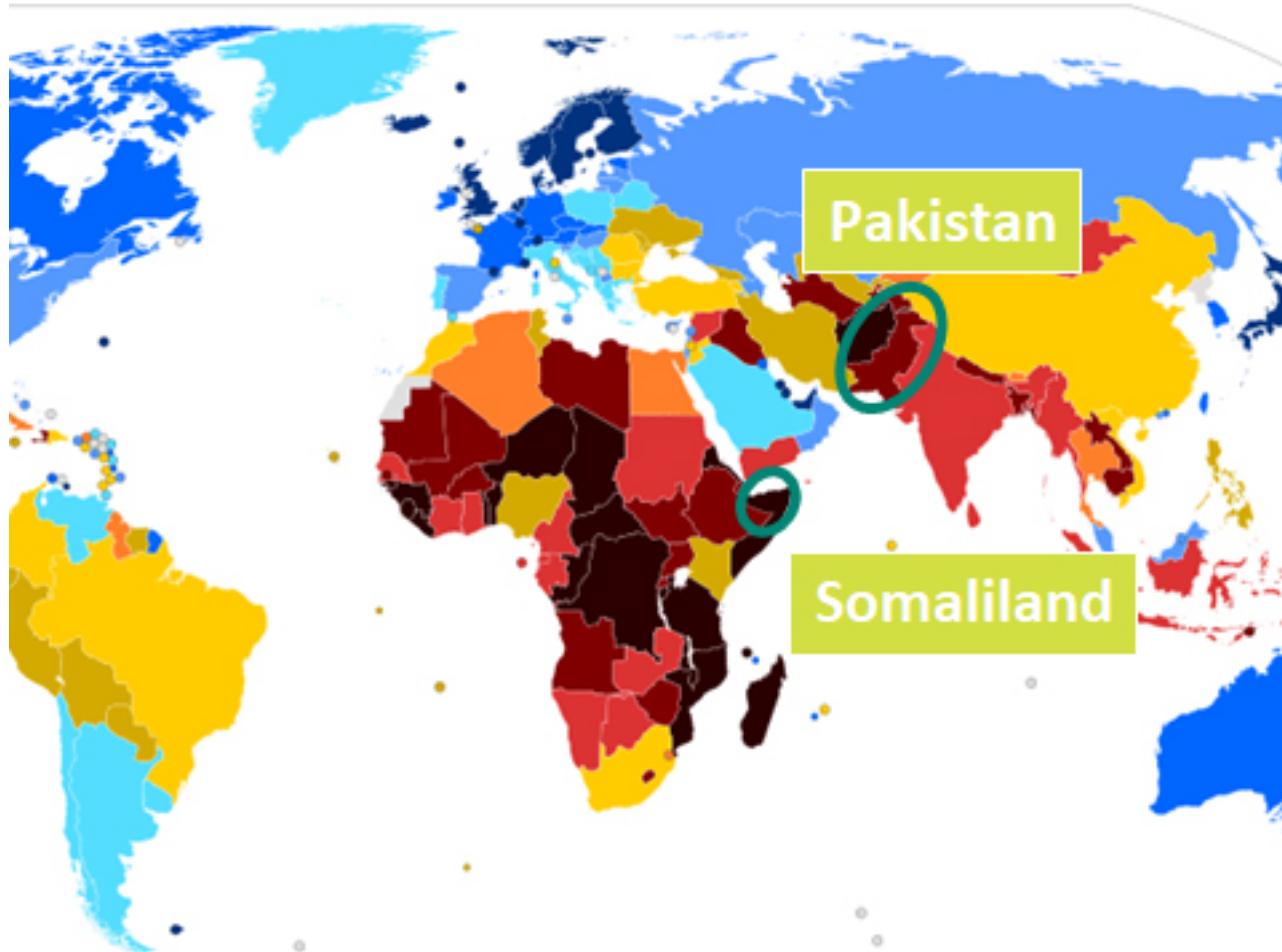


# Embedding Data Sharing in Biodiversity Research

Mary E. Barkworth<sup>1</sup> and Neil Cobb<sup>2</sup>

<sup>1</sup>Intermountain Herbarium, Biology Department, Utah State University

<sup>2</sup>Merriam Powell Center for Environmental Research, Northern Arizona University



