

***Accumulation versus  
collection  
– documentation makes a  
difference.***

# What is a botanical garden?



Schönbrunn, Austria, 2015

# What is a botanical garden?



BG Bonn, Germany, 2016

*accumulation versus collection* – M. Weigend – Plant Records Conference

# What is a botanical garden?



BG Firenze, Italy, 2018

# What is a botanical garden?

universität bonn  

**ASTERIDEN**  
Boraginales – Raublattgewächsartige 

**2755 Arten in 148 Gattungen und 7 Familien**

- oft Schlundschuppen in der Kronnhöhle  
- Blütenstände: meist Wickel  
- meist Klausenfrucht  
(vier einsamige Teilfrüchte entstehen aus zwei Fruchtblättern)

  
Blüte von Borasich (*Borago officinalis*) – Boraginaceae

  
REM Aufnahme einer Klausenfrucht (*Baptosoides spec.*) – Boraginaceae

  
Blütenstand von Teide-Natternkopf (*Echium wildpretii*) – Boraginaceae

**Familien im System:**  
**Boraginaceae** (80 Gattungen, ca. 1700 Arten): Die Raublattgewächse (Boraginaceae) sind die wichtigste Familie der Ordnung, die einzige Familie dieser Ordnung. Der bekannteste und namensgebende Vertreter ist der Borretsch (*Borago officinalis*). Bei uns heimisch sind auch Natternkopf (*Echium vulgare*), Lungenkraut (*Pulmonaria*) und Vergißmeinnicht (*Myosotis*). Herausragende Beispiele für „Inselgigantismus“ sind die Riesen-Natternköpfe von den Kanarischen Inseln. Dort, aber auch auf Madeira und den Azoren, sind die Natternköpfe gewissermaßen außer Rand und Band geraten: etwa 30 eigenständige Arten sind Evolution entstanden. Im ersten Jahr bilden sie eine gewaltige Blattrosette aus, im zweiten schießt, wie bei unserem *Echium pininana* von der Insel La Pama, eine etwa 5 m hohe Blütenkerze in die Höhe. Eine weitere beeindruckende Art, die in der Regel im


Mai im Botanischen Garten zur Blüte kommt, ist der Teide-Natternkopf (*Echium wildpretii*), das Wahrzeichen der Insel Teneriffa. Beide sind im Mittelmeerraum zu bewundern. Über diese Pflanzenfamilie wird am Nees-Institut für Biodiversität der Pflanzen intensiv geforscht.

**Weitere Familien:**  
Die ganz auf die Neue Welt beschränkten **Hydrophyllaceae** (15/300) umfassen auch den häufig kultivierten Bienenfreund (*Phacelia tanacetifolia*). Wichtige Zierpflanzen stellen die weitgehend subtropische Gattung *Heliotropium* aus den **Heliotropiaceae** (4/450). Die **Ehretiaceae** (11/500) sind eine wichtige Familie auch waldbildender Bäume v.a. in den Subtropen. Die beiden nur aus jeweils einer Gattung bestehenden Familien **Codonaceae** (1/2) und **Wellstodiaceae** (1/6) sind auf Trockengebiete Afrikas beschränkt.

  
Verbreitungsgebiet Boraginaceae

BG Bonn, Germany

**BEM-VINDOS AO JARDIM DE LINEU!**

  
CARL LINNAEUS (1707-1778)

Professur, médico e naturalista sueco, CARL LINNAEUS (lineu) é considerado o "pai da taxonomia", pois, há mais de 200 anos, estabeleceu as grandes categorias que são usadas nos sistemas internacionais de classificação biológica e criou a nomenclatura binomial. A qual, até hoje, é usada para a classificação dos seres vivos.

**ENTENDA A NOMENCLATURA BINOMIAL**  
Observe as placas de identificação das plantas do Jardim Botânico e note que o nome é sempre composto por duas palavras.

**xaxim-verdadeiro**  
*Dioscorea zingiberana* Hooker  
Dicksoniaceae  
América Central e do Sul

A primeira palavra refere-se ao gênero (do xaxim) e a segunda (do-verdadeiro) é o termo que identifica aquela espécie (Dioscorea). Assim, você já conheceu do mesmo gênero, por sua característica.

Quando falamos do caso das plantas, é sempre acompanhado do nome do cientista (autor) que deu o nome àquela espécie e descreveu suas características.

**A IMPORTÂNCIA DO NOME CIENTÍFICO**  
Quando falamos de plantas, usamos o nome científico. Isso porque, ao contrário do nome popular, que varia de região para região, o nome científico é universal e único para cada espécie.

**A IMPORTÂNCIA DA TAXONOMIA**  
A taxonomia possibilita a organização das plantas em grupos, de acordo com suas características morfológicas, fisiológicas, evolutivas e genéticas. Isso facilita o entendimento das relações entre as plantas.

**www.botgarden-bonn.de**  
(C. Moore ex F. Muell.) F.M. Bailey

BG Sao Paulo, Brazil

BG Rome, Italy

Universität Rostock  Traditio et Innovatio 

**RoSA – die Rostocker Schulgarten Akademie**

Hier befindet sich die Gartenfläche der Rostocker Schulgarten Akademie. Anders als im restlichen Botanischen Garten sind hier auch Beete mit Gemüse und experimentellen Ansätzen zu finden. Wir wollen bei unseren zukünftigen Biologielehrern das Interesse am Anlegen und der Bewirtschaftung eines „eigenen“ Schulgartens wecken sowie Möglichkeiten aufzeigen, Schulgärtnern mit naturwissenschaftlichem Arbeiten im Unterricht zu verbinden.

**Wie aber wirken sich Gartenarbeit und Naturbegegnung im Garten auf das Wohlbefinden sowie die Entwicklung sozialer Kompetenzen bei Schüler\_innen aus?**

Dieser Fragestellung gehen wir in einer wissenschaftlichen Untersuchung gemeinsam mit Schüler\_innen und Lehrer\_innen der Borwinschule nach. Dazu wird der Biologieunterricht zweier 6. Klassen jede zweite Woche in den Monaten Mai, Juni und Juli in unseren Hochschulgärten verlegt. Insgesamt 54 Schüler\_innen sind somit regelmäßig in dieser Saison naturwissenschaftlich-biologisch im Garten tätig. Im letzten Jahr waren es 150 Schüler\_innen. Die Schüler\_innen legen Beete an, säen Pflanzen, jäten das Unkraut und führen Versuche und Beobachtungen im Freien durch. Die Unterrichtsstunden sind an den Lernzielen und der angestrebten Kompetenzentwicklung entsprechend den vorgegebenen Bedingungen des Rahmenplans ausgerichtet. Die relevanten Themen „Pflanzen in unserem Leben“ und „Der Boden unter meinen Füßen“ werden somit in Theorie und Praxis vermittelt.

**Die Untersuchung folgt der Fragestellung:**

Welche Auswirkung hat die theoretische und praktische Arbeit im Schulgarten von Schüler\_innen der Jahrgangsstufe 6 auf

- das Wohlbefinden?
- die Entwicklung sozialer Kompetenzen?

Zur Erfassung des aktuellen Wohlbefindens werden nach den Unterrichtseinheiten Befragungen mittels Fragebögen durchgeführt. Die Schüler\_innen dokumentieren die im Unterricht empfundenen Emotionen dabei in Form von Selbstberichten. Die wahrgenommenen Gefühle werden dabei nach der Intensität bewertet und genauer beschrieben. Parallel dazu erfolgt eine direkte Beobachtung der Schüler\_innen durch geschulte Beobachter.

Dieses Forschungsprojekt wird von Frau Susan Pollin (susan.pollin@uni-rostock.de), Mitarbeiterin der Fachdidaktik Biologie der Universität Rostock, geleitet.

