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Traits used to distinguish the recognized subspecies of *Erigeron acris L.*

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Abstract

Erigeron acris L was first described in 1753. Subspecies (*ssp.*) has since been added resulting in today's five having distribution in Nordic countries. However the treatment and characteristics of these are not consistent in all floras and some traits are described for a few subspecies and not stated at all for others. Subspecies have perhaps in some cases been added without fully reviewing the taxa that earlier have been described. This study is trying to give some direction into which traits actually separates the subspecies and discusses whether these are enough to define them as separate. 23 variables were studied on 113 herbaria specimens divided among the subspecies, as they are defined today. The specimens were mainly from Lund Botanical Museum. However, specimens from the Museum of Natural History in Stockholm and the Museum of Natural History in Helsinki were also lent and processed.

The data were then analyzed through ANOVA (Analysis of Variance) and PCA (Principal Components Analysis). The Principal Components Analysis was used to illustrate if and how the subspecies overlapped. The ANOVA was used to see if there were any traits significantly separating the subspecies. The first ANOVA was only made on *E. a.* ssp. *acris, E. a. ssp. droebachiensis* and *E. a. ssp. politus*. Four traits could here be found which significantly separated the three *ssp*. Three characters could not distinguish any from the others and the rest of the characters could distinguish one of the three subspecies, in different combinations.

When looking at the ANOVA made with all five subspecies, four traits could not distinguish any of these subspecies from the others. All other 19 traits had some subspecies partly or completely overlapping and some could only be distinguished from some others. In three of these cases *E. a. ssp. acris* could be separated from all the other subspecies. The other four subspecies were overlapping with at least one other in all traits.

E. a. ssp. droebachiensis and *E. a. ssp. brachycephalus* overlapped partly or completely in 22 out of 23 traits. *E. a. ssp. droebachiensis* and *E. a. ssp. decoloratus* could as well only be separated by one trait completely. As a consequence, a possible reduction of the number of subspecies is discussed.

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Last but not least I would like to give credit and admiration to my family and friends whom have put up with my blabbering about involucral bracts, glandular hairs and score plots. A special thanks to Lina and Hanna whom have always been there to give encouragements.

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Introduction

Identifying diversity

"The first step in wisdom is to know the things themselves; this notion consists in having a true idea of the objects; objects are distinguished and known by classifying them methodically and giving them appropriate names. Therefore, classification and name-giving will be the foundation of our science.-Carolus Linneaus"

(Linneaus, 1735 see Today in Science History, 2016 [Trans Engel-Ledeboer and H. Engel, 1964])

Taxonomy is to name and be able to classify organisms. However most importantly, to name and classify organisms is to classify and order knowledge, which is of high importance in many disciplines, not the least in the growing field of conservation. How can one know what to conserve if one does not know what there is?

Erigeron acris L (Blue Fleabane in English, Gråbinka in Swedish) is a species where there is some discussion about classification, specifically the classification of its subspecies.

Erigeron acris L was first described by Carl von Linnaeus in 1753 (Linneaus, 1753). Subspecies has since been added, five of which having part of, or the whole of, their distribution area in Nordic countries. However the treatment and characteristics of these are not consistent in all floras and some traits are described for a few subspecies and not stated at all in others. Subspecies have perhaps in some cases been added without fully reviewing the taxa that earlier have been described. Hence this project's main questions. Are the subspecies, as they are defined today, different? Which traits are separating them?

Aim

The aim of this project is to see how and with which characters one can separate the subspecies as they are defined today. Furthermore, also try to give some idea of how many subgroups of *E. acris L* there are in the Nordic countries through morphometric and multivariate statistical analyses, as recommended and used by Tyler (2007).

This is being done by measuring traits that are used in floras to separate now recognized subspecies. The measurements will be taken on specimens at Lund Botanical Museum (LD) and borrowed specimens from the Museum of Natural History in Helsinki (H), and the Museum of Natural History in Stockholm (S). The project will be limited to specimens collected in Nordic countries, mainly Sweden and Finland. Two main questions have been used to guide the project.

1. Are the subspecies, as they are defined today, different?
2. Which traits are separating them?

Erigeron acris L

Erigeron L. is a genus which includes around 150 species (Naturhistoriska riksmuseet, 2000) of which five can be found in the Nordic countries (Mossberg and Stenberg, 2003). The genus consists of mainly annuals and biennials (Naturhistoriska riksmuseet, 2000) which seems to prefer a dry habitat characterized by rock, sand or gravel. This is why some can be found in man-made habitats such as gravel roads (Mäkelä, 1980).

Erigeron acris L. is a member of the *Asteraceae* family, also known as *Compositae*. According to Svensk Kulturväxtdatabas (SKUD, 2015-03-09) *Erigeron acris L.* has two commonly used synonyms; *E. acre* and *E. acer*. The latter is frequently used in Nordic floras such as Den Nya Nordiska Floran (Mossberg and Stenberg, 2003) and *Retkeilykasvio* (Hämet-Ahti, Suominen, Ulvinen and Uotila, 1998). The Plan List (2013) does though confirm that *E. acris* is the officially accepted species epithet whereas *E. acre* and *E. acer* are not.

Subspecies of *Erigeron acris*

Four Floras has been used in this study to try to determine valuable characters; Den Nya Nordiska Floran (Mossberg and Stenberg, 2003), Retkeilykasvio (Hämet-Ahti *et al*, 1998), Suuri Kasvikirja III (Mäkelä, 1980) and Flora Europea (Burges *et al* 1976). All the information in this report gathered from the texts in Retkeilykasvio (Hämet-Ahti *et al*, 1998) and Suuri Kasvikirja III (Mäkelä, 1980) has been translated from Finish to English by Raino Lampinen. The information in this report from Den Nya Nordiska Floran (Mossberg and Stenberg, 2003) has been translated from Swedish by the author of this report.

Five subspecies under the species name of *E. acer* is recognized in the Swedish flora, Den Nya Nordiska Floran (Mossberg and Stenberg, 2003) and The Finish flora Retkeilykasvio (Hämet-Ahti *et al*, 1998); *E. a. ssp. acer, E. a. ssp. droebachiensis, E. a. ssp. politus, E. a. ssp. brachycephalus* and *E. a. ssp. decoloratus*. A second Finish flora, Suuri Kasvikirja III (Mäkelä, 1980) recognizes three subspecies with Nordic distribution; *E. a. ssp. acer, E. a. ssp. droebachiensis* and *E. a. ssp. politus,* while *E. a. ssp. brachycephalus* and *E. a. ssp. decoloratus* are treated as species (*E. brachycephalus* and *E. decoloratus)*. Flora Europea (Burges *et al*, 1976) recognizes seven possible subspecies, however only five of which are having the Nordic countries as part of their distribution area. See table 1. The authors of Flora Europea (Burges *et al*, 1976) does also point out that the two subspecies, existing in Finland and Russia (*E. a. ssp. brachypetalus* and *E. a. ssp. decoloratus*), would need further studies.

Table I. Subspecies of *Erigeron acer* (synonym to *E. acris*) according to four floras. Except for two subspecies in Flora Europea (Burges *et al*, 1976), all have a Nordic country or countries as part of their area of distribution. In Suuri Kasvikirja III (Mäkelä, 1980), *brachycephalus* and *decoloratus* is treated as species.

Den Nya Nordiska Floran (Mossberg and Stenberg 2003)	**Retkeilykasvio (Hämet-Ahti *et al*, 1998)**
E. a. ssp. acer (acris)	*E. a. ssp. acer (acris)*
E. a. ssp. droebachiensis	*E. a. ssp. droebachiensis*
E. a. ssp. politus	*E. a. ssp. politus*
E. a. ssp. brachycephalus	*E. a. ssp. brachycephalus*
E. a. ssp. decoloratus	*E. a. ssp. decoloratus*
Flora Europea (Burges *et al*, 1976)	**Suuri Kasvikirja III (Mäkelä, 1980)**
E. a. ssp. acer (ssp. acris)	*E. a. ssp. acer (ssp. acris)*
E. a. ssp. droebachiensis	*E. a. ssp. droebachiensis*
E. a. ssp. politus	*E. a. ssp. politus*
E. a. ssp. brachypetalus	*Erigeron brachycephalus*
E. a. ssp. decoloratus	*Erigeron decoloratus*
E. a. ssp. angulosus (C. Europe)	
E. a. ssp. macrophyllus (Carpathians and E. Austria)	

Erigeron acris L. ssp. acris (Gråbinka in Swedish) can be found all over the Nordic countries except Iceland and some mountainous areas. It prefers open and dry habitats with for example gravel (Mossberg and Stenberg, 2003). *E. a. ssp. politus,* (Fr.) H. Lindb (Brunbinka in Swedish), can mainly be found in mountainous areas while many *E. a. ssp. droebachiensis,* (O. F. Müll.) Arcang (Kalbinka in Swedish) often are found in coastal areas and/or rock walls (Naturhistoriska riksmuseet, 2005) from eastern Norway to southern Finland (Stenberg and Mossberg, 2003). According to Flora Europea (Burges (EDT), Heywood (EDT), Moore, (EDT) *et al* 1976) *E. a. ssp. brachycephalus,* (H. Lindb.) Hiitonen (Östbinka in Swedish) and *E. a. ssp. decoloratus,* (H. Lindb.) Hiitonen (Blekbinka in Swedish) have only been found in relatively small areas of Finland and Russia. Mossberg and Stenberg (2003) do though include eastern Sweden in the distribution range of *E. a. ssp. brachycephalus.*

Traits in literature

Erigeron acris ssp. *acris*

(*E. acer ssp. acer*)

Height (10-)20-40 centimeters (cm), stem and leaves densely hairy, length of involucral bracts 3,5-5,5 (-5,6) millimeters (mm), width of involucral bracts 0,6(-0,7) mm, colour of involucral bracts green or with reddish apex, capitulas less than 10, ray flowers extends around 1 mm above pappus, colour of ray flowers purple (Hämet-Ahti *et al*, 1998; Mossberg and Stenberg, 2003; Mäkelä, 1980).

Burges *et al* (1976) and Mossberg and Stenberg (2003) argues that the whole plant of *ssp. acris*/*acer* is densely hairy. According to Hämet-Ahti *et al* (1998) the involucral bracts are

covered in a lot of both glandular and eglandular hairs, while Mossberg and Stenberg (2003) states that there are no glandular hairs on the involucral bracts. See table 2.

Table 2. Summary of traits and their values used in the literature for *Erigeron acris ssp. acris*. Involucral bracts (In. bracts), Centimeters (cm), Millimeters (mm), Number (no), Ray flowers (Rf), Ray flowers reach above pappus (Rf. Reach), mean value (Mean), Standard deviation (SD).
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
*** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits/Literature	**Burges *et al* (1976)**	**Hämet-Ahti *et al* (1998)**	**Mossberg and Stenberg (2003)**	**Mäkelä (1980)**	**Observations in this project**
Height (cm)	Not stated	20-40	10-40	20-40	8,0-47 Mean: 27,6 SD:9,48
Stem (hairs)	Densely hairy	Densely eglandular	Densely hairy	Densely hairy	ca >5 eglandular hairs per mm^2. Mean: 3,5* SD: 0,67*
Leaves (hairs)	Densely hairy	Densely eglandular	Densely hairy	Not stated	Ca 5-10 eglandular hairs per mm^2 Mean: 3* SD: 0,81*
In. bracts, length (mm)	Not stated	3,5-5,5	3,5-5,5	3,5-5,6	3,5-6 Mean: 4,8 SD: 0,62
In. bracts, width (mm)	Not stated	0,6-0,7	Circa 0,6	0,6-0,7	0,5-1,0 Mean: 0,6 SD: 0,13
In. bracts, hair	The whole plant is densely hairy	Densely hairy, glandular and eglandular hairs	Whole plant densely hairy, no glandular hairs on In. bracts.	Not stated	Ca >10 eglandular hairs per mm^2, densely glandular Mean: 3,9* SD: 0,55*
In. bracts, colour	Not states	Green or with reddish apex	Not stated	Green or with reddish apex	Medium coloration Mean: 1,8** SD: 0,55**
Capitulas (no)	Not stated	Not stated	<60	Not stated	3-46 Mean: 11,1 SD: 9,53
Rf. Reach (mm)	Not stated	1	Not stated	ca 1	0-2,5 Mean: 0,7 SD: 0,61
Rf. colour	Not stated	Not stated	Purple	Not stated	White Mean: 1*** SD: 0***

Erigeron acris ssp. droebachiensis
(*E. acer ssp. droebachiensis*)

Stem, leaves and involucral bracts glabrous or almost so, involucral bracts length and width not stated, colour of involucral bracts reddish brown, ray flowers height above pappus and colour not stated. (Burges *et al*, 1976; Hämet-Ahti *et al*, 1998; Mossberg and Stenberg, 2003; Mäkelä, 1980). See table 3 for further information.

Table 3. Summary of traits and their values used in literature for *Erigeron acris ssp. droebachiensis*. Involucral bracts (In. bracts), Centimeters (cm), Millimeters (mm), Number (no), Ray flowers (Rf), Ray flowers reach above pappus (Rf. Reach), mean value (Mean), Standard deviation (SD).
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
*** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits/Literature	Burges *et al* (1976)	Hämet-Ahti *et al* (1998)	Mossberg and Stenberg (2003)	Mäkelä (1980)	Observations in this project
Height (cm)	Not stated	Not stated	Not stated	Not stated	7,5-79,5 Mean: 34,3 SD: 14,46
Stem (hairs)	Not stated	Glabrous or almost so	Glabrous or almost so	Not stated	Ca 0-5 eglandular hairs per mm^2 Mean:1,8* SD: 1,03*
Leaves (hairs)	Glabrous	Glabrous or almost so	Glabrous or almost so	Not stated	Ca 0-5 eglandular hairs per mm^2 Mean: 1,4* SD: 0,66*
In. bracts, length (mm)	Not stated	Not stated	Not stated	Not stated	3,5-5,5 Mean: 4,4 SD: 0,61
In. bracts, width (mm)	Not stated	Not stated	Not stated	Not stated	0,3-0,8 Mean: 0,5 SD: 0,08
In. bracts, hair	Glabrous or nearly so	Almost glabrous	Glabrous or nearly so	Not stated	Ca 0-10 eglandular hairs per mm^2, densely glandular Mean: 2,6* SD: 1,08*
In. bracts, colour	Green with lilac apex	Reddish brown	Reddish brown	Reddish brown	Medium coloration Mean: 1,5** SD: 0,67**
Capitulas (no)	<30	>10	10-30	Not stated	3-48 Mean: 14,9 SD: 11,31
Rf. Reach (mm)	Almost the same as pappus	Not stated	Not stated	Not stated	(-2)-2 Mean: 0,5 SD: 0,78
Rf. Colour	Not stated	Almost always purple	Not stated	Not stated	Mostly white Mean: 1,3*** SD: 0,73

Erigeron acris ssp. *politus*
(E. acer ssp. politus)

Height less than 30 cm, stem and leaves glabrous or almost so, leaves possibly glossy, involucral bracts width (4,5-)4,6-6,3(-6,5) mm, length circa 0,8 mm, the colour of the involucral bracts are dark reddish brown or uniformly purplish, capitulas 3-10(<10), ray flowers extends the pappus by around 1,5mm (Burges *et al*, 1976; Hämet-Ahti *et al*, 1998; Mossberg and Stenberg, 2003; Mäkelä, 1980). See table 4 for further information.

There are a lot of glandular hairs on the involucral bracts according to Hämet-Ahti *et al* (1998) and Mäkelä (1980). Hämet-Ahti *et al* (1998) adds that there are some eglandular hairs. Burges *et al*, (1976) does not mention glabrous hairs but states that there are some eglandular hairs at base of bracts. On the other hand Mossberg and Stenberg (2003) states that the involucral bracts are almost glabrous. See table 4.

