Towards more effective identification keys – a study of people identifying plant species characters: supplemental document of the online survey

QUESTIONS OF THE SURVEY AND SPECIES IMAGES

This online survey was structured into two sections. In the first section, we inquired about participants' education, and preexisting plant knowledge. In the second section, participants were asked to identify plant characters from a number of plant images. For this purpose we displayed all character states as pictograms accompanied by a brief explanation; however, no further definitions of botanical terms were provided to the participants. Participants were asked to click on the pictogram that best matched the depicted plant species. The pictograms and the corresponding brief explanations are shown in Table S1.1. To simulate the observation of real plants as closely as possible, we represented each plant by images showing them from six different perspectives. The used images are shown in Table S1.2. The survey was conducted in German language.

First section: Participants' education, and preexisting plant knowledge

The follwing questions served to divide the participants of the study into different groups with different prior knowledge and interests. Each question had be answered. The question where asked only in German.

In welchem Jahr wurden Sie geboren? *

Haben Sie eine Farbsehstörung und möglicherweise Schwierigkeiten z.B. Blütenfarben zu erkennen? *

- ○ Ja
- ○ Nein

Wie sind Ihre Deutschkenntnisse? *

- ○ Muttersprache
- ○ Fließend
- ○ Gute Kenntnisse
- ○ Grundkenntnisse

Was ist Ihr höchster Bildungsabschluss? *

- ○ Noch SchülerIn
- ○ Kein Abschluss
- ○ Hauptschulabschluss (bzw. Volksschulabschluss)
- ○ Realschulabschluss (Mittlere Reife), Polytechnische Oberschule 10. Klasse
- ○ Allgemeine oder fachgebundene Hochschulreife/Abitur
- ○ Universität (Bachelor / Master / Diplom / Staatsexamen)
- ○ Promotion
- ○ Anderer Abschluss, und zwar:

Spielt Pflanzenkenntnis eine Rolle in Ihrer beruflichen Tätigkeit *(auch Studium bei Studierenden)*? *

- ○ Ja
- ○ Nein

Wie viele Wildpflanzenarten (keine Garten-, Zimmer- oder Balkonpflanzen) kennen Sie mit Namen? *

- ○ < 20
- ○ 20 - 100
- ○ > 100

Haben Sie schon einmal eine Pflanze mit einen Bestimmungsbuch (mit dichotomen Schlüssel; kein Bilderbuch) bestimmt? *

- ○ Noch nie
- ○ Einmal und nie wieder
- ○ Mehrmals
- ○ Regelmäßig

Wodurch haben Sie Ihre bisherigen Pflanzenkenntnisse erworben? (Sie können mehrere Kästchen ankreuzen) *

- ☐ Kein oder sehr geringes Wissen über Pflanzenarten vorhanden
- ☐ Familie/Freunde
- ☐ Schule
- ☐ Studium
- ☐ Teilnahme an Kursen
- ☐ Selbst beigebracht

Wie würden Sie sich in Bezug auf Pflanzenkenntnisse einschätzen? *

- ○ Keine Pflanzenkenntnisse
- ○ Laie
- ○ Kenner
- ○ Experte

Second section: Question for identification of plant characters

Participants had to answer a total of 26 out of the following questions . The first question served as a warming-up question, making the participants familiar with the questionnaire and the survey environment. The remaining 25 questions were dynamically assigned from the 665 character state-taxon combinations. The question where asked only in German. The English translation is shown only for this supporting material.

Table S1.1. Overview of all characters with corresponding character states, icons and species.

	Character	Character state	Icon	Species
CF1	What is the symmetry of the flower? *Wie ist die Blütensymmetrie?*	radial symmetric *radiärsymetrisch*		*Capsella bursa-pastoris, Campanula rapunculoides, Ranunculus repens,Geranium robertianum, Stellaria media*
		zygomorphic *zygomorph*		*Trifolium repens,Consolida regalis, Prunella vulgaris, Vicia cracca, Glechoma hederacea*
CF2	Is the flower single-colored or multi-colored? *Ist die Blüte ein- oder mehrfarbig?*	single-colored *einfarbig*		*Capsella bursa-pastoris, Daucus carota, Ranunculus repens, Lathyrus pratensis, Stellaria media*
		multi-colored *mehrfarbig*		*Adonis aestivalis, Bellis perennis, Solanum dulcamara, Geranium robertianum, Polygonum aviculare*
CF3	What is the basic color of the flower? *Welche Grundfarbe hat die Blüte?*	white *weiss*		*Capsella bursa-pastoris, Aegopodium podagraria, Sambucus nigra, Cerastium fontanum, Stellaria media*
		blue/purple *blau/violett*		*Solanum dulcamara, Myosotis arvensis, Centaurea cyanus, Campanula rotundifolia, Vicia cracca*
		yellow *gelb*		*Hypericum perforatum, Ranunculus repens, Potentilla anserina, Lapsana communis, Taraxacum*
		red/pink *rot/rosa*		*Epilobium hirsutum, Adonis aestivalis, Trifolium pratense, Papaver rhoeas, Erodium cicutarium*
		brown/green *braun/grün*		*Listera ovata, Asarum europaeum, Urtica dioica, Helleborus viridis, Chenopodium album*
CF4	Are the petals at least partially fused or are they completely separated? *Sind die Kronblätter zumindest teilweise verwachsen oder vollständig getrennt?*	fused *verwachsen*		*Trifolium repens, Prunella vulgaris, Sambucus nigra, Galium mollugo, Vicia cracca*
		separated *getrennt*		*Capsella bursa-pastoris, Aegopodium podagraria, Ranunculus repens, Cerastium fontanum, Stellaria media*
CF5	How are the flowers arranged? *Wie sind die Blüten angeordnet?*	single or a few *einzeln oder zu wenigen*		*Anagallis arvensis, Convolvulus arvensis, Anemone nemorosa, Veronica arvensis, Viola arvensis*
		umbrella shaped *schirmartig*		*Aegopodium podagraria, Angelica sylvestris, Heracleum sphondylium, Daucus carota, Anthriscus sylvestris*
		irregular spreading *unregelmässig ausladend*		*Hypericum perforatum, Lychnis flos-cucul, Filipendula ulmaria, Bunias orientalis, Galium mollugo*
		elongated *langgestreckt*		*Digitalis purpurea, Campanula rapunculoides, Echium vulgare, Lolium perenne, Vicia cracca*
		spherical *kugelig*		*Trifolium repens, Phyteuma orbiculare, Prunella vulgaris, Medicago lupulina, Allium carinatum*

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Table S1.1. Overview of all characters with corresponding character states, icons and species.

