Appendix S2. Further Information about the data in D^3

Downloaded on January 31st, 2013 from www.seed-dispersal.info.

All numbering of tables and figures relates to the respective paragraph.

Content

Diaspore Typology

Summary

DIASPORE TYPOLOGY is a categorical trait which describes the morphological structure that acts as the diaspore, i.e. the dispersal unit (e.g. a seed or a fruit). Generally, we only regard long-distance dispersal strategies.

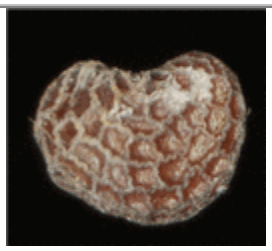
Trait description

DIASPORE TYPOLOGY (column code: DIA_TYPE) is coded as one of the categories listed in Tab. 1.

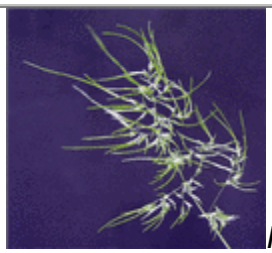
Some species may produce more than one diaspore type. For instance, in *Festuca ovina* agg. the fruit of one flower (including the surrounding glumes) as well as all fruits of one spikelet (including the surrounding glumes) may act as diaspores. Such species are marked as 'heterodiaspore' (see Heterodiaspory), and additional diaspore types are characterized in the ‘comment’ field.

Furthermore, some species are not able to produce any diaspores (e.g. sterile hybrids) or reproduce by vegetative parts without long-distance dispersal potential (e.g. clonal growth by rhizomes). Generally, we disregard these organs because they do not influence long-distance dispersal and only list them if no other diaspore type is known (more details see No. 7 in Tab. 1). In contrast, vegetative parts which allow long-distance dispersal, like turions or bulbils that easily detach from the mother plant, are marked as 'specialized vegetative part' (more details see No. 6 in Tab. 1).

Tab. 1. Categorization of diaspore types

No.	Category	Description and examples	
1	seed ('seed' in Morphology Code)	The seed acts as the diaspore. The diaspore may also include additional structures (e.g. elaiosomes) but never comprises a complete fruit. E.g. many Gymnospermes, Brassicaceae, Campanulaceae, Caryophyllaceae, Papaveraceae	 *Papaver rhoeas* - The seed acts as the diaspore and is released from a capsule.

2	fruit segment ('segm' in Morphology Code)	Fruit segments act as the diaspores. Fruit segments develop from a fruit that splits into several parts during maturity (e.g. *Acer*) or from a fruit that is composed ab initio of several fruitlets (e.g. *Ranunculus*). The diaspore may also include additional structures but never comprises a complete fruit. E.g. many Aceraceae, Apiaceae, Boraginaceae, Lamiaceae	 *Acer tataricum* - During maturity the fruit is splitting into two fruit segments (diaspores) which are dispersed independently.  *Ranunculus acris* - The fruit consists of many not connate nutlets (diaspores) which are dispersed independently.
3	fruit ('fruit' in Morphology Code)	The fruit acts as the diaspore. The diaspore may also include additional structures but NEVER comprises fruits from MORE THAN ONE flower. E.g. many Asteraceae, Poaceae, *Fragaria*, *Malus*, *Rubus*	 *Taraxacum* Sect. *Ruderalia* - The fruit (including the pappus) acts as the diaspore.

4	infructescence ('infr' in Morphology Code)	The infructescence or a part of the infructescence with fruits from MORE THAN ONE flower acts as the diaspore. Also included are compound fruits which are composed of tightly adnate fruits. E.g. *Ananas comosa*, *Tilia, Morus*	 *Tilia platyphyllos* - The diaspore is built from a few fruits of an infructescence and its adnate bract.
5	whole plant ('plant' in Morphology Code)	More or less the whole plant, mostly the above-ground part including MORE THAN ONE infructescence, acts as the diaspore. E.g. tumbleweeds like *Salsola tragus*	*Salsola tragus* - The aboveground part is drifted by the wind and acts as the diaspore.
6	specialized vegetative part ('vege' in Morphology Code)	Specialized vegetative structures, e.g. bulbils, offshoots or turions, act as diaspores AND allow - in principle - long-distance dispersal as they detach easily from the mother plant. This category is NOT applied to seeds that develop without sexual recombination (e.g. by apomixes) or clonal growth organs (e.g. rhizoms, stolons, bulbs) that do not allow long-distance dispersal. E.g. *Dentaria bulbifera*, *Poa bulbosa*, *Trapa natans*	 *Poa bulbosa* - The spikelets are transformed into vegetatively produced bulbils, which rapidly start their development (pseudovivipary).

7	no diaspore ('no' in Morphology Code)	Reserved for sterile hybrids or taxa with ONLY short-distance dispersal with vegetative parts (clonal growth, fragmentation of vegetative parts etc.). E.g. *Betula x aurata* (sterile)	
8	cone ('cone' in Morphology Code)	Reserved for gymnosperms if the whole cone functions as a diaspore. E.g. *Juniperus, Ephedra*	 *Juniperus communis* - branch with several fleshy cones.
9	spore ('spore' in Morphology Code)	Reserved for non-spermatophytes, which are not included in D³ yet. E.g. mosses and ferns	 *Dryopteris* sp. - spore (above) and leaves with sori, i.e. groups of sporangia with spores on their underneath.
10	other ('other' in Morphology Code)	Diaspore types that are not covered by one of the above mentioned categories.	

Data sources

DIASPORE TYPOLOGY was categorized by visual inspection of diaspores and fruits or respective images in addition to an intensive literature and web research.

Selected literature

Bojňanský, V. & Fargašová, A. (2007): Atlas of seeds and fruits of Central and East-European flora. The Carpathian Mountains region. Springer, Dordrecht.

Brouwer, W. & Stählin, A. (1975): Handbuch der Samenkunde für Landwirtschaft, Gartenbau und Forstwirtschaft. DLG-Verlag, Frankfurt.

Cappers, R.T.J., Bekker, R.M. & Jans, J.E.A. (2006): Digital Seed Atlas of the Netherlands. Barkhuis. Eelde (NL).

Graf, J. et al. (1987): Tafelwerk zur Pflanzensystematik. Einführung in das natürliche System der Blütenpflanzen. Springer-Verlag.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Hilger, H.H. & Hoppe, J.R. (1995): Die morphologische Vielfalt der generativen Diasporen – Präsentation eines Lehr- und Lernschemas. Feddes Repertorium 106, 503-513.

Müller-Schneider, P. (1977): Verbreitungsbiologie (Diasporologie) der Blütenpflanzen. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel 61.