Neben den Schüler\_innen sind im Sommersemester 2017 aber auch zwei Studiengruppen des Lehramtsstudienganges Biologie mit eigenen Beeten und naturwissenschaftlichen Versuchen im HochSchulgarten aktiv.

Dieses Poster können Sie hier herunterladen: 

  
Plan unseres Gartens 2017

  
BG Rostock, Germany

INSTITUT FÜR BIOWISSENSCHAFTEN | FACHDIDAKTIK BIOLOGIE  
Leiterin: Prof. Dr. C. Retzlaff-Fürst | Universität Rostock, Universitätsplatz 4,  
18055 Rostock, Germany | Tel.: +49 (0)381 498 6190

# What is a botanical garden?

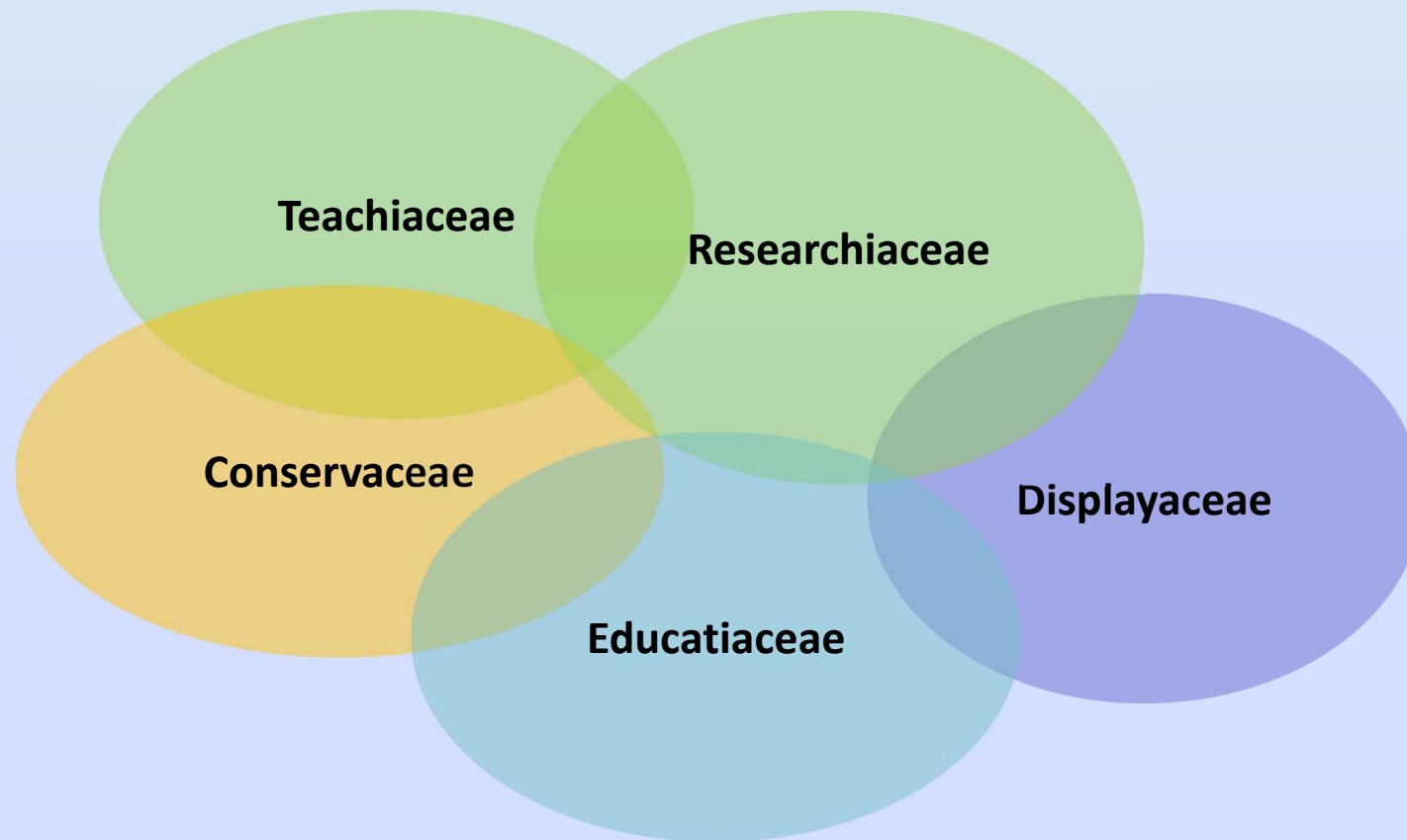
Botanical gardens are institutions cultivating **documented living collections** in order to fulfil functions in **scientific research** and **teaching, education** and **species and nature conservation**.

*(Botanische Gärten sind Institutionen, die dokumentierte lebende Sammlungen kultivieren, um insbesondere Aufgaben in den Bereichen wissenschaftlicher Forschung und Lehre, der Bildung sowie des Arten- und Naturschutzes zu erfüllen - Rauer et al. 2000)*



## Plant families in collections

Botanical gardens are institutions cultivating **documented living collections** in order to fulfil functions in **scientific research** and **teaching, education** and **species and nature conservation**. (Rauer et al. 2000)



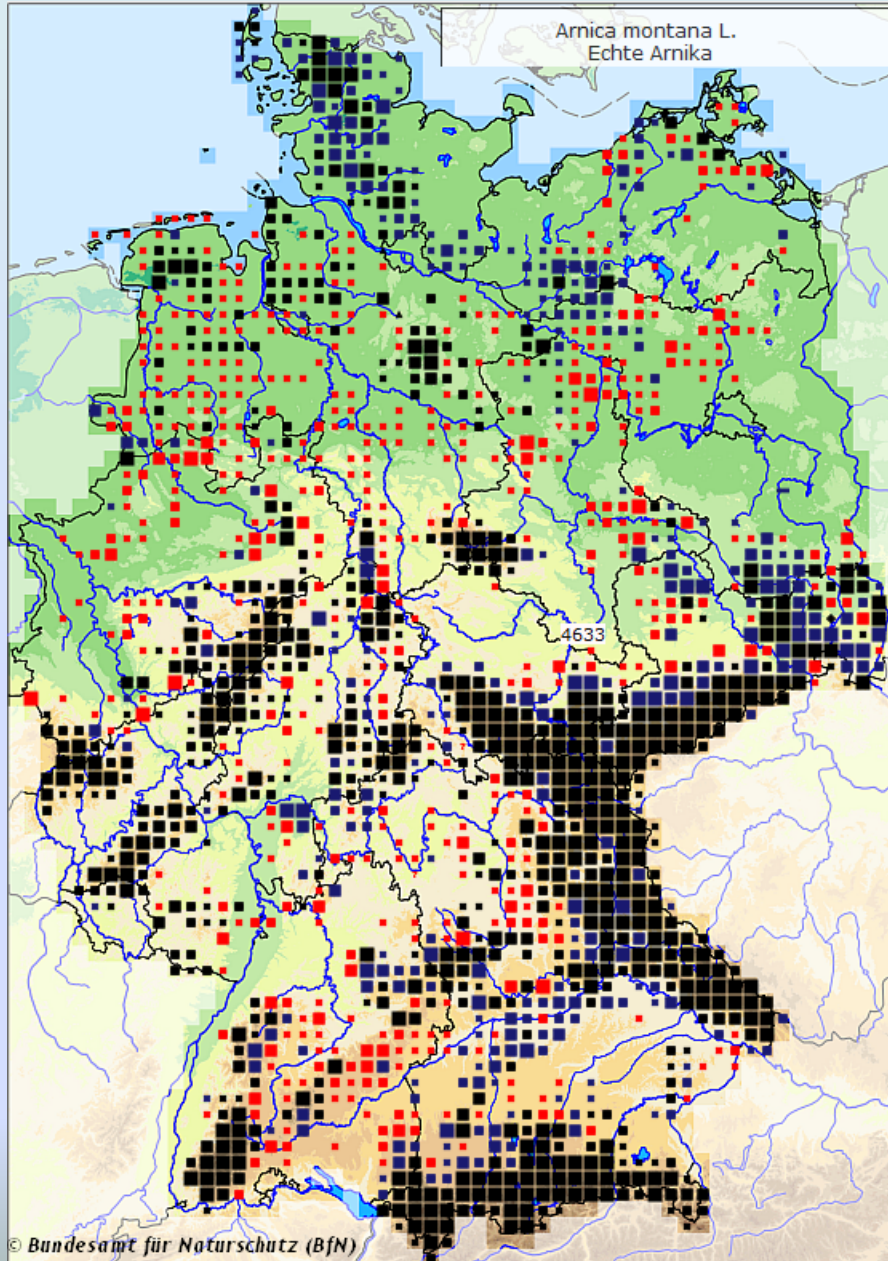
*Should they **all** be “documented”? And if so, **why**? And **how**?*