	Character	Character state	Icon	Species
CF6	Is there a calyx present? *Ist ein Blütenkelch erkennbar?*	discernible *erkennbar*		*Malva neglecta, Melilotus albus, Agrimonia eupatoria, Lathyrus pratensis, Epilobium parviflorum*
		not discernible *nicht erkennbar*		*Anemone nemorosa, Allium ursinum, Trollius europaeus, Persicaria lapathifolia, Chenopodium album*
CF7	What is the basic type of the flower? *Welche Grundform hat die Blume?*	flat outspread *flach ausgebreitet*		*Hypericum perforatum, Capsella bursa-pastoris, Chelidonium majus, Ranunculus repens, Stellaria media*
		upper and/or lower lip *Ober- und/oder Unterlippe*		*Lamium album, Prunella vulgaris, Scrophularia nodosa, Dactylorhiza maculata, Glechoma hederacea*
		butterfly-like flower *Schmetterlingsblüte*		*Melilotus albus, Trifolium repens, Medicago lupulina, Lotus corniculatus, Vicia cracca*
		bell-/jug-shaped *Glocke/Trichter*		*Convolvulus arvensis, Convallaria majalis, Echium vulgare, Calystegia sepium, Campanula rotundifolia*
		capitulum *Korb*		*Achillea millefolium, Senecio vulgaris, Lapsana communis, Crepis biennis, Tripleurospermum maritimum*
		cone-shaped *kolben-/zapfenartig*		*Plantago major, Typha latifolia, Persicaria lapathifolia, Alopecurus pratensis, Phleum pratense*
		inconspicuous *unscheinbar*		*Urtica dioica, Sagina procumbens, Carex ornithopoda, Chenopodium album, Parthenocissus quinquefolia*
CF8	Does the plant have a spur? *Hat die Blüte einen Sporn?*	with a spur *mit Sporn*		*Fumaria officinalis, Cymbalaria muralis, Impatiens parviflora, Viola arvensis, Chaenorhinum minus*
		without a spur *ohne Sporn*		*Capsella bursa-pastoris, Bellis perennis, Urtica dioica, Glechoma hederacea, Stellaria media*
CF9	What is the shape of the petals' front margin? *Welche Form hat der vordere Rand der Kronblätter?*	straight/rounded *gerade/gerundet*		*Capsella bursa-pastoris, Myosotis arvensis, Ranunculus repens, Geum urbanum, Sinapis alba*
		indented *eingebuchtet*		*Malva neglecta, Rosa canina, Alyssum montanum, Cerastium semidecandrum, Geranium pusillum*
		acuminate *zugespitzt*		*Gentianella germanica, Sedum acre, Allium ursinum, Ligustrum vulgare, Galium album*
		dentate *gezähnt*		*Dianthus deltoides, Mycelis muralis, Anagallis foemina, Leontodon hispidus, Alisma plantago-aquatica*
		deeply 2-lobed *tief 2-spaltig*		*Silene latifolia, Heracleum sphondylium, Epilobium parviflorum, Cerastium fontanum, Stellaria media*
		multiple incisions *mehrfach eingeschnitten*		*Dianthus superbus, Lychnis flos-cuculi*
CF10	Is the flower upright or nodding? *Ist die Blüte aufrecht oder nickend?*	nodding *nickend*		*Polygonatum multiflorum, Convallaria majalis, Galanthus nivalis, Campanula rapunculoides, Carduus nutans*
		upright *aufrecht*		*Hypericum perforatum, Capsella bursa-pastoris, Bellis perennis, Achillea millefolium, Trifolium repens*
CF11	How many petals does the flower have? *Wie viele Kronblätter hat die Blüte?*	one to three *eins bis drei*		*Circaea lutetiana, Sagittaria sagittifolia, Stratiotes aloides, Alisma plantago-aquatica, Baldellia ranunculoides*

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		four *vier*		*Epilobium angustifolium, Capsella bursa-pastoris, Chelidonium majus, Galium album, Cardamine pratensis*
		five *fünf*		*Aegopodium podagraria, Ranunculus repens, Cerastium fontanum, Polygonum aviculare, Stellaria media*
		six *sechs*		*Pulsatilla vulgaris, Lythrum salicaria, Gagea lutea, Berberis vulgaris, Eranthis hyemalis*
		more than six *mehr als sechs*		*Nymphaea alba, Trientalis europaea, Hepatica nobilis, Trollius europaeus, Ficaria verna*
CF12	Are the flowers solitary or arranged in inflorescences? *Stehen die Blüten einzeln oder als Blütenstand?*	solitary *einzeln*		*Pulsatilla vulgaris, Potentilla anserina, Veronica arvensis, Viola arvensis, Cerastium fontanum*
		inflorescences *Blütenstand*		*Lythrum salicaria, Capsella bursa-pastoris, Trifolium repens, Dactylis glomerata, Knautia arvensis*
CF13	Are any stalks visible within the inflorescence? *Sind innerhalb des Blütenstandes Ästchen erkennbar?*	stalks visible *mit Ästchen*		*Aegopodium podagraria, Campanula rapunculoides, Sambucus nigra, Galium mollugo, Poa annua*
		no stalks visible *ohne Ästchen*		*Campanula glomerata, Trifolium repens, Prunella vulgaris, Plantago major, Lolium perenne*
CF14	Is the inflorescence elongated or rounded? *Ist der Blütenstand länglich oder rundlich?*	elongated *länglich*		*Campanula rapunculoides, Urtica dioica,Plantago major, Lolium perenne, Vicia cracca*
		rounded *rundlich*		*Aegopodium podagraria, Achillea millefolium, Allium ursinum, Trifolium repens, Sambucus nigra*
CF15	Do the flowers of the inflorescence lie on more than one level? *Liegen die Blüten des Blütenstandes auf einer oder mehreren Ebenen?*	one level *eine Ebene*		*Aegopodium podagraria, Bellis perennis, Allium ursinum, Trifolium repens, Lotus corniculatus*
		more than one level *mehrere Ebenen*		*Anthericum ramosum, Urtica dioica, Chenopodium album, Galium mollugo, Poa annua*
CF16	How are the composite flowerheads structured? *Wie sind die Blütenkörbe aufgebaut?*	ray- and discflowers *Strahlen- und Röhrenblüten*		*Bellis perennis, Achillea millefolium, Galinsoga parviflora, Anthemis tinctoria, Senecio nemorensis*
		only ray flowers *nur Strahlenblüten*		*Cichorium intybus, Lapsana communis, Mycelis muralis, Crepis biennis, Taraxacum*
		only disc flowers *nur Röhrenblüten*		*Centaurea scabiosa, Petasites hybridus, Senecio vulgaris, Matricaria discoidea, Tanacetum vulgare*
CF17	Does the flower have lip-like structures? *Hat die Blüte eine lippenartige Struktur?*	with lips *mit Lippen*		*Lamium album, Prunella vulgaris, Scrophularia nodosa, Dactylorhiza maculata, Glechoma hederacea*
		without lips *ohne Lippen*		*Capsella bursa-pastoris, Bellis perennis, Urtica dioica, Plantago major, Stellaria media*
CF18	Does the flower have wing-shaped structures? *Hat die Blüte flügelartige Strukturen?*	with wings *mit Flügel*		*Melilotus albus, Trifolium repens, Medicago lupulina, Lotus corniculatus, Vicia cracca*
		without wings *ohne Flügel*		*Capsella bursa-pastoris, Bellis perennis, Ranunculus repens, Aconitum lycoctonum, Stellaria media*
CF19	Is the petal margin smooth or does it have certain structures? *Ist der Kronenblattrand glatt oder strukturiert?*	smooth *glatt*		*Capsella bursa-pastoris, Anemone nemorosa, Chelidonium majus, Ranunculus repens, Geranium robertianum*

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		structured *strukturiert*		*Lychnis flos-cuculi, Rosa canina, Circaea lutetiana, Heracleum sphondylium, Stellaria media*
CF20	Is a conspicous flower corolla discernible? *Ist eine Blütenkrone deutlich erkennbar?*	visible *erkennbar*		*Capsella bursa-pastoris, Bellis perennis, Achillea millefolium, Polygonum aviculare, Stellaria media*
		not visible *nicht erkennbar*		*Urtica dioica, Plantago major, Dactylis glomerata, Mercurialis perennis, Thalictrum minus*
CL21	How are the leaves structured *Wie sind die Blätter gegliedert?*	simple *einfach*		*Bellis perennis, Urtica dioica, Plantago major, Dactylorhiza maculata, Stellaria media*
		compound *zusammengesetzt*		*Aegopodium podagraria, Chelidonium majus, Potentilla anserina, Sambucus nigra, Anthriscus sylvestris*
		incised *eingeschnitten*		*Centaurea scabiosa, Cirsium arvense, Senecio vulgaris, Crataegus monogyna, Viburnum opulus*
		finely divided *fein zerteilt*		*Adonis aestivalis, Consolida regalis, Matricaria discoidea, Asparagus officinalis, Tripleurospermum maritimum*
CL22	What is the basic shape of single leaves? *Welche Form haben die ungeteilten Blätter?*	linear (at least 8x as long as wide) *linealisch (mind. 8x lg. wie br.)*		*Anthericum ramosum, Galanthus nivalis, Campanula persicifolia, Carex ornithopoda, Poa annua*
		lanceolate (3-8x as long as wide) *lanzettlich (3-8x so lg. wie br.)*		*Plantago lanceolata, Rumex crispus, Sonchus oleraceus, Galium aparine*
		ovate (1.5-3x long as wide) *oval (1,5-3x lg. wie br.)*		*Impatiens parviflora, Euphorbia helioscopia, Moehringia trinervia, Galeopsis tetrahit, Stellaria media*
		orbicular (1-1.5x as long as wide) *rundlich (1-1,5x lg. wie br.)*		*Nymphaea alba, Kickxia spuria, Veronica serpyllifolia, Pyrola rotundifolia*
		cordate *herzförmig*		*Anagallis arvensis, Lamium maculatum, Stachys sylvatica, Aristolochia clematitis, Fagopyrum esculentum, Lunaria annua*
		arrow-shaped *pfeilförmig*		*Convolvulus arvensis, Rumex acetosa, Fallopia convolvulus, Arum maculatum, Calystegia sepium*
		reniform *nierenförmig*		*Malva neglecta, Saxifraga granulata, Ranunculus auricomus, Ficaria verna, Asarum europaeum*
		scale-shaped *schuppenförmig*		*Sedum acre, Orobanche caryophyllacea, Salicornia europaea, Neottia nidus-avis, Corallorhiza trifida*
		needle-shaped *nadelförmig*		*Erica carnea, Fumana procumbens, Hippuris vulgaris, Ulex europaeus, Empetrum nigrum*
CL23	Does the plant have spikes or thorns? *Hat die Pflanze Stacheln oder Dornen?*	with spikes/thorns *mit Stacheln/Dornen*		*Eryngium campestre, Rosa canina, Cirsium vulgare, Rubus, Ulex europaeus*
		without spikes/thorns *ohne Stacheln/Dornen*		*Capsella bursa-pastoris, Bellis perennis, Plantago major, Dactylis glomerata, Stellaria media*

