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TOWARDS A COMPREHENSIVE SURVEY OF C_3 AND C_4 PHOTOSYNTHETIC PATHWAYS IN CYPERACEAE

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ABSTRACT

Members of the family Cyperaceae were surveyed by original observation and from the literature to assess the distribution of C_3 and C_4 photosynthetic pathways in the family. All 107 genera were included in the current sample, with 91 genera assessed as consistently C_3 and 11 genera as C_4. The genera *Abildgaardia, Cyperus, Eleocharis, Fimbristylis,* and *Rhynchospora* are variable for this trait. Of the total number (1474) of specific (1406) and infraspecific (68) taxa sampled, 938 taxa (63%) are C_3, 527 taxa (36%) are C_4, and nine species of *Eleocharis* are debatably intermediate or variable in pathway. Some data suggesting further infrageneric variation in photosynthetic pathways are discussed. The ''one cell distant criterion'' accurately predicts C_4 pathway in sedges, except in *Eleocharis.* Distribution and variability of photosynthetic pathways in *Eleocharis* are discussed. Photosynthetic pathway was found to be a useful taxonomic marker in Cyperaceae, despite variability in this trait at various taxonomic levels and the apparently multiple origin of C_4 photosynthesis within the family. A checklist of 3395 records of C_3 and C_4 sedges is presented.

Key words: C_3, C_4, C_3-C_4 intermediate, Cyperaceae, $\delta^{13}C$ values, *Eleocharis,* Γ, photosynthetic pathway, sedge.

INTRODUCTION

Two distinct patterns of vegetative anatomy in sedges have long been recognized (Haberlandt 1884: 281). One, with ''radiate'' chlorenchyma and a green (chlorenchymatous) sheath situated within the vascular bundles (Kranz anatomy), ''is seen in certain species of *Cyperus*'' (Haberlandt 1884: 284). The other, exemplified by *Carex* and many other *Cyperus* species, involves non-radiate chlorenchyma and vascular bundles enclosed by a ''sheath of large colorless cells.'' Botanists were quick to incorporate these discontinuities into the taxonomic framework of Cyperaceae, e.g., ''Chlorocyperaceen'' and ''Eucyperaceen'' of Rikli (1895: 560), see also Clarke (1908). More recent authors (e.g., Druyts-Voets 1970; Metcalfe 1971), in extending these anatomical studies and recognizing further variants (e.g., Sharma and Mehra 1972; Carolin et al. 1977; Gilliland and Gordon-Gray 1978; Bruhl et al. 1987; Bruhl 1995), have extended the taxonomic utility of vegetative anatomy in this family.

Subsequent to the discovery of the C_4 photosynthetic pathway, the correlations between chlorocyperoid (Kranz) anatomy and C_4 photosynthesis, and eucyperoid anatomy and C_3 (Calvin cycle) photosynthesis became apparent. Further correlations were detected within Cyperaceae, as with other families, of photosynthetic pathways with characteristic carbon isotope ratio ($\delta^{13}C$ value) ranges (Bender 1971), with CO_2 compensation point (Γ) values (Krenzer et al. 1975), and with geographical distributions, there being a concentration of C_4 sedge species and genera in the tropics and C_3 taxa in the temperate regions (Raynal 1972). Biochemistry has also been used to assess pathways (Bruhl et al. 1987; Sage et al. 1999), by measuring the ratio of phosphoenolpyruvate carboxylase (PEPCase) to ribulose-1,5-bisphosphate carboxylase (Rubisco) activity and by measuring the initial products of photosynthesis. Use of these correlates, particularly anatomical and $\delta^{13}C$ values, has allowed extensive prediction of C_3 and C_4 photosynthetic pathways in sedges (Bruhl et al. 1992; Bruhl 1993, 1995), and has led to a reassessment, along structural/functional and evolutionary lines (Soros and Bruhl 2000), of earlier taxonomic decisions based on purely anatomical discontinuities. Thus Raynal (1973) positioned his predominantly C_4 Cypereae and Fimbristylideae as terminal assemblages in a scheme of phylogenetic relationships of the Cyperoideae, with the C_4 genera uppermost, indicating their assumed derived states. Molecular studies by Muasya et al. (1998, 2002) found C_3 taxa sister to C_4 taxa, indicating that *rbc*L, a photosynthetic gene, reflects phylogeny.

There is need for some caution when using anatomical observations or $\delta^{13}C$ values alone as predictors of photosynthetic pathway, since C_3–C_4 intermediates may be overlooked (Bruhl et al. 1987; Hattersley 1987; Bruhl and Perry 1995; Sage 2002). The ''maximum cells distant count'' (Hattersley and Watson 1975) has proved to be a very reliable anatomical criterion in relation to grasses (Hattersley 1987). This explicit anatomical criterion for C_3/C_4 assignment, though seemingly applicable to sedges (Hattersley et al. 1977), had not previously been tested on them on a large scale. Instead, the relatively vague concepts of ''radiate'' chlorenchyma and ''Kranz'' anatomy (e.g., Ueno and Koyama 1987) have continued in use (Bruhl et al. 1987).

Cyperaceae have been covered in a number of surveys of photosynthetic pathway variation (e.g., Black 1976; Raghavendra and Das 1976; Takeda et al. 1985; Wang 2003), and

various taxonomic conclusions regarding the family have been drawn (Lerman and Raynal 1972; Raynal 1973; Takeda et al. 1985). Major contributions to C_3/C_4 assessments, in terms of the numbers of species and genera sampled, have been made by Lerman and Raynal (1972, see below) and Takeda et al. (1985). No genus remains unknown in this respect, though there is conflicting information about the photosynthetic pathways of some.

We have obtained additional anatomical, $\delta^{13}C$ and Γ data to examine critically the correlation between physiological, biochemical, and anatomical data pertaining to photosynthetic pathways, and to fill significant gaps in the taxonomic coverage, to locate new variation within genera, and to identify taxa where C_3-C_4 intermediates may occur. In what follows, those new observations are presented and current knowledge of C_3/C_4 photosynthetic pathway variation in Cyperaceae is summarized. Appendix 1 contains the first extensive, up-to-date compilation of photosynthetic pathway determinations for Cyperaceae, with sources, and presents, also for the first time, the valuable, original data underlying the publications by Lerman and Raynal (1972), Raynal (1972, 1973), and Stock et al. (2004). All new, previously unpublished data and previously published data are compiled in Appendix 1. The compilation is believed to be comprehensive with respect to the physiological and biochemical data.

MATERIALS AND METHODS

Plant Material

For study of living material, plants collected from across Australia were grown under half-shade in glasshouses maintained between 35°C (day maximum) and 15°C (night minimum), and regularly fertilized with Ruakura nutrient solution (Smith et al. 1983). Identities were checked and vouchers have been lodged at CANB or NE (by JJB) or NSW (by KLW). Where samples were taken from herbarium material, voucher labels were attached to the sheets.

Anatomy and ''One Cell Distant Criterion''

Plant material was selected and prepared as stated in Bruhl et al. (1987), Wilson (1991), and Bruhl and Perry (1995). Hand-cut sections of rehydrated herbarium material or fresh material, temporarily mounted, are generally adequate for ascertaining the ''maximum cells distant count'' and applying the ''one cell distant criterion.'' The latter states that ''in C_4 species no chlorenchymatous mesophyll cell is separated from the nearest parenchymatous bundle sheath (PBS) cell by more than one other chlorenchymatous mesophyll cell'' (Hattersley and Watson 1975: 325). In Cyperaceae, application of this criterion involves counting the numbers of primary carbon assimilation (PCA) cells distant from the photosynthetic carbon reduction (PCR) cells, ignoring non-PCR mestome sheath cells, PBS cells and any non-chlorenchymatous cells.

CO_2 Compensation Point Analyses

A pulse flow system for CO_2 compensation point analysis (Brown et al. 1985; Brown and Hattersley 1989) was used. Fresh healthy leaves or culms (photosynthetic material only) of glasshouse-grown plants were placed in a 50 mL clear glass syringe. The syringe was fitted with a needle and the needle tip sealed with a rubber plug. The plunger was made airtight by lubrication with liquid paraffin. The sealed loaded syringe was placed in a growth cabinet under a photosynthetic photon flux density of 500 μmol quanta $m^{-2}s^{-1}$ at 30°C, and was incubated for at least 20 minutes. A 30 mL gas sample from the syringe was then passed through a calcium chloride H_2O trap, to an infrared CO_2 gas analyzer (model ZAR, Fuji Electric, Tokyo, Japan). High grade nitrogen, at a flow rate of 4 liters min^{-1}, was used as a carrier gas. The output from the analyzer was recorded on an RDK Rikadenki chart recorder (RDK, Tokyo, Japan). The system was calibrated with 1, 2, and 3 mL samples of pure CO_2 (delivered with an SGE microlitre syringe) equivalent to 33.3, 66.6, and 100 parts per million (ppm) of CO_2 in 30 mL volumes, respectively. The CO_2 concentration of the sample gas was calculated from the peak height of the CO_2 pulse. Controls were used to ensure that the sole source of CO_2 was that derived from the sample, and constituted the delivery of 30 mL of CO_2-free air, which resulted in no pen movement beyond the base line. The Γ values of JJB presented in Appendix 1 represent means based on four replicates, except for the controls, where there were two replicates.

$\delta^{13}C$ Values

(a) This study (see Bruhl 1990).—For $\delta^{13}C$ value determinations by JJB, mature healthy leaf or culm samples from cultivated plants oven-dried at 70°C, or from herbarium specimens, were ground finely in liquid nitrogen with a mortar and pestle, or chopped finely with a razor. Samples of 0.2 to 3 mg were combusted using a modification of the classical Dumar method in a Carlo Erba 1106 Elemental Analyzer (CE Instruments, Milan, Italy). The CO_2 produced was trapped automatically at liquid nitrogen temperature, then distilled from the cold finger and passed to a VG Isogas Sira-24 mass spectrometer (Thermo Electron Corporation, Boston, Massachusetts, USA) for analysis. Standards used were the laboratory internal CO_2 standard gas and a standardized sucrose calibrated against international carbonate standards. The $^{13}C/^{12}C$ ratios are reported as $\delta^{13}C$ values in ‰.

(b) Source of values used in Lerman and Raynal (1972).—Before his untimely death, Jean Raynal gave K. L. Wilson (NSW) a copy of the data sheets for the $\delta^{13}C$ value determinations associated with their landmark papers (Lerman and Raynal 1972; Raynal 1972, 1973). After receiving a copy and seeking permission from Dr. Lerman, J. J. Bruhl incorporated these data in a survey of photosynthetic pathways (Bruhl 1990). Lerman and Raynal's data are presented here, in full, in a refereed publication for the first time.

(c) Source of values used in Stock et al. (2004).—While the present paper was in review, a paper by Stock et al. (2004) appeared in *Austral Ecology* with data in summary form only. Professor Will Stock and Dr. Tony Verboom kindly agreed to make their data available to us, and we present them here, in full, for the first time.

Evaluation of Literature; Nomenclature

Photosynthetic pathway determinations were collated from original publications, rather than from reviews, and anatomical data from publications preceding the discovery of C_4 photosynthesis have been used only where they permit unambiguous interpretation. Description of leaf or stem chlorenchyma as radiate is not a reliable criterion for assigning photosynthetic pathway (Bruhl et al. 1987) and was ignored. For example, consider ''chlorenchyma slightly radiating'' (Govindarajalu 1969*a*: 28) for species of *Fuirena* that are C_3 and ''chlorenchyma not radiating'' (Govindarajalu 1974: 245–246) for *Cyperus clarkei* T. Cook, which is C_4. For methods used to assess photosynthetic pathways see the original papers.

Nomenclature and generic and subgeneric circumscriptions used here are informed by the relatively recent classifications and studies of Cyperaceae (especially Bruhl 1995; Goetghebeur 1998; Muasya et al. 2000) and the arrangement of Cyperaceae at the National Herbarium of New South Wales (NSW) by KLW, as well as the draft World Checklist of Cyperaceae being coordinated by D. Simpson and R. Govaerts from Royal Botanic Gardens, Kew, with contributions from other cyperologists such as the present authors.

RESULTS AND DISCUSSION

The draft World Checklist of Cyperaceae (see above) lists 103 genera and about 5400 species in Cyperaceae. For the current study we recognize 107 genera of which all genera and 1406 species and an additional 68 subspecies and varieties have been investigated for photosynthetic pathway (Appendix 1) anatomically (2350 records), or physiologically and/or biochemically (1045 records), totaling 3395 records (Appendix 1). The compilation includes new Γ values for seven genera and 29 species, new $\delta^{13}C$ value determinations for 15 genera and 50 species and 1047 new anatomical records obtained in this study, along with 1305 anatomical records based on our assessment of published literature. In addition, we present the 246 original $\delta^{13}C$ value determinations summarized by, but not presented in, Lerman and Raynal (1972), as well as the 68 original $\delta^{13}C$ value records of Stock et al. (2004).

The determination of photosynthetic pathways, particularly at the generic level, is comprehensive for this reasonably large family, and affords a sound basis from which to generalize about the likelihood of finding further variation, predict the photosynthetic pathway of the unassessed taxa, and discuss taxonomic implications of the available data. All genera that we recognize here can be assigned to a photosynthetic pathway (Table 1) with confidence on the basis of biochemical, physiological, and anatomical evidence (Appendix 1). The present state of knowledge shows that *Abildgaardia, Cyperus* s.l., *Eleocharis, Fimbristylis,* and *Rhynchospora* s.l. are variable, comprising both C_3 and C_4 species, while the remaining genera are consistently either C_3 (91 genera) or C_4 (11 genera) (Table 1; Appendix 1) (see also Bruhl et al. 1987; Bruhl and Perry 1995; Soros and Bruhl 2000). Of the total number (1474) of specific (1406) and infraspecific (68) taxa sampled, 938 taxa (63%) are C_3, 527 taxa (36%) are C_4, and nine species of *Eleocharis* are debatably intermediate or variable in pathway.

Sage et al. (1999), based on data and generalizations from Bruhl et al. (1992) and Bruhl (1995), gave the percentage of genera and species of Cyperaceae that are C_4 as 21% and 27%, respectively. Here, not recognizing as many segregate genera, and including only the species actually examined (Appendix 1), we find that 15% of genera (including the five genera that are variable for photosynthetic pathway) and 34% of the species sampled are C_4. Given the different bases of the calculations, their similarity provides some confidence in them. The differences in numbers, however, indicate the need to continue to improve the estimate of phylogeny for the family and hence a better basis for its classification, and the need to complete the survey of photosynthetic pathways of species of Cyperaceae.

The anatomical sample is rather patchy at the species level, in that most of the smaller genera, along with some large ones (e.g., *Cyperus, Eleocharis,* and *Rhynchospora*) have been extensively sampled, while other large genera such as *Lagenocarpus* and *Pleurostachys* have been examined for only one or two species. Nonetheless, the sample size compares favorably with those used for many other micromorphological or anatomical features. For example, recent taxonomic treatments (Raynal 1973; Goetghebeur 1986; Bruhl 1995; Goetghebeur 1998) of Cyperaceae placed a great deal of reliance on embryo morphology, where the available data are much less comprehensive.

''One Cell Distant Criterion''

Cross-referencing between the different kinds of evidence presented in Appendix 1 shows excellent correspondence between the different methods of assessing photosynthetic pathways in this family. It also shows that, perhaps with the exception of some species of *Eleocharis* (see below), all the photosynthetic pathways are correctly predicted using anatomical criteria. The few conflicting records are considered below. The data tabulated in Appendix 1 allow evaluation of the ''maximum cells distant count'' as a predictor of photosynthetic pathway in Cyperaceae. Of the 105 genera investigated anatomically for this criterion by us (i.e., except for *Pleurostachys* and *Trichoschoenus*), 84 genera and many of the species sampled have also been analyzed for their $\delta^{13}C$ values, and 14 genera and 91 species for Γ. The photosynthetic pathway of 14 of the genera including 63 species has been determined biochemically. Congruence of the data shows, with the exception of *Eleocharis,* that the ''one cell distant criterion'' (Hattersley and Watson 1975) is an accurate predictor of C_4 in Cyperaceae, while counts of greater than one cell accurately predict C_3. Given the simplicity and ease with which anatomical preparations can be made to determine photosynthetic pathway type, it is reasonable to suggest that such evidence and determinations should accompany the descriptions of new species and genera as a matter of routine.

In *Eleocharis,* the unequivocally C_4 taxa (Appendix 1; Bruhl et al. 1987) yield counts of one to four cells, i.e., often exceeding a count of one, even if the chlorophyllous layer of cells adjacent to the mestome sheath is considered to constitute a PBS and ignored (Bruhl et al. 1987). However, the chloroplast abundance in the PCA (C_4 mesophyll) cells is relatively low and the more distant cells are equivocally

Table 1. Genera and generic sample for distribution of photosynthetic pathway in Cyperaceae. (^ = World Checklist of Cyperaceae; *www.kew.org/wcsp/home.do*) (Simpson et al. 2005); incl. = including; PP = photosynthetic pathway; * = includes two additional species published since first version of Checklist was distributed to cyperologists in 2004).

Genera sampled (unless indicated otherwise)	PP	World Checklist^	No. of species^
Abildgaardia Vahl	C_3/C_4	(= *Fimbristylis*)	
Actinoschoenus Benth.	C_3	*Actinoschoenus*	3
Actinoscirpus (Ohwi) R. Haines & K. Lye	C_3	*Actinoscirpus*	1
Afrotrilepis (Gilg) J. Raynal	C_3	*Afrotrilepis*	2
Alinula J. Raynal	C_4	*Alinula*	4
Amphiscirpus Oteng-Yeboah	C_3	*Amphiscirpus*	1
Androtrichum (Brongn.) Brongn.	C_3	*Androtrichum*	2
Arthrostylis R. Br.	C_3	*Arthrostylis*	1
Ascolepis Nees ex Steud.	C_4	*Ascolepis*	22
Asterochaete Nees	C_3	(= *Carpha*)	
Baumea Gaudich.	C_3	(= *Machaerina*)	
Becquerelia Brongn.	C_3	*Becquerelia*	8
Bisboeckelera Kuntze	C_3	*Bisboeckelera*	4
Blysmus Panz. ex Schult.	C_3	*Blysmus*	3
Bolboschoenus (Aschers.) Palla	C_3	*Bolboschoenus*	10
Bulbostylis Kunth	C_4	*Bulbostylis*	206
Calyptrocarya Nees	C_3	*Calyptrocarya*	8
Capeobolus J. Browning	C_3	*Capeobolus*	1
Capitularina Kern	C_3	*Capitularina*	1
Carex L. (incl. *Cymophyllus* Mack. ex Britton & A. Br. and *Vesicarex* Steyerm.)	C_3	*Carex*	1757
Carpha Banks & Sol. ex R. Br.	C_3	*Carpha*	16
Caustis R. Br.	C_3	*Caustis*	5
Cephalocarpus Nees	C_3	*Cephalocarpus*	4
(= *Eleocharis*)		*Chillania* Roiv.	1
Chorizandra R. Br.	C_3	*Chorizandra*	5
Chrysitrix L.	C_3	*Chrysitrix*	4
Cladium P. Browne	C_3	*Cladium*	3
Coleochloa Gilly	C_3	*Coleochloa*	7
Costularia C. B. Clarke (incl. *Lophoschoenus* Stapf)	C_3	*Costularia*	24
Courtoisina Soják	C_3	*Courtoisina*	2
Crosslandia W. V. Fitzg.	C_4	*Crosslandia*	1
Cyathochaeta Nees	C_3	*Cyathochaeta*	6
Cyathocoma Nees	C_3	(= *Tetraria*)	
Cyperus L. (incl. *Anosporum* Nees, *Juncellus* (Griseb.) C. B. Clarke, *Mariscus* Vahl, *Remirea* Aubl., *Torulinium* Desv.)	C_3/C_4	*Cyperus*	686
(= *Carex*)	C_3	*Cymophyllus*	1
Cypringlea M. Strong	C_3	*Cypringlea*	2
Desmoschoenus Hook. f.	C_3	*Desmoschoenus*	1
Didymiandrum Gilly	C_3	*Didymiandrum*	1
Diplacrum R. Br.	C_3	*Diplacrum*	9
Diplasia Rich. ex Pers.	C_3	*Diplasia*	1
Dulichium Pers.	C_3	*Dulichium*	1
Egleria L. T. Eiten	C_3	*Egleria*	1
Eleocharis R. Br.	C_3/C_4	*Eleocharis*	252
Epischoenus C. B. Clarke	C_3	*Epischoenus*	8
Eriophorum L. (incl. *Eriophoropsis* Palla & *Erioscirpus* Palla)	C_3	*Eriophorum*	18
Evandra R. Br.	C_3	*Evandra*	2
Everardia Ridl. ex Oliver	C_3	*Everardia*	12
Exocarya Benth.	C_3	*Exocarya*	1
Exochogyne C. B. Clarke	C_3	*Exochogyne*	3
Ficinia Schrad. (incl. *Sickmannia* Nees)	C_3	*Ficinia*	72
Fimbristylis Vahl (incl. *Tylocarya* Nelmes)	C_3/C_4	*Fimbristylis*	306
Fuirena Rottb.	C_3	*Fuirena*	58
Gahnia J. R. Forst. & G. Forst.	C_3	*Gahnia*	41
Gymnoschoenus Nees	C_3	*Gymnoschoenus*	2
Hellmuthia Steud.	C_3	*Hellmuthia*	1
Hypolytrum Rich.	C_3	*Hypolytrum*	57
Isolepis R. Br. (incl. *Eleogiton* Link)	C_3	*Isolepis*	74
Karinia A. Reznicek & R. McVaugh	C_3	*Karinia*	1
Khaosokia D. A. Simpson, Chayam. & J. Parn.	C_3	(Not in first version of World Checklist)	1

Table 1. Continued.

Genera sampled (unless indicated otherwise)	PP	World Checklist^	No. of species^
Kobresia Willd.	C_3	*Kobresia*	71
Koyamaea W. W. Thomas & G. Davidse	C_3	*Koyamaea*	1
Kyllinga Rottb. (~ *Cyperus*)	C_4	*Kyllinga*	73
Kyllingiella R. Haines & K. Lye	C_3	*Kyllingiella*	3
Lagenocarpus Nees	C_3	*Lagenocarpus*	61
Lepidosperma Labill.	C_3	*Lepidosperma*	56
Lepironia Rich.	C_3	*Lepironia*	1
Lipocarpha R. Br.	C_4	*Lipocarpha*	36
Machaerina Vahl	C_3	*Machaerina*	51
Mapania Aubl. (incl. *Thoracostachyum* Kurz)	C_3	*Mapania*	84
Mesomelaena Nees	C_3	*Mesomelaena*	5
Microdracoides Hua	C_3	*Microdracoides*	1
Morelotia Gaudich.	C_3	*Morelotia*	2
Neesenbeckia Levyns	C_3	*Neesenbeckia*	1
Nelmesia Van der Veken	C_4	*Nelmesia*	1
Nemum Desv.	C_4	*Nemum*	5
Oreobolopsis T. Koyama & E. R. Guaglianone	C_3	*Oreobolopsis*	3
Oreobolus R. Br. (incl. *Chillania* Roiv.)	C_3	*Oreobolus*	17
Oxycaryum Nees	C_3	*Oxycaryum*	1
Paramapania Uittien	C_3	*Paramapania*	7
Phylloscirpus C. B. Clarke	C_3	*Phylloscirpus*	3*
Pleurostachys Brongn.	C_3	*Pleurostachys*	50
Principina Uittien	C_3	*Principina*	1
Pseudoschoenus (C. B. Clarke) Oteng-Yeboah	C_3	*Pseudoschoenus*	1
Ptilothrix K. L. Wilson	C_3	*Ptilothrix*	1
Pycreus Beauv. (~ *Cyperus*)	C_4	*Pycreus*	118
Queenslandiella Domin (~ *Cyperus*)	C_4	*Queenslandiella*	1
Reedia F. Muell.	C_3	*Reedia*	1
(= *Cyperus*)		*Remirea* Aubl.	1
Rhynchocladium T. Koyama	C_3	*Rhynchocladium*	1
Rhynchospora Vahl	C_3/C_4	*Rhynchospora*	341
Schoenoplectus (Rchb.) Palla	C_3	*Schoenoplectus*	64
Schoenoxiphium Nees	C_3	*Schoenoxiphium*	20
Schoenus L.	C_3	*Schoenus*	108
Scirpodendron Zipp. ex Kurz	C_3	*Scirpodendron*	2
Scirpoides Ség.	C_3	*Scirpoides*	3
Scirpus L.	C_3	*Scirpus*	67
Scleria Berg.	C_3	*Scleria*	264
Sphaerocyperus K. Lye	C_4	*Sphaerocyperus*	1
Sumatroscirpus Oteng-Yeboah	C_3	*Sumatroscirpus*	1
Tetraria Beauv.	C_3	*Tetraria*	57
Trachystylis S. T. Blake	C_3	*Trachystylis*	1
Trianoptiles Fenzl	C_3	*Trianoptiles*	3
Trichophorum Pers.	C_3	*Trichophorum*	9
Trichoschoenus J. Raynal	C_3	*Trichoschoenus*	1
Tricostularia Nees	C_3	*Tricostularia*	5
Trilepis Nees	C_3	*Trilepis*	7
Uncinia Pers.	C_3	*Uncinia*	66
Volkiella Merxm. & Czech.	C_3	*Volkiella*	1
Websteria S. H. Wright	C_3	*Websteria*	1
Zameioscirpus Dhooge & Goetgh.	C_3	(Not in first version of World Checklist)	
107 genera sampled		104 genera	5401

chlorophyllous. Even where the criterion can be applied with confidence, the PBS may be chlorophyllous or more or less non-chlorophyllous (e.g., in *Fimbristylis*), with variation apparent within and between species. The stoichiometric and physiological significance of such variation is not clear, and warrants further investigation.

C_4 sedges are generally NADP-ME, whereas the C_4 species of *Eleocharis* are NAD-ME type—the only occurrence of this biochemical type in Cyperaceae. So variation in biochemical type coincides with breakdown of the C_4 anatomical predictor (Ueno et al. 1986; Bruhl et al. 1987). The breakdown does not seriously impair use of the ''one cell

distant criterion'' in predicting photosynthetic pathway, because of the apparent rarity of the NAD-ME type in this family. Although C_4 *Eleocharis* species would be incorrectly assigned to photosynthetic pathway using this criterion, they are accurately predicted by ultrastructural features of the mitochondria and chloroplast grana in PCR cells (Bruhl and Perry 1995). Exceptions to the ''one cell distant criterion'' highlight the advantage of using at least two means to assess photosynthetic pathway in Cyperaceae. Anatomy, $\delta^{13}C$ value, and ultrastructure have the advantage that they can be assessed from fresh or herbarium samples.

Conflicting Reports

There are conflicting reports about the photosynthetic pathway status of some species (marked with ''+'' in Appendix 1). We suggest that most, if not all, of these conflicts result from misidentification of the material studied (see Appendix 2 for discussion). Some vouchers have been reexamined and redetermined by the current authors. These redeterminations together with our assessment of the conflicts are indicated in Appendix 1.

One case is presented here as it highlights the need for publication of data (= results) and for vouchers to be lodged in recognized herbaria to underpin discussion and conclusions in scientific papers. In their recent publication, Stock et al. (2004) submitted $\delta^{13}C$ data linked to vouchers deposited in a recognized herbarium but were not allowed by the journal to include them in the paper. The summary $\delta^{13}C$ data (Stock et al. 2004: Table 1) contained two surprises. One species of *Lipocarpha* is listed as C_3 and one of *Schoenoplectus* is listed as C_4. The specific data obtained from the authors reveal these species to be *L. rehmannii* and *S. pulchellus* (Appendix 1). Their datum for *L. rehmannii* is at odds with five other records for the species based on anatomical observations and $\delta^{13}C$ values. All the pieces of this specimen appear to match other material of *L. rehmannii* at BOL (A. Verboom pers. comm., Aug 2004). We hope to examine this specimen anatomically. The C_4 $\delta^{13}C$ value for *S. pulchellus* is the first report for this species. We do not yet have access to material of this species to check it. The specimen in question is not mixed and appears to have been correctly identified by cyperologist Jane Browning (A. Verboom pers. comm., Aug 2004). There are 52 records of C_3 pathway for the genus (Appendix 1), plus two apparently anomalous C_4 reports for *S. lateriflorus* (Hofstra et al. 1972). We plan to survey all the species in this genus for photosynthetic pathway and clarify the photosynthetic pathway status of *S. pulchellus.* To minimize the chance of erroneous reports, to support novel findings, and to allow the authentication of names used in botanical studies it is crucial that journals and book editors insist on the publication at the same time of supporting data linked to voucher specimens lodged in a recognized herbarium (see also Goldblatt et al. 1992; Hosking et al. 1996).

Significance of Photosynthetic Pathways for Solving Taxonomic Problems

Two contrasting and independent examples indicate the value of photosynthetic pathway data in posing or solving taxonomic problems. Firstly, the monotypic *Syntrinema* H. Pfeiff. is variously regarded, largely on the basis of floral morphology, as belonging to *Rhynchospora* (Ballard 1934; Goetghebeur 1986; Wayt Thomas pers. comm.) or as a genus belonging to a separate tribe (Eiten 1976). It is C_4 (Appendix 1), and its vegetative anatomy (Bruhl et al. 1987; Ueno and Koyama 1987) is typical of the C_4 *Rhynchospora* species with rhynchosporoid anatomy (Bruhl et al. 1987). Rhynchosporoid anatomy is found only in these two genera and, therefore, strongly supports the former taxonomic affiliation. We have included *Syntrinema* here under *Rhynchospora.*

Secondly, *Abildgaardia* and *Fimbristylis,* two closely related and often synonymized genera (Bruhl et al. 1992; Bruhl 1995; Ghamkhar et al. 2007), have previously been considered to be exclusively C_4 (Appendix 1). Indeed, Raynal (1973) and Goetghebeur (1986) place these genera in a tribe in part characterized by C_4 photosynthesis and fimbristyloid anatomy (see Bruhl et al. 1987). Our anatomical observations and $\delta^{13}C$ value data (Appendix 1), however, indicate that *Abildgaardia hygrophila* and *Fimbristylis variegata* are C_3. Furthermore, Gordon-Gray's (1971: 562) observations for *F. variegata* (''even the smaller bundles of the outer ring lie not within the mesophyll but merely in contact with its inner margin . . . The mesophyll in this species is especially well organized, the cells being palisade-like''), considered in retrospect, also hint at C_3 anatomy and Metcalfe's (1971: 276) description of the chlorenchyma in *A. hygrophila* (treated under *Fimbristylis*; ''up to 6 layers of palisade cells'') clearly indicates C_3 anatomy.

Photosynthetic pathway and vegetative anatomy are valuable in substantiating the inclusion of *Syntrinema* in *Rhynchospora.* In most cases, photosynthetic pathway is a valuable taxonomic criterion (as seen by its consistency within most genera), but the *Abildgaardia* example illustrates the need for caution when generalizing from small samples of species.

Eleocharis

Rikli's (1895) ''Chlorocyperaceen'' genera have generally been found to be C_4 (Lerman and Raynal 1972), e.g., *Ascolepis, Cyperus* subgen. *Cyperus, Fimbristylis, Kyllinga, Lipocarpha,* and *Monandrus* ined. Rikli (1895) suggested division of the essentially helophytic genus *Eleocharis* (as *Heleocharis*) into two genera: *Eleocharis* with ''eucyperoid'' anatomy, and *Chlorocharis* with ''chlorocyperoid'' anatomy (i.e., with an inner chlorophyllous parenchyma sheath, or boundary layer cells). This seemed to be misleading in the context of photosynthetic pathways, in that subsequent literature on *Eleocharis* anatomy and photosynthetic pathway indicated a solidly C_3 genus, i.e., including some of his species of *Chlorocharis.*

More recently it has been shown that at least some species of *Eleocharis* (including one ''*Chlorocharis*'' species) are C_4 (Appendix 1) (Bruhl et al. 1987; Ueno et al. 1988*b*; see also Bruhl and Perry 1995). Of the eight species included in Rikli's (1895) *Chlorocharis,* he listed *C. palustris* (L.) Rikli (= *E. palustris*), *C. tuberculosa* (Michx.) Rikli (= *E. tuberculosa*) and *C. vivipara* (Link) Rikli (= *E. vivipara*) as having an ''inner and outer parenchymatous sheath''. Terrestrial forms of *Eleocharis vivipara* have recently been found to be C_4 (and NAD-ME) (Bruhl et al. 1987; Ueno et al. 1988*b*, etc.), but $\delta^{13}C$ values for *E. palustris,* and *E. tuberculosa* are

typical of C_3 species (Appendix 1). Rikli (1895) listed five other species—*C. balansaeana* (Boeck.) Rikli (= *E. filiculmis*), *C. emarginata* (Nees) Rikli (= *E. quinquangularis*), *C. capitata* (L.) Rikli (= *E. geniculata*), *C. geniculata* (L.) Rikli (= *E. geniculata*), and *C. subprolifera* Rikli (= *E. pellucida*)—as having only an ''inner parenchymatous sheath'' (i.e., possessing prominent chlorophyllous border parenchyma), implying that a typical PBS is absent. However, one of these species, *Eleocharis geniculata,* has been examined in the present study, and it possesses an obvious non-chlorenchymatous C_3-like PBS outside the mestome sheath (Bruhl et al. 1987); while $\delta^{13}C$ and Γ values (Appendix 1) and biochemical assays (Bruhl et al. 1987) all confirm its C_3 status. This is despite the border parenchyma cells being somewhat more prominent and chlorophyllous than in most other C_3 species (cf. Bruhl and Perry 1995).