Table 4. Summary of traits and their values used in literature for *Erigeron acris ssp. politus*. Involucral bracts (In. bracts), Centimeters (cm), Millimeters (mm), Number (no), Ray flowers (Rf), Ray flowers reach above pappus (Rf. Reach), mean value (Mean), Standard deviation (SD).
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
*** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits/Literature	**Burges *et al* (1976)**	**Hämet-Ahti *et al* (1998)**	**Mossberg and Stenberg (2003)**	**Mäkelä (1980)**	**Observations in this project**
Height (cm)	Not stated	<30	Not stated	<30	20,5-53 Mean: 33,5 SD: 8,61
Stem (hairs)	Not stated	Glabrous	Almost glabrous	Glabrous	Ca <5 eglandular hairs per mm^2 Mean: 1,5* SD: 0,67*
Leaves (hairs)	Glabrous sometimes glossy	Almost glabrous	Glabrous	Glabrous and glossy	Ca <5 eglandular hairs per mm^2, Mean: 1,2* SD: 0,5*
In. bracts, length (mm)	Not stated	4,5-6,5	4,5-6,5	4,6-6,3	4-6,5 Mean: 5,3 SD: 0,57
In. bracts, width (mm)	Not stated	0,8-0,9	Circa 0,8	0,8-0,9	0,5-1 Mean: 0,7 SD: 0,11
In. bracts, hair	Glabrous hairs not stated, few eglandular hairs at base	A lot of glandular hairs and some eglandular hairs	Almost glabrous	A lot of glandular hairs	Ca <5 eglandular hairs per mm^2, densely glandular Mean: 1,8* SD: 0,82*

In. bracts, colour	Uniformly purplish	Dark reddish brown	Not stated	Dark reddish brown	Varying coloration Mean: 2,2** SD: 0,85**
Capitulas (no)	Not stated	<10	3-10	Not stated	3-16 Mean: 7,1 SD: 3,0
Rf. Reach (mm)	Not stated	>1,5	Not stated	Circa 1,5	0,3-2,5 Mean: 1,3 SD: 0,56
Rf. Colour	Not stated	Almost always purple	White to purple	Not stated	Mainly White Mean: 1,2*** SD: 0,46***

Erigeron acris ssp. *brachycephalus*

(E. acris ssp. brachypetalus. E. acer ssp. brachycephalus. E. brachycephalus)

Height 40-50(-80), stem and leaves sparsely hairy, the width of the involucral bracts are 0,5 mm, colour of the involucral bracts are pale green, ray flowers reach about the same level as the pappus. (Hämet-Ahti *et al*, 1998; Mossberg and Stenberg, 2003; Mäkelä, 1980).
See table 5 for further information.

According to Hämet-Ahti *et al* (1998) and Mäkelä (1980) the involucral bracts have glandular hairs all over as well as some eglandular hairs at the base. Mossberg and Stenberg (2003) writes that the bracts are sparsely hairy, not noting which kind of hairs.

Mossberg and Stenberg (2003) and Mäkelä (1980) write that the colour of the ray flowers are white to purple while Burges *et al* (1976) says that they are white. See table 5.

Table 5. Summary of traits and their values used in literature for *Erigeron acris ssp. brachycephalus*. Involucral bracts (In. bracts), Centimeters (cm), Millimeters (mm), Number (no), Ray flowers (Rf), Ray flowers reach above pappus (Rf. Reach), mean value (Mean), Standard deviation (SD).
[a] The normal range is described as 40-50 cm while they, in some cases, can reach as much as 80 cm.
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
*** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits/Literature	**Burges *et al* (1976)**	**Hämet-Ahti *et al* (1998)**	**Mossberg and Stenberg (2003)**	**Mäkelä (1980)**	**Observations in this project**
Height (cm)	Not stated	40-50	40-50(-80)[a]	40-50	21,5-56,5 Mean: 39,9 SD: 10,17
Stem (hairs)	Not stated	Sparsely hairy	Sparsely hairy	Sparsely hairy	Ca 0-5 eglandular hairs per mm^2 Mean: 2* SD: 0,93*

Leaves (hairs)	Not stated	Sparsely eglandular	Not stated	The whole plant is sparsely hairy	Ca 0-5 eglandular hairs per mm^2 Mean: 1,9* SD: 0,83*
In. bracts, length (mm)	Not stated	3-5	5	2,8-5,1	4-4,5 Mean: 4,2 SD: 0,26
In. bracts, width (mm)	Not stated	0,5	0,5	0,5	0,4-0,5 Mean: 0,5 SD: 0,05
In. bracts, hair	Not stated	Glandular hairs all over and some eglandular at base	Sparsely hairy	A lot of glandular hairs and some eglandular	Ca 0-10 eglandular hairs per mm^2, densely glandular Mean: 2,6* SD: 0,92*
In. bracts, colour	Not stated	Pale green	Pale green	Pale green	Light - Medium coloration Mean: 1,5** SD: 0,76**
Capitulas (no)	Not stated	30-50	30-50	30-50	9-35 Mean: 22 SD: 10,46
Rf. Reach (mm)	Not stated	Same height as pappus	Not stated	Same height as pappus	0-0,8 Mean: 0,3 SD: 0,27
Rf. Colour	White	White to purple	White to purple	White to purple	White - Purple Mean: 2,0*** SD: 0,93***

Erigeron acris ssp. *decoloratus*

(*E. acer* ssp. *decoloratus. E. decoloratus*)

Height 25-35 cm, stem and leaves sparsely hairy, involucral bracts are pale green, (3,5-)3,6-5,8 mm long and (0,7-)0,8(-0,9) mm wide, both glandular and eglandular hairs present. Capitulas 3-15, ray flowers reaching around 1 mm above pappus and are white (Burges *et al*, 1976; Hämet-Ahti *et al*, 1998; Mossberg and Stenberg, 2003; Mäkelä, 1980). See table 6 for further information.

Table 6. Summary of traits and their values used in literature for *Erigeron acris ssp. decoloratus*. Involucral bracts (In. bracts), Centimeters (cm), Millimeters (mm), Number (no), Ray flowers (Rf), Ray flowers reach above pappus (Rf. Reach), mean value (Mean), Standard deviation (SD).
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
*** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits/Literature	**Burges *et al* (1976)**	**Hämet-Ahti *et al* (1998)**	**Mossberg and Stenberg (2003)**	**Mäkelä (1980)**	**Observations in this project**
Height (cm)	Not stated	25-35	25-35	25-35	24,3-45 Mean: 33,3 SD: 7,87
Stem (hairs)	Not stated	Sparsely hairy	Sparsely hairy	Sparsely hairy, eglandular and long	Ca 0-10 eglandular hairs per mm^2 Mean: 2,2* SD: 0,41*
Leaves (hairs)	Not stated	Sparsely hairy	Sparsely hairy	Sparsely hairy, long	Ca 0-5 eglandular hairs per mm^2 Mean: 1,3* SD: 0,52*
In. bracts, length (mm)	Not stated	3,5-5,8	3,5-5,8	3,6-5,8	4,5-5,5 Mean: 4,9 SD: 0,38
In. bracts, width (mm)	Not stated	0,8	0,8	0,7-0,9	0,6-0,9 Mean: 0,7 SD: 0,12
In. bracts, hair	Not stated	Glandular and eglandular hairs present	Not stated	Glandular and eglandular hairs present	>5 eglandular hairs per mm^2, densely glandular Mean: 3,3* SD: 0,52*
In. bracts, colour	Not stated	Pale green	Pale green	Pale green	Light to medium coloration Mean: 1,2** SD: 0,41**
Capitulas (no)	Not stated	3-15	3-15	3-15	6-40 Mean: 15,7 SD: 14,15
Rf. Reach (mm)	Not stated	1	Not stated	Circa 1	0-1,5 Mean: 0,8 SD: 0,51
Rf. colour	White	Pale purple to white	White	White	Mostly white Mean: 1,3*** SD: 0,82***

Material and Method

Choosing characteristics

Traits were chosen from a few floras in which they had been used to separate subspecies of *Erigeron acris L*. The literature that was used to determine which characteristics to measure was Den Nya Nordiska Floran (Mossberg and Stenberg, 2003), Retkeilykasvio (Hämet-Ahti *et al*, 1998), Suuri Kasvikirja III (Mäkelä, 1980) and Flora Europea (Burges *et al*, 1976).

To broaden the study further, additional characteristics were measured. In contrast, some traits described in literature were not, for this study, possible to quantify. By the nature of the dried plant material and the reality of taking the measurements, the list of traits was altered, some deleted and some added. For example achene shape and structure were traits deleted as these often were partially hidden by involucral bracts and could not be studied without compromising the specimen.

The traits could be divided into qualitative and quantitative data. Guidelines for how and with which restrictions these characteristics were measured were then constructed as described below. For all the qualitative data ordinal scales were constructed. See "Measurement Specifications" and Table 13 for further information about the traits.

Choosing specimens

The specimens were first and foremost selected by their completeness. Namely if they had all the parts that were going to be measured, including capitulas, developed ray flowers, developed achene, so that one could see where the pappus began, stem leaves etc. There could be no cropped branches. A part of the root should be present so that one could know that the stem had not been pruned and shortened. Neither could the specimen have completely faded colours.

Secondly, specimens were selected on the basis of geographical distribution by not selecting plants from exactly the same area. Thus lessen the risk of having a large part of the selection from a local form.

Measuring

The measurements were taken on herbaria specimens, mainly from the botanical collections of Lund Botanical Museum (LD). However herbaria specimens lent from the Museum of Natural History in Helsinki (H) as well as lent specimens from the Museum of Natural History in Stockholm (S) were also used to complement the collections in Lund. In total 113 specimens were measured; 33 of *E. a. ssp. acris,* 33 of *E. a. ssp. politus,* 33 of *E. a. ssp. droebachiensis,* 8 specimens of *E. a. ssp. brachycephalus* and 6 specimens of *E. a. ssp. decoloratus.* There were no more suitable specimens available at this time of *E. a. ssp. brachycephalus* or *E. a. ssp. decoloratus.*

It was taken into consideration that the biological material was dried and that certain features, such as hairs on stem, could have been altered by the friction between the specimen and the overlying sheet. Focus was therefor on the parts of the specimens with less risk of alteration by such causes, for example side of stem rather than the upward facing side.

The instruments used were mainly a ruler of up to 30 cm and a stereo microscope with up to x40 magnification including a measuring scale of up to 1 cm. The same microscope and ruler were used during the whole project. All the measurements were also taken by the same person, the author.

Height and length of stem leaves and internodes were measured by ruler. Number of capitulas and involucral bracts were quantified by counting. Densities were measured with the help of the microscope's scale and counting. Qualitative values were measured by the authors own observations. All other traits were measured by the measurement scale in the stereo microscope. Further details for every trait can be found in the sections below.

Measurement specifications

Height (cm): The height of the plant was measured from the soil line up to the top of the highest positioned capitula in centimeters. If two stalks were joined under the soil line they were treated as two specimens. Branching of a stalk above this line was counted as part of the specimen. This is of importance when counting capitulas and stalk leaves.

Stem leaves (no): The number of leaves on main stem. No bracts, bracteoles or basal leaves were counted. Bracts are here defined as a leaf adjacent to a structure that is or is the start of inflorescence. A minimum length of this inflorescence was set to 5 mm. The leaves were still counted even if they were damaged or if only part of the petiole was left.

Stem leaf length (cm): The middle leaf was measured in centimeters from apex to where it was attached to the stem. If an even number of leaves, the upper one of the two leaves in the middle were chosen. If this leaf was damaged, missing or in any other way impossible to measure, the one above this was chosen.

Internode (cm): The internode was measured in centimeters from the leaf, whose length had been measured, to the leaf above it. If there only was one stem leaf the internode was measured from this leaf up to the next branch or inflorescence.

Leaf lamina, density of eglandular hair (ordinal scale): Density was measured per square millimeter (mm^2) on a scale of 1, 2, 3 and 4. See table 7.

Table 7. Explanation of scale of, from 1-4. This scale relates to all eglandular and glandular hair densities measured in this project.

1: Represents specimens with no or very little and or scattered hairs, which could include specimens with only some hairs along main nerve or at apex.
2: Represents specimens with a density varying from 0 to 5 hairs per mm^2.
3: Represents specimens with a hair density of 5 to 10 hairs per mm^2.
4: Represents specimens with a density of 10 or more hairs per mm^2.

This density was measured on stem leaves only, as this could vary among, stem leaves, bracts and basal leaves. A density able to represent the specimen was chosen taking into consideration that the hairs on leaf surfaces in direct contact with the specimen sheet on top may have been worn of.

Leaf lamina, eglandular hair length (mm): The length of the hairs on the leaf lamina was measured in millimeters. A length that seemed to correctly represent the 40 percent of the longest hairs was chosen. Only stem leaves were considered.

Leaf margin, amount of eglandular hair (ordinal scale): Amount of hair on the margin of the leaves was measured per millimeter. These were only measured on stem leaves. A density able to represent the specimen was chosen. This was noted on a scale of 1, 2, 3 and 4, see table 8.

Table 8. Explanations of scale concerning the amount of eglandular hairs on leaf margin.

1: Represents specimens with no or near to no eglandular hairs, this could also include specimen where hairs only at certain small areas such as leaf base or apex.
2: Represents specimens with 0 to 5 eglandular hairs per mm.
3: Represents specimens with 5 to 10 eglandular hairs per mm.
4: Represents specimens with 10 or more eglandular hairs per mm.

Leaf margin, eglandular hair length (mm): The length of the hairs on the leaf margin was measured in millimeters. A length that seemed to correctly represent the 40 percent of the longest hairs was chosen. Only stem leaves were considered.

Stem, eglandular hair density (ordinal scale): Density was measured per square millimeter (mm^2) on a scale of 1, 2, 3 and 4. See table 7 for further information about the scale.
A density able to represent the whole specimen was chosen taking into consideration that the hairs on stem surfaces in direct contact with the specimen sheet on top may have been worn of. The density was first and foremost taken from the middle of the stem and not near the base or top.

Stem, eglandular hair length (mm): A length that seemed to correctly represent the 40 percent of the longest hairs was chosen.

Capitulas (no): The number of capitulas was counted. However, only capitulas with a minimum of 7 millimeters of width was considered as not to confuse other structures for capitulas. Remaining values measured on the capitulas were only taken on developed capitulas where at least the ray flowers were or had been fully developed.

Involucral bracts (no): The involucral bracts were only counted on the capitulas that were developed to at least the degree that the ray flowers hade developed. As the specimens were mounted on sheets of paper only the involucral bracts on one side of the capitulas could be counted. These were then multiplied by two to get a number representing the capitula. The involucral bracts on all the capitulas on the specimen were counted, and a number representing the whole specimen was chosen. Capitulas with extreme values were not considered if the other capitulas had relatively similar numbers.

Involucral bracts, width (mm): The width of the involucral bracts was measured at the base where they clearly separated from the involucre. The width was measured on several bracts on all capitulas and a number which could represent the whole specimen was chosen.

Involucral bracts, length (mm): The length of the involucral bracts was measured from the base, where they clearly separated from the involucre, to the apex. The length was measured on several bracts on all capitulas and a number which could represent the whole specimen was chosen.

Involucral bracts, density of glandular hairs (ordinal scale): The density of glandular hairs was measured in mm^2 on a scale of 1, 2, 3 and 4. See table 7 for further information about the scale. A density which seemed representable for the specimen was chosen.

Involucral bracts, span of glandular hairs (mm): Measurements were taken on how far up the involucral bracts the glandular hairs reached. This was measured from the base of the bracts, where they clearly separated from the involucre, and upwards. This was measured on several involucral bracts on all capitulas and a span that could represent the whole specimen was chosen.

Involucral bracts, density of eglandular hairs (ordinal scale): The density of eglandular hairs was measured in mm^2 on a scale of 1, 2, 3 and 4. See table 7 for further information about the scale. This was measured on several involucral bracts on all capitulas and a span that could be representing the specimen was chosen.

Involucral bracts, span of eglandular hairs (mm): Measurements were taken on how far up the involucral bracts the eglandular hairs reached. This was measured from the base of the bracts, where they clearly separated from the involucre, and upwards. This was measured on several involucral bracts on all capitulas and a span that could be representing the specimen was chosen.