Müller-Schneider, P. (1986): Verbreitungsbiologie der Blütenpflanzen Graubündens. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 85.

Otto, B. (2002): Merkmale von Samen, Früchten, generativen Germinulen und generativen Diasporen. In: Klotz, S., Kühn, I. & Durka, W. [Hrsg.] (2002): BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. Schriftenreihe für Vegetationskunde 38, Bonn: Bundesamt für Naturschutz, 177-196.

Poschlod, P., Tackenberg, O. & Bonn, S. (2005): Plant dispersal potential and its relation to species frequency and coexistence. In: Van der Maarel, E. (Editor). Vegetation Ecology, chapter 6. Wiley-Blackwell.

Fruit Typology

Summary

FRUIT TYPOLOGY is a categorical trait which describes ecological characteristics of the fruit that are related to seed dispersal.

Trait description

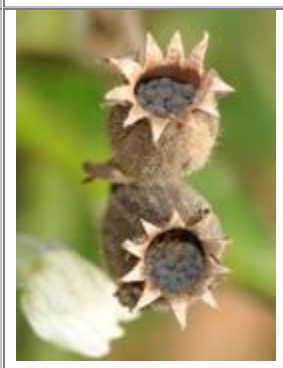
FRUIT TYPOLOGY (column code: FRUIT_TYPE) is coded as one of the categories listed in Tab. 1. The coding scheme has two hierarchical levels with the first level mainly focusing if the fruit opens or stays closed during seed ripening and dispersal, whereas the second level addresses how the pericarp is constructed or opens.

In case of compound fruits or if fruits include additional structures or the whole infructescence, the whole structure is addressed if it affects seed dispersal, especially interactions with animals. For instance, *Fragaria vesca* with nutlets (i.e. several indehiscent hardcoated fruitlets) and *Rubus idaeus* with drupelets (i.e. several indehiscent fruitlets with fleshy mesocarp) are both categorized as fleshy fruits.

Species with more than one fruit type (e.g. *Rosa* species in which the complete rose hip may act as a fleshy fruit or it may open later, set the nutlets free and thus act as a dehiscent fruit) are marked as 'heterodiaspore' (see Heterodiaspory).

Tab. 1. Categorization of different ecological fruit types

No.	Category	Description and examples	Further Information
1	indehiscent fruit	The pericarp is not opening during ripening.	This category is only used if it is not possible to address the subordinate hierarchical level.
1a	non-fleshy indehiscent fruit	Indehiscent fruits with a hard or woody pericarp. E.g. Poaceae, Asteraceae, *Quercus, Ranunculus*	 *Quercus robur* - infructescence with three nuts.

1b	fleshy fruit	Indehiscent single or compound fruits with a fleshy pericarp, independent of the ontogenetic origin of the fruit flesh. E.g. *Malus, Prunus, Rubus, Fragaria*	 *Rubus fruticosus agg.* - Fruit is built from many drupelets.
1c	pepo	Indehiscent fruits with coriaceous or solid paring and a fleshy inner layer. E.g. *Citrus, Cucurbita*	 *Cucurbita pepo* - The fruit has a solid paring.
2	dehiscent fruit	The pericarp opens during ripening and the seeds typically act as the diaspores. Dehiscent fruits include e.g. follicles, capsules, legumes or siliques.	This category is only used if it is not possible to address the subordinate hierarchical level.
2a	fruit with upright aperture	Dehiscent fruits with typically a small aperture located at the upper (distal) end. This position may allow seeds to stay for a longer time in the open fruit. E.g. *Papaver rhoeas,* many Caryophyllaceae, Saxifragaceae	 *Silene noctiflora* - Seeds are released from the opened capsule through the upright aperture.

2b	fruit with lateral aperture	Dehiscent fruits with typically a large aperture located lateral or basal. This position may allow seeds to be released fast. However, the seeds may also stay longer, e.g. if they are tightly connected to the fruit. E.g. many Brassicaceae, Fabaceae, Scrophulariaceae, *Epilobium*	 *Laburnum anagyroides* - legume, already opened at front and back seams of the carpels with seeds still attached to the fruit that has a lateral aperture.
3	explosive release mechanism	Indehiscent or dehiscent fruits with an explosive release mechanism. E.g. many *Cardamine*, *Euphorbia, Geranium, Impatiens*	 *Geranium sanguineum* - fruit before (left) and after (right) explosive seed release.
4	gymnosperme type	Gymnosperm seeds with or without hull structures. Gymnospermes, e.g. *Abies, Pinus, Juniperus, Taxus*	 *Larix decidua* - cone with many winged seeds (not visible), which act as diaspores.

5	other	Fruit types that are not covered by one of the above mentioned categories.	
6	not applicable	Reserved for a) species that typically do not produce diaspores, e.g. the sterile hybrid *Betula x aurata*, and b) for vegetative diaspore types, e.g. some species from the grass genera *Poa*, *Deschampsia.*	 *Poa alpina* - The spikelets are transformed into vegetatively produced bulbils which rapidly start their development (pseudovivipary).

Data sources

FRUIT TYPOLOGY was categorized by visual inspection of fruits or respective images in addition to an intensive literature and web research.

Selected literature

Bojňanský, V. & Fargašová, A. (2007): Atlas of seeds and fruits of Central and East-European flora. The Carpathian Mountains region. Springer, Dordrecht.

Brouwer, W. & Stählin, A. (1975): Handbuch der Samenkunde für Landwirtschaft, Gartenbau und Forstwirtschaft. DLG-Verlag, Frankfurt.

Graf, J. et al. (1987): Tafelwerk zur Pflanzensystematik. Einführung in das natürliche System der Blütenpflanzen. Springer-Verlag.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Hilger, H.H. & Hoppe, J.R. (1995): Die morphologische Vielfalt der generativen Diasporen – Präsentation eines Lehr- und Lernschemas. Feddes Repertorium 106, 503-513.

Müller-Schneider, P. (1977): Verbreitungsbiologie (Diasporologie) der Blütenpflanzen. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel 61.

Müller-Schneider, P. (1986): Verbreitungsbiologie der Blütenpflanzen Graubündens. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel 85.

Otto, B. (2002): Merkmale von Samen, Früchten, generativen Germinulen und generativen Diasporen. In: Klotz, S., Kühn, I. & Durka, W. [Hrsg.] (2002): BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. - Schriftenreihe für Vegetationskunde 38, Bonn: Bundesamt für Naturschutz, 177-196.

Heterodiaspory

Summary

A heterodiaspore species features more than one diaspore type.

Trait description

With HETERODIASPORY we describe the phenomenon that a species may produce diaspores of more than one type. Such species are marked with '1' in the column DIA_HETERO and more details are given in the textual comments for the species.

