



**BIOLOG**

# Improving Knowledge Management and Workflow Efficiency

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G. Hagedorn, Berlin

# Fingerprint identification



**automatic**

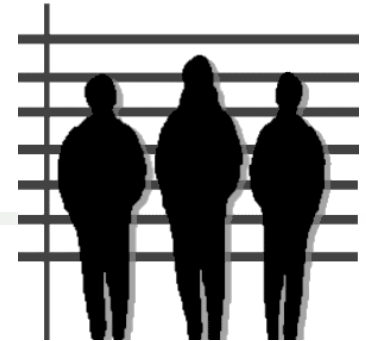
**interactive  
(computer assisted)**

**digital library**

**direct manual  
comparison**



# Direct comparison



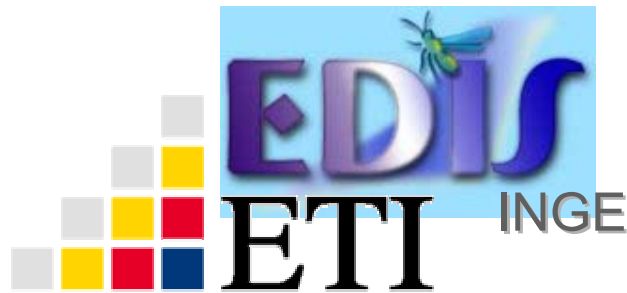
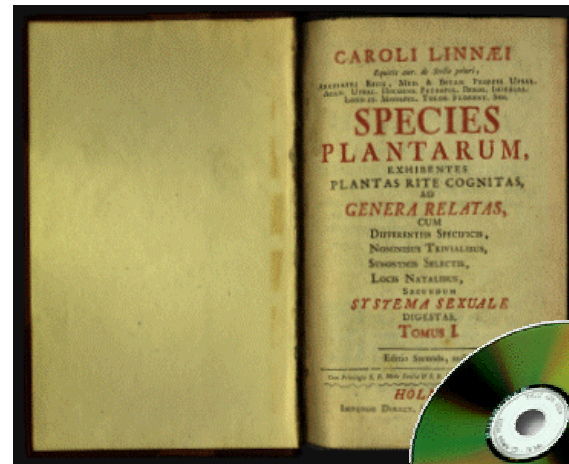
- Collections are the biggest libraries of information for identification
- For most taxonomic groups the information quality is very high
- Access is slow and local. Objects are not replicated (except for exsiccata)



# Media comparison



- On paper,
- CD-ROM, or
- Internet



- Images are becoming increasingly available
- Distribution increasingly simplified

# Interactive Identification tools

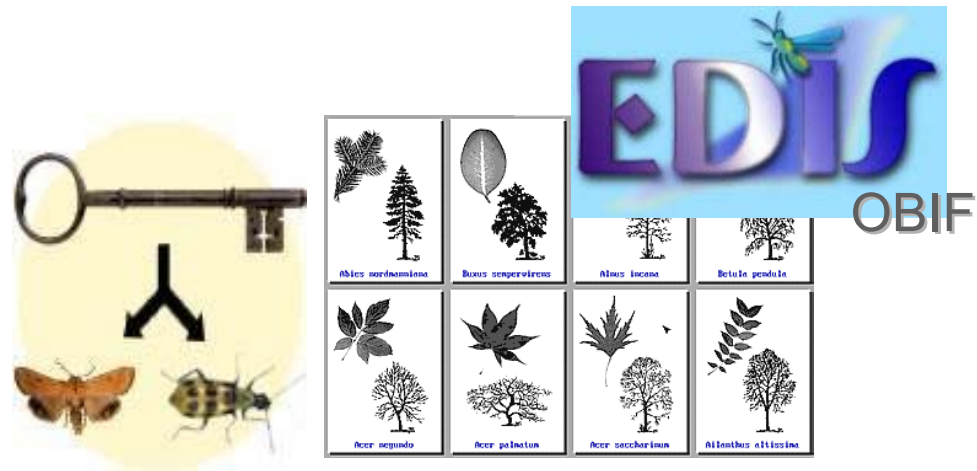


Image based keys

# Interactive Identification tools

**Identify: Online identification of items**

Characters: Categorical/numerical characters

CID	Type	CharName	Best
2	UM	longevity of plants	
3	RN	mature culms maximum height: data un...	
4	UM	culms whether woody or herbaceous	
5	UM	culms whether branched above	
6	UM	culm nodes whether hairy or glabrous	
7	OM	leaf blades shape: data incomplete	
8	RN	leaf blades mid-width: data very incom...	
9	UM	leaf blades whether pseudopetiolate	
10	UM	adaxial ligule presence	
11	OM	adaxial ligule form [X_] avoid seedlings	
12	UM	plants whether monoecious, with bisex...	
13	UM	inflorescence chasmogamous: overall t...	
14	UM	inflorescence whether open or contrac...	
15	UM	inflorescence whether comprising a co...	
16	UM	spikelet-bearing axes whether disartic...	
17	UM	spikelet-bearing axes manner of disarti...	
18	UM	spikelets grouping: recorded mainly in s...	
19	UM	spikelets whether secund: currently a c...	
20	UM	spikelets whether in regular 'long-and-...	
21	UM	spikelets detail of 'long-and-short' comb...	
22	UM	pedicels of the 'pedicellate' spikelets w...	
23	UM	the 'shorter' andropogonoid spikelets s...	
24	UM	the 'longer' andropogonoid spikelets pe...	
26	RN	female-fertile spikelets approximate len...	
27	OM	female-fertile spikelets plane of compre...	
28	UM	female-fertile spikelets location of disar...	

