RANDOM-ACCESS GUIDE
TO SEDGES OF THE BRITISH ISLES
USING A MICROCOMPUTER

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ABSTRACT

An identification guide for British sedges of the genus Carex is provided for IBM-compatible or BBC microcomputers using the Random-Access Identification system (Legg, 1992). The guide includes a database of 182 character states for 73 species and two sub-species. The database uses flowering and vegetative characters for the plants and information on distribution and habitat. Some new characters based on the structure of the leaf epidermis are included.

INTRODUCTION

This illustrated guide to sedges of the genus Carex (Cyperaceae) and the associated computer database are designed for use with the Random-access KEY program which runs on either the BBC-B computers or IBM PC compatible machines using MS-DOS. The KEY program is described elsewhere (Legg, 1992) and is available from the Field Studies Council, Preston Montford, Montford Bridge, Shrewsbury SY4 1HW. Users should refer to the instructions distributed with the program before using this database.

The characters used in this key are based largely on the descriptions and illustrations given in Jermy, Chater and David (1982) and Clapham, Tutin and Warburg (1962) but all characters have been checked on fresh material or herbarium sheets where fresh plants were not available. Many of the leaf characters (N, n, O, and P) are new and, though derived from direct observations, have not been checked on a wide range of material so may show more intra-specific variation than is indicated here.

The characters are arranged in order from the top of the plant and its flowers down through stem, leaves, rhizomes and roots, with habitat and distribution last. A plant should not necessarily be scored in this order. Some characters are more useful than others, either because they are constant for particular groups of species, or because they are relatively easy to score without error. These characters are indicated in bold type in the illustrations which follow. Some other characters require a microscope for reliable recognition and these are described in italics. It is not usually necessary to use the microscopic characters, though they may provide valuable additional information on difficult or incomplete specimens.
The identification will be fastest and most efficient if any unusual or distinctive features of the unknown plant are scored first. Failing this, however, you should start with the characters indicated in bold type.

If you wish to reduce the size of the database by using exclusive characters (by using the ! function - see instructions in Legg, 1992), then the number of stigmas (J) is very reliable for young plants, and the distribution (Z) is sufficiently well known for British sedges that you are unlikely to find species outside their known range. Other characters can be used with discretion. For example, the inflorescence structure (A) is a valuable character, but there is some variation between A4 and A5 (number of male spikes). If this is to be used as an exclusive character you should enter both A4 and A5 before the ! so that all species with distinct male spikes are included in the reduced set of species.

Related characters in the illustrations are grouped under a single letter code, but this does not mean that the characters so grouped are mutually exclusive. If your plant is intermediate between two character states then you should enter both characters into the key.

Note that the characters listed for each species in the database are not intended as accurate descriptions of the species; they are intended to include all characters which may possibly be recorded for that species including likely errors of observation. For example, Carex maritima is normally considered by taxonomists to have an inflorescence of several similar spikes (A2). However, the spikes are small and densely packed into a tight head superficially giving the impression of a single spike (A1). Conversely, if examined closely, the terminal spike may be found to be entirely male and different in appearance from the lower spikes; the inflorescence would then be recorded as A4. The database therefore includes A1, A2 and A4 for this species.

The comments which appear on the computer screen after each description include an English name and brief notes on similar species or particular diagnostic features. The number which appears beside the English name is the species number in Jermy, Chater and David (1982) except for the two sub-species (C. muricata lamprocarpa and C. divulsa leersii which are numbered 74 and 75). The species are included in the database in the same order as in this paper so the ‘absolute numbers’ used to access information on particular species (function 6 in the program) are the same numbers as used by the book except for the two subspecies. These numbers are indexed on pages 34 and 35.

A major problem for the complete beginner may be to distinguish the members of the genus Carex (the true sedges) from other ‘grass-like’ plants. The diagram on page 36 shows the structure of a typical sedge plant and also illustrates some of the diagnostic features which will distinguish them from other members of the sedge family (Cyperaceae), and from grasses and rushes. The bottle shaped utricle enclosing the nut in the female flower is diagnostic for Carex, but other features are valuable; for example, nearly all other species (except the very rare Kobresia) have hermaphrodite flowers containing both male and female parts. No British members of the genus Carex have cottony flowers, or hollow, tubular leaves; all have at least some fully developed leaf blades.