## Conservaceae



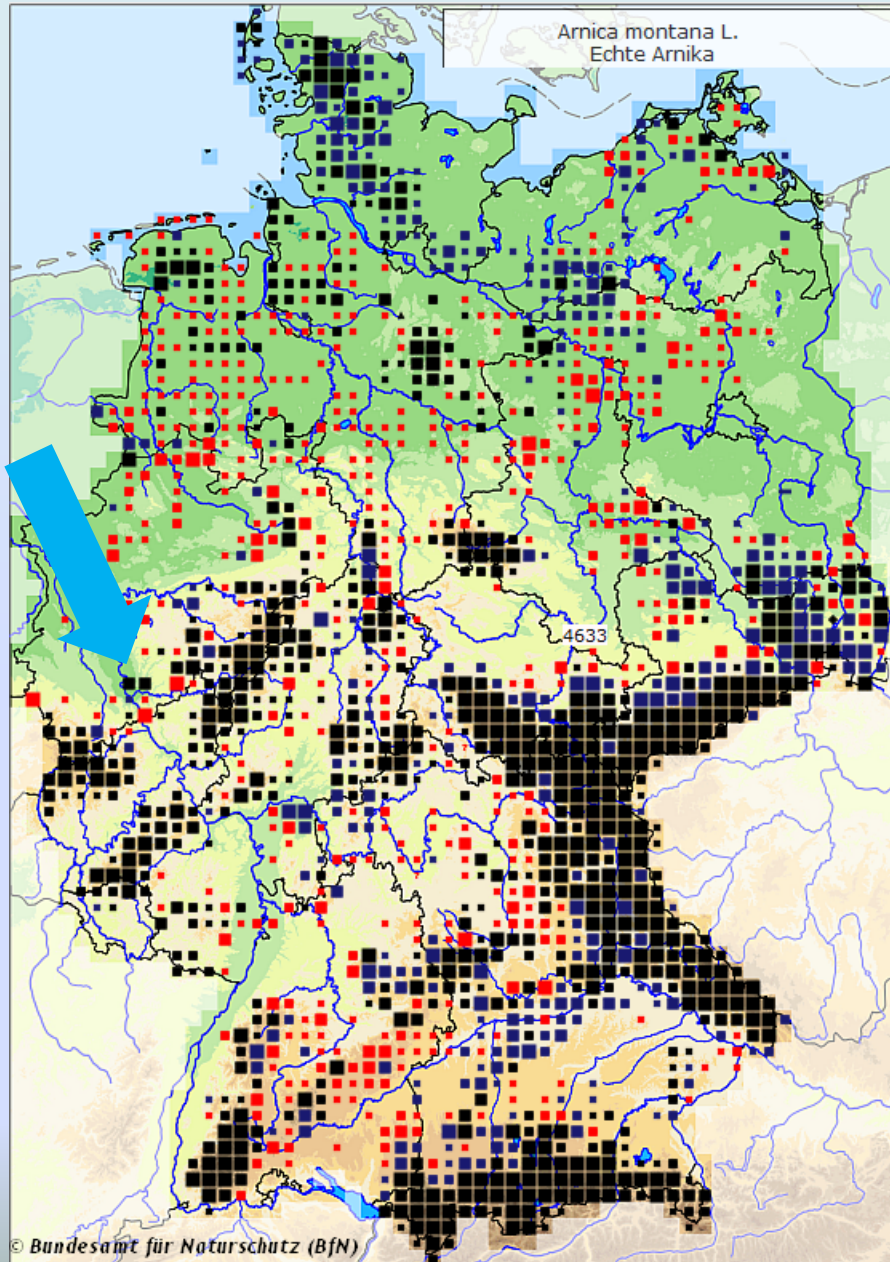


# Conservaceae



*ex situ*-conservation *Arnica montana*, Bonn BG

## Conservaceae

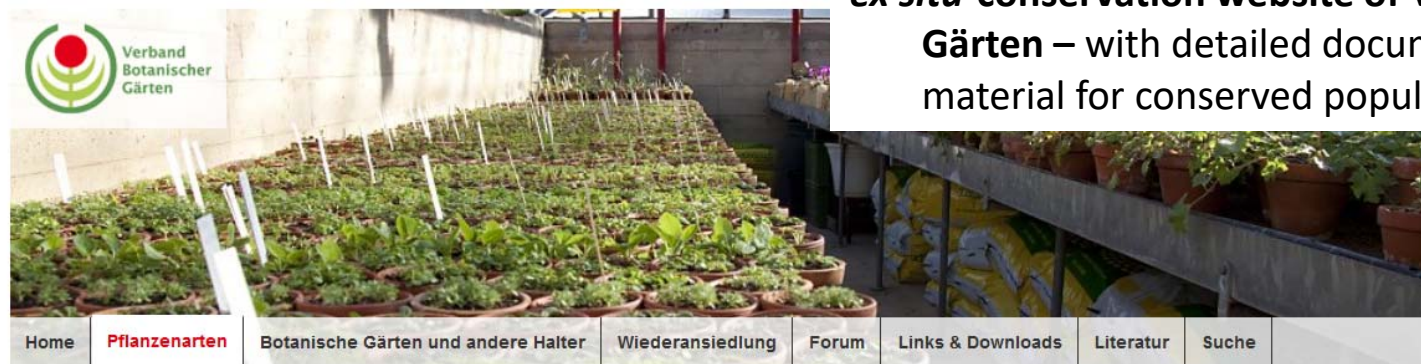


*ex situ*-conservation *Arnica montana*, Bonn  
BG

- conservation of **marginal populations** of a widespread species
- only makes sense, if the **local ecotype**, i.e. representatives of local metapopulation are conserved
- this requires a **detailed documentation** of source material

# Conservaceae

*ex situ*-conservation website of Verband Botanischer Gärten – with detailed documentation of source material for conserved populations.