Character states of selected character:

Items	* CS	CharStateName
8	1	linear
5	2	linear-lanceolate
1	3	lanceolate
0	4	ovate-lanceolate
0	5	ovate
0	6	elliptic
0	7	obovate

Identification steps so far: 1

CID	Condition
7	leaf blades shape: data incomplete: 2/3 = linear-lanceolate OR lanceolate

Present     Absent       

Items or taxa remaining: 6

3	Anisopogon R.Br.
9	Festuca L.
10	Oryza L.
12	Phragmites Adans.
12	Phragmites Adans.
13	Poa L.

Retrieval mode: Analysis/data retrieval



## Software and Links

- [DELTA](#)   [Databases](#)   [Ecology](#)   [Morphometrics](#)   [Paleont](#)
- [Cladistics](#)   [Libraries](#)   [Languages](#)   [Archives](#)

### DELTA and Identification Software



#### DELTA

*Description Language for Taxonomy*. The DELTA format is a The DELTA system is an integrated set of programs based on descriptions and conventional taxonomic keys, conversion of identification and information retrieval. By [Mike Dallwitz, To](#)



#### DELTA-L

A discussion forum for users of the DELTA System and relate variety of taxonomic software. Software and data that takes: Subscribers are often professional taxonomists and others pr packages. Managed by [Eric Gouda](#)



#### DELCODE

DELTA editor for MS-Windows. *Experimental version*. By [M](#)



#### DEDIT

DELTA editor for MS-DOS. By [Richard Pankhurst](#)



#### DeltaAccess

DELTA database engine implemented in MS-Access '95 or '97



#### DELTA Libraries



#### KeyOut

MS-Windows software to automate the construction of dichotomous keys. By [Jim Bayers](#)



#### MEKA

*Multiple-Entry Key Algorithm*. MS-Windows interactive program to enable identification of biological specimens. Includes a MS-DOS based editor (**MEKAEdit**) to create keys with. By [Christopher Meacham](#)



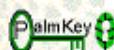
#### MONTANUS

A user friendly MS-DOS clone of the DELTA INTKEY and CONFOR all rolled into one. Includes Turbo Pascal source code. By [Jason Nunn](#)



#### NaviKey

Java applet multiple-entry identification key, and interface to viewing DELTA files. Java [source code](#) is also available. By [Michael Bartley](#) and [Noel Cross](#)



#### PalmKey

A simple interactive identification key for the PalmPilot. By [Cam Webb](#)



#### PANKEY

A suite of key generation and identification MS-DOS programs based on the DELTA format. A [demonstration version](#) of the interactive identification and information retrieval ONLINE program is also available. By [Richard Pankhurst](#)



#### PICKEY

*Pictured Interactive Computerized biological KEY*. An interactive multi-entry polychotomous key for identification of organisms by intensive use of images. By [Andrei Lobanov](#) and [Mikhail Dianov](#)



#### Polly's Home PollyClave

Web-based multiple-entry identification key. ANSI C source code for CGI program is also available. By [Tim Dickinson](#) and co-workers.

# Improving efficiency

- Both for direct collection and media comparison
  - Digital catalog of objects
  - Online access to catalog
  - Online access to digitized objects (books, high resolution images of specimen, etc.)
- Interactive identification tools
  - Guided keys (hyperlinked)
  - Picture keys
  - Multiple access interactive identification
- Automatic identification
  - Digital image / audio analysis
  - Automated molecular analysis





# Knowledge management

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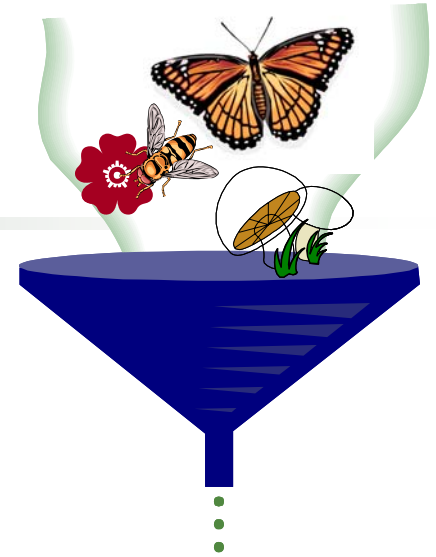
## Aspects:

- Information retrieval
- Information application
- Information building

## ... Biological Identification:

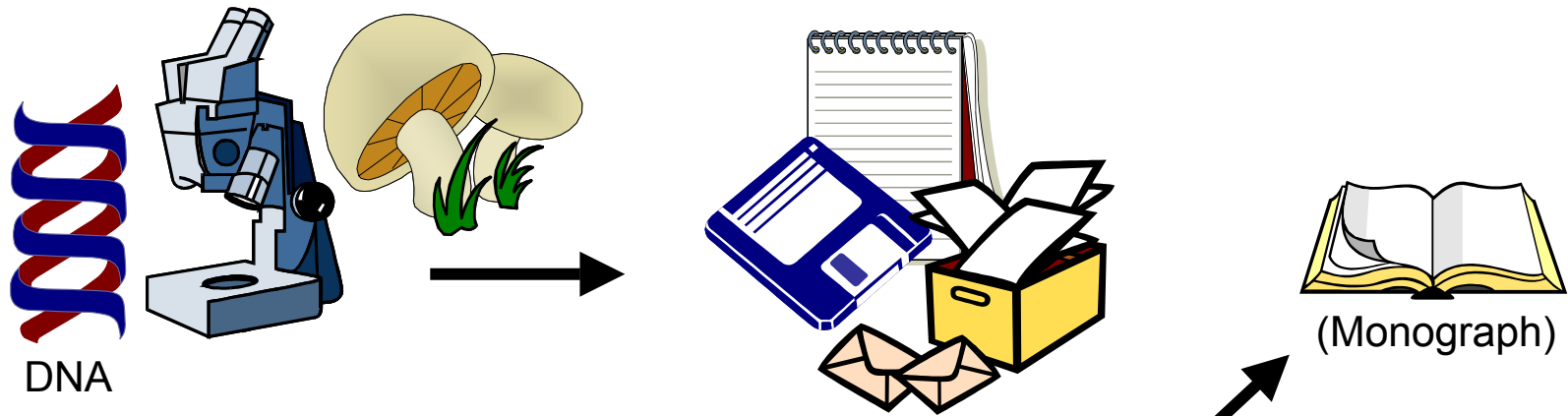
- Digital catalog & access
- Identification tools
- Integrated information system