Identifications using the random-access key should always be checked against illustrations and descriptions in a conventional flora. The book by Jermy, Chater and David (1982) is particularly valuable, but those by Fitter, Fitter & Farrer (1984) and Rose (1989) are also recommended.
ACKNOWLEDGEMENTS

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REFERENCES


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Structure of the Sedge Plant

Female flower
Stigmas, J
Beak, I
Utricle enclosing the nut, E, F, G, H
Spike of male flowers, A
Spike of female flowers, B
Spike of both male and female flowers, A

Flowers of Sedges (Cyperaceae) other than Carex
Flowers hermaphrodite, fruit not enclosed in utricle

Flower of Rush
Hermaphrodite, parts in threes or sixes

Flower hermaphrodite with two scales

Structure of Grasses
Cylindrical stem
Ligule free not attached to leaf surface
Sheaths open with overlapping margins
Spikelet with flowers in two rows

Fig. 1
Structure of the sedge plant
A  Inflorescence Type

Each spike contains a number of individual flowers. Male flowers may be very hard
to find in A1, A2 and A3 but usually show the remains of stamens (filaments) except
in old specimens. Spikes which are entirely male in A4 and A5 usually have more
closely appressed glumes (scales), are darker in colour and more slender than the
fruiting female spikes.

A1  Single, unbranched terminal spike of
several to numerous flowers

A2  Several unbranched spikes, all very
similar in appearance. The spikes may
be tightly clustered and appear
superficially like a single head of
flowers. Most spikes contain
both male and female flowers

A3  Spikes all similar, but forming a
branched panicle (i.e. at least the
lower branches are themselves
branched)

A4  Single terminal spike entirely male
and distinct from the one or more
lateral female spikes

A5  Two or more male spikes distinct
from the lower female spikes
B Lateral Spikes

These characters apply to the lower, lateral spikes of plants in A2 and A3 above, and to the female spikes in A4 and A5. They cannot be applied to plants in category A1 above which do not have lateral spikes.

B1 All spikes sessile (without a stalk joining them to the main stem). Note that the stalk of some species may be hidden within the sheath of the lower bract, see C5 below

B2 The lowest spikes with a peduncle (stalk), but the upper spikes sessile

B3 All lateral spikes with a peduncle more than 2mm long

B4 Lower spikes short, length less than twice the width

B5 Lower spikes long and narrow, length more than twice the width

B6 All spikes clustered near the top of the stem

B7 At least some spikes well spaced out down the stem
C Lowest Bract

The lowest bract is the leaf-like structure or papery scale on the main stem where the lowest spike is attached. Unusual bracts may occur where the lowest spike is in the bottom third of the flowering stem and these should be ignored.

C1 Bract shorter than the lowest spike

C2 Bract longer than the lowest spike, but shorter than the whole inflorescence

C3 Bract longer than the whole inflorescence

C4 Base of lowest bract not sheathing the stem

C5 Base of lowest bract forming a tubular sheath enclosing the main stem and the base of the peduncle

C6 Lowest bract flat, green and leaf-like

C7 Lowest bract setaceous (bristle-like), solid and triangular in section for most of its length

C8 Lowest bract glumaceous (a brown and papery scale similar in appearance to the female glumes)
D Female Glume Colour and Shape

The glume is the papery scale at the base of each individual flower. All young flowers tend to have pale glumes so colour should only be scored on mature flower heads. Examine several glumes for D6 to D8 as the tips are brittle and easily damaged.

D1 Female glumes colourless, greenish, or pale brown

D2 Female glumes mid-brown or reddish-brown

D3 Female glumes purple-brown to blackish

D4 Midrib of female glume of contrasting colour

D5 Margin of female glume white, silvery or transparent and colourless

D6 Apex of membranous portion of female glume obtuse (with or without extending midrib)

D7 Apex of female glume acute

D8 Apex of female glume acuminata or midrib extending in a short point
E  Glume and Utricle Length

The length of the glume includes the projecting midrib (if present) and the length of the utricle includes the beak. The glumes break easily so it is better to measure several. Measure only mature fruit. The utricle is the bottle-shaped structure which encloses the fruit.

E1  Female glume less than 3 mm long

E2  Female glume 3 - 5 mm long

E3  Female glume more than 5 mm

E4  Male glume much longer than the female glume (by at least 1 mm)

E5  Male glume about equal in length to female, or shorter

E6  Utricle less than 3 mm long including beak

E7  Utricle 3 to 5 mm long

E8  Utricle more than 5 mm long
F  Utricle Shape

The utricle is the bottle-shaped structure enclosing the nut and the shape is critical in the identification of many species, but difficult to define precisely. F1 to F3 concern whether the widest point of the utricle is above or below the middle (excluding the beak). F6 to F8 concern the length and shape of the beak.