Pakistan (1961, 1972)

~20 herbaria

Almost completed flora

Mostly by Pakistani botanists

Somaliland (1991, not recognized)

First university in 1998

First museum/herbarium (HARG) 2018

No taxonomy programs

rk, based on figures from the Wikipedia:List of countries by number of Internet users article in the English Wikipedia, which is in turn based on figures from the International Telecommunications Union (ITU) for 2010 (updated to use figures for 2012 on 28 June 2013). The source code of this SVG is valid. The specified vector image was created with a text editor. This vector image includes elements that have been taken or adapted from this:

BlankMap-World6.svg., CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=19202338>



> 1 billion records

Geographic distribution uneven

Provider distribution more uneven

Concern

Unevenness limits utility

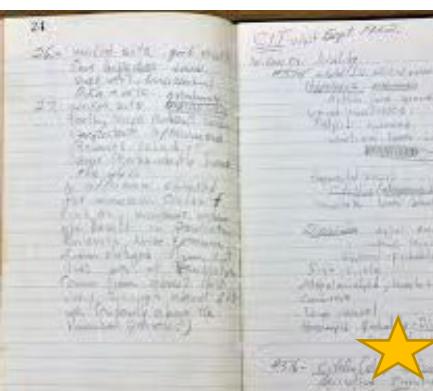
**People** not learning to use  
today's resources and tools

# Obstacles

- No benefit seen
- Lack of know how
- Choosing software
- Cost
- Internet access



It starts in the  
field





## People

Students  
Educators  
Professionals  
Public

Collections  
Institutions  
Governments  
NGOs



## Education



## Flexible input

Live – via browser  
Upload csv from  
Institutional  
database  
Spreadsheet  
[SPINDEL]



## Low learning curve?

- 18 independent networks with 2-300 collections
- Over 7 million records
- Data capture by
  - Undergraduates
  - Inmates, past and present
  - Public
  - Staff

## Embedded tools

- Data cleaning
- Geolocate
- Links to
  - EoL
  - GenBank (bidirectional)
- Crowd-sourcing
- Semi-directed keys



## Teaching checklists

**Intermountain Region Herbarium Network**

PSC 5550/6550 Set 4 Weeds

Authors: Corey V. Ransom and Heather Elwood  
More Details

Families: 18 Genera: 24 Species: 25 (species rank) Total Taxa: 25 (including subspp. and var.)

Options: Search: Common Names, Synonyms  
Filter: Original Checklist, Common Names, Check as species, Show Taxa Alphabetically, Rebuild List, Print, Export

**Current node:** Flowers radially symmetric; petals not overlapping in bud; stamens as many or twice as many as the petals or numerous; leaves almost always bipinnate, sometimes reduced to a simple or entire blade-like phyllode; seeds normally with an areole on each side.

**Remaining items (87):**

- Abrus ►
- Acacia ►
- Adenopodia
  - Adenopodia rotundifolia
- Aeschynomene ►
- Afzelia
  - Afzelia quanzensis
- Albizia ►
- Alysicarpus ►
- Arachis
- Argylolobium ►
- Arthocarpum
  - Arthocarpum somalense
- Baobinia ►

**Path:**

Flora of Western Regions > PSC 5550/6550 Set 4 Weeds

**Images:**

- Toxicodendron rydbergii [ANACARDIACEAE]
- Conium maculatum [APIACEAE]
- Asclepias speciosa [ASCLEPIADACEAE]
- Ambrosia artemisiifolia [ASTERACEAE]
- Carduus nutans
- Cirsium arvense
- Cirsium vulgare
- Grindelia squarrosa
- Iva xanthifolia
- Oenopodium acanthium
- Lepidium latifolium [BRASSICACEAE]
- Dipsacus fullonum [CAPRIFOLIACEAE]