Involucral bracts, length of eglandular hairs (mm): The length of the hairs on the involucral bracts was on several involucral bracts on all capitulas. A length that seemed to correctly represent the 40 percent of the longest hairs was chosen.

Involucral bracts, colour (ordinal scale): The colour of the bracts were noted on a scale from 1 to 3. This was chosen as to represent the whole specimen. See table 9.

Table 9. Explanation of numbers in ordinal scale of the colour of the involucral bracts.

1: Light
2: Medium
3: Dark

Pappus, length (mm): From the top of the achene to the apex of the pappus. This was measured on all capitulas and a value representing the whole specimen was chosen.

Ray flowers, reach beyond pappus (mm): The part of the ray flowers reaching above the apex of the pappus was measured in millimeters. If they were shorter, a negative value was given. This was measured on all capitulas and a value which could represent the whole specimen was chosen.

Ray flowers, colour (ordinal scale): White, White-Purple or Purple. See table 10.

Table 10. Explanations of the scale used to describe the colour of ray flowers.

1: If all flowers were white the specimen were given the value 1.
2: If some capitulas only had white flowers and some capitulas only had purple flowers the specimen were given the value 2.
3: If there were at least a hint of purple in all capitulas, taking fading of colour in dried specimens into consideration, the specimen were given the number 3.

Statistical Analysis

Microsoft Excel was used for keeping a record of the primary data; Minitab was then used to analyze the data. The Principal Components Analysis was used as recommended and used by Tyler (2007).

Principal Component Analysis

To see how the subspecies were grouped, Principal Component Analysis (PCA) was used. PCA is a multivariate statistical method which can analyze data with numerous variables. PCA has the possibility to illustrate correlations among variables, and perhaps most importantly to illustrate patterns. The objects, specimens in this project, on which the values of the variables have been taken, are spread out in a graph in relation to two axis. Specimens with similar observations will be grouped together while those not as similar will be further apart. The variables themselves are also spread out in a graph which can then be combined with the first graph to see how the variables relate to the objects (Naturvårdsverket, 2016).

Every variable, traits in this case, gives one dimension. In this project we have 23 traits and therefore 23 dimensions. The illustrations made with the method and program used in this project need though be two-dimensional. The PCA searches for a view with the most variation; dimension one or Principal component one (PC1). From this view it finds a second dimension with the next greatest variation; dimension two or Principal component two (PC2) (Dallas, 2013). In a two-dimension illustration you cannot show all dimension at the same time.

Analysis of Variance

To see which traits separate the different subspecies, ANOVA (Analysis of Variance) was used. ANOVA can for example show if there is any differences in the mean value between populations (Engstrand, Olsson and Englund, 2005), which in this case are the subspecies, and see if they, in relation to a trait, are statistically different. In this study one-way ANOVA with Tukey´s test at 5% significance level was used.

Result

The subspecies *E. a. ssp. decoloratus* and *E. a. ssp. brachycephalus* are in some literature treated separately from the other three. In Flora Europea (Burges *et al*, 1976) these are mentioned as subspecies that need further investigation, and in Suuri Kasvikirja III (Mäkelä, 1980) they are treated as separate species. They have also a smaller distribution area. Therefor the three subspecies of *E. a. ssp. acris, E. a. ssp. droebachiensis* and *E. a. ssp. politus* are treated in a separate Score Plot, Loading Plot and ANOVA, followed by a Score Plot, Loading Plot and ANOVA with all five subspecies.

To produce trustworthy results, possible outliers, for example possibly wrongly determined or wrongly measured, were identified and removed. To find these, the specimens for every subspecies were examined based on Score Plots made in Minitab for the individual subspecies, in combination with a Score Plot based on all subspecies.

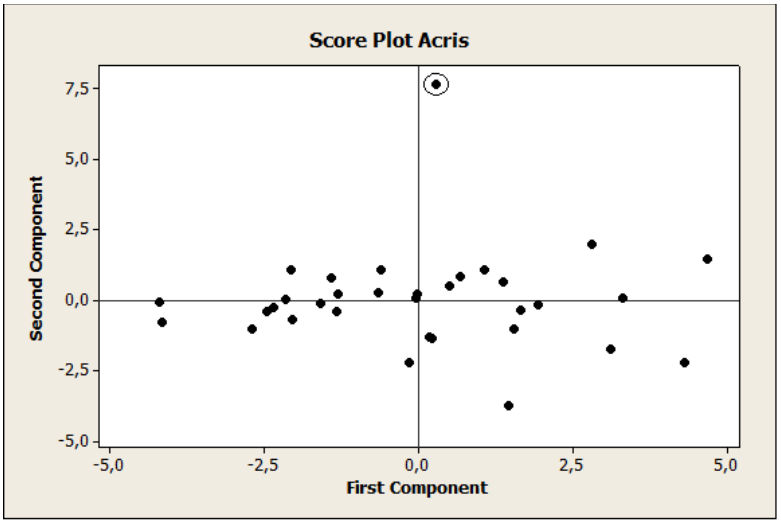

Figure 1. Score Plot for *Erigeron acris ssp. acris.* Number 21, encircled, of the *E. a. ssp. acris* specimens was removed for the analysis. Further information about the specimens, see Appendix 1.

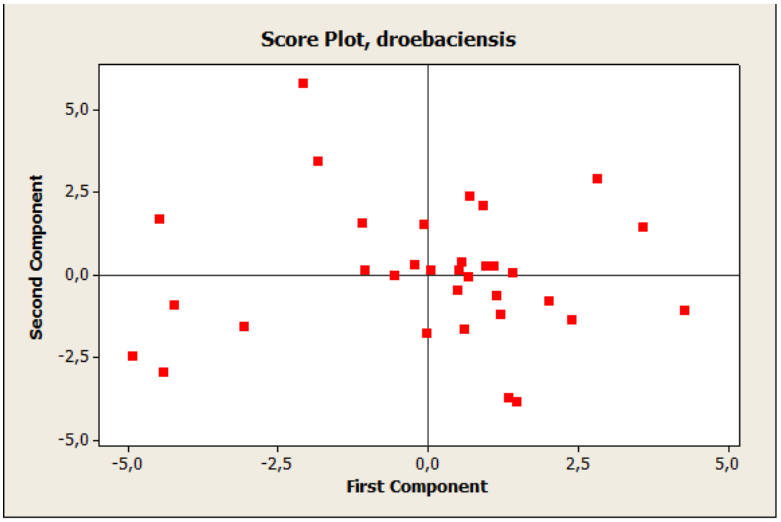

Figure 2. Score Plot for *Erigeron acris ssp. droebachiensis.* None of the *E. a. ssp. droebachiensis* specimens were removed for the analysis. For further information about the specimens, see Appendix 2.

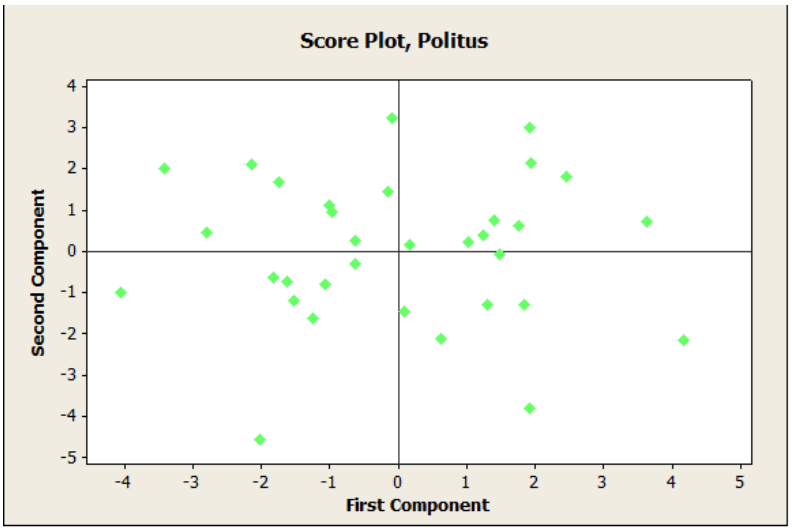

Figure 3. Score Plot for *Erigeron acris ssp. politus.* None of the *E. a. ssp. politus* specimens were removed for the analysis. See Appendix 3 for further details about the specimens.

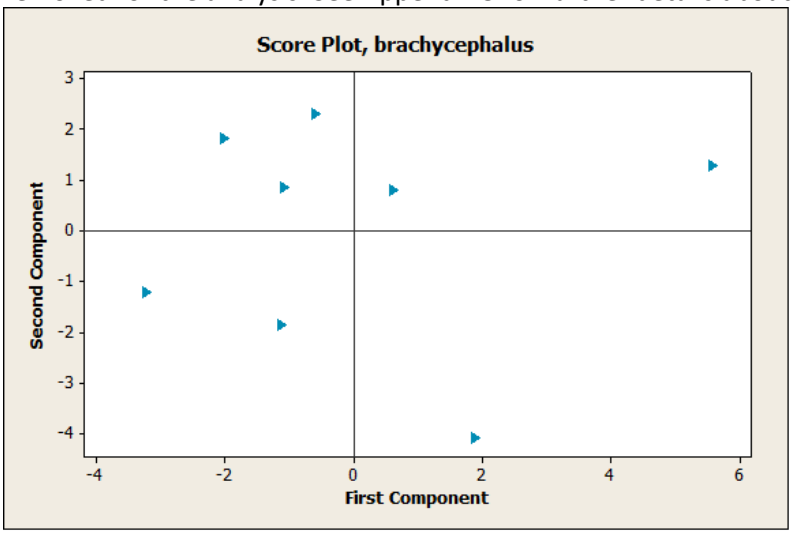

Figure 4. Score Plot for *Erigeron acris ssp. brachycephalus*. None of the *E. a. ssp. brachycephalus* specimens were removed for the analysis. See Appendix 4 for further details about the specimens.

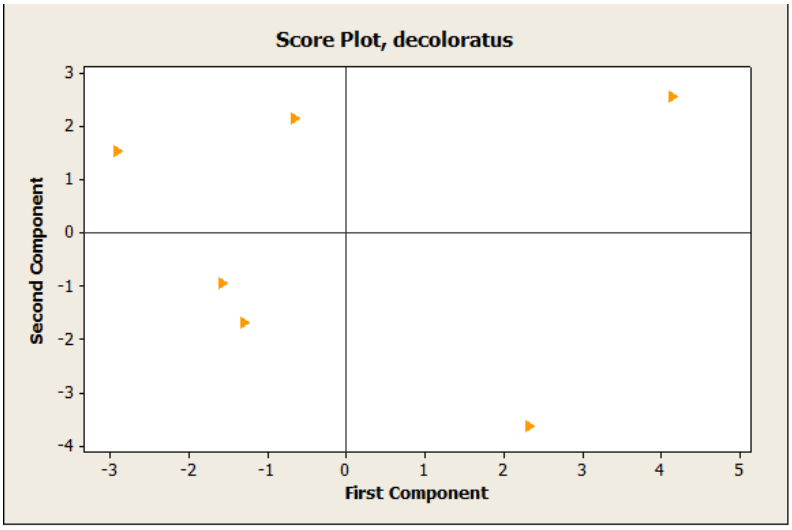

Figure 5. Score Plot for *Erigeron acris ssp. decoloratus.* None of the *E. a. ssp. decoloratus* specimens were removed for the analysis. See Appendix 5 for further details about the specimens.

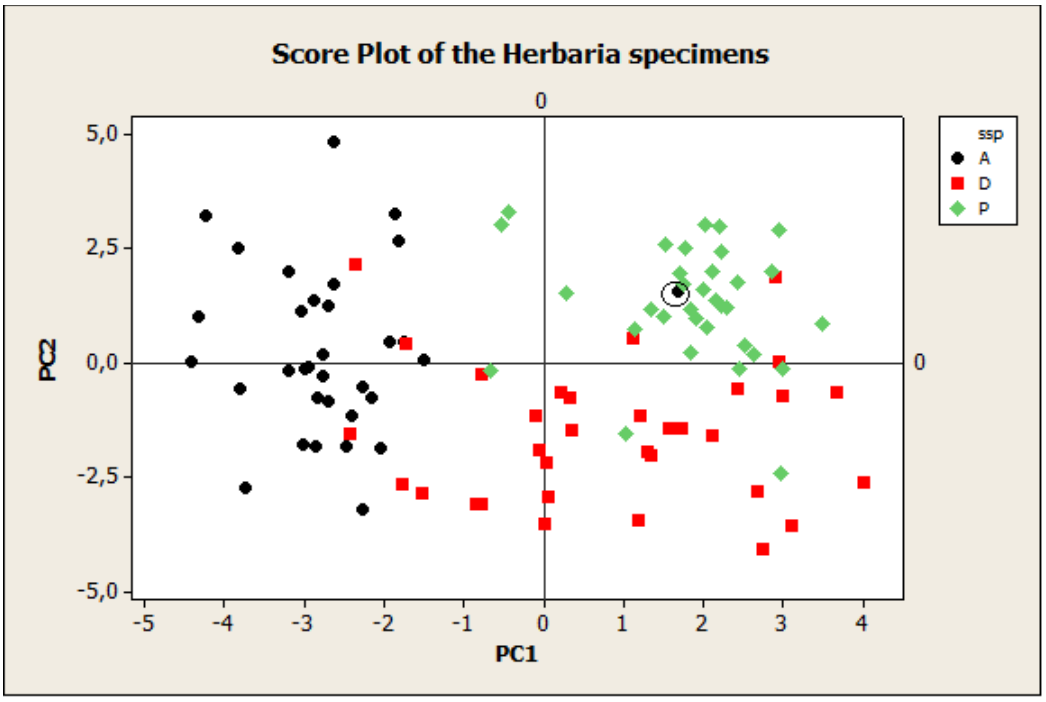

Figure 6. Score Plot in two-dimensions of *Erigeron acris* ssp. *acris* (A)*, ssp. droebachiensis* (D) and *ssp. politus* (P). Outlier removed is encircled. First Component explains 25,2% of the variation and the second component explains a further 17,1%.

Number 21 was removed from *E. a. ssp. acris* while none were removed from ssp. *droebachiensis*, *ssp. politus, ssp. brachycephalus or ssp. decoloratus.* Once the outlier had been removed, a One-Way ANOVA was made on all traits. See "Statistical Analysis" for further information.

Results of the One-Way ANOVA with 3 *ssp*

In the one-way ANOVA, three traits showed no significant difference between any of the subspecies: length of pappus, amount of glandular hairs, and length of stem leaf. Four traits could distinguish all three subspecies from each other, length and width of the involucral bracts, span of glandular hairs on the involucral bracts and amount of eglandular hairs on the involucral bracts. The other 16 traits could distinguish one subspecies from the other in different combinations. See table 11.