# Information building

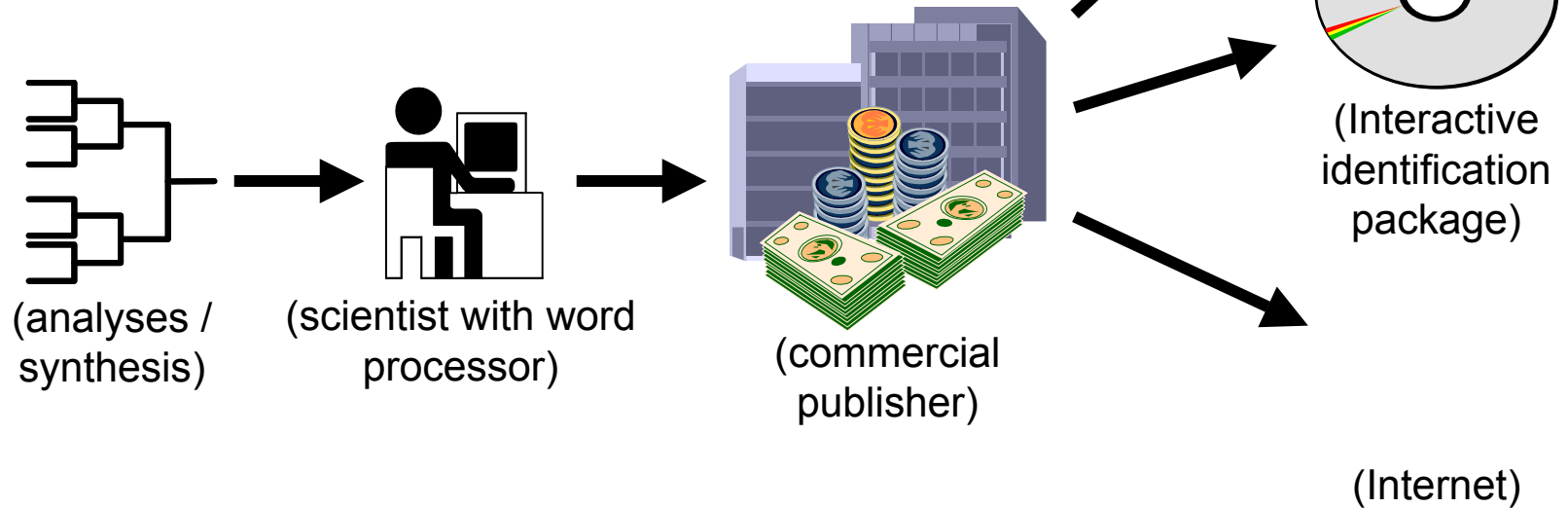


- **Information building** is the true bottle neck, e.g. describing new species, not retrieval & application
- Improving information retrieval and application does help in information building
- However, integrated information systems can increase the efficiency of knowledge building far more!
- → Workflow optimization:

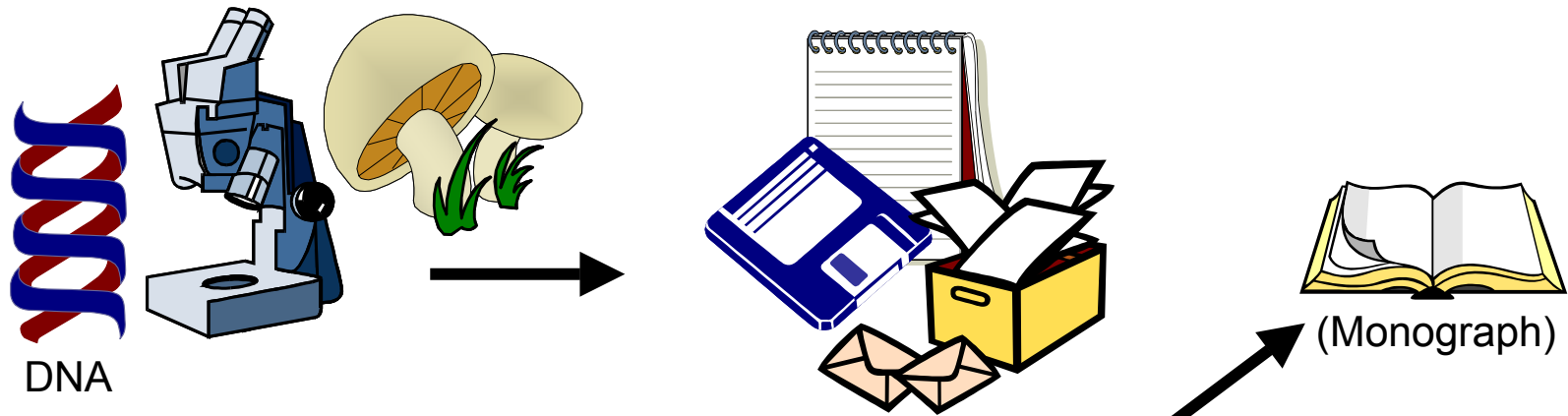
# Recording observations



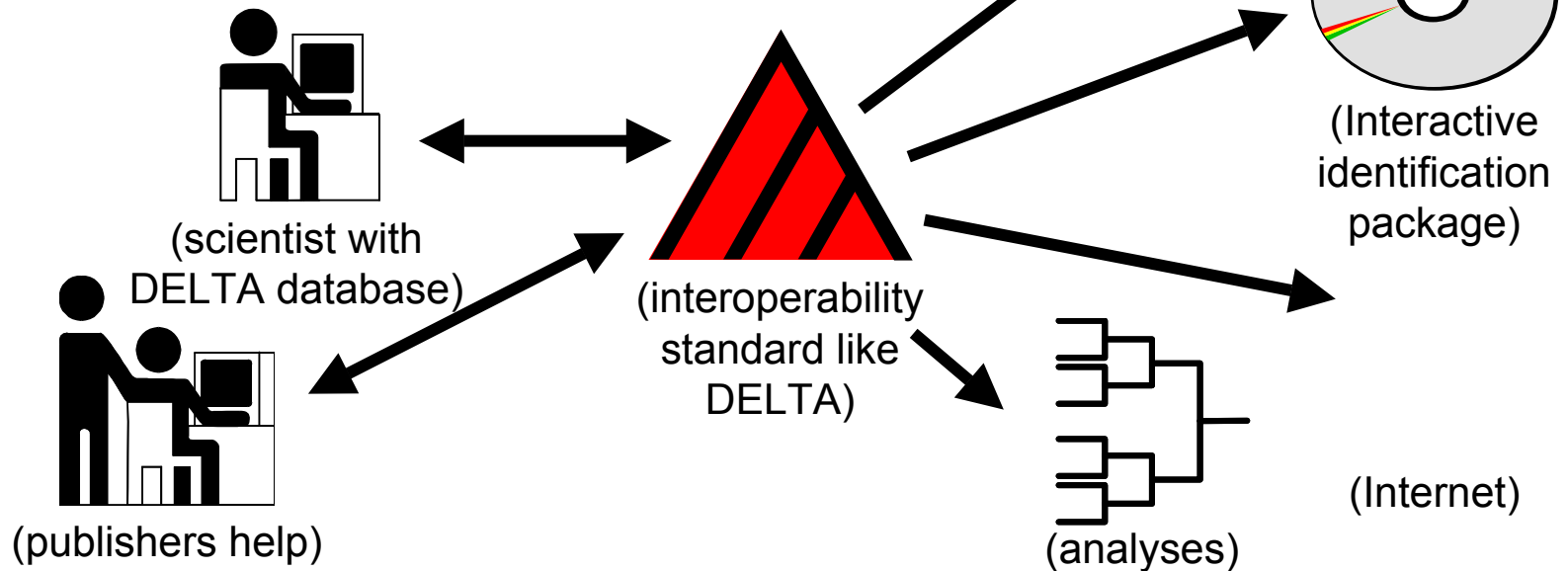
# Analysis, writing & publishing



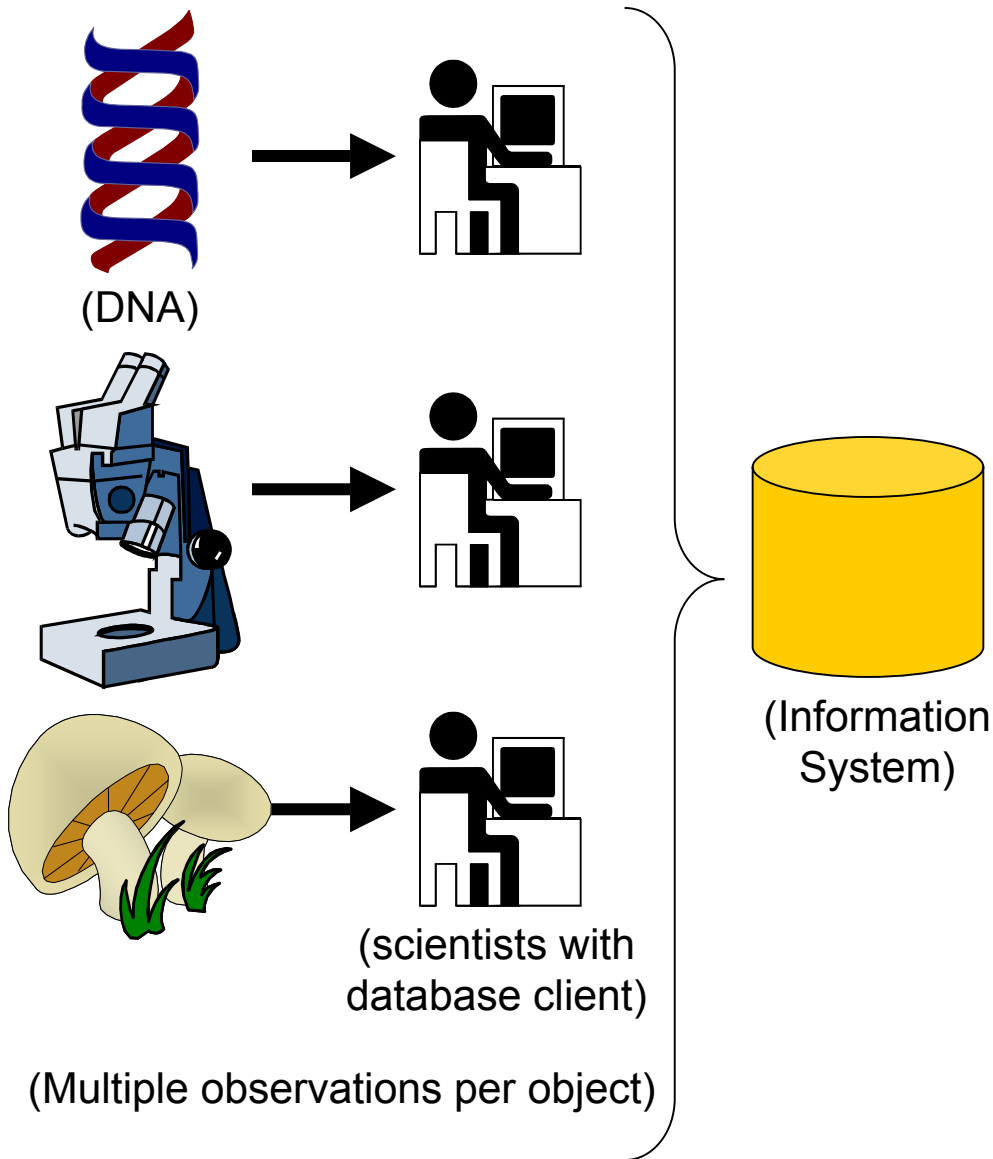
# Recording observations



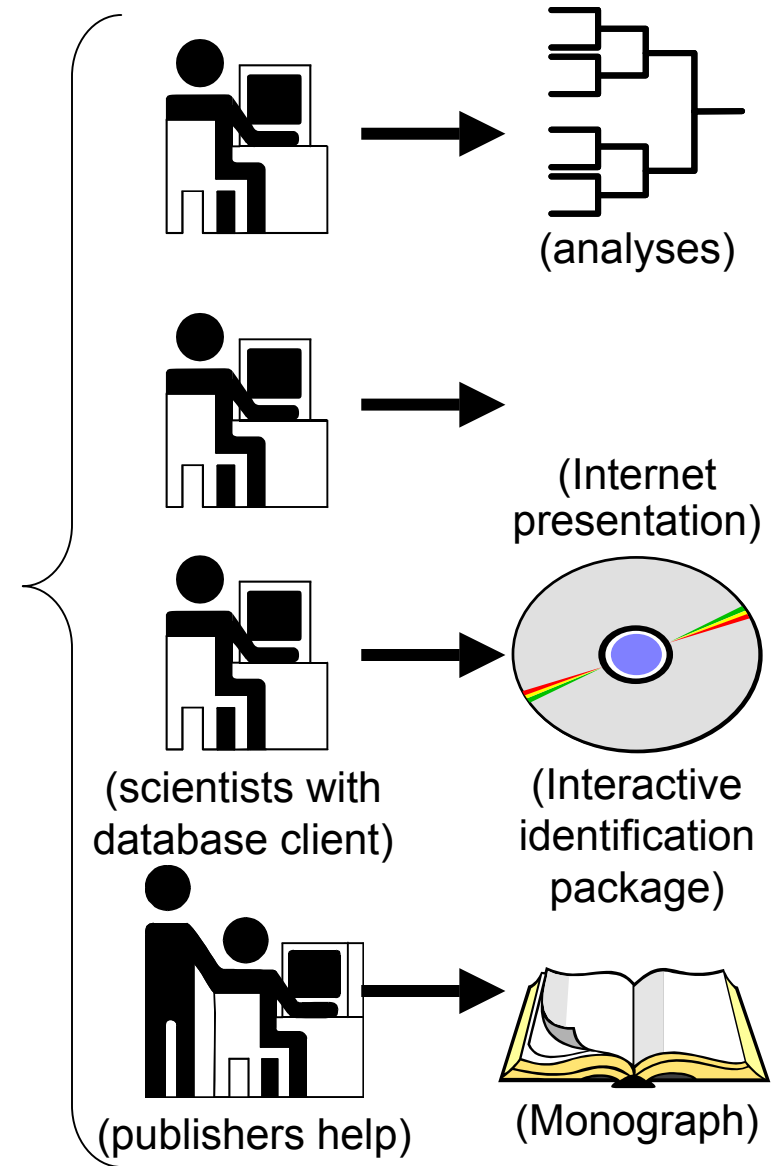
# Analysis, writing & publishing



# Recording observations



# Analysis & publishing





**BIOLOG**

Biologische  
Bundesanstalt

Bioinformatics & IT

Host-Pathogen Index



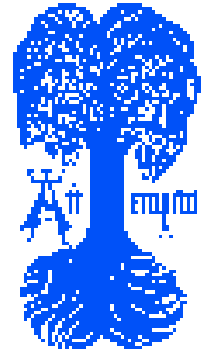
# GLOPP

Global Information System  
for the Biodiversity  
of Plant Pathogenic Fungi

Universität Tübingen

Oomycota

Uredinales



Botanische  
Staatsammlung  
München

Erysiphales



Universität Halle

Erysiphales



Universität Frankfurt

Smut fungi





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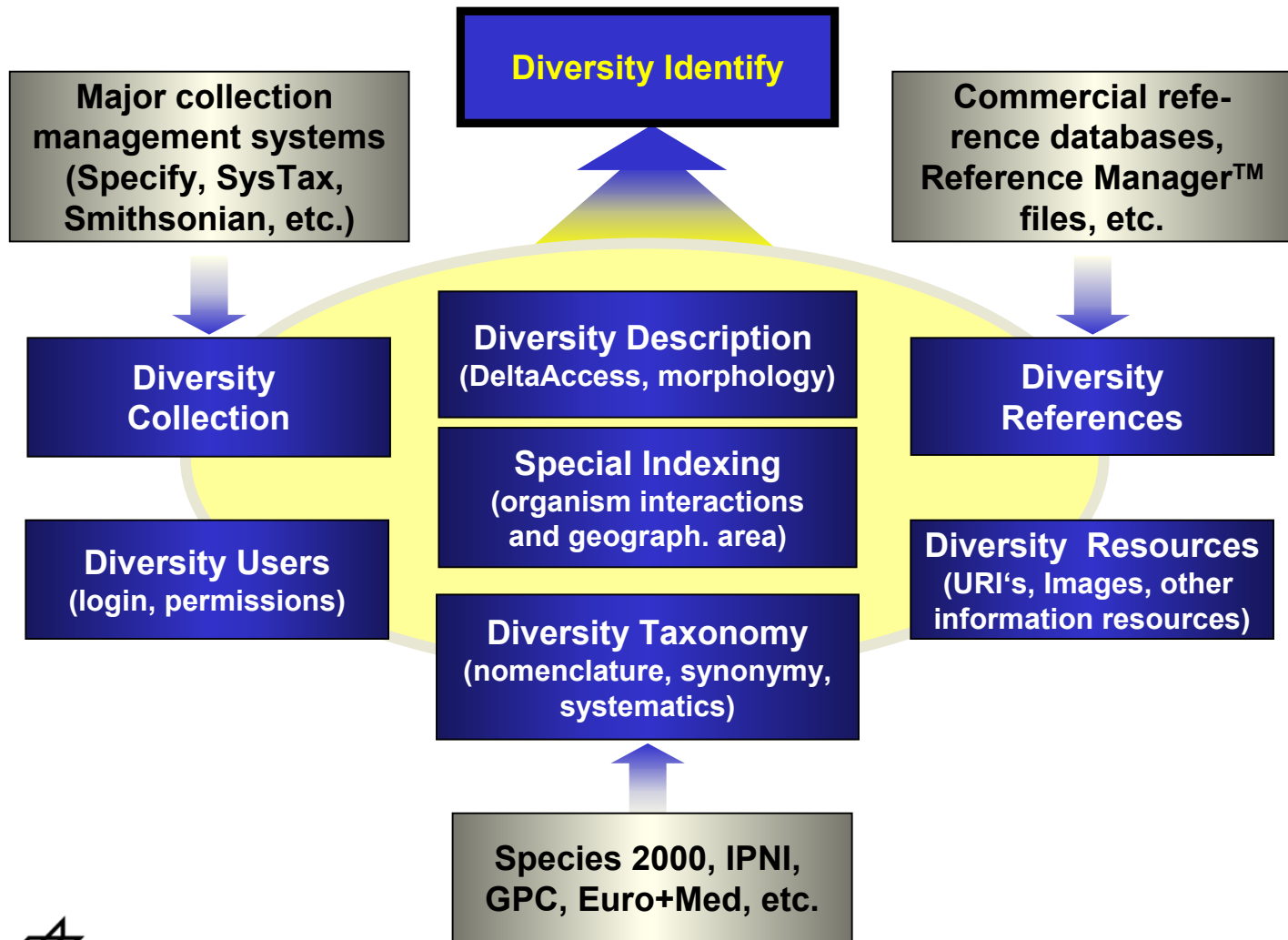
Erysiphales

Universität Halle

Universität Frankfurt

Smut fung

# DiversityWorkbench





## Erysiphe betae (Vanha) Weltzien – Input Form

### Ascospores ▲

LIAS

- 526. Ascospores number (categorical)**  1. 1-2 per ascus  
 2. **c. 4 per ascus**  3. c. 8 per ascus  4. 12-16 per ascus  
 5. 16-32 per ascus  6. more than 32 per ascus

(Select a char. state:  to add this modifier: )