The essentially terrestrial species *E. filiculmis, E. pellucida,* and *E. quinquangularis* were studied by Ueno et al. (1989). They are members of the series *Sulcatae* and *Multicaules* (with spirally disposed bracts; Svenson 1939), and are not closely related to the C_4 species of *Eleocharis* that constitute part of the series *Tenuissimae* possessing distichous floral bracts (Svenson 1937). These three species, therefore, were predicted to be C_3 (Bruhl 1990). Ueno et al. (1989) found the first two species to be C_3, while *E. quinquangularis* was reported to be ''C_3–C_4?''. Of Rikli's *Chlorocharis,* only *E. tuberculosa* and *E. vivipara* were assigned to series *Tenuissimae* by Svenson (1937); the former is also C_3 (Ueno et al. 1989), while the dimorphic *E. vivipara* can be C_4 (Ueno et al. 1988*a*) (Appendix 1).

Ueno et al. (1988*b*) provided convincing evidence in the form of $\delta^{13}C$ values, pulse-chase experiments and C_4 acid decarboxylation enzyme assays that the terrestrial form of *E. vivipara* is C_4 and the submerged aquatic form is C_3. Subsequent studies by Ueno and colleagues (e.g., Ueno 2001; Ueno and Ishimaru 2002) have focused on variation between and within individuals. *Eleocharis baldwinii* displays much of the intraspecific variation in photosynthetic pathway seen in *E. vivipara* (Ueno et al. 1989; Uchino et al. 1995; Ueno and Ishimaru 2002; Ueno 2004) (Appendix 1).

The variability correlates with the breakdown in the ''one cell distant criterion'' amongst the previously known C_4 sedges (see above; Bruhl et al. 1987), suggesting that these variabilities may have a common basis. Both the C_4 forms of *E. vivipara* and *E. baldwinii,* and the apparently consistently C_4 species of *Eleocharis* are NAD-ME type (Bruhl et al. 1987; Ueno and Samejima 1989; Bruhl and Perry 1995; Ueno 2004) and are members of ser. *Tenuissimae* (Bruhl and Smith 2002).

Eleocharis is home to further photosynthetic pathway variations that highlight its importance in understanding photosynthetic pathway evolution and development. On the basis of intermediate anatomy (Bruhl and Perry 1995), low or undetectable C_4 enzyme values (Bruhl et al. 1987), C_3 $\delta^{13}C$ values and intermediate G values (Appendix 1), supported by some ultrastructural evidence (Bruhl and Perry 1995), *E. pusilla* is interpretable as a C_3-like C_3–C_4 intermediate. Similarly, on the basis of intermediate anatomy and mostly C_3-like $\delta^{13}C$ values (Ueno et al. 1989; Guaglianone and Ueno 1990) *E. cylindrica, E. quinquangularis,* and *E. reverchonii* are C_3-like C_3–C_4 intermediates or variable and in need of further study.

The variability, especially infraspecific, of photosynthetic pathways in *Eleocharis* is interesting in the context of the mechanism of development of C_4 photosynthesis (see Ueno 2001; Agarie et al. 2002; Ueno and Ishimaru 2002; Ueno and Kobayashi 2002; Ueno 2004). There is evidence that *E. baldwinii* responds to different CO_2 environments in water by shifting the relative proportion of C_3 and C_4 photosynthesis; C_4-like intermediacy in this species is considered to be a response to CO_2 depletion (Ueno 2004).

These findings further highlight *Eleocharis* in general and specifically series *Tenuissimae* (see Bruhl and Smith 2002) as a singularly appropriate group to study the evolution and expression of the C_4 syndrome. Studies should be extended to grow a wider sample of species of *Eleocharis* that exhibit a range of photosynthetic pathway characteristics (Appendix 1) and the related aquatic monotypics *Egleria* and *Websteria* (Bruhl 1995; Roalson and Friar 2000) under terrestrial conditions to test the stability of their C_3 status.

CONCLUSIONS

The taxonomic sample for photosynthetic pathways in Cyperaceae is particularly broad, covering all genera recognized here. Some large genera remain poorly sampled, notably *Carex* and *Scleria,* but these are considered likely not to be variable. On the other hand, more biochemical typing is necessary across the family, particularly with regard to C_4 anatomical variation in *Eleocharis* and *Rhynchospora.* Usefulness of the ''one cell distant criterion'' is confirmed for all groups of Cyperaceae except *Eleocharis.* The most promising and interesting area for discovery of further C_4 species or further infrageneric variation is the predominantly C_3 Scirpeae (sensu Bruhl 1995), within and around *Eleocharis.* Similarly, more study is needed of *Rhynchospora* s.l. and Abildgaardieae.

Information on photosynthetic pathway variation, especially with regard to anatomical aspects, has had a significant impact on taxonomy particularly at the species and generic levels (see Raynal 1973; Haines and Lye 1983).

The helophytic habit, typically associated with high light and high temperature and, by definition, availability of water, coupled with cold sensitivity, and tolerance of salinity and low nitrogen levels (Wilson 1991: 391) of many (perhaps most) C_4 sedges, particularly the C_4 species of *Eleocharis,* offers an attractive model to investigate the functional significance of C_4 photosynthesis in terms of nitrogen-use efficiency, as well as in terms of the traditional, but seemingly inappropriate, hypothesis which relates C_4 photosynthesis to water-use efficiency (see also Bruhl 1990). ''CO_2-use efficiency'' seems important for C_4 species when submerged (Ueno 2004). Future investigations of the mechanisms of C_4 photosynthesis regulation in sedges should also address questions of particular agronomic interest (e.g., control of the ''world's most troublesome weeds'' (Wills 1987), the C_4 *Cyperus rotundus* and *C. esculentus*), as well as addressing fundamental questions of differentiation and development.

This paper is part of our ongoing study of photosynthetic pathways in Cyperaceae. We intend to follow up with an update of phylogenetic aspects of photosynthetic pathway (cf. Soros and Bruhl 2000). Finally, given the significance and application of a knowledge of photosynthetic pathway, we will present and maintain the survey data for Cyperaceae

via the Internet (see *www.une.edu.au/botany/jjbres.htm*), and encourage those who make and publish observations to contribute these new records to the ongoing database, where of course they will be fully acknowledged.

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APPENDIX 1: Published and Inferred Records of Photosynthetic Pathway Type in Cyperaceae

This list includes both previously published records of photosynthetic pathway type in species of Cyperaceae and newly published records.

Column 1: Species.—A taxon is listed by what the present authors believe is its currently accepted name. For previously published records, the name used in the original publication is indicated if different from the current name. The present authors have examined and confirmed or re-determined the vouchers concerned in some cases. For example, one of the vouchers for *Mesomelaena stygia* (*Coveny 8296,* NSW) cited by Takeda et al. (1985) is actually *M. preissii* (Wilson 1981). Similarly, Takeda et al. (1985) cited NT 42319 (*Henshall 249*) as *Cyperus angustatus,* but that specimen belongs to *C. fucosus* (voucher re-determined by KLW at NSW; Wilson 1991). For other records, the authors have updated the nomenclature from recent monographic and floristic works, as well as the draft World Checklist being coordinated by D. Simpson and R. Govaerts, and by consulting other cyperologists (see Acknowledgments). This does not guarantee, of course, that the vouchers were correctly identified by the original researchers, so the vouchers should be reexamined in any critical cases.

Column 2: Photosynthetic pathway.—Pathway type is indicated as being C_3, C_4, or apparently intermediate or variable in some species. These types are inferred by the present authors from the analyses either quoted here for new records or given in previously published works. + = an anomalous record that is discussed in Appendix 2 or in the text.

Column 3: References.—References are to previously published and new records, which are treated differently.

Previously published records.—For these, the publication is cited, followed by the method by which the pathway type was assessed, using the abbreviations below, and as discussed in the main text. In some older publications that pre-date recognition of the significance of anatomical arrangements, we have inferred the pathway type from the anatomical sections illustrated—indicated by ''[A]''. Actual values are not given here. For these, the reader should consult the original publications or the current authors' database, which will be available on-line by the second half of 2006 (or by contacting one of the two authors).

A	=	anatomy
[A]	=	anatomy deduced from older publications
c	=	chlorocyperoid anatomy
e, [e]	=	eleocharoid anatomy
f	=	fimbristyloid anatomy
r	=	rhynchosporoid anatomy
B	=	biochemistry
Γ	=	CO_2 compensation point (ml/liter or ppm CO_2)
$\delta^{13}C$	=	$\delta^{13}C$ values in ‰
IL	=	immunofluorescence labelling of Rubisco
ASP	=	aspartate as the initial product of photosynthesis
MAL	=	malate as the initial product of photosynthesis
NAD	=	NAD-malic enzyme (ME)
NADP	=	NADP-ME
PHOS	=	sugar phosphates as the initial products of photosynthesis
PIB	=	post-illumination CO_2 burst effect
US	=	ultrastructure
S	=	submerged form of an *Eleocharis* species
T	=	terrestrial form of an *Eleocharis* species

New records.—Records newly published here come from several sources. Many are from the current authors' separate or joint research, indicated by ''JB'',''KW'' or ''BW'' (see abbreviations listed below). Records for *Phylloscirpus* are based on leaf sections cut by Sandra Dhooge (GENT) and interpreted by JB and KW. Records labelled as ''LR'' are the original analyses by J. C. Lerman and the late Jean Raynal in the early 1970s that were the basis of several publications (Lerman and Raynal 1972; Raynal 1972, 1973). Similarly, those labelled as ''SCV'' come from the work of W. D. Stock, D. K. Chuba, and G. A. Verboom and underlie their recent publication on South African species (Stock et al. 2004). See text for further discussion. All vouchers for new LR records are in P; all vouchers for SCV records are in BOL. The default herbarium is NSW for new records from Bruhl and Wilson; all other herbaria are indicated using the abbreviations in Index Herbariorum (current version accessible on the New York Botanical Garden website, *www.nybg.org*).

JB	=	J. J. Bruhl, this study, including records listed in Bruhl (1990)
KW	=	K. L. Wilson, this study
BW	=	J. Bruhl and K. Wilson, this study
BDW	=	J. Bruhl, S. Dhooge, and K. Wilson, this study
LR	=	the records from J. C. Lerman and J. Raynal that underlaid Lerman and Raynal (1972) and Raynal (1972, 1973)
SCV	=	the records from W. D. Stock, D. K. Chuba, and G. A. Verboom that underlay Stock et al. (2004).