The differences in diaspore type within one species can be attributed to different levels:

1. Species may produce different fruit types, fruits or even specialized vegetative parts that develop in various ways that affect the diaspore type. For instance, in some *Rosa* species the complete rose hip as well as a single nutlet may act as the diaspore if the rose hip opens - rarely - during maturity (Fig. 1). The rose hip diaspore is classified as a fleshy diaspore whereas the nutlets are classified as fruit segments that are released from a dehiscent fruit. This type of heterodiaspory can also be found in many pepo-species where the pepo as well as single seeds may act as diaspores.

Fig. 1. *Rosa* sp. – Both, the complete rose hip (top) and single nutlets (bottom left) after lateral rupture of the rose hip (bottom right) can act as diaspores.

2. Species may produce morphological different fruits (heterocarpy, seed heteromorphism). For instance, the central achenes of *Calendula officinalis* differ considerably from the achenes produced in the outer part of the seed head (Fig. 2).

Fig. 2. *Calendula officinalis* - heteromorphic fruits (diaspores): from the inner part of the seed head (left) and from the outer part of the seed head with smooth and coarse surface (right).

3. Species may produce diaspores that can break into smaller units which may also act as diaspores. For instance, in many Poaceae a complete spikelet as well as single florets may act as diaspores (Fig. 3).

Fig. 3. *Festuca filiformis* - The spikelet (left, without the basal glumes), a part of the spikelet (middle) or a single floret (right) can act as a diaspore.

Furthermore, some species produce not only generative diaspores but also vegetative parts which can enhance dispersal. Generally, we disregard unspecialized vegetative forms of dispersal like rhizoms etc. because they do not influence long-distance dispersal. In contrast, vegetative parts which allow long-distance dispersal, like turions or bulbils in the infructescence, are marked as 'specialized vegetative part' (see Diaspore Typology).

Data sources

HETERODIASPORY was categorized by visual inspection of fruits and diaspores or respective images in addition to an intensive literature and web research.

Selected literature

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Müller-Schneider, P. (1977): Verbreitungsbiologie (Diasporologie) der Blütenpflanzen. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel 61.

Müller-Schneider, P. (1986): Verbreitungsbiologie der Blütenpflanzen Graubündens. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel 85.

Otto, B. (2002): Merkmale von Samen, Früchten, generativen Germinulen und generativen Diasporen. In: Klotz, S., Kühn, I. & Durka, W. [Hrsg.] (2002): BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. - Schriftenreihe für Vegetationskunde 38, Bonn: Bundesamt für Naturschutz, 177-196.

Diaspore Morphology

Summary

DIASPORE MORPHOLOGY describes morphology, appendages and structure of diaspores (which may be the whole plant, infructescences, compound fruits, fruits, fruit segments or seeds, often with additional structures). In D³ DIASPORE MORPHOLOGY is technically treated as a bundle of binary traits in order to describe multiple categories of DIASPORE MORPHOLOGY which often can be found on one single diaspore (e.g. Fig. 1).

Additionally, we present a **Morphology Code** describing the diaspore morphology shortly.

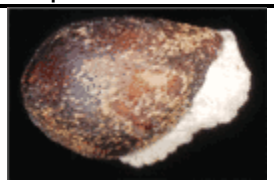
Trait description

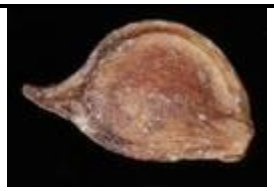
DIASPORE MORPHOLOGY describes morphology, appendages and structure of diaspores in respect to seed dispersal. It is coded in several binary variables as listed in Tab. 1. Each morphological structure that appears in the diaspores of a species is coded with '1' in the respective variable whereas '0' means that this feature is not applicable in this species.

In order to minimize the number of binary traits, we only present the main hierarchical level in the online version of the database.

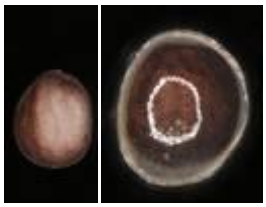
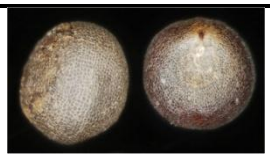
The complete information on the diaspore morphology is available in a compact formula in the field **Morphology Code** (DIA_MORPH) which includes the information on DIASPORE TYPOLOGY and the numeric codes from Tab. 1. In case of heterodiaspory the morphology codes of additional diaspore types are listed in a 'comment' field. Furthermore, in case of heterodiaspory with two morphological identical diaspores, the morphology codes are consecutively numbered.

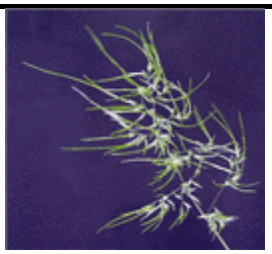
Tab. 1. Categorization of DIASPORE MORPHOLOGY

No.	Variable name	Description	Examples
1	NUTRIENTS	The diaspore contains a significant amount of nutrients, either in quantity (typically large diaspores) or in quality (e.g. fruits with extraordinary high levels of fatty acids, proteins or other nutrients). This category is only used if it is not possible to address the subordinate hierarchical level.	
1a	nutrient-rich envelope	The nutrient-containing structure encloses the seeds. While on purpose typically only the fruit flesh is fed, seeds may be dispersed if they are spit or if they are fed (accidentally) and survive digestion. E.g. *Sorbus*, *Rubus, Prunus*	 *Prunus spinosa* – drupes.
1b	nutrient-containing appendage	Diaspores with nutrient-rich appendages, which can often be separated easily from the seed (e.g. aril, elaiosome). Typically the seeds are dispersed without being digested. E.g. *Euphorbia* with elaiosome, *Taxus* with aril	 *Viola palustris* - brown seed with white elaiosome.
1c	nutrient rich seed	The nutrients are stored in the seed. That means utilisation of the nutrients by seed dispersing animals (endozoo - or dysochory) is intrinsically related to severe damage or death of the embryo. E.g. *Fagus* or *Castanea* with high quantities of nutrients, and most Poaceae (due to the aleuron layer) and many Fabaceae (due to high nitrogen contents) with a high quality of nutrients	 *Quercus robur* - nutrient-rich nuts.