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CL24	Does the plant have tendrils *Hat die Pflanze Ranken?*	with tendrils *mit Ranken*		*Bryonia dioica, Lathyrus pratensis, Fallopia convolvulus, Calystegia sepium, Vicia cracca*
		without tendrils *ohne Ranken*		*Capsella bursa-pastoris, Bellis perennis, Urtica dioica, Plantago major, Stellaria media*
CL25	How ars the tops of the leaves colored? *Wie ist die Blattoberseite gefärbt?*	plain green *einfarbig grün*		*Urtica dioica, Plantago lanceolata, Lolium perenne,Phleum pratense, Stellaria media*
		dark patches *dunkle Flecken*		*Phyteuma spicatum, Hypochaeris maculata, Persicaria lapathifolia, Arum maculatum, Dactylorhiza maculata*
		light spots *helle Flecken*		*Trifolium pratense, Cerinthe minor, Pulmonaria officinalis, Galeobdolon luteum, Silybum marianum*
		white central strip *weißer Mittelstreifen*		*Eupatorium cannabinum, Cirsium arvense, Tanacetum vulgare, Crepis biennis, Sambucus nigra*
CL26	What shape isa single leaflet? *Welche Form haben die Blättchen?*	linear (at least 8x as long as wide) *lineal (mind. 8x lg. wie br.)*		*Adonis aestivalis, Consolida regalis, Matricaria discoidea, Asparagus officinalis, Tripleurospermum maritimum*
		lanceolate (3-8x long as wide) *lanzettlich (3-8x lg wie br.)*		*Eupatorium cannabinum, Daucus carota, Lupinus polyphyllus, Tanacetum vulgare, Sambucus racemosa*
		ovate (1.5-3x long as wide) *oval (1,5-3x lg. wie br.)*		*Rosa canina, Trifolium pratense, Aegopodium podagraria, Sambucus nigra, Lotus corniculatus*
		rounded (1-1.5x long as wide) *rundlich (1-1,5x lg. wie br.)*		*Cardamine hirsuta, Trifolium repens, Medicago lupulina, Colutea arborescens, Aquilegia vulgaris*
CL27	What is the shape of the leaf margin? *Welche Form hat der Blattrand?*	entire margin *ganzrandig*		*Plantago major, Cerastium fontanum, Dactylorhiza maculata, Poa annua, Stellaria media*
		crenate *gekerbt*		*Lamium maculatum, Chelidonium majus, Geranium pusillum, Viola arvensis, Glechoma hederacea*
		serrate *gesägt*		*Sanguisorba officinalis, Aegopodium podagraria, Potentilla anserina, Urtica dioica, Sambucus nigra*
		dentate *gezähnt*		*Petasites hybridus, Thlaspi arvense,Melilotus albus, Trifolium repens, Sonchus oleraceus*
		spiny toothed *stachelig gezähnt*		*Carlina acaulis, Eryngium campestre, Cirsium vulgare, Echinops sphaerocephalus, Mahonia aquifolium*
CL28	Are the leaflets stalked? *Sind die einzelnen Blättchen gestielt?*	stalked *gestielt*		*Clematis vitalba, Daucus carota, Sambucus nigra, Aethusa cynapium, Ruta graveolens*
		unstalked *gestielt*		*Filipendula ulmaria, Potentilla anserina, Astragalus glycyphyllos, Lotus corniculatus, Vicia cracca*
CL29	How deep are the leaf incisions? *Wie tief sind die Blatteinschnitte?*	25-40%		*Cymbalaria muralis, Lycopus europaeus, Nicandra physalodes, Chenopodium album, Veronica hederifolia*

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		40-60%		*Malva sylvestris, Cirsium arvense, Bryonia dioica, Viburnum opulus, Leontodon hispidus*
		over 60% *über 60%*		*Echinops sphaerocephalus, Senecio vulgaris, Eranthis hyemalis, Geranium pusillum, Taraxacum*
CL30	Are the leaves elongated or rounded? *Sind die Blätter länglich oder rundlich?*	elongated *länglich*		*Cirsium arvense, Capsella bursa-pastoris, Achillea millefolium, Plantago lanceolata, Dactylis glomerata*
		rounded *rundlich*		*Trifolium repens,Ranunculus repens, Tussilago farfara, Plantago major, Stellaria media*
CL31	How are the compound leaves structured? *Wie sind die geteilten Blätter gegliedert?*	one time compound *einfach gegliedert*		*Cardamine hirsuta, Trifolium repens, Potentilla anserina, Sambucus nigra, Vicia cracca*
		at least two times compound *mehrfach gegliedert*		*Corydalis cava, Aegopodium podagraria, Chaerophyllum aureum, Descurainia sophia, Ruta graveolens*
CL32	Are the leaflets elongated or rounded? *Sind die Blättchen länglich oder rundlich?*	elongated *länglich*		*Potentilla anserina, Tanacetum vulgare, Lathyrus pratensis, Anthriscus sylvestris, Vicia cracca*
		rounded *rundlich*		*Rosa canina, Oxalis acetosella, Trifolium repens, Chelidonium majus, Colutea arborescens*
CL33	What is the basic shape of the leaflets? *Wie sind die Blättchen geformt?*	rounded (1-1.5x as long as wide) *rundlich (1-1,5x lg. wie br.)*		*Cardamine hirsuta, Oxalis acetosella, Trifolium repens, Medicago lupulina, Colutea arborescens*
		ovate (1.5-3x as long as wide) *oval (1,5-3x lg. wie br.)*		*Trifolium pratense, Aegopodium podagraria, Melilotus albus, Potentilla anserina, Sambucus nigra*
		narrow (more than 3x as long as wide) *schmal (mehr als 3x lg. wie br.)*		*Lathyrus sylvestris, Helleborus foetidus, Bunium bulbocastanum, Falcaria vulgaris, Vicia cracca*
		strongly structured *stark strukturiert*		*Adonis aestivalis, Fumaria officinalis, Anemone nemorosa, Aethusa cynapium, Anthriscus sylvestris*
CL34	Is the basic shape of the entire compound leaf elongated or rounded? *Ist die Grundform des gesamten Blattes länglich oder rundlich?*	elongated *länglich*		*Filipendula ulmaria, Tanacetum vulgare, Colutea arborescens, Pimpinella saxifraga, Vicia cracca*
		rounded *rundlich*		*Aegopodium podagraria, Trifolium repens, Ranunculus repens, Anthriscus sylvestris, Aquilegia vulgaris*
CL35	How are the leaf sections arranged? *Wie sind die Blattabschnitte angeordnet?*	trilobate *dreilappig*		*Hepatica nobilis, Hedera helix, Viburnum opulus, Ajuga chamaepitys, Saxifraga tridactylites*
		palmate *handförmig*		*Malva sylvestris, Bryonia dioica, Geranium pusillum, Sanicula europaea, Alchemilla vulgaris*
		pinnate *fiederförmig*		*Cirsium arvense, Achillea millefolium, Senecio vulgaris, Matricaria discoidea, Taraxacum*
CL36	Are all leaflets equally sized? *Sind alle Blättchen gleich groß?*	all equal *gleich groß*		*Fragaria vesca, Trifolium repens, Lathyrus pratensis, Cardamine bulbifera, Vicia cracca*

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Table S1.1. Overview of all characters with corresponding character states, icons and species.