Table 11. Result of the ANOVA test, for *Erigeron acris ssp. acris* (A)*, ssp. droebachiensis* (D) and *ssp. politus* (P). *ssp*: Subspecies. No: number of replicates/specimens. Mean: Mean value of all variables within the same subspecies. Grouping: Subspecies with the same letter are not significantly different from each other, based on Tukey´s test with a significance level of 5%.
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, amount of hairs on leaf margin. See table 8 for explanations.
*** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
**** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Trait	ssp.	No	Mean	Grouping	Trait	ssp.	No	Mean	Grouping
Height P-value: 0,038	D P A	33 33 32	34,3 33,5 27,6	A A B B	Stem leaves, no P-value: 0,041	D P A	33 33 32	6,8 5,6 4,8	A A B B
Internode, length P-value: 0,000	P A D	33 32 33	3,6 3,0 2,1	A A B	Eglandular hairs on lamina, amount* P-value: 0,000	A D P	32 33 33	3,0 1,4 1,2	A B B
Eglandular hairs on lamina, length P-value: 0,000	A D P	32 33 33	0,6 0,3 0,3	A B B	Eglandular hairs on leaf margin, amount** P-value: 0,000	A D P	32 33 33	2,8 2,0 1,9	A B B
Eglandular hairs on leaf margin, length P-value: 0,000	A D P	32 33 33	0,6 0,5 0,4	A A B	Eglandular hairs on stem, amount* P-value: 0,000	A D P	32 33 33	3,5 1,8 1,5	A B B
Eglandular hairs on stem, length P-value: 0,001	A P D	32 33 33	0,7 0,6 0,5	A B B	Capitulas P-value: 0,002	D A P	33 32 33	14,9 11,3 7,1	A A B B
Involucral bracts, no P-value: 0,005	D A P	33 32 33	39,7 37,4 34,4	A A B B	Involucral bracts, width P-value: 0,000	P A D	33 32 33	0,7 0,6 0,5	A B C
Involucral bracts, length P-value: 0,000	P A D	33 32 33	5,3 4,8 4,4	A B C	Span of glandular hairs on involucral bracts P-value: 0,000	P A D	33 32 33	5,3 4,8 4,5	A B C
Eglandular hairs on involucral bracts, amount.* P-value: 0,000	A D P	32 33 33	4,0 2,6 1,8	A B C	Span of eglandular hairs on involucral bracts P-value: 0,000	A D P	32 33 33	4,8 2,3 1,9	A B B
Length of eglandular hairs on involucral bracts P-value: 0,000	A D P	32 33 33	0,8 0,6 0,5	A B B	Ray flowers reach above pappus P-value: 0,000	P A D	33 32 33	1,3 0,7 0,5	A B B
Colour of Ray flowers**** P-value: 0,054	D P A	33 33 32	1,3 1,2 1,0	A A B B	Colour, involucral bracts*** P-value: 0,001	P A D	33 32 33	2,2 1,8 1,5	A A B B

Pappus, length P-value: 0,395	P 33 5,5 A A 32 5,3 A D 33 5,2 A	Amount of glandular hairs on involucral bracts* P-value: 1	D 33 4 A P 33 4 A A 32 4 A
Stem leaf, length P-value: 0,132	D 33 5,3 A P 33 5,1 A A 32 4,3 A		

Results of the One-Way ANOVA with 5 *ssp*

Four traits could not distinguishing any of the subspecies from the others; number of stem leaves, length of stem leaf, number of involucral bracts and amount of glandular hairs on involucral bracts.

All other 19 traits had some subspecies partly or completely overlapping and some could be distinguished from some others. In three of these cases *E. a. ssp. acris* could be distinguished from all other subspecies; amount of eglandular hairs on lamina and stem, length of eglandular hairs on involucral bracts.

Table 12. Result of the ANOVA test, for *Erigeron acris ssp. acris* (A), *ssp. brachycephalus* (B), *ssp. decoloratus* (De), *ssp. droebachiensis* (D) and ssp. *politus* (P). *ssp*: Subspecies. No: number of replicates/specimens. Mean: Mean value of all variables within the same subspecies. Grouping: Subspecies with the same letter are not significantly different from each other, based on Tukey´s test with a significance level of 5%.
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, amount of hairs on leaf margin. See table 8 for explanations.
*** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
**** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Trait	ssp.	No	Mean	Grouping	Trait	ssp.	No	Mean	Grouping
Height P-value: 0,032	B D P De A	8 33 33 6 32	39,9 34,3 33,5 33,3 27,6	A A B A B A B B	Internode, length P-value: 0,000	P De A B D	33 6 32 8 33	3,6 3,5 3,0 2,8 2,1	A A B A B A B B
Eglandular hairs on lamina, amount* P-value: 0,000	A B D De P	32 8 33 6 33	3,0 1,9 1,4 1,3 1,2	A B B B B	Eglandular hairs on lamina, length P-value: 0,000	A De B D P	32 6 8 33 33	0,6 0,5 0,4 0,3 0,3	A A B B C C C
Eglandular hairs on leaf margin, amount** P-value: 0,000	A B De D P	32 8 6 33 33	2,8 2,4 2,0 2,0 1,9	A A B B B B	Eglandular hairs on leaf margin, length P-value: 0,000	A De B D P	32 6 8 33 33	0,6 0,6 0,5 0,5 0,4	A A B A B A B B

Eglandular hairs on stem, amount* P-value: 0,000	A	32	3,5	A		Eglandular hairs on stem, length P-value: 0,003	A	32	0,7	A	
	De	6	2,2		B		De	6	0,7	A	B
	B	8	2,0		B		B	8	0,6	A	B
	D	33	1,8		B		P	33	0,6		B
	P	33	1,5		B		D	33	0,5		B
Capitulas P-value: 0,000	B	8	22,0	A		Involucral bracts width P-value: 0,000	P	33	0,7	A	
	De	6	15,7	A	B		De	6	0,6	A	B
	D	33	14,9	A	B		A	32	0,6		B
	A	32	11,3		B		D	33	0,5		B C
	P	33	7,1		B		B	8	0,5		C
Involucral bracts, length P-value: 0,000	P	33	5,3	A		Span of glandular hairs on involucral bracts P-value: 0,000	P	33	5,3	A	
	De	6	4,9	A	B		De	6	4,9	A	B
	A	32	4,8		B		A	32	4,8		B
	D	33	4,4		B		D	33	4,5		B
	B	8	4,2		B		B	8	4,2		B
Eglandular hairs on involucral bracts, amount.* P-value: 0,000	A	32	4,0	A		Span of eglandular hairs on involucral bracts P-value: 0,000	A	32	4,8	A	
	De	6	3,3	A	B		De	6	4,3	A	
	D	33	2,6		B		B	8	2,6		B
	B	8	2,6		B C		D	33	2,3		B
	P	33	1,8		C		P	33	1,9		B
Length of eglandular hairs on involucral bracts P-value: 0,000	A	32	0,8	A		Colour involucral bracts*** P-value: 0,000	P	33	2,2	A	
	B	8	0,6		B		A	32	1,8	A	B
	D	33	0,6		B		D	33	1,5		B
	De	6	0,6		B		B	8	1,5	A	B
	P	33	0,5		B		De	6	1,2		B
Colour ray flowers**** P-value: 0,001	B	8	2,0	A		Pappus length P-value: 0,076	P	33	5,5	A	
	De	6	1,3	A	B		A	32	5,3	A	B
	D	33	1,3		B		D	33	5,2	A	B
	P	33	1,2		B		De	6	5,1	A	B
	A	32	1,0		B		B	8	4,6		B
Ray flowers reach above pappus P-value: 0,000	P	33	1,3	A		Stem leaves, number P-value: 0,028	B	8	7,5	A	
	De	6	0,8	A	B		D	33	6,8	A	
	A	33	0,7		B		P	33	5,6	A	
	D	33	0,5		B		A	32	4,8	A	
	B	8	0,3		B		De	6	4,0	A	
Stem leaf, length P-value: 0,266	De	6	5,8	A		Involucral bracts, number P-value: 0,018	B	8	40,5	A	
	D	33	5,3	A			D	33	39,7	A	
	P	33	5,1	A			De	6	37,7	A	
	B	8	4,8	A			A	32	37,4	A	
	A	32	4,3	A			P	33	34,4	A	
Mount of glandular hairs on involucral bracts* P-value: 1	B	8	4	A							
	D	33	4	A							
	P	33	4	A							
	A	32	4	A							
	De	6	4	A							

Loading Plot with 3 *ssp*

The PCA can also illustrate how variables, traits in this case, relate to the replicas, specimens. This is done in a so called Loading Plot.

A general trend can be found in Figure 7. One can see that traits related to hairs such as densities, lengths and span can be found to the left of origo. Variables that were counted, such as number of capitulas, involucral bracts and stem leaves, are found close to the lower right corner. The lone variable of colour is situated to the right of origo. Meanwhile, variables which were measured, except for lengths of hair, are gathered at the upper right corner.

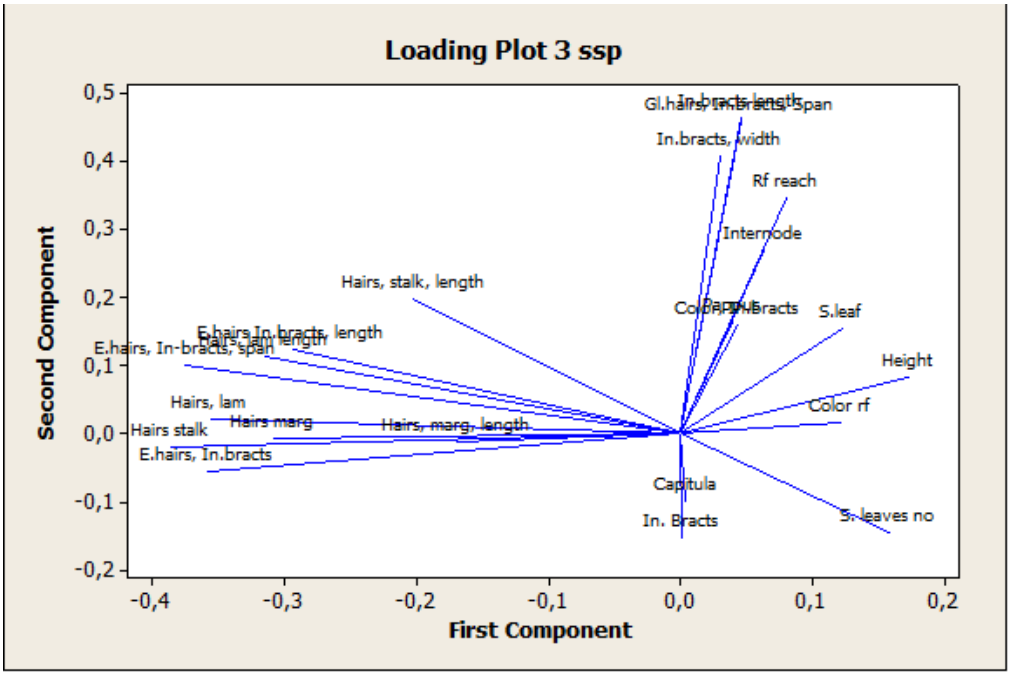

Figure 7: Loading plot of a PCA made on the traits measured on the herbaria specimens of *Erigeron acris ssp. acris, ssp. droebachiensis* and ssp. *politus*. The loading Plot illustrates how the variables, traits, differentiate between the objects, specimens. Long lines illustrate a greater importance when separating the specimens and shorter lines indicates lesser importance. Two dimension illustration.

Full names of traits followed by bracketed abbreviations: Height (Height), Stem leaves, (S.leaves no), Stem leaf length (S.leaf), Internode (Internode), Leaf lamina, density of eglandular hair (Hairs, lam), Leaf lamina, eglandular hair length (Hairs, lam length), Leaf margin, amount of eglandular hair (Hairs marg), Leaf margin, eglandular hair length (Hairs, marg, length), Stem, eglandular hair density (Hairs, stem), Stem, eglandular hair length (Hairs, stem, length), Capitulas (Capitula), Involucral bracts (In. bracts), Involucral bracts, width (In. bracts, width), Involucral bracts, length (In. bracts, length), Involucral bracts, density of glandular hairs (Gl, hairs), Involucral bracts, span of glandular hairs (Gl. hairs, span), Involucral bracts, density of eglandular hairs (E. hairs, In. bracts), Involucral bracts, span of eglandular hairs (E. hairs, span), Involucral bracts, length of eglandular hairs (E. hairs, length), Involucral bracts, colour (Colour, In. bracts), Pappus, length (Pappus), Ray flowers, reach beyond pappus (Rf, reach), Ray flowers, colour (Colour, rf). See "Measurement specifications" for further information about the traits.

Loading Plot with 5 *ssp*

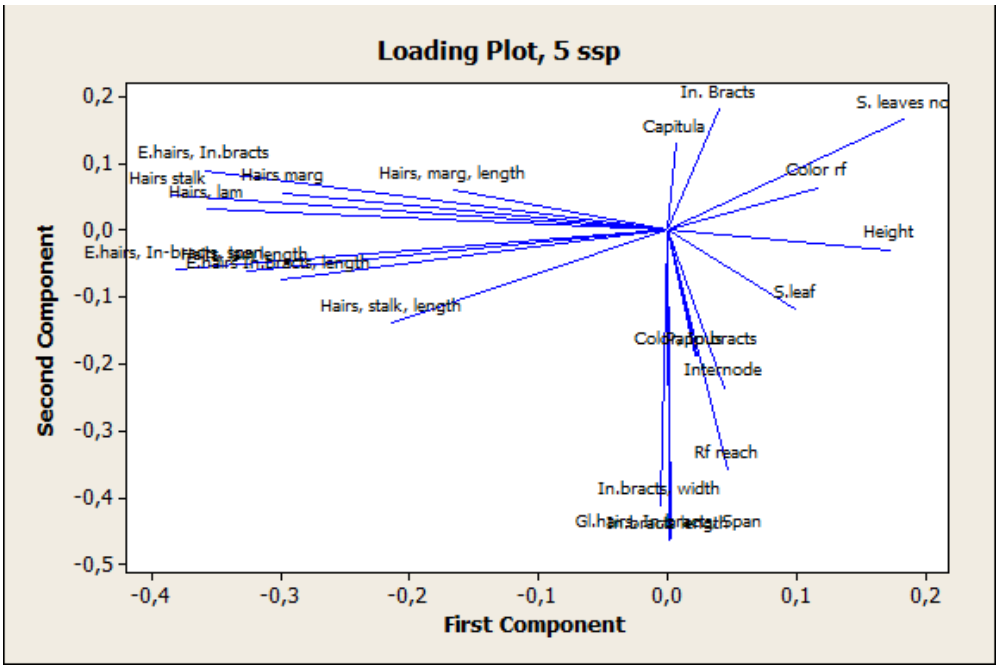

Figure 8. Loading plot for *E. a. ssp. acris, E. a. ssp. droebachiensis, E. a. ssp. politus, E. a. ssp. brachycephalus* and *E. a. ssp. decoloratus.* The loading plot illustrates how the variables, traits, differentiate between the objects, specimens. Long lines illustrate a greater importance when separating the specimens and shorter lines indicates lesser importance. Two dimension illustration. See figure text for Figure 7 for full names of the abbreviations.

Score Plot with 5 *ssp.*

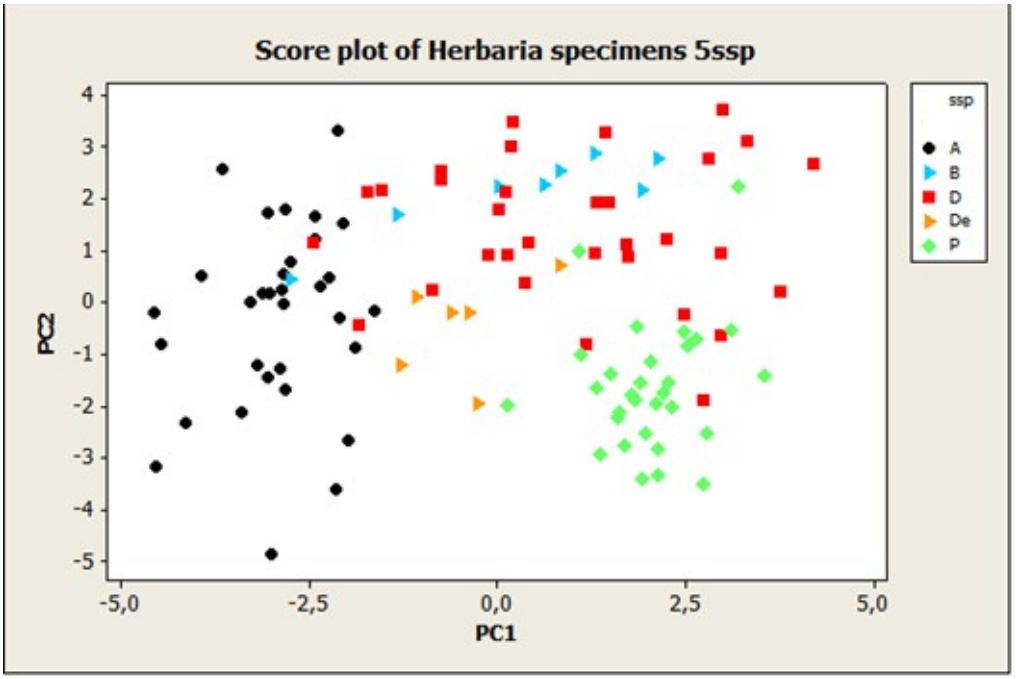

Figure 9. Score Plot from a PCA made of observations of subspecies of *Erigeron acris ssp. acris* (A), *ssp. droebachiensis* (D), *ssp. politus* (P), *ssp. brachycephalus* (B) and *ssp. decoloratus* (De). Two-dimensional illustration where the first component explains 24,3% of the variation and the second component explains 17,1%

Descriptions

The following descriptions of the subspecies are based on the specimens and traits used in this project. See Table 13 in Appendix 6 for further information about the values.