(Select a char. state:  to add this note/comment: )

- 528. Ascospores shape**  1. globose  2. subglobose  
 3. broadly ellipsoidal  4. **ellipsoidal**  5. oval  
 6. fusiform-elongate  7. bifusiform  8. filiform  
 9. acerose  10. cylindrical  11. oblong-obtuse  
 12. oblong-truncate  13. discoid (in surface view)  
 14. discoid (in side view)  15. lenticular (in surface view)  
 16. lenticular (in side view)  17. sigmoid  18. reniform  
 19. allantoid  20. lunate  21. falcate  22. **ovoid**  
 23. obovoid  24. pyriform  25. obpyriform  26. clavate

(Select a char. state:  to add this modifier: )

(Select a char. state:  to add this note/comment: )

### 529. Ascospores length (numerical)

Min:	Lower range:	Mean:	Upper range:	Max:	Unit:
<input type="text" value="16"/>	<input type="text" value="18"/>	<input type="text" value="21.3"/>	<input type="text" value="26"/>	<input type="text"/>	<input type="text" value="µm long"/>

### 530. Ascospores width (numerical)

Min:	Lower range:	Mean:	Upper range:	Max:	Unit:
<input type="text"/>	<input type="text" value="11"/>	<input type="text" value="13.7"/>	<input type="text" value="16"/>	<input type="text"/>	<input type="text" value="µm wide"/>