2	AERENCHYM	Aerenchyms favour the adherence of air to the diaspore. Air is +/- enclosed in the tissue or by hull-structures and cannot leak. Aerenchyms decrease the effective density of the diaspore and may promote dispersal by water or wind. E.g. *Carex* (and other Cyperaceae), *Nymphaea alba*, *Menyanthes trifoliata*	 *Carex vesicaria* - top view on a diaspore (left) and longitudinal section (right) showing the air-filled space between the small fruit (with a long stylus) and the utricle which forms the hull.
3	WINGS	Flat, thin appendages (wings, perianths, bracts etc.) which stick out of the more compact part of the diaspore that contains the embryo. Wings typically enhance wind dispersal. E.g. *Acer*, *Betula*, *Fraxinus*, *Tilia*, many Pinaceae	 *Pinus mugo* - seed with wing.
4	ELONGATED	All structures that prominently elongate the main body of the diaspore, which contains the embryo. This category is only used if it is not possible to address the subordinate hierarchical level.	
4a	one short appendage	One short appendage.	 *Ranunculus repens* - The style is classified as one short appendage.

4b	many short appendages	More than one short appendage (e.g. short hairs).	 *Bromus intermedius* - The short hairs are classified as many short appendages.
4c	one long appendage	One long appendage (e.g. an awn). E.g. *Geum*, *Pulsatilla*, many Poaceae with awns	 *Bromus intermedius* - The awn is classified as one long appendage.
4d	many long appendages	More than one long appendage (e.g. pappus or long hairs) could enhance anemo- and epizoochory. E.g. *Taraxacum*, *Arnica*, *Centaurea*	 *Arnica montana* - The pappus hairs are classified as many long appendages.
5	HOOKED	Appendages with hooks or other structures which imply adhesion, except glueing substances. E.g. *Agrimonia*, *Arctium*, some *Bidens* species	 *Agrimonia repens* - diaspore with many hooked appendages.

6	MUCILAGINOUS	Diaspores with a mucilaginous surface. In many species the diaspore becomes mucilaginous only if the diaspores become wet. This phenomenon is little studied and its function still unclear. The sticky surface may enhance adhesion which can inhibit long distance dispersal (ateleochory) but also enhance epizoochory. Furthermore, seeds could be protected against digestion. E.g. many Anthemideae, Brassicaceae, *Salvia pratensis*	 *Salvia pratensis* - Dry fruit segments (left) are not mucilaginous, whereas wetted segments develop a mucilaginous coat within short time (right).
7	NO SPECIALIZATIONS	Diaspores without any of the above mentioned (or other) specializations. This category is only used if it is not possible to address the subordinate hierarchical level.	
7a	coarse surface	Diaspores with a structured surface and no further appendages or specializations. E.g. many Caryophyllaceae	 *Silene vulgaris* - seed with a coarse surface.
7b	smooth surface	Diaspores with a smooth surface and no further appendages or specializations. E.g. many Brassicaceae	 *Brassica oleraceae* ssp. *oleraceae*- seeds with a smooth surface.

8	OTHER SPECIALIZATIONS	Reserved for specialized vegetative parts.	 *Poa bulbosa* - The spikelets are transformed into vegetatively produced bulbils, which rapidly start their development (pseudovivipary).

A short example (Fig. 1) illustrates the classification of multiple appendages: Using the compact formula, the **Morphology Code** of the diaspore of *Helictotrichon versicolor* is described as **fruit|1c.3.4b.4c.5|** in the field DIA_MORPH.

Fig. 1. The diaspore of the Poaceae *Helictotrichon versicolor* is typically a single floret, i.e. a **fruit** (with additional structures: the glumes and the callus). The diaspore shows several adaptations that may be related to seed dispersal: The seeds contain valuable nutrients, especially proteins and vitamins in the aleuron-layer and starch in the large endosperm. The diaspore is therefore categorized as having a **nutrient-rich seed** (No. 1c in Tab.1). The glumes are wing-like and classified as **flat appendages** (No. 3 in Tab.1). The callus has many fine hairs, which are addressed as **many short elongated appendages** (No. 4b in Tab.1), and the lemma has a long awn, which is classified as **one long elongated appendage** (No. 4c in Tab.1). The whole diaspore may act as a **hook** (No. 5 in Tab.1), especially the geniculate awn in combination with the stiff callus hairs.

Data sources

The used categorization scheme was inspired by the LEDA approach (Römermann et al., 2005) but significantly modified, so that the classification was done independently from the LEDA approach for all species. DIASPORE MORPHOLOGY therefore represents a new original dataset, which was derived from visual inspection of the diaspores or respective images and an intensive literature and web research.

Selected literature

Bojňanský, V. & Fargašová, A. (2007): Atlas of seeds and fruits of Central and East-European flora. The Carpathian Mountains region. Springer, Dordrecht.

Cappers, R.T.J., Bekker, R.M. & Jans, J.E.A. (2006): Digital Seed Atlas of the Netherlands. Barkhuis.

Graf, J. et al. (1987): Tafelwerk zur Pflanzensystematik. Einführung in das natürliche System der Blütenpflanzen. Springer-Verlag.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Hilger, H.H. & Hoppe, J.R. (1995): Die morphologische Vielfalt der generativen Diasporen – Präsentation eines Lehr- und Lernschemas. Feddes Repertorium 106, 503-513.

Otto, B. (2002): Merkmale von Samen, Früchten, generativen Germinulen und generativen Diasporen. In: Klotz, S., Kühn, I. & Durka, W. [Hrsg.] (2002): BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. - Schriftenreihe für Vegetationskunde 38, Bonn: Bundesamt für Naturschutz, 177-196.

Römermann, C., Götzenberger, L., Tackenberg, O. & Poschlod, P. (2005): Morphology of dispersal unit. In: Knevel, I.C., Bekker, R.M., Kunzmann, D., Stadler, M., Thompson, K. (eds.): The LEDA traitbase collecting and measuring standards.

Diaspore Size

Summary

DIASPORE SIZE quantifies the size of diaspores (in mm) in three perpendicular axes: length, width and height.

Trait description

DIASPORE SIZE is coded in three continuous variables that represent the three perpendicular axes (length, width and height, given in mm), at which length is the longest and height the shortest dimension (see Tab. 1 and Fig. 1). Typical values range between 0.1 to 500 mm. If more than one measurement was available, generally only the mean value is presented. Raw data are available on request.

Tab. 1. Continuous variables related to DIASPORE SIZE.

No.	Variable name	Unit	Description
1	DIA_LENGTH	mm	Length of the diaspore, i.e. the longest axis, which is measured including all appendages.
2	DIA_WIDTH	mm	Width of the diaspore, i.e. the second longest axis, which is measured perpendicular to length and includes all appendages.
3	DIA_HEIGHT	mm	Height of the diaspore, i.e. the shortest axis, which is measured perpendicular to length and width and includes all appendages.