	Character	Character state	Icon	Species
		different sized *verschieden gross*		*Ranunculus repens, Agrimonia eupatoria, Tanacetum vulgare, Anthriscus sylvestris, Torilis japonica*
CL37	What is the type of leaf venation? *Welche Form hat die Blattnervatur?*	pinnate *fiederförmig*		*Rosa canina, Trifolium repens, Sambucus nigra, Chenopodium album, Stellaria media*
		palmate *handförmig*		*Nymphaea alba, Cymbalaria muralis, Ranunculus repens, Tussilago farfara, Geranium pusillum*
		reticulate *netznervig*		*Lamium maculatum, Digitalis purpurea, Berberis vulgaris, Salvia pratensis, Stachys recta*
		parallel *parallel*		*Allium ursinum, Plantago major, Dactylis glomerata, Dactylorhiza maculata, Veratrum album*
		single-veined *einnervig*		*Myosotis arvensis, Stellaria graminea, Cerastium fontanum, Galium aparine, Leucanthemum vulgare*
		not visible *nicht erkennbar*		*Sedum acre, Fumaria officinalis, Matricaria discoidea, Fumana procumbens, Asperula cynanchica*
CL38	How are the leaflets arranged? *Wie sind die Blättchen angeordnet?*	ternate *dreiteilig*		*Fragaria vesca, Oxalis acetosella, Melilotus albus, Trifolium repens, Ranunculus repens*
		palmate *handförmig*		*Malva moschata, Lupinus polyphyllus, Potentilla erecta, Ranunculus repens, Parthenocissus quinquefolia*
		pinnate *fiederförmig*		*Potentilla anserina, Tanacetum vulgare, Sambucus nigra, Anthriscus sylvestris, Vicia cracca*
CL39	What is the location of the broadest part of the leaf? *Wo befindet sich die breiteste Stelle im Blatt?*	below the center *unterhalb der Mitte*		*Convolvulus arvensis, Rumex acetosa, Prunella vulgaris, Urtica dioica, Fallopia convolvulus*
		above the center *oberhalb der Mitte*		*Bellis perennis, Euphorbia helioscopia, Plantago lanceolata, Galium aparine, Leucanthemum vulgare*
		at the center *in der Mitte*		*Polygonatum multiflorum, Impatiens parviflora, Plantago major, Stachys recta, Pyrola rotundifolia*
		uniformly broad *überall gleich breit*		*Anthericum ramosum, Typha latifolia, Asperula cynanchica, Carex ornithopoda, Dactylis glomerata*
CL40	Are the leaves stalked or sitting directly on the stem? *Sind die Blätter gestielt oder direkt am Stängel sitzend?*	sessile *ungestielt*		*Euphorbia cyparissias, Galanthus nivalis, Lolium perenne, Cerastium fontanum, Dactylorhiza maculata*
		petiolate *gestielt*		*Bellis perennis, Urtica dioica, Plantago major, Sambucus nigra, Chenopodium album*
CL41	What is the form of the incised leaf? *Welche Form hat das eingeschnittene Blatt?*	palmate-lobed *handförmig gelappt*		*Bryonia dioica, Ranunculus sceleratus, Geranium pusillum, Alchemilla vulgaris, Veronica hederifolia*
		pinnately lobed *fiederförmig gelappt*		*Cirsium arvense, Crepis biennis, Taraxacum, Artemisia vulgaris, Chenopodium album*
CL42	How are the leaf sections shaped? *Welche Form haben die Blattabschnitte?*	rounded sections, acuminate incisions *Abschnitte rund, Einschnitte spitz*		*Chelidonium majus, Ranunculus sceleratus, Artemisia absinthium, Alchemilla vulgaris*

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Table S1.1. Overview of all characters with corresponding character states, icons and species.

	Character	Character state	Icon	Species
		rounded sections, rounded incisions *Abschnitte rund, Einschnitte rund*		*Hypochaeris radicata, Scorzoneroides autumnalis, Alcea rosea, Barbarea vulgaris, Sinapis alba*
		acuminate sections, acuminate incisions *Abschnitte spitz, Einschnitte spitz*		*Papaver rhoeas, Tanacetum vulgare, Falcaria vulgaris, Artemisia vulgaris, Knautia arvensis*
		acuminate sections, rounded incisions *Abschnitte spitz, Einschnitte rund*		*Centaurea scabiosa, Cirsium arvense, Heracleum sphondylium, Crepis biennis, Mahonia aquifolium*
CL43	Is the terminal leaf section enlarged? *Ist der Endabschnitt des Blattes vergrößert?*	enlarged *vergrößert*		*Bunias orientalis, Raphanus raphanistrum, Rorippa islandica, Barbarea vulgaris, Sinapis alba*
		not enlarged *nicht vergrößert*		*Cirsium arvense, Cichorium intybus, Crepis biennis, Artemisia vulgaris, Chenopodium album*

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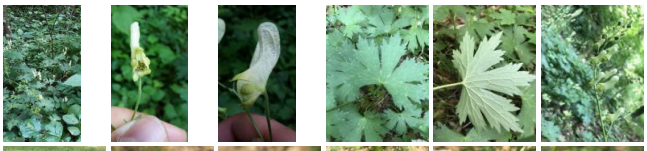
To simulate the observation of real plants as closely as possible, we represented each plant by images showing them from six different perspectives.

Table S1.2. Overview of all images per species Due to upload limit of the journal, images are not shown in full resolution.

Achillea millefolium

Aconitum lycoctonum

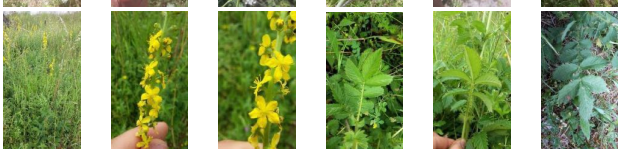


Adonis aestivalis

Aegopodium podagraria

Aethusa cynapium

Agrimonia eupatoria



Due to upload limit of the journal, images are not shown in full resolution.

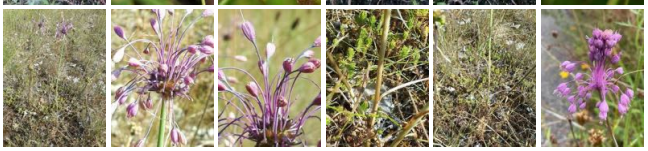
Ajuga chamaepitys

Alcea rosea

Alchemilla vulgaris

Alisma plantago-aquatica

Allium carinatum



Allium ursinum

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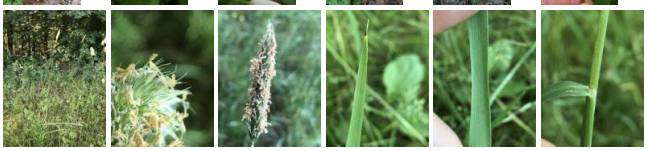
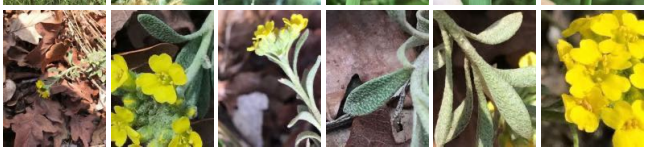
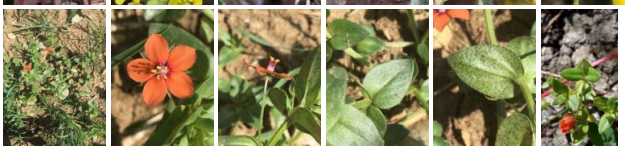
Alopecurus pratensis