F1  Utricle obtuse, widest above the middle (pear-shaped)

F2  Utricle obtuse, widest at about the middle (ellipsoid)

F3  Utricle obtuse, widest below the middle (ovoid)

F4  Utricle (excluding the beak) acute, ovoid

F5  Utricle narrowly lanceolate

F6  Beak of utricle gradually tapered

F7  Beak of utricle abrupt

F8  Beak of utricle very short or absent
G Surface of Utricle

A hand lens (x10) is essential for G1 and G2 while G5 can only be seen clearly with a x40 binocular microscope. See sections N and P for illustrations of papillae and notes on how they should be observed.

G1 Utricle strongly ribbed, or at least with two marginal veins prominent - x10

G2 Utricle faintly veined, or only ribbed at the base - x10

G3 Utricle smooth (with or without ribs), but with a dull matt surface

G4 Utricle with a shiny, glossy surface

G5 Utricle surface covered with minute papillae (see section N) - x40

G6 Utricle surface hairy - x10

H Colour of utricle

All young fruits may be pale so record only mature fruits or those with a well developed colour.

H1 Utricle mid-green to dark green

H2 Utricle pale greyish green to blue-green, glaucous (with a waxy bloom)

H3 Utricle yellowish to olive-green

H4 Utricle straw or golden to pale brown

H5 Utricle mid- to dark brown

H6 Utricle reddish or red-brown

H7 Utricle flushed with purple or blackish
I   Apex of Utricle Beak

Use a hand lens to score I1 to I6; I7 and I8 require x40 magnification from a binocular microscope.

I1  Beak tip truncate (neither notched, nor oblique) - x10

I2  Beak tip oblique - x10

I3  Beak tip shallowly notched - x10

I4  Beak tip deeply bifid - x10

I5  Beak split, at least down one side - x10

I6  Margins of the beak winged - x10

I7  Margins of the beak rough or scabrous - x40

I8  Margins of the beak not rough or scabrous (though they may be papillose) - x40

J   Number of Stigmata

Stigmata are easily seen on young flowers but are soon damaged where one may fall off, or two stick together. This character is very valuable taxonomically, but it is important to count several flowers using a hand lens, or a binocular microscope on older flowers.

J1  Three stigmata per flower - x10

J2  Two stigmata per flower - x10
K  Length, Shape and Roughness of Flowering Stem

For shape and roughness of the stem, examine just below the lowest node of the inflorescence (i.e. just below the lowest bract)

K1  Flowering stems shorter than the leaves

K2  Flowering stems about as long as the leaves

K3  Flowering stems longer than the leaves

K4  Stems more or less cylindrical or grooved, but not three-sided

K5  Stems triangular in section, but with convex faces and blunt angles

K6  Stems sharply triangular with flat or concave faces and either with acute angles or winged

K7  Stem minutely rough, at least on the angles near the apex (if in doubt, roughness can best be felt with the tip of the tongue - but take care not to cut yourself!)

K8  Stem entirely smooth (though the peduncles and stem above the lowest bract may be rough)
1. **Shape of Leaf in Section, and Leaf Tip**

Examine the leaf section in about mid-leaf. This is best done by cutting or breaking the leaf and viewing it from the cut end. The leaf tips should be examined with a hand lens.

- **L1** Leaf more or less flat in cross section

- **L2** Leaves channelled (U-shaped) or with the margins inrolled

- **L3** Leaves folded along the midrib or strongly keeled

- **L4** Leaves plicate (M-shaped)

- **L5** Leaves bristle-like and solid

- **L6** Leaf tip flat or channelled

- **L7** Leaf tip triangular in cross section for a short length

- **L8** Leaf tip with a long whip-like tip, triangular in cross section

- **L9** Leaf gradually tapered to the apex

- **LA** Leaf abruptly narrowed at a point just below the apex

- **LB** Leaf abruptly broadening just below the apex
M Leaf Size

Measure the largest leaves. Measure width at about mid leaf, and length of the blade from the top of the leaf sheath.