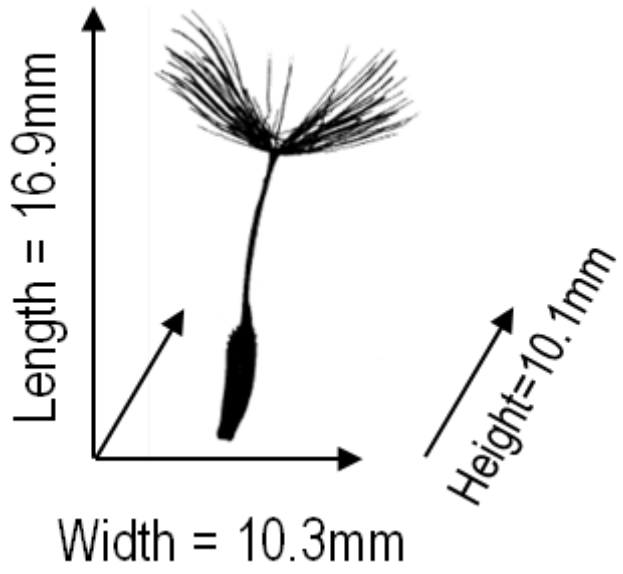


Fig. 1. DIASPORE SIZE of dandelion (*Taraxacum* Sect. *Ruderalia*).

Data sources

The presented data refer to the size of the diaspore including all appendages. The original measurements of diaspores or respective images do not overlap with databases like LEDA or BIOPOP. Additionally, data published by Müller-Schneider (1986) are included.

Literature

Götzenberger, L. (2005). Seed weight and seed shape. In: Knevel, I.C., Bekker, R.M., Kunzmann, D., Stadler, M., Thompson, K. (eds.): The LEDA traitbase - Collecting and measuring standards of life-history traits of the Northwest European Flora. Pages 101-104. LEDA Traitbase Project, University of Groningen.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Müller-Schneider, P. (1977): Verbreitungsbiologie (Diasporologie) der Blütenpflanzen. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 61.

Müller-Schneider, P. (1986): Verbreitungsbiologie der Blütenpflanzen Graubündens. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 85.

Moles, A.T., Ackerly, D.D., Tweddle, J.C., Dickie, J.B., Smith, R., Leishman, M.R., Mayfield, M.M., Pitman, A., Wood, J.T. & Westoby, M. (2007): Global patterns in seed size. Global Ecology and Biogeography 16, 109-116.

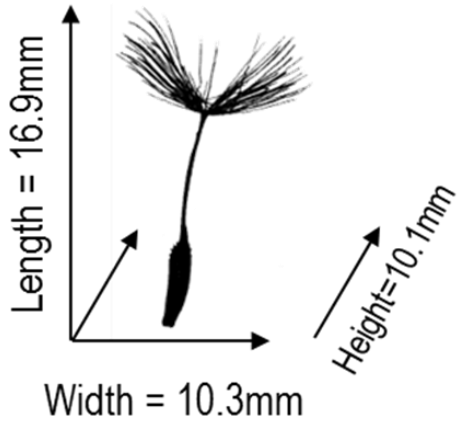
Diaspore Shape

Summary

DIASPORE SHAPE is a dimensionless index ranging from 0 to ca. 0.23. It describes the deviation of a diaspore's shape from a sphere in three dimensions. 0 addresses a perfect sphere, whereas values > 0 addresses flat or elongated diaspores.

Trait description

The dimensionless index DIASPORE SHAPE (column code: DIA_SHAPE) is calculated as the variance of the standardized mean size of the three dimensions of the diaspore (Fig. 1; additionally see Diaspore Size) (Thompson et al., 1993).



$$Shape = \text{variance}\left(\frac{length}{length}, \frac{width}{length}, \frac{height}{length}\right)$$

$$= \text{variance}\left(\frac{16.9}{16.9}, \frac{10.3}{16.9}, \frac{10.1}{16.9}\right)$$

$$= 0.03$$

Fig. 1. Calculation of DIASPORE SHAPE for dandelion (*Taraxacum* Sect. *Ruderalia*).

Data sources

DIASPORE SHAPE is calculated from all information on diaspore size that was available. Accordingly, it cannot be directly calculated from the presented information on diaspore size in some species.

Literature

Bekker, R.M., Bakker, J.P., Grandin, U., Kalamees, R., Milberg, P., Poschlod, P., Thompson, K. & Willems, J.H. (1998): Seed size, shape and vertical distribution in the soil: indicators of seed longevity. Functional Ecology 12, 834-842.

Thompson, K., Band, S.R. & Hodgson, J.G. (1993): Seed size and shape predict persistence in soil. Functional Ecology 7, 236-241.

Diaspore Form

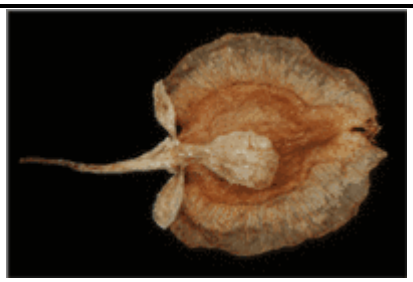
Summary

The DIASPORE FORM is a categorical trait which describes the form of the diaspore in four categories: spherical, elongated, flat and elongated & flat.

Trait description

DIASPORE FORM (column code: DIA_FORM) is a categorical trait which describes the form of the diaspore as one of the following categories (Tab. 1). In contrast to diaspore shape, it allows distinguishing between flat and elongated forms.

Tab. 1. Categorization of DIASPORE FORM

Form	Examples	Constraints
spherical	 *Glycine max*	(length/width < 3) and (width/height < 3) and (length/width + width/height < 4.5)
flat	 *Oxyria digyna*	(width/height ≥ 3) and (length/width < 3)
elongated	 *Festuca rubra*	(length/width ≥ 3) and (width/height < 3)

elongated & flat	 *Pinus nigra*	(length/width + width/height ≥ 4.5) OR (length/width ≥ 3) and (width/height ≥ 3)

Data sources

DIASPORE FORM is calculated from all information on diaspore size that was available. For each taxon the mean values of the size measurements were used if more than one measurement was available. Accordingly, it cannot be directly calculated from the presented information on diaspore size in some species.

Diaspore Surface Structure

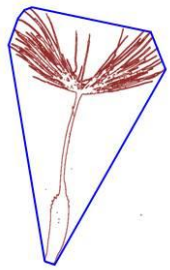
Summary

DIASPORE SURFACE STRUCTURE is a dimensionless index that describes the smoothness of a diaspore's surface based on images of the diaspores, i.e. in two dimensions. It ranges from 0 to 1 with 0 indicating rough and 1 indicating smooth diaspore surfaces.