## PORTAL FÜR ERHALTUNGSKULTUREN EINHEIMISCHER WILDPFLANZEN

ARTEN: A | B

- ▶ *Papaver hybrid*
- ▶ *Parietaria officin*
- ▶ *Parnassia palus*
- ▶ *Pedicularis sce*
- ▶ *Peucedanum al*
- ▶ *Peucedanum or*
- ▶ *Peucedanum d*
- ▶ *Peucedanum pa*
- ▶ *Phleum panicul*
- ▶ *Phleum phleoid*
- ▶ *Phyllitis scolop*
- ▶ *Phyteuma orbic*
- ▶ *Pilosella acutifo*
- ▶ *Pilosella austro*
- ▶ *Pilosella bauhini*
- ▶ *Pilosella cymiflo*

### Akzessionen:

Nr.	IPEN	Art	Level	Zugang	Herkunft
1	DE-0-TUEB-49	<i>Anthriscus sylvestris subsp. stenophylla</i>	1	2008	Baden-Württemberg, Lkr. Sigmaringen, Beuron, Finstertal östlich Irndorf
2	DE-0-TUEB-1415	<i>Anthriscus sylvestris subsp. stenophylla</i>	1	2009	Baden-Württemberg, Lkr. Sigmaringen, Beuron, Finstertal östlich Irndorf
3	DE-0-TUEB-54	<i>Anthriscus sylvestris subsp. stenophylla</i>	1	2003	Baden-Württemberg, Bad Urach, Lkr. Reutlingen
4	DE-0-TUEB-1027	<i>Apium graveolens subsp. graveolens</i>	1	2009	Baden-Württemberg, Lkr. Karlsruhe, Bruchsal, Salzquelle bei Ubstadt-Weiher
5	DE-0-TUEB-2149	<i>Athamanta cretensis</i>	1	2008	Baden-Württemberg, NSG Gräbelesberg bei Hossingen, Zollernalbkreis

# “chain of custody” makes conservation meaningful

Undocumented or incompletely documented material means:

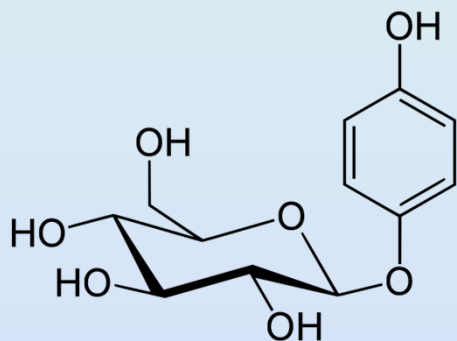
- **legal status** unclear
- re-introduction in the wild (in a different population) may **contribute to genetic erosion** rather than reducing it
- preservation of the **genetic diversity** in *ex situ*-collections can not be verified
- in the case of clonal propagation a **single genotype** (= genetic individual) may be preserved



***ex situ*-conservation requires comprehensive documentation and record keeping**



# Researchiaceae



## arbutin content of in different accessions of bearberry (*Arctostaphylos uva-ursi*)

source	arbutin-gehalt (% dw)	vitality
FRIESLAND	7,18	very good
FRIESLAND	8,23	very good
NATURWUCHS	9,19	moderate
FRIESLAND	9,25	good
RÜHLEMANN'S	9,67	good
STAUDEN STADE	10,04	very good
FRIESLAND	10,23	moderate
ARKTISCH-ALPINER GARTEN	10,65	bad
Wild collected 1a	11,66	very good
Wild collected 1b	11,79	very good
Wild collected 1c	11,80	very good
Wild collected 1d	12,44	very good
Wild collected 1e	12,56	very good
Wild collected 2a	13,68	very good
Wild collected 2b	13,73	very good
Wild collected 2c	14,44	very good
Wild collected 2d	15,32	very good
Wild collected 2e	15,37	very good

# Researchiaceae

## *Urtica dioica* phytochemistry



*Urtica dioica* subsp. *dioica* var. *pilosa*

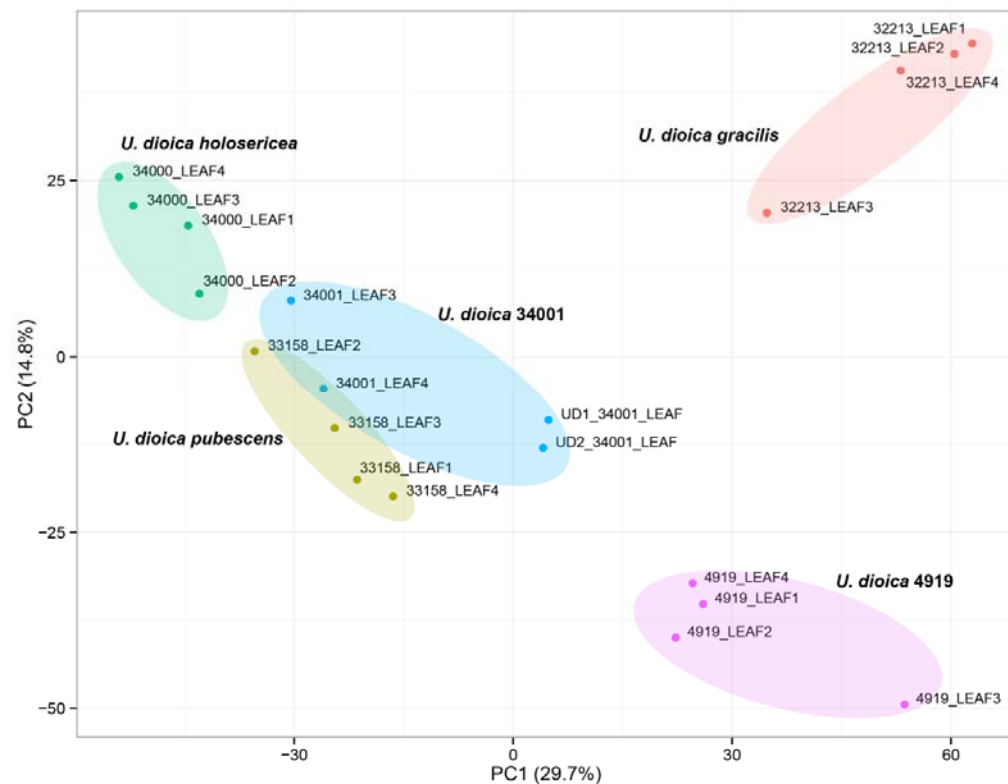
**accumulation versus collection** – M. Weigend – Plant Records Conference