## Erysiphe betae (Vanha) Weltzien – Description

**Data maintenance:** Data compiled and standard item. Data record authors: Kainz C. (01-07-20). Record not revised (01-08-28).

**Nomenclature:** Taxonomic status: accepted name. Taxonomic level: species. Basionym: *Microsphaera betae* Vanha. Family: Erysiphaceae Tul. & C. Tul. Order: Erysiphales. References: Braun U., Beih. Nova Hedwigia 89: 1-700 [217-218] (1987).

**Geography and Ecology:** Global distribution: Africa, Asia-Temperate, Europe, Northern America, Southern America, and Asia-Tropical. Life habit: phytopathogenic.

**Ascoma morphology:** Ascomata present, cleistothecoid, gregarious or subgregarious, on thallus, orbicular, (0.075)-0.1-0.12-(0.135) mm in diam.; external filaments present, mycelloid, 3.5-9 µm in diam., hyaline, numerous, at lower half of ascomata, wall thin, not ramified, septate.

**Asci:** Asci unitunicate, 3-8, at basis rarely not or indistinctly stipitate, 45-75 µm long, 30-45-(50) µm wide. **Ascospores:** Ascospores c. 4 per ascus, ellipsoidal or slightly ovoid, (16)-18-21.3-26 µm long, 11-13.7-16 µm wide, aseptate; wall thin and smooth, hyaline, remaining hyaline.

