a generally suitable open condition, such as by cattle trampling (though this must not be excessive) (Table 3).

TABLE 3. CONSERVATION STATUS AND CURRENT THREATS TO *CYPERUS FUSCUS* SITES. NNR = NATIONAL NATURE RESERVE. SSSI = SITE OF SPECIAL SCIENTIFIC INTEREST. SSI = SITE OF SPECIAL INTEREST (JERSEY)

Site	Status	Management	Threats
Berkshire 1	SSSI	Cattle grazed. Clearance of willows in pond by English Nature/ National Trust.	
Buckinghamshire 1	None	Heavily cattle-grazed common land.	Possible changes in water table due to Maidenhead flood relief scheme; pollution from road run-off; significant increase or decrease in stocking levels.
Hampshire 1	SSSI	Cattle-grazed. Some ditch clearance has been carried out to provide suitable water levels.	Possibly pollution from road run-off; significant increase or decrease in stocking levels.
Hampshire 2	SSSI	Cattle- and pony-grazed common land.	Spread of <i>Myriophyllum aquaticum</i> ; significant increase or decrease in stocking levels.
Middlesex 1	SSSI	Cattle-grazed common. Clearance of willows by Plantlife.	Spread of <i>Crassula helmsii</i> and <i>Myriophyllum aquaticum</i> ; pollution from road run-off; significant increase or decrease in stocking levels; trampling by fishermen; lack of management.
Somerset 1	NNR	Ditch in horse-grazed pasture.	Inappropriate ditch maintenance; marked changes in water table.
Surrey 1	None	Old common no longer grazed. Margins disturbed in 1989 with-out success; pond dredged in 1992 and some willows cleared, but pond has not dried out since.	Local residents require a fish and duck pond which is in conflict with the <i>Cyperus</i> requirements.
Jersey 2	SSI	Ungrazed common. Reeds cleared in parts annually, and also mown.	Changes to local water table; cess-pit effluent; lack of management.

*C. fuscus* is not grazed by horses and cattle primarily due to its small size. The associated trampling may result in loss of some individuals, but these losses are probably compensated for by maintenance of short open vegetation which is suitable for other individuals.

It has also benefited from conservation work at Middlesex 1 and Berkshire 1 which had become overgrown with scrub. Clearance of tall dense willow scrub at Middlesex 1 in September 1993 resulted in the reappearance of the plants in 1994 (no plants had been observed at this site since 1989); further clearances were carried out in 1996. Clearance of willow scrub at Berkshire 1 in 1994 has produced a less spectacular response, but plants are recolonising newly exposed mud. Plants were found at Jersey 1 after clearance of reeds in an old pond.

The timing of management work is critical. Clearly it should not be carried out when plants are growing, but at other times of year ponds are often too wet to work in safely. Experience has shown that disturbance late in the season produces good results the following year. Disturbance could also be carried out immediately the mud is exposed in early summer prior to germination. In Somerset 1, *C. fuscus* was reported to benefit from ditch clearance as late as June (White 1912).

Calculations have shown that a minimum sample size of 172 plants is required to preserve all, or very nearly all, polymorphic genes with frequency over 0.05 in a population (Lawrence *et al.* 1995a, b). It is thus proposed that conservation management should aim to achieve at least 172 *C. fuscus* plants at each site each year. On this basis, three sites have populations consistently above the minimum sizes, and four below (Table 2).

## STATUTORY PROTECTION

Table 3 summarises the protection and threats to each site. *C. fuscus* is protected under the Wildlife and Countryside Act 1981, which should prevent deliberate uprooting and collection. Five extant sites are protected as statutory Sites of Special Scientific Interest in England, though only one of these is specifically for *C. fuscus*; one site has no protection. Jersey 1 is a statutory Site of Special Interest.

This species is still under threat in Britain. A Species Action Plan is currently being drawn up by Plantlife for English Nature.

## MONITORING AND RESEARCH

It is essential that populations are monitored each year to determine the results of the conservation work, assess natural variation due to weather and to watch out for new threats to sites. Between 1993 and 1996 monitoring was carried out cost-effectively by simply counting plants, taking photographs and making observations on management with the help of volunteers.

In the longer term, population sizes should be correlated against weather patterns and pond water levels to determine how close the links are between population peaks and good weather and *vice versa*. Research should also be carried out into seed set and germination under different environmental conditions (temperature, water-logging, etc.).