Appendix 1. Published and inferred records of photosynthetic pathway type in Cyperaceae.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
Abildgaardia hygrophila (Gordon-Gray) K. Lye	C_3	JB (A: *Ward 2794* BRI, *5519* BRI. $\delta^{13}C$: −27.9, *Ward 2794,* −28.2, *Ward 5519*)
A. macrantha (Boeck.) ined., as *Fimbristylis macrantha* Boeck.	C_4	Takeda et al. 1985 (Af)
A. ovata (Burm. f.) Kral, as *Fimbristylis monostachyos* (L.) Hassk.[a], as *F. ovata* (Burm. f.) Kern[b]	C_4	Gordon-Gray 1971 ([A])[b]; Sharma and Mehra 1972 ([A])[a]; Raghavendra and Das 1976 (A. Γ)[a]; Carolin et al. 1977 (USf)[b]; Hesla et al. 1982 ($\delta^{13}C$)[b]; Kuoh and Chiang 1984 (A)[b]; Bruhl et al. 1987 (Af. B)[b]; LR ($\delta^{13}C$: −11.3, *Chevalier 22172*)[b]
A. oxystachya (F. Muell.) ined., as *Fimbristylis oxystachya* F. Muell.	C_4	Takeda et al. 1985 (Af)
A. schoenoides R. Br., as *Fimbristylis squarrulosa* F. Muell.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
A. triflora (L.) Abeyw., as *Fimbristylis triflora* (L.) K. Schum.[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; JB (Af: *Davidse 8228* BRI. $\delta^{13}C$: −10.6, *Davidse 8228*); LR ($\delta^{13}C$: −12.0, *Boivin s. n.*)[a]
A. vaginata R. Br., as *Fimbristylis brownii* Benth.	C_4	Bruhl et al. 1987 (Af. B); JB (Af: *s. coll.* CANB 114505; *Bruhl 233, 236* CANB)
Actinoschoenus filiformis (Thwaites) Benth.	C_3	JB (A: *Ramos* NSW 181450); LR ($\delta^{13}C$: −27.4, *Poilane 23085*)
Actinoscirpus grossus (L. f.) Goetgh. & D. A. Simpson, as *Hymenochaeta grossa* (L. f.) Nees[a], as *Scirpus grossus* L. f.[b]	C_3	Govindarajalu 1976 ([A])[b]; Takeda et al. 1985 (A)[a]; JB (A: *Specht 1243* CANB)
Afrotrilepis jaegeri J. Raynal	C_3	JB (A: *Jaeger 7869* NSW 181677)
A. pilosa (Boeck.) J. Raynal, as *Eriospora pilosa* (Boeck.) Benth.[a]	C_3	Chermezon 1930 ([A])[a]; JB (A: *Letouzey 13915*); LR ($\delta^{13}C$: −32.3, *Hallé & Villiers 4978,* −33.1, Serre Orsay cult., 1972)
Alinula lipocarphoides (Kük.) J. Raynal	C_4	JB (Ac: *Robinson 5018* EA)
A. malawica (J. Raynal) Goetgh. & Vorster, as *Mariscus malawicus* J. Raynal	C_4	Raynal 1973 (A)
A. paradoxa (Cherm.) Goetgh. & Vorster	C_3	SCV ($\delta^{13}C$: −25.08, *Burtt-Davy 1749*)
A. peteri (Kük.) Goetgh. & Vorster, as *Ascolepis peteri* Kük.[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; JB (Ac: *Greenway 13488* EA); LR ($\delta^{13}C$: −14.1, *Robinson 4438*)[a]
Amphiscirpus nevadensis (S. Watson) Oteng-Yeboah	C_3	JB (A: *Peck 15386* K)
Androtrichum trigynum (Spreng.) H. Pfeiff.	C_3	JB (A: *Rosengurttx B3904* U); LR ($\delta^{13}C$: −27.5, *Hatschbach 15198*)
Arthrostylis aphylla R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Reeve 127* CANB); LR ($\delta^{13}C$: −27.4, *Leichhardt 33*)
Ascolepis capensis (Kunth) Ridl.	C_4	Hesla et al. 1982 ($\delta^{13}C$); JB (Ac: *Cooper,* Mar 1873, MEL 1543822); LR ($\delta^{13}C$: −12.4, *Meurillon CNAD 688*); SCV ($\delta^{13}C$: −10.31, *Bolus 3944*)
A. dipsacoides (K. Schum.) J. Raynal	C_4	LR ($\delta^{13}C$: −10.3, *Annet 53*)
A. pinguis C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
A. protea Welwitsch	C_4	LR ($\delta^{13}C$: −10.4, *Letouzey 7567*)
A. pusilla Ridl.	C_4	LR ($\delta^{13}C$: −11.4, *Demange 3276*)
Asterochaete capitellata Nees (*Carpha capitellata* (Nees) Boeck.)	C_3	JB (A: MEL 1543862)
Baumea acuta (Labill.) Palla	C_3	JB (A: *Newbey 4625* CANB)
B. articulata (R. Br.) S. T. Blake, as *Machaerina articulata* (R. Br.) Koyama	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
B. deplanchei Boeck.	C_3	LR ($\delta^{13}C$: −30.4, *Raynal & Jaffré 16490*)
B. glomerata Gaud.	C_3	JB (A: *van Royen 5218* CANB)
B. juncea (Nees) Boeck., as *Machaerina juncea* (R. Br.) Koyama	C_3	Takeda et al. 1985 (A)
B. rubiginosa (Spreng.) Boeck., as *Machaerina nipponensis* (Ohwi) Ohwi & Koyama[a], as *Machaerina rubiginosa* (Spreng.) Koyama[b]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[b]; Ueno et al. 1986 (A. B)[a]; JB (A: *Bruhl 518* CANB)
B. teretifolia (R. Br.) Palla, as *Machaerina teretifolia* (R. Br.) Koyama	C_3	Takeda et al. 1985 (A)
B. tetragona (Labill.) S. T. Blake	C_3	KW (A: *Beauglehole 36048*; *Sharpe 1365*)
Becquerelia cymosa Brongn. subsp. *cymosa*	C_3	JB (A: *Harley 20171* K); LR ($\delta^{13}C$: −32.0, *Sastre 97*)
Bisboeckelera irrigua (Nees) Kuntze	C_3	LR ($\delta^{13}C$: −36.6, *Smith 2785*)
B. microcephala (Boeck.) Koyama	C_3	JB (A: *Florschuetz 1819* U)
Blysmus compressus (L.) Panz. ex Link	C_3	JB (A: *Manchester 1387*); LR ($\delta^{13}C$: −27.5, *Duclos s. n.,* 1924)
B. rufus (Huds.) Link (*Blysmopsis rufa* (Huds.) Oteng-Yeboah)	C_3	JB (A: *Stafleu 338*; *Laurer* NSW 181496)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
Bolboschoenus cf. *medianus* (V. J. Cook) Soják, as *Scirpus maritimus* L.	C_3	Takeda et al. 1985 (A)
B. fluviatilis (Torr.) Soják, as *Scirpus fluviatilis* (Torr.) A. Gray[a]	C_3	Takeda et al. 1985 (A)[a]; Ueno et al. 1986 (A. B)[a]; JB (A: *Gray 3921* CANB)
B. maritimus (L.) Palla, as *Scirpus maritimus* L.[a]	C_3	Sabnis 1921 ([A])[a]; Govindarajalu 1976 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); Mateu Andres 1991 ([A])[a]; LR ($\delta^{13}C$: −29.7, *Perrottet 818*)
B. robustus (Pursh) Soják, as *Scirpus robustus* Pursh	C_3	Bender 1971 ($\delta^{13}C$)
Bulbostylis abortiva (Steud.) C. B. Clarke	C_4	LR ($\delta^{13}C$: −13.3, *Tisserant 3161*)
B. argenteobrunnea C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. atrosanguinea (Boeck.) C. B. Clarke	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
B. barbata (Rottb.) C. B. Clarke	C_4	Govindarajalu 1966 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Af); Ueno et al. 1986 (Af. B); Ueno et al. 1988*b* (USf); Ueno and Takeda 1992 (A. Γ); JB (Af: *McKee 10720* CANB; *Bruhl 540* CANB)
B. basalis Fosberg	C_4	Hnatiuk 1980 (A)
B. boeckeleriana (Schweinf.) Beetle	C_4	Hesla et al. 1982 ($\delta^{13}C$: −10.7)
B. bozumensis Cherm.	C_4	LR ($\delta^{13}C$: −13.8, *Badré 40*)
B. coleotricha (Hochst. ex A. Rich.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −12.5, *Pobéguin 408*)
B. contexta (Nees) Bodard	C_4	Gordon-Gray 1971 ([A])
B. densa (Wall. ex Roxb.) Hand.-Mazz., as *B. capillaris* (L.) C. B. Clarke subsp. *trifida* (Nees) Koyama[a], as *B. capillaris* var. *trifida* (Nees) C. B. Clarke[b]	C_4	Govindarajalu 1966 ([A])[b]; Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Af. $\delta^{13}C$); Ueno and Takeda 1992 (A)[a]
subsp. *afrimontana* (K. Lye) R. Haines, as *B. capillaris*	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. filamentosa (Vahl) C. B. Clarke, as *B. cardiocarpa* (Ridl.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. hispidula subsp. *filiformis* (C. B. Clarke) R. Haines, as *B. filiformis* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. glaberrima Kük.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. hispidula (Vahl) R. W. Haines, as *Fimbristylis hispidula* (Vahl) Kunth	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −13.4, *Chevalier 9243*)
B. humilis (Kunth) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. lanata (Kunth) Lindm.	C_4	JB (Af: *McKee 10720* CANB)
B. laniceps C. B. Clarke	C_4	LR ($\delta^{13}C$: −14.1, *Chevalier 27599*)
B. lanifera (Boeck.) Kük.	C_4	LR ($\delta^{13}C$: −12.6, *Berhaut 2617*)
B. mucronata C. B. Clarke	C_4	LR ($\delta^{13}C$: −10.6, *Humbert 15943*)
B. oligostachys (Hochst. ex A. Rich.) K. Lye, as *Fimbristylis oligostachys* Hochst. ex A. Rich.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. oritrephes (Ridl.) K. Lye	C_4	LR ($\delta^{13}C$: −12.0, *Letouzey 8733*)
B. paradoxa (Spreng.) Lindm.	C_4	JB (Af^2, *McKee 11199* CANB)
B. pilosa (Willd.) Cherm.	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −12.0, *Boivin s. n.,* 1850)
B. puberula (Poir.) C. B. Clarke var. *gracilis* (Nees) Fisch.	C_4	Govindarajalu 1966 ([A])
var. *puberula,* as *B. puberula*	C_4	Govindarajalu 1966 ([A])
B. pusilla (Hochst. ex A. Rich.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −16.0, *Le Testu 2868*)
B. schimperiana (A. Rich.) C. B. Clarke, as *Fimbristylis humilis* A. Peter	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. subspinescens C. B. Clarke	C_4	Govindarajalu 1966 ([A])
B. swamyi Govindarajalu	C_4	Govindarajalu 1985 ([A])
B. trichobasis (Baker) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
B. turbinata S. T. Blake	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
B. vanderystii Cherm.	C_4	LR ($\delta^{13}C$: −11.3, *Chevalier 27314*)
Calyptrocarya glomerulata (Brongn.) Urb.	C_3	JB (Af: *Campbell* MEL 1543844; *Harris 438* K); LR ($\delta^{13}C$: −37.2, *Pinto & Sastre 971*)
Capeobolus brevicaulis (C. B. Clarke) J. Browning	C_3	JB (A: *Bruhl 1720, 1736* NE; *Moss 7612* K)
Capitularina involucrata (Valck. Sur.) Kern	C_3	JB (A: *van Royen 4005* CANB); LR ($\delta^{13}C$: −33.8, *Hombron s. n.,* 1841)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
Carex alligata Boott, as *C. sandwichensis* [sic] Boeck.	C_3	Standley 1990 ([A])
C. appressa R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl 119* CANB; *Bruhl 15* CANB); LR ($\delta^{13}C$: −24.6, *Drummond 272*)
C. baccans Nees	C_3	Hofstra et al. 1972 (A. Γ)
C. bequaertii De Wild.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. bohemica Schreb., as *C. cyperoides* L.	C_3	LR ($\delta^{13}C$: −27.7, *Duclos s. n.,* 1929)
C. breviculmis R. Br.	C_3	Takeda et al. 1985 (A)
C. camptoglochin Krech.	C_3	Kukkonen 1970 ([A])
C. capillacea Boott	C_3	JB (A: *Adams 2619* CANB)
C. castanostachya K. Schum.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. cephalotes F. Muell.	C_3	JB (A: *Doing,* 8 Jan 1964 CANB; *Gray 4785* CANB)
C. chlorosaccus C. B. Clarke	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. collumanthus (Steyerm.) L. E. Mora (*Vesicarex collumanthus* Steyerm.)	C_3	JB (A: *Cleef 5611* U)
C. conferta Hochst. ex A. Rich.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
var. *lycurus* (K. Schum.) K. Lye, as *C. lycurus* K. Schum.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. cruciata Vahl	C_3	Saxena and Ramakrishnan 1984 (A)
C. cuchumatanensis Standley & Steyerm.	C_3	Standley 1987*b* ([A]); Standley 1990 ([A])
C. curvula Allioni	C_3	Körner et al. 1988 ($\delta^{13}C$)
C. decidua Boott	C_3	Standley 1987*b* ([A])
C. declinata Boott	C_3	Takeda et al. 1985 (A)
C. dietrichiae Boeck.	C_3	LR ($\delta^{13}C$: −31.7, *Schlechter 18277*)
C. doniana Spreng., as *C. japonica* Thunb. subsp. *chlorostachys* (D. Don) Koyama	C_3	Ueno et al. 1986 (A. B)
C. duriuscula C. A. Mey., as *C. eleocharis* L. H. Bailey	C_3	Boutton et al. 1980 (A)
C. echinochloe Kunze	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. elgonensis Nelmes	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. emoryi Dewey	C_3	Standley 1987*a* ([A])
C. ericetorum Pollich	C_3	LR ($\delta^{13}C$: −25.9, *Lerman s. n.,* 1970)
C. erythrorrhiza Boeck.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. extensa Good.	C_3	Mateu Andres 1991 ([A])
C. fascicularis Solander ex Boott	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Gray 5825* CANB)
C. filifolia Nutt.	C_3	Boutton et al. 1980 (A)
C. flava L.	C_3	LR ($\delta^{13}C$: −27.4, *Lerman s. n.,* 1971)
C. fraserianus (Ker Gawl.) Kartesz & Gandhi (*Cymophyllus fraseri* (Andrews) Mack.)	C_3	JB (A: *s. coll.* MEL 154850)
C. grayi J. Carey	C_3	Hofstra et al. 1972 (A. Γ)
C. haydenii Dewey	C_3	Standley 1987*a* ([A])
C. hermannii Cochrane	C_3	Standley 1987*b* ([A])
C. indica L.	C_3	LR ($\delta^{13}C$: −27.8, *Zollinger 313*)
C. inversa R. Br.	C_3	JB (A: *Moore 8135* CANB)
C. johnstonii Boeck.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. kobomugi Ohwi	C_3	Akita et al. 1969 ([A]); Takeda et al. 1980 (A. Γ)
C. lacustris Willd.	C_3	Bender 1971 ($\delta^{13}C$)
C. lenticularis Michx. var. *lenticularis*	C_3	Standley 1987*a* ([A]); Standley 1990 ([A])
C. liparocarpos Gaudin	C_3	Kalapos et al. 1997 (A. Γ)
C. maculata Boott	C_3	KW (A: *Wilson 10201*)
C. maritima Gunnerus, as *C. incurva* Lightfoot	C_3	LR ($\delta^{13}C$: −26.9, *Duclos s. n.,* 1938)
C. microglochin Wahlenb.	C_3	Kukkonen 1970 ([A])
C. monostachya A. Rich.	C_3	Hesla et al. 1982 (A. $\delta^{13}C$); Aucour et al. 1994 ($\delta^{13}C$)
C. neoguinensis C. B. Clarke	C_3	Hofstra et al. 1972 (A. Γ); JB (A: *Smith ANU 15115* CANB)
C. nigra (L.) Reichard	C_3	Standley 1987*a* ([A])
C. obnupta L. H. Bailey	C_3	Standley 1990 ([A])
C. pachystylis J. Gay	C_3	Winter and Troughton 1978 ($\delta^{13}C$); LR ($\delta^{13}C$: −33.1, Phytotron Gif cult., 1972)
C. peregrina Link	C_3	Hesla et al. 1982 ($\delta^{13}C$)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. petitiana A. Rich., as *C. cuprea* (Kük.) Nelmes[a], as *C. fischeri* K. Schum.[b], as *C. longipedunculata* K. Schum.[c], as *C. ninagongensis* (Kük.) Robyns[d]	C_3	Hesla et al. 1982 ($\delta^{13}C$)[a,b,c,d]
C. pilulifera L.	C_3	LR ($\delta^{13}C$: −30.3, *Seyrat s. n.,* 1912)
C. polyantha F. Muell.	C_3	JB (A: *Bruhl,* 17 Nov 1985 CANB)
C. rafflesiana Boott	C_3	JB (A: *Bruhl 551* CANB); Hofstra et al. 1972 (A. Γ)
C. runssoroensis K. Schum.	C_3	Aucour et al. 1994 ($\delta^{13}C$); Hesla et al. 1982 ($\delta^{13}C$)
C. setifolia Kunze ex Kunth	C_3	LR ($\delta^{13}C$: −31.9, Phytotron Gif cult., 1972)
C. simensis A. Rich.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. sp.	C_4^+	Smith and Epstein 1971 ($\delta^{13}C$)
C. sp.	C_3	Troughton et al. 1974 ($\delta^{13}C$)
C. sp.	C_3	Boutton et al. 1980 (A)
C. spicatopaniculata C. B. Clarke	C_3	SCV ($\delta^{13}C$: −27.72, *Schlechter 4759*)
C. stenophylla Wahlenb.	C_3	Williams and Monson 1981 ([A]. Γ)
C. stricta Lam.	C_3	Bender 1971 ($\delta^{13}C$); Standley 1987*a* ([A])
C. strigosa Huds.	C_3	LR ($\delta^{13}C$: −30.1, *De Vergnes s. n.,* 1902)
C. subinflata Nelmes	C_3	SCV ($\delta^{13}C$: −25.18, *Dod 3467*)
C. torta Boott	C_3	Standley 1987*a* ([A]); Standley 1990 ([A])
C. vallis-rosetto K. Schum., as *C. greenwayi* Nelmes	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. verticillata Zoll. & Moritzi	C_3	Hofstra et al. 1972 (A. Γ)
C. vesicaria L.	C_3	Shepherd 1976 ([A])
Carpha alpina R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Craven 1770* CANB; *NGF 10208* CANB); LR ($\delta^{13}C$: −26.6, *Le Guillou s. n.,* 1840)
C. nivicola F. Muell.	C_3	JB (A: *Totterdell 373* CANB)
Caustis blakei Kük.	C_3	Takeda et al. 1985 (A)
C. dioica R. Br.	C_3	Takeda et al. 1985 (A)
C. flexuosa R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl 130* CANB)
C. pentandra R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); LR ($\delta^{13}C$: −30.7, *Rodway 1558*)
C. recurvata Spreng.	C_3	Takeda et al. 1985 (A)
Cephalocarpus rigidus Gilly	C_3	JB (A: *Maguire 32831*U); LR ($\delta^{13}C$: −27.7, *Maguire et al. 30159*)
C. australis K. L. Wilson	C_3	KW (A: *Bates 4022; Beauglehole 68256*; *Williamson* NSW 122681)
C. cymbaria R. Br.	C_3	Takeda et al. 1985 (A); JB (A: *Bruhl 101* CANB; *Prober 243* CANB); KW (A: *Beauglehole 24875*; *Constable 6204, 4443*; *Coveny 3832, 5050, 6236, 6693, 9093*; *Jacobs 3229*; *Johnson* NSW 241350; *McBarron 9276*; *McKee 30542, 43984* NOU; *Olsen 2017*; *Rodway 268*; *Schmid 3080* NOU; *Wilson 3053, 3086, 3094*); LR ($\delta^{13}C$: −27.4, *Raynal & Jaffré 16459*)
C. enodis Nees	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Blake 20736*; *Coveny 8102*; *Gunn 1401*; *Maiden* NSW 22493; *Melville 1612*; *Walter* NSW 242326; *Wilson 2773*)
C. multiarticulata Nees	C_3	KW (A: *Conn 3545*; *P.G. Wilson 7069* PERTH)
C. sphaerocephala R. Br.	C_3	KW (A: *Beauglehole 32890*; *Brooks* NSW 242163; *Camfield* NSW 2249, NSW 22496; *Coveny 831, 3755, 5025, 6283, 6704*; *Constable* NSW 46244; *Maiden* NSW 242388; *McBarron 8208*; *Rodway* NSW 242331, NSW 242387)
Chorizandra sp. G (*Wilson 7192*)	C_3	KW (A)
Chrysitrix capensis L.	C_3	JB (A: *Williams 3240* PRE); LR ($\delta^{13}C$: −27.9, *Humbert 9600*)
C. dodii C. B. Clarke	C_3	JB (A: *Esterhuysen 2917* PRE)
C. junciformis C. B. Clarke	C_3	JB (A: *Taylor 3888* PRE); SCV ($\delta^{13}C$: −23.33, *Stokoe s. n.*)
Cladium jamaicense Crantz, as *C. mariscus* (L.) Pohl subsp. *jamaicense* (Crantz) Kük.[a], as *C. mariscus* var. *jamaicense* (Crantz) ined.[b]	C_3	Bender 1971 ($\delta^{13}C$); Hesla et al. 1982 ($\delta^{13}C$); Aucour et al. 1994 ($\delta^{13}C$)[b]; LR ($\delta^{13}C$: −26.0, *Degener 27989*)[a]
C. mariscus (L.) Pohl	C_3	Aucour et al. 1994 ($\delta^{13}C$)
C. procerum S. T. Blake[a], as *C. mariscus*[b]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[a,b]; JB (A: *Crisp 6878* CBG)
Coleochloa abyssinica (A. Rich.) Gilly, as *Eriospora abyssinica* Hochst. ex A. Rich.[a]	C_3	Chermezon 1930 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −26.1, *Dillon & Pettit s. n.,* 1842)
C. schweinfurthiana (Boeck.) Nelmes	C_3	JB (A: *s. coll.* MEL 1543821)
C. setifera (Ridl.) Gilly, as *Eriospora setifera* (Ridl.) C. B. Clarke[s]	C_3	Chermezon 1930 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); SCV ($\delta^{13}C$: −22.20, *Esterhuysen 21464*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
Costularia arundinacea (Solander ex Vahl) Kük. (*Lophoschoenus arundinaceus* (Solander ex Vahl) Stapf)	C_3	LR ($\delta^{13}C$: −27.7, *Raynal & Jaffré 16508*)
C. chamaedendron (Guill.) Kük.	C_3	JB (A: *McPherson 3055*); LR ($\delta^{13}C$: −29.6, *Raynal & Jaffré 16514,* −30.4, Serre Orsay cult., 1972)
C. comosa (C. B. Clarke) Kük. (*Lophoschoenus comosus* (C. B. Clarke) Stapf)	C_3	JB (A: *McKee 7726* BRI)
C. fragilis (Däniker) Kük.	C_3	JB (A: *Hartley 15075* CANB)
C. leucocarpa (Ridl.) H. Pfeiff.	C_3	JB (A: *Bossa 7773* K)
C. pantopoda (Baker) C. B. Clarke	C_3	LR ($\delta^{13}C$: −25.1, *Humbert 22674*)
C. pilisepala (Steud.) Kern, as *C. urvilleana* (Gaud. ex Boeck.) Kük.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
C. pubescens J. Raynal (*Lophoschoenus pubescens* (J. Raynal) ined.)	C_3	JB (A: *McKee 1051A* BRI)
C. stagnalis (Däniker) Kük.	C_3	JB (A: *Hartley 15072* CANB)
Courtoisina assimilis (Steud.) Maquet, as *Mariscus assimilis* (Steud.) Podlech	C_3	Hesla et al. 1982 ($\delta^{13}C$); Vorster 1996 (A)
C. cyperoides (Roxb.) Soják	C_3	Druyts-Voets 1970 ([A]); Vorster 1996 (A); JB (A: MEL 1543845, MEL 1543847); LR ($\delta^{13}C$: −28.2, *Fotius 931*)
Crosslandia setifolia W. V. Fitzg., as *Crosslandia*[a]	C_4	Lerman and Raynal 1972 (A)[a]; Takeda et al. 1985 (Af. $\delta^{13}C$); JB (Af: *van Rijn 19* CANB; *Latz 2774* CANB; *Leutert 74* CANB); LR ($\delta^{13}C$: −11.5, *MacKee 8432*)
Cyathochaeta avenacea (R. Br.) Benth.	C_3	Takeda et al. 1985 (A); JB (A: *Morrison,* 3 Dec 1903 BRI. $\delta^{13}C$: −26.3, *Morrison,* 3 Dec 1903); LR ($\delta^{13}C$: −25.9, *Morrison s. n.,* 1915)
C. diandra (R. Br.) Nees	C_3	Takeda et al. 1985 (A)
Cyathocoma hexandra (Nees) J. Browning, as *Macrochaetium hexandrum* (Nees) H. Pfeiff.[a]	C_3	JB (A: *Garside,* 10 Oct 1920 K); LR ($\delta^{13}C$: −29.3, *Drège 3944*)[a]
Cyperus acuminatus Torr. & Hook.	C_3	Denton 1983 (A); Li et al. 1999 (A)
C. aggregatus (Willd.) Endl.	C_4	KW (Ac: *Jacobs* NSW 144403)
	C_3+	Li et al. 1999 (A)
C. ajax C. B. Clarke	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. albopilosus (C. B. Clarke) Kük., as *Mariscus albopilosus* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. albosanguineus Kük., as *Mariscus albosanguineus* (Kük.) Napper	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. albostriatus Schrad.	C_3	KW (A: *Schlechter 2569*; *Wilson 4383*)
	C_4+	Sonnenberg and Botha 1992 (A. PIB: NADP)
C. alopecuroides Rottb.	C_4	Druyts-Voets 1970 ([Ac]); Hesla et al. 1982 ($\delta^{13}C$); Li and Jones 1994 (A)
C. alterniflorus R. Br.	C_4	KW (Ac: *Martensz 263*)
C. alternifolius L.	C_3	Haberlandt 1884 ([A]); Rikli 1895 ([A]); Brown 1975 (A); Takeda et al. 1980 (A. Γ); Hesla et al. 1982 ($\delta^{13}C$); Krenzer et al. 1975 (Γ); Li 1993 (A. Γ. $\delta^{13}C$); Li and Jones 1994 (A); LR ($\delta^{13}C$: −30.3, *Perrier 14816,*-35.5, Serre Orsay cult., 1972)
C. amabilis Vahl	C_4	Druyts-Voets 1970 ([A]); Meinzer 1978 (A); Hesla et al. 1982 ($\delta^{13}C$); KW (Ac: *Adam 2258* P; *de la Bâthie 13097*); LR ($\delta^{13}C$: −13.0, *Boivin s. n.*); SCV ($\delta^{13}C$: −12.31, *Schupers 893*)
C. amauropus Steud., as *Mariscus amauropus* (Steud.) Cufod.[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *s. coll. 1301,* Kenya P); LR ($\delta^{13}C$: −14.0, *Humbert 8502 bis*)[a]
C. amuricus Maxim.	C_4	Ueno and Takeda 1992 (A); KW (Ac: *Inamasu 425*)
C. anderssonii Boeck.	C_4	KW (Ac: *Schimpff 13* P)
C. andinus Palla	C_3	LR ($\delta^{13}C$: −26.5, *Mandon 1396*)
C. angolensis Boeck.	C_4	Druyts-Voets 1970 ([A]); KW (Ac: *Robinson 2683* P)
C. angustatus R. Br.	C_4	KW (Ac: *Latz 3651*)
C. aquatilis R. Br.	C_3	Carolin et al. 1977 (US); Takeda et al. 1985 (A. $\delta^{13}C$)
C. articulatus L.	C_4	Druyts-Voets 1970 ([Ac]); Hesla et al. 1982 ($\delta^{13}C$); Meinzer 1978 (A)
C. astartodes K. L. Wilson	C_4	KW (Ac: *Specht 649; Wilson 5151*)
C. atractocarpus Ridl.	C_4	Druyts-Voets 1970 ([A])
C. atroviridis C. B. Clarke, as *C. aterrimus* Steud.	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)
C. aucheri Jaub. & Spach	C_4	KW (Ac: *H. Wilson 4,* Arabia P)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. baoulensis (Chevalier) Kük.	C_4	KW (Ac: *Hall 306* P)
C. bellus Kunth [may be referable to *C. tanganyicanus* (Kük.) K. Lye]	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. bernieri Cherm.	C_4	KW (Ac: *Boivin Voyage 1847–52, 2320* P)
C. betchei (Kük.) S. T. Blake subsp. *betchei*	C_4	KW (Ac: *Payne 4*; *Wilson 746*)
subsp. *commiscens* K. L. Wilson	C_4	KW (Ac: *Latz 7090*)
C. bifax C. B. Clarke, as *Cyperus rotundus* subsp. *retzii*[a]	C_4	Carolin et al. 1977 (USc); Druyts-Voets 1970 ([A])[a]; Takeda et al. 1985 (Ac. $\delta^{13}C$)
C. blakeanus K. L. Wilson	C_4	KW (Ac: *Latz 2200*; *Wilson 5373*)
C. blysmoides C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. bowmanii F. Muell. ex Benth.	C_4	Carolin et al. 1977 (USc); Takeda et al. 1985 (Ac. $\delta^{13}C$)
C. bulbosus Vahl	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac); KW (Ac: *O'Connell* NSW 121327); LR ($\delta^{13}C$: −14.0, *Audru 2536*)
C. burkartii Guaglianone	C_3	Guaglianone 1990 ([A])
C. callistus Ridl.	C_4	Druyts-Voets 1970 ([A]); KW (Ac: *Gossweiler 209* P)
C. cancrorum Cherm.	C_4	KW (Ac: *Decary 1686* P)
C. capensis (Steud.) Endl. var. *capensis*	C_4	KW (Ac: *Schlechter 3779*)
C. capitatus Vandelli	C_4	Collins and Jones 1985 ($\delta^{13}C$); Li 1993 (A. $\delta^{13}C$); JB (Ac: *s. coll.* MEL 1543828); LR ($\delta^{13}C$: −11.1, *Mabille Hb Cors. 96*)
C. carinatus R. Br.	C_4	KW (Ac: *Latz 5176*; *Wilson 4669*)
C. castaneus Willd.	C_4	Carolin et al. 1977 (USc); Takeda et al. 1985 (Ac. $\delta^{13}C$)
C. centralis K. L. Wilson	C_4	KW (Ac: *Latz 1911, 2012*)
C. cephalotes Vahl (*Anosporum cephalotes* (Vahl) Kurz)	C_3	Hesla et al. 1982 ($\delta^{13}C$); JB (A: *Dharmawardhana 25* CANB; *Pullen 7523* CANB); KW (A: *Schmid s. n.,* Indochina P)
C. chalaranthus J. Presl & C. Presl	C_3	KW (A: *Lescure 604* P)
C. chordorrhizus Chiovenda	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. chrysocephalus (K. Schum.) Kük.	C_4	KW (Ac: *Baum 311a* BRI; *de Witte 7185* PRE)
C. circumclusus (C. B. Clarke) Kük., as *Mariscus circumclusus* C. B. Clarke[a], as *M. macropus* C. B. Clarke[b]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a,b]; KW (Ac: *Lewalle s. n.*, Burundi P); LR ($\delta^{13}C$: −11.1 *Tisserant 1877*)[b]
C. clarus S. T. Blake	C_4	KW (Ac: *Blake 5174*; *Wilson 5749*)
C. clavinux C. B. Clarke	C_4	KW (Ac: *Fotius 1603*)
C. colymbetes Kotschy & Peyr.	C_3	Druyts-Voets 1970 ([A])
C. compactus Retz., as *Mariscus compactus* (Retz.) Boldingh[a]	C_4	Takeda et al. 1985 (Ac); Ueno and Takeda 1992 (A)[a]
C. compressus L.	C_4	Druyts-Voets 1970 ([Ac]); Hofstra et al. 1972 (A. Γ); Prakash et al. 1976 (A); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac); Ueno et al. 1986 (Ac. B); Ueno and Takeda 1992 (A. Γ); Lin et al. 1993 (Ac); KW (Ac: *Henty* NGF9870); LR ($\delta^{13}C$: −9.2, *Boivin s. n.,* 1847); SCV ($\delta^{13}C$: −9.85, *de Winter and Giess 6889*)
C. concinnus R. Br.	C_3	KW (A: *Wilson 1463*)
C. confertus Sw.	C_4	Rikli 1895 ([A])
C. congensis C. B. Clarke	C_4	Druyts-Voets 1970 ([A])
C. congestus Vahl, as *Mariscus congestus* (Vahl) C. B. Clarke[a]	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$); Li 1993 (A. Γ. $\delta^{13}C$); Li and Jones 1994 (A); Sonnenberg and Botha 1992 (A. PIB: NADP)[a]; KW (Ac: *Wilson 1442*); SCV ($\delta^{13}C$: −9.56, *Mogg 11683*)[a]
C. conglomeratus Rottb.	C_4	Sabnis 1921 ([A]); Druyts-Voets 1970 ([A]); Hnatiuk 1980 (A); KW (Ac: *de Fabrègues 2759* P); LR ($\delta^{13}C$: −11.6, *Jamin s. n.,* 1852)
C. conicus (R. Br.) Boeck.	C_4	Carolin et al. 1977 (USc); Takeda et al. 1985 (Ac); KW (Ac: *Wilson 1502, 3529*)
C. constanzae Urban	C_3	KW (A: *Ekman 6879* K; *Harris 12350* K)
C. cornelii-ostenii Kük.	C_4	KW (Ac: *Krapovickas 24323* P)
C. corymbosus Rottb., as *C. corymbosus* var. *longispiculatus* (O. Kuntze) Kük.[a]	C_4	Mani 1963 ([A])[a]; SCV ($\delta^{13}C$: −10.33, *Maputaland Expedition 14319*)
C. cracens K. L. Wilson	C_4	KW (Ac: *Benson 2088b*; *Craven 5826*)
C. crassipes Vahl, as *C. maritimus* Poir.[a]	C_4	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Adam 1538* P); LR ($\delta^{13}C$: −12.0, *Mahoux SF6764*)[a]
C. crispulus K. L. Wilson	C_4	KW (Ac: *Blake 17673*; *Dunlop 5240*; *Wilson 5303*)
C. croceus Vahl (*C. globulosus* Aublet)	C_4	KW (Ac: *Schallert 28257* P)
C. cunninghamii (C. B. Clarke) C. Gardner subsp. *cheradicus* K. L. Wilson	C_4	KW (Ac: *Wilson 5454*)
subsp. *cunninghamii,* as *C. cunninghamii*[a]	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$)[a]; KW (Ac: *Coveny 517*; *Latz 9499*; *Mitchell 453*; *Tate* NSW 22742; *Wilson 5379*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
subsp. *uniflorus* K. L. Wilson	C_4	KW (Ac: *Wilson 5302*)
C. cuspidatus Kunth	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac); KW (Ac: *de la Bâthie 16099*)
C. cyperinus (Retz.) Valck. Sur.	C_4	Mani 1963 ([A]); Hofstra et al. 1972 (A. Γ)
C. cyperoides (L.) Kuntze, as *Mariscus sieberianus* Nees ex C. B. Clarke[a], as *M. sumatrensis* (Retz.) J. Raynal[b]	C_4	Hofstra et al. 1972 (A. Γ); Hesla et al. 1982 ($\delta^{13}C$)[a]; Ueno and Takeda 1992 (A. Γ)[b]
C. dactylotes Benth.	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$); KW (Ac: *Latz 5126*; *Martensz 4134*)
C. deciduus Boeck.	C_3+	Druyts-Voets 1970 ([A]); Vorster 1990 ([A]); KW (A: *Angus 2987* P; *Miller 5634*; *Robinson 4020* P)
C. decompositus (R. Br.) F. Muell.	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$); KW (Ac: *Tryon* NSW 608854)
C. dentatus Torr.	C_3	Li et al. 1999 (A. $\delta^{13}C$); KW (A: *Fernald 16273*)
C. denudatus L. f.[a], as *C. phaeorrhizus* K. Schum.[b], as *C. phaeorrhizus* var. *filifolia* ined.[c]	C_3	Druyts-Voets 1970 ([A])[a,b,c]; Hesla et al. 1982 (A. $\delta^{13}C$)[a,b]; Aucour et al. 1994 ($\delta^{13}C$)[a]
C. dereilema Steud.[a], as *C. dereilema* var. *deckenii* (Boeck.) ined.[b]	C_3	Druyts-Voets 1970 ([A])[a,b]; Hesla et al. 1982 ($\delta^{13}C$)[a]
C. dichroostachyus A. Rich.	C_3	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)
C. dietrichiae Boeck.	C_4	KW (Ac: *Flecker* NSW 608855)
C. difformis L.	C_3	Akita et al. 1969 ([A]); Druyts-Voets 1970 ([A]); Hofstra et al. 1972 (A. Γ); Imai and Murata 1979 (Γ); Takeda et al. 1980 (A. Γ); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A); Li 1993 (A. Γ. $\delta^{13}C$); Li et al. 1999 (A. $\delta^{13}C$); KW (A: *Wilson 1464*)
C. digitatus Roxb.	C_4	Ueno and Takeda 1992 (A); LR ($\delta^{13}C$: −13.4, *Drummond 6576*)
subsp. *auricomus* (Sieb. ex Spreng.) Kük., as *C. auricomus* Sieb. ex Spreng.	C_4	Druyts-Voets 1970 ([A]); Li 1993 ($\delta^{13}C$)
C. disjunctus C. B. Clarke	C_3	KW (A: *Wilson 9907*)
C. distans L. f.[a], as *C. distans* var. *densiflorus* Kük.[b]	C_4	Druyts-Voets 1970 ([A])[a,b]; Hesla et al. 1982 ($\delta^{13}C$)[a]; Ueno et al. 1986 (Ac. B)[a]; Ueno et al. 1988*b* (USc)[a]; Ueno and Takeda 1992 (A)[a]; KW (Ac: *Berhaut 3611* P; *Flecker* NSW 65486; *Wilson 3805*)[a]
C. distinctus Steud.	C_3	Denton 1983 (A)
C. diurensis Boeck., as *Mariscus diurensis* (Boeck.) C. B. Clarke[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Humbert 7234* P)
C. dives Del.[a], as *C. immensus* C. B. Clarke[b]	C_4	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a,b]; KW (Ac: *Berhaut 5100* P)[a]; LR ($\delta^{13}C$: −13.0, *Schlieben 1274*)[b]
C. drummondii Torr. & Hook., as *C. virens* var. *drummondii* (Torr. & Hook.) Kük.	C_3	Denton 1983 (A)
C. dubius Rottb., as *Mariscus dubius* (Rottb.) Kük. ex Fisch.[a]	C_4	Hnatiuk 1980 (A): Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Vorster 2566*); LR ($\delta^{13}C$: −12.7, *Chevalier 21665* P)[a]
C. duripes I. M. Johnst.	C_4	KW (Ac: *Anthony 400* US)
C. durus Kunth, as *Mariscus durus* (Kunth) C. B. Clarke	C_4	Vorster 1990 (A)
C. echinatus (L.) Alph. Wood, as *C. ovularis* (Michx.) Torr.	C_4	Li 1993 ($\delta^{13}C$)
C. ekmannii Kük.	C_4	KW (Ac: *Ekman 14980* US)
C. elatus L.	C_4	Mani 1960 ([A])
C. elegans L.	C_4	Druyts-Voets 1970 ([A]); KW (Ac: *Pringle 5946*; *Gentle 801*); LR ($\delta^{13}C$: −11.3, *Rodriguez 3200*)
C. entrerianus Boeck.	C_3	LR ($\delta^{13}C$: −26.6, *Hassler 7866*)
C. eragrostis Vahl, as *C. vegetus* Willd.[a]	C_3	Druyts-Voets 1970 ([A]); Denton 1983 (A); Bruhl et al. 1987 (A. B); Li 1993 (A. Γ. $\delta^{13}C$); Li and Jones 1994 (A)[a]; Soros and Dengler 2001 (A); JB (A: *Bruhl 658* CANB; *Ferreira 63* BRI; *Tryon* BRI 186483. Γ: 42, 46, *Bruhl 658*. $\delta^{13}C$: −26.6, *Tryon* BRI 186483); KW (A: *Wilson 633*); LR ($\delta^{13}C$: −26.8, *Duffort SEFFH 1649,* −27.6, *Brown 119*)
	C_4+	Downton and Tregunna 1968 (Γ); Troughton et al. 1974 ($\delta^{13}C$)
C. erythrorhizos Muhl.	C_4	Li et al. 1999 (A)
C. esculentus L.	C_4	Moss et al. 1969 (Γ); Chen et al. 1970 (Γ); Druyts-Voets 1970 ([A]); Syvertsen et al. 1976 (A); Krenzer et al. 1975 (Γ); Hesla et al. 1982 ($\delta^{13}C$); Li 1993 (Γ. $\delta^{13}C$); Li et al. 1999 (A. $\delta^{13}C$); JB (Ac: *Everist 6052* BRI); KW (Ac: *Johnson 7692*); LR ($\delta^{13}C$: −12.1, *Sellier Sté Roch. 4501* P)
C. exaltatus Retz.	C_4	Mani 1963 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac); JB (Ac: *s. coll.* CANB 112270); KW (Ac: *Solling 496*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
subsp. *iwasakii* (Makino) T. Koyama	C_4	Ueno and Takeda 1992 (A)
C. exilis Willd. ex Kunth	C_4	KW (Ac: *Bosser 15824* P)
C. fastigiatus Rottb.	C_4	Sonnenberg and Botha 1992 (A. PIB: NAD/PCK); KW (Ac: *Burchell 1773*)
C. fertilis Boeck.	C_3	Druyts-Voets 1970 ([A]); LR ($\delta^{13}C$: −33.7, Serre Orsay cult., 1972 P, −36.6, *de Witte 7660*)
C. filiculmis Vahl	C_4	Bender 1971 ($\delta^{13}C$); Li et al. 1999 (A. $\delta^{13}C$)
C. fischerianus A. Rich.	C_3	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)
C. fissus Steud.	C_4	Druyts-Voets 1970 ([A])
C. flaccidus R. Br.	C_3	Ueno and Takeda 1992 (A. Γ); KW (A: *Coveny 4861*)
C. flexuosus Vahl (*Torulinium flexuosum* (Vahl) T. Koyama)	C_4	KW (Ac: *Wilson 2399*)
C. foliaceus C. B. Clarke	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. frerei C. B. Clarke	C_3	Hesla et al. 1982 ($\delta^{13}C$)
C. fucosus K. L. Wilson, as *C. angustatus* [voucher re-determined at NSW by KLW]	C_4	Takeda et al. 1985 (A. $\delta^{13}C$)[a]; KW (Ac: *Wilson 5501*)
C. fulgens C. B. Clarke, as *C. fulgens* var. *fulgens*[a]	C_4	Druyts-Voets 1970 ([A]); SCV ($\delta^{13}C$: −11.41, *Rev. Lawson s. n.*)[a]
C. fuligineus Chapm.	C_4	KW (Ac: *Shafer 2488* P)
C. fulvus R. Br.	C_4	Carolin et al. 1977 (USc); KW (Ac: *Coveny 3916; Wilson 5820, 5826*)
C. fuscus L.	C_3	Li 1993 (A. $\delta^{13}C$) Kalapos et al. 1997 (A. Γ. $\delta^{13}C$); LR ($\delta^{13}C$: −28.1, *Bec in Arènes 3742*)
C. gardneri Nees var. *gardneri*	C_3	KW (A: *van Hermann 107* P)
var. *vegetior* Kük.	C_3	KW (A: *Wilson 1344* P)
C. giganteus Vahl	C_4	Rodrigues and Estelita 2003 (A); LR ($\delta^{13}C$: −12.1, *Glaziou s. n.,* 1880)
C. gilesii Benth., as *C.* aff. *gilesii*[a]	C_4	Carolin et al. 1977 (USc)[a]; Takeda et al. 1985 (Ac. $\delta^{13}C$); KW (Ac: *Mills & Cox 23; Milthorpe & Cunningham 1725*)
C. glaber L., as *Chlorocyperus glaber* (L.) Palla[a]	C_4	Collins and Jones 1985 ($\delta^{13}C$); Li 1993 (A. $\delta^{13}C$); Kalapos et al. 1997 (A. $\delta^{13}C$)[a]
	C_3+	Li 1993 (A. $\delta^{13}C$)
C. glaucophyllus Boeck.	C_3	Druyts-Voets 1970 ([A])
C. glomeratus L., as *Chlorocyperus glomeratus* (L.) Palla[a]	C_4	Collins and Jones 1985 ($\delta^{13}C$); Ueno and Takeda 1992 (A); Li 1993 (A); Kalapos et al. 1997 (A. $\delta^{13}C$)[a]; KW (Ac: *Licent 1671* P)
	C_3+	Li 1993 (A)
C. gracilis R. Br.	C_3	JB (A: *Bruhl 519* CANB. Γ: 40, *Bruhl 519*); LR ($\delta^{13}C$: −29.2, *Schmid 3472,* −31.2, Serre Orsay cult., 1972)
C. grandibulbosus C. B. Clarke (*C. giolii* Chiovenda)	C_4	KW (Ac: *Mwangangi 600* P)
C. grandis C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. grayi Torr.	C_4	Li et al. 1999 (A. $\delta^{13}C3$); KW (Ac: *Dowell 6014*)
C. grayoides Mohl., as *C.* ''*grayioides*'' [sic]	C_4	Li et al. 1999 (A. $\delta^{13}C$)
C. gunnii Hook. f. subsp. *gunnii,* as *Mariscus gunnii* (Hook. f.) C. B. Clarke[a]	C_4	Bruhl et al. 1987 (Ac. B)[a]; JB (Ac: *Bruhl 29* CANB); KW (Ac: *Salasoo 2996*; *Wilson 4422, 4439*)
subsp. *novaehollandiae* (Boeck.) K. L. Wilson	C_4	KW (Ac: *Wilson 3789*)
C. gymnocaulos Steud.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Martensz 3249* CANB)
C. hamulosus M. Bieb. (''*Monandrus hamulosus*'' (M. Bieb.) ined.)	C_4	Li 1993 (A. $\delta^{13}C$); JB (Ac: *Paun* MEL 11543826; *Smith 1138* PRE); KW (Ac: *Ramsay 8* MEL)
C. haspan L.	C_3	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1986 (A. B); Ueno and Takeda 1992 (A. Γ)
C. hemisphaericus Boeck., as *Mariscus hemisphaericus* (Boeck.) C. B. Clarke[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Pawek 6514* P; *Wilson 2014*)
C. hensii C. B. Clarke	C_4	Druyts-Voets 1970 ([A]); KW (Ac: *Chevalier 11242* P)
C. hermaphroditus (Jacq.) Standley, as *C. incompletus* (Jacq.) Link	C_4	Rikli 1895 ([Ac])
C. hesperius K. L. Wilson	C_4	KW (Ac: *Beauglehole 11352, 48650*)
C. hieronymi Boeck.	C_3	KW (A: *Venturi 6841* US)
C. hillebrandii Boeck.	C_4	KW (Ac: *Hillebrand* NSW 608853)
C. holoschoenus R. Br.	C_4	Carolin et al. 1977 (USc); Takeda et al. 1985 (Ac. $\delta^{13}C$); KW (Ac: *Blake 12556, 16301*)
C. holostigma C. B. Clarke ex Schweinf.	C_4	KW (Ac: *Kelly 129* P)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. holstii Kük.	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −10.5, *Sacleux 2310*)
C. houghtonii Torr.	C_4	Li et al. 1999 (A. $\delta^{13}C$); KW (Ac: *Umbach 2470*)
C. humilis Kunth	C_3	KW (A: *von Turkheim* NSW 608978); LR ($\delta^{13}C$: −28.0)
C. hystricinus Fernald	C_4	Li et al. 1999 (A)
C. imbricatus Retz.	C_4	Mani 1963 ([A]); Druyts-Voets 1970 ([A]); Ueno and Takeda 1992 (A); LR ($\delta^{13}C$: −13.1, *Le Testu 2847*)
C. impubes Steud., as *Mariscus impubes* (Steud.) Napper	C_4	Hesla et al. 1982 ($\delta^{13}C$)
var. *fallax* (Cherm.) Kük. (*C. fallax* Cherm.)	C_4	KW (Ac: *de la Bâthie 13098* P)
C. incompressus C. B. Clarke	C_4	KW (Ac: *Jacques-Félix 7216* P); LR ($\delta^{13}C$: −11.0, *Jacques-Félix 7216*)
C. incomtus Kunth	C_3	KW (A: *Venturi 5633*)
C. indecorus Kunth	C_4	KW (Ac: *O'Connor 16*)
C. indecorus var. *decurvatus* (C. B. Clarke) Kük.	C_4	KW (Ac: *Vorster 2504*)
C. intricatus Schrad. ex Schultes	C_3	Denton 1983 (A)
C. involucratus Rottb., as *C. alternifolius* L. subsp. *flabelliformis* (Rottb.) Kük.[a], as *C. flabelliformis* Rottb.[b]	C_3	Druyts-Voets 1970 ([A])[b]; Hofstra et al. 1972 (A. Γ)[b]; Ehleringer et al. 1987 ($\delta^{13}C$)[a]; Li and Jones 1994 (A); KW (A: *Wilson 4384*)
C. iria L.	C_4	Akita et al. 1969 ([A]); Druyts-Voets 1970 ([A]); Hofstra et al. 1972 (A. Γ); Carolin et al. 1977 (USc); Takeda et al. 1980 (Ac. Γ); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac); Ueno et al. 1986 (Ac. B); Ueno et al. 1988*b* (USc); Lin et al. 1993 (Ac); Ueno 1998*a* (US); Ueno 2004 (B [kinetics]); JB (Ac: *Bruhl 207* CANB; *Latz 1527* CANB); KW (Ac: *Coveny 3499*; *Streimann & Kairo NGF 27568*); LR ($\delta^{13}C$: −11.9, *Chevalier 24693*)
var. *flavescens* Benth.	C_4	Druyts-Voets 1970 ([A])
C. isabellinus K. L. Wilson	C_4	KW (Ac: *Wilson 3348*)
C. ixiocarpus F. Muell.	C_4	KW (Ac: *Chippendale 2078*; *Latz 1255, 6698*)
C. javanicus Houtt., as *M. javanicus* (Houtt.) Merr. & Metc.[a]	C_4	Hofstra et al. 1972 (A. Γ); Ueno and Takeda 1992 (A)[a]
C. jeminicus Rottb.	C_4	LR ($\delta^{13}C$: −12.7, *Chevalier 1235*)
C. kaessneri C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. kappleri Hochst. ex Steud.	C_4	KW (Ac: *Holt 260* NY)
C. karlschumanii C. B. Clarke	C_4	KW (Ac: *Aké Assi 6513* P)
C. kerstenii Boeck., as *Mariscus kerstenii* (Boeck.) C. B. Clarke	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
C. kilimandscharicus Kük.	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
C. kipasensis Cherm., as *C. platycaulis* var. *kipasensis* (Cherm.) A. Peter & Kük.[a]	C_3	Druyts-Voets 1970 ([A])[a]; KW (A: *de Witte 3339* NSW ex P)
C. kirkii C. B. Clarke	C_4	KW (Ac: *Biegel 2065* P)
C. koyaliensis Cherm.	C_4	LR ($\delta^{13}C$: −12.6, *Chevalier 20553* P)
C. lacunosus Griseb.	C_4	KW (Ac: *Leon 8199* P)
C. laeteflorens (C. B. Clarke) Kük.	C_4	KW (Ac: *McKee 7956*)
C. laevigatus L., as *Juncellus laevigata* [sic] (L.) C. B. Clarke[a]	C_4	Borchers et al. 1982 (A); Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Frey and Kürschner 1983 (A. $\delta^{13}C$); Takeda et al. 1985 (Ac. $\delta^{13}C$); Li 1993 (A. $\delta^{13}C$); Bruhl et al. 1987 (Ac. B)[a]; JB (Ac: *Bruhl 65* CANB; *Paijmans 2762* CANB; *Symon 13169* CANB); KW (Ac: *Barry 65*); LR ($\delta^{13}C$: −12.1, *Balansa 736* P); SCV ($\delta^{13}C$: −9.31, *Bolus 715*)
C. laevis R. Br.	C_3	KW (A: *Rodd 2262*)
C. lancastriensis Porter	C_4	Li et al. 1999 (A. $\delta^{13}C$)
C. latifolius Poir.	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Aucour et al. 1994 ($\delta^{13}C$); LR ($\delta^{13}C$: −13.0, *Humbert 7778*)
C. latzii K. L. Wilson	C_4	KW (Ac: *Latz 5270*)
C. laxus Lam., as *C. diffusus* Vahl[a]	C_3	Prakash et al. 1976 (A); LR ($\delta^{13}C$: −32.7, Serre Orsay cult., −36.5, *Gilles 180*)
subsp. *buchholzii* (Boeck.) K. Lye, as *C. diffusus* subsp. *buchholzii* (Boeck.) Kük.	C_3	Druyts-Voets 1970 ([A])
subsp. *sylvestris* (Ridl.) K. Lye, as *Cyperus diffusus* subsp. *sylvestris* (Ridl.) Kük.	C_3	Druyts-Voets 1970 ([A])