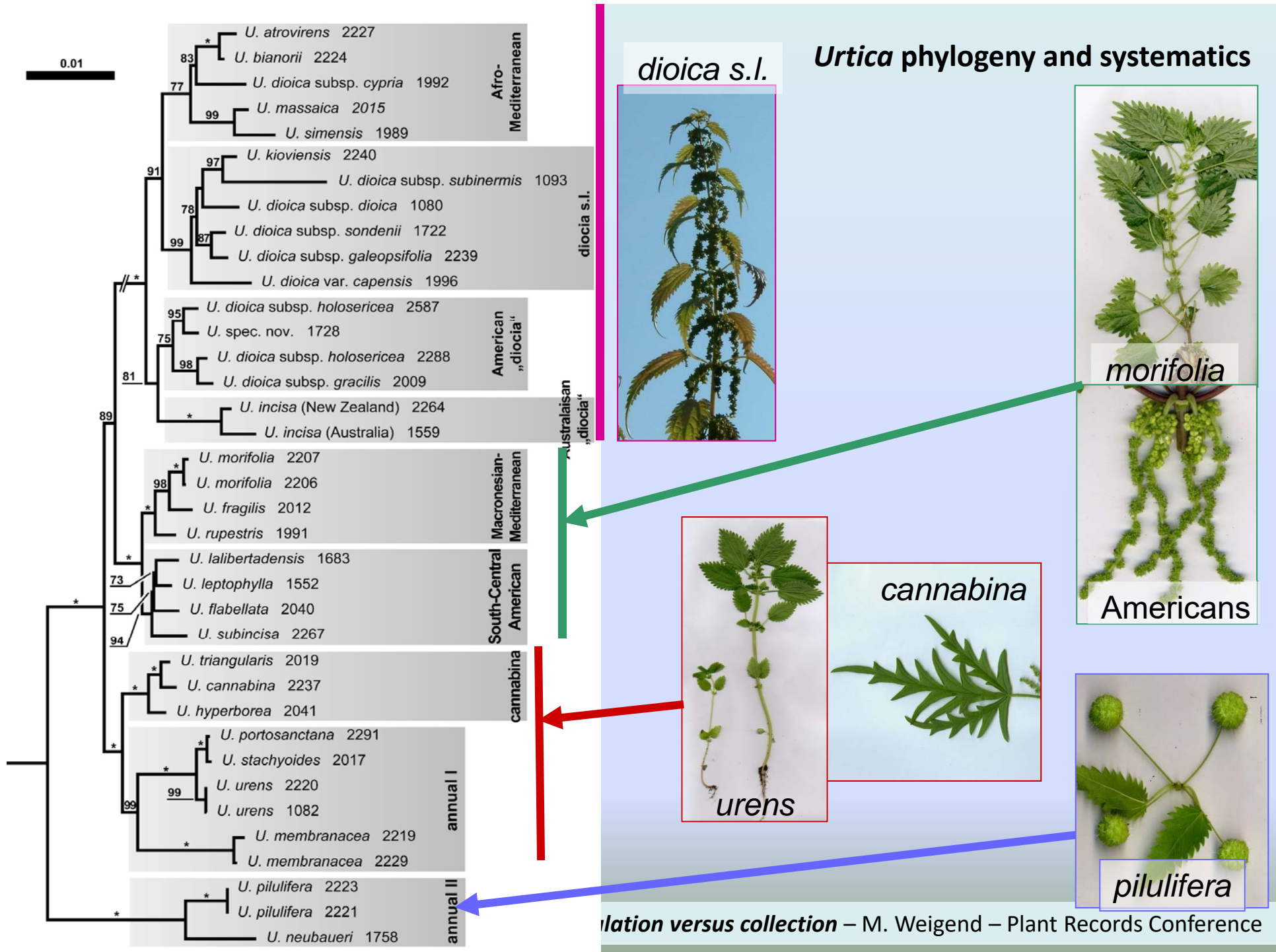
# Researchiaceae

## *Urtica dioica* phytochemistry

Principal component analysis shows highly divergent chemical composition between different accessions

- analytical results can not be verified/falsified without direct reference to a plant individual/accession.
- complex infraspecific taxonomy







## Researchiaceae in Botanic Gardens – in real life

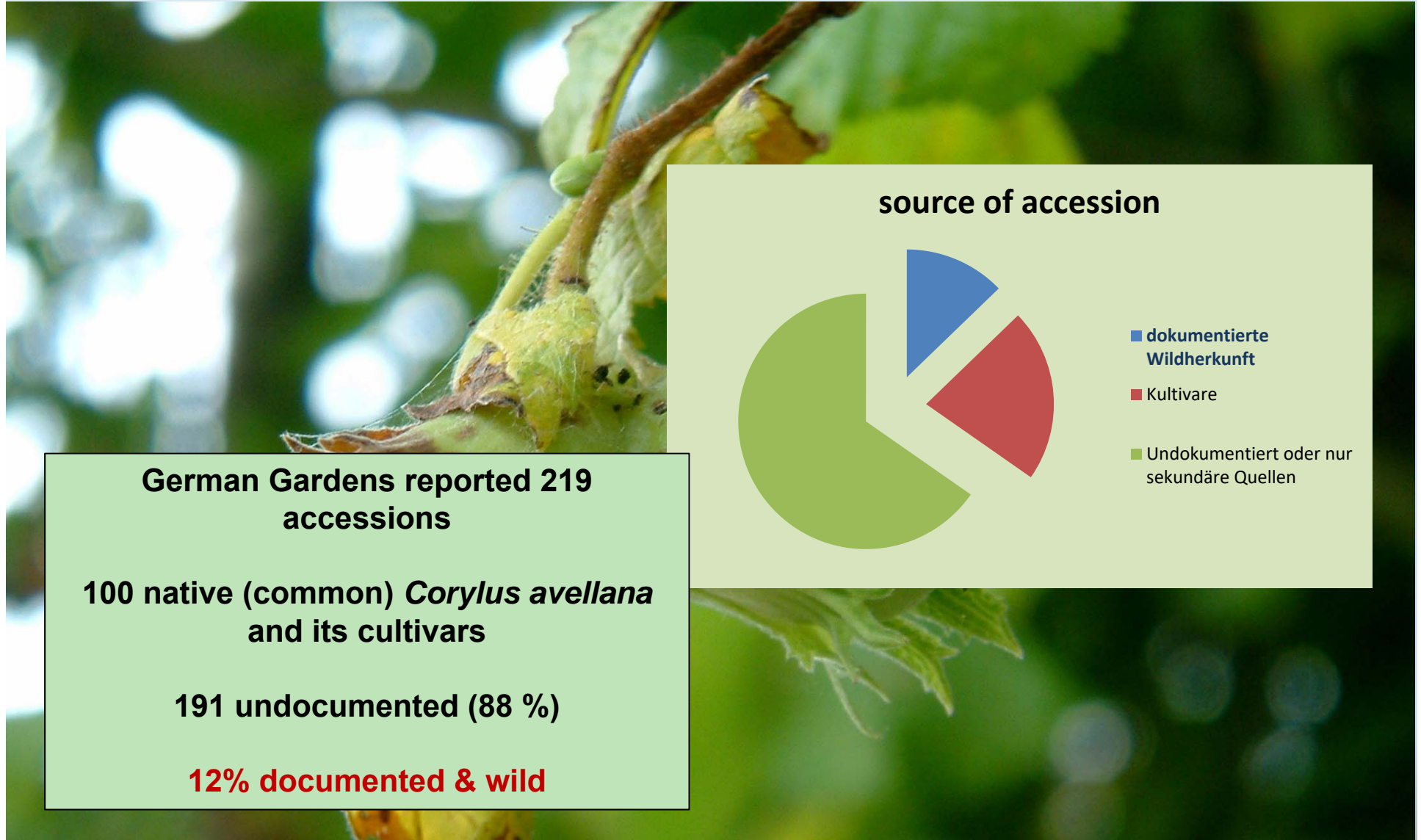
Sourcing *Corylus* for a phylogenetic project from living collections



*accumulation versus collection* – M. Weigend – Plant Records Conference

# Researchiaceae in Botanic Gardens – in real life

## Sourcing *Corylus* for a phylogenetic project from living collections



**German Gardens reported 219 accessions**

**100 native (common) *Corylus avellana* and its cultivars**

**191 undocumented (88 %)**

**12% documented & wild**

# Implications of documentation for collection use in research

- research results are not (fully) **reproducible** if documentation incomplete
- same **or** different genotype may be present in different collections (clonal propagation)
- phylogeny or phytochemical screening (unpredictably) **biased** by multiple samples of same genetic individual/source population
- **representativeness** of data sets unclear (geographical, population level)
- **legality** of research unclear

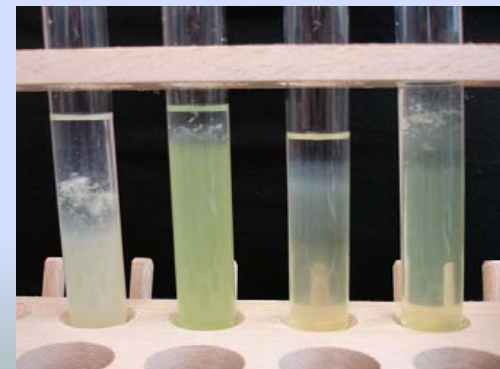
**➔ Convention on Biological Diversity & Nagoya Protocol**



© [BGBM Berlin](#)



© [Madeleine Price Ball](#)