## ACKNOWLEDGMENTS

I would like to thank all those who have helped with information and conservation work, especially John Alder, Clive Chatters, Robert Cropper, Jiri Danihelka, Ruth Davis, Geoff Dawes, Lynne Farrell, Geoffrey Field, Mike Freeman, Peter Grainger, Paul Harmes, Nick Hinson, Jan Kirschner, Mark and Clare Kitchen, John Knight, Frances Le Sueur, Margaret Long, Martin Love, Peter Marren, Andy McVeigh, Steve Parker, David Pearman, John Ounsted, John Pinel, Ron Porley, David Rees-Jones, Sarah Richardson, Tony Robinson, Francis Rose, Alan Showler, Dave Simpson, Shaun Swarbrick, Joyce Smith, Alison Templeton, Janet Terry, Audrey Thorne, Peter Tinning, Elizabeth Young, Heather Winship and Martin Wigginton. I would like to thank Del Monte, English Nature, Greenhams, the Royal Botanic Garden Wakehurst Place, and Spelthorne Natural History Society for access permission and help, and English Nature for access to files. The work was funded by Plantlife and Spelthorne Borough Council.

## REFERENCES

- DRUCE, G. C. (1926). *The flora of Buckinghamshire*. T. Buncle & Co., Arbroath.
- ELLENBERG, H. (1988). *Vegetation ecology of central Europe*. 4th ed. Cambridge University Press, Cambridge.
- EVERETT, S. (1987). Rare plant survey of South Region. Confidential report to Nature Conservancy Council, Peterborough.
- GRAY, J. E. (1871). *Cyperus fuscus* not a native. *Journal of botany* **1871**: 148.
- GILLET, J. M. (1971). *Cyperus fuscus* L. new to Canada. *Canadian field-naturalist* **85**: 190.
- HAEUPLER, H. & SCHONFELDER, P. (1989). *Atlas der Farn- und Blütenpflanzen der Bundesrepublik Deutschland*. Ulmer, Stuttgart.
- HULTÉN, E. & FRIES, M. (1986). *Atlas of north European vascular plants, north of the tropic of cancer*. Koeltz Scientific Books, Königstein, Germany.
- HUSÁK, S. (1953). *The Lednice fishponds*. Propagacni Tvorba, Praha.
- LINDBERG, P. (1979). *Cyperus fuscus* in Sweden. *Svensk Botanisk Tidskrift* **71**: 69–77.
- LOUSLEY, J. E. (1976). *Flora of Surrey*. David and Charles, Newton Abbot.
- MCCLEINTOCK, D. (1975). *The wild flowers of Guernsey*. Collins, London.
- RICH, T. C. G. (1993a). *The status of Brown Galingale (Cyperus fuscus L.) in Britain*. Back from the brink project report no. 14. Plantlife, London.
- RICH, T. C. G. (1993b). *Clearance at Shortwood Common for Brown Galingale (Cyperus fuscus L.)*. Back from the brink project report no. 15. Plantlife, London.
- RICH, T. C. G. (1994). *The status of Brown Galingale (Cyperus fuscus L.) in Britain in 1994*. October 1994. Back from the brink project report no. 36. Plantlife, London.
- RICH, T. C. G. (1995). *The status of Brown Galingale (Cyperus fuscus L.) in Britain in 1995*. October 1995. Back from the brink project report no. 63. Plantlife, London.

- RICH, T. C. G., *et al.* (1996). *The status of Brown Galingale (Cyperus fuscus L.) in Britain in 1996*. Back from the brink project report no. 74. Plantlife, London.
- SALISBURY, E. J. (1970). The pioneer vegetation of exposed mud and its biological features. *Proceedings of the Royal Society* **259**: 207–255.
- TUTIN, T. G. (1953). *Natural factors contributing to a change in our flora*, in LOUSLEY, J. E., ed. *The changing flora of Britain*, pp. 19–25. B.S.B.I., London.
- WEEDON, R. R. & STEPHENS, H. A. (1969). *Cyperus fuscus* in Nebraska and South Dakota. *Rhodora* **71**: 433.
- WHITE, J. W. (1912). *The flora of Bristol*. John Wright and Sons, Bristol.

(Accepted April 1998)