M1 Leaf width less than 2 mm

M2 Leaf width 2 - 5 mm

M3 Leaf width 5 - 10 mm

M4 Leaf width more than 10 mm

M5 Leaf length less than 12 cm

M6 Leaf length 12 - 25 cm

M7 Leaf length 25 - 50 cm

M8 Leaf length 50 - 75 cm

M9 Leaf length more than 75 cm
N Upper Surface of Leaf (Uppercase N)

Character N8 can usually be seen with a hand lens, and N6 can usually be felt with the finger (or tongue - but take care not to cut yourself), but other characters require a microscope. Epidermal papillae (N2, N3) are difficult to see even with a binocular microscope, but can become very clear at x40 magnification by touching the surface of the leaf with certain types of ink which then flows between the cells. The author has found black ‘Uni-ball micro’ deluxe waterproof pens ideal for this purpose. Papillae may not cover the whole surface of the leaf; those at the extreme margin should be scored under O7 and O8. Stomata can usually also be seen on x40 when treated with ink, but are best observed by removing fragments of the epidermis and viewing under a compound microscope at x100 magnification.

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PLATE 1.
C. extensa upper surface x100

N1 Upper epidermis not papillose - x40 (Plate 1)

N2 Some cells of upper epidermis slightly papillose, or with elongate cells swollen at one end - x40 (Plate 2)

N3 Some cells of upper epidermis more or less isodiometric and strongly papillose - x40 (Plate 3)

N4 Upper surface not at all scabrous x 40 (Plate 1)

N5 Upper surface of leaf scabrous near apex only (Plate 5)

N6 Upper surface of leaf rough-scabrous throughout (Plate 5)

N7 Leaf without hairs on upper surface x10 (Plate 1)

N8 Leaf with hairs on upper surface x10 (Plate 6)

N9 Upper surface of leaf without stomata - x100 (Plate 1)

NA Upper surface of leaf with stomata present - x 100 (Plate 7)

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PLATE 2.
C. diculsa upper surface x100

PLATE 3.
C. aquatilis upper surface x200
n  Lower Surface of Leaf (Lowercase n)

Character n8 can usually be seen with a hand lens, and n5 and n6 can usually be felt with the finger (or tongue - but take care not to cut yourself), but other characters require a microscope. Papillae may not cover the whole surface of the leaf; those at the extreme margin should be scored under O7 and O8.

n1  Lower epidermis not at all papillose (Plate 1)

n2  Some cells of lower epidermis slightly papillose, or with elongate cells swollen at one end (Plate 2)

n3  Some cells of lower epidermis more or less isodiametric and strongly papillose (Plate 3)

n4  Lower surface of mid-leaf not at all scabrous (Plate 1)

n5  Lower surface of mid-leaf scabrous on midrib only (Plate 4)

n6  Lower surface of leaf rough-scabrous throughout (on lamina as well as midrib) (Plate 5)

n7  Leaf without hairs on lower surface - x10 (Plate 1)

n8  Leaf with hairs present on lower surface - x10 (Plate 6)
Leaf Colour and Leaf Margin

Record leaf colour only on young, fresh leaves. Teeth on the leaf margin can normally be felt with the finger (or, failing this, with the tip of the tongue - but do not cut yourself!) but O4 may need a microscope for confirmation. Epidermal papillae should be examined under a binocular microscope as described for N above.

**Plate 8.**
*C. pseudocyperus* upper surface x100

O1 Leaves mid-green or dark green

O2 Leaves pale yellowish-green

O3 Leaves blue-green or glaucous (with a waxy bloom), at least on the under surface when young

**Plate 9.**
*C. curta* upper surface x100

O4 Leaf margin not toothed at mid leaf (though may be toothed near the apex) (Plate 1)

O5 Leaf with marginal teeth in mid-leaf (Plate 8)

**Plate 10.**
*C. laevigata* lower surface x100

O6 Epidermal cells of leaf margin not papillose - x40 (Plate 1)

O7 Epidermal cells of leaf margin slightly papillose, or with elongate epidermal cells swollen at one end (Plate 9)

O8 Epidermal cells of leaf margin more or less isodiametric and strongly papillose (Plate 10)
Leaf Venation and Thickness

The number of longitudinal veins is most easily counted at the top of the leaf sheath where the tissue is often slightly translucent. A binocular microscope is useful for these characters, though a hand lens is sufficient for many specimens.

P1 Leaves with 3 longitudinal veins - x10

P2 Leaves with 5 - 7 veins - x10

P3 Leaves with 9 - 13 veins - x10

P4 Leaves with 15 - 21 veins - x10

P5 Leaves with 23 - 35 veins - x10

P6 Leaves with more than 35 veins - x10

P7 Leaf lamina in cross section uniformly thin throughout - x10

P8 Leaf lamina becoming thicker and spongy with large air spaces between the main secondary veins - x10

P9 Main secondary (lateral) veins of the lamina forming prominent ridges on the upper surface - x10
Q  Leaf Sheath and Ligule

The inner face of the leaf sheath is the face opposite the angle bearing the leaf blade. The apex of the inner face must be viewed on very young leaves as this splits and becomes damaged very easily. The ligule is best seen on the leaves at the base of flowering stems when the leaf blade is pulled back and flattened. Examine young, undamaged leaves for Q8.