Quelle: [Wikimedia Commons](#)

# Implications of documentation for collection use in research

108 states are party (purple)  
1 ratified, not yet party (orange)  
94 not party (black)  
Cut-off date 11.Oct.2014



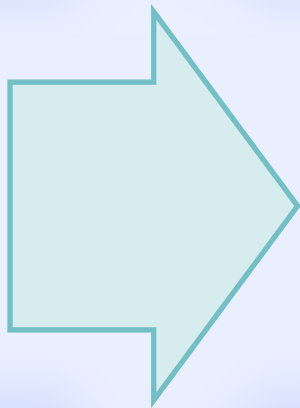
source: official clearing house-website of Nagoya Protocol, accessed 5.2.2019 (<https://absch.cbd.int>)

# Implications of documentation for collection use in research

## Access & Benefit-Sharing (ABS) – some terminology

**access** = obtaining genetic resources  
(from the wild or from a collection)

**utilization** = research and/or development on genetic and/or biochemical composition of genetic resources



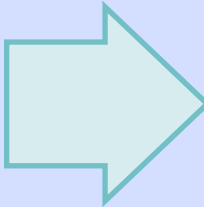
- *rules apply both to commercial and non-commercial „utilization“*
- *exact scope of „utilization“ differs from one country to the next*

Crucial information: **when** and **where** (exactly) was the material sourced?  
**which** additional rules apply (e.g., collection permit)?

# Implications of documentation for collection use in research

**International Plant Exchange Network (IPEN)** as a tool for increasing **legal certainty** (IPEN-numbers. e.g., GE-0-M-2012/3378)

- **standardizes** plant records and **transfer of information**
- regulates **access** from countries of origin
- regulates **exchange** between parties to IPEN
- regulates **transfer** to non-IPEN-members
- has provisions for **ABS**

- 
- source of germplasm traceable throughout (“**chain of custody**”)
  - characterizes **legal framework** (Research permissible? Which conditions attached?)



Katse Alpine Garden (Lesotho)

# Implications of documentation for collection use in research



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## The International Plant Exchange Network

The International Plant Exchange Network is an instrument for the acquisition and exchange of living plant genetic resources at botanic gardens.

[Implementing Access and Benefit Sharing](#)

[The International Plant Exchange Network](#)

[The Principles on Access to Genetic Resources and Benefit Sharing](#)

Botanic Gardens Conservation International (BGCI):  
<http://www.bgci.org/policy/ipen/> (all IPEN-documents as download)

***accumulation versus collection*** – M. Weigend – Plant Records Conference

# “chain of custody” retains crucial information

Material brought into gardens is nearly never „representative“ of a species or even a population.

Here three wild collected „forms“ of one species - explicitly advertized as such. Neither of them is „typical“ of the species.

(Zingiberaceae)

## Cautleya spicata 'Bleddyn's Beacon' - BSWJ2408



Pot Size: 2 litre (deep)

Price: £10.00

Description:

One of the **best forms** we have grown, outperforming in flower, any of our other collections. Which means the plant's energy is concentrated on flowering rather than increasing at the root, unfortunately meaning it is in short supply. Of a stocky nature with strong dark red stems (hence old species name of *C. robustum*, not the cultivar) bearing longer than normal terminal inflorescences of dark red overlapping bracts with sizeable protruding yellow flowers over a long period June to October. Easily grown in any type of humus rich but drained soil in sun to light shade, protect the rhizomes from freezing in cold areas, with a mulch. Hardy to -15C. Our collection from the Darjeeling area of northern India.

[add to wheelbarrow >>](#)

(Zingiberaceae)

## Cautleya spicata 'Arun Flame' - HWJK2172



Pot Size: 4 litre (deep)

Price: £12.00

Description:

A **distinct collection** of this ornamental perennial we gathered from **Eastern Nepal** in 2002 with Dan Hinkley and Jamaica Kincaid. Which has the darkest red stems to about 1m tall, of yellow orange flushed flowers in dense terminal spikes, sheathed by dark red bracts July-September, while the backs of the leaves are tinged purple-red. We have found this collection to be perfectly hardy in an open field even in full sun, all we have done is to apply an 8cm bark

mulch every winter. Multi-stemmed mature plants.

(Zingiberaceae)

## Cautleya spicata 'Crûg Canary' - BSWJ2103



Pot Size: 2 litre (deep)

Price: £10.00

Description:

Our own wild collection of this rhizomatous perennial, from the **Darjeeling area** of Northern India. Forming wide clumps of vertical mahogany-red stems, with broadly lanceolate ribbed leaves, to 1m tall. Bearing June-Oct. terminal spikes of deep-red bracts with protruding orange-yellow orchid-like flowers. Sun or shade in humus rich well drained soil, protect in cold areas. Hardy to -10c.

[add to wheelbarrow >>](#)

© mailorder.crug-farm.co.uk



# “chain of custody” is what makes science science

38698 + *Chaerophyllum bulbosum* DE-0-BONN-38698  
*Index seminum* Deutschland, Rheinland-Pfalz, Rechtes Moselufer bei Neumagen-Dhron,  
*BG Bonn 2017* höher gelegener Uferbereich, R. Wisskirchen, 38/16, 01.09.2016

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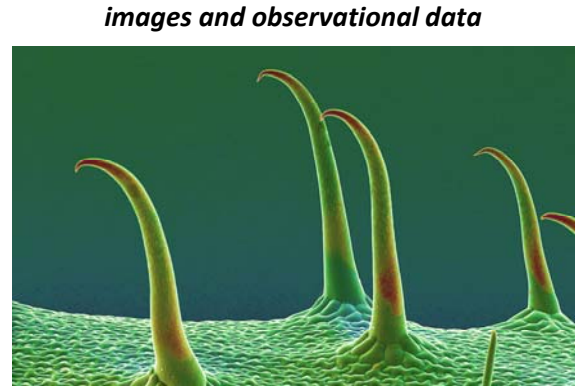


seed sample

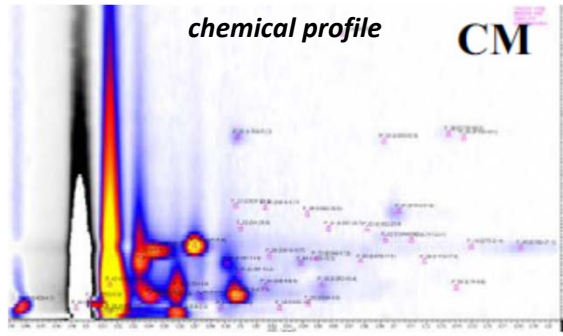
voucher for verification



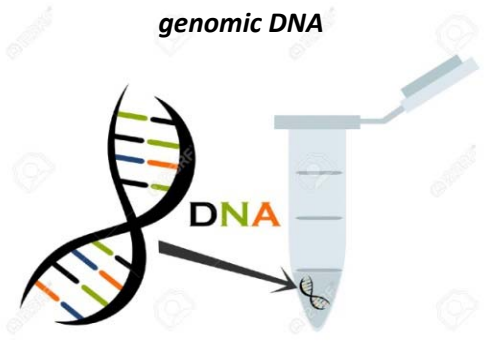
living plant in collection



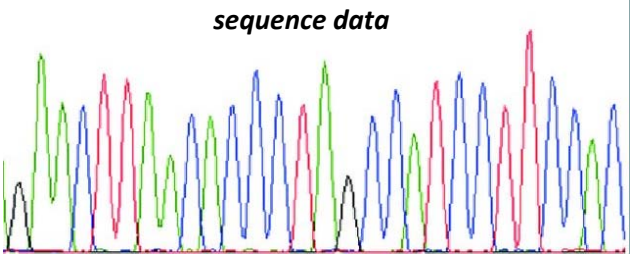
images and observational data



chemical profile



genomic DNA



sequence data

# “chain of custody” is what makes science science

38698 + *Chaerophyllum bulbosum* DE-0-BONN-38698  
*Index seminum* Deutschland, Rheinland-Pfalz, Rechtes Moselufer bei Neumagen-Dhron,  
*BG Bonn 2017* höher gelegener Uferbereich, R. Wisskirchen, 38/16, 01.09.2016