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. lecontei Torr. ex Steud.	C_3	KW (A: *Curtiss 5714*)
C. leiocaulon Benth.	C_4	Carolin et al. 1977 (USc); KW (Ac: *Payne 16*)
C. leptocladus Kunth	C_3	SCV ($\delta^{13}C$: −27.37, *Maputaland Expedition 14316*)
C. leucocephalus Retz.	C_3	Simpson 1990 (A); KW (A: *Nat. Collector no. D1210,* Thailand P)
C. lhotskyanus Boeck. (*Mariscus rutilans* C. B. Clarke), as *C. rutilans* (C. B. Clarke) Maiden & Betche[a]	C_4	Hattersley et al. 1977 (Ac. B [IL])[a]; Takeda et al. 1985 (Ac. $\delta^{13}C$)[a]; JB (Ac: *Hattersley,* 10 Dec 1979 voucher at RSBS); KW (Ac: *Beauglehole 49697*; *Rupp* NSW 65130; *Wilson 4441, 4442, 5877, 5878*)
C. ligularis L., as *Mariscus ligularis* (L.) Urb.[a]	C_4	Hnatiuk 1980 (A); LR ($\delta^{13}C$: −11.1, *Leprieur s. n.,* 1824)[a]
C. limosus Maxim.	C_3	LR ($\delta^{13}C$: −26.0, *Maximowicz s. n.,* 1859, R. Amur)
C. longibracteatus Cherm., as *Mariscus longibracteatus* Cherm.[a]	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Bosser 7220* P); LR ($\delta^{13}C$: −10.8, *Le Testu 8875*)[a]
var. *niger* (C. B. Clarke) K. Lye, as *Mariscus keniensis* (Kük.) S. S. Hooper	C_4	Hesla et al. 1982 ($\delta^{13}C$); Vorster 1990 (A); SCV ($\delta^{13}C$: −9.99, *Burtt-Davy s. n.*)
var. *rubrotinctus* (Cherm.) Kük., as *Mariscus rubrotinctus* Cherm.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. longus L., as *C. longus* var. *longus*[a]	C_4	Haberlandt 1882 ([Ac]); Lerman and Raynal 1972 (A); Jones et al. 1981 (Ac. B. Γ. USc); Hesla et al. 1982 ($\delta^{13}C$); Li 1993 (A. Γ. $\delta^{13}C$); Li and Jones 1994 (A); LR ($\delta^{13}C$: −9.1, *Lejeune 713*); SCV ($\delta^{13}C$: −8.16, *Schlechter 3925*)[a]
subsp. *tenuiflorus* (Rottb.) Kük., as *C. longus* var. *tenuiflorus* (Rottb.) Boeck.[a]	C_4	Druyts-Voets 1970 ([A]); SCV ($\delta^{13}C$: −10.90, *Bolus 3926*)[a]
var. *pallidus* Boeck.	C_4	Druyts-Voets 1970 ([Ac]); Borchers et al. 1982 (A)
C. lucidus R. Br. (*Mariscus lucidus* (R. Br.) C. B. Clarke)	C_4	JB (Ac: *Bruhl 75* CANB); KW (Ac: *Constable 6217*; *Corrick 7936*)
C. lupulinus (Spreng.) Marcks	C_4	Li et al. 1999 (A. $\delta^{13}C$); KW (Ac: *Tolstead 41551* MO)
subsp. *macilentus* (Fernald) Marcks	C_4	KW (Ac: *Kneucker 91*)
C. luteus Boeck., as *Mariscus luteus* (Boeck.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. luzulae (L.) Retz.	C_3	Druyts-Voets 1970 ([A]); Denton 1983 (A); KW (Ac: *Wilson 1586*); LR ($\delta^{13}C$: −30.0, *Rodriguez 4853*)
C. macrocarpus (Kunth) Boeck., as *Mariscus macrocarpus* C. B. Clarke[a]	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)[a]; KW (Ac: *Troupin 7178* P; *Vorster 2637*)
var. *humbertii* (Cherm.) Kük.	C_4	KW (Ac: *Bosser 18951* P)
var. *pseudoflavus* (Kük.) K. Lye, as *Mariscus macer* Kunth	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. macrocephalus Liebm. (*Torulinium macrocephalum* (Liebm.) C. B. Clarke, *C. eggersii* Boeck.)	C_4	KW (Ac: *Croat 23370* P; *Leon 9120* P)
C. maculatus Boeck.	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)
C. malaccensis Lam.	C_4	Mani 1963 ([A]; Hofstra et al. 1972 (A. Γ); KW (Ac: *Floyd* NGF 8041)
C. manimae Kunth var. *asperrimus* (Liebm.) Kük.	C_4	KW (Ac: *Pringle 13237*)
var. *manimae* (*C. phaeocephalus* Griseb.)	C_4	KW (Ac: *Benoist 2646* P)
C. mannii C. B. Clarke	C_3	LR ($\delta^{13}C$: −33.0, *Letouzey 7957*)
C. mapanioides C. B. Clarke	C_3	Druyts-Voets 1970 ([A]); LR ($\delta^{13}C$: −31.9, *Le Testu 2763*)
var. *major* Boeck.	C_3	Druyts-Voets 1970 ([A])
C. maranguensis K. Schum.	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
C. margaritaceus Vahl[a], as *C. margaritaceus* var. *prorepens* Kük.[b], as *C. margaritaceus* var. *pseudoniveus* (Boeck.) C. B. Clarke[c]	C_4	Druyts-Voets 1970 ([A])[a,b,c]; KW (Ac: *Schlechter 11591*); LR ($\delta^{13}C$: −10.6, *Sacleux 873*)[a]
C. marginatus Thunb.	C_3	SCV ($\delta^{13}C$: −26.27, *Ward 12292*)
C. medusaeus Chiovenda	C_4	Kukkonen and Lye 1996 (A)
C. meeboldii Kük.	C_4	LR ($\delta^{13}C$: −12.5, *Audru 2215*)
C. megalanthus (Kük.) G. C. Tucker, as *C. pseudovegetus* var. *megalanthus* Kük.	C_3	Denton 1983 (A)
C. meyenianus Kunth	C_4	KW (Ac: *Montes 1507*; *Orth 708; Riedel 904* US)
C. michelianus (L.) Delile, as *Dichostylis micheliana* (L.) Nees[a], as *C. michelianus* subsp. *michelianus*[b]	C_4	Druyts-Voets 1970 ([A]); Li 1993 (A. $\delta^{13}C$); Kalapos et al. 1997 (A. $\delta^{13}C$)[a]; KW (Ac: *Kneucker 33a*); LR ($\delta^{13}C$: −12.3, *Duclos s. n.,* 1933)[b]
C. michoacanensis Britton	C_3	Simpson 1990 (A); KW (A: *Pringle 4269* P; *Purpus 267 p.p.* US)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. microcephalus R. Br. [identity unclear: voucher number is for a dicot]	C_4	Takeda et al. 1985 (A)
subsp. *chersophilus* K. L. Wilson	C_4	KW (Ac: *Fitzgerald* NSW 153243; *Wilson 4891*)
subsp. *microcephalus*	C_4	KW (Ac: *Black 14*; *Latz 7377; Wilson 4874, 5202, 5556*)
subsp. *saxicola* K. L. Wilson	C_4	KW (Ac: *Jacobs 1535; Latz 3102; Wilson 5191, 5223*)
C. microglumis D. A. Simpson	C_3	Simpson 1990 (A)
C. microiria Steud.	C_4	Imai and Murata 1979 (Γ); Ueno et al. 1986 (Ac. B); Ueno and Takeda 1992 (A. Γ); Li et al. 1999 (A); KW (Ac: *Ohwi NSM 308*; *Hashimoto TNS 1269*)
C. miliifolius Poepp. & Kunth ex Kunth	C_3	KW (A: *Croat 19806* P)
C. mitis Steud.	C_4	Mani 1963 ([A])
C. mollipes (C. B. Clarke) K. Schum. (*Ascopholis gamblei* C. E. C. Fisch.), as *Mariscus mollipes* C. B. Clarke[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; JB (Ac: *Nijalingappa* NSW 709497); KW (Ac: *Lewalle 2052* P)
C. mutisii (Kunth) Griseb.	C_4	KW (Ac: *Barkley 14092* NY; *Pringle 4476*)
C. nanus Willd.	C_4	KW (Ac: *Harris 12359* P)
C. natalensis Hochst.	C_4	SCV ($\delta^{13}C$: −9.95, *Hood 860*)
C. nayaritensis Tucker	C_3	Simpson 1990 (A)
C. nduru Cherm., as *C. margaritaceus* var. *nduru* (Cherm.) Kük.	C_4	Druyts-Voets 1970 ([A])
C. nipponicus Franch. & Sav.	C_4	Ueno et al. 1986 (Ac. B); Ueno et al. 1988*b* (USc); Ueno and Takeda 1992 (A. Γ)
C. niveus Retz.	C_4	Sabnis 1921 ([A]); Hnatiuk 1980 (A)
var. *flavissimus* (Schrad.) K. Lye, as *C. obtusiflorus* var. *flavissimus* (Schrad.) Boeck.	C_4	Druyts-Voets 1970 ([A])
var. *leucocephalus* (Kunth) Fosberg, as *C. obtusiflorus* Vahl[a], as *C. obtusiflorus* var. *tenerior* C. B. Clarke[b], as *C. obtusiflorus* var. *macrostachys* ined.[c]	C_4	Druyts-Voets 1970 ([A])[a,b,c]; Hesla et al. 1982 ($\delta^{13}C$); KW (Ac: *Decary 12835*); LR ($\delta^{13}C$: −12.4, *Bachmann 78*)
var. *tisserantii* (Cherm.) K. Lye	C_4	KW (Ac: *Boudet 2420* P)
C. nutans Vahl	C_4	Ueno et al. 1986 (Ac. B); Ueno and Takeda 1992 (A)
subsp. *eleusinoides* (Kunth) Haines	C_4	KW (Ac: *Blake 7718*)
C. oblongo-incrassatus Kük., as *Mariscus taylori* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. obsoletinervosus A. Peter & Kük., as *Mariscus obsoletinervosus* (A. Peter & Kük.) Greenway[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Polhill & Paulo 964* P)
C. ochraceus Vahl	C_3	Denton 1983 (A)
C. odoratus L., as *Torulinium odoratum* (L.) S. S. Hooper[a], as *T. ferax* (Rich.) Ham.[b]	C_4	Bender 1971 ($\delta^{13}C$); Ueno et al. 1988*b* (USc)[b]; Ueno and Takeda 1992 (A)[a]; Ueno et al. 1986 (Ac. B)[b]; Li et al. 1999 (A. $\delta^{13}C$); JB (Ac: *Darbyshire 708*); KW (Ac: *Heller 2466* P); LR ($\delta^{13}C$: −10.5, *Mocquerys s. n.,* Venezuela)[a]
C. ohwii Kük.	C_4	Ueno et al. 1986 (Ac. B); Ueno and Takeda 1992 (A. Γ)
C. orgadophilus K. L. Wilson	C_4	KW (Ac: *Latz 7144*)
C. orthostachys Franch. & Sav., as *C. truncatus* C. A. Mey. ex Turcz.[a]	C_4	Lerman and Raynal 1972 (A)[a]; Ueno et al. 1986 (Ac. B); Ueno and Takeda 1992 (A. Γ); KW (Ac: *Fox* NSW 618282); LR ($\delta^{13}C$: −15.0, *Karo 90*)[a]
C. oxycarpus S. T. Blake	C_4	KW (Ac: *Blake 9209*; *Latz 7298*)
C. oxylepis Nees ex Steud.	C_4	KW (Ac: *Pedersen 9611*)
C. palianparaiensis Govindarajalu	C_3	Govindarajalu 1990*b* ([A])
C. panamensis (C. B. Clarke) Britton	C_4	KW (Ac: *Standley 29144* US)
C. pangorei Rottb.	C_4	KW (Ac: *Wight* NSW 608850)
C. pannonicus Jacq., as *Acorellus pannonicus* (Jacq.) Palla[a]	C_4	Li 1993 (A. $\delta^{13}C$); Kalapos et al. 1997 (A. $\delta^{13}C$)[a]; JB (Ac: *s. coll.* MEL 1543854)
C. papyrus L.[a], as *C. papyrus* subsp. *ugandensis* Chiov.[b]	C_4	Haberlandt 1884 ([Ac])[a]; Rikli 1895 ([A])[a]; Druyts-Voets 1970 ([A])[a,b]; Krenzer et al. 1975 (Γ)[a]; Jones and Milburn 1978 (A. Γ)[a]; Hesla et al. 1982 (A. $\delta^{13}C$)[a]; Li 1993 (A. Γ. $\delta^{13}C$)[a]; Aucour et al. 1994 ($\delta^{13}C$)[a]; Li and Jones 1994 (A)[a]; JB (Ac: *Lau 2112* NE; *Lepschi 1505* NE)[a]; LR ($\delta^{13}C$: −11.0, −11.9, *Dang 178,* −12.0, −12.8, *Killick 3419*)[a]
as *Papyrus* [sic][b], as *Papyrus cicuta*[a]	C_3+	Moss et al. 1969 (Γ)[a]; Tregunna et al. 1970 (A. B. Γ. $\delta^{13}C$)[b]; Hofstra et al. 1972 (A. Γ)
C. pectinatus Vahl, as *C. nudicaulis* Poir.[a]	C_3	Druyts-Voets 1970 ([A])[a]; Ellery et al. 1992 ($\delta^{13}C$); LR ($\delta^{13}C$: −27.8, *Leprieur s. n.,* Senegal)[a]

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. pedunculatus (R. Br.) Kern, as *Remirea*[a], as *Remirea maritima* Aubl.[b], as *Mariscus pedunculatus* (R. Br.) Koyama[c]	C_4	Hofstra et al. 1972 (A. Γ); Lerman and Raynal 1972 (A)[a]; Ueno and Takeda 1992 (A)[c]; JB (Ac: *Blake 8261* BRI*; Bruhl 496* CANB*; Lazarides 563* CANB*; Pullen 1181* CANB); LR ($\delta^{13}C$: −13.5, *Chevalier 23474*)[b]
C. perangustus S. T. Blake	C_4	KW (Ac: *Blake 11304*)
C. perennis (M. E. Jones) O'Neill	C_3	KW (A: *Gentry 14432* US; *Purpus 267* p.p. US)
C. phillipsiae (C. B. Clarke) Kük., as *Mariscus phillipsiae* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. phleoides (Nees ex Kunth) Hillebr. var. *hawaiiensis* (H. Mann) Kük.	C_4	KW (Ac: *Alexander 5234*)
C. picardae Boeck.	C_4	KW (Ac: *Howard 8842* P)
C. pilosus Vahl	C_4	Ehleringer et al. 1987 ($\delta^{13}C$); Ueno et al. 1986 (Ac. B); Ueno et al. 1988*b* (USc); Ueno and Takeda 1992 (A. Γ); KW (Ac: *McKee 1547*; *Murata T-15902* P)
C. plateilema (Steud.) Kük., as *Mariscus plateilema* Steud.	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
C. platycaulis Baker[a], as *C. platycaulis* var. *lucenti-nigricans* (K. Schum.) Kük.[b], as *C. platycaulis* var. *serpens* (Cherm.) Kük.[c]	C_3	Druyts-Voets 1970 ([A])[a,b,c]; Hesla et al. 1982 ($\delta^{13}C$)[a]
C. platystylis R. Br.	C_3	Mani 1960 ([A]); Druyts-Voets 1970 ([A]); Takeda et al. 1985 (A); KW (A: *Specht 1159*); LR ($\delta^{13}C$: −27.7, *Poilane 21428*)
C. plukenetii Fernald	C_4	Li et al. 1999 (A)
C. podocarpus Boeck.	C_4	KW (Ac: *Adam 14957* P)
C. portae-tartari K. L. Wilson, as *C. ixiocarpus* F. Muell.[a]	C_4	Carolin et al. 1977 (USc)[a]; KW (Ac: *Dunlop 4455*; *Jacobs 1527*)
C. procerus Rottb.	C_4	Mani 1960 ([A]); KW (Ac: *Auld* NSW 84668; *Salasoo* NSW 91196)
var. *vanderystii*	C_4	Druyts-Voets 1970 ([A])
C. prolifer Lam.	C_3	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$); KW (A: *Wilson 4382*)
C. prolixus Kunth	C_4	KW (Ac: *Pedersen 9601* P); LR ($\delta^{13}C$: −12.7, *Bourgeau s. n.,* 1866)
C. pseudoleptocladus Kük.[a], as *C. pseudoleptocladus* var. *polycarpus* Kük.[b]	C_3	Druyts-Voets 1970 ([A])[a,b]; Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (A: *Pawek 6484* P)[a]
C. pseudovegetus Steud., as *C. pseudovegetus* var. *pseudovegetus*[s]	C_3	Denton 1983 (A)[a]; Li et al. 1999 (A)
C. pseudovestitus (C. B. Clarke) Kük. (*Mariscus goniobolbus* Cherm.), as *Mariscus pseudovestitus* C. B. Clarke[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; Vorster 1990 (A)[a]; KW (Ac: *Bosser 13474* P; *Vorster 2497*)
C. pulchellus R. Br., as *C. leucocephalus* Retz. var. *pulchellus* (R. Br.) ined.[a]	C_3	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A. $\delta^{13}C$); Simpson 1990 (A); KW (A: *Bosser 4654* P; *McKee 9189* P)
C. pulchellus	C_4+	LR ($\delta^{13}C$: −13.2, *Gillet 1698*)
C. pulcher Thunb.	C_3	Sonnenberg and Botha 1992 (A. PIB)
C. pustulatus Vahl	C_4	Druyts-Voets 1970 ([A])
C. pycnostachyus (Kunth) Kunth	C_4	KW (Ac: *Pringle 6313* P)
C. pygmaeus Rottb., as *C. michelianus* subsp. *pygmaeus* (Rottb.) Aschers. & Graebn.[a]	C_4	Carolin et al. 1977 (USc); Hesla et al. 1982 ($\delta^{13}C$); Ueno and Takeda 1992 (A. Γ)[a]; JB (Ac: *H. Eichler 18182* CANB); KW (Ac: *Beauglehole 46512*; *McGillivray 2943*; *Solling 486*; *Wilson 1465*); LR ($\delta^{13}C$: −13.3, *Kotschy 329*)[a]
C. radians Nees & Meyen	C_4	KW (Ac: *Petelot 5480, 5602* P)
C. reduncus Boeck.	C_3	Druyts-Voets 1970 ([A])
C. reflexus Vahl, as *C. reflexus* var. *reflexus*[a], as *C. reflexus* var. *fraternus* (Kunth) Kuntze[b]	C_3	Denton 1983 (A)[a,b]; KW (A: *Wilson 1441*)
C. retroflexus var. *pumilus* (Britton) R. Carter & S. D. Jones (*C. subuniflorus* Britton)	C_4	KW (Ac: *Pringle 807* P)
C. refractus Engelm. ex Boeck.	C_4	Li et al. 1999 (A)
C. remotus (C. B. Clarke) Kük., as *Mariscus remotus* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. renschii Boeck.	C_3	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)
C. retrofractus (L.) Torr.	C_4	Li et al. 1999 (A); KW (Ac: *Radford & Bozeman 11380* P)
C. retrorsus Chapm.	C_4	Li et al. 1999 (A. $\delta^{13}C$)
C. rhynchosporoides Kük.	C_4	KW (Ac: *Richards 16898* P)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. rigens J. Presl & C. Presl	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$); KW (Ac: *Wilson 1445*)
C. rigidellus (Benth.) J. Black, as *C. subpinnatus* Kük.[a]	C_4	Takeda et al. 1985 (Ac)[a]; KW (Ac: *Beauglehole 23111*; *Wilson 742, 1466*)
C. rigidifolius Steud.	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 (A. $\delta^{13}C$); LR ($\delta^{13}C$: −12.9, *Pappi 2155*)
C. rohlfsii Boeck., as *Mariscus rohlfsii* (Boeck.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. rotundus L., as *C. rotundus* subsp. *rotundus*[a]	C_4	Sabnis 1921 ([A]); Mani 1963 ([A]); Akita et al. 1969 ([A]); Chen et al. 1970 (Γ); Druyts-Voets 1970 ([Ac]); Black and Mollenhauer 1971 (Ac); Black et al. 1973 (B); Hofstra et al. 1972 (A. Γ)[a]; Chen et al. 1974 (A. B); Troughton et al. 1974 ($\delta^{13}C$); Prakash et al. 1976 (A); Meinzer 1978 (A); Takeda et al. 1980 (Ac. Γ); Borchers et al. 1982 (A); Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1986 (Ac. B); Bruhl et al. 1987 (Ac. B); Li 1993 (A. Γ. $\delta^{13}C$); Lin et al. 1993 (Ac); Li and Jones 1994 (A); Li et al. 1999 (A. $\delta^{13}C$); JB (Ac: *I. B. Wilson 197* CANB); KW (Ac: *Wilson 902*)
subsp. *merkeri* (C. B. Clarke) Kük., as *C. merkeri* C. B. Clarke[a]	C_4	Druyts-Voets 1970 ([A]); Hesla et al. 1982 ($\delta^{13}C$)[a]
C. rubicundus Vahl, as *C. teneriffae* Poir.[a]	C_4	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Subko 104* P); LR ($\delta^{13}C$: −11.8, *Schimper 1323*)[a]
C. rubiginosus Hook. f.	C_4	KW (Ac: *Hooker s. n.* P; *Schimpff 14* US; *Wheeler et al. 5* US; *Wiggins & Porter 568* NY)
C. rupestris Kunth	C_4	KW (Ac: *Biegel 2065* P; *Pienaar 271* PRE; *Wood 8546*)
C. sandwicensis Kük.	C_4	KW (Ac: *Degener 8460* NY)
C. sanguineo-ater Boeck.	C_4	KW (Ac: *Pringle 3844*)
C. scaber R. Br., as *Mariscus scaber* (R. Br.) Boeck.[a]	C_4	Bruhl et al. 1987 (Ac. B)[a]; JB (Ac: *Bruhl 234, 497* CANB); KW (Ac: *McKee 9040* P)
C. scariosus R. Br.	C_4	Takeda et al. 1985 (Ac. $\delta^{13}C$)
C. schimperianus Steud., as *C. schimperianus* var. *minor* Boeck.[a]	C_4	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)
C. schomburgkianus Nees	C_3	Simpson 1990 (A)
C. schweinitzii Torr.	C_4	Li et al. 1999 (A. $\delta^{13}C$)
C. secubans K. L. Wilson	C_4	KW (Ac: *Coveny 8812*)
C. seemanianus Boeck.	C_4	KW (Ac: *Campbell* NSW 22740)
C. semitrifidus Schrad.	C_4	KW (Ac: *Schlechter 2513*)
C. serotinus Rottb., as *Juncellus serotinus* (Rottb.) C. B. Clarke[a]	C_4	Akita et al. 1969 ([A]); Takeda et al. 1980 (Ac. Γ); Collins and Jones 1985 ($\delta^{13}C$); Ueno et al. 1986 (Ac. B); Li 1993 (A. Γ. $\delta^{13}C$); Kalapos et al. 1997 ($\delta^{13}C$)[a]; JB (Ac: *s. coll.* MEL 1543840); KW (Ac: *Naito* NSW 608949); LR ($\delta^{13}C$: −13.1, *Bourgeau 32*)
C. seslerioides Kunth	C_3	LR ($\delta^{13}C$: −30.3, *Pringle 806*)
C. setigerus Torr. & Hook.	C_4	Li et al. 1999 (A)
C. sexflorus R. Br.	C_4	KW (Ac: *Blake 17534*; *de Lestang 338*; *Wilson 5341*)
C. socialis C. B. Clarke	C_4	KW (Ac: *Halle 3059* P)
C. solidus Kunth, as *Mariscus solidus* (Kunth) Vorster var. *involutus* (C. B. Clarke) Vorster ined.[a]	C_4	Vorster 1990 (A)[a]; KW (Ac: *Guillaumin s. n.,* cult. P; *Medley Wood 12023*)
C. sordidus J. Presl & C. Presl (*C. howellii* O'Neill & Ben. Ayers)	C_4	KW (Ac: *Mason & Hanna 14594* US)
C. soyauxii Boeck., as *Mariscus soyauxii* (Boeck.) C. B. Clarke[a]	C_4	KW (Ac: *Adam 1918*); LR ($\delta^{13}C$: −12.8, *Adam 1918*)[a]
C. sp. (*Isolepis humillima* (Benth.) K. L. Wilson)	C_4	KW (Ac: *Clarke 24*)
C. sp.	C_4	Smith and Epstein 1971 ($\delta^{13}C$)
C. sp. as *Cyperus japonicus* Makino	C_4+	Li and Jones 1994 (A)
C. sp. as *Mariscus psilostachys* (C. B. Clarke) Kük. (non *C. psilostachys* Steud.)[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Gillett 12841* P)
C. sp. nov. aff. *pedunculosus* F. Muell.	C_3	KW (A: *Sharpe 1455*)
C. sp. aff. *sexflorus*	C_4	Carolin et al. 1977 (USc)
C. speciosus Vahl	C_4	KW (Ac: *Kotov s. n.,* Transcaucasia P)
C. spectabilis Spreng.	C_4	KW (Ac: *Arsène 5914* P; *Pringle 13233*)
C. sphacelatus Rottb.	C_4	Druyts-Voets 1970 ([A])