Erigeron acris ssp. acris

Height 8-47 cm, 1-17 stem leaves, middle stem leaf 1,6-10,5 cm, middle internode 0,7-5,7 cm, very little to very much eglandular hairs on lamina, length of eglandular hairs on lamina 0,3-1,1 mm, little to a lot of hairs on leaf margin, length of eglandular hairs on leaf margin 0,4-1 mm, very little to a lot of hairs on stem normally 5->10 hairs per mm^2. Capitulas 3-46, involucral bracts per capitula 24-50, light to dark colouration, width 0,5-1 mm, length 3,5-6 mm. A high density of glandular hairs covering the whole involucral bracts, very little to a lot of eglandular hairs normally 5->10 hairs per mm^2 reaching 2,5-6 mm up the involucral bracts, length of eglandular hairs on involucral bracts 0,5-1 mm. Pappus length 4-7 mm. Ray flowers white, reaching 0-2,5 mm beyond the pappus.

Erigeron acris ssp. droebachiensis

Height 7,5-79,5 cm, 1-15 stem leaves, middle stem leaf 1,2-11 cm, middle internode, 0,3-4,5 cm, very little to a lot of eglandular hairs on lamina, length of eglandular hairs on lamina 0-0,6 mm, very little to higher amount of eglandular hairs on leaf margin normally 0-10 per mm, length of eglandular hairs on leaf margin 0,3-0,8 mm. Stem with very little to higher density of eglandular hairs, length of eglandular hairs on stem 0-1 mm. Capitulas 3-48, number of involucral bracts per capitula 16-52, light to dark colouration, width 0,3-0,8 mm, length 3,5-5,5 mm, high density of glandular hairs covering the whole involucral bracts , very little to a lot of eglandular hairs, normally 5-10 hairs per mm^2 reaching 0,5-5,5 mm up the involucral bracts, length of eglandular hairs on involucral bracts 0,3-0,8 mm. Pappus 3-6,5 mm. Ray flowers white to purple, reaching 2 mm lower than pappus to 2 mm above pappus.

Erigeron acris ssp. politus

Height 20,5-53 cm, 2-11 stem leaves, middle stem leaf 1,8-8,6 cm, middle internode 1,5-7,3 cm, very little to higher density of eglandular hairs on lamina normally 0-5 mm^2, length of eglandular hairs on lamina <0,6 mm. 0-10 hairs per mm on leaf margin, 0,2-0,8 mm long. <10 hairs per mm^2 on stem, <1 mm long. 3-16 capitulas, 22-42 involucral bracts per capitula. Involucral bracts light to dark colouration, width 0,5-1 mm, length 4-6,5 mm, high density of glandular hairs covering the whole involucral bracts, very little to a lot of eglandular hairs reaching 0,3-6 mm up the involucral bracts, eglandular hairs 0,2-0,8 mm. Pappus 3,5-8 mm. Ray flowers white to purple, normally white, reaching 0,3-2,5 mm above pappus.

Erigeron acris ssp. brachycephalus

Height 21,5-56,5 cm, middle internode 1,5-4 cm, number of stem leaves 3-12, middle stem leaf 2,9-7 cm, eglandular hairs on lamina <10 per mm^2, 0,3-0,6 mm long. Eglandular hairs on leaf margin <30 per mm, 0,3-0,8 mm long. Eglandular hairs on stem <10 per mm^2, <1 mm long. Capitulas 9-35, involucral bracts per capitula 20-56, light to dark colouration, width 0,4-0,5, length 4-4,5 mm, a lot of glandular hairs covering the whole involucral bracts, a little to >10 eglandular hairs per mm^2, reaching 1,5-4,5 mm up the involucral bracts, eglandular hairs 0,4-0,8 mm long. Pappus 3-5,5 mm. Ray flowers white to purple, reaching up to 0,8 mm above pappus.

Erigeron acris ssp. decoloratus

Height 24,3-45 cm, internode 1,3-6,3 cm, number of stem leaves 3-6, middle stem leaf 2,8-10,5 cm, eglandular hair on lamina <5 per mm^2, length 0,3-0,8 mm. Eglandular hairs on leaf margin <10 per mm, length 0,4-0,7 mm. Eglandular hairs on stem <10 per mm^2, length 0,5-0,8. Capitulas 6-40, involucral bracts per capitula 32-44, light to medium colouration, width 0,6-0,9, length 4,5-5,5 mm a lot of glandular hairs covering the whole involucral bracts, eglandular hairs >5 per mm^2, reaching 3,5-5 mm up the involucral bracts, eglandular hairs length 0,5-0,7 mm. Pappus 4,5-6,5 mm. Ray flowers white to purple, reaching up to 1,5 mm above pappus.

Discussion

Analysis of the Results

One-Way ANOVA

There are differences in the traits for *Erigeron acris ssp. acris, E. a. ssp. politus* and *E. a. ssp. droebachiensis*. In the one-way ANOVA, three traits showed no significant difference between any of the subspecies: Length of Pappus, amount of glandular hairs, length of stem leaf. This points to that these are not as important to look at when trying to separate these subspecies. Neither is there a lot of information about these traits in the literature and are therefore not a good trait to base ones determination on, based on both the statistical as well as the literary part of this study.

Four traits could distinguish all three subspecies from each other, length and width of the involucral bracts, span of glandular hairs on the involucral bracts and amount of eglandular hairs on the involucral bracts. This suggests that these are valuable traits when separating these subspecies. The other 16 traits could distinguish one subspecies from the other in different combinations. See Table 11 for details. One has thought to consider whether these traits are different due to genetics or ecological variation.

When looking at the ANOVA made with all five subspecies, see Table 12, four traits could not distinguish any of these subspecies from each other. All other 19 traits had some subspecies partly or completely overlapping. In three of these cases only *E. a. ssp. acris* could be separated from all the other subspecies in three traits. The other four subspecies were overlapping with at least one other in all traits.

Looking at figure 9, one can see tendencies that *E. a. ssp. brachycephalus* and *ssp. droebachiensis* are overlapping. The ANOVA made on all five subspecies shows that they overlapped completely or partly in 18 traits. If adding the traits that could not separate any subspecies the number adds up to 22 out of 23 traits. The colour of the ray flowers was the only trait which could separate the two. *E. a. ssp. brachycephalus* had three specimens with white flowers, two with both colours and three specimens with purple flowers, see Appendix 4. Five specimens of *E. a. ssp. droebachiensis* were purple while the rest, 28 specimens, were white, see Appendix 2. If there had been more specimens now given the name *E. a. ssp. brachycephalus* there is the possibility that there would not be a difference in this trait either, as it shows that the colour could be either white or purple in both subspecies. This would suggest that these two, in one form or another could possibly merge.

E. a. ssp. politus and *ssp. decoloratus* can be separated completely or partly by four traits. *E. a. ssp. decoloratus* and *ssp. droebachiensis* can be completely separated by one trait only; length of eglandular hair on lamina. The question is if this is enough to call it a separate subspecies? Of course it would also in this case be desirable to include more specimens.

One should also consider how much weight and importance the traits should be given. In these specimens the glandular hairs covered the whole involucral bracts which is causing the traits “Length of involucral bracts” and “Span of glandular hairs on involucral bracts” to have the same values. Traits which are more likely to be altered by difference in habitat and climate conditions such as nutrient and water availability, for example height, could perhaps be given lesser attention than a trait more likely not to be altered by this.

Score Plot

Looking at figure 10 below, even considering that there is overlapping, the three subspecies of *E. a. ssp. acris, ssp. droebachiensis* and *ssp. politus* could be considered distinct groups. The specimens now defined as *E. a. acris* are gathered on the left half of the plot. The *ssp. politus* specimens are occupying the upper half of the right side while the specimens of *ssp. droebachiensis* are mostly gathered at the lower right half even though this particular subspecies spread out on a larger area.

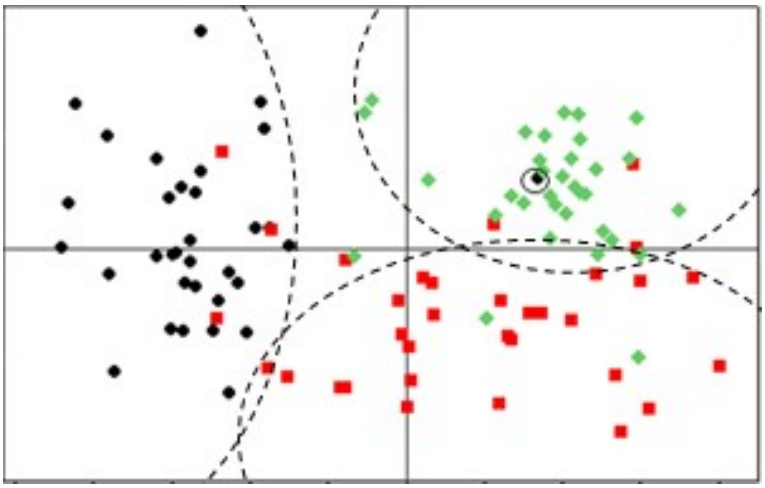

Figure 10. Score Plot. Black circles; *E. a. ssp. acris,* Red squares: *E. a. ssp. droebachiensis,* Green diamonds; *E. a. ssp. politus.*

If looking at figure 9 including all five subspecies one can see that *E. a. ssp. politus* and *E. a. ssp. droebachiensis* have switched places, otherwise these two subspecies and *E. a. ssp. acris* holds the same positions as on the other score plot. When considering all subspecies, all the specimens of *E. a. ssp. brachycephalus* could fit into the current range of *E .a. ssp. droebachiensis. E. a. ssp. decoloratus* have somewhat an own range in the middle of the figure. However the range of the three subspecies, *E. a. ssp. acris, ssp. politus* and/or *ssp. droebachiensis,* would not need to be increased by much to be able to include specimens of *ssp. decoloratus.* Together with the ANOVA this would point to that *E. a. ssp. decoloratus* could perhaps merge in one form or another with *ssp. droebachiensis*. Or that some of the specimens would be included in this subspecies while others could merge into *E. a. ssp. politus* or *ssp. acris*.

All subspecies in the score plot are overlapping with at least one other. One possible explanation to why some subspecies are overlapping and some specimens seem to be in-between subspecies may be hybridization. *E. a. decoloratus* could be seen as having an own range in the middle of the plot but hybridization might also be an explanation to the small gathering of specimens between the other subspecies.

Loading Plot

A general trend can be found in Figure 7. One can see that traits related to hairs such as densities, lengths and span can be found to the left of origo. Variables that were counted, such as number of capitulas, involucral bracts and stem leaves, are found close to the lower right corner. The lone variable of colour is situated to the right of origo. Meanwhile, variables which were measured, except for lengths of hair, are gathered at the upper right corner.

This would point to, when considering both figure 6 and figure 7 together in a so called biplot, that *E. a. ssp. acris,* is mainly defined by variables related to hair. *E. a. ssp. politus* on the other hand can be separated from the other subspecies based on measurable

characteristics. *E. a. ssp. droebachiensis* would then, with this reasoning, be connected to countable data, even though this particular subspecies is not as clearly defined.
When considering the Score Plot of all five subspecies, Figure 9, and the Loading Plot for all five subspecies, Figure 8, the pattern is the same for *E. a. ssp. acris, ssp. droebachiensis* and *ssp. politus* as in the previously mentioned figures. As *E. a. ssp. brachycephalus* seem to have the same range as *E. a. droebachiensis,* they also have the same pattern in the loading plot. *E. a. ssp. decoloratus* do not seem to be distinguished by any character based on the Loading Plot, further supporting that the idea of considering whether this truly is an own subspecies is valid.

For all illustrations based on PCA, one has though to take into consideration that all possible dimensions cannot be presented.

Variation

Even from the groups that can be defined, there are specimens not sticking to their group which would perhaps, solely based on these figures, be better suited in another subspecies. This might not be as easy as that. For sure, the reason why these specimens are not sticking to their group might just be for the reason that they are wrongly identified. And therefore defined as a specimen of a subspecies they do not truly belong to. The human factor of wrongly taken measurements could also be contributing. Hybridization is a known phenomenon in this genera and a valid explanation to why some are breaking the pattern.

Ecological variation is another subject to take into consideration. It might be that a specimen has been growing in an area where fertilizer has been spread. Or that it was collected in a year when there was plenty of rainfall and therefor is much taller and has a greater abundance of stem leaves and capitulas than other specimens of the same subspecies. Or another example may have been that there had been a mutation causing this specimen, or a local population, to have less hair. Being different in this trait might weigh heavy enough to cause a particular specimens to be excluded from a group in the figures. For these reasons it is very important to have many replicates from a variety of locations. However, as this study is of a more general nature, not looking at specific specimens but at whole subspecies, a low number of outliers are of interest but not of great importance.

Only one specimen has in this project had such a great difference to its assigned subspecies to be given the title “outlier”, number 21 of the specimens of *E. a. ssp acris*. This subspecies has relatively high densities and long lengths of hairs on many parts of the plant. However, this particular specimen has low densities of eglandular hairs on leaf lamina, margin, stem and on involucral bracts, and also has shorter lengths of hairs on lamina, margin and stem. This would point to that this particular specimen might be wrongly classified and perhaps better suited in another subspecies.

Future Studies

One can speculate in the weight and value of each trait as a separating tool and of how many of them varies with ecological variation. As the subspecies have different types of habitats it would be of interest to conduct cultivation trials. This is to see if the differences between them persist when given the same habitat with as little ecological variation as possible. Perhaps a lot of the variation is due to climate and growing conditions. Growing them in this way would make it possible to eliminate traits which only are an expression of the plants external stimuli rather than genetics.

It may also be of interest to look at living material, if one for example would like to further develop the study of coloration or to be sure that the drying and storage conditions have not altered the material.

Extra care would also be needed, when giving weight to traits, when looking at traits measured in an ordinal scale. Scales were created for qualitative values and densities: 1, 2 and 3 for colour, light, medium and dark. 1,2,3 and 4 for hair densities; no or very little and or scattered hairs, 0 to 5 hairs per mm^2, 5 to 10 hairs per mm^2, and 10 hairs or more per mm^2. However, it would perhaps be the case that the scales should for example be 1, 2 and 4 instead of 1, 2 and 3. One value might have a greater impact. A few attempts were made of changing the scales to see if there were any greater differences in the figures. There were however no noticeable difference on those changes. It would however be a possible subject for further studies.

Another subject for continued work would be genetic analyses. This could shed some light into if these groups are genetically separated groups, or if there genetically could be a larger or smaller number of them. If these genetically determined groups differed from groups that can be distinguished by morphological traits, these would have another implementation. These molecularly distinct groups would be of great interest to, for example, conserve genetic diversity. On the other hand, these groups would only be accessible to persons with access to laboratory equipment for genetic analyses. Subspecies defined by morphological traits visible by a microscope or perhaps even a handheld lens would have a broader range of usability as it could be accessible to smaller institutions with a smaller gadget budget as well as to the public.

If there ever would come a time when someone would consider doing a revision of the subspecies of *Erigeron acris L,* examining type material would of course be preferable.