## Post keys & link to taxon pages

**KeyBase** Teaching old keys new tricks...

Barkworth | Manage account | Log out

**Flora of Somaliland and Somalia: Fabaceae genera**

By: Thulin, M.  
Adapted from: Thulin, M. (1993). Fabaceae. In: Thulin, M. (Ed.), *Flora of Somalia 1*, pp. 341-465. Royal Botanic Gardens, Kew, Whitstable, U.K. Published with permission.

Interactive Bracketed Indented About

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- Arachis
- Argylolobium ►
- Arthocarpum
  - Arthocarpum somalense
- Baobinia ►

**Path:**

Discarded items (0)

## Other benefits

Better field notes  
More collaborations  
Vouchered checklists  
Localized keys

## Taxon pages

**Open Herbarium** An Open Vascular Plant Herbarium Network

**Parkinsonia aculeata** L.

M. Thulin Somali Uses

Flora of Somalia 1: 348

**Plants** evergreen shrubs or trees up to 6 m tall, with slender, often pendulous branches. **Leaves** with short petioles and rachises, the rachises extended into a straight, well-developed spine, with 1-3 pairs of pinnae with flattened rachises, each pinna with many, opposite to alternate leaflets; **leaflets** 2-7 mm long, 1.2-2.5 mm wide, oblong to oblong-elliptic, glabrous. **Racemes** up to 20 long, lax. **Flowers:** **sepals** 6-7 mm long; **petals** 8-12 mm long, 6-8 mm wide, ovate-rhombic, yellow, the upper one with red markings, a rounder blade and longer claw. **Pods** 3-15 cm long, 0.6-0.8 cm wide, constricted into oblong or elliptic segments, pointed or beaked, the sides coriaceous, diagonally striate, eventually dehiscent along the upper stipe; **seeds** 7.5-10 mm long, 3.5-4 mm wide, oblong-ellipsoid, brownish, sometimes mottled.

*Parkinsonia aculeata* is native to tropical and subtropical America but it is widely cultivated as an ornamental species, for shade, and as a

**Images:**

- Giant Sheba
- Hectomichus
- Stem Sheba
- Hectomichus
- Hectomichus

**Map:** Open Interactive Map

**Data density dependent Specimen heat maps**  
[Taxon & clade heat maps]  
[Phenology predictor]



# Education – beyond how to

## Objectives

- Understand concepts critical to biodiversity data sharing
- Be familiar with online resources for sharing biodiversity data
- Create online resources for engaging others with a region's/group's taxonomic diversity
- Encourage structured collaboration
- Develop at least two presentations on the resource(s) developed

## Structure

- One semester 3 credit class offered as modules.
- Online, face to face, or combination
- Projects may be collaborative but presentations individual



- Joining an existing network
  - Currently FREE but network-level policy
    - Expand taxonomic and geographic backbone
    - Add regional/taxonomic URL
    - Preprinted barcodes
  - Many online help resources
  - Symbiota working group
  - [Formal teaching modules]
- Currently, iDigBio hosts all networks

## Funding Sources for Symbiota Projects



Ministry of the Environment  
Government of Japan



Various other government & non-government organizations



# Thank you

## Individuals

Ed Gilbert  
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Abdur Rashid  
Zahid Ullah  
Mustaq Ahmad  
Lubna Fareed  
Mohammad Qaiser  
  
Niels Klazenga

## Organizations and resources

Pakistan Higher Education Commission  
Pakistan Science Foundation  
Biodiversity Information Fund for Asia  
National Science Foundation  
  
Global Biodiversity Information Facility  
Nomenclatural databases  
Collection managers





# Pakistan