==



seed sample

## Why herbarium specimens?

*Aquilegia vulgaris*, wild type und introgression of horticultural varieties [© Ackermann, Weigend]



... herbarium specimens (and possibly genomic DNA) are also important to track possible hybridization or effects of domestication in garden material

voucher for verification



# “chain of custody” is what makes science science

38698 + *Chaerophyllum bulbosum* DE-0-BONN-38698  
*Index seminum* Deutschland, Rheinland-Pfalz, Rechtes Moselufer bei Neumagen-Dhron,  
*BG Bonn 2017* höher gelegener Uferbereich, R. Wisskirchen, 38/16, 01.09.2016

## Why herbarium specimens?



*Caiphora lateritia* – wild type from Argentina

... herbarium specimens (and possibly genomic DNA) are important to track possible hybridization or effects of **domestication** in garden material



*Caiphora lateritia* – „garden type“ after ca. 140 years in cultivation (© Ackermann)



# “chain of custody” is what makes science science



Which parts of the collection need to be documented?

Displayaceae



Keukenhof, Netherlands, 2017

*accumulation versus collection* – M. Weigend – Plant Records Conference

## Which parts of the collection need to be documented?

## Displayaceae

.. ...may not be an integral part of collections („seasonal plantings“)



BG Siegen, Germany, 2017

*accumulation versus collection* – M. Weigend – Plant Records Conference

## Which parts of the collection need to be documented?

## Educatiaceae

.. ...or may be an integral - albeit primarily ornamental - part of the collection



BG Pisa, Italy, 2018

Which parts of the collection need to be documented?

Educatiaceae



*Taxodium distichum* in Bonn BG – **historical relevance**, seeds sent from South Carolina by an ex-student of Eduard Strasburger in the early 20th Century – **role in education/outreach**

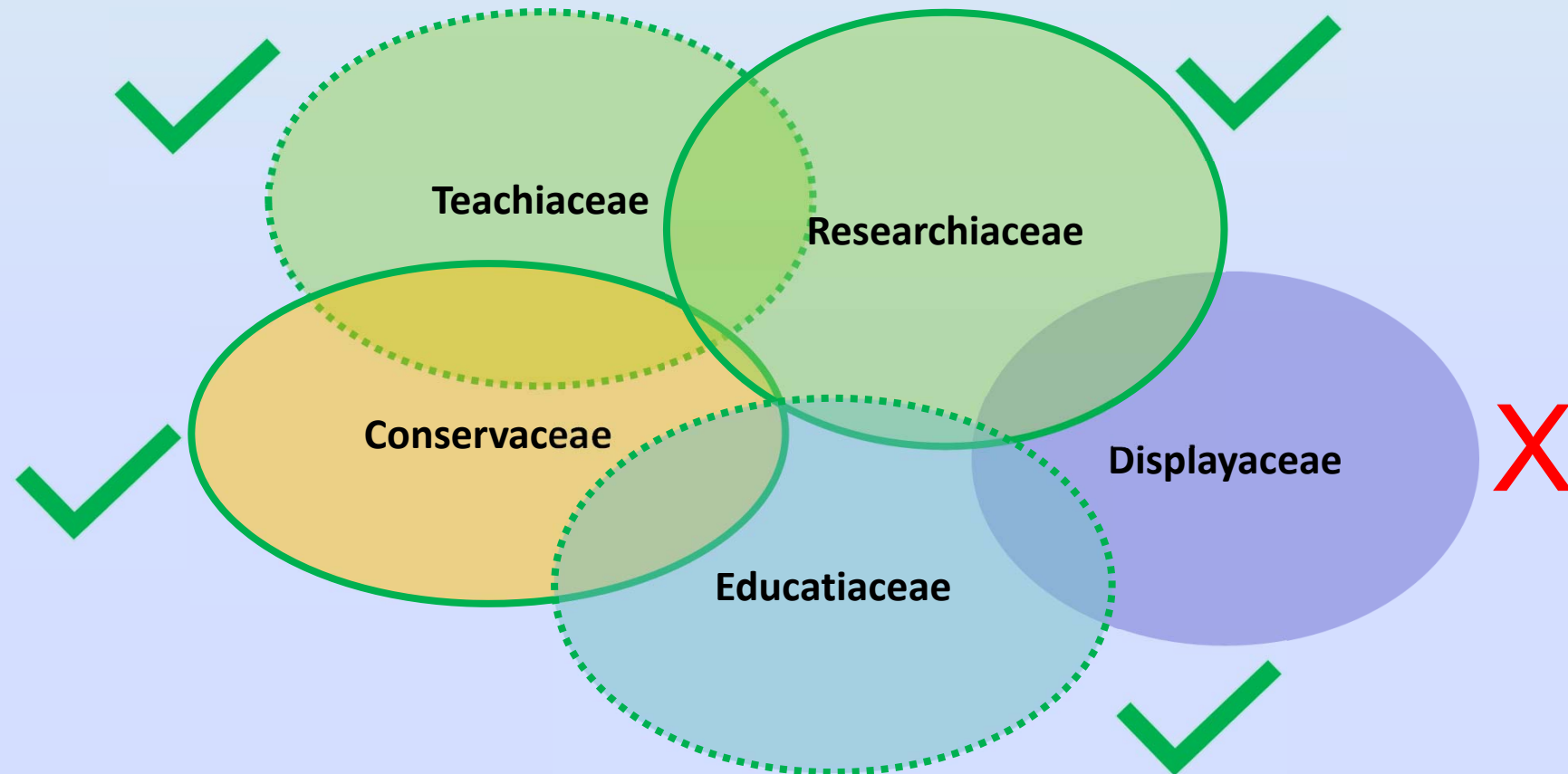
BG Bonn, Germany, 2020

*accumulation versus collection* – M. Weigend – Plant Records Conference



## Which parts of the collection need to be documented?

Botanical gardens are institutions cultivating **documented living collections** in order to fulfil functions in **scientific research** and **teaching, education** and **species and nature conservation**. (Rauer et al. 2000)



*Detailed (incl. historical) information on a plant may play **a crucial role in education**.  
Record keeping for plants **exclusively for display** seems of little relevance.*

## The importance of record keeping in Botanical Gardens

Botanical gardens are institutions cultivating **documented living collections** in order to fulfil functions in **scientific research** and **teaching, education** and **species** and **nature conservation**. (Rauer et al. 2000)

Detailed records of plant accessions is a **key requirement** for botanical gardens to fulfil their **defining missions in research, teaching, conservation** and helpful in education and outreach.

Both **research** and **conservation** can **only meaningfully be carried out** with (fully) documented collections („chain of custody“).