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. sphaerospermus Schrad.	C_3	KW (A: *O'Connor 71* PRE)
C. sporobolus R. Br.	C_4	KW (Ac: *Dunlop 4096*)
C. squarrosus L. (*Monandrus squarrosus* (L.) ined.)[a], as *C. aristatus* Rottb.[b], as *C. aristatus* var. *inflexus*[c], as *Mariscus squarrosus* (L.) C. B. Clarke[d]	C_4	Mani 1960 ([A])[b]; Druyts-Voets 1970 ([A])[a,b]; Mulroy and Rundel 1977 (A)[c]; Baskin and Baskin 1981 (A)[c]; Hesla et al. 1982 ($\delta^{13}C$)[d]; Takeda et al. 1985 (Ac)[a]; Li 1993 (A. $\delta^{13}C$)[a]; Li et al. 1999 (A. $\delta^{13}C$)[a]; JB (Ac: *Davidson 347* BRI; *Steele,* 6 Aug 1909 BRI); KW (Ac: *Wilson 1501*); LR ($\delta^{13}C$: −13.1, *Gillet 3272*)[d]
C. stenophyllus Valck. Sur.	C_4	KW (Ac: *Schlechter 16700* P)
C. stolonifer Retz.	C_4	Ueno and Takeda 1992 (A)
C. stradbrokensis Domin	C_3	KW (A: *Johnson 7593*)
C. strigosus L., as *Mariscus strigosus* (L.) C. B. Clarke[a]	C_4	Lerman and Raynal 1972 (A)[a]; Li 1993 (A. $\delta^{13}C$); Li et al. 1999 (A. $\delta^{13}C$); LR ($\delta^{13}C$: −12.0, *Louis Marie s. n.,* 1927)[a]
C. subbadius Kük.	C_4	KW (Ac: *Leroy s. n.,* Madagascar P; *Decary 644G*)
C. sublimis (C. B. Clarke) Dandy, as *M. sublimis* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −12.6, *Waterlot 1265*)
C. submicrolepis Kük.	C_3	Druyts-Voets 1970 ([A])
C. subparadoxus Kük., as *Mariscus paradoxus* (Cherm.) Cherm.[a]	C_4	KW (Ac: *Haines 4138* P); LR ($\delta^{13}C$: −13.5, *Haines 4138*)[a]
C. subulatus R. Br.	C_4	KW (Ac: *Whittet* NSW 65182; *Wilson 1493*)
C. subumbellatus Kük., as *Mariscus alternifolius* Vahl	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]
C. subxerophilus Kük.	C_3	Druyts-Voets 1970 ([A])
C. surinamensis Rottb.	C_3	Denton 1983 (A); LR ($\delta^{13}C$: −28.3, *Leblond 40*)
C. tabularis Schrad.	C_4	KW (Ac: *Schlechter 10675*)
C. tanganyicanus (Kük.) K. Lye, as *C. bellus* var. *tanganyicanus* Kük.	C_4	Druyts-Voets 1970 ([A])
C. tenax Boeck.[a], as *C. tenax* var. *actinostachys* (Welw. ex Ridl.) Kük.[b]	C_4	Druyts-Voets 1970 ([A])[a,b]; Hesla et al. 1982 ($\delta^{13}C$)[a]; KW (Ac: *Stolz 1046* P)[a]
C. tenellus L. f.	C_3	Druyts-Voets 1970 ([A]); Takeda et al. 1985 (A. $\delta^{13}C$)
C. tenerrimus J. Presl & C. Presl	C_3	Simpson 1990 (A)
C. tenuiculmis Boeck.[a], as *C. zollingeri* var. *parvus* C. B. Clarke[b], as *C. tenuiculmis* f. *compactus* ined.[c], as *C. tenuiculmis* var. *densior* ined.[d]	C_4	Druyts-Voets 1970 ([A])[a,b,c,d]; KW (Ac: *Audru 3760* P; *Wilson 3819*)[a]; LR ($\delta^{13}C$: −11.9, *Hooker s. n.,* India 1853)[a]
var. *tenuiculmis,* as *C. tenuiculmis* var. *longiramulosus* Kük.	C_4	Druyts-Voets 1970 ([A])
var. *schweinfurthianus* (Boeck.) S. S. Hooper, as *C. schweinfurthianus* Boeck.	C_4	Druyts-Voets 1970 ([A])
C. tenuis var. *luridus* (C. B. Clarke) Kük., as *Mariscus luridus* C. B. Clarke (non *C. luridus* Govindarajalu)	C_4	LR ($\delta^{13}C$: −12.3, *Chevalier 23601*)
C. tenuispica Steud.	C_3	Mani 1960 ([A]); Druyts-Voets 1970 ([A]); Nautiyal and Das 1982 ([A]); Ueno and Takeda 1992 (A); LR ($\delta^{13}C$: −28.1, *Jacques-Félix 7241*)
C. tenuispiculatus Boeck.	C_4	KW (Ac: *de la Bâthie,* Madagascar Apr 1928 P)
C. tetracarpus Boeck.	C_4	KW (Ac: *Blake 15581*)
C. textilis Thunb.	C_3	Druyts-Voets 1970 ([A])
	C_4+	Li 1993 (A)
C. thomsonii Boeck.	C_4	KW (Ac: *Balansa 2836* P)
C. thunbergii Vahl	C_4	KW (Ac: *Humbert 10215* P)
C. thyrsiflorus Junghuhn	C_4	KW (Ac: *Fisher* NSW 608977)
C. tomaiophyllus K. Schum., as *Mariscus tomaiophyllus* (K. Schum.) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −11.9, *Humbert 8639*)
C. tonkinensis C. B. Clarke	C_4	KW (Ac: *Tixier 11* P)
var. *baikei* (C. B. Clarke ex Kük.) S. S. Hooper, as *C. baikiei* C. B. Clarke ex Kük.	C_4	Druyts-Voets 1970 ([Ac])
C. trachysanthos Hook. & Arn.	C_4	KW (Ac: *Degener 11059* BRI; *Forbes 2359.0* P)
C. trichodes Griseb.	C_4	KW (Ac: *Harris 12882* NY; *Proctor 34283* NY)
C. tuberosus Rottb., as *C. rotundus* subsp. *tuberosus* (Rottb.) Kük.[a]	C_4	Druyts-Voets 1970 ([Ac])[a]; Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
C. turrillii Kük., as *Mariscus laxiflorus* Turrill[a]	C_4	KW (Ac: *Koechlin 5313* P); SCV ($\delta^{13}C$: −10.55, *Rogers 7006*)[a]
C. uncinulatus Schrad. ex Nees	C_3	LR ($\delta^{13}C$: −27.4, *Weddell 3056*)
C. undulatus Kük.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. usitatus Burch.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
var. *stuhlmannii* (C. B. Clarke) K. Lye, as *Cyperus stuhlmannii* C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$)
C. ustulatus A. Rich.	C_4	Troughton et al. 1974 ($\delta^{13}C$)
C. vaginatus R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Payne 20*; *Wilson 1354*)
C. varicus (C. B. Clarke) Kük.	C_4	KW (Ac: *Decary 10649* P)
C. vestitus Krauss, as *Mariscus vestitus* (Krauss) C. B. Clarke	C_4	Hesla et al. 1982 ($\delta^{13}C$); SCV ($\delta^{13}C$: −9.99, *Acocks 21042*)
C. victoriensis C. B. Clarke	C_4	Carolin et al. 1977 (USc); Takeda et al. 1985 (Ac); KW (Ac: *Payne 19*)
C. virens Michx., as *C. virens* var. *virens*[a]	C_3	Denton 1983 (A)[a]; LR ($\delta^{13}C$: −29.4, *Curtis 5238*)
var. *minarum* (Boeck.) Denton	C_3	Denton 1983 (A)
var. *montanus* (Boeck.) Denton	C_3	Denton 1983 (A)
C. viscidulus K. L. Wilson	C_4	KW (Ac: *Beauglehole 47687*; *Dunlop 5231*)
C. vorsteri K. L. Wilson, as *Mariscus grantii* C. B. Clarke	C_4	Vorster 1990 (A)
C. zollingeri Steud., as *C. rubroviridis* Cherm.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
Cypringlea analecta (Beetle) M. T. Strong	C_3	BW (A: *Lyonet 1318* US; *Pringle 3175* US; *Purpus 2889* US)
Desmoschoenus spiralis (A. Rich.) Hook. f.	C_3	JB (A: *Clifford,* 17 Nov 1973 BRI. $\delta^{13}C$: −24.6, *Clifford,* 17 Nov 1973); LR ($\delta^{13}C$: −24.7, *Hombron s. n.*, ca. 1840)
Didymiandrum stellatum (Boeck.) Gilly	C_3	JB (A: *Prance 9789* K)
Diplacrum africanum C. B. Clarke	C_3	JB (A: *Schweinfurth 2573* BRI); LR ($\delta^{13}C$: −29.1, *Jacques-Félix 7328*)
D. caricinum R. Br., as *Scleria caricina* (R. Br.) Benth.[a]	C_3	Govindarajalu 1975*a* ([A])[a]; JB (A: *Brass 19343* CANB; *Schweinfurth 2573* BRI)
D. pygmaeum (R. Br.) Nees ex Boeck., as *Scleria pygmaea* R. Br.[a]	C_3	Takeda et al. 1985 (A)[a]; JB (A: *Bruhl 304* CANB)
Diplasia karataefolia Rich. ex Pers.	C_3	Koyama 1967 ([A]); Metcalfe 1971 ([A]); JB (A: *Croat 17547*)
Dulichium arundinaceum (L.) Britton, as *Dulichium*[a]	C_3	Lerman and Raynal 1972 (A)[a]; JB (A: *Smith,* 25 Aug 1946 BRI); LR ($\delta^{13}C$: −30.7, *Barkley Bogdan 380028*)
Egleria fluctuans L. T. Eiten	C_3	JB (A: *Ducke*, 20 July 1912 BRI. $\delta^{13}C$: −25.6, −27.6, *Ducke,* 20 July 1912 BRI)
Eleocharis acicularis (L.) Roem. & Schult.	C_3	Akita et al. 1969 ([A]); Sternberg et al. 1984 ($\delta^{13}C$); Keeley et al. 1986 ($\delta^{13}C$); Ueno et al. 1989 (A. $\delta^{13}C$); Ueno and Takeda 1992 (A); Lin et al. 1993 (A); JB (A: MEL 1543839; MEL 1543860)
E. acuta R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); Bruhl et al. 1987 (A. B); Ueno et al. 1989 (A); Bruhl and Perry 1995 (US); JB (A: *Phillips 2841761* CANB; *Bruhl 33, 74, 125* CANB. Γ: 44, *Bruhl 74*; 47, *Bruhl 33*; 47, *Bruhl 125*. $\delta^{13}C$: −28.2, *Bruhl 125; −28.4, Bruhl 125*)
E. acutangula (Roxb.) Roem. & Schult., as *E. fistulosa* (Poir.) Link[a]	C_3	Govindarajalu 1975*a* ([A]); Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1989 (A)[a]; Ueno and Takeda 1992 (A)[a]; KW (A: *Blake 9371*); LR ($\delta^{13}C$: −27.3, *Smith 6710*)
E. acutisquamata Buckley	C_3	Ueno et al. 1989 (A)
E. albibractea Nees & Meyen	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. albida Torr.	C_3	Ueno et al. 1989 (A)
E. alveolata Svenson	C_4	Ueno et al. 1989 (A. $\delta^{13}C$)
E. amazonica C. B. Clarke	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. ambigens Fernald	C_3	Ueno et al. 1989 (A)
E. atricha R. Br.	C_3	Takeda et al. 1985 (A); JB (A: *Beauglehole 6525* CANB)
E. atropurpurea (Retz.) Presl	C_3	Govindarajalu 1975*a* ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A); Ueno et al. 1989 (A); Ueno and Takeda 1992 (A); JB (A: *Latz 2226* CANB); SCV ($\delta^{13}C$: −26.90, *Schlieben 6398*)
E. attenuata (Franch. & Sav.) Palla	C_3	Ueno and Takeda 1992 (A); JB (A: *Flennley ANU 2536* CANB)
E. bahamensis Boeck.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. baldwinii (Torr.) Chapm.	C_4	Uchino et al. 1995 (A (T): [e]. B(T). B ^{14}C pulse-^{12}C chase (T)); Ueno and Samejima 1989 (B); Ueno et al. 1989 (A. $\delta^{13}C$); Ueno and Samejima 1990 ($\delta^{13}C$)
	C_4 & C_4-like C_3	Uchino et al. 1995 (A [S]: [e]. B [S]. B ^{14}C pulse-^{12}C chase [S]); Ueno 2004 (A. B. B [antiserum]. B [IL]. B [kinetics]. US: NAD)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
	C_3–C_4	Ueno and Samejima 1990 ($\delta^{13}C$)
	C_3	Ueno and Samejima 1990 ($\delta^{13}C$)
E. bella (Piper) Svenson	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. bolanderi A. Gray	C_3	Ueno et al. 1989 (A)
E. bonariensis Nees	C_3	Ueno et al. 1989 (A)
E. brassii S. T. Blake	C_3	Takeda et al. 1985 (A); KW (A: *Wilson 5318, 5375*)
E. caespitosissima J. G. Baker	C_4	Bruhl et al. 1987 (Ae. B); Bruhl and Perry 1995 (USe); JB (Ae, *Dunlop 4212* CANB; *Bruhl 356, 357, 365, 399, 409* CANB. Γ: 1, *Bruhl 356*; 1, *Bruhl 375*; 1, *Bruhl 375*. $\delta^{13}C$: −13.0, −13.6, *Bruhl 356*)
E. cancellata S. Wats.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$); JB (A: *Pringle 3269* MEL)
E. capillacea Kunth	C_3	Ueno et al. 1989 (A)
E. cellulosa Torr.	C_3	Ueno et al. 1989 (A)
E. compressa Sull.	C_3	Ueno et al. 1989 (A)
E. congesta D. Don	C_3	Govindarajalu 1975*a* ([A]); Ueno et al. 1989 (A. $\delta^{13}C$); Ueno 2004 (B [kinetics]); JB (A: *Uva,* Sep 1890 PDA)
subsp. *japonica* (Miq.) Koyama	C_3	Ueno and Takeda 1992 (A. Γ); JB (A: *?Koniegalle 1867* PDA)
E. crinalis (Griseb.) C. B. Clarke	C_3	Ueno et al. 1989 (A)
E. cylindrica Buckley	C_3–C_4	Guaglianone and Ueno 1990 (A)
as *E. spegazzinii* Barros	C_3–C_4?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. cylindrostachys Boeck.	C_3	Ueno et al. 1989 (A)
E. debilis Kunth	C_3	Ueno et al. 1989 (A)
E. decumbens C. B. Clarke	C_3	Ueno et al. 1989 (A)
E. densa Benth.	C_3	Ueno et al. 1989 (A)
E. dietrichiana Boeck.	C_3	Ueno et al. 1989 (A)
E. dombeyana Kunth	C_3	Ueno et al. 1989 (A)
E. dulcis (Burm. f.) Hensch.	C_3	Takeda et al. 1985 (A); Ueno and Takeda 1992 (A); Ueno et al. 1989 (A. $\delta^{13}C$); Ellery et al. 1992 ($\delta^{13}C$); JB (A: *Dharmawardhana 14* CANB. Γ: 49, *Dharmawardhana 14*); KW (A: *Wilson 5005, 5097a*)
E. dunensis Kük.	C_3	Ueno et al. 1989 (A)
E. elegans (Kunth) Roem. & Schult.	C_3	Ueno et al. 1989 (A)
E. elliptica Kunth	C_3	Ueno et al. 1989 (A)
E. elongata Chapm.	C_3	Ueno et al. 1989 (A)
E. engelmannii Steud.	C_3	Ueno et al. 1989 (A)
E. equisetina J. Presl & C. Presl	C_3	Takeda et al. 1985 (A); KW (A: *Constable 6535*; *Wilson 3825*)
E. equisetoides (Elliott) Torr.	C_3	Ueno et al. 1989 (A)
E. erythropoda Steud., as *E. calva* Torr. [nom. inval.]	C_3	Ueno et al. 1989 (A)
E. exigua (Kunth) Roem. & Schult.	C_3?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. filiculmis Kunth	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. flavescens (Poir.) Urban	C_3	Ueno et al. 1989 (A)
var. *olivacea* (Torr.) Gleason, as *E. olivacea* Torr.	C_3	Ueno et al. 1989 (A)
E. geniculata (L.) Roem. & Schult.[a], as *E. caribaea* (Rottb.) S. F. Blake[b]	C_3	Govindarajalu 1975*a* ([A]); Takeda et al. 1985 (A)[a,b]; Bruhl et al. 1987 (A. B); Ueno et al. 1989 (A); Ueno and Takeda 1992 (A); Bruhl and Perry 1995 (US); JB (A: *Bruhl 231* CANB. Γ: 51, *Bruhl 231*. $\delta^{13}C$: −28.1, *Bruhl 231*); LR ($\delta^{13}C$: −29.8, *Sintenis 1968*)
E. glauca Boeck.	C_4	Ueno et al. 1989 (A. $\delta^{13}C$)
E. gracilis R. Br., as *E. cunninghamii* Boeck.[a]	C_3	Takeda et al. 1985 (A); Ueno et al. 1989 (A)[a]
E. grisea Kük.	C_3	Ueno et al. 1989 (A)
E. haumaniana Barros	C_3	Ueno et al. 1989 (A)
E. intermedia Schult.	C_3	Ueno et al. 1989 (A)
E. interstincta (Vahl) Roem. & Schult.	C_3	Eiten 1969 ([A]); Ueno et al. 1989 (A)
E. intricata Kük.	C_3	Ueno et al. 1989 (A); JB (A: *Arnold 470* PRE)
E. kamtschatica (C. A. Mey.) Komarov	C_3	Ueno et al. 1989 (A); Ueno and Takeda 1992 (A)
E. kuroguwai Ohwi	C_3	Akita et al. 1969 ([A]); Ueno and Takeda 1992 (A. Γ)
E. lanceolata Fernald	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. limosa (Schrad.) Schult.	C_3	Ueno et al. 1989 (A); SCV ($\delta^{13}C$: −26.17, *Flanagan 903*)
× *E. macounii* Fernald (= *E. intermedia* Schult. × *E. obtusa* (Willd.) Schult.)	C_3	Ueno et al. 1989 (A)
E. macrostachya Britton	C_3	Keeley et al. 1986 ($\delta^{13}C$); Ueno et al. 1989 (A)
E. maculosa (Vahl) Roem. & Schult.	C_3	Ueno et al. 1989 (A)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
E. mamillata (Lindb.) Lindb.	C_3	Ueno et al. 1989 (A); Ueno and Takeda 1992 (A)
E. margaritacea (Hulten) Miyabe & Kudo	C_3	Ueno and Takeda 1992 (A)
E. marginulata Steud.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
E. melanocarpa Torr.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. melanostachys (Urville) C. B. Clarke	C_3	Ueno et al. 1989 (A)
E. microcarpa Torr.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. minarum Boeck.	C_3	Ueno et al. 1989 (A)
E. minima Kunth	C_4	Ueno et al. 1989 (A. $\delta^{13}C$)
E. minuta Boeck.	C_3	Ueno et al. 1989 (A); JB (A: *Bruhl 201* CANB. Γ: 47, *Bruhl 201*. $\delta^{13}C$: −28.0, *Bruhl 201*)
E. minutissima Britton	C_3	Ueno et al. 1989 (A)
E. mitracarpa Steud.	C_3	Ueno et al. 1989 (A)
E. mitrata (Griseb.) C. B. Clarke	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. montana (Kunth) Roem. & Schult., as *E. nodulosa* (Roth) Schult.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. montevidensis Kunth[a], as *E. palmeri* Svenson[b]	C_3	Ueno et al. 1989 (A)[a,b]
E. multicaulis Sm.	C_3	Ueno et al. 1989 (A)
E. mutata (L.) Roem. & Schult.	C_3	Ueno et al. 1989 (A); LR ($\delta^{13}C$: −27.4, *Mélinon 13*)
E. nana Kunth	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. naumanniana Boeck.	C_3	JB (A: *Smith 2988* PRE)
E. nervata Svenson	C_3	Ueno et al. 1989 (A)
E. nigrescens (Nees) Steud.	C_3	Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1989 (A. $\delta^{13}C$)
E. nitida Fernald	C_3	Ueno et al. 1989 (A); JB (A: *Fernald 328* MEL)
E. nuda C. B. Clarke	C_3	Ueno et al. 1989 (A)
E. nudipes (Kunth) Palla	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. nupeensis Hutch. & Dalziel	C_3	Ueno et al. 1989 (A)
E. obicis L. Johnson & O. Evans	C_3	KW (A: *Wilson 5655*)
E. obtusa (Willd.) Schult.	C_3	Ueno et al. 1989 (A)
E. ochrostachys Steud.	C_3	JB (A: *Dharmawardhana 17* CANB. Γ: 47, *Dharmawardhana 17*)
E. oligantha C. B. Clarke	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. ovata (Roth) Roem. & Schult.	C_3	Ueno et al. 1989 (A); Ueno and Takeda 1992 (A)
E. pachycarpa E. Desv.	C_3?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. pachystyla (C. Wright) C. B. Clarke	C_3?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. pallens S. T. Blake	C_3	Takeda et al. 1985 (A); JB (A: *Bruhl 33, 246* CANB. Γ: 45, *Bruhl 246*)
E. palustris (L.) Roem. & Schult.[a], as *E. smallii* Britton[b]	C_3	Ueno et al. 1989 (A[a,b]. $\delta^{13}C$[b]); LR ($\delta^{13}C$: −27.3, *Buchet s. n.,* 1853)
E. palustris subsp. *parvinux* (Ohwi) T. Koyama	C_3	Ueno and Takeda 1992 (A)
E. parishii Britton	C_3	Ueno et al. 1989 (A)
E. parodii Barros	C_3	Ueno et al. 1989 (A)
E. parvula (Roem. & Schult.) Link ex Bluff	C_3	Bender 1971 ($\delta^{13}C$); Ueno et al. 1989 (A); LR ($\delta^{13}C$: −24.5, *Bourgeau 453*)
E. pellucida J. Presl & C. Presl	C_3	Ueno et al. 1989 (A)
E. philippinensis Svenson	C_3	KW (A: *Wilson 3587*)
E. plana S. T. Blake	C_3	Takeda et al. 1985 (A)
E. plicarhachis (Griseb.) Svenson	C_3	Ueno et al. 1989 (A)
E. pusilla R. Br.	C_3–C_4?	Bruhl et al. 1987 (A. B)
	C_3-like	Bruhl and Perry 1995 (US); JB (A: *Anderson 45, 384, 1667, 1678* CANB; *Canning 3543A* CANB; *Eichler 15636* CANB; *Gauba 347, 2422* CANB; *Moore 799* CANB. Γ: 29, *Bruhl 179* CANB; 29, 30, 31, *Bruhl 682* CANB. $\delta^{13}C$: −26.7, *Bruhl 179*)
	C_3–C_4	
E. quadrangulata (Michx.) Roem. & Schult.	C_3	Ueno et al. 1989 (A)
E. quinquangularis Boeck.	C_3–C_4?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. quinqueflora (Hartmann) O. Schwarz, as *E. pauciflora* (Lightf.) Link[a]	C_3	Boutton et al. 1980 (A)[a]; Ueno et al. 1989 (A)[a]
E. radicans (Poir.) Kunth	C_3	Ueno et al. 1989 (A)
E. retroflexa (Poir.) Urb.	C_3+	Govindarajalu 1975*a* ([A])
subsp. *chaetaria* (Roem. & Schult.) T. Koyama	C_4	Ueno and Samejima 1989 (B); Ueno et al. 1989 (A. $\delta^{13}C$); Ueno 2004 (B. B [antiserum]); JB (Ae, *Sonder 187* MEL 1543842. $\delta^{13}C$: −10.4, −10.9, *Sonder 187*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
subsp. *retroflexa,* as *E. retroflexa*[a]	C_4	Bruhl et al. 1987 (Ae. B)[a]; Ueno et al. 1989 (A. $\delta^{13}C$); Bruhl and Perry 1995 (USe); Soros and Dengler 2001 (Ae); JB (Ae, *Blake 14421* CANB; *Godwin C.2967* CANB. $\delta^{13}C$: −12.9, −12.9, *Godwin C.2967*)
subsp. *subtilissima* (Nelmes) K. Lye	C_4	JB (Ae, *Ellery 15* PRE. $\delta^{13}C$: −14.4, −14.7, *Ellery 15*)
E. reverchonii Svenson	C_3–C_4?	Ueno et al. 1989 (A. $\delta^{13}C$)
E. robbinsii Oakes	C_3	Ueno et al. 1989 (A)
E. rostellata (Torr.) Torr.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. schaffneri Boeck.	C_3	Ueno et al. 1989 (A)
E. schlechteri C. B. Clarke	C_3	JB (A: *Schlechter 3829* PRE)
E. schweinfurthiana Boeck.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. sellowiana Kunth	C_3	Ueno et al. 1989 (A)
E. setifolia (A. Rich.) J. Raynal	C_3	JB (A: *Latz 2751* CANB)
E. sintenisii Boeck.	C_3	Ueno et al. 1989 (A)
E. sp. (?cf. *acuta*), as *E. carniolica* C. Koch	C_3	Ueno et al. 1989 (A)
E. sp. aff. *nuda* (*Wilson 5245*)	C_3	KW (A: *Wilson 5012*)
E. sp. aff. *ochrostachys* (*Wilson 5166*)	C_3	KW (A)
E. sp. aff. *variegata* (*Wilson 5248*)	C_3	KW (A: *Wilson 5160*)
E. sphacelata R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); Bruhl et al. 1987 (A. B); Ueno et al. 1989 (A); JB (A: *Bruhl 124, 579* CANB. Γ: 42, *Bruhl 124,* 51, *Bruhl 579*); KW (A: *Coveny 5031*; *Wilson 2075*)
E. spiralis (Rottb.) Roem. & Schult.	C_3	Govindarajalu 1975*a* ([A]); Takeda et al. 1985 (A. $\delta^{13}C$); Ueno et al. 1989 (A); KW (A: *Wilson 3666, 5097*)
E. squamigera Svenson	C_3	Ueno et al. 1989 (A)
E. stenocarpa Svenson	C_3	Ueno et al. 1989 (A)
E. subarticulata (Nees) Boeck.	C_3	Ueno et al. 1989 (A)
E. subcancellata C. B. Clarke	C_4	JB (Ae, *Pringle 4339* MEL 1543837, 1543838. $\delta^{13}C$: −11.3, −13.0, *Pringle 4339* MEL 1543837, −11.4, −11.9, *Pringle 4339* MEL 1543838)
	C_3+	Ueno et al. 1989 (A. $\delta^{13}C$)
E. sundaica Kern	C_3	KW (A: *Wilson 5011, 5165*)
E. tenuis (Willd.) Schult.	C_3	Ueno et al. 1989 (A)
E. tetraquetra Nees	C_3	Govindarajalu 1975*a* ([A]); Ueno and Takeda 1992 (A); JB (A: *Bruhl 672* CANB. Γ: 41, *Bruhl 672*)
E. tortilis (Link) Schult.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. tricostata Torr.	C_3	Ueno et al. 1989 (A)
E. tuberculosa (Michx.) Roem. & Schult.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$); LR ($\delta^{13}C$: −30.1, [collector's name obscured] 1919 Louisiana)
E. tucumanensis Barros	C_3	Guaglianone et al. 1998 (A)
E. uniglumis (Link) Schult.[a], as *E. halophila* (Fernald & Brackett) Fernald[b]	C_3	Ueno et al. 1989 (A)[a,b]
E. variegata (Poir.) C. Presl	C_3	Ueno et al. 1989 (A)
E. viridans Kük.	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
E. vivipara Link.	C_4	Ueno et al. 1988*a* (A. B. $\delta^{13}C$); Ueno et al. 1989 (A. $\delta^{13}C$); Ueno and Samejima 1990 ($\delta^{13}C$); Soros and Dengler 2001 (Ae)
	C_3 & C_4+	Ueno 1996 (A. US: NAD); Ueno 1998*b* (A. B. US); Ueno 2004 (B. B [antiserum]. B [kinetics])
	C_3+	Ueno et al. 1988*a* (A. B); Ueno and Samejima 1990 ($\delta^{13}C$)
E. wichurai Boeck.	C_3	Ueno and Takeda 1992 (A. Γ)
E. wolfii (A. Gray) A. Gray ex Britton	C_3	Ueno et al. 1989 (A. $\delta^{13}C$)
Epischoenus adnatus Levyns	C_3	LR ($\delta^{13}C$: −27.3, *Schlechter 7402*)
E. cernuus Levyns	C_3	SCV ($\delta^{13}C$: −24.73, *Levyns 8873*)
E. complanatus Levyns	C_3	JB (A: *Esterhuysen 17776* PRE; *Stokoe 2162* PRE); SCV ($\delta^{13}C$: −26.21, *Esterhuysen 11575*)
E. dregeanus (Boeck.) Levyns	C_3	SCV ($\delta^{13}C$: −24.45, *Levyns 9379*)
E. gracilis Levyns	C_3	JB (A: *Esterhuyen 27597* PRE)
E. lucidus (C. B. Clarke) Levyns	C_3	SCV ($\delta^{13}C$: −25.20, *Esterhuysen 11312*)
E. villosus Levyns	C_3	SCV ($\delta^{13}C$: −22.07, *Esterhuysen 16927*)
Eriophorum angustifolium Honckeny	C_3	Bender 1971 ($\delta^{13}C$); JB (A: *Watson,* 9 July 1987 pickled fragments at RSBS, ANU)
E. comosum (Wall.) Wall. ex Nees (*Eriosciрpus comosus* (Wall.) Palla)	C_3	Sharma 1973 ([A]); JB (A: *Singh 189*)
E. latifolium Hoppe	C_3	LR ($\delta^{13}C$: −29.6, *Bec in Arènes 1222*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
E. microstachyum Boeck. (*Erioscirpus microstachyus* (Boeck.) Palla)	C_3	JB (A: *Parker 2785*)
E. virginicum L. (*Eriophoropsis virginica* (L.) Palla)	C_3	JB (A: *Knowlton,* NSW 709552; *Roy 3950*)
Evandra aristata R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); LR ($\delta^{13}C$: −28.5, *Drummond 397*)
E. pauciflora R. Br.	C_3	JB (A: *Royce 2683* BRI. $\delta^{13}C$: −28.0, *Royce 2683*)
Everardia montana Ridl.	C_3	LR ($\delta^{13}C$: −28.2, *Wurdeck 1380*)
E. montana subsp. *duidae* (Gilly) T. Koyama & Maguire	C_3	JB (A: *Steyermark 93322* K)
Exocarya sclerioides (F. Muell.) Benth.	C_3	Koyama 1967 ([A]); Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Brass 18277* CANB; *Jones 3437* CANB)
Exochogyne amazonica C. B. Clarke	C_3	JB (A: *Steyermark*, 1 Sep 1961 BRI. $\delta^{13}C$: −26.9, *Steyermark,* 1 Sep 1961)
Ficinia acuminata (Nees) Nees	C_3	SCV ($\delta^{13}C$: −25.40, *Levyns 11212*)
F. angustifolia C. B. Clarke	C_3	JB (A: *Esterhuysen 90877* K); SCV ($\delta^{13}C$: −24.20, *Esterhuysen 26427*)
F. capillifolia C. B. Clarke	C_3	JB (A: *Fourcade 3017* K)
F. elongata Boeck.	C_3	JB (A: *Stirton 6382* K)
F. fascicularis Nees	C_3	JB (A: *Acocks 9090* K)
F. filiformis (Lam.) Schrad.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
F. gracilis (Poir.) Schrad.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
F. gydomontana Arnold	C_3	SCV ($\delta^{13}C$: −21.20, *Esterhuysen 27706*)
F. indica (Lam.) H. Pfeiff.	C_3	LR ($\delta^{13}C$: −26.8, *Schlechter 8402*)
F. nodosa (Rottb.) Goetgh., A. M. Muasya & D. A. Simpson, as *Scirpus nodosus* Rottb.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
F. pallens (Schrad.) Nees var. *lithosperma* (Boeck.) Arnold	C_3	JB (A: *Arnold 1007* K)
F. radiata (L.) Kunth (*Sickmannia radiata* (L. f.) Nees)	C_3	JB (A: *Arnold 965* PRE)
F. stolonifera Boeck.	C_3	SCV ($\delta^{13}C$: −25.31, *Levyns 6863*)
Fimbristylis acicularis R. Br.	C_4	Takeda et al. 1985 (Af)
F. acuminata Vahl, as *F. rhyticarya* F. Muell.	C_4	Takeda et al. 1985 ($\delta^{13}C$)
F. aestivalis (Retz.) Vahl	C_4	Akita et al. 1969 ([A]); Kuoh and Chiang 1984 (A); Takeda et al. 1985 (Af); Bruhl et al. 1987 (Af. B); Ehleringer et al. 1987 ($\delta^{13}C$)
F. annua (Allioni) Roem. & Schult.	C_4	Ehleringer et al. 1987 ($\delta^{13}C$)
F. aphylla Steud.	C_4	LR ($\delta^{13}C$: −12.7, *Tisserant 3330*)
F. autumnalis (L.) Roem. & Schult.	C_4	Ueno and Takeda 1992 (A. Γ)
F. bisumbellata (Forsk.) Bubani	C_4	Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Af. $\delta^{13}C$); Ueno and Takeda 1992 (A)
F. bivalvis (Lam.) K. Lye (*F. longiculmis* Steud.)	C_4	SCV ($\delta^{13}C$: −10.05, *Rogers 4563*)
F. caespitosa R. Br.	C_4	Takeda et al. 1985 (Af)
F. caroliniana (Lam.) Fernald	C_4	Brown 1975 (Af)
F. cephalophora F. Muell.	C_4	Takeda et al. 1985 (Af)
F. compacta Turrill	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. complanata (Retz.) Link	C_4	Sharma and Mehra 1972 ([A]); Hesla et al. 1982 (A. $\delta^{13}C$); Ehleringer et al. 1987 ($\delta^{13}C$); Ueno et al. 1988*b* (USf); Ueno and Takeda 1992 (A. Γ); Ueno et al. 1986 (Af. B)
subsp. *keniaeensis* (Kük.) K. Lye, as *F. keniaeensis* Kük.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
F. consanguinea Kunth	C_4	Hofstra et al. 1972 (A. Γ)
F. corynocarya F. Muell.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. cymosa R. Br., as *F. cymosa* subsp. *spathacea* (Roth) T. Koyama[a], as *F. spathacea* Roth[b]	C_4	Hofstra et al. 1972 (A. Γ); Prakash et al. 1976 (A)[b]; Meinzer 1978 (A)[b]; Hnatiuk 1980 (A); Hesla et al. 1982 ($\delta^{13}C$); Kuoh and Chiang 1984 (A); Takeda et al. 1985 (Af); Ueno and Takeda 1992 (A)[a]
F. densa S. T. Blake	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. denudata R. Br.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$); Bruhl et al. 1987 (Af. B)
F. depauperata R. Br.	C_4	Takeda et al. 1985 (Af)
F. dichotoma (L.) Vahl	C_4	Hattersley et al. 1977 (Af. B [IL]); Gilliland and Gordon-Gray 1978 (USf); Hesla et al. 1982 ($\delta^{13}C$); Kuoh and Chiang 1984 (A); Takeda et al. 1985 (Af); Ueno et al. 1986 (Af. B); Bruhl et al. 1987 (Af. B); Ueno et al. 1988*b* (USf); Ueno and Takeda 1992 (A. Γ); Ueno 1998*a* (US); LR ($\delta^{13}C$: −10.5, *Bon 2186*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
F. diphylloides Makino	C_4	Ueno et al. 1986 (Af. B); Ueno and Takeda 1992 (A. Γ)
F. dipsacea (Rottb.) C. B. Clarke subsp. *verrucifera* (Maxim.) T. Koyama	C_4	Ueno et al. 1986 (Af. B); Ueno and Takeda 1992 (A)
F. ferruginea (L.) Vahl	C_4	Hofstra et al. 1972 (A. Γ); Hnatiuk 1980 (A); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Af. $\delta^{13}C$); LR ($\delta^{13}C$: −11.6, *Jacques-Félix 7218*)
F. fimbristyloides (F. Muell.) Druce	C_4	Ueno and Takeda 1992 (A)
F. furva R. Br.[a], as *F. capitata* R. Br.[b]	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)[a,b]
F. hirsutifolia Govindarajalu	C_4	Govindarajalu 1990*a* ([A])
F. kadzusana Ohuai	C_4	Ueno and Takeda 1992 (A)
F. leptoclada Benth.	C_4	Ueno and Takeda 1992 (A)
F. leucocolea Benth.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. littoralis Gaud.	C_4	Akita et al. 1969 ([A]); Carolin et al. 1977 (USf); Takeda et al. 1980 (Af. Γ); Takeda et al. 1985 (Af); Ueno et al. 1986 (Af. B)
F. microcarya F. Muell.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. miliacea (L.) Vahl, as *F. quinquangularis* Kunth[a]	C_4	Hofstra et al. 1972 (A. Γ); Meinzer 1978 (A); Hesla et al. 1982 ($\delta^{13}C$)[a]; Kuoh and Chiang 1984 (A); Lin et al. 1993 (Af)
F. nelmesii Kern (*Tylocarya cylindrostachya* Nelmes)	C_4	JB (Af: *Kerr 21294* BM, L)
F. nuda Boeck.	C_4	Takeda et al. 1985 (Af)
F. nutans (Retz.) Vahl	C_4	Takeda et al. 1985 (Af); Ueno and Takeda 1992 (A)
F. obtusifolia (Lam.) Kunth	C_4	LR ($\delta^{13}C$: −13.0, *Chevalier 20054*)
F. oligocephala W. V. Fitzg.	C_4	Takeda et al. 1985 (Af)
F. pallida S. T. Blake	C_4	Takeda et al. 1985 (Af)
F. pauciflora R. Br.	C_4	Takeda et al. 1985 (Af); Ueno and Takeda 1992 (A)
F. phaeoleuca S. T. Blake	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. pierotii Miq.	C_4	Ueno and Takeda 1992 (A. Γ)
F. pilosa Vahl	C_4	LR ($\delta^{13}C$: −12.1, *Pobéguin 419*)
F. polytrichoides (Retz.) R. Br.	C_4	Hesla et al. 1982 ($\delta^{13}C$); Kuoh and Chiang 1984 (A); Takeda et al. 1985 (Af. $\delta^{13}C$); Bruhl et al. 1987 (Af. B); JB (Af: *Bruhl 204, 443* CANB. $\delta^{13}C$: −11.1, −11.6, −11.7, *Bruhl 443*); LR ($\delta^{13}C$: −15.3, *Sacleux 1652*)
F. pseudomicrocarya Govindarajalu	C_4	Govindarajalu 1990*a* ([A])
F. pterygosperma R. Br.	C_4	Takeda et al. 1985 (Af)
F. punctata R. Br.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. rara R. Br.	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. recta F. M. Bailey	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$)
F. scabrida Schum. & Thonn.	C_4	LR ($\delta^{13}C$: −13.2, *Chevalier 23501*)
F. schoenoides (Retz.) Vahl	C_4	Takeda et al. 1985 (Af. $\delta^{13}C$); Ehleringer et al. 1987 ($\delta^{13}C$)
F. schultzii Boeck.	C_4	Takeda et al. 1985 (Af)
F. sericea R. Br.	C_4	Ueno and Takeda 1992 (A. Γ); Ueno et al. 1986 (Af. B); JB (Af: *s. coll.* CANB 272779)
F. sieboldii Miq.	C_4	Kuoh and Chiang 1984 (A); Ueno et al. 1986 (Af. B); Ueno and Takeda 1992 (A. Γ)
F. solidifolia F. Muell.	C_4	Takeda et al. 1985 (Af)
F. sp. (*Carolin 8690*)	C_4	Carolin et al. 1977 (USf)
F. sphaerocephala Benth.	C_4	Takeda et al. 1985 (Af)
F. splendida C. B. Clarke	C_4	LR ($\delta^{13}C$: −11.6, *Sita 495*)
F. squarrosa Vahl, as *F. aestivalis* (Retz.) Vahl subsp. *squarrosa* (Vahl) T. Koyama[a]	C_4	Takeda et al. 1985 (Af); Ueno et al. 1986 (Af. B)[a]; Ueno et al. 1988*b* (USf)[a]; Ueno and Takeda 1992 (A)[a]
F. stauntonii Debeaux & Franch. subsp. *tonensis* (Makino) T. Koyama	C_4	Ueno and Takeda 1992 (A)
F. subbispicata Nees & Meyen ex Nees, as *F. tristachya* subsp. *subbispicata* (Nees & Meyen) T. Koyama[a]	C_4	Kuoh and Chiang 1984 (A); Ueno et al. 1986 (Af. B)[a]; Ueno et al. 1988*b* (USf)[a]; Ueno and Takeda 1992 (A. Γ)[a]
F. tenera Schult.	C_4	Sabnis 1921 ([A])
F. tetragona R. Br.	C_4	Carolin et al. 1977 (USf); Takeda et al. 1985 (Af); Bruhl et al. 1987 (Af. B); Bruhl and Perry 1995 (USf)
F. trachycarya F. Muell.	C_4	Takeda et al. 1985 (Af)
F. trigastrocarya F. Muell.	C_4	Takeda et al. 1985 (Af)
F. tristachya R. Br., as *F. marianna* Gaud.[a]	C_4	Takeda et al. 1985 (Af); JB (Af: *Brown* MEL 1543831); LR ($\delta^{13}C$: −12.1, *Poilane 20844*)[a]

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
F. uliginosa Hochst. ex Steud.	C_4	Raghavendra and Das 1976 (A. Γ)
F. umbellaris (Lam.) Vahl, as *F. globulosa* (Retz.) Kunth[a]	C_4	Kuoh and Chiang 1984 (A); Ueno and Takeda 1992 (A)[a]
F. variegata Gordon-Gray (*Abildgaardia variegata* (Gordon-Gray) K. Lye)	C_3	JB (A: *Ward 1108* BRI)
F. velata R. Br.	C_4	Carolin et al. 1977 (USf); Bruhl et al. 1987 (Af. B)
F. xyridis R. Br.	C_4	Takeda et al. 1985 (Af)
Fuirena ciliaris (L.) Roxb., as *F. ciliaris* var. *ciliaris*[a]	C_3	Govindarajalu 1969*a* ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A); JB (A: *Hartley 13767* CANB); SCV ($\delta^{13}C$: −26.63, *Rogers 13216*)[a]
F. glomerata Lam.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
F. incrassata S. T. Blake	C_3	Takeda et al. 1985 (A); JB (A: *Bruhl 445* CANB)
F. leptostachya Oliv.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
var. *nudiflora* C. B. Clarke	C_3	SCV ($\delta^{13}C$: −26.81, *Swynnerton 16027*)
F. obcordata P. L. Forbes	C_3	SCV ($\delta^{13}C$: −26.03, *Maputaland Expedition 14313*)
F. ochreata Kunth, as *F. calolepis* K. Schum.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
F. pachyrrhiza Ridl., as *F. pachyrrhiza* var. *pachyrrhiza*[a]	C_3	Hesla et al. 1982 ($\delta^{13}C$); SCV ($\delta^{13}C$: −25.04, *Pegler 309*)[a]
F. pubescens (Poir.) Kunth	C_3	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −26.8, *Taton 1068*)
var. *pergamentacea* Fisch.	C_3	Govindarajalu 1969*a* ([A])
F. simplex Vahl	C_3	LR ($\delta^{13}C$: −28.9, *Stanley 20533,* −34.3, Serre Orsay cult., 1972)
F. squarrosa Michx.	C_3	JB (A: *Radford 15859* MEL)
F. stricta Steud.	C_3	Hesla et al. 1982 ($\delta^{13}C$); Ellery et al. 1992 ($\delta^{13}C$); SCV ($\delta^{13}C$: −25.86, *Eyles 3850*)
F. umbellata Rottb.	C_3	Govindarajalu 1969*a* ([A]); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A); Bruhl et al. 1987 (A. B); JB (A: *Bruhl 214* CANB; *Dharmawardhana 15* CANB. Γ: 43, *Bruhl 214*); SCV ($\delta^{13}C$: −25.07, *Rogers 13277*)
F. uncinata Kunth	C_3	Govindarajalu 1969*a* ([A])
F. wallichiana Kunth	C_3	Govindarajalu 1969*a* ([A])
F. zambesiaca K. Lye	C_3	Hesla et al. 1982 ($\delta^{13}C$)
Gahnia aspera (R. Br.) Spreng.	C_3	Takeda et al. 1985 (A)
G. baniensis Benl	C_3	LR ($\delta^{13}C$: −28.3, *Poilane 29003*)
G. clarkei Benl	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Wilson 7652*)
G. deusta (R. Br.) Benth., as "*G. densta*" [sic]	C_3	Takeda et al. 1985 (A)
G. erythrocarpa R. Br.	C_3	KW (A: *Wilson 7653*)
G. howeana R. O. Gardner	C_3	KW (A: *Brown 2003/46*)
G. javanica Zoll. & Mor. ex Mor.	C_3	Hofstra et al. 1972 (A. Γ)
G. lacera (A. Rich.) Steud.	C_3	Troughton et al. 1974 ($\delta^{13}C$)
G. lanigera (R. Br.) Benth.	C_3	Takeda et al. 1985 (A)
G. melanocarpa R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
G. procera J. R. Forst. & G. Forst.	C_3	Betts 1920 ([A])
G. radula (R. Br.) Benth.	C_3	Takeda et al. 1985 (A)
G. sieberiana Kunth	C_3	Takeda et al. 1985 (A); KW (A: *Wilson 7651*)
G. subaequiglumis S. T. Blake	C_3	Takeda et al. 1985 (A); JB (A: *Prober 161* CANB)
G. trifida Labill.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
Gymnoschoenus anceps (R. Br.) Nees	C_3	KW (A: *Jackson* NSW 22510)
G. sphaerocephalus (R. Br.) Hook. f.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl 635* CANB); KW (A: *Coveny 6302, 6322*)
Hellmuthia membranacea (Thunb.) Haines & K. Lye	C_3	JB (A: *Arnold 705* PRE; *van Jaarsveld 4491* PRE)
Hypolytrum bullatum C. B. Clarke	C_3	Alves et al. 2002 ([A])
H. compactum Nees & Mey. ex Kunth	C_3	JB (A: *van Royen 3212* CANB)
H. glaziovii Boeck.	C_3	Alves et al. 2002 ([A])
H. heteromorphum Nelmes	C_3	LR ($\delta^{13}C$: −29.5, Serre Orsay cult., 1972, −36.3, *Lorougnon 1272*)
H. jenmanii C. B. Clarke	C_3	Koyama 1967 ([A])
H. lancifolium C. B. Clarke	C_3	LR ($\delta^{13}C$: −36.0, *Le Testu 9334*)
H. longifolium (Rich.) Nees	C_3	Alves et al. 2002 ([A])
subsp. *rubescens* (C. B. Clarke) T. Koyama, as *H. sylvaticum* Poepp. & Kunth subsp. *rubescens* (C. B. Clarke) T. Koyama	C_3	Koyama 1967 ([A])