Trait description

DIASPORE SURFACE STRUCTURE (column code: DIA_SURFACESTRUCTURE) is a dimensionless index that describes the smoothness of a diaspore's surface based on images of the diaspores, i.e. in two dimensions. The index ranges from 0 (rough surface) to 1 (smooth surface). It is calculated as the quotient of the perimeter of the smallest convex hull polygon around the diaspore and the perimeter of the diaspore (Fig. 1).

If more than one measurement was available, generally only the mean value is presented. Raw data are available on request.



$$\mathrm{DIA}_{\mathrm{SURFACESTRUCTURE}} = \frac{\mathrm{Perimeter}_{\mathrm{Hull}}}{\mathrm{Perimeter}_{\mathrm{Diaspore}}} = \frac{48\ mm}{269\ mm} = 0.18$$

Fig. 1. DIASPORE SURFACE STRUCTURE for one diaspore of dandelion (*Taraxacum* Sect. *Ruderalia*). DIASPORE SURFACE STRUCTURE is the quotient of the perimeter of the smallest convex hull polygon around the diaspore (in blue) and the perimeter of the diaspore (in red).

Data sources

DIASPORE SURFACE STRUCTURE is calculated from digital images of the diaspores. Most images were made with an AZ-100 loupe (Nikon, Tokyo, Japan) and camera-type DS-Fi, 5.07 megapixel (Nikon, Tokyo, Japan). Image analysis was performed with NIS-Elements (Nikon, Tokyo, Japan).

Literature

Römermann, C. et al. (2005): How to predict attachment potential of seeds to sheep and cattle coat from simple morphological seed traits. Oikos 110, 219-230.

Will, H., Maussner, S. & Tackenberg, O. (2007): Experimental studies of diaspore attachment to animal coats: Predicting epizoochorous dispersal potential. Oecologia 153, 331-339.

Diaspore Mass

Summary

DIASPORE MASS is the weight (in mg) of one diaspore including all appendages.

Trait description

DIASPORE MASS (column code: DIA_MASS) is the weight (in mg) of one diaspore including all appendages. If more than one measurement was available, generally only the mean value is presented. Raw data are available on request.

Data sources

DIASPORE MASS mostly comprises original measurements. Additionally, some larger datasets (e.g. Müller-Schneider, 1986; Luftensteiner, 1982; Brouwer & Stählin, 1975) from published literature are also included, whereas larger third party datasets like LEDA or BIOPOP are not included.

Selected literature

Brouwer, W. & Stählin, A. (1975) Handbuch der Samenkunde für Landwirtschaft, Gartenbau und Forstwirtschaft. DLG-Verlag, Frankfurt.

Götzenberger, L. (2000): SEED WEIGHT & SEED SHAPE. In: Knevel, I.C., Bekker, R.M., Kunzmann, D., Stadler, M., Thompson, K. (eds.): The LEDA traitbase - Collecting and measuring standards of life-history traits of the Northwest European Flora.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Luftensteiner, H.W. (1982) Untersuchungen zur Verbreitungsbiologie von Pflanzengemeinschaften an vier Standorten in Niederösterreich. Bibliotheka Botanica, pp. 68. Schweizerbartsche Buchhandlung, Stuttgart.

Müller-Schneider, P. (1977): Verbreitungsbiologie (Diasporologie) der Blütenpflanzen. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 61.

Müller-Schneider, P. (1986): Verbreitungsbiologie der Blütenpflanzen Graubündens. Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 85.

Otto, B. (2002): Merkmale von Samen, Früchten, generativen Germinulen und generativen Diasporen. In: Klotz, S., Kühn, I. & Durka, W. [Hrsg.] (2002): BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen der Gefäßpflanzen in Deutschland. Schriftenreihe für Vegetationskunde 38, Bonn: Bundesamt für Naturschutz, 177-196.

Terminal Velocity

Summary

The TERMINAL VELOCITY is the maximum speed (in m/s) of a falling diaspore in still air.

Trait description

TERMINAL VELOCITY (column code: VTERM) is a continuous trait that describes the maximum speed (in m/s) of a falling diaspore in still air.

Diaspores (as any falling object) accelerate during the free fall and approximate TERMINAL VELOCITY only after a well-defined time period, which depends mainly on its mass and drag coefficient. Original measurements thus generally do NOT refer to the TERMINAL VELOCITY but to an average velocity measured during the initial acceleration phase. The difference between the measured and the 'real' TERMINAL VELOCITY will often be significant: For medium-sized spherical seeds the measured velocity will often be 1.5 to 2 times smaller than the real TERMINAL VELOCITY, for heavy diaspores the difference might be considerably higher, depending mainly on the drop height. TERMINAL VELOCITY in our database is therefore corrected for this initial acceleration wherever possible. The correction factor is derived from a discretised simulation of free fall of the diaspores with drag based on the laws of physics following Schäfer (2002).

If more than one measurement was available, generally only the mean value is presented. Raw data are available on request.

Data sources

The original measurements were mostly made with a custom made terminal velocity-meter, which is a further development of the apparatus presented by Askew et al. (1997). TERMINAL VELOCITY of large diaspores or diaspores with dynamic flight behaviour (e.g. *Acer* spec.) was measured manually. TERMINAL VELOCITY mostly comprises original measurements of diaspores, which were corrected for the effect of initial acceleration. Some datasets from published literature are also included, if the measurement method was not likely to underestimate terminal velocity significantly. In contrast, larger third party datasets (e.g. from LEDA) are not included here.

Literature

Askew, A.P., Corker, D., Hodkinson, D.J. & Thompson, K. (1997): A new apparatus to measure the rate of fall of seeds. Functional Ecology 11, 121-125.

Jongejans, E. & Schippers, P. (1999): Modeling seed dispersal by wind in herbaceous species. Oikos 87, 362-372.

Luftensteiner, H.W. (1982): Untersuchungen zur Verbreitungsbiologie von Pflanzengemeinschaften an vier Standorten in Niederösterreich. Bibliotheka Botanica. Schweizerbartsche Buchhandlung, Stuttgart.

Schäfer, M. (2002): Beobachtung, Analyse und Beschreibung von realen Fallbewegungen. DLR, Göttingen.

Tackenberg, O. (2001): Methoden zur Bewertung gradueller Unterschiede des Ausbreitungspotentials von Pflanzenarten. - Modellierung des Windausbreitungspotentials und regelbasierte Ableitung des Fernausbreitungspotentials. Cramer, Berlin.

Thompson, K. (2005): Terminal Velocity. In: Knevel, I.C., Bekker, R.M., Kunzmann, D., Stadler, M., Thompson, K. (eds.): The LEDA traitbase - Collecting and measuring standards of life-history traits of the Northwest European Flora.