Q1  Apex of inner face of sheath concave

Q2  Apex of inner face of sheath more or less flat

Q3  Apex of inner face of sheath convex, or with a tongue-like protrusion

Q4  Inner face of sheath becoming fibrilloscose as the persistent veins form a ladder-like network of fibres when the sheath decomposes

Q5  Basal sheaths becoming thick, soft and spongy

Q6  Ligule acute, longer than the width of the leaf

Q7  Ligule rounded or obtuse, shorter than the width of the leaf

Q8  Undamaged ligule tubular with the whitish membrane surrounding the young shoot
R Basal Sheaths

Examine the colour developing in the older sheaths at the base of the plant. Characters R6 to R8 concern the way old leaf sheaths decay.

R1 Basal sheaths becoming pale straw, yellowish or pinkish

R2 Basal sheaths becoming brown

R3 Basal sheaths becoming red, red-brown or at least flushed with red

R4 Basal sheaths becoming flushed with purple

R5 Basal sheaths becoming blackish

R6 Basal sheaths persistent, not decaying rapidly nor becoming fibrous

R7 Basal sheaths becoming fibrous through persistence of the main veins when the soft tissue decays

R8 Basal sheaths soon decaying and leaving no trace
S Habit and Rhizomes

Monopodial rhizomes (S5) have a terminal bud which continues growing horizontally while the aerial shoots form from lateral buds. In most species (with sympodial rhizomes, S1-S4) the terminal bud of the rhizome turns upwards to form the aerial shoots and lateral buds grow out to form new rhizomes.

S1  Plant forming dense tussocks which feel firm when kicked

S2  Plant tufted, sometimes with short rhizomes growing obliquely upwards

S3  Plant turf or mat-forming with shortly creeping rhizomes

S4  Plant spreading with long rhizomes giving rise to aerial shoots singly or in small clusters

S5  Plant with monopodial rhizomes giving rise to isolated shoots or small clusters in straight lines

S6  Plant with creeping, decumbent shoot bases spreading above ground
T  Rhizome Scales

Rhizome scales are easily found on spreading rhizomes, but may be hard to locate on plants classed as S1 or S2 above. The colour may be darker than normal when growing in black anaerobic mud and peat.

T1  Rhizome scales pale grey-brown

T2  Rhizome scales yellowish or orange-brown

T3  Rhizomes scales dark brown or red-brown

T4  Rhizome scales purplish or blackish

T5  Rhizome scales persistent, neither decaying rapidly nor becoming fibrous

T6  Rhizome scales becoming fibrous on decaying

T7  Rhizome scales soon decaying with only traces remaining

U  Root colour

Examine living roots two or three cm behind the growing tip. Root tips may always be pale while older roots may stain darker in anaerobic mud and peat.

U1  Roots pale grey-brown

U2  Roots yellowish or orange-brown

U3  Roots dark brown or red-brown

U4  Roots purplish
W Habitat

W1 Plants growing in standing water, or in fen or swamp vegetation on deep organic soils

W2 Wet flushes (wet sites with shallow soils and moving ground water)

W3 Sphagnum bog and blanket bog

W4 Heath and dry acidic moorland

W5 Eutrophic marsh on mineral soil

W6 Mountains above 600 m (2000 ft) altitude

W7 Lowland grassland, rough grazing, roadsides, etc.

W8 Coastal dunes, sea cliffs and brackish marshes

W9 Woodland, scrub and shady places
X  Soil Reaction

Soil pH can be measured by mixing roughly one part of soil with two of distilled water and measuring with a pH meter or placing a drop of the solution onto pH papers. With experience, however, knowledge of the rock and soil types, or of other plant species in the community will give a sufficient indication of soil quality.

X1  Acidic soils (pH below ca. 5.5)

X2  Neutral soils (pH in range ca. 5.5 - 7.0)

X3  Calcareous soils (pH above about 7.0)

X4  Brackish or estuarine soil water, or within the influence of sea spray.

Z  Distribution

Z1  Southern England, south of a line from the Mersey to the Humber

Z2  Northern England, north of a line from the Mersey to the Humber

Z3  Wales

Z4  Southern Scotland, south of a line from the Clyde to the Tay

Z5  Scottish Highlands and Islands north of a line from the Clyde to the Tay

Z6  Ireland