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
H. nemorum (Vahl) Spreng.	C_3	Hofstra et al. 1972 (A. Γ); Takeda et al. 1985 (A. $\delta^{13}C$); Ehleringer et al. 1987 ($\delta^{13}C$); JB (A: *Bruhl 478* CANB); KW (A: *Farina s. n.,* Queensland NE)
H. nudum C. B. Clarke	C_3	Koyama 1967 ([A])
H. pulchrum (Rudge) H. Pfeiff.	C_3	Koyama 1967 ([A]); Alves et al. 2002 ([A]); LR ($\delta^{13}C$: −31.7, *Sagot 889*)
H. rigens Nees	C_3	Alves et al. 2002 ([A])
H. schraderianum Nees	C_3	Alves et al. 2002 ([A])
H. sp. nov. (Alves et al. 1915)	C_3	Alves et al. 2002 ([A])
H. sphaerostachyum Boeck.	C_3	Alves et al. 2002 ([A])
H. stemonifolium T. Koyama	C_3	Alves et al. 2002 ([A])
H. strictum Poepp. ex Kunth	C_3	Koyama 1967 ([A])
H. verticillatum T. Koyama	C_3	Alves et al. 2002 ([A])
Isolepis cernua (Vahl) Roem. & Schult., as *Scirpus cernuus* Vahl[a]	C_3	Troughton et al. 1974 ($\delta^{13}C$); Takeda et al. 1985 (A. $\delta^{13}C$)[a]; LR ($\delta^{13}C$: −27.3, *Dieterlen 705*)
I. costata Hochst. ex A. Rich., as *Scirpus constatus*[a] [sic]	C_3	Hesla et al. 1982 ($\delta^{13}C$)[a]; LR ($\delta^{13}C$: −29.6, *Peter 41441*)
I. crassiuscula Hook. f. (*Eleogiton crassiusculus* (Hook. f.) Benth.)	C_3	JB (A: *van Royen 10857* CANB)
I. fluitans (L.) R. Br., as *Eleogiton fluitans* (L.) Link[a], as *Scirpus fluitans* L.[b]	C_3	Govindarajalu 1976 ([A])[b]; Hesla et al. 1982 (A. $\delta^{13}C$)[b]; Takeda et al. 1985 (A)[b]; JB (A: *Evans 2778* CANB; *Telford 10203* CANB; *van Royen 11001* CANB); LR ($\delta^{13}C$: −29.7, *Pappi 749*)[a]; SCV ($\delta^{13}C$: −25.71, *Dummer 1620*)
I. graminoides (R. Haines & K. Lye) K. Lye, as *Scirpus graminoides* R. Haines & K. Lye	C_3	Hesla et al. 1982 ($\delta^{13}C$)
I. habra (Edgar) Soják	C_3	JB (A: *Bruhl ex-147* CANB)
I. hystrix (Thunb.) Nees	C_3	LR ($\delta^{13}C$: −24.1, *Drège 1601b*)
I. inundata R. Br., as *Scirpus inundatus* (R. Br.) Poir.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
I. marginata (Thunb.) A. Dietr., as *Scirpus antarcticus* L.	C_3	Takeda et al. 1985 (A)
I. platycarpa (S. T. Blake) Soják, as *Scirpus platycarpus* S. T. Blake	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
I. prolifera (Rottb.) R. Br., as *Holoschoenus prolifer* (Rottb.) ined.[a]	C_3	JB (A: *Bruhl 126* CANB. Γ: 46, *Bruhl 126*); LR ($\delta^{13}C$: −26.8, *Ecklon s. n.,* −34.8, Serre Orsay cult., 1972)[a]
I. sepulcralis Steud., as *Scirpus chlorostachys* Levyns[a], as *Isolepis* sp. (*Richards 17045*)[b]	C_3	Hesla et al. 1982 ($\delta^{13}C$)[a]; LR ($\delta^{13}C$: −27.1, *Richards 17045*)[b]
I. setacea (L.) R. Br., as *Scirpus setaceus* L.[a]	C_3	Hesla et al. 1982 ($\delta^{13}C$)[a]; LR ($\delta^{13}C$: −28.4, *Koernicke FGGE 1774*)
I. tenuissima (Nees) Kunth	C_3	SCV ($\delta^{13}C$: −24.03, *Esterhuysen 28973*)
Karinia mexicana (Britton) Reznicek & McVaugh	C_3	JB (A: *Kral 27601* MO); KW (A: *Arsène 8431* P)
Khaosokia caricoides Simpson et al.	C_3	Simpson et al. 2005 ($\delta^{13}C$); JB (A: *Simpson, De Wilde et al. 1886* TCD)
Kobresia laxa Nees	C_3	Sharma and Mehra 1970 ([A])
K. myosuroides (Vill.) Fiori, as *K. bellardii* (Allioni) Degland ex Loiseleur[a]	C_3	JB (A: *Clokey* MEL 1543850; *Clokey* MEL 1543852; *Asplund,* 8 Aug 1946 MEL); LR ($\delta^{13}C$: −25.9, *Humbert s. n.,* 1911, Col Arsine)[a]
K. nitens C. B. Clarke	C_3	Sharma and Mehra 1970 ([A])
Koyamaea neblinensis W. W. Thomas & G. Davidse	C_3	JB (A: *Stein 1668* MO)
Kyllinga alata Nees (*Cyperus alatus* (Nees) F. Muell.)	C_4	Getliffe Norris 1983 (A)
K. alba Nees (*Cyperus cristatus* (Kunth) Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); Getliffe Norris 1983 (A); KW (Ac: *O'Connor 4*)
K. auroealata (K. Lye) ined., as *Kyllinga alata* [auct. non Nees]	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. brevifolia Rottb., as *Cyperus brevifolius* (Rottb.) Hassk.[a], as *C. breviformis* [sic][b], as *K. colorata* (L.) Druce[c]	C_4	Akita et al. 1969 ([A]); Govindarajalu 1969*b* ([A])[a]; Carolin et al. 1977 (USc)[a]; Gilliland and Gordon-Gray 1978 (USc)[c]; Getliffe Norris 1983 (A)[c]; Takeda et al. 1985 (Ac)[a]; Li 1993 (A)[b]; Bruhl et al. 1987 (Ac. B); Lin et al. 1993 (Ac); JB (Ac: *Bruhl 162, Bruhl 163* CANB. $\delta^{13}C$: −10.4, *Bruhl 163,* −10.8, *Bruhl 162*); KW (Ac: *Wilson 678, 3302*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
subsp. *leiolepis* (Franch. & Sav.) T. Koyama	C_4	Ueno and Takeda 1992 (A. Γ)
K. bulbosa P. Beauv. (*Cyperus richardii* Steud.), as *K. macrocephala* A. Rich.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. cartilaginea K. Schum. (*Cyperus cartilagineus* (K. Schum.) Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. chrysantha K. Schum. (*Cyperus aureostramineus* Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. crassipes Boeck. (*Cyperus bulbipes* Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. elata Steud.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. elatior Kunth (*Cyperus pinguis* (C. B. Clarke) Mattf. & Kük.)	C_4	Gilliland and Gordon-Gray 1978 (USc); Hesla et al. 1982 (A. $\delta^{13}C$); Getliffe Norris 1983 (A); SCV ($\delta^{13}C$: −10.31, *Medley Wood 3993*)
K. erecta C. B. Clarke (*Cyperus erectus* (K. Schum.) Mattf. & Kük.), as *K. colorata* [auct.][a]	C_4	Hesla et al. 1982 ($\delta^{13}C$)[a]; Getliffe Norris 1983 (A); JB (Ac: *Gibbs Russell 2869* BRI)
K. intermedia R. Br. (*Cyperus sphaeroideus* L. Johnson & O. Evans)	C_4	KW (Ac: *Wilson 1453*)
K. intricata Cherm. (*Cyperus brevifolius* subsp. *intricatus* (Cherm.) K. Lye), as *K. aurata* [sensu Napper non Nees]	C_4	Hesla et al. 1982 (A. $\delta^{13}C$)
K. comosipes (Mattf. & Kük.) Napper (*Cyperus comosipes* Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. melanosperma Nees subsp. *bifolius* (Miq.) ined., as *Cyperus melanospermus* (Nees) Valck. Sur. subsp. *bifolius* (Miq.) Kern	C_4	Govindarajalu 1969*b* ([A])
subsp. *melanosperma,* as *Cyperus melanospermus* (Nees) Valck. Sur.	C_4	Govindarajalu 1969*b* ([A]); Hesla et al. 1982 ($\delta^{13}C$); Getliffe Norris 1983 (A)
K. microstyla C. B. Clarke (*Cyperus microstylis* (C. B. Clarke) Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
K. nemoralis (Forst. & Forst. f.) Dandy ex Hutch. & Dalziel, as *Cyperus kyllingia* Endl.[a]	C_4	Govindarajalu 1969*b* ([A])[a]; Hofstra et al. 1972 (A. Γ); Getliffe Norris 1983 (A); LR ($\delta^{13}C$: −14.4, *Squires 790,* −14.6, Serre Orsay cult., 1972); SCV ($\delta^{13}C$: −9.53, *Fourcade 1966*)
K. nervosa Steud. (*Cyperus oblongus* (C. B. Clarke) Kük. subsp. *nervosus* (Steud.) K. Lye)	C_4	Hesla et al. 1982 ($\delta^{13}C$); McNaughton et al. 1983 (A)
K. odorata Vahl, as *Cyperus sesquiflorus* (Torr.) Mattf. & Kük.[a], as *K. cylindrica* Nees[b], as *K. sesquiflora* Torr. subsp. *cylindrica* (Nees) T. Koyama[c]	C_4	Govindarajalu 1969*b* ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); Hesla et al. 1982 ($\delta^{13}C$)[b]єtliffe Norris 1983 (A); Takeda et al. 1985 (Ac)[a]; Ueno and Takeda 1992 (A)[c]; KW (Ac: *Wilson 1557*); LR ($\delta^{13}C$: −13.6, *Adam 5802*)
K. pauciflora Ridl. (*Cyperus ridleyi* Mattf. & Kük.)	C_4	Getliffe Norris 1983 (A)
K. polyphylla Willd. ex Kunth, as *Cyperus aromaticus* (Ridl.) Mattf. & Kük.[a]	C_4	Prakash et al. 1976 (A)[a]; Hesla et al. 1982 ($\delta^{13}C$); Getliffe Norris 1983 (A); Bruhl et al. 1987 (Ac. B); JB (Ac: *Bruhl 512* CANB; *Dharmawardhana 25* CANB. $\delta^{13}C$: −11.1, −11.2, *Bruhl 512*); KW (Ac: *Parham 9611*)
K. pulchella Kunth (*Cyperus teneristolon* Mattf. & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); Getliffe Norris 1983 (A); KW (Ac: *Schlechter 4030*); SCV ($\delta^{13}C$: −9.99, *Sister Stephany 27728*)
K. pumila Michx., as *Cyperus tenuifolius* (Steud.) Dandy[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$); Li et al. 1999 (A)[a]
K. squamulata Vahl, as *Cyperus metzii* (Hochst. ex Steud.) Mattf. & Kük.	C_4	Rikli 1895 ([A]); Govindarajalu 1969*b* ([A])[a]
K. tenuifolia Steud., as *Cyperus triceps* (Rottb.) Endl.[a], as *K. triceps* Rottb.[b]	C_4	Govindarajalu 1969*b* ([A])[a]; Raghavendra and Das 1976 (A. Γ)[b]
K. welwitschii Ridl. (*Cyperus welwitschii* (Ridl.) K. Lye)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
Kyllingiella microcephala (Steud.) Haines & K. Lye, as *Scirpus microcephalus* (Steud.) Dandy[a], as *Isolepis microcephala* (Steud.) K. Lye[b]	C_3	Druyts-Voets 1970 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; JB (A: *Wanntorp 405* PRE); LR ($\delta^{13}C$: −29.3, *Adam 12362*)[b]

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
K. polyphylla (A. Rich.) K. Lye, as *Isolepis polyphylla* A. Rich.[a]	C_3	JB (A: *Gillett 12991* EA); LR ($\delta^{13}C$: −27.3, *Pappi 3859*)[a]
Lagenocarpus guianensis Nees	C_3	JB (A: *Broadway 759* K)
L. rigidus (Kunth) Nees	C_3	LR ($\delta^{13}C$: −27.7, *Irwin et al. 13523*)
L. verticillatus (Spreng.) T. Koyama & Maguire	C_3	JB (A: *Steyermark 89702* BRI)
Lepidosperma aphyllum R. Br.	C_3	KW (A: *Whaite 4323A*; *Wilson 2853*)
L. avium K. L. Wilson	C_3	KW (A: *Forde 905*)
L. brunonianum Nees	C_3	KW (A: *Newbey 4676*; *Tindale 150*; *Wilson 2796*)
L. canescens Boeck.	C_3	Takeda et al. 1985 (A); KW (A: *Beauglehole 37932, Beauglehole 39126*)
L. carphoides F. Muell. ex Benth.	C_3	Takeda et al. 1985 (A); KW (A: *Johnson 7924*; *Streimann 3312*; *Whibley 3605*; *Wilson 3060*)
L. concavum R. Br.	C_3	KW (A: *Beauglehole 25305*; *Blake 22763*; *Blakely* NSW 463671; *Canning 2543C*; *Durrington 1222*; *McKay* NSW 150413; *Phillips* NSW 464140; *Wilson 464, 2204, 2241, 2391*)
L. congestum R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Symon 6395*; *Wilson 1079*)
L. costale Nees	C_3	KW (A: *Coveny 7967*)
L. curtisiae K. L. Wilson & D. I. Morris	C_3	KW (A: *Boorman* NSW 517775; *Wilson 1708*)
L. drummondii Benth.	C_3	KW (A: *Fitzgerald* NSW 19781)
L. effusum Benth.	C_3	JB (A: *Crisp 5231* CBG); KW (A: *Crisp 5231* NSW)
L. elatius Labill.	C_3	KW (A: *Wilson 10203*)
L. ensiforme (Rodway) D. I. Morris	C_3	KW (A: *Wilson 10200*)
L. evansianum K. L. Wilson	C_3	KW (A: *Wilson 8626*)
L. filiforme Labill.	C_3	KW (A: *Armstrong 866*; *Beauglehole 25024*; *Boyd 1871*; *Constable 7340, 7352,* NSW 53920*; Coveny 4901; Evans* NSW 136815*; Henshall* SYD 367116*; McGillivray 148*)
L. forsythii A. A. Hamilton	C_3	KW (A: *Beauglehole 30224*; *Coveny 6286, 7374, 10051*)
L. gladiatum Labill.	C_3	Takeda et al. 1985 (A); KW (A: *Beard 7735*; *Cheel* NSW 150436; *Jones* NSW 150435; *Pickard 1123*; *Telford 1859*)
L. gracile R. Br.	C_3	KW (A: *Blake 18027*; *Tindale 3913*)
L. gunnii Boeck.	C_3	KW (A: *Adams 1841*; *Constable 5027*; *Johnson 7053, 8536*; *McBarron 12361*)
L. inops Rodway ex F. Muell.	C_3	JB (A: *Bruhl 630* CANB); KW (A: *Ratkowsky 545*)
L. latens K. L. Wilson	C_3	KW (A: *Coveny 598*; *Evans 2610*; *Moore 1932*; *Wilson 8631*)
L. laterale R. Br.[a], as *L. lineare* R. Br.[b]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[a,b]; KW (A: *Barry 27*; *Blake 5312*; *Blaxell 814*; *Briggs* NSW 466982; *Campbell & Pickard 1221*; *Constable 5503*; *Evans* NSW 128084; *Johnson 2132,* NSW 20431*, 156454*; *McKee 11566*; *Milthorpe & Cunningham 5523*; *Salasoo 3663*; *Wilson 822, 2319, 3992, 3696, 4419*)[a]
L. leptostachyum Benth. var. *asperatum* Kük.	C_3	KW (A: *Newbey 4678*)
L. limicola N. A. Wakefield	C_3	KW (A: *Constable 4356*; *Coveny 6132, 6310*; *Gregson* NSW 464158; *Johnson 622*; *Wilson 3206*)
L. longitudinale Labill.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Briggs 4278*; *Betche* NSW 295546; *Johnson* NSW 79147; *Kenneally 7178*; *Lucas* NSW 150437; *Williamson* NSW 295762; *Wilson 1190, 1601, 2168, 2404*)
L. neesii Kunth	C_3	KW (A: *Coveny 4903*; *McBarron 10516*; *Opie & van Rees 128*; *Wilson 4029*)
L. obtusum Kük.	C_3	KW (A: *Wilson 8882*)
L. oldfieldii Hook. f.	C_3	KW (A: *Rodway* NSW 150438)
L. perteres C. B. Clarke	C_3	LR ($\delta^{13}C$: −25.7, *Raynal & Jaffré 16520*)
L. pruinosum Kük. var. *rigidulum* Kük.	C_3	KW (A: *Newbey 4699*; *Wilson 2579*)
L. pubisquameum Steud.	C_3	KW (A: *Salasoo 4117*; *Wilson 2834*)
L. quadrangulatum A. A. Hamilton	C_3	KW (A: *Coveny 4893*; *McGillivray 2298*)
L. scabrum Nees	C_3	KW (A: *Wilson 2695*)
L. semiteres F. Muell. ex Boeck.	C_3	Takeda et al. 1985 (A); KW (A: *Beauglehole 43906*; *Blake 16830*)
L. sp. A1 (*Wilson 2578*)	C_3	KW (A)
L. sp. aff. *elatius* (*Fallding* NSW 150145)	C_3	KW (A: *Boorman* NSW 519847; *Fallding* NSW 150145; *Williams K4*)
L. sp. B2 (*Crisp 4833*)	C_3	KW (A)
L. sp. E3 (*Whaite 4105*)	C_3	KW (A)
L. sp. E4 (*Wilson 2703*)	C_3	KW (A)
L. sp. F (*Pulley 1481*)	C_3	KW (A: *Pulley 1481*; *Koch 1208*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
L. sp. F1 (*Fitzgerald* NSW 19769)	C_3	KW (A)
L. sp. I (*Wilson 3015*)	C_3	KW (A)
L. sp. P (*Tindale 166A*)	C_3	KW (A)
L. sp. Q (*Wilson 2717*)	C_3	KW (A)
L. sp. S2 (*Coveny 7871*)	C_3	KW (A)
L. sp. T2 (*Wilson 2982*)	C_3	KW (A)
L. sp. U1 (*Tindale 3846*)	C_3	KW (A)
L. sp. U3 (*Blake 18076*)	C_3	KW (A)
L. sp. Z (*Wilson 9102*)	C_3	KW (A)
L. squamatum Labill.	C_3	KW (A: *Whaite 4318*; *Wilson 2954*)
L. striatum R. Br.	C_3	KW (A: *Wilson 2946*)
L. tenue Benth.	C_3	KW (A: *Wilson 2764*)
L. tetraquetrum Nees	C_3	KW (A: *Wilson 3022*)
L. tortuosum F. Muell.	C_3	KW (A: *Fuhrer & Beauglehole 39756*; *Johnson 7062*; *Ratkowsky 1606*; *Tindale* NSW 83944)
L. tuberculatum Nees	C_3	Takeda et al. 1985 (A); KW (A: *Fitzgerald* NSW 19796, NSW 19798)
L. urophorum N. A. Wakefield	C_3	Takeda et al. 1985 (A); KW (A: *Beauglehole 32798*; *Coveny 959*; *Wilson 2277, 3119*)
L. ustulatum Steud.	C_3	KW (A: *Wilson 2949*)
L. viscidum R. Br.	C_3	Takeda et al. 1985 (A); KW (A: *Beauglehole 37332*; *Coveny 10067*; *Johnson* NSW 365502; *Mulham W832*; *Wilson 1091, 8628*)
Lepironia articulata (Retz.) Domin[a], as *L. mucronata* Rich.[b]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[a,b]; JB (A: *Bruhl 526* CANB; *Lazarides 8120* CANB); KW (A: *Wilson 10195*)[a]; LR ($\delta^{13}C$: −28.1, *Poilane 23083*)[a]
Lipocarpha albiceps Ridl.	C_4	Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −11.3, *Audru 774*)
L. chinensis (Osb.) Kern	C_4	Govindarajalu 1974 ([A]); Hesla et al. 1982 ($\delta^{13}C$); Ueno and Takeda 1992 (A); SCV ($\delta^{13}C$: −10.30, *Jeague 520*)
L. hemisphaerica (Roth) Goetgh., as *Hemicarpha isolepis* Nees[a]	C_4	LR ($\delta^{13}C$: −10.4, *Leprieur s. n.,* St Louis, Senegal)[a]; SCV ($\delta^{13}C$: −9.45, *Rogers 6024*)
L. kernii (Raym.) Goetgh., as *Rikliella kernii* (Raym.) J. Raynal	C_4	Raynal 1973 (Ac); LR ($\delta^{13}C$: −12.7, *Schweinfurth 2572*)[a]
L. micrantha (Vahl) G. C. Tucker, as *Hemicarpha subsquarrosa* (Muhl.) Nees	C_4	LR ($\delta^{13}C$: −11.1, *Hall s. n.,* 1866)
L. microcephala (R. Br.) Kunth	C_4	Takeda et al. 1985 (Ac); Ueno et al. 1986 (Ac. B); Bruhl et al. 1987 (Ac. B); Ehleringer et al. 1987 ($\delta^{13}C$); Ueno and Takeda 1992 (A); JB (Ac: *Bruhl 181, 287* CANB)
L. nana (A. Rich.) Cherm.	C_4	Hesla et al. 1982 ($\delta^{13}C$); SCV ($\delta^{13}C$: −10.34, *Bolus 6025*)
L. occidentalis (A. Gray) G. C. Tucker (*Hemicarpha occidentalis* A. Gray)	C_4	JB (Ac: *s. coll.* MEL 1543861)
L. prieuriana Steud.	C_4	LR ($\delta^{13}C$: −11.9, *Fotius 1886*)
L. raynaliana Govindarajalu	C_4	Govindarajalu 1981 ([A])
L. rehmannii (Ridl.) Goetgh., as *Rikliella rehmannii* (Ridl.) J. Raynal[a]	C_4	Raynal 1973 (Ac)[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; JB (Ac: *Taylor 10652* K); LR ($\delta^{13}C$: −12.3, *Dinter 7560*)[a]
	C_3+	SCV ($\delta^{13}C$: −24.57, *Bolus 4529*)
L. squarrosa (L.) Goetgh., as *Rikliella squarrosa* (L.) J. Raynal[a]	C_4	Sharma 1972 ([A]); Raynal 1973 (Ac); Govindarajalu and Raynal 1976 ([A]); LR ($\delta^{13}C$: −13.5, *Couderc s. n.,* 1920, Cambodia)
Machaerina anceps (Poir.) Boj.	C_3	LR ($\delta^{13}C$: −26.4, *Bosser 147*)
M. falcata (Nees) T. Koyama	C_3	JB (A: *Sleumer BW14012* CANB)
M. insularis (Benth.) T. Koyama	C_3	JB (A: *Hoogland 8807* CANB); KW (A: *Brown 2003/35*)
Mapania baldwinii Nelmes	C_3	LR ($\delta^{13}C$: −33.5, Serre Orsay cult., 1972)
M. bancana (Miq.) Benth. & Hook. f. ex B. D. Jacks., as *Thoracostachyum bancanum* (Miq.) Kurz[a]	C_3	Koyama 1967 ([A])[a]; JB (A: *Jacobs 5647* CANB); LR ($\delta^{13}C$: −28.0, *Beccari 3332*)[a]
M. coriandrum Nelmes	C_3	LR ($\delta^{13}C$: −31.3, Serre Orsay cult., 1972, −37.4, *Lorougnon 1260*)
M. cuspidata (Miq.) Uittien, as *M. humilis* auct. non (Steud.) P. Villar	C_3	Koyama 1967 ([A])
M. cuspidata (Miq.) Uittien var. *petiolata* (C. B. Clarke) Uittien	C_3	JB (A: *s. coll.* MEL 1543834)
M. effusa (C. B. Clarke) T. Koyama, as *Mapaniopsis effusa* C. B. Clarke	C_3	Koyama 1967 ([A]); Metcalfe 1971 ([A])
M. macrantha (Boeck.) H. Pfeiff.	C_3	LR ($\delta^{13}C$: −33.4, Serre Orsay cult., 1972)
M. macrocephala (Gaud.) K. Schum.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
M. macrophylla (Boeck.) H. Pfeiff.	C_3	Koyama 1967 ([A])