**Conidiomata:** Present, hyphomycetous. **Conidiophores and conidia:** Conidiophores hyphae ramified. Hyphae foot cells 18-35-(40) µm long, 7-11 µm wide; conidia macroconidial, single, ellipsoidal, cylindrical, or ovoid, 30-50 µm long, (11)-14-22.5 µm wide, aseptate, not ramified; fibrosin bodies invisible.

**Host taxa:** Host plant / phorophyte family(-ies): Chenopodiaceae.



## The Species of Erysiphaceae

An interactive key using the Delta Access Perl web interface

### Characters

- [ascomata presence](#)
- [ascomata development](#)
- [ascomata grouping](#)
- [ascomata origin](#)
- [ascomata external filaments shape](#)
- [ascomata external filaments localisation](#)
- [ascomata external filaments wall thickness](#)
- [ascomata external filaments ramifications presence](#)
- [ascomata external filaments ramification kind](#)
- [ascomata external filaments septation presence](#)
- [ascospores number \(categorical\)](#)
- [ascospores shape](#)
- [ascospores poles shape](#)
- [ascospores cells size \(relative\)](#)
- [ascospores wall width, ornamentation \(categorical\)](#)
- [conidiomata presence](#)
- [conidiomata kind](#)

### States for character *ascospores shape*

- [globose](#)
- [cylindrical](#)
- [oblong-obtuse](#)
- [oblong-truncate](#)
- [discoid \(in surface view\)](#)
- [discoid \(in side view\)](#)
- [subglobose](#)
- [ovoid](#)
- [obovoid](#)
- [clavate](#)
- [obclavate](#)
- [broadly ellipsoidal](#)
- [ellipsoidic-cylindrical](#)
- [curved](#)
- [semilunate](#)
- [narrow ellipsoid](#)
- [ellipsoidal](#)



DeltaAccess

### Working Criteria List [view list](#) [reset list](#)

- [delete](#) ascomata grouping : **scattered**
- [delete](#) ascomata external filaments appearance : **mycelioid**
- [delete](#) ascomata external filaments localisation : **at lower half of ascomata**
- [delete](#) ascospores shape : **ellipsoidal**

### Items

(1 match)  
***Erysiphe convolvuli* DC.**

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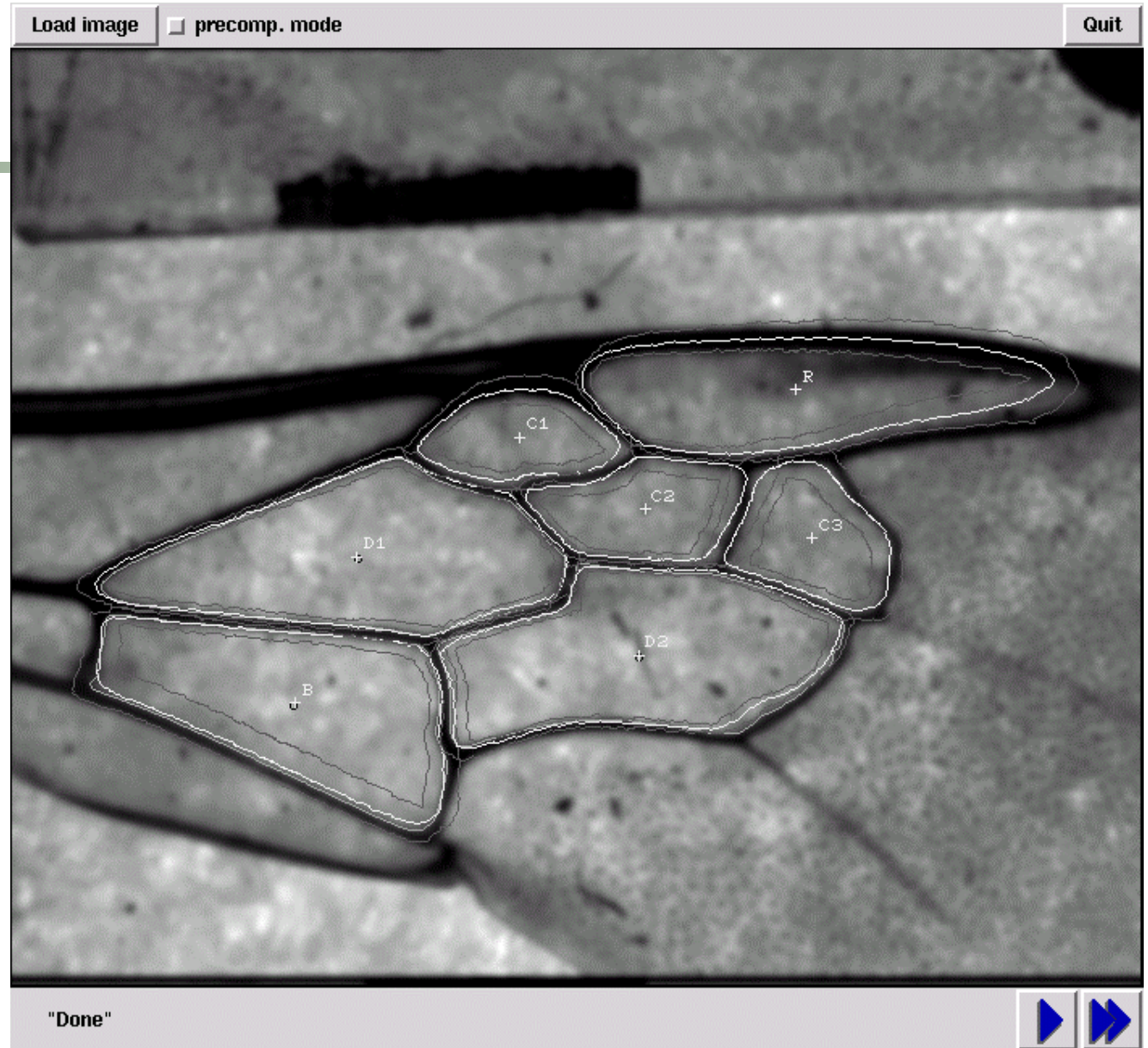
# Digital Image Analysis