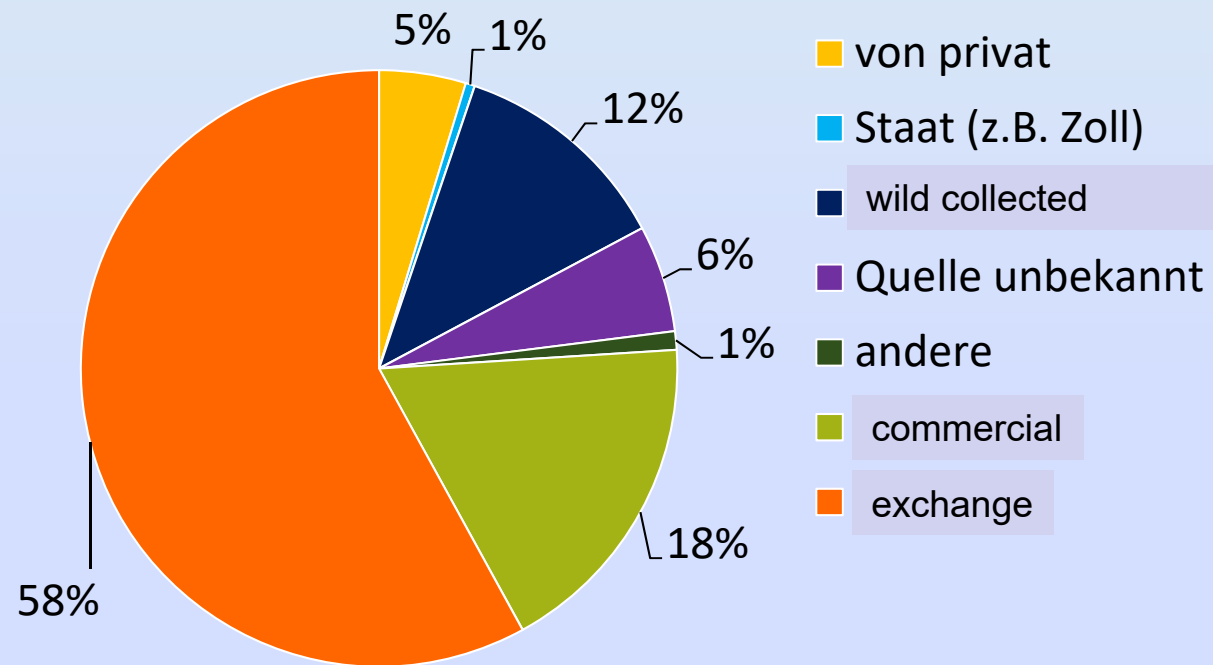
There is an **added value** for documented collections in **teaching and outreach/education**.

Increasingly, record keeping is becoming a **key legal requirement** for the **scientific work** with or even **possession of plants** (e.g., CITES, Nagoya - chain of custody!).



## Particular challenges in record keeping?

Exchange of plants and seeds is the single most important source of new plants in German BGs



Can record keeping aid quality control?



Krebs et al. 2002: Samentausch von Botanischen Gärten [...]. Gärtnerisch-Bot. Brief Nr. 149 (2002/4)

## Particular challenges in record keeping?

an accession should be **subset of the genetic/phenotypic diversity of a wild population** of a single, defined species.

***Pulmonaria spec.*** (Boraginaceae) – nearly all species hybridize if cultivated side by side in the garden (here *Pulmonaria mollis*, *P. saccharata*, *P. obscura*, *P. vulgaris* © Ackermann, Mohr, Weigend)





**major problem:** obligate outcrossers, esp. trees – possibly (only) hybrid seeds

universität bonn  

Rekordbaum in Nordrhein-Westfalen 

**Schuppenrinden-Hickorynuss**  
**Carya ovata (Mill.)K.Koch**



Die Schuppenrinden-Hickorynuss stammt aus den östlichen USA. Ihre Früchte sind sehr ölhaltig und werden gerne gegessen. Der Name „Hickory“ leitet sich von dem Wort pawcohiccora der Algonquian-Indianern ab.

Unser Exemplar (1895) wurde ca. 1840 gepflanzt und gehört somit zu unseren ältesten Bäumen. Es hat einen Stammumfang von 2,33 m; ist ca. 30 m hoch und hat einen Kronendurchmesser von ca. 13 m.

Akzessionsnummer: 1895-9-1840

Weitere Information zu Rekordbäumen:  
[www.championtrees.de](http://www.championtrees.de)

[www.botgart.uni-bonn.de](http://www.botgart.uni-bonn.de) 

## Particular challenges in record keeping?

an accession should be **subset of the genetic/phenotypic diversity of a wild population** (seedlings from wild collected *Rhus copallinum*)...



## Particular challenges in record keeping?

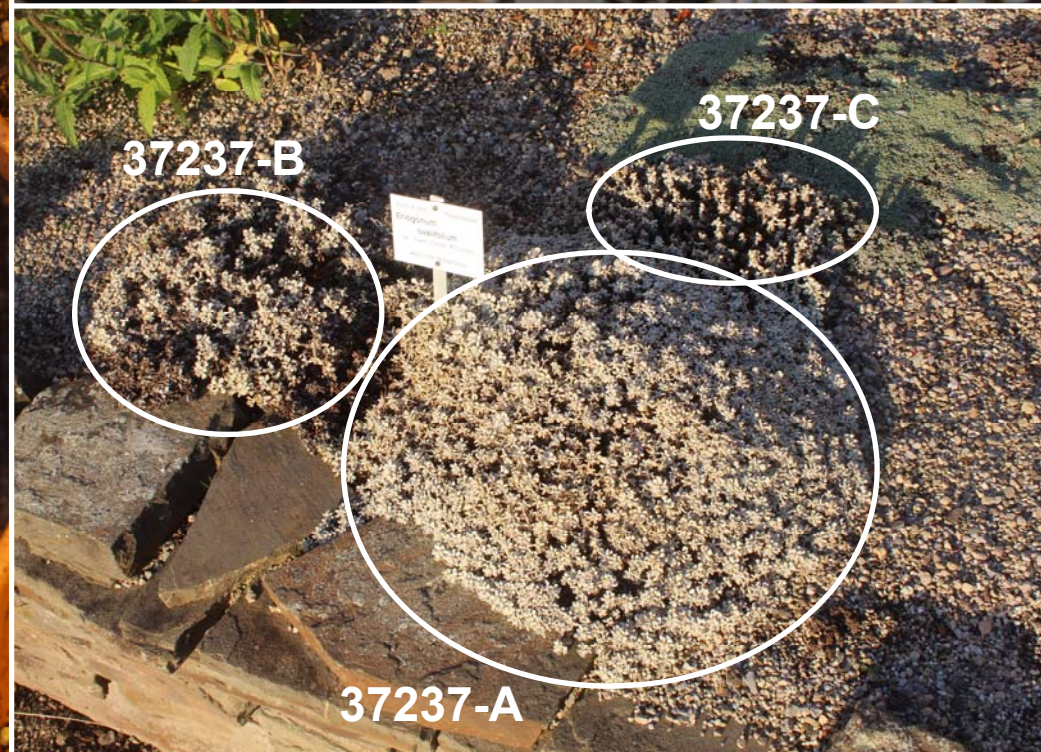
... but **clonal propagation (cuttings, divisions) is common** – esp. in perennial herbs and shrubs - „accessions“ may be represented by **single genotypes**



*accumulation versus collection* – M. Weigend – Plant Records Conference

## Particular challenges in record keeping?

clonal propagation potentially „homogenizes“ accessions - no standard way for keeping track of this in record keeping.





## Particular challenges in record keeping?

„homogenous“ accessions may be self-sterile or even represent a single gender - all *Laurus nobilis* in Bonn BG were male – until we sourced cuttings of a female clone



## Conclusion – record keeping and collection quality



## Conclusion – record keeping and collection management

*How can record keeping help with **mission match**?*

*How can we track **genetic integrity** of our accessions?*

*How can we track **genetic diversity** of our accessions?*

*How can we optimize collection value for **conservation**?*

**Record keeping**  
-access date and modalities  
-taxonomic identity  
-exact source  
-genetic characterization

*How can we increase collection value to **science**?*

*How can we increase **legal certainty** for our collections?*