Conclusion

Working with biological material is a challenge as there are so many causes for variation. The question is where you draw the line for how much variation there can be in a taxon. There certainly is variation in *Erigeron acris* and cause for division into subspecies. However, the treatment and characteristics of the subspecies are not consistent in all floras as some traits are described for a few subspecies and not stated at all in others. Perhaps it is the case that some subspecies have been added without fully reviewing the taxa that earlier have been described.

In this project 23 traits on 113 herbaria specimens were quantified after which ANOVA was used to show if there are traits separating the subspecies and which these were.

E. a. ssp. droebachiensis and *E. a. ssp. brachycephalus* overlapped partly or completely in 22 out of 23 traits, only the colour of the ray flowers could separate them. *E. a. ssp. brachycephalus* had three specimens with white flowers, two with both colours and three specimens with purple flowers. 28 specimens of *E. a. ssp. droebachiensis* were white, while five specimens were purple. As these are somewhat overlapping, a larger number of specimens examined could cause the difference no longer to be statistically significant.

E. a. ssp. droebachiensis and *E. a. ssp. decoloratus* could to only be separated by one trait completely, but are in the Score Plot not showing such a clear common distribution with *E. a. ssp. droebachiensis* as *E. a. ssp. brachycephalus* does.

So the question is if this is enough to separate *E. a. ssp. brachycephalus* and *E. a. ssp. decoloratus* as separate subspecies?

When considering the specimens and the traits used in this project I wish to suggest that *E. a. ssp. brachycephalus* could merge with *E. a. ssp. droebachiensis.* Considering the position and distribution of the *E. a. ssp. decoloratus* specimens in the Score Plot, the possibility of hybridization need to be considered. Otherwise *E. a. ssp. decoloratus* would need further studies to see if some of the specimens might merge into *E. a. ssp. acris, E. a. ssp. politus* and/or *E. a. ssp. droebachiensis.*

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ssp	Acc.no	Height	S.leaves	S.leaf	Internode	H. lam	H. lam, l	H. marg	H. marg, l	H. stem	H. stem, l	Capitula	In. bracts	In.bracts, w	In.bracts, l	Gl. H	Gl.h, span	E.h	E.h, span	E.h, l	C, In.bracts	C rf	Pappus	Rf reach	Origin of specimens
A	1495016LD	39,0	7	6,1	2,1	4	0,60	4	1,00	4	1,00	11	44	0,50	5,5	4	5,5	4	5,5	0,75	2	1	6,5	0,50	Denmark, the Island Peberholm, Öresund
A	1789816LD	47,0	1	10,5	4,2	3	0,60	3	0,45	3	0,50	46	40	0,50	5,0	4	5,0	4	5,0	0,75	2	1	6,0	0,25	Denmark, Jutland
A	1780533LD	36,5	6	5,4	3,0	2	0,40	2	1,00	3	0,75	30	24	0,50	5,0	4	5,0	4	4,5	0,60	1	1	5,0	1,25	Finland, Keminmaa, Törmä
A	1786213LD	23,0	4	4,5	2,2	3	0,60	3	0,50	4	0,60	14	40	0,50	4,0	4	4,0	4	4,0	0,75	2	1	4,5	0,50	Finland, Keski-Pohjanmaa
A	1778101LD	32,5	9	5,2	3,9	3	0,50	3	0,50	4	0,50	10	36	0,50	4,5	4	4,5	4	4,5	0,75	1	1	5,0	0,25	Finland, Nylandia, Ekenäs
A	1798504LD	28,5	2	3,1	4,1	3	0,50	3	0,60	4	0,60	5	32	0,60	5,5	4	5,5	3	4,5	1,00	1	1	5,5	0,00	Finland, Fennia, Ostrobottnia
A	1779173LD	8,0	2	2,8	0,7	4	0,50	3	0,50	4	0,50	3	48	0,50	4,0	4	4,0	4	4,0	0,75	1	1	4,5	0,25	Finland, Alandia
A	1779829LD	20,5	7	1,6	2,7	4	0,50	3	0,50	4	0,50	5	40	0,50	5,0	4	5,0	4	5,0	0,50	2	1	4,5	0,75	Finland, Kemin Lappi
A	1780197LD	39,0	3	4,1	3,3	4	0,60	3	0,60	3	0,60	28	40	0,50	5,0	4	5,0	4	5,0	0,75	2	1	6,0	0,00	Finland, Lokalahti, Riihiranta
A	1799845LD	20,0	5	3,3	1,0	2	0,50	3	0,50	3	0,50	21	40	0,50	4,5	4	4,5	4	4,5	0,60	3	1	4,5	0,00	Finland, Kuopio
A	1779813LD	25,5	7	2,0	1,5	3	0,60	3	0,60	3	0,75	7	38	0,50	4,5	4	4,5	4	4,5	0,60	1	1	4,0	0,25	Norway, Nordland, Fauske
A	1780517LD	34,5	6	7,4	3,0	3	0,50	3	0,60	3	0,60	15	38	0,75	5,5	4	5,5	4	5,5	1,00	2	1	5,0	0,50	Norway, Sörtröndelag, Drivstua
A	1783521LD	12,0	5	2,0	1,0	3	0,75	3	0,75	4	0,75	5	36	0,60	5,0	4	5,0	4	5,0	1,00	2	1	6,0	0,00	Norway, Vest-Agder, Lista
A	1616851LD	30,5	5	5,0	3,3	3	0,50	2	0,60	4	0,75	19	38	0,50	4,5	4	4,5	4	4,5	1,00	2	1	5,0	1,00	Sweden, Norrbotten, Nedertårneå-Happaranda
A	1376611LD	47,0	4	4,5	3,6	4	0,60	3	0,50	3	0,75	15	40	0,60	4,5	4	4,5	4	4,5	0,80	1	1	5,0	1,50	Sweden, Norrbotten, Luleå
A	1375831LD	21,0	3	2,5	2,9	3	0,40	2	0,40	4	0,50	5	26	0,60	5,0	4	5,0	4	5,0	0,50	2	1	5,5	1,00	Sweden, Norrbotten, Boden
A	1385311LD	38,0	4	6,3	5,5	3	0,75	3	0,50	3	0,75	6	26	1,00	5,5	4	5,5	4	5,5	1,00	2	1	6,0	2,50	Sweden, Åsele lappmark, Vilhelmina
A	1376251LD	29,0	6	4,5	2,0	3	0,50	3	0,50	4	0,60	14	40	0,60	4,5	4	4,5	4	4,5	0,75	1	1	5,5	0,75	Sweden, Pite lappmark, Vilhelmina, Bångnäs
A	1374991LD	27,5	4	5,0	5,0	3	0,60	3	0,50	4	0,75	5	38	0,50	4,5	4	4,5	4	4,5	0,75	1	1	5,0	1,00	Sweden, Lycksele lappmark, Måla socken.
A	1368811LD	16,0	1	3,2	3,8	4	0,50	3	0,60	4	0,75	6	24	0,75	3,5	4	3,5	4	3,5	0,90	1	1	5,0	1,00	Sweden, Lule lappmark, Jokkmokk, Pajerim
A	1377188LD	28,0	4	5,0	4,6	1	0,30	2	0,40	1	0,50	5	32	0,80	5,0	4	5,0	1	2,5	0,70	2	1	5,0	1,25	Sweden, Torne lappmark
A	1377407LD	24,0	3	3,5	2,5	3	0,60	3	0,40	3	0,75	8	36	0,50	4,5	4	4,5	4	3,5	0,60	2	1	6,5	0,50	Sweden, Härjedalen, Tännäs, Hamra-fjället
A	1315610LD	31,0	5	4,0	5,7	1	0,60	2	0,60	3	1,00	3	50	0,75	5,5	4	5,5	4	5,5	0,90	2	1	4,0	2,00	Sweden, Jämtland, Åreskutan
A	1846199LD	29,0	5	4,3	3,1	4	0,60	3	0,75	4	1,00	5	32	0,75	6,0	4	6,0	4	6,0	1,00	2	1	5,5	1,00	Sweden, Jämtland, Östersund
A	1378531LD	19,0	2	4,4	3,2	3	0,60	3	0,50	3	0,75	4	38	0,80	5,0	4	5,0	4	5,0	1,00	2	1	5,5	1,50	Sweden, Jämtland, Frösö
A	1379011LD	27,5	3	5,0	2,8	2	0,50	2	0,40	4	0,75	4	36	0,75	6,0	4	6,0	4	6,0	0,75	3	1	7,0	1,00	Sweden, Medelpad, Ljustorp, Sanna-Frötuna
A	1390231LD	26,0	3	4,7	4,7	3	0,75	2	0,75	3	0,90	4	32	0,75	4,5	4	4,5	4	4,5	0,75	2	1	5,0	1,00	Sweden, Västerbotten, Degerfors, Vindeln
A	1376431LD	10,0	1	5,0	3,0	2	0,60	2	0,50	4	0,50	5	40	0,60	4,5	4	4,5	4	4,5	0,60	2	1	5,0	0,00	Sweden, Ångermanland, Härnösand
A	1368107LD	39,5	6	6,3	2,0	2	1,10	2	0,60	4	1,50	17	26	0,60	5,5	4	5,5	4	5,5	1,00	2	1	6,0	0,50	Sweden, Skåne, Åhus
A	1381297LD	18,5	5	3,0	2,5	3	0,75	2	1,00	3	0,75	6	48	0,50	5,0	4	5,0	4	5,0	0,75	2	1	6,0	0,50	Sweden, Skåne, Sjötorp
A	1135214LD	25,0	10	1,6	1,8	4	0,50	3	0,50	3	0,50	5	44	0,50	4,5	4	4,5	4	4,5	0,60	2	1	6,0	0,00	Sweden, Blekinge, Aspö
A	1661523LD	30,5	3	4,9	1,8	3	0,60	3	0,60	3	0,75	20	40	0,70	5,5	4	5,5	4	5,5	0,75	2	1	6,0	0,50	Sweden, Öland, Gärdslösa
A	1230651LD	28,5	17	2,7	2,7	3	0,40	3	0,50	4	0,75	11	46	0,60	3,5	4	3,5	4	3,5	0,75	2	1	4,0	0,00	Sweden, Gotland, Buttle

Appendix 1

Ssp. acris - Measured specimens and their observations

Abbreviations

Ssp.: Subspecies

Acc.no: Accession number

Height: Height of specimen (cm)

S. leaves: Number of stem leaves (no)

S. leaf: Stem leaf length (cm)

H. lam: Hairs on lamina (ordinal scale)

H. lam, l: Hairs on lamina, length (mm)

H. marg: Hairs on margin (ordinal scale)

H. marg, l: Hairs on margin, length (mm)

H. stem: Hairs on stem (ordinal scale)

Capitula: Number of capitulas (no)

H. stem, l: Hairs on stem, length (mm)

In. bracts: Number of involucral bracts (no)

In. bracts, w: Involucral bracts, width (mm)

In. bracts, l: Involucral bracts, length (mm)

Gl. H: Glandular hairs on involucral bracts (ordinal scale)

Gl. h, span: Glandular hairs, span on involucral bracts (mm)

E.h: Eglandular hairs on involucral bracts (ordinal scale)

E. h, span: Eglandular hairs, span on involucral bracts (mm)

E. h, l: Length of eglandular hairs on involucral bracts (mm)

C, In. bracts: Colour of involucral bracts (ordinal scale)

C. rf: Colour of ray flowers

Pappus: Length of pappus

Rf reach: Length of ray flowers above pappus.

ssp	Acc.no	Height	S.leaves	S.leaf	Internode	H. lam	H. lam, l	H. marg	H. marg, l	H. stem	H. stem, l	Capitula	In. bracts	In.bracts, w	In.bracts, l	Gl. H	Gl.h, span	E.h	E.h, span	E.h, l	C, In.bracts	C rf	Pappus	Rf reach	Origin of specimens
D	S8-2552	48,5	13	5,2	1,0	1	0,40	1	0,30	1	0,75	19	40	0,50	5,0	4	5,0	1	0,5	0,25	3	1	6,5	0,75	Sweden, Medelpad, Timrå, Gistaholmen
D	S8-2555	44,0	6	5,5	3,5	2	0,50	2	0,60	2	0,60	12	46	0,50	5,0	4	5,0	3	2,5	0,75	1	3	5,0	0,00	Sweden, Dalsland, Skållerud, Håfverud
D	S-A15137-31	79,5	15	11,0	4,3	1	0,00	2	0,50	1	0,00	40	44	0,50	4,0	4	4,0	2	1,5	0,50	1	1	5,5	0,50	Sweden, Värmland, Sunne, Gettjärnsklätten
D	S-A1111-11	37,0	11	4,7	2,7	1	0,00	2	0,50	1	0,50	9	36	0,50	4,5	4	4,5	3	1,5	0,50	1	1	4,5	1,50	Sweden, Hälsingland, Alfta, Sjuberget
D	S-GST-2889	29,5	2	6,8	1,0	1	0,00	2	0,75	1	0,25	48	32	0,50	5,0	4	5,0	2	1,5	0,60	2	1	4,5	0,50	Sweden, Gästrikland, Valbo, Lugnet
D	S-LK-38322	28,0	10	5,7	1,5	1	0,30	2	0,50	1	0,50	12	50	0,50	5,0	4	5,0	2	2,5	0,50	1	1	5,0	0,75	Sweden, Södermanland, Nämndö, Mörtöklobb
D	S-LK-38321	40,0	12	5,0	2,4	1	0,50	2	0,60	1	0,75	13	40	0,50	4,0	4	4,0	4	2,5	0,75	1	1	6,0	0,00	Sweden, Södermanland, Ornö
D	S-HS-7997	25,0	3	3,2	2,5	1	0,25	2	0,40	1	0,00	3	38	0,50	5,0	4	5,0	1	1,5	0,50	3	1	6,0	0,75	Sweden, Lule lappmark, Jokkmokk, Njammats
D	VG-32803	41,0	8	5,7	1,7	1	0,30	2	0,40	1	0,60	8	40	0,50	4,5	4	4,5	3	1,5	0,75	1	1	4,5	1,50	Sweden, Dalsland, Ånimskog, Bolet
D	S-VG-32755	38,5	7	3,8	3,2	3	0,50	2	0,50	2	0,60	10	36	0,50	4,0	4	4,0	3	1,5	0,50	1	1	5,5	0,50	Sweden, Dalsland, Steneby, Skuggetorpsön
D	S16-116	10,0	2	2,7	1,0	3	0,30	2	0,50	4	0,50	5	40	0,50	5,0	4	5,0	4	5,0	0,60	2	1	3,0	0,00	Sweden, Bohuslän, Lysekil
D	S16-152	11,5	1	1,5	0,9	1	0,00	3	0,30	4	0,40	8	26	0,50	3,5	4	3,5	4	3,5	0,75	3	1	5,5	0,00	Sweden, Bohuslän, Skee, Hällastrand
D	S16-149	10,2	1	1,9	1,4	2	0,25	3	0,40	3	0,30	6	38	0,50	4,0	4	4,0	4	4,0	0,60	2	1	5,0	0,00	Sweden, Bohuslän, Kville, Fjällbacka
D	S16-108	38,5	2	8,4	4,5	2	0,60	2	0,40	3	0,75	17	40	0,50	4,5	4	4,5	4	3,5	0,50	2	1	5,5	0,25	Sweden, Uppland, Värmdö, Stavnäs
D	S15-66952	46,0	10	7,8	2,0	1	0,25	2	0,50	1	0,60	15	48	0,50	4,5	4	4,5	4	2,0	0,50	1	1	5,5	0,00	Sweden, Uppland, Djurö, Munkö
D	S15-70473	42,7	4	8,2	1,5	2	0,60	3	0,50	3	0,75	34	40	0,60	5,0	4	5,0	4	4,0	0,75	2	1	5,5	1,00	Sweden, Medelpad, Haverö, Byberget
D	1051942LD	38,0	7	4,5	1,8	1	0,50	2	0,75	2	0,50	13	44	0,50	4,5	4	4,5	3	2,5	0,50	2	1	6,0	0,50	Sweden, Småland, Huskvarna
D	1377451LD	36,7	10	5,2	1,8	1	0,25	2	0,75	3	0,75	11	52	0,50	4,0	4	4,5	3	2,0	0,50	1	1	5,5	-2,00	Sweden, Bohuslän, Uddevalla, Emaus
D	1367911LD	7,5	3	1,2	0,5	2	0,25	2	0,40	4	0,25	5	16	0,50	3,5	4	3,5	3	3,5	0,35	2	1	5,0	0,50	Sweden, Bohuslän, Strömstad, Hålkedalskilen
D	1368091LD	12,0	2	2,0	0,3	1	0,30	2	0,30	3	0,40	7	42	0,50	4,0	4	4,0	4	4,0	0,50	1	1	5,5	0,00	Sweden, Bohuslän, Fjällbacka, Vassholmen
D	1367791LD	23,2	8	5,1	0,9	1	0,50	2	0,50	1	0,60	18	48	0,50	4,5	4	4,5	2	2,0	0,60	1	3	5,5	0,50	Sweden, Dalsland, Frändefors, Bastungens fyr
D	1376791LD	50,5	9	10,3	3,6	1	0,00	1	0,75	1	0,75	15	40	0,60	4,5	4	4,5	2	2,0	0,60	1	3	4,5	0,50	Sweden, Västergötland, Trollhättan
D	1367671LD	40,0	14	3,6	2,5	1	0,00	2	0,75	1	0,25	7	40	0,60	4,0	4	4,0	2	2,0	0,50	1	3	4,5	0,50	Sweden, Västergötland, Västra Tunhem, Lilleskog
D	1329254LD	43,5	5	4,0	2,2	3	0,60	2	0,60	3	1,00	12	40	0,75	5,5	4	5,5	4	5,5	0,80	1	1	5,0	2,00	Sweden, Hälsingland Ljusdal
D	1329314LD	40,0	4	6,5	0,5	1	0,50	2	0,75	2	0,75	43	40	0,60	4,5	4	4,5	3	2,5	0,60	2	1	5,5	0,50	Sweden, Värmland, Norra råda, Hjärn
D	1329374LD	40,5	11	3,2	2,8	1	0,40	2	0,50	1	0,25	7	42	0,50	3,5	4	3,5	2	2,0	0,75	1	1	5,0	0,00	Sweden, Värmland, Sunne, Gettjärnsklätten
D	1374211LD	45,0	6	8,5	1,4	2	0,50	2	0,40	2	0,75	30	42	0,50	3,5	4	3,5	3	2,0	0,60	1	1	4,0	0,50	Sweden, Värmland, Karlskoga, Klaråsforsen
D	1374151LD	39,2	5	7,5	4	1	0,20	1	0,50	1	0,75	14	36	0,75	5,5	4	5,5	2	1,5	0,60	1	3	5,0	1,50	Sweden, Torne lappmark, Abisko, Njulla
D	1781876LD	25,5	5	6,0	3	1	0,00	2	0,40	1	0,50	12	32	0,50	5,0	4	5,0	1	1,0	0,40	2	1	6,0	1,50	Norway, Oppland, Dovre
D	1785121LD	32,0	9	5,4	1,5	1	0,00	1	0,40	1	0,50	10	38	0,30	3,5	4	3,5	1	1,0	0,60	1	1	5,5	0,00	Norway, Buskerud, Ringerike, Skaret
D	1560946LD	32,5	8	5,5	2,8	2	0,40	2	0,60	2	0,60	5	50	0,60	5,5	4	5,5	1	1,5	0,60	2	1	5,0	1,00	Norway, Troms, Pålnoröset
D	1784545LD	22,0	4	4,5	2,1	1	0,50	3	0,40	2	0,60	13	38	0,60	4,5	4	4,5	2	1,5	0,50	2	1	5,0	1,00	Norway, NordlandBeiarn
D	1784498LD	32,5	8	3,5	2,2	1	0,00	1	0,30	1	0,30	11	36	0,50	4,0	4	4,0	1	1,5	0,40	1	1	6,0	-1,50	Finland, Karelia ladogensis, Kirjavalaks, Suosaari