Exposure of Diaspores

Summary

EXPOSURE OF DIASPORES is a categorical trait that describes the accessibility of dispersal vectors (e.g. wind, animals) to the generative diaspores within the infructescence.

Trait description

EXPOSURE OF DIASPORES (column code: DIA_EXPOSURE) is coded as one of the categories listed and described below (Tab. 1). Category four is reserved for taxa without generative diaspores or generally no dispersal.

Tab. 1. Categories for EXPOSURE OF DIASPORES

No.	Category	Description	Examples	
1	exposed	Dispersal vectors (e.g. wind, animals) have more or less unobstructed access to the diaspores: Hull structures do not hide the diaspore for/in the time span of ripening and dispersal. In general, the diaspore is exposed and accessible over a longer period.	*Acer, Agrimonia, Arrhenatherum, Carex, Galium, Lonicera, Malus, Peucedanum, Polygonatum, Prunus, Pulsatilla, Quercus, Ranunculus, Rosa, Rubus, Senecio, Sorbus, Vaccinium*	 *Agrimonia procera* - diaspores (fruits) **exposed.**

2	covered partly	Dispersal vectors (e.g. wind, animals) have limited access to the diaspores: Hull structures cover parts of the diaspore. For/in the time span of ripening and dispersal the diaspore is less accessible over a longer period.	*Abies, Epilobium, Juncus, Lamium, Luzula, Phleum, Populus, Teucrium, Scutellaria, Sedum*	 *Teucrium scorodonia* - diaspores (four nutlets) **covered partly.**
3	enclosed	Dispersal vectors (e.g. wind, animals) have hardly any direct access to the diaspores: Hull structures hide the diaspore (nearly) complete. For/in the time span of ripening and dispersal the diaspore is not or hardly accessible.	*Dianthus, Epipactis, Gentiana, Lilium, Orchis, Papaver, Plantago, Primula, Silene, Veronica, Viola*	 *Papaver rhoeas* - capsules with **enclosed** diaspores (seeds).
4	not applicable	Species without generative diaspores: Sterile taxa or specialized and unspecialized vegetative parts of the plants acting as diaspores.	*Allium* (bulbils), *Betula x aurata* (sterile), *Elodea* (turions)	 *Allium cepa* - infructescence with bulbils.

Data sources

EXPOSURE OF DIASPORES was categorized by visual inspection of diaspores and fruits and infructescences or respective images in addition to an intensive literature and web research.

Literature

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Jäger, E.J. & Werner, K. (1995) Rothmaler - Exkursionsflora von Deutschland. Gefäßpflanzen: Atlasband. Fischer, Jena.

Seeds per Diaspore

Summary

SEEDS PER DIASPORE is an ordinal scaled trait that describes the number of seeds per diaspore.

Trait description

SEEDS PER DIASPORE is an ordinal scaled trait that describes how many seeds are enclosed in one diaspore. Based on images and drawings of plants and their diaspores in combination with an intensive literature and web research we estimated the number of seeds per diaspore. All assessments were made in categories with log-scaled boundaries according to Tab. 1.

Tab. 1. Categories used for assessing SEEDS PER DIASPORE

Seed class	Minimum number	Maximum number	Mean number
0	-	-	no seeds
1	1	1	1
2	2	10	6
3	11	100	56
4	101	1 000	550
5	1 001	10 000	5 500
6	10 001	100 000	55 000
7	100 001	1 000 000	550 000
8	1 000 001	10 000 000	5 500 000
9	10 000 001	100 000 000	55 000 000
10	100 000 001	1 000 000 000	550 000 000

Data sources

SEEDS PER DIASPORE was derived from drawings and images of the species in addition to an intensive literature and web research.

Literature

Graf, J. et al. (1987): Tafelwerk zur Pflanzensystematik. Einführung in das natürliche System der Blütenpflanzen. Springer-Verlag.

Hegi, G. (1908ff): Illustrierte Flora von Mittel-Europa. Mit besonderer Berücksichtigung von Deutschland, Oesterreich und der Schweiz. Zahlreiche Bände in drei Auflagen. J. F. Lehmanns Verlag, 2. und 3. Auflage bei Paul Parey und Weissdorn-Verlag.

Ranking Indices

RANKING INDICES are indices that allow an assessment how well a species is adapted to a certain dispersal mode in comparison to other species and dispersal modes. They are derived from indicators, i.e. dispersal traits or experimental assessments.

RANKING INDICES are here calculated as the percentile rank of this indicator in relation to all species for which data are available in D^3. They range from 0 to 1 with 0 addressing species with the lowest and 1 addressing species with the highest dispersal potential (details see in the respective section). Please note that we used the lowest rank in case of identical values.

For example, *Fraxinus excelsior* (anemochory ranking = 0.70, epizoochory ranking = 0.01, hydrochory ranking = 0.17) is well adapted to anemochory (wind dispersal). 30 % of the species for which data are available in D^3 show a lower (or identical) terminal velocity and are better (or equal) adapted to wind dispersal. In contrast, *F. excelsior* shows nearly no adaptation to epizoo- or hydrochory in comparison to the other species in the database.

Anemochory Ranking Index

Summary

ANEMOCHORY RANKING INDEX allows an assessment how well a certain species is adapted to anemochory (wind dispersal) in comparison to other species and dispersal modes.

Trait description

ANEMOCHORY RANKING INDEX is an index that ranges from 0 to 1, with 0 addressing species with the lowest and 1 addressing species with the highest potential for anemochory. We use terminal velocity as an indicator of anemochory potential and calculate ANEMOCHORY RANKING INDEX as the percentile rank of (descending) terminal velocity of the respective species in relation to the terminal velocities of all species for which data were available. A value of e.g. 0.98 means that 2 % of the species possess a higher (or identical) anemochory potential and a lower (or identical) terminal velocity, respectively.

Data sources

ANEMOCHORY RANKING INDEX is calculated from all data on terminal velocities that were available.

Literature

Kleyer, M., Bekker, R.M., Knevel, I.C., Bakker, J.P., Thompson, K., Sonnenschein, M., Poschlod, P., van Groenendael, J.M., Klimes, L., Klimesova, J., Klotz, S., Rusch, G.M., Hermy, M., Adriaens, D., Boedeltje, G., Bossuyt, B., Dannemann, A., Endels, P., Gotzenberger, L., Hodgson, J.G., Jackel, A.K., Kuhn, I., Kunzmann, D., Ozinga, W.A., Romermann, C., Stadler, M., Schlegelmilch, J., Steendam, H.J., Tackenberg, O., Wilmann, B., Cornelissen, J.H.C., Eriksson, O., Garnier, E., Peco, B., 2008. The LEDA Traitbase: a database of life-history traits of the Northwest European flora. J. Ecol., 96, 1266-1274.