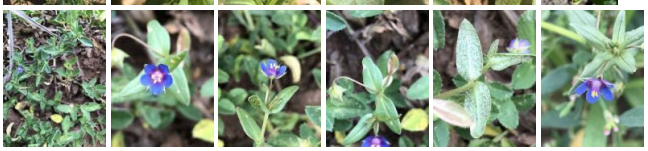
Alyssum montanum



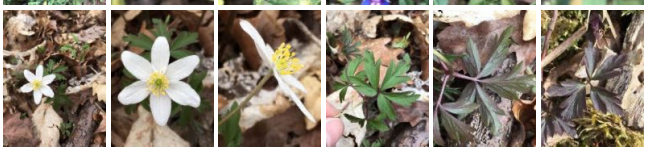
Anagallis arvensis



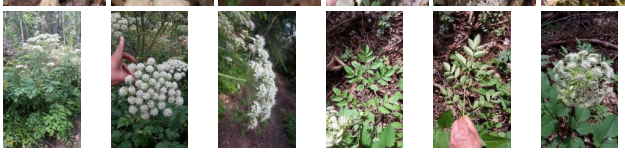
Anagallis foemina



Anemone nemorosa



Angelica sylvestris



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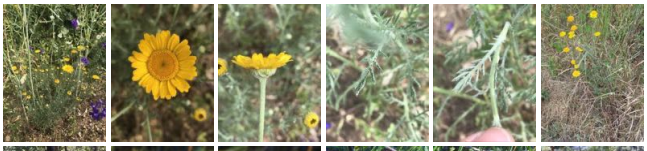
Anthemis tinctoria



Anthericum ramosum

Anthriscus sylvestris

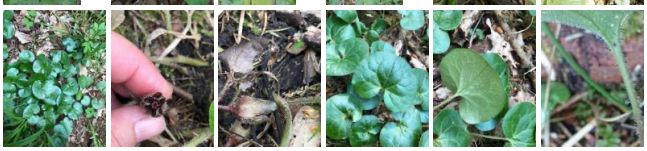
Aquilegia vulgaris

Aristolochia clematitis

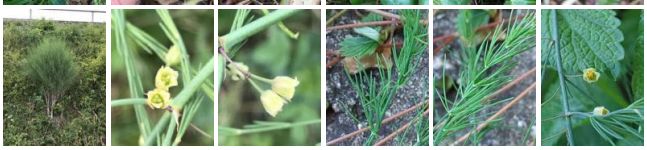
Artemisia vulgaris

Arum maculatum

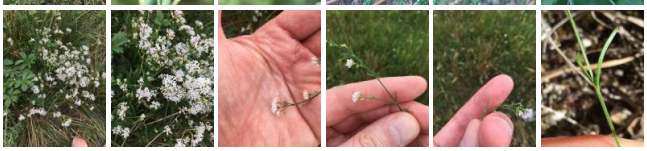
Asarum europaeum



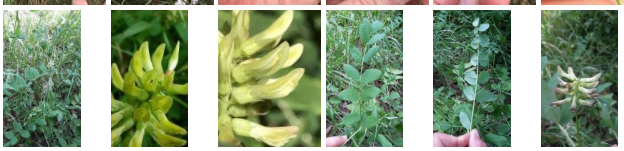
Asparagus officinalis



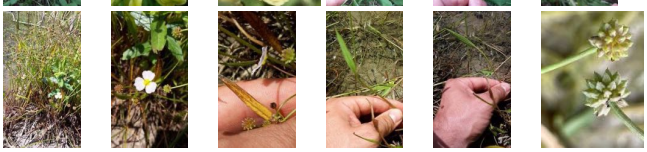
Asperula cynanchica



Astragalus glycyphyllos



Baldellia ranunculoides



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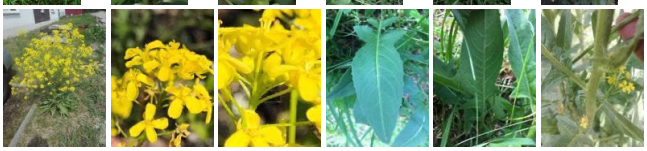
Barbarea vulgaris

Bellis perennis

Berberis vulgaris

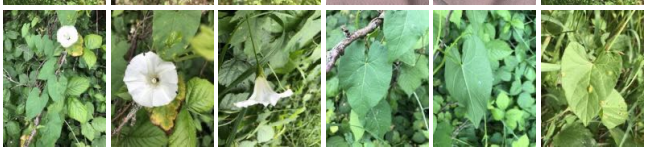
Bryonia dioica

Bunias orientalis



Bunium bulbocastanum

Calystegia sepium



Campanula glomerata

Campanula persicifolia

Campanula rapunculoides

Campanula rotundifolia

Capsella bursa-pastoris

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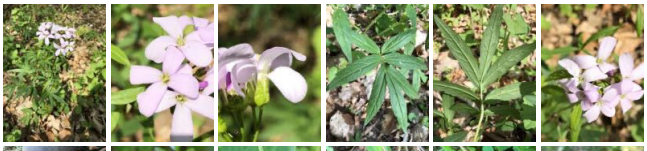
Cardamine bulbifera



Cardamine hirsuta

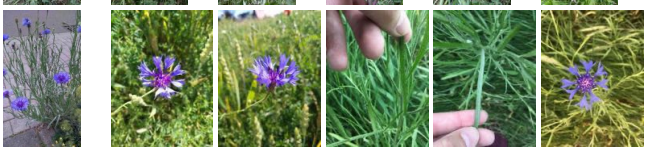
Cardamine pratensis

Carduus nutans

Carex ornithopoda

Carlina acaulis

Centaurea cyanus



Centaurea scabiosa

Cerastium fontanum

Cerastium semidecandrum

Cerinthe minor

Chaenorhinum minus

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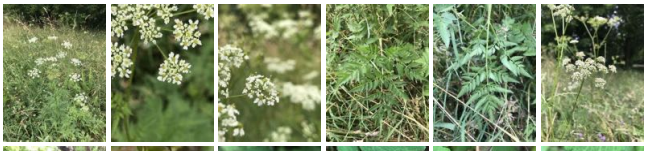
Chaerophyllum aureum

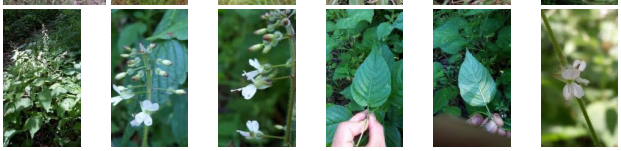


Chelidonium majus

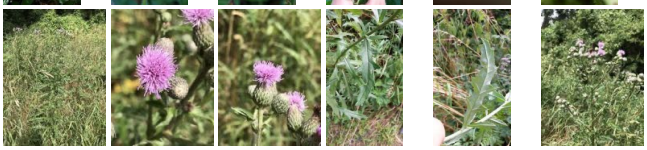
Chenopodium album

Cichorium intybus

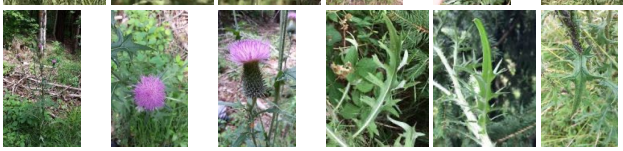
Circaea lutetiana



Cirsium arvense



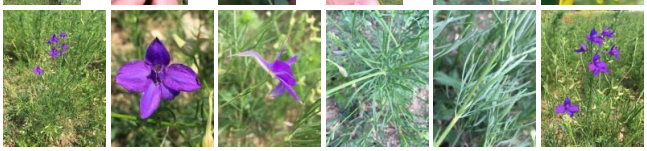
Cirsium vulgare



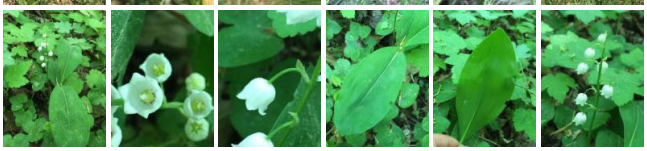
Clematis vitalba

Colutea arborescens

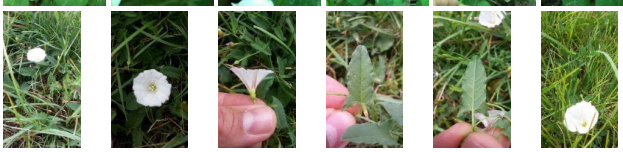
Consolida regalis



Convallaria majalis



Convolvulus arvensis



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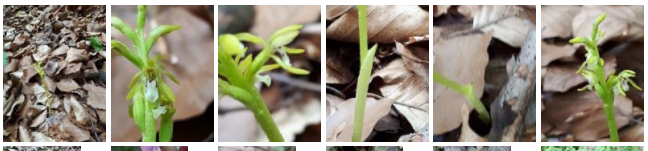
Corallorhiza trifida