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
M. mannii C. B. Clarke	C_3	LR ($\delta^{13}C$: −32. ?[illegible], Serre Orsay cult., −36.2, *Farron 4099*)
M. soyauxii (Boeck.) H. Pfeiff.	C_3	LR ($\delta^{13}C$: −35.6, *Hallé & Villiers 5429,* −35.8, Serre Orsay cult., 1972)
M. sumatrana (Miq.) Benth., as *Thoracostachyum sumatranum* (Miq.) Kurz[a]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[a]; JB (A: *Bruhl 308* CANB)
M. sylvatica Aubl.	C_3	Koyama 1967 ([A]); LR ($\delta^{13}C$: −35.4, *Mangenot 3*)
Mesomelaena graciliceps (C. B. Clarke) K. L. Wilson	C_3	KW (A: *Newbey 4976*; *Wilson 2888, 2924, 2957*)
M. preissii Nees, as *M. stygia*[a] [voucher *Coveny 8296* re-determined by KLW in NSW]	C_3	Takeda et al. 1985 (A)[a]; KW (A: *Canning WA/68 2493*; *Koch 1729*; *Wilson 2606, 2771, 2782*)
M. pseudostygia (Kük.) K. L. Wilson	C_3	KW (A: *Blake 18149*; *Coveny 3119*; *Wilson 2632*)
M. stygia (R. Br.) Nees subsp. *deflexa* (Kük.) K. L. Wilson	C_3	KW (A: *Hnatiuk 8000012*; *Mueller s. n.* B)
M. stygia subsp. *stygia*	C_3	KW (A: *Tindale 3849*; *Weston 8209*; *Wilson 2897, 2907, 2919, 2993*)
M. tetragona (R. Br.) Benth.	C_3	Takeda et al. 1985 (A); JB (A: *Bailey* CANB 63655); KW (A: *Tindale 284*; *Wilson 2918*); LR ($\delta^{13}C$: −25.0, *Home s. n.,* Australia)
Microdracoides squamosus Hua	C_3	Chermezon 1933 ([A]); JB (A: *Morton K685* K. $\delta^{13}C$: −26.6, −27.1, *Morton K685*); LR ($\delta^{13}C$: −28.4, *Leeuwenberg 5451,* −33.7, Serre Orsay cult., 1972)
Morelotia affinis (Brongn.) S. T. Blake	C_3	JB (A: *Bagnall 56270* NSW)
M. gahniiformis Gaud.	C_3	JB (A: *Henrickson 3490*; *Ordoney,* 14 Jul 1940 CANB)
Neesenbeckia punctoria (Vahl) Levyns	C_3	JB (A: *Orchard 36* K; *Taylor 3266* PRE); LR ($\delta^{13}C$: −29.0, *McOwan 1688*); SCV ($\delta^{13}C$: −26.01, *Levyns 8328*)
Nelmesia melanostachya Van der Veken, as *Nelmesia*[a]	C_4	Lerman and Raynal 1972 (A)[a]; LR ($\delta^{13}C$: −12.8, *Gérard 57*)
Nemum spadiceum (Lam.) Desv. ex Hamilton, as *N. angolensis* (C. B. Clarke) J. Raynal ined.	C_4	LR ($\delta^{13}C$: −11.6, *Le Testu 3384*)
N. equitans (Kük.) J. Raynal	C_4	Raynal 1973 (Af); LR ($\delta^{13}C$: −13.2, *Robinson 3912*)
Oreobolopsis inversa Dhooge & Goetgh.	C_3	Dhooge and Goetghebeur 2002 ([A])
O. tepalifera T. Koyama & Guaglianone	C_3	Koyama and Guaglianone 1987 ([A])
Oreobolus acutifolius S. T. Blake	C_3	JB (A: *Bruhl 626* CANB)
O. ambiguus Kük. & Steenis	C_3	Takeda et al. 1985 (A. $\delta^{13}C$:); JB (A: *Hope ANU 16067* CANB)
O. distichus F. Muell.	C_3	Takeda et al. 1985 (A); JB (A: *Gray 4834* CANB)
O. kuekenthalii Steenis	C_3	JB (A: *Nooteboom 2023* CANB)
O. obtusangulus Gaud.	C_3	LR ($\delta^{13}C$: −24.1, *Holm & Iltis 571*)
O. oligocephalus W. M. Curtis (*Schoenoides oligocephalus* (W. M. Curtis) O. Seberg)	C_3	JB (A: *Bruhl 626* CANB)
O. oxycarpus S. T. Blake	C_3	Takeda et al. 1985 (A)
O. pumilio R. Br. subsp. *pumilio,* as *O. pumilio*[a]	C_3	Takeda et al. 1985 (A)[a]; JB (A: *Telford 3686* CBG)
Oxycaryum cubense (Poepp. & Kunth) K. Lye	C_3	JB (A: *Smith 611* PRE; *Ward 8044* PRE); KW (A: *Krapovickas 24620* P); LR ($\delta^{13}C$: −27.6, *Trochain 2135*)
Paramapania parvibractea (C. B. Clarke) Uittien	C_3	Takeda et al. 1985 (A)
P. radians (C. B. Clarke) Uittien	C_3	JB (A: *Jacobs 5597* CANB; *Ramos,* Aug 1915 BRI 002215. $\delta^{13}C$: −29.2, *Ramos,* Aug 1915); LR ($\delta^{13}C$: −30.4, *Ramos 23642*)
P. simplex (Ridl.) Uittien	C_3	JB (A: *Brass 13481* BRI. $\delta^{13}C$: −31.7, *Brass 13481*)
Phylloscirpus acaulis (Philippi) Goetgh. & D. A. Simpson, as *Scirpus acaulis* Philippi[a]	C_3	Ponessa et al. 1997 ([A]); BDW (A: *Laegaard S-54783* AAU)
P. boliviensis (Barros) Dhooge & Goetgh.	C_3	BDW (A: *Beck 22360* GENT)
P. deserticola (Philippi) Dhooge & Goetgh.	C_3	BDW (A: *Laegaard S-54816* AAU)
Pleurostachys gaudichaudii Brongn.	C_3	LR ($\delta^{13}C$: −30.2, *Riedel s. n.,* 1823)
Principina grandis Uittien	C_3	JB (A: *Exell 703* BM)
Pseudoschoenus inanus (Thunb.) Oteng-Yeboah	C_3	JB (A: *Muller 619* K)
Ptilothrix deusta (R. Br.) K. L. Wilson, as *Ptilanthelium deustum* (R. Br.) Kük.[a]	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)[a]; JB (A: *Bruhl 71* CANB; *Prober 356* CANB); KW (A: *Coveny 6687*)
Pycreus aethiops (Ridl.) C. B. Clarke (*Cyperus aethiops* Ridl.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
P. atroglumosus (Govindarajalu) P. Singh & V. Singh, as *Cyperus atroglumosus* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. bipartitus (Torr.) C. B. Clarke, as *Cyperus bipartitus* Torr.	C_4	Li et al. 1999 (A. $\delta^{13}C$)
P. compressiformis Cherm. (*Cyperus compressiformis* (Cherm.) Kük.)	C_4	KW (Ac: *Leandri 1029* P)
P. diandrus (Torr.) C. B. Clarke, as *Cyperus diandrus* Torr.	C_4	Li et al. 1999 (A. $\delta^{13}C$)
P. divulsus (Ridl.) C. B. Clarke (*C. divulsus* Ridl.)	C_4	KW (Ac: *Bosser 15364* PRE)
P. fibrillosus (Kük.) Cherm. (*P. scaettae* Cherm., *Cyperus fibrillosus* Kük.)	C_4	LR ($\delta^{13}C$: −12.2, *Le Testu 7452*)
P. filicinus (Vahl) T. Koyama, as *Cyperus filicinus* Vahl	C_4	Li et al. 1999 (A. $\delta^{13}C$)
P. flavescens (L.) Beauv. ex Rchb., as *Cyperus flavescens* L.[a]	C_4	Meinzer 1978 (A)[a]; Hesla et al. 1982 ($\delta^{13}C$); Kalapos et al. 1997 ($\delta^{13}C$); Li et al. 1999 (A. $\delta^{13}C$)[a]; LR ($\delta^{13}C$: −11.9, *Chevalier 908*); SCV ($\delta^{13}C$: −10.93, *Pegler 1089*)
P. flavescens (L.) Rchb., as *Cyperus flavescens* L.[a]	C_3+	Li 1993 (A. $\delta^{13}C$)
P. flavicomus (Michx.) C. D. Adams, as *Cyperus albomarginatus* (Mart. & Schrad. ex Nees) Steud.[a], as *C. flavicomus* Michx.[b]	C_4	Downton and Tregunna 1968 (Γ)[a]; Tregunna et al. 1970 (Ac. B. Γ. $\delta^{13}C$)[a]; Meinzer 1978 (A)[a]; Li et al. 1999 (A)[b]
P. flavidus (Retz.) T. Koyama, as *Cyperus flavidus* Retz.[a], as *P. globosus* (All.) Rchb.[b]	C_4	Hofstra et al. 1972 (A. Γ)[b]; Govindarajalu 1978 ([A])[a]; Saxena and Ramakrishnan 1984 (A)[b]; Takeda et al. 1985 (A. $\delta^{13}C$); Ueno et al. 1986 (Ac. B)[b]; Ueno et al. 1988*b* (USc)[b]; Ueno and Takeda 1992 (A. Γ); Li 1993 ($\delta^{13}C$)[a]; JB (Ac: *Lazarides 7350* CANB)
P. flavidus (Retz.) T. Koyama, as *Cyperus flavidus* Retz.[a], as *P. globosus* (All.) Rchb.[b]	C_3+	Saxena and Ramakrishnan 1984 (A)
P. govindarajalui V. S. Raju., as *Cyperus decumbens* Govindarajalu (non *P. decumbens* T. Koyama)	C_4	Govindarajalu 1978 ([A])
P. hildebrandtii C. B. Clarke (*Cyperus pseudohildebrandtii* Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
P. intactus (Vahl) J. Raynal (*Cyperus intactus* Vahl), as *P. ferrugineus* (Poir.) C. B. Clarke	C_4	Gilliland and Gordon-Gray 1978 (USc)
P. intermedius (Steud.) C. B. Clarke (*Cyperus subintermedius* Kük.)	C_4	KW (Ac: *Audru 6062* P)
P. lanceolatus (Poir.) C. B. Clarke, as *Cyperus lanceolatus* Poir.	C_4	Hesla et al. 1982 ($\delta^{13}C$)
P. latespicatus (Boeck.) C. B. Clarke, as *Cyperus latespicatus* Boeck.	C_4	Govindarajalu 1978 ([A])
P. latevaginatus (Govindarajalu) P. & V. Singh, as *Cyperus latevaginatus* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. longistolon (A. Peter & Kük.) Napper (*Cyperus longistolon* A. Peter & Kük.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
P. luridus (Govindarajalu) P. Singh & V. Singh, as *Cyperus luridus* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. macranthus (Boeck.) C. B. Clarke (*Cyperus macranthus* Boeck.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); KW (Ac: *Rudatis 702*)
P. macrostachyos (Lam.) J. Raynal, as *Cyperus albomarginatus* (Mart. & Schrad. ex Nees) Steud.[a], as *C. macrostachyos* Lam.[b]	C_4	Carolin et al. 1977 (USc)[b]; Govindarajalu 1978 ([A])[b]; Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (Ac. $\delta^{13}C$)[a]; KW (Ac: *Decary 16455* P)[b]
P. mundii Nees, as *Cyperus mundtii* [sic] (Nees) Kunth[a]	C_4	Hesla et al. 1982 ($\delta^{13}C$); Li 1993 (A. Γ)[a]; LR ($\delta^{13}C$: −12.0, *Gaston 688*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
P. nervulosus (Kük.) ined., as *Cyperus nervulosus* (Kük.) S. T. Blake	C_4	Carolin et al. 1977 (USc)
P. niger (Ruiz & Pav.) Cufod., as *Chlorocyperus cimicinus* (J. Presl & C. Presl) Rikli	C_4	Rikli 1895 ([A])
P. niger (Ruiz & Pav.) Cufod. subsp. *elegantulus* (Steud.) K. Lye (*Cyperus niger* Ruiz & Pav. subsp. *elegantulus* (Steud.) K. Lye), as *P. elegantulus* (Steud.) C. B. Clarke[a]	C_4	Lerman and Raynal 1972 (A)[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; LR ($\delta^{13}C$: −12.2, *Schimper 118*)[a]
P. nigricans (Steud.) C. B. Clarke (*Cyperus nigricans* Steud.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); KW (Ac: *Lye 5288* P)
P. nitidus (Lam.) J. Raynal (*Cyperus nitidus* Lam.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); Ellery et al. 1992 ($\delta^{13}C$); SCV ($\delta^{13}C$: −10.02, *Tyson 1681*)
P. pelophilus (Ridl.) C. B. Clarke (*Cyperus pelophilus* Ridl.)	C_4	Hesla et al. 1982 ($\delta^{13}C$); SCV ($\delta^{13}C$: −10.93, *Russell 2076*)
P. permutatus (Boeck.) Napper (*Cyperus permutatus* Boeck.)	C_4	Hesla et al. 1982 ($\delta^{13}C$)
P. pervillei (Boeck.) C. B. Clarke (*Cyperus pervillei* Boeck.)	C_4	KW (Ac: *Humbert 4045* P)
P. plumbeonuceus (Govindarajalu) P. Singh & V. Singh, as *Cyperus plumbeonuceus* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. plurinodosus (Govindarajalu) P. Singh & V. Singh, as *Cyperus plurinodosus* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. polystachyos (Rottb.) Beauv., as *Cyperus polystachyos* Rottb.[a]	C_4	Carolin et al. 1977 (USc)[a]; Govindarajalu 1978 ([A])[a]; Takeda et al. 1985 (Ac)[a]; Bruhl et al. 1987 (Ac. B); Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1986 (Ac); Ueno and Takeda 1992 (A. Γ); Li 1993 (A. $\delta^{13}C$)[a]; Lin et al. 1993 (Ac); Bruhl and Perry 1995 (USc); Li et al. 1999 (A. $\delta^{13}C$)[a]; Soros and Dengler 2001 (Ac); JB (Ac: *Bruhl 190* CANB); KW (Ac: *Wilson 1447*)
var. *laxiflorus* Benth.	C_4	SCV ($\delta^{13}C$: −10.43, *McOwan 1326*)
P. pumilus (L.) Nees, as *Cyperus pumilus* L.[a]	C_4	Govindarajalu 1978 ([A])[a]; Hnatiuk 1980 (A); Hesla et al. 1982 ($\delta^{13}C$); LR ($\delta^{13}C$: −11.3, *Chevalier 9857*)
P. puncticulatus (Vahl) Nees, as *Cyperus punticulatus* Vahl	C_4	Govindarajalu 1978 ([A])
P. sanguinolentus (Vahl) Nees, as *Cyperus sanguinolentus* Vahl[a], as *C. sanguissolentus* [sic][b], as *Cyperus sanguinolentus* subsp. *sanguinolentus*[c]	C_4	Hattersley et al. 1977 (Ac. B [IL])[a]; Govindarajalu 1978 ([A])[c]; Hesla et al. 1982 ($\delta^{13}C$); Ueno et al. 1986 (Ac); Ueno et al. 1988*b* (USc); Ueno and Takeda 1992 (A. Γ); Li and Jones 1994 (A)[b]; KW (Ac: *Wilson 1444*)
subsp. *cyrtostachys* (Miq.) S. Karthikeyan, as *Cyperus sanguinolentus* subsp. *cyrtostachys* (Miq.) Kern	C_4	Govindarajalu 1978 ([A])
var. *micronux* (C. B. Clarke) S. Karthikeyan, as *Cyperus sanguinolentus* var. *micronux* (C. B. Clarke) Kük.	C_4	Govindarajalu 1978 ([A])
P. stramineus (Nees) C. B. Clarke, as *Cyperus substramineus* Kük.	C_4	Govindarajalu 1978 ([A])
P. stricticulmis (Govindarajalu) P. Singh & V. Singh, as *Cyperus stricticulmis* Govindarajalu	C_4	Govindarajalu 1978 ([A])
P. sulcinux (C. B. Clarke) C. B. Clarke, as *Cyperus sulcinux* C. B. Clarke	C_4	Govindarajalu 1978 ([A])
P. unioloides (R. Br.) Urb., as *Cyperus unioloides* R. Br.[a]	C_4	Akita et al. 1969 ([A]); Govindarajalu 1978 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$); JB (Ac: *Bruhl,* 16 Apr 1986 CANB)
Queenslandiella hyalina (Vahl) Ballard, as *Cyperus hyalinus* Vahl[a], as *Queenslandiella*[b]	C_4	Lerman and Raynal 1972 (A)[b]; Govindarajalu 1975*b* ([A])[a]; JB (Ac: *Bogdan 5353* K; *Cooray 69121001R* PDA; *van Oostroom 13596* CANB); LR ($\delta^{13}C$: −13.7, *Boivin s. n.*, ca. 1850)
Reedia spathacea F. Muell.	C_3	Takeda et al. 1985 (A); JB (A: *Maslin 1682c* CANB)
Rhynchocladium steyermarkii (T. Koyama) T. Koyama	C_3	JB (A: *Davidse 27377* NY)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
Rhynchospora affinis W. Fitzg.	C_4	Takeda et al. 1980 (Ar); Takeda et al. 1985 (Ar. $\delta^{13}C$); Ueno and Koyama 1987 (Ar)
R. alba (L.) Vahl	C_3	Takeda et al. 1980 (A. Γ); Ueno and Koyama 1987 (A)
R. albescens (Miq.) Kük.	C_3	Ueno and Koyama 1987 (A)
R. albiceps Kunth	C_3	Ueno and Koyama 1987 (A)
R. albomarginata Kük.	C_3	Ueno and Koyama 1987 (A)
R. albotuberculata Kük.	C_4	Ueno and Koyama 1987 (Ar)
R. amazonica Poepp. & Kunth	C_3	Ueno and Koyama 1987 (A)
R. andina Kük.	C_3	Ueno and Koyama 1987 (A)
R. angustifolia Palla	C_3	Ueno and Koyama 1987 (A)
R. arechavaletae Boeck.	C_3	Ueno and Koyama 1987 (A)
''*R. argentina* Standley'' [?= *R. argentea* Standley]	C_3	Ueno and Koyama 1987 (A)
R. aripoensis Britton	C_3	Ueno and Koyama 1987 (A)
R. aristata Boeck.	C_3	Ueno and Koyama 1987 (A)
R. armerioides J. Presl & C. Presl	C_4+	Ueno and Koyama 1987 (Ac); JB (Ac: *McKee 10847* CANB. $\delta^{13}C$: −10.0, *McKee 10847*)
R. baldwinii A. Gray	C_3	Ueno and Koyama 1987 (A)
R. barbata (Vahl) Kunth	C_4+	Ueno and Koyama 1987 (Ac); JB (Ac: *King 721* CANB; *McKee 10573* CANB. $\delta^{13}C$: −10.4, −10.8, *King 721*)
R. berteroi (Spreng.) C. B. Clarke, as *R. pusilla* (Sw.) Griseb.	C_3	Ueno and Koyama 1987 (A)
R. biflora Boeck.	C_3	Ueno and Koyama 1987 (A)
R. brachychaeta C. Wright	C_3	Ueno and Koyama 1987 (A)
R. brevirostris Griseb.	C_3	Ueno and Koyama 1987 (A)
R. brownii Roem & Schult., as *R. rugosa*[a], as *R. rugosa* subsp. *brownii* (Roem. & Schult.) Koyama[b]	C_3+	Govindarajalu 1975*a* ([A])[a]; Gilliland and Gordon-Gray 1978 (US)[a]; Takeda et al. 1980 (A. Γ)[b]; Ueno and Koyama 1987 (A)[a]
R. cacuminicola Gale	C_3	Ueno and Koyama 1987 (A)
R. caduca Elliott	C_3	Ueno and Koyama 1987 (A)
R. californica Gale	C_3	Ueno and Koyama 1987 (A)
R. candida (Nees) Boeck.	C_3	Ueno and Koyama 1987 (A); LR ($\delta^{13}C$: −27.0, *Humbert 18779*)
R. capillacea Torr.	C_3	Ueno and Koyama 1987 (A)
R. capitata (Kunth) Roem. & Schult.	C_4	Ueno and Koyama 1987 (Ar)
R. caracasana (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. cariciformis Nees	C_3	Ueno and Koyama 1987 (A)
R. cephalantha A. Gray (incl. *R. cephalantha* var. *pleiocephala* Fernald & Gale)	C_3	Ueno and Koyama 1987 (A); JB (A: *Smith,* 17 Aug 1939 BRI. $\delta^{13}C$: −26.5, *Smith,* 17 Aug 1939)
R. cephalotes (L.) Vahl	C_3	Ueno and Koyama 1987 (A); JB (A: *McKee 10709* CANB. $\delta^{13}C$: −26.9, −27.5, *McKee 10709*)
R. cernua Griseb.	C_3	Ueno and Koyama 1987 (A)
R. chalarocephala Fernald & Gale	C_3	Ueno and Koyama 1987 (A)
R. chapmanii M. A. Curtis	C_3	Ueno and Koyama 1987 (A)
R. chinensis Nees & Meyen ex Wight	C_3	Takeda et al. 1980 (A. Γ)
R. fauriei Franch., as *R. chinensis* subsp. *fauriei* (Franch.) Koyama	C_3	Takeda et al. 1980 (A)
R. ciliaris (Michx.) Vahl	C_3	Ueno and Koyama 1987 (A)
R. ciliata Vahl, as *R. nervosa* subsp. *ciliata* (Vahl) T. Koyama[a], as *Dichromena ciliata* Vahl[b]	C_3	Thomas 1984 (A)[a]; LR ($\delta^{13}C$: −30.4, *Husnot 31*)[b]
R. ciliolata Boeck.	C_3	Ueno and Koyama 1987 (A)
R. colorata (L.) H. Pfeiff., as *R. stellata* (Lam.) Griseb.[a]	C_3	Thomas 1984 (A); Ueno and Koyama 1987 (A)[a]; JB (A: *s. coll.* MEL 1543827)
R. comata (Link) Roem. & Schult.	C_3	Ueno and Koyama 1987 (A)
R. compressa J. Carey ex Chapm.	C_3	Ueno and Koyama 1987 (A)
R. confinis (Nees) C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. confusa F. Ballard (*Syntrinema brasiliense* Radk. & H. Pfeiff.)	C_4	Ueno and Koyama 1987 (Ar); JB (Ar, *Luetzelburg 1223* M. $\delta^{13}C$: −10.0, *Luetzelburg 1223*)
R. consanguinea (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. coriifolia Boeck.	C_3	Ueno and Koyama 1987 (A)
R. corniculata (Lam.) A. Gray	C_3	Ueno and Koyama 1987 (A)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
R. corymbosa (L.) Britton, as *R. aurea* Vahl[a]	C_3	Hofstra et al. 1972 (A. Γ); Govindarajalu 1975*a* ([A]); Gilliland and Gordon-Gray 1978 (US); Prakash et al. 1976 (A)[a]; Takeda et al. 1980 (A); Bruhl et al. 1987 (A. B); Ueno and Koyama 1987 (A); JB (A: *Bruhl 196* CANB; *Pullen 8152* CANB. Γ: 46, *Bruhl 196*)
R. cubensis Griseb.	C_3	Ueno and Koyama 1987 (A)
R. curtissii Britton	C_3	Ueno and Koyama 1987 (A)
R. curvula Griseb.	C_4	Ueno and Koyama 1987 (Ar)
R. cyperoides (Sw.) Mart.	C_3	Ueno and Koyama 1987 (A); JB (A: *Eggers* Jul 1881 BRI. $\delta^{13}C$: −25.5, *Eggers,* Jul 1881)
R. decurrens Chapm.	C_3	Ueno and Koyama 1987 (A)
R. dentinux C. B. Clarke	C_4	Ueno and Koyama 1987 (Ar)
R. diamantina C. B. Clarke ex Kük.	C_4	Ueno and Koyama 1987 (Ar)
R. dissitiflora Steud.	C_3	Ueno and Koyama 1987 (A)
R. divergens Chapm. ex M. A. Curtis	C_3	Ueno and Koyama 1987 (A)
R. dives Standley, as *R. orizabensis* C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. duckei R. Gross	C_3	Ueno and Koyama 1987 (A)
R. ebracteata (Standley) H. Pfeiff.	C_3	Ueno and Koyama 1987 (A)
R. elatior Kunth	C_4	Ueno and Koyama 1987 (Ar)
R. elliottii A. Dietrich, as *R. schoenoides* (Elliott) A. Wood	C_3	Ueno and Koyama 1987 (A)
R. elongata Boeck.	C_3	Ueno and Koyama 1987 (A)
R. emaciata (Nees) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. exaltata Kunth	C_3	Ueno and Koyama 1987 (A)
R. eximia (Nees) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. faberi C. B. Clarke	C_3	Akita et al. 1969 ([A]); Takeda et al. 1980 (A. Γ); Ueno and Koyama 1987 (A)
R. fascicularis (Michx.) Vahl	C_3	Ueno and Koyama 1987 (A)
R. filifolia A. Gray	C_3	Ueno and Koyama 1987 (A)
R. filiformis Vahl, as *R. podosperma* C. Wright	C_3	Ueno and Koyama 1987 (A)
R. flexuosa C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. fusca (L.) Aiton f.	C_3	Ueno and Koyama 1987 (A)
R. gigantea Link	C_3	Ueno and Koyama 1987 (A)
R. glaziovii Boeck.	C_3	Ueno and Koyama 1987 (A)
R. globosa (Kunth) Roem. & Schult.	C_4	Ueno and Koyama 1987 (Ar)
R. globularis (Chapm.) Small	C_3	Ueno and Koyama 1987 (A)
R. glomerata (L.) Vahl	C_3	Ueno and Koyama 1987 (A)
R. gollmeri Boeck.	C_3	Ueno and Koyama 1987 (A)
R. gracilenta A. Gray	C_3	Ueno and Koyama 1987 (A)
R. gracillima Thwaites	C_3	Govindarajalu 1975*a* ([A]); Ueno and Koyama 1987 (A)
R. graminea Uittien	C_3	Ueno and Koyama 1987 (A)
R. grayi Kunth	C_3	Ueno and Koyama 1987 (A)
R. grisebachii Boeck. ex Urb.	C_3	Ueno and Koyama 1987 (A)
R. hassleri C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. heterocaulis C. B. Clarke	C_4	Ueno and Koyama 1987 (Ac)
R. heterochaeta S. T. Blake[a], as *R. longisetis* R. Br. [voucher re-determined by KLW at NSW][b], as *R. wightiana* (Nees) Steud. [voucher *Ramos 21743* re-determined by KLW at NSW][c]	C_4	Takeda et al. 1980 (Ar)[a]; Takeda et al. 1985 (Ar. $\delta^{13}C$)[a]; Ueno and Koyama 1987 (Ar)[a,b,c]; JB (Ar, *Bruhl 213* CANB)[a]
R. hieronymii Boeck.	C_3	Ueno and Koyama 1987 (A)
R. hirsuta Vahl	C_3	Ueno and Koyama 1987 (A)
R. hirta (Nees) Boeck.	C_4	Ueno and Koyama 1987 (Ac)
R. hispidula (Vahl) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. holoschoenoides (Rich.) Herter	C_3	Gilliland and Gordon-Gray 1978 (US); Takeda et al. 1980 (A)
R. inexpansa (Michx.) Vahl	C_3	Ueno and Koyama 1987 (A)
R. joveroensis Britton	C_3	Ueno and Koyama 1987 (A)
R. junciformis (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. knieskernii J. Carey	C_3	Ueno and Koyama 1987 (A)
R. kunthii Nees ex Kunth	C_3	Ueno and Koyama 1987 (A)
R. lapensis C. B. Clarke	C_3	Ueno and Koyama 1987 (A)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
R. leae C. B. Clarke	C_4	Takeda et al. 1980 (Ar); Takeda et al. 1985 (Ar. $\delta^{13}C$); Ueno and Koyama 1987 (Ar)
R. lechleri Steud.	C_3	Ueno and Koyama 1987 (A)
R. leptorrhyncha C. Wright	C_3	Ueno and Koyama 1987 (A)
R. lindeniana Griseb.	C_3	Ueno and Koyama 1987 (A)
R. longibracteata Rottb.	C_3	Ueno and Koyama 1987 (A); JB (A: *McKee 107572* CANB. $\delta^{13}C$: −24.0, *McKee 107572*)
R. longiflora C. Presl	C_3	Ueno and Koyama 1987 (A)
R. longisetis R. Br.	C_4	Takeda et al. 1980 (Ar); Takeda et al. 1985 (Ar. $\delta^{13}C$)
R. luzuliformis Boeck.	C_3	Ueno and Koyama 1987 (A)
R. macrochaeta Steud.	C_3	Ueno and Koyama 1987 (A)
R. malasica C. B. Clarke	C_3	Takeda et al. 1980 (A); Ueno and Koyama 1987 (A)
R. marisculus Nees	C_3	Ueno and Koyama 1987 (A)
R. megalocarpa A. Gray	C_3	Ueno and Koyama 1987 (A)
R. mexicana (Liebm.) Steud.	C_4	Ueno and Koyama 1987 (Ac)
R. micrantha Vahl	C_3	Ueno and Koyama 1987 (A)
R. microcarpa Baldwin ex A. Gray	C_3	Ueno and Koyama 1987 (A)
R. miliacea (Lam.) A. Gray	C_3	Ueno and Koyama 1987 (A)
R. mixta Britton	C_3	Ueno and Koyama 1987 (A)
R. nardifolia (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. nervosa (Vahl) Boeck., as *Dichromena nervosa* Vahl[a]	C_3	Ueno and Koyama 1987 (A); JB (A: *s. coll.* MEL 153840); LR ($\delta^{13}C$: −34.1, Serre Orsay cult., 1972)[a]
R. nipensis Britton	C_3	Ueno and Koyama 1987 (A)
R. nitens (Vahl) A. Gray	C_3	Ueno and Koyama 1987 (A)
R. nivea Boeck.	C_3	Ueno and Koyama 1987 (A)
R. odorata C. Wright ex Griseb.	C_3	Ueno and Koyama 1987 (A)
R. oligantha A. Gray	C_3	Ueno and Koyama 1987 (A)
R. organensis C. B. Clarke, as *R. rostrata* Lindm.	C_3	Ueno and Koyama 1987 (A)
R. patuligluma C. B. Clarke ex Lindm., as *R. pallida* (Nees) Steud.	C_3	Ueno and Koyama 1987 (A)
R. paraensis Schrad. ex Kunth	C_3	Ueno and Koyama 1987 (A)
R. perrieri Cherm.	C_3	Gilliland and Gordon-Gray 1978 (US); Takeda et al. 1980 (A); Hesla et al. 1982 ($\delta^{13}C$); Ueno and Koyama 1987(A)
R. pilosa (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. plumosa Elliott	C_3	Ueno and Koyama 1987 (A)
R. polyantha Steud.	C_3	Ueno and Koyama 1987 (A)
R. polyphylla Vahl	C_3	Ueno and Koyama 1987 (A)
R. praecincta Maury	C_3	Ueno and Koyama 1987 (A)
R. pruinosa Griseb.	C_3	Ueno and Koyama 1987 (A)
R. pterochaeta F. Muell.	C_4	Takeda et al. 1980 (Ar); Takeda et al. 1985 (Ar. $\delta^{13}C$); Ueno and Koyama 1987 (Ar); KW (A: *Blake 13395*)
R. pubera (Vahl) Boeck.	C_3	Thomas 1984 (A); Ueno and Koyama 1987 (A)
R. punctata Elliott	C_3	Ueno and Koyama 1987 (A)
R. pusilla Chapm. ex M. A. Curtis[a], as *R. intermixta* C. Wright[b]	C_3	Ueno and Koyama 1987 (A)[a,b]
R. racemosa C. Wright	C_3	Ueno and Koyama 1987 (A)
R. radicans (Schlecht. & Cham.) H. Pfeiff.	C_3	Ueno and Koyama 1987 (A)
R. radicans subsp. *microcephala* (Bertero ex Spreng.) W. W. Thomas, as *R. microcephala* (Bertero ex Spreng.) Kük.[a]	C_3	Thomas 1984 (A); Ueno and Koyama 1987 (A)[a]
R. rariflora (Michx.) Elliott	C_3	Ueno and Koyama 1987 (A)
R. recurvata (Nees) Steud.	C_3	Ueno and Koyama 1987 (A)
R. reptans (Rich.) Boeck., as *Dichromena reptans* (Rich.) Pers.[a]	C_3	Thomas 1984 (A); Ueno and Koyama 1987 (A); LR ($\delta^{13}C$: −28.5, *Smith 2113*)[a]
R. ridleyi C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. robusta (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. roraimae Kük.	C_3	Ueno and Koyama 1987 (A)
R. rubra (Lour.) Makino subsp. *rubra,* as *R. parva* (Nees) Steud. var. *boninensis* (Nakai ex Tuyama) T. Koyama[a]	C_4	Govindarajalu 1975*a* ([A]); Takeda et al. 1980 (Ar. Γ); Takeda et al. 1980 (Ar)[a]; Bruhl et al. 1987 (Ar. B); Gilliland and Gordon-Gray 1978 (USr); Ueno and Koyama 1987 (Ar); Ueno et al. 1986 (Ar. B); Ueno et al. 1988*b* (USr); Bruhl and Perry 1995 (USr); Soros and Dengler 2001 (Ar); JB (Ar, *Bruhl 573* CANB)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
subsp. *africana* J. Raynal	C_4	Takeda et al. 1980 (Ar); SCV ($\delta^{13}C$: −10.21, *Schlechter 12090*)
R. rufa (Nees) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. rugosa (Vahl) Gale	C_3	Takeda et al. 1980 (A)
R. schiedeana (Schlecht.) Kunth	C_3	Ueno and Koyama 1987 (A)
R. schomburgkiana (Boeck.) Koyama (*Micropapyrus viviparoides* Suess.)	C_3	Ueno and Koyama 1987 (A); JB (A: *Luetzelburg 22381* M)
R. scirpoides (Torr.) Griseb.	C_3	Ueno and Koyama 1987 (A)
R. sclerioides Hook. & Arn.	C_3	Ueno and Koyama 1987 (A)
R. scutellata Griseb. (*R. pringlei* Greenman)	C_3	Ueno and Koyama 1987 (A); JB (A: *s. coll.* MEL 1543836)
R. seslerioides Griseb.	C_3	Ueno and Koyama 1987 (A)
R. setigera (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A); JB (A: *Montes 1173*. $\delta^{13}C$: −27.6, −27.8, *Montes 1173*)
R. shaferi Britton	C_3	Ueno and Koyama 1987 (A)
R. siguaneana Britton	C_3	Ueno and Koyama 1987 (A)
R. simplex (Kük.) Kük.	C_3	Ueno and Koyama 1987 (A)
R. solitaria R. M. Harper	C_3	Ueno and Koyama 1987 (A)
R. sp. (*McKee 10493* CANB)	C_3	JB (A. $\delta^{13}C$: −25.0, −25.1)
R. sp. A (*Wilson 5171*), as *R. exserta* C. B. Clarke[a]	C_4	Ueno and Koyama 1987 (Ar)[a]; KW (A)
R. sp. B (*Cowie 1123*)	C_3	KW (A: *Cowie 1123, Craven 6196*)
R. sp. C (*Dunlop 5330*)	C_4	KW (A)
R. splendens Lindm.	C_3	Ueno and Koyama 1987 (A)
R. stenocarpa Kunth	C_3	Ueno and Koyama 1987 (A)
R. stenophylla Chapm.	C_3	Ueno and Koyama 1987 (A)
R. subimberbis Griseb.	C_4	Ueno and Koyama 1987 (Ac)
R. subplumosa C. B. Clarke	C_4	Ueno and Koyama 1987 (Ac#)
R. subquadrata Cherm.	C_3	Ueno and Koyama 1987 (A)
R. subtenuifolia Kük., as *R. submarginata* Kük. [voucher re-determined by KLW at NSW][a], as *R. tenuifolia* Benth. non Griseb.[b]	C_4	Takeda et al. 1980 (Ar)[b]; Bruhl et al. 1987 (Ar. B); Ueno and Koyama 1987 (Ar)[a]; Takeda et al. 1985 (Ar. $\delta^{13}C$)[b]; JB (Ar, *Bruhl 344* CANB)
R. subtilis Boeck.	C_3	Ueno and Koyama 1987 (A)
R. tenella (Nees) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. tenerrima Nees ex Spreng. subsp. *tenerrima,* as *R. setacea* (Berg) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. tenuifolia Griseb.	C_3	Ueno and Koyama 1987 (A)
R. tenuis Link	C_3	Ueno and Koyama 1987 (A)
R. terminalis (Nees) Steud.	C_4	Ueno and Koyama 1987 (Ar)
R. torreyana A. Gray	C_3	Ueno and Koyama 1987 (A)
R. trichochaeta C. B. Clarke	C_4	Ueno and Koyama 1987 (Ac)
R. triflora Vahl	C_3	Ueno and Koyama 1987 (A)
R. trispicata (Nees) Schrad. ex Steud.	C_3	Ueno and Koyama 1987 (A)
R. tuerckheimii C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. umbraticola Poepp. & Kunth	C_3	Ueno and Koyama 1987 (A)
R. uniflora Boeck.	C_3	Ueno and Koyama 1987 (A)
R. velutina (Kunth) Boeck.	C_3	Ueno and Koyama 1987 (A)
R. viridilutea C. B. Clarke	C_3	Ueno and Koyama 1987 (A)
R. vulcani Boeck.	C_3	Ueno and Koyama 1987 (A)
R. warmingii Boeck.	C_3	Ueno and Koyama 1987 (A)
R. wightiana (Nees) Steud.	C_4	Bruhl et al. 1987 (Ar. B); Ueno and Koyama 1987 (A); JB (Ar, *Bruhl 404* CANB. Γ: 1, *Bruhl 404*)
	C_3+	Govindarajalu 1975*a* ([A])
R. wrightiana Boeck.	C_3	Ueno and Koyama 1987 (A)
R. yasudana Makino	C_3	Ueno and Koyama 1987 (A)
subsp. *leviseta* T. Koyama	C_3	Takeda et al. 1980 (A. Γ)
Schoenoplectus americanus (Pers.) Volkart ex Schinz & R. Keller, as *Scirpus olneyi* A. Gray	C_3	Bender 1971 ($\delta^{13}C$)
S. articulatus (L.) Palla, as *Scirpus articulatus* L.[a]	C_3	Govindarajalu 1976 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]; Takeda et al. 1985 (A. $\delta^{13}C$)[a]; LR ($\delta^{13}C$: −29.2, *Boivin s. n.*, ca. 1850)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
S. brachyceras (Hochst. ex A. Rich.) K. Lye, as *Scirpus brachyceras* Hochst. ex A. Rich.[a], as *Scirpus inclinatus* (Del.) Aschers. & Schweinf.[b]	C_3	Govindarajalu 1976 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[b]; SCV ($\delta^{13}C$: −23.71, *Rogers 6431*)
S. californicus (C. A. Mey.) Soják, as *S. riparius* (J. Presl & C. Presl) Palla	C_3	LR ($\delta^{13}C$: −25.4, *St Hilaire C2 2302,* −27.5, *Infantes 6228*)
S. confusus (N. E. Br.) K. Lye, as *Scirpus confusus* N. E. Br.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
subsp. *natalitius* J. Browning	C_3	SCV ($\delta^{13}C$: −24.11, *Gibbs 106*)
S. corymbosus (Roem. & Schult.) J. Raynal	C_3	LR ($\delta^{13}C$: −27.5, *Chevalier 8999*)
S. dissachanthus (S. T. Blake) J. Raynal, as *Scirpus dissachanthus* S. T. Blake	C_3	Takeda et al. 1985 (A)
S. junceus (Willd.) J. Raynal, as *Scirpus aureiglumis* S. S. Hooper	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. juncoides (Roxb.) Palla, as *Scirpus juncoides* Roxb.	C_3	Govindarajalu 1976 ([A])
S. lacustris (L.) Palla	C_3	Troughton et al. 1974 ($\delta^{13}C$); JB (A: *Holm-Nielsen,* 23 July 1970 BRI)
S. laevis (S. T. Blake) J. Raynal, as *Scirpus laevis* S. T. Blake	C_3	Takeda et al. 1985 (A)
S. lateriflorus (J. F. Gmel.) K. Lye, as *Scirpus lateriflorus* J. F. Gmel.[a]	C_3	Govindarajalu 1976 ([A])[a]; Takeda et al. 1985 (A)[a]; JB (A: *Bruhl 454* CANB)
	C_4+	Hofstra et al. 1972 (A. Γ)
S. lineolatus (Franch. & Sav.) T. Koyama	C_3	Lin et al. 1993 (A)
S. litoralis (Schrad.) Palla, as *Scirpus litoralis* Schrad.[a], as *Scirpus littoralis* [sic][b]	C_3	Govindarajalu 1976 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[b]; Takeda et al. 1985 (A)[a]; Bruhl et al. 1987 (A. B); JB (A: *Bruhl 432* CANB. Γ: 46, *Bruhl 538* CANB)
S. mucronatus (L.) Palla ex Kerner, as *Scirpus mucronatus* L.[a]	C_3	Govindarajalu 1976 ([A])[a]; JB (A: *Bruhl 460, 538* CANB); LR ($\delta^{13}C$: −27.2, *Pobéguin 2191*)
S. muricinux (C. B. Clarke) J. Raynal	C_3	KW (A: *Smook 6866*)
S. paludicola (Kunth) Palla	C_3	KW (A: *Musil 105*)
S. praelongatus (Poir.) J. Raynal	C_3	SCV ($\delta^{13}C$: −23.99, *Bolus 9476*)
S. pulchellus (Kunth) J. Raynal	C_4+	SCV ($\delta^{13}C$: −10.59, *Potts 1076*)
S. pungens (Vahl) Palla, as *Scirpus americanus* Pers.	C_3	Takeda et al. 1985 (A)
S. purshianus (Fernald) M. T. Strong, as *Scirpus juncoides* Roxb.	C_3	Lin et al. 1993 (A)
S. roylei (Nees) Ovczinn & Czukav., as *Scirpus roylei* (Nees) Parker[a], as *Scirpus quinquefarius* Buch.-Ham. ex Boeck[b]	C_3	Sabnis 1921 ([A])[b]; Govindarajalu 1976 ([A])[a]; Hesla et al. 1982 ($\delta^{13}C$)[a]
S. senegalensis (Steud.) J. Raynal, as *Schoenoplectus jacobii* (C. E. Fisch.) K. Lye[a], as *Scirpus jacobi* C. E. Fisch.[b], as *Scirpus jacobii*[c]	C_3	Govindarajalu 1976 ([A])[b]; Hesla et al. 1982 ($\delta^{13}C$)[c]; LR ($\delta^{13}C$: −27.5, *Heudelot 319*)[a]
S. subulatus (Vahl) K. Lye	C_3	LR ($\delta^{13}C$: −27.2, *Trochain 3191*)
S. supinus (L.) Palla	C_3	LR ($\delta^{13}C$: −27.9, *Sacleux 2561*)
S. validus (Vahl) A. Löve & D. Löve, as *Scirpus validus* Vahl[a]	C_3	Bender 1971 ($\delta^{13}C$)[a]; Govindarajalu 1976 ([A])[a]; JB (A: *Bruhl s. n.,* Sullivans Creek CANB)
S. wallichii (Nees) T. Koyama	C_3	Lin et al. 1993 (A)
Schoenoxiphium lehmannii (Nees) Steud.	C_3	LR ($\delta^{13}C$: −30.6, *Napper 1931*)
S. sparteum (Wahlenb.) C. B. Clarke	C_3	JB (A: *Smook 995* BRI. $\delta^{13}C$: −25.4, *Smook 995*); SCV ($\delta^{13}C$: −27.71, *Pegler 1196*)
Schoenus acuminatus (R. Br.) Nees	C_3	KW (A: *Wilson 2960*)
S. andrewsii W. V. Fitzg.	C_3	KW (A: *Fitzgerald* NSW 74075)
S. apogon Roem. & Schult.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); Ueno and Takeda 1992 (A); JB (A: *Bruhl,* Black Mtn. CANB); KW (A: *Gardner 924*; *Ratkowsky 1576*)
S. armeria Nees	C_3	KW (A: *Blake 18102*)
S. asperocarpus F. Muell.	C_3	KW (A: *Wilson 3033*)
S. benthamii F. Muell.	C_3	KW (A: *Fitzgerald* NSW 74033)
S. bifidus (Nees) Boeck.	C_3	KW (A: *Wilson 3040*)
S. breviculmis Benth.	C_3	Takeda et al. 1985 (A)
var. *tepperi* (F. Muell.) Kük.	C_3	KW (A: *Beauglehole 49577*; *Wilson 3157*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
S. brevifolius R. Br.	C_3	Takeda et al. 1985 (A); KW (A: *Balansa 700*; *Johnson 7476*; *Petrie* NSW 149802); LR ($\delta^{13}C$: −28.6, *Filhol 829*)
S. brevisetis (R. Br.) Roem. & Schult.	C_3	KW (A: *Wilson 3058*)
S. caespititius W. V. Fitzg.	C_3	KW (A: *Wilson 2884, 2978*)
S. calostachyus (R. Br.) Roem. & Schult.	C_3	Takeda et al. 1985 (A); Ueno and Takeda 1992 (A); KW (A: *Henty & Foreman* NGF 49405; *Wilson 3693*; *s. coll.* NSW 149804)
S. calyptratus Kük.	C_3	KW (A: *Ratkowsky 1583*)
S. carsei Cheeseman	C_3	KW (A: *Beauglehole 33397*; *Sinclair* NSW 149803)
S. curvifolius (R. Br.) Roem. & Schult.	C_3	Takeda et al. 1985 (A); KW (A: *Coveny 8185*)
S. curvulus F. Muell.	C_3	KW (A: *Elmer 11379*; *Frodin* NGF 26818)
S. deformis (R. Br.) Roem. & Schult.	C_3	Takeda et al. 1985 (A); KW (A: *Beauglehole 38249*)
S. discifer Tate	C_3	KW (A: *Newbey 4861*)
S. efoliatus F. Muell.	C_3	KW (A: *Coveny 8120*; *Wilson 2958*)
S. ericetorum R. Br.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Blake 10782* BRI); KW (A: *Blake 15918*; *Hamilton* NSW 74127)
S. evansianus K. L. Wilson	C_3	KW (A: *Wilson 1709*)
S. falcatus R. Br.	C_3	Takeda et al. 1985 (A); Ueno and Takeda 1992 (A); KW (A: *Beauglehole 11486*; *Ramos BS32717*)
S. ferrugineus L.	C_3	KW (A: *Charpin* NSW 149911)
S. fluitans Hook. f.	C_3	Takeda et al. 1985 (A)
S. grammatophyllus F. Muell.	C_3	KW (A: *Blake 17984*)
S. grandiflorus Nees ex Lehm.	C_3	KW (A: *Fitzgerald* NSW 4337; *Salasoo 4017*)
S. hexandrus F. Muell. & Tate	C_3	KW (A: *Whaite 4063*)
S. imberbis (R. Br.) Poir.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl,* Grose Road CANB); KW (A: *Melville 2769*; *Tindale* NSW 18250)
S. insolitus K. L. Wilson	C_3	KW (A: *Wilson 2690*)
S. juvenis C. B. Clarke	C_3	KW (A: *Jaffré 554*)
S. kennyi F. M. Bailey	C_3	Takeda et al. 1985 (A); KW (A: *Coveny 10065*; *Wilson 3453*)
S. laevinux (Kük.) Ohwi	C_3	KW (A: *Croft* LAE 68984)
S. lanatus Labill.	C_3	KW (A: *Coveny 7986*)
S. latelaminatus Kük.	C_3	KW (A: *Beauglehole 29865*)
S. latitans S. T. Blake	C_3	KW (A: *Wilson 2625*)
S. lepidosperma (F. Muell.) K. L. Wilson subsp. *lepidosperma*	C_3	KW (A: *Archer* NSW 74168; *Corrick 6176*)
S. lepidosperma subsp. *pachylepis* (S. T. Blake) K. L. Wilson	C_3	KW (A: *Coveny 10477*; *Hamilton* NSW 74162)
S. maschalinus Roem. & Schult.	C_3	JB (A: *Bruhl,* 7 Oct 1986 CANB); KW (A: *Wilson 3085*)
S. melanostachys R. Br.	C_3	Takeda et al. 1985 (A); KW (A: *Constable 5440, 5744*)
S. microcephalus Kern	C_3	KW (A: *McKee 7990*)
S. minutulus F. Muell.	C_3	KW (A: *Crisp 5213*)
S. moorei Benth.	C_3	KW (A: *Coveny 2323, Hamilton* NSW 149805)
S. multiglumis Benth.	C_3	KW (A: *Wilson 3007*)
S. neocaledonicus C. B. Clarke	C_3	KW (A: *MacKee 21092*)
S. nigricans L.	C_3	Mateu Andres 1991 ([A]); KW (A: *Curtiss 130*; *Kneucker 44a*)
S. nitens (R. Br.) Roem. & Schult.	C_3	Takeda et al. 1985 (A); KW (A: *Lucas* NSW 74160)
S. obtusifolius (Nees ex Lehm.) Boeck.	C_3	KW (A: *Wilson 2975*)
S. ornithopodioides (Kük.) S. T. Blake	C_3	KW (A: *Johnson* NSW 55308)
S. paludosus (R. Br.) Roem. & Schult. (*Tricostularia paludosa* (R. Br.) Benth.)	C_3	Takeda et al. 1985 (A); JB (A: *Burbidge,* 4 Apr 1948 CANB); KW (A: *Blake 13131; Wilson 3116*)
S. pauciflorus (Hook. f.) Hook. f.	C_3	KW (A: *Briggs* NSW 90812)
S. pedicellatus (R. Br.) Roem. & Schult.	C_3	KW (A: *Fitzgerald* NSW 74348)
S. pleiostemoneus F. Muell.	C_3	KW (A: *Coveny 7811; Wilson 2626*)
S. punctatus R. Br.	C_3	KW (A: *Latz 7397*)
S. racemosus J. Black	C_3	Takeda et al. 1985 (A)
S. rigens S. T. Blake	C_3	KW (A: *Blake 17985*)
S. scabripes Benth.	C_3	KW (A: *Coveny 4961*)
S. sculptus (Nees) Boeck.	C_3	Takeda et al. 1985 (A)
S. sesquispiculus C. B. Clarke	C_3	KW (A: *Newbey 4207*)
S. sp. nov. A1 (*Crisp 5589*)	C_3	KW (A: *Crisp 5589*)
S. sp. nov. A2 (*Crisp 5209*)	C_3	KW (A: *Crisp 5209*)
S. sp. aff. *brevifolius* (*Wilson 3001*)	C_3	KW (A: *Wilson 3001*)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
S. sp. aff. *brevisetis* (*Wilson 2870*)	C_3	KW (A: *Fitzgerald* NSW 74087; *Newbey 6493*; *Whittaker & Niering D68-6*; *Wilson 2870, 2926, 2935, 2977, 3014*)
S. sp. aff. *elegans* S. T. Blake (*Wilson 3041*)	C_3	KW (A: *Wilson 3041*)
S. sp. aff. *falcatus* (*Lazarides 7859*)	C_3	KW (A: *Lazarides 7859*)
S. sp. aff. *laevigatus* (*Crisp 4966*)	C_3	KW (A: *Crisp 4966*)
S. sp. aff. *lanatus* (*Crisp 5472*)	C_3	KW (A: *Crisp 5472*)
S. sp. aff. *pleiostemoneus* (*Wilson 2903*)	C_3	KW (A: *Canning WA/68 7274*; *Coveny 3281, 3293a*; *Wilson 2903*)
S. sp. aff. *punctatus* (*Dunlop 4444*)	C_3	KW (A: *Dunlop 4444*)
S. sp. aff. *sparteus* (*Henderson 1155*)	C_3	KW (A: *Henderson 1155*)
S. sp. aff. *subbarbatus* (*Crisp 5284*)	C_3	KW (A: *Crisp 5284*)
S. sp. aff. *subfascicularis* (*Wilson 2792*)	C_3	KW (A: *Wilson 2792, 2877*)
S. sp. aff. *trachycarpus* (*Wilson 2904*)	C_3	KW (A: *Wilson 2904*)
S. sp. nov. 'Grey Rhizome' (*Wilson 2922*)	C_3	KW (A: *Wilson 2922*)
S. sp. nov. 'Murchison' (*Haegi 1952*)	C_3	KW (A: *Haegi 1952*)
S. sparteus R. Br.	C_3	Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A); KW (A: *Blake 23116*; *Henty & Foreman* NGF 49415)
S. subaphyllus Kük.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Cunningham 3309*; *Pickard 2495*)
S. subbarbatus Kük.	C_3	KW (A: *Wilson 2976*)
S. subbarbatus Kük vel sp. nov. aff.	C_3	KW (A: *Wilson 2864*)
S. subbulbosus Benth.	C_3	KW (A: *Wilson 2959*)
S. subfascicularis Kük.	C_3	KW (A: *Wilson 2700, 2724*)
S. subflavus Kük. vel sp. nov. aff.	C_3	KW (A: *Wilson 2603, 2776, 2923*)
S. sublaxus Kük.	C_3	KW (A: *Wilson 2885*)
S. submicrostachyus Kük.	C_3	KW (A: *Wilson 2871*)
S. tendo (Hook. f.) Hook. f. var. *triander* Kük.	C_3	KW (A: *Franc 2174*)
S. tesquorum J. Black	C_3	KW (A: *Melville 1935*)
S. trachycarpus F. Muell.	C_3	KW (A: *Melville 4408*)
S. turbinatus (R. Br.) Roem. & Schult.	C_3	KW (A: *Blake 7490*; *Rodway* NSW 74069)
S. unispiculatus F. Muell. ex Benth.	C_3	KW (A: *Blake 18101*)
S. vaginatus F. Muell. ex Benth.	C_3	KW (A: *Sharpe 2409*)
S. villosus R. Br.	C_3	Takeda et al. 1985 (A); KW (A: *Blakely* NSW 74308; *Boorman* NSW 122302)
Scirpodendron ghaeri (Gaertn.) Merr.	C_3	Koyama 1967 ([A]); Takeda et al. 1985 (A); JB (A: *White BSIP 75* CANB; *Stevens* LAE 58624); KW (A: *Wilson 10194*); LR ($\delta^{13}C$: −25.1, −25.6, *Buwalda 5861*)
Scirpoides holoschoenus (L.) Soják, as *Holoschoenus vulgaris* Link[a], as *Scirpus holoschoenus* L.[b]	C_3	Mateu Andres 1991 ([A])[b]; JB (A: *Caine* NSW 181479); LR ($\delta^{13}C$: −27.4, *Bourgeau 490*)[a]
Scirpus macrolepis Philippi [?= *Phylloscirpus acaulis*; S. Dhooge, pers. comm.]	C_3	Ponessa et al. 1997 ([A])
S. polystachyus F. Muell.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Austin 86* CANB; *Bruhl 25* CANB)
S. sylvaticus L.	C_3	LR ($\delta^{13}C$: −27.5, *Maire s. n.,* La Ferté Alais, 1841)
Scleria abortiva Nees ex Kunth	C_3	Chermezon 1926 ([A])
S. angusta Nees ex Kunth	C_3	SCV ($\delta^{13}C$: −29.19, *Wood 3863*)
S. bancana Miq.	C_3	Prakash et al. 1976 (A)
S. brownii Kunth	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
S. bulbifera A. Rich.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. ciliaris Nees	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl 295, 505* CANB; *Hyland 8380* CANB. Γ: 46, *Bruhl 295,* 52, *Bruhl 505*)
S. corymbosa Roxb.	C_3	Govindarajalu 1975*a* ([A])
S. distans Poir., as *S. nutans* Willd. ex Kunth	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. foliosa A. Rich.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. graeffeana Boeck.	C_3	JB (A: *Christan 3* CANB)
S. greigiifolia (Ridl.) C. B. Clarke (*Acriulus greigiifolius* Ridl.)	C_3	JB (A: *Haines 129* K); LR ($\delta^{13}C$: −26.3, *Angus 2725*); SCV ($\delta^{13}C$: −25.98, *Stohr 427*)
S. iostephana Nelmes	C_3	LR ($\delta^{13}C$: −28.6, *Liben 2191*)
S. levis Retz.	C_3	Govindarajalu 1975*a* ([A]); Takeda et al. 1985 (A); Bruhl et al. 1987 (A. B); Ehleringer et al. 1987 ($\delta^{13}C$); JB (A: *Bruhl 522* CANB; *Dunlop 5877* CANB. Γ: 45, *Bruhl 227* CANB)