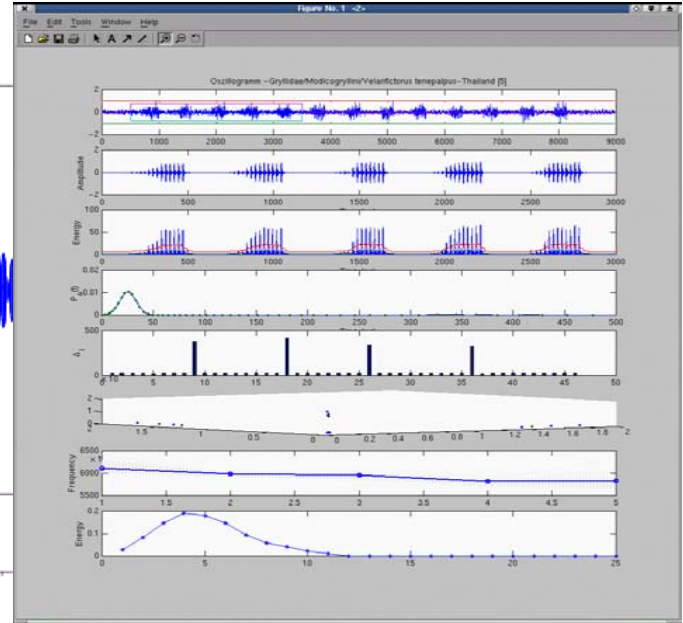
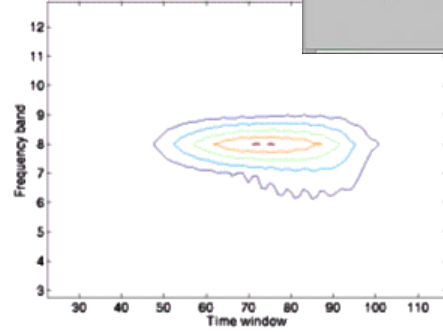
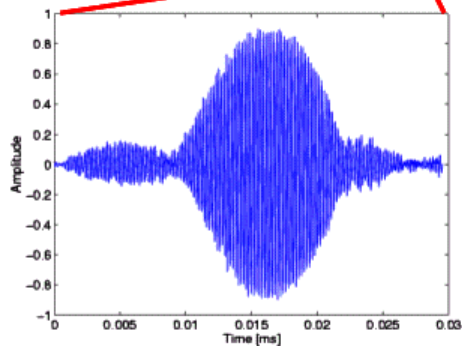
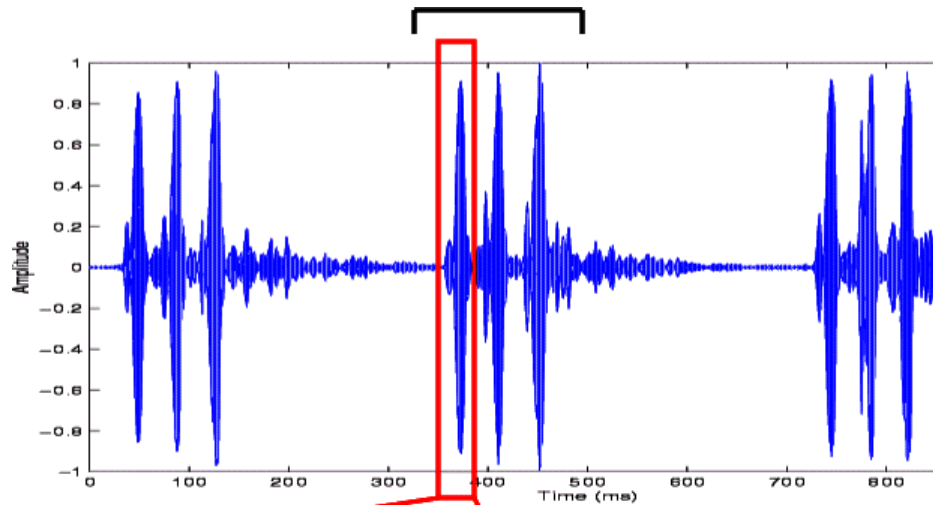


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# Digital Image Analysis



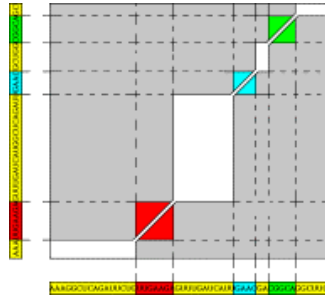
# Automated acoustic identification



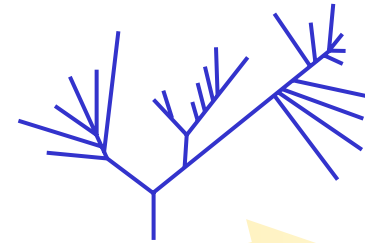
# Molecular identification methods



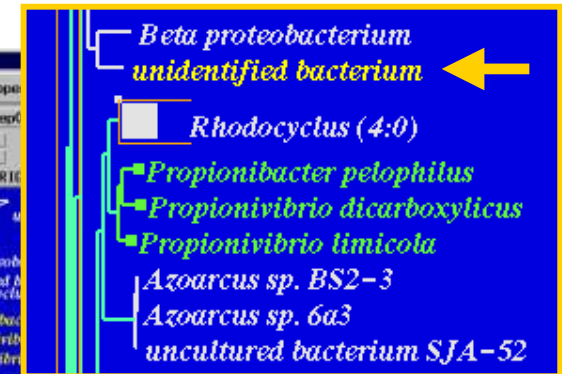
Automated DNA sequencer



Assembly & Alignment



Phylogenetic inference



Database comparison and identification