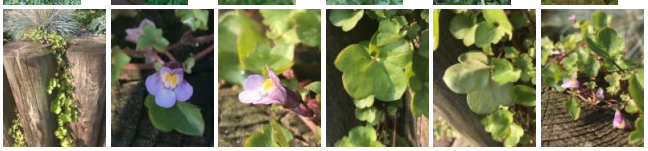


Corydalis cava

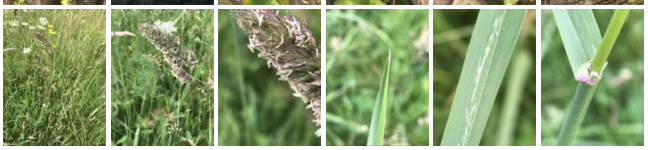
Crataegus monogyna

Crepis biennis

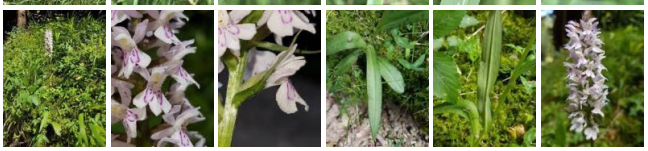
Cymbalaria muralis



Dactylis glomerata



Dactylorhiza maculata



Daucus carota

Descurainia sophia

Dianthus deltoides

Dianthus superbus

Digitalis purpurea

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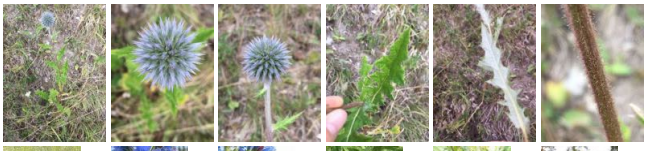
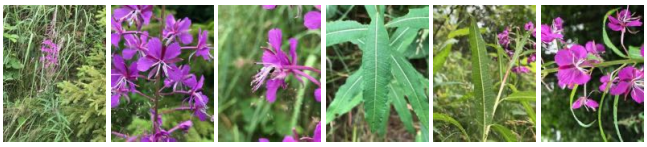
Echinops sphaerocephalus



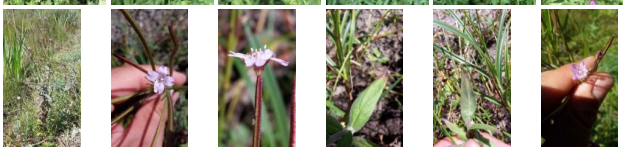
Echium vulgare

Epilobium angustifolium

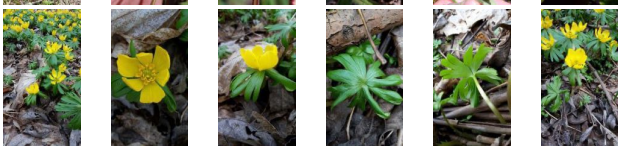


Epilobium hirsutum

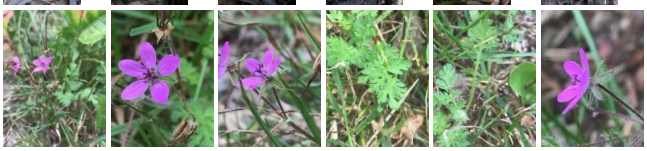
Epilobium parviflorum



Eranthis hyemalis

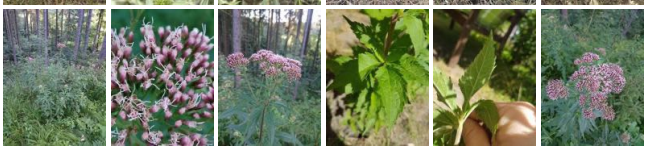


Erodium cicutarium

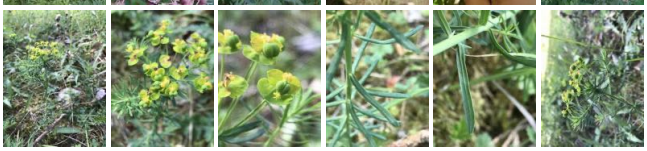


Eryngium campestre

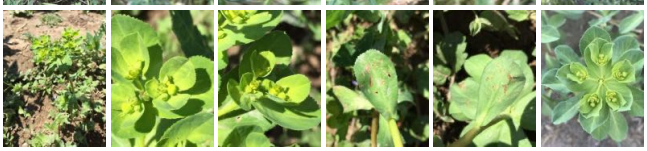
Eupatorium cannabinum



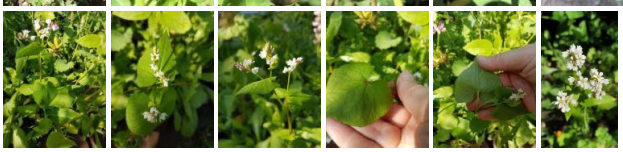
Euphorbia cyparissias



Euphorbia helioscopia



Fagopyrum esculentum



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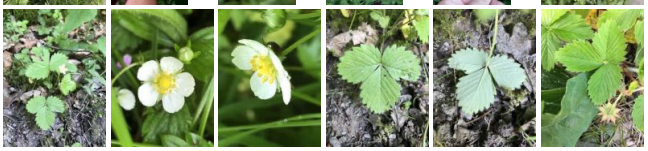
Falcaria vulgaris

Fallopia convolvulus

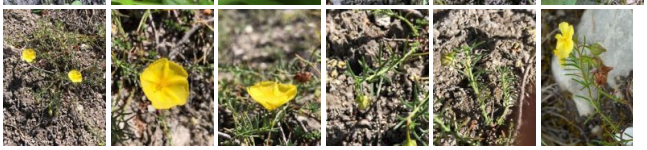
Ficaria verna

Filipendula ulmaria

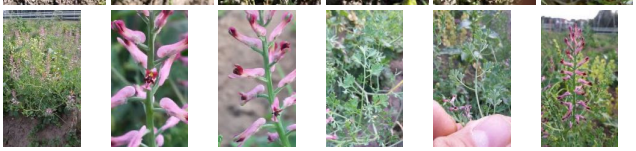
Fragaria vesca



Fumana procumbens



Fumaria officinalis



Gagea lutea

Galanthus nivalis

Galeobdolon luteum

Galeopsis tetrahit

Galinsoga parviflora

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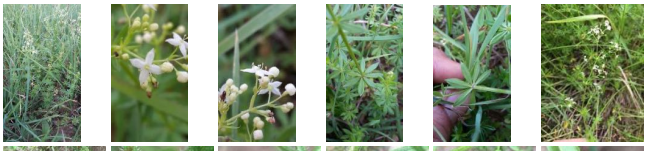
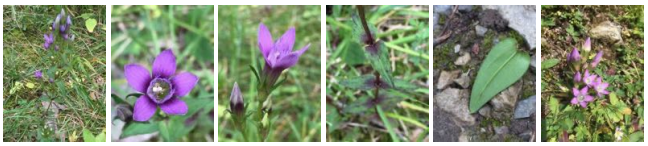
Galium album