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
S. lithosperma (L.) Sw., as *S. lithosperma* var. *lithosperma*[a]	C_3	Govindarajalu 1975*a* ([A])[a]; Prakash et al. 1976 (A); Hesla et al. 1982 ($\delta^{13}C$); Takeda et al. 1985 (A. $\delta^{13}C$)
	C_4+	Hofstra et al. 1972 (A. Γ); Raghavendra and Das 1976 (A)
var. *linearis* Benth.	C_3	Govindarajalu 1975*a* ([A])
var. *multispiculata* Govindarajalu	C_3	Govindarajalu 1975*a* ([A])
var. *muricata* Govindarajalu	C_3	Govindarajalu 1975*a* ([A])
S. mackaviensis Boeck.	C_3	Takeda et al. 1985 (A)
S. melanomphala Kunth	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. mikawana Makino	C_3	LR ($\delta^{13}C$: −32.0, *Robinson 3582*)
S. novaehollandiae Boeck.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
S. poaeoides Ridl.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. poiformis Retz.	C_3	Govindarajalu 1975*a* ([A])
S. racemosa Poir.	C_3	Hesla et al. 1982 ($\delta^{13}C$)
S. rehmannii C. B. Clarke	C_3	SCV ($\delta^{13}C$: −23.86, *Bolus 1893*)
S. rugosa R. Br.	C_3	Takeda et al. 1985 (A)
S. sphacelata F. Muell.	C_3	Takeda et al. 1985 (A); JB (A: *Bruhl 515* CANB; *Craven 5599* CANB)
S. sumatrensis Retz.	C_3	Koyama 1967 ([A]); Govindarajalu 1975*a* ([A])
S. terrestris (L.) Fass.	C_3	Govindarajalu 1975*a* ([A]); Ehleringer et al. 1987 ($\delta^{13}C$)
S. tessellata Willd.	C_3	Govindarajalu 1975*a* ([A])
S. transvaalensis E. F. Franklin	C_3	SCV ($\delta^{13}C$: −25.11, *Meyer 15*)
S. tricuspidata S. T. Blake	C_3	Takeda et al. 1985 (A)
Sphaerocyperus erinaceus (Ridl.) K. Lye, as *Cyperus erinaceus* (Ridl.) Kük.[a]	C_4	Druyts-Voets 1970 ([Ac])[a]; Lerman and Raynal 1972 (A)[a]; JB (Ac: *Richards 15066* K); KW (Ac: *Robinson 3553* P); LR ($\delta^{13}C$: −11.7, *Gossweiler 4229*)
Sumatroscirpus junghuhnii (Miq.) Oteng-Yeboah	C_3	BW (A: *de Wilde 15236* L)
Tetraria capillaris (F. Muell.) J. M. Black	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Blake 15846* CANB); KW (A: *Coveny 6244*; *McBarron 11442*); LR ($\delta^{13}C$: −28.1, *X . . . s. n.,* Port Jackson, 1900)
T. compacta Levyns	C_3	SCV ($\delta^{13}C$: −24.49, *Levyns 8726*)
T. cuspidata (Rottb.) C. B. Clarke	C_3	LR ($\delta^{13}C$: −28.2, *Schlechter 7429*)
T. exilis Levyns	C_3	JB (A: *Schlechter 7341*); SCV ($\delta^{13}C$: −25.94, *Levyns 6229*)
T. natalensis (C. B. Clarke) Koyama	C_3	SCV ($\delta^{13}C$: −25.80, *Rogers 19183*)
T. octandra (Nees) Kük. (*Tetrariopsis octandra* (Nees) C. B. Clarke)	C_3	JB (A: *Blake 2240* CANB; *Seabrook 130* CANB; *P.G. Wilson 3965* CANB)
Trachystylis stradbrokensis S. T. Blake	C_3	JB (A: *Blake 22673* BRI*; Clarkson 5156* BRI; *Perry 439* CANB. $\delta^{13}C$: −29.8, *Clarkson 5156*); LR ($\delta^{13}C$: −26.7, *Blake 13201*)
Trianoptiles capensis (Steud.) Harvey	C_3	JB (A: *Parker 4132* K); LR ($\delta^{13}C$: −27.6, *Schlechter 9137*); SCV ($\delta^{13}C$: −28.02, *Levyns 7762*)
T. solitaria (C. B. Clarke) Levyns	C_3	SCV ($\delta^{13}C$: −25.82, *Esterhuysen 34682*)
T. stipitata Levyns	C_3	SCV ($\delta^{13}C$: −29.24, *Levyns 7678*)
Trichophorum alpinum (L.) Pers.	C_3	LR ($\delta^{13}C$: −26.1, *De la Pylaie 1643*)
T. cespitosum (L.) Hartm., (*Baeothryon caespitosum* (L.) A. Dietrich), as *Scirpus cespitosus* L.[a]	C_3	Bender 1971 ($\delta^{13}C$)[a]; JB (A: *Townsend 73/154* PDA); LR ($\delta^{13}C$: −27.1, *Lerman s. n.,* Oetztal, 1971)
T. subcaptitatum (Thwaites) D. A. Simpson, as *Scirpus subcapitatus* Thwaites	C_3	Govindarajalu 1976 ([A])
Trichoschoenus bosseri J. Raynal	C_3	LR ($\delta^{13}C$: −24.9, *Humbert 28576*)
Tricostularia compressa Nees ex Lehm.	C_3	Takeda et al. 1985 (A. $\delta^{13}C$)
T. pauciflora (F. Muell.) Benth.	C_3	Takeda et al. 1985 (A); JB (A: *Willis,* 1 Oct 1959 CANB)
T. undulata (Thwaites) J. Kern	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); JB (A: *Bruhl 325* CANB); LR ($\delta^{13}C$: −26.5, *Evrard 2315*)
Trilepis lhotzkiana Nees	C_3	JB (A: *Harley 19425* K; LR ($\delta^{13}C$: −28.7, *Weddell 471*)
Uncinia angustifolia Hamlin	C_3	Kukkonen 1967 ([A])
U. brevicaulis Thouars	C_3	Kukkonen 1967 ([A])
U. compacta R. Br.	C_3	JB (A: *Bruhl 634* CANB; *Smith 15531* CANB); KW (A: *Thompson 4048*)
U. dawsonii Hamlin	C_3	LR ($\delta^{13}C$: −32.8, *MacKee 9783*)
U. divaricata Boott	C_3	Kukkonen 1967 ([A]); KW (A: *Seppelt 12453*)
U. elegans (Kük.) Hamlin	C_3	KW (A: *Rodway* NSW 52591)
U. erinacea (Cav.) Pers.	C_3	Kukkonen 1967 ([A])
U. flaccida S. T. Blake	C_3	Takeda et al. 1985 (A. $\delta^{13}C$); KW (A: *Thompson 3025*)
U. hamata (Schwartz) Urb.	C_3	Kukkonen 1967 ([A])

Appendix 1. Continued.

Species	Photosynthetic pathway	References (method: value [as appropriate], voucher [if new record])
U. hookeri Boott	C_3	KW (A: *Seppelt 12101, 12681*)
U. nemoralis K. L. Wilson	C_3	KW (A: *Coveny 5913*)
U. nervosa Boott	C_3	KW (A: *Druce* CHR 131588)
U. riparia R. Br.	C_3	KW (A: *Ratkowsky 1596*)
U. sp. nov. aff. *filiformis* Colenso ex Boott (*Blake 18413*)	C_3	KW (A: *Blake 18413*)
U. sulcata K. L. Wilson	C_3	KW (A: *Pickard & Coveny 2749*)
U. tenella R. Br.	C_3	Kukkonen 1967 ([A]); Takeda et al. 1985 (A); KW (A: *Gray 5403*)
U. uncinata (L. f.) Kük.	C_3	Kukkonen 1967 ([A])
Volkiella disticha Merxm. & Czech., as *Volkiella*[a]	C_3	Lerman and Raynal 1972 (A)[a]; JB (A: *Mueller 493* PRE); LR ($\delta^{13}C$: −13.6, *Volk 1815*)
Websteria confervoides (Poir.) S. S. Hooper, as *Websteria*[a]	C_3	Lerman and Raynal 1972 (A)[a]; JB (A: *Smith 1797* PRE); LR ($\delta^{13}C$: −23.3, *Hallé & Guillaumin s. n.,* Moossou, Côte d'Ivoire, 1960)
Zameioscirpus muticus Dhooge & Goetgh.	C_3	Dhooge et al. 2003 (A)

APPENDIX 2: Assessment of Conflicting Data on Photosynthetic Pathway Status in Cyperaceae

Our survey of literature on photosynthetic pathways in Cyperaceae found various inconsistent records. We have seen some but not all of the vouchers for these records. However, in most, perhaps all, of these cases we concluded that they resulted from misidentification of the material used or misapplication of names, rather than the species concerned being variable in this regard. See, for example, the discussion below about records of *Cyperus eragrostis,* which we suggest involved confusion in usage of that name. These suspect records are tagged in Appendix 1 with ''+''.

Carex.—Smith and Epstein's (1971) C_4 $\delta^{13}C$ value for an unnamed *Carex* species is at variance with all other available data for that genus, including one biochemically typed species, $\delta^{13}C$ value determinations for 33 species, anatomical data for 48 species and Γ values for eight species.

Cyperus *s.l.*—*Cyperus aggregatus* was reported as C_3 by Li et al. (1999). This species, previously known as *C. flavus* (Vahl) Nees or *C. cayennensis* (Lam.) Britton, is C_4, as are all the other species so far as known in Kükenthal's (1935, 1936) *Cyperus* sect. *Mariscus* apart from *C. deciduus* (see below).

Cyperus albostriatus was reported as C_4 by Sonnenberg and Botha (1992) but our samples (Appendix 1) show this to be C_3, as are all the other species sampled in Kükenthal's (1935, 1936) *Cyperus* sect. *Diffusi.*

Cyperus deciduus was treated by Kükenthal (1935, 1936) as a member of *Cyperus* subgen. *Mariscus,* mainly on account of its spikelets falling as a unit as in other species in that subgenus as traditionally circumscribed. However, its characteristics, including non-Kranz anatomy, suggest that it is better placed with the ''C_3'' species of *Cyperus* in subgen. *Pycnostachys* (Wilson 1991). Vorster (1990, 1996) reported unusual anatomy in this species, with a partial inner chlorenchymatous sheath as in Kranz anatomy. However, the ''maximum cells distant'' count is in accord with non-Kranz anatomy. Further study of this unusual species is warranted.

Conflicting data have been presented in the literature for *C. eragrostis* (Appendix 1). The C_4 values were obtained from one laboratory. We sampled two Australian and two New Zealand accessions of *C. eragrostis.* All four proved to be C_3, with C_3 anatomy (Appendix 1), very low or undetectable levels of C_4 acid decarboxylating enzymes (Bruhl et al. 1987) and with Γ and $\delta^{13}C$ values (Appendix 1) typical of a C_3 species. It seems, therefore, that *C. eragrostis* is C_3. The C_4 records may result from the misapplication of that name to *C. sanguinolentus* Vahl, which was commonly known as *C. eragrostis* Vahl (non Lam.) in Europe over the last couple of centuries (Kukkonen 1995).

Cyperus glaber was listed by Li (1993) as C_3. However, other records show this to be a C_4 species, as are all the other species in Kükenthal's (1935, 1936) *Cyperus* sect. *Compressi.*

Cyperus glomeratus was reported to be C_3 by Li (1993), but other studies record this as C_4, as are all the other species (so far as known) in Kükenthal's *Cyperus* sect. *Distantes.*

For *C. papyrus,* both C_3 and C_4 determinations were obtained from several laboratories (Appendix 1). Our own anatomical observations on two accessions support the C_4 status of this species, in agreement with Lerman and Raynal (1972; Appendix 1) and Jones and Milburn (1978). We wonder whether the C_3 determinations were made on the morphologically somewhat similar *C. prolifer* or *C. involucratus,* both of which are commonly cultivated and are sometimes known as ''papyrus'' (or ''dwarf papyrus'' in the case of the former species).

The C_4 record for *C. pulchellus* of Lerman and Raynal (1972; Appendix 1) is at odds with C_3 $\delta^{13}C$ values obtained for this species by Hesla et al. (1982) and Takeda et al. (1985) and anatomical observations of several workers. Plants of this species have been misidentified as species of *Lipocarpha* (C_4), *Ascolepis* (C_4) and *Kyllingiella* (C_3) (Haines and Lye 1983).

Cyperus textilis was reported as C_4 by Li (1993). However, another study records this as C_3, which is in line with the other species in Kükenthal's (1935, 1936) *Cyperus* sect. *Vaginati.*

Li and Jones (1994) reported a form of C_4 anatomy that they called Kranzkette (literally ''chain of garlands'') from the arrangement of the vascular bundles so that they form a ''ring'' around airspaces as seen in cross-section. This anatomical type is indeed interesting, but the paper is unsatisfactory in several ways. Firstly, in discussing this unusual anatomy, they fail to mention Metcalfe's (1971: 382) designation of the extreme form of this as ''*Mariscus* A-type anatomy'' (characterized by adaxial epidermal cells being of similar size to those of the abaxial layer; and with vascular bundles surrounding air spaces). This type of anatomy was also distinguished by Bruhl et al. (1992) as ''vascular bundles forming 'ring' or 'horseshoe' patterns''. As discussed by Wilson (1991), it is present in species of *Cyperus* sections *Pinnati, Glutinosi, Thunbergiani* and *Turgiduli* p.p. (sectional names as in Kükenthal [1935, 1936]). The form described by Li and Jones (1994) is the same as described and illustrated by Metcalfe (1971: 316, Fig. 42F) for *C. serotinus* under the name *Juncellus serotinus* (Rottb.) C. B. Clarke. Secondly, it is not clear what species the authors were studying. They named it *C. japonicus* Makino, but that name is a synonym of *C. microiria* Steud. which has ''ordinary'' C_4 anatomy with a single row of vas-

cular bundles in the two specimens examined by the current authors. Indeed, all the other species examined in *Cyperus* sect. *Iriae* (as updated by the current authors from Kükenthal [1935, 1936]: *C. amuricus, C. alulatus* Kern*, C. iria*) have this type of C_4 anatomy, except for *C. orthostachys,* which has *Mariscus* A-type (''Kranzkette'') anatomy in the outer quarter of its leaves but a single row of vascular bundles closer to the midrib, as seen in cross-section. *Cyperus orthostachys* is also an Asian species, so perhaps Li and Jones were using that species. However, a more likely alternative is that their material was of *C. serotinus,* mentioned above, which also grows in Asia and exhibits a well-developed example of this type of anatomy.

Eleocharis.—The evidence for the C_4 status of *E. retroflexa* is compelling with 20 records including assessment of anatomy, ultrastructure, biochemistry and $\delta^{13}C$ value determinations (Appendix 1). By contrast the semi-diagrammatic drawing by Govindarajalu (1975*a*: Fig. 1a) suggests C_3 status due to a ''maximum cells distant'' count of greater than one. His tissue map and description of the vascular bundles for this species do not help resolve this conflict which most likely stems from the breakdown of the ''one cell distant'' criterion in *Eleocharis,* as discussed in the main text.

We present three anatomical records and four $\delta^{13}C$ value determinations for *E. subcancellata* that clearly indicate this species is C_4. In contrast, Ueno et al. (1989: 430) presented one anatomical and one $\delta^{13}C$ value assessment of this species and assigned the species as ''C_3?''. Their typical C_3 value of -23.2 for *E. subcancellata* indicates that either the specimen was incorrectly identified or this species is another member of the genus that is variable for photosynthetic pathway (see discussion on *Eleocharis* in the text) and worthy of detailed study.

Lipocarpha.—This genus is generally C_4, with reports for 12 species cited in Appendix 1. The report of C_3 for a species of *Lipocarpha* (Stock et al. 2004) from a single $\delta^{13}C$ value for *L. rehmannii* (Appendix 1) is at odds with four other records for the species based on anatomical observations and $\delta^{13}C$ values, and with the other species in the genus. The specimen in question appears to be a collection of multiple individuals but with all components matching other material of *L. rehmannii* at BOL (A. Verboom, pers. comm., Aug 2004). These specimens are in need of anatomical study and broader sampling for $\delta^{13}C$ values.

Pycreus.—*Pycreus flavescens* (as *Cyperus flavescens*) was reported as being C_3 by Li (1993). However, other reports for this species record it as C_4, as are all known members of the genus *Pycreus* (*Cyperus* subgen. *Pycreus*).

Saxena and Ramakrishnan (1984) reported *P. flavidus* (as *P. globosus*) as anatomically C_3. By contrast, all other evidence (including ultrastructural, physiological, biochemical, and further anatomical characteristics) reported for this species and the genus in general (Appendix 1) indicate C_4. It is possible that Saxena and Ramakrishnan sampled a specimen of the C_3 species *Cyperus tenuispica*, which has at times in the past been known (erroneously) as *Cyperus flavidus*.

Rhynchospora.—The Γ values presented by Takeda et al. (1980) for 17 species of *Rhynchospora* include values that are higher than classic C_4 values (for species with rhynchosporoid anatomy, e.g., *R. rubra*: 10 μL liter^{-1}), and that are lower than typical C_3 values (e.g., *R. brownii*: 32 μL liter^{-1}). Such values are usually indicative of C_3-C_4 intermediates (Hattersley et al. 1986) (Appendix 1: cf. *Eleocharis pusilla*). Indeed the two values fall outside the range of values Takeda et al. (1980: 57) obtained for control species: i.e., ''less than 10 μl l^{-1} (for C_4 species) and . . . more than 40 μl l^{-1} for C_3 species'', though they did not query these results. More recent anatomical and biochemical investigations of *R. rubra* have, however, corroborated its C_4 status (Bruhl et al. 1987; Ueno and Koyama 1987).

The $\delta^{13}C$ values and C_4 anatomy (Appendix 1) for *R. armerioides* and *R. barbata* confirm that *Rhynchospora* species with chlorocyperoid anatomy are also consistently C_4, as Ueno and Koyama (1987) initially reported (see also Bruhl et al. 1987; Bruhl 1995).

Schoenoplectus.—The listing by Hofstra et al. (1972) of *S. lateriflorus* as C_4, based on C_4 anatomy and a low Γ value, conflicts with other observations for this species (Appendix 1), and for the 26 other species surveyed. Our anatomical observations do not indicate even remotely C_4-like anatomy for *S. lateriflorus.*

The C_4 $\delta^{13}C$ value for *S. pulchellus* is the first report for this species. The specimen in question is not mixed and appears to have been correctly identified by cyperologist Jane Browning (A. Verboom, pers. comm., Aug 2004). Hayasaka (2002) puts *S. pulchellus* in the ''*S. corymbosus* complex'' of species (viz. *S. brachyceras, S. confusus, S. corymbosus, S. decipiens* (Nees) J. Raynal, *S. muricinux, S. muriculatus* (Kük.) J. Browning, *S. paludicola,* and *S. pulchellus*) on morphological grounds. The five other species of the complex so far sampled are C_3 (Appendix 1), and we suspect that *S. pulchellus* will also prove to be C_3. Nevertheless, the photosynthetic pathway of all species of *Schoenoplectus* clearly merits assessment.

Scleria.—Variation in photosynthetic pathway has also been reported for *S. lithosperma* (Appendix 1), but ''these discrepancies . . . may have resulted from identificatory error of plant materials'' (Takeda et al. 1985: 405). Another 20 species of *Scleria* appear in the literature as C_3, and our anatomical observations and Γ values (Appendix 1) for *Scleria* also support the contention that the genus is wholly C_3.