Appendix 2

Ssp. droebachiensis - Measured specimens and their observations

Abbreviations

Ssp.: Subspecies

Acc.no: Accession number

Height: Height of specimen (cm)

S. leaves: Number of stem leaves (no)

S. leaf: Stem leaf length (cm)

H. lam: Hairs on lamina (ordinal scale)

H. lam, l: Hairs on lamina, length (mm)

H. marg: Hairs on margin (ordinal scale)

H. marg, l: Hairs on margin, length (mm)

H. stem: Hairs on stem (ordinal scale)

Capitula: Number of capitulas (no)

H. stem, l: Hairs on stem, length (mm)

In. bracts: Number of involucral bracts (no)

In. bracts, w: Involucral bracts, width (mm)

In. bracts, l: Involucral bracts, length (mm)

Gl. H: Glandular hairs on involucral bracts (ordinal scale)

Gl. h, span: Glandular hairs, span on involucral bracts (mm)

E.h: Eglandular hairs on involucral bracts (ordinal scale)

E. h, span: Eglandular hairs, span on involucral bracts (mm)

E. h, l: Length of eglandular hairs on involucral bracts (mm)

C, In. bracts: Colour of involucral bracts (ordinal scale)

C. rf: Colour of ray flowers

Pappus: Length of pappus

Rf reach: Length of ray flowers above pappus.

ssp	Acc.no	Height	S.leaves	S.leaf	Internode	H. lam	H. lam, l	H. marg	H. marg, l	H. stem	H. stem, l	Capitula	In. bracts	In.bracts, w	In.bracts, l	Gl. H	Gl.h, span	E.h	E.h, span	E.h, l	C, In.bracts	C rf	Pappus	Rf reach	Origin of specimens
P	1373491 LD	30,5	7	2,5	3,50	1	0,30	2	0,30	1	0,60	4	30	1,00	5,5	4	5,5	3	3,0	0,60	1	2	6,0	1,75	Sweden, Dalarna, Älvdalen, Jöllen
P	1374091 LD	33,5	5	5,0	6,40	1	0,00	2	0,60	1	0,40	7	40	0,70	6,0	4	6,0	2	2,5	0,60	1	1	8,0	0,75	Sweden, Dalarna, Särna.
P	1373191 LD	37,0	7	6,0	7,30	1	0,35	2	0,35	2	0,50	4	34	0,60	5,5	4	5,5	3	2,0	0,50	1	1	7,0	1,25	Sweden, Dalarna, Idre, Lillfjäten
P	1367431 LD	53,0	11	6,5	2,00	2	0,25	2	0,15	1	0,50	10	40	0,70	5,5	4	5,5	2	2,5	0,60	3	1	7,5	0,25	Sweden, Jämtland, Stugun, Mårdsjön
P	1378891 LD	44,5	9	4,0	5,20	1	0,25	2	0,25	1	0,50	11	40	0,50	4,0	4	4,0	2	0,3	0,20	1	1	3,5	0,75	Sweden, Jämtland, Östersund, Rannåsbäcken
P	1378831 LD	38,0	5	8,0	6,00	2	0,50	2	0,30	2	0,75	7	27	0,70	6,0	4	6,0	3	6,0	0,75	1	1	6,0	0,50	Sweden, Jämtland, Kall, Suljätten
P	1373371 LD	39,5	7	4,1	3,00	1	0,15	1	0,30	1	0,70	6	30	0,60	5,0	4	5,0	2	1,5	0,60	2	1	6,0	0,75	Sweden, Jämtland, Undersåker, vid Indalsälven
P	1367491 LD	46,0	11	6,2	4,10	1	0,00	3	0,40	1	0,75	6	36	0,70	6,0	4	6,0	2	1,5	0,75	3	1	5,0	2,50	Sweden, Jämtland, Åre, Duved
P	no number	44,5	7	7,2	1,50	1	0,25	2	0,60	1	0,75	13	28	0,80	5,5	4	5,5	3	1,5	0,50	3	1	5,0	1,00	Sweden, Jämtland, Ström, Strömsund
P	1606674 LD	20,5	6	1,8	2,90	1	0,25	2	0,40	2	0,50	3	32	0,50	4,0	4	4,0	2	1,5	0,60	3	1	5,0	1,00	Sweden, Norrbotten, Tärendö
P	1385495 LD	28,7	3	3,5	2,50	1	0,40	2	0,30	1	0,25	8	30	0,50	5,0	4	5,0	1	0,3	0,50	3	1	5,5	1,00	Sweden, Norrbotten, Pajala, Palokorva
P	1372291 LD	26,0	4	4,7	3,50	2	0,30	2	0,30	2	0,60	7	38	0,75	4,5	4	4,5	1	2,0	0,30	1	2	6,0	1,50	Sweden, Åsele lappmark
P	1390175 LD	31,5	9	2,0	3,20	1	0,00	2	0,30	1	0,50	3	40	0,60	5,0	4	5,0	1	1,5	0,40	3	1	6,0	1,00	Sweden, Pite Lappmark
P	1808512 LD	44,5	4	7,5	2,10	2	0,40	2	0,50	1	0,60	16	38	0,75	5,5	4	5,5	1	2,0	0,30	3	2	5,0	1,50	Sweden, Åsele lappmark
P	1390055 LD	43,5	6	5,0	4,20	1	0,00	2	0,50	1	0,00	10	40	0,75	5,5	4	5,5	1	1,0	0,50	2	1	5,5	1,00	Sweden, Lycksele lappmark, Tärna, Vinberget
P	1336307 LD	32,5	3	7,3	2,00	1	0,25	2	0,30	3	0,50	8	38	0,75	5,5	4	5,5	4	4,5	0,50	3	1	5,0	1,00	Sweden, Pite Lappmark, Arjeplog
P	1374391 LD	48,0	5	8,6	3,00	1	0,00	2	0,50	2	0,75	9	36	0,60	6,5	4	6,5	2	3,0	0,60	1	1	4,5	1,50	Sweden, Lule lappmark, jokkmokk, kvikkjokk,
P	1373911 LD	26,0	6	4,3	3,00	1	0,30	2	0,50	1	0,50	6	38	0,60	5,5	4	5,5	2	3,0	0,60	2	1	6,0	1,50	Sweden, Lule lappmark, jokkmokk, Ludvigsudde
P	1377399 LD	26,0	3	7,0	2,20	1	0,30	1	0,25	1	0,30	9	32	0,80	6,0	4	6,0	2	2,0	0,60	2	2	6,5	2,00	Sweden, Lule lappmark, Gällivare, Langasjaure
P	1369951 LD	22,2	4	3,2	1,50	2	0,60	2	0,60	3	0,60	3	22	0,60	4,5	4	4,5	2	2,5	0,60	2	1	4,5	1,50	Sweden, Torne lappmark, Abisko, Jebrenjokk
P	1368691 LD	33,0	5	4,5	5,00	1	0,25	1	0,40	1	0,40	7	40	0,60	5,0	4	5,0	2	1,5	0,50	3	1	5,0	0,50	Sweden, Torne lappmark, Ortovare, Torne träsk
P	1368631 LD	26,5	6	4,4	2,50	1	0,30	2	0,50	1	0,50	7	26	0,75	5,5	4	5,5	3	2,5	0,40	1	3	4,5	2,50	Sweden, Torne lappmark, Abisko, Björkliden
P	1329554 LD	32,2	3	2,8	2,50	1	0,40	2	0,40	1	0,60	10	30	0,75	5,0	4	5,0	2	0,5	0,50	3	1	4,5	2,00	Sweden, Torne lappmark, Polno
P	1785569 LD	26,0	4	4,3	4,30	3	0,60	3	0,25	3	0,90	5	36	0,75	6,0	4	6,0	1	3,0	0,50	2	1	5,0	1,50	Finland, Inari lapland, Utsjoki
P	1781746 LD	22,5	5	6,2	3,00	1	0,40	2	0,30	1	0,60	6	36	0,60	5,5	4	5,5	1	1,5	0,50	3	1	6,0	1,00	Finland, Lapponia, Kemensis, Muonio
P	1786276 LD	24,0	5	2,8	3,90	1	0,30	2	0,50	1	0,40	3	30	0,75	5,0	4	5,0	1	1,5	0,60	2	1	5,0	1,50	Norway, Sör-Tröndelag, Kongsvoll
P	1782884 LD	33,5	5	5,7	4,30	1	0,30	1	0,15	1	0,50	6	38	0,70	5,5	4	5,5	1	1,5	0,75	3	1	6,0	1,00	Norway, Finnmark, Alta-fjord
P	1782005 LD	36,6	8	5,4	3,20	1	0,50	2	0,60	1	0,50	7	40	0,75	5,0	4	5,0	1	1,5	0,50	3	1	5,0	1,00	Norway, Sör-Tröndelag, Oppdal, Drivdalen.
P	1471525 LD	22,5	2	5,5	5,50	1	0,30	1	0,50	2	0,75	4	26	0,80	5,0	4	5,0	1	1,0	0,50	3	1	6,0	0,50	Norway, Troms fylke, Nordreisa
P	1779957 LD	43,0	8	6,0	4,20	2	0,40	2	0,75	2	0,50	7	42	0,80	6,0	4	6,0	1	1,5	0,40	3	1	6,0	2,00	Norway, Oppland, Dovre
P	1781749 LD	28,5	4	5,3	4,80	1	0,40	2	0,50	2	0,50	6	40	0,70	5,0	4	5,0	1	1,5	0,60	2	1	4,0	1,75	Norway, Troms, Målselv, Kirkesdalen
P	1781237 LD	32,0	4	5	3,40	1	0,30	2	0,30	2	0,60	6	34	0,70	5,5	4	5,5	1	1,0	0,40	2	1	5,0	1,00	Norway, Hedmark, Lillelvedal
P	1385555 LD	28,5	5	7,4	2,80	1	0,25	2	0,50	2	1,00	11	28	0,60	5,0	4	5,0	2	1,5	0,50	1	1	5,0	1,50	Sweden, Ångermanland, Tåsjö, Hoting

Appendix 3

Ssp. politus - Measured specimens and their observations

Abbreviations

Ssp.: Subspecies

Acc.no: Accession number

Height: Height of specimen (cm)

S. leaves: Number of stem leaves (no)

S. leaf: Stem leaf length (cm)

H. lam: Hairs on lamina (ordinal scale)

H. lam, l: Hairs on lamina, length (mm)

H. marg: Hairs on margin (ordinal scale)

H. marg, l: Hairs on margin, length (mm)

H. stem: Hairs on stem (ordinal scale)

Capitula: Number of capitulas (no)

H. stem, l: Hairs on stem, length (mm)

In. bracts: Number of involucral bracts (no)

In. bracts, w: Involucral bracts, width (mm)

In. bracts, l: Involucral bracts, length (mm)

Gl. H: Glandular hairs on involucral bracts (ordinal scale)

Gl. h, span: Glandular hairs, span on involucral bracts (mm)

E.h: Eglandular hairs on involucral bracts (ordinal scale)

E. h, span: Eglandular hairs, span on involucral bracts (mm)

E. h, l: Length of eglandular hairs on involucral bracts (mm)

C, In. bracts: Colour of involucral bracts (ordinal scale)

C. rf: Colour of ray flowers

Pappus: Length of pappus

Rf reach: Length of ray flowers above pappus.