Galium aparine

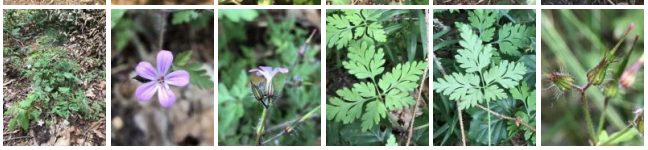
Galium mollugo

Gentianella germanica

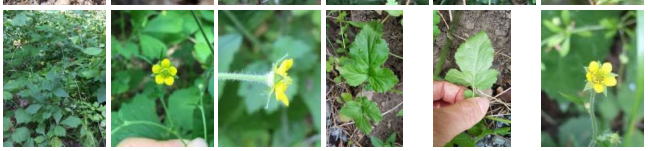


Geranium pusillum

Geranium robertianum



Geum urbanum



Glechoma hederacea

Helleborus foetidus

Helleborus viridis

Hepatica nobilis

Heracleum sphondylium

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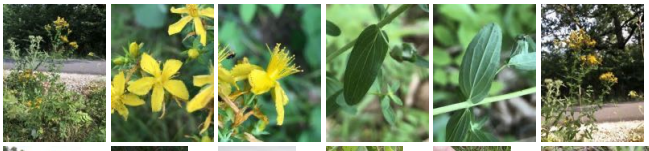
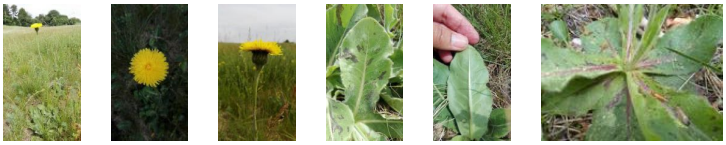
Hypericum perforatum



Hypochaeris maculata



Hypochaeris radicata

Impatiens parviflora

Kickxia spuria

Knautia arvensis

Lamium album

Lamium maculatum

Lapsana communis

Lathyrus pratensis

Lathyrus sylvestris

Leontodon hispidus

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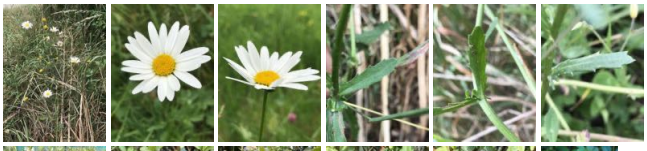
Leucanthemum vulgare



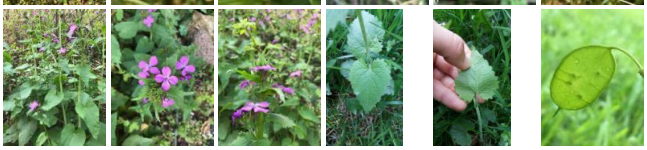
Ligustrum vulgare

Listera ovata

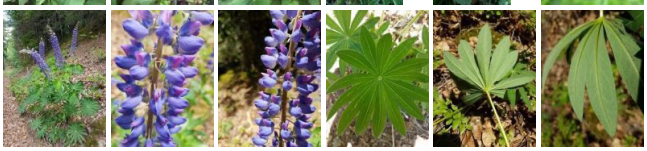
Lolium perenne

Lotus corniculatus

Lunaria annua



Lupinus polyphyllus



Lychnis flos-cuculi

Lycopus europaeus

Lythrum salicaria

Mahonia aquifolium

Malva moschata

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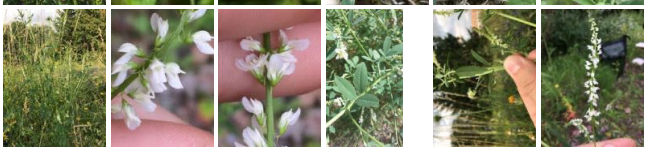
Malva neglecta

Malva sylvestris

Matricaria discoidea

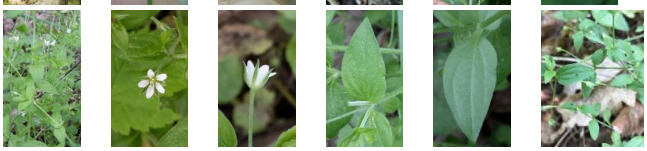
Medicago lupulina

Melilotus albus

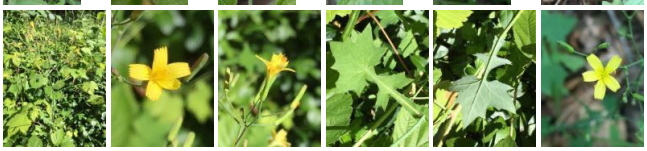


Mercurialis perennis

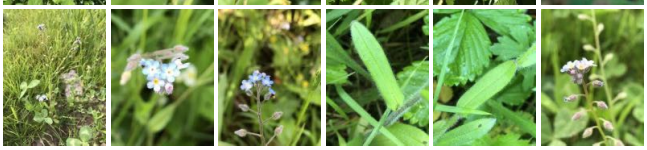
Moehringia trinervia



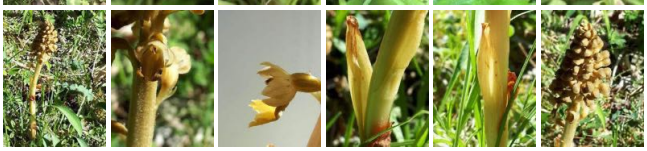
Mycelis muralis



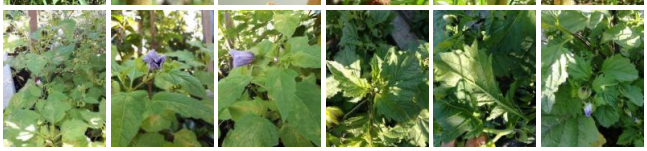
Myosotis arvensis



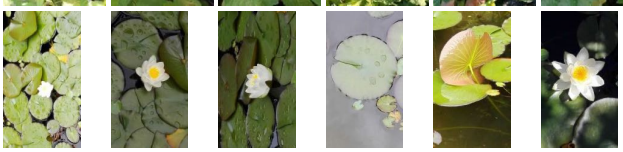
Neottia nidus-avis



Nicandra physalodes



Nymphaea alba



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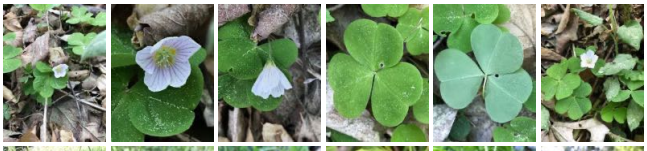
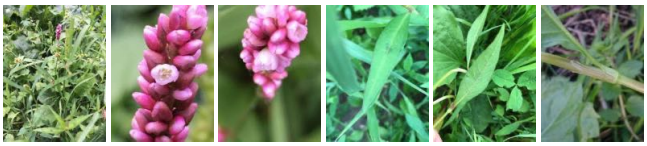
Oxalis acetosella



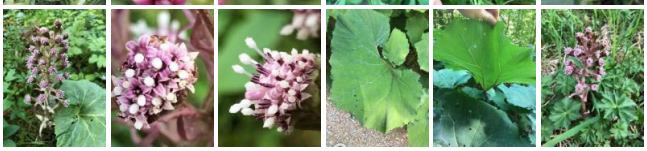
Papaver rhoeas

Parthenocissus quinquefolia

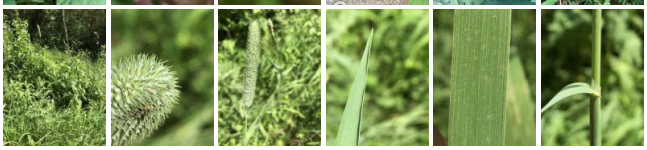
Persicaria lapathifolia



Petasites hybridus



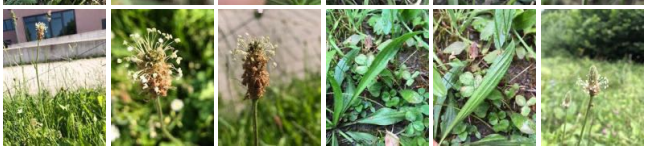
Phleum pratense



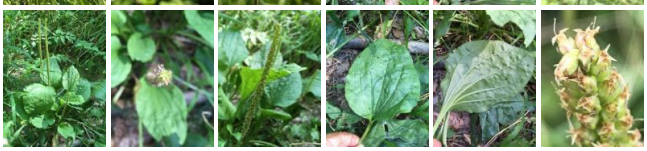
Phyteuma orbiculare

Pimpinella saxifraga

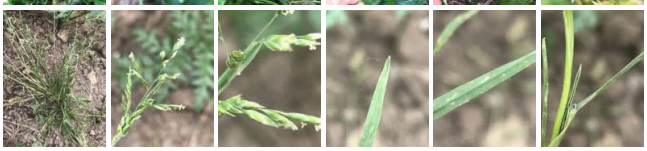
Plantago lanceolata



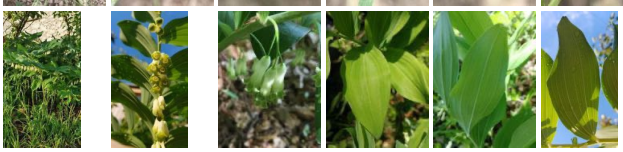
Plantago major



Poa annua



Polygonatum multiflorum



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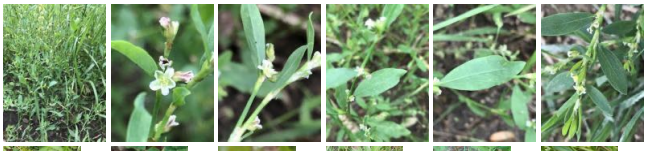
Polygonum aviculare