Tackenberg, O., Poschlod, P. & Bonn, S. (2003): Assessment of Wind Dispersal Potential in Plant Species. Ecological Monographs 73(2), 191-205.

Epizoochory Ranking Index

Summary

EPIZOOCHORY RANKING INDEX allows an assessment how well a certain species is adapted to epizoochory (external animal dispersal) in comparison to other species and dispersal modes.

Trait description

EPIZOOCHORY RANKING INDEX is an index that ranges from 0 to 1, with 0 addressing species with the lowest and 1 addressing species with the highest potential for epizoochory. We use a combination of attachment potential (ATP; Will et al., 2007) and retention potential (RTP; Römermann et al., 2005; Tackenberg et al., 2006) as an indicator of epizoochory potential. This potential can be interpreted as the proportion of seeds that are transported by an animal over a longer time period that principally allows long distance dispersal. The index was computed for the transport in woolly hair. Based on our experience the difference between various fur types in EPIZOOCHORY RANKING INDEX is negligible for many applications, although some differences exist (cf. Römermann et al. 2005, Tackenberg et al. 2006).

Specifically, EPIZOOCHORY RANKING INDEX is calculated as the percentile rank of (ascending) ATP*RTP of the respective species in relation to the values of all species for which data were available.

A value of e.g. 0.7 means that 30 % of the species possess a higher (or identical) epizoochory potential and a higher (or identical) proportion of seeds are transported by animal furs for a significant time period, respectively.

Data sources

EPIZOOCHORY RANKING INDEX is calculated for all species with relevant data available.

Further reading

Römermann, C. et al. (2005): How to predict attachment potential of seeds to sheep and cattle coat from simple morphological seed traits. Oikos 110, 219-230.

Tackenberg, O., Römermann, C., Thompson, K. & Poschlod, P. (2006): What does seed morphology tell us about external animal dispersal? Results from an experimental approach measuring retention times. Basic and Applied Ecology 7, 45-58.

Will, H., Maussner, S., Tackenberg, O. (2007): Experimental studies of diaspore attachment to animal coats: Predicting epizoochorous dispersal potential. Oecologia 153, 331-339.

Hydrochory Ranking Index

Summary

HYDROCHORY RANKING INDEX allows an assessment how well a certain species is adapted to hydrochory (water dispersal) in comparison to other species and dispersal modes.

Trait description

HYDROCHORY RANKING INDEX is an index that ranges from 0 to 1, with 0 addressing species with the lowest and 1 addressing species with the highest potential for hydrochory. We use the proportion of floating seeds measured in a standardized lab experiment (Römermann et al., 2005 and unpublished data) as an indicator of hydrochory potential.

Specifically, HYDROCHORY RANKING INDEX is calculated as the percentile rank of the proportion of the respective species still floating after 1 week in relation to all species for which data were available. A value of e.g. 0.55 means that 45 % of the species possess a higher (or identical) hydrochory potential and a higher (or identical) proportion of seeds still floating after 1 week, respectively.

Actually, the values range from 0.00 and 0.89 as 11 % of the species show a proportion of 100 % floating diaspores after 1 week.

Data sources

HYDROCHORY RANKING INDEX is calculated from data of floating potential from the LEDA database (Kleyer et al. 2008) as well as from unpublished data.

Literature

Kleyer, M., Bekker, R., Bakker, J., Knevel, I., Thompson, K., Sonnenschein, M., Poschlod, P., van Groenendael, J., Klimes, L., Klimesova, J., Klotz, S., Rusch, G., Hermy, M., Adriaens, D., Boedeltje, G., Bossuyt, B., Endels, P., Götzenberger, L., Hodgson, J., Jackel, A., Dannemann, A., Kühn, I., Kunzmann, D., Ozinga, W., Römermann, C., Stadler, M., Schlegelmilch, J., Steendam, H., Tackenberg, O., Wilmann, B., Cornelissen, J., Eriksson, O., Garnier, E., Fitter, A. und Peco, B. (2008): The LEDA Traitbase: A database of plant life-history traits of North West Europe. - Journal of Ecology 96:1266-1274.

Römermann, C., Tackenberg, O. & Poschlod, P. (2005): Buoyancy. In: Knevel, I.C., Bekker, R.M., Kunzmann, D., Stadler, M., Thompson, K. (eds.): The LEDA traitbase - Collecting and measuring standards of life-history traits of the Northwest European Flora. 101-104. LEDA Traitbase Project, University of Groningen.

Information from Literature

Summary

INFORMATION FROM LITERATURE quantifies how the dispersal mode of a plant species was categorized in published literature.

Trait description

INFORMATION FROM LITERATURE is coded in eight variables which quantify how often an assessment of the addressed dispersal mode was found in literature (No. 1 in Tab. 1) and how high the proportion of citations for the seven considered dispersal modes was (No. 2-8 in Tab. 1). Only dispersal modes and vectors with a high potential for long-distance dispersal are considered.

We recommend using the proportions only if at least five citations per species are available.

Tab. 1. Variables related to INFORMATION FROM LITERATURE

No.	**Variable name**	**Scale and range**	**Description**
1	CITATION_TOTAL	integer	Number of citations how often an assessment of any of the considered dispersal modes was found in literature.
2	CITATION_PROP_ANE	continuous [0-1]	Proportion of the citations for anemochory, i.e. dispersal by wind. These data do not include boleochor species.
3	CITATION_PROP_DYSO	continuous [0-1]	Proportion of the citations for dysochory (including stomatochory), i.e. dispersal by scatterhording animals.
4	CITATION_PROP_ENDO	continuous [0-1]	Proportion of the citations for endozoochory, i.e. dispersal by animals after feeding and digestion.
5	CITATION_PROP_EPI	continuous [0-1]	Proportion of the citations for epizoochory, i.e. dispersal on the coats or hooves of animals.
6	CITATION_PROP_HEM	continuous [0-1]	Proportion of the citations for hemerochory, i.e. dispersal by humans and human activities.

7	CITATION_PROP_HYDRO	continuous [0-1]	Proportion of the citations for hydrochory, i.e. dispersal on the surface of water.
8	CITATION_PROP_OTHER	continuous [0-1]	Proportion of the citations for other dispersal modes that offer the possibility of long-distance dispersal, e.g. bythisochory or chamaechory.

Data Sources

The raw data used for the calculations are mainly taken from DIASPORUS (Bonn et al., 2000), BIOPOP (Poschlod et al., 2006), LEDA (Kleyer et al., 2008) and unpublished data.

Literature

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