Appendix 4

Ssp. brachycephalus - Measured specimens and their observations

Abbreviations

Ssp.: Subspecies

Acc.no: Accession number

Height: Height of specimen (cm)

S. leaves: Number of stem leaves (no)

S. leaf: Stem leaf length (cm)

H. lam: Hairs on lamina (ordinal scale)

H. lam, l: Hairs on lamina, length (mm)

H. marg: Hairs on margin (ordinal scale)

H. marg, l: Hairs on margin, length (mm)

H. stem: Hairs on stem (ordinal scale)

Capitula: Number of capitulas (no)

H. stem, l: Hairs on stem, length (mm)

In. bracts: Number of involucral bracts (no)

In. bracts, w: Involucral bracts, width (mm)

In. bracts, l: Involucral bracts, length (mm)

Gl. H: Glandular hairs on involucral bracts (ordinal scale)

Gl. h, span: Glandular hairs, span on involucral bracts (mm)

E.h: Eglandular hairs on involucral bracts (ordinal scale)

E. h, span: Eglandular hairs, span on involucral bracts (mm)

E. h, l: Length of eglandular hairs on involucral bracts (mm)

C, In. bracts: Colour of involucral bracts (ordinal scale)

C. rf: Colour of ray flowers

Pappus: Length of pappus

Rf reach: Length of ray flowers above pappus.

ssp	Acc.no	Height	S.leaves	S.leaf	Internode	H. lam	H. lam, l	H. marg	H. marg, l	H. stem	H. stem, l	Capitula	In. bracts	In.bracts, w	In.bracts, l	Gl. H	Gl.h, span	E.h	E.h, span	E.h, l	C, In.bracts	C rf	Pappus	Rf reach	Origin of specimens
B	1061318 LD	21,5	3	2,9	1,5	3	0,50	3	0,50	3	0,50	23	20	0,50	4,5	4	4,5	4	4,5	0,75	2	1	5,5	0,75	Finland, Nylandia, Ekenäs
B	1061382 LD	37,0	9	4,8	2,2	2	0,35	2	0,50	3	0,50	35	38	0,40	4,0	4	4,0	2	1,5	0,60	3	1	5,0	0,50	Finland, Nylandia, Ekenäs, Dragsvik
B	1060998 LD	38,5	4	6,2	4,0	2	0,50	3	0,50	1	0,75	9	42	0,40	4,0	4	4,0	2	2,0	0,60	1	1	3,5	0,25	Finland, Tenala, Trollhovsda
B	1061126 LD	48,0	5	7,0	3,0	3	0,60	2	0,50	3	0,75	33	40	0,50	4,5	4	4,5	4	4,5	0,50	2	2	3,0	0,00	Finland, Kirjavalahti
B	5347006 H	34,5	8	4,0	3,0	2	0,30	3	0,60	2	0,70	33	40	0,50	4,0	4	4,0	2	1,5	0,40	1	3	5,5	0,50	Finland
B	5347007 H	41,5	9	3,4	2,5	1	0,25	2	0,30	1	0,50	12	42	0,50	4,0	4	4,0	2	1,5	0,60	1	2	4,5	0,00	Finland, Lohja, Hongisto
B	5347008 H	41,5	10	3,7	2,5	1	0,25	2	0,50	1	0,30	15	46	0,50	4,5	4	4,5	3	2,5	0,60	1	3	5,0	0,50	Finland, Lohja, Osuniemi
B	5347014 H	56,5	12	6,1	3,4	1	0,40	2	0,75	2	0,75	16	56	0,50	4,0	4	4,0	2	3,0	0,60	1	3	4,5	0,25	Finland, Tenala, Trollhovsda

Appendix 5

Ssp. decoloratus - Measured specimens and their observations

Abbreviations

Ssp.: Subspecies

Acc.no: Accession number

Height: Height of specimen (cm)

S. leaves: Number of stem leaves (no)

S. leaf: Stem leaf length (cm)

H. lam: Hairs on lamina (ordinal scale)

H. lam, l: Hairs on lamina, length (mm)

H. marg: Hairs on margin (ordinal scale)

H. marg, l: Hairs on margin, length (mm)

H. stem: Hairs on stem (ordinal scale)

Capitula: Number of capitulas (no)

H. stem, l: Hairs on stem, length (mm)

In. bracts: Number of involucral bracts (no)

In. bracts, w: Involucral bracts, width (mm)

In. bracts, l: Involucral bracts, length (mm)

Gl. H: Glandular hairs on involucral bracts (ordinal scale)

Gl. h, span: Glandular hairs, span on involucral bracts (mm)

E.h: Eglandular hairs on involucral bracts (ordinal scale)

E. h, span: Eglandular hairs, span on involucral bracts (mm)

E. h, l: Length of eglandular hairs on involucral bracts (mm)

C, In. bracts: Colour of involucral bracts (ordinal scale)

C. rf: Colour of ray flowers

Pappus: Length of pappus

Rf reach: Length of ray flowers above pappus.

ssp	Acc.no	Height	S.leaves	S.leaf	Internode	H. lam	H. lam,l	H. marg	H. marg,l	H. stem	H. stem,l	Capitula	In. bracts	In.bracts,w	In.bracts,l	Gl. H	Gl.h,span	E.h	E.h, span	E.h,l	C, In.bracts	C rf	Pappus	Rf reach	Origin of specimens
De	1008790 LD	26,2	6	4,	3,5	2	0,50	3	0,60	3	0,50	7	32	0,60	5,0	4	5,0	3	5,0	0,50	1	3	4,	0,75	Finland, Kuusamo
De	5347009H	30,5	4	4,	3,8	1	0,30	1	0,40	2	0,60	6	40	0,60	4,5	4	4,5	3	4,0	0,50	1	1	5,	0,00	Finland
De	5347010H	34,5	3	6,	6,3	1	0,75	2	0,60	2	0,75	8	44	0,60	5,0	4	5,0	4	5,0	0,70	1	1	6,	0,50	Finland, Salla, Onkamo
De	5347011H	39,0	4	2,	1,3	1	0,50	2	0,50	2	0,75	40	34	0,90	5,5	4	5,5	3	5,0	0,50	2	1	4,	1,50	Finland, kuusamo
De	5347012H	24,3	3	6,	3,7	1	0,60	2	0,60	2	0,60	7	34	0,60	4,5	4	4,5	3	3,5	0,60	1	1	5,	1,00	Finland, Kuusamo
De	5347013H	45,0	4	10,5	2,5	2	0,50	2	0,70	2	0,80	26	42	0,60	5,0	4	5,0	4	3,5	0,60	1	1	4,	1,00	Finland, Kuusamo

Appendix 6

Table 13. Traits and their values observed in this project based on the specimens in Appendix 1, 2, 3, 4 and 5 of *E. a. ssp. acris, E. a. politus, E. a. ssp. droebachiensis, E. a. ssp. brachycephalus* and *E. a. ssp. decoloratus.*
*Ordinal scale, hair densities. See table 7 for explanations.
** Ordinal scale, amount of hairs on leaf margin. See table 8 for explanations.
*** Ordinal scale, colour of involucral bracts. See table 9 for explanations.
**** Ordinal scale, colour of ray flowers. See table 10 for explanations.

Traits /*E. a. ssp.*	***acris***	***droebachiensis***	***Politus***	***brachycephalus***	***decoloratus***
Height (cm)	Mean: 27,6 SD: 9,48 Min: 8 Max: 47	Mean: 34,3 SD: 14,46 Min: 7,5 Max: 79,5	Mean: 33,5 SD: 8,61 Min: 20,5 Max: 53	Mean: 39,9 SD: 10,17 Min: 21,5 Max: 56,5	Mean: 33,3 SD: 7,87 Min: 24,3 Max: 45
Stem leaves (no)	Mean: 4,8 SD: 3.08 Min: 1 Max:17	Mean: 6,8 SD: 3,91 Min: 1 Max: 15	Mean: 5,6 SD: 2,23 Min: 2 Max: 11	Mean: 7,5 SD: 3,16 Min: 3 Max: 12	Mean: 4 SD: 1,1 Min: 3 Max: 6
Stem leaf (cm)	Mean: 4,3 SD: 1,80 Min: 1,6 Max: 10,5	Mean: 5,3 SD: 2,39 Min: 1,2 Max: 11	Mean: 5,1 SD: 1,77 Min: 1,8 Max: 8,6	Mean: 4,8 SD: 1,51 Min: 2,9 Max: 7	Mean: 5,8 SD: 2,61 Min: 2,8 Max: 10,5
Internode (cm)	Mean: 3 SD: 1,25 Min: 0,7 Max:5,7	Mean: 2,1 SD: 1,11 Min: 0,3 Max: 4,5	Mean: 3,6 SD: 1,41 Min: 1,5 Max: 7,3	Mean: 2,8 SD: 0,77 Min: 1,5 Max: 4	Mean: 3,5 SD: 1,66 Min: 1,3 Max: 6,3
Amount of eglandular hairs on lamina (ordinal scale)*	Mean: 3 SD: 0,81 Min: 1 Max: 4	Mean: 1,4 SD: 0,66 Min: 1 Max: 3	Mean: 1,2 SD: 0,50 Min: 1 Max: 3	Mean: 1,9 SD: 0,84 Min: 1 Max: 3	Mean: 1,3 SD: 0,52 Min: 1 Max: 2
Length of eglandular hairs on lamina (mm)	Mean: 0,6 SD: 0,14 Min: 0,3 Max: 1,1	Mean: 0,3 SD: 0,21 Min: 0 Max: 0,6	Mean: 0,3 SD: 0,16 Min: 0 Max: 0,6	Mean: 0,4 SD: 0,13 Min: 0,3 Max: 0,6	Mean: 0,5 SD: 0,15 Min: 0,3 Max: 0,8
Amount of eglandular hair on leaf margin (ordinal scale)**	Mean: 2,7 SD: 0,52 Min: 2 Max: 4	Mean: 2 SD: 0,53 Min: 1 Max: 3	Mean: 1,9 SD: 0,46 Min: 1 Max: 3	Mean: 2,4 SD: 0,52 Min: 2 Max: 3	Mean: 2,0 SD: 0,63 Min: 1 Max: 3
Length of eglandular hair on leaf margin (mm)	Mean: 0,6 SD: 0,16 Min: 0,4 Max: 1	Mean: 0,5 SD: 0,14 Min: 0,3 Max: 0,8	Mean: 0,4 SD: 0,14 Min: 0,2 Max: 0,8	Mean: 0,5 SD: 0,13 Min: 0,3 Max: 0,8	Mean: 0,6 SD: 0,1 Min: 0,4 Max: 0,7
Amount of eglandular hair on stem (ordinal scale)*	Mean: 3,5 SD: 0,67 Min: 1 Max: 4	Mean: 1,8 SD: 1,03 Min: 1 Max: 4	Mean: 1,5 SD: 0,67 Min: 1 Max: 3	Mean: 2 SD: 0,93 Min: 1 Max: 3	Mean: 2,2 SD: 0,41 Min: 2 Max: 3
Length of eglandular hair on stem (mm)	Mean: 0,7 SD: 0,21 Min: 0,5 Max: 1,5	Mean: 0,5 SD: 0,23 Min: 0 Max: 1	Mean: 0,6 SD: 0,19 Min: 0 Max: 1	Mean: 0,6 SD: 0,17 Min: 0,3 Max: 0,8	Mean:0,7 SD: 0,12 Min: 0,5 Max: 0,8
Capitula (no)	Mean: 11,1 SD: 9,53 Min: 3 Max: 46	Mean: 14,9 SD: 11,31 Min: 3 Max: 48	Mean: 7,1 SD: 3,00 Min: 3 Max: 16	Mean: 22 SD: 10,46 Min: 9 Max: 35	Mean: 15,7 SD: 14,15 Min: 6 Max: 40

Involucral bracts (no)	Mean: 37,2 SD: 6,80 Min: 24 Max: 50	Mean: 39,7 SD: 6,91 Min: 16 Max: 52	Mean: 34,4 SD: 5,37 Min: 22 Max: 42	Mean: 40,5 SD: 10,01 Min: 20 Max: 56	Mean: 37,7 SD: 4,97 Min: 32 Max: 44
Involucral bracts, width (mm)	Mean: 0,6 SD: 0,13 Min: 0,5 Max: 1	Mean: 0,5 SD: 0,08 Min: 0,3 Max: 0,8	Mean: 0,7 SD: 0,11 Min: 0,5 Max: 1	Mean: 0,5 SD: 0,05 Min: 0,4 Max: 0,5	Mean: 0,7 SD: 0,12 Min: 0,6 Max: 0,9
Involucral bracts, length (mm)	Mean: 4,8 SD: 0,62 Min: 3,5 Max: 6	Mean: 4,4 SD: 0,61 Min: 3,5 Max: 5,5	Mean: 5,3 SD: 0,57 Min: 4 Max: 6,5	Mean:4,2 SD: 0,26 Min: 4 Max: 4,5	Mean: 4,9 SD: 0,38 Min: 4,5 Max: 5,5
Amount of glandular hairs on involucral bracts (ordinal scale)*	Mean: 4 SD: 0 Min: 4 Max: 4	Mean: 4 SD: 0 Min: 4 Max: 4	Mean: 4 SD: 0 Min: 4 Max: 4	Mean: 4 SD: 0 Min: 4 Max: 4	Mean: 4 SD: 0 Min: 4 Max: 4
Span of glandular hairs on involucral bracts (mm)	Mean: 4,8 SD: 0,62 Min: 3,5 Max: 6	Mean: 4,5 SD: 0,60 Min: 3,5 Max: 5,5	Mean: 5,3 SD: 0,57 Min: 4 Max: 6,5	Mean: 4,2 SD: 0,26 Min: 4 Max: 4,5	Mean: 4,9 SD: 0,38 Min: 4,5 Max: 5,5
Amount of eglandular hairs on involucral bracts (ordinal scale)*	Mean: 3,9 SD: 0,55 Min: 1 Max: 4	Mean: 2,6 SD: 1,08 Min: 1 Max: 4	Mean: 1,8 SD: 0,82 Min: 1 Max: 4	Mean: 2,6 SD: 0,92 Min: 2 Max: 4	Mean: 3,3 SD: 0,52 Min: 3 Max: 4
Span of eglandular hairs on involucral bracts (mm)	Mean: 4,7 SD: 0,76 Min:2,5 Max: 6	Mean: 2,3 SD: 1,18 Min: 0,5 Max: 5,5	Mean: 1,9 SD: 1,14 Min: 0,3 Max: 6,0	Mean: 2,6 SD: 1,27 Min: 1,5 Max: 4,5	Mean: 4,3 SD: 0,75 Min: 3,5 Max: 5
Length of eglandular hair on involucral bracts (mm)	Mean: 0,8 SD: 0,16 Min: 0,5 Max: 1	Mean: 0,6 SD: 0,13 Min: 0,3 Max: 0,8	Mean: 0,5 SD: 0,12 Min: 0,2 Max: 0,8	Mean: 0,6 SD: 0,1 Min: 0,4 Max: 0,8	Mean: 0,6 SD: 0,08 Min: 0,5 Max: 0,7
Colour of involucral bracts (ordinal scale)*	Mean: 1,8 SD: 0,55 Min: 1 Max: 3	Mean: 1,5 SD: 0,67 Min: 1 Max: 3	Mean: 2,2 SD: 0,85 Min: 1 Max: 3	Mean: 1,5 SD: 0,76 Min: 1 Max: 3	Mean: 1,2 SD: 0,41 Min: 1 Max: 2
Colour of ray flowers (ordinal scale)**	Mean: 1 SD: 0 Min: 1 Max: 1	Mean: 1,3 SD: 0,73 Min: 1 Max: 3	Mean: 1,2 SD: 0,46 Min: 1 Max: 3	Mean: 2 SD: 0,93 Min: 1 Max: 3	Mean: 1,3 SD: 0,82 Min: 1 Max: 3
Pappus length (mm)	Mean: 5,3 SD: 0,76 Min: 4 Max: 7	Mean: 5,2 SD: 0,68 Min: 3 Max: 6,5	Mean: 5,5 SD: 0,95 Min: 3,5 Max: 8	Mean: 4,6 SD: 0,9 Min: 3 Max: 5,5	Mean: 5,1 SD: 0,8 Min: 4,5 Max: 6,5
Ray flowers reach above pappus (mm)	Mean: 0,7 SD: 0,61 Min: 0 Max: 2,5	Mean: 0,5 SD: 0,78 Min: -2, Max: 2	Mean: 1,3 SD: 0,56 Min: 0,3 Max: 2,5	Mean: 0,3 SD: 0,27 Min: 0 Max: 0,8	Mean: 0,8 SD: 0,51 Min: 0 Max: 1,5