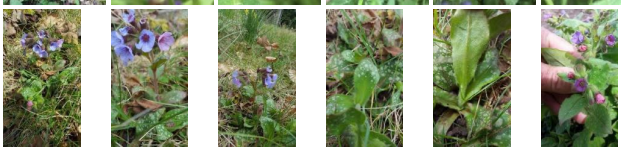


Potentilla anserina

Potentilla erecta

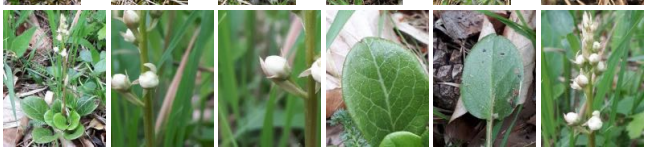
Prunella vulgaris

Pulmonaria officinalis

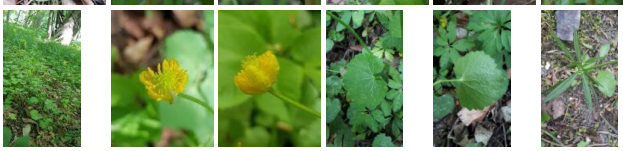


Pulsatilla vulgaris

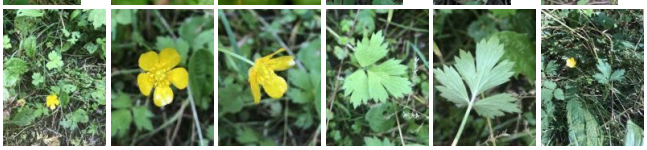
Pyrola rotundifolia



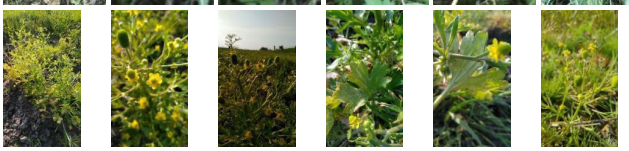
Ranunculus auricomus



Ranunculus repens

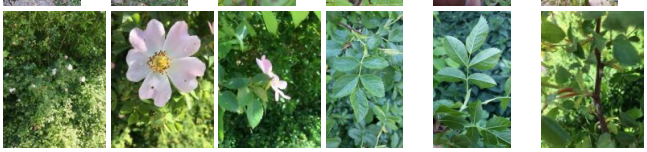


Ranunculus sceleratus



Rorippa islandica

Rosa canina



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Rubus

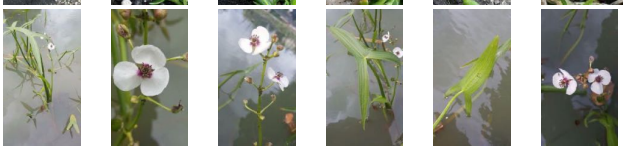
Rumex acetosa

Rumex crispus

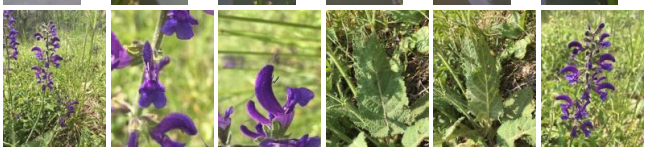
Ruta graveolens

Sagina procumbens

Sagittaria sagittifolia



Salvia pratensis



Sambucus nigra

Sambucus racemosa

Sanguisorba officinalis

Sanicula europaea

Saxifraga granulata

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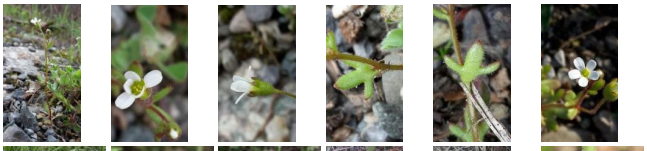
Saxifraga tridactylites

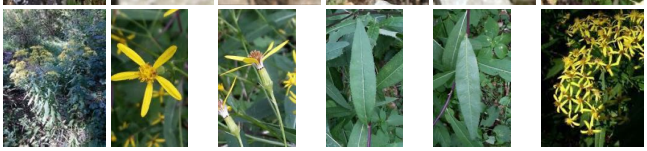


Scorzoneroides autumnalis

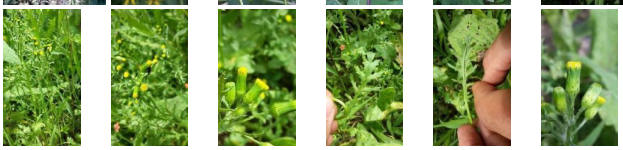
Scrophularia nodosa

Sedum acre

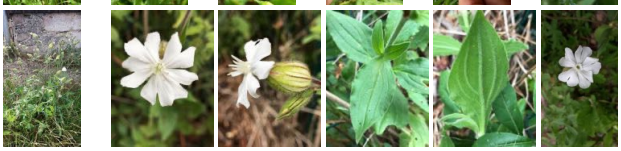
Senecio nemorensis



Senecio vulgaris



Silene latifolia



Silybum marianum

Sinapis alba

Solanum dulcamara

Sonchus oleraceus

Stachys recta

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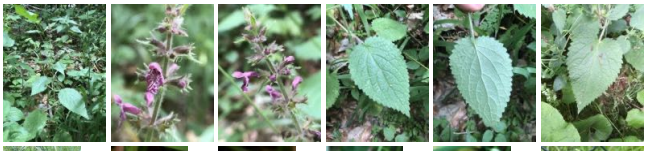
Stachys sylvatica



Stellaria graminea

Stellaria media

Tanacetum vulgare

Taraxacum

Thalictrum minus

Thlaspi arvense

Torilis japonica

Trientalis europaea

Trifolium pratense

Trifolium repens

Tripleurospermum maritimum

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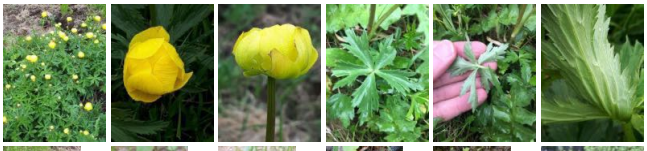
Trollius europaeus

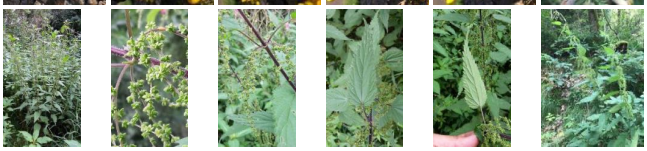


Tussilago farfara

Typha latifolia

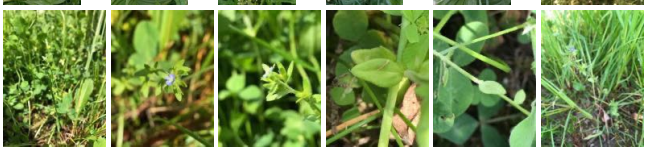
Ulex europaeus

Urtica dioica



Veratrum album

Veronica arvensis



Veronica hederifolia

Veronica serpyllifolia

Viburnum opulus

Vicia cracca

Viola arvensis