100 Uses for an Herbarium (Well at Least 72)

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For the past year or so I have been keeping a list of uses of herbaria. Two recent events have greatly increased that list. First, I published an article titled "The Importance of Herbaria" (Funk 2003) and a number of my colleagues sent in additional uses. Second, I attended a "Workshop to Produce a Decadal Vision for Taxonomy and Natural History Collections" (held in Gainsville, Florida, sponsored by NSF). In preparing for the workshop the list increased to ca. 50 and during the workshop additional uses were mentioned and the current total is 72. Hopefully the list will have 100 after this article is published. This list would not have been possible without the help of many colleagues and I thank them all. If you would like to use this list you can download it on line at the Biological Diversity of the Guianas web site HTTP://www.mnh.si.edu/biodiversity/bdg/ but please send any additions to me so that I can update the site.

Herbaria, dried pressed plant specimens and their associated collections data, ancillary collections (e.g., photographs) and library materials, are remarkable and irreplaceable sources of information about plants and the world they inhabit. They provide the comparative material that is essential for studies in taxonomy, systematics, ecology, anatomy, morphology, conservation biology, biodiversity, ethnobotany, and paleobiology, as well as being used for teaching and by the public. They are a veritable gold mine of information and the foundation of comparative biology. According to the updated website of Index Herbariorum (Holmgren & Holmgren, 2003), there are 3240 herbaria in the world. Just in the USA there are more than 60 million specimens in 628 herbaria (Funk and Morin, 2000). At the US National Herbarium (National Museum of Natural History, Smithsonian Institution) there are nearly 5 million specimens, and, just for the record, about 500,000 of the US specimens are in the Compositae.

Recent articles have highlighted the problems that are being faced by state and university natural history collections, including herbaria. An article from Nature (Dalton, 2003) and one from BioScience (Gropp, 2003) make it clear that natural history collections are being targeted unfairly in the current budget crises in states and universities. From Los Angeles to Iowa, Nebraska and Virginia, natural history collections are being closed or given away and the staff either re-assigned or fired. All of this has a negative impact on our ability to train systematists (Gropp 2003) and causes much concern over the fate of organismal biology. Hopefully lists such as this one will help those fighting to save their collections from death or dismemberment.

An herbarium can be used to:

Basic Functions & Research

1. discover or confirm the identity of a plant or determine that it is new to science (taxonomy);
2. document the concepts of the specialists who have studied the specimens in the past (taxonomy);
3. provide material for making morphological measurements (taxonomy, systematics);
4. provide locality data for planning field trips (taxonomy, systematics, teaching);
5. provide data for floristic studies (taxonomy);
6. serve as a repository of new collections (taxonomy and systematics);
7. provide data for revisions and monographs (systematics);
8. verify plant Latin names (nomenclature);
9. serve as a secure repository for "type" specimens (taxonomy);
10. provide infrastructure for obtaining loans etc. of research material (taxonomy and systematics);
11. facilitate and promote the exchange of new material among institutions (taxonomy);
12. allow for the documentation of flowering and fruiting times and juvenile forms of plants (taxonomy, systematics, ecology, phenology);
13. provide the basis for an illustration of a plant (taxonomy and general publishing);
14. provide material for DNA analysis (systematics, evolution, genetics);
15. provide information for GIS studies of past and future collecting expeditions (taxonomy, ecology, etc.);
16. house vouchers for photographs that can be used in lectures, web sites, and publications (taxonomy);
17. provide information on rare, extirpated, or extinct species that can no longer be found in nature (taxonomy, conservation biology);
18. provide modern specimens for comparisons with fossils (e.g. classification of leaf patterns; paleobotany);
19. to trace the history of usage of binomials for a given taxon in a given area (local flora);

Related Research - Collections are the lynchpin of biological research

20. provide pollen for taxonomic, systematic, and pollination studies as well as allergy studies (taxonomy, systematics, pollination ecology, insect ecology, and medical studies);
21. provide reference samples for the identification of plants eaten by animals (animal ecology);
22. determine native ranges and document which plants grew where through time (invasive species, climate change, habitat destruction, etc.)
23. document what plants grew with what other plants (phytogeography, ecology);
24. provide material for microscopic observations (anatomy and morphology);
25. document the morphology and anatomy of individuals of a particular species in different locations (environmental variation);
26. serve as a repository for voucher specimens (ecology, ethnobotany, environmental impact studies, etc.);
27. provide material for chemical analysis (lead-uptake; pollution documentation; bio-prospecting, for coralline algae - determining past ocean temperatures and chemical concentration);
28. provide information for studies of expeditions and explorers (history of science);
29. provide the label data and field notebooks necessary for accurate data-basing of specimens (biodiversity and conservation biology, biogeography);
30. serve as a reference library for the identification of parts of plants (e.g., seeds) found in archeology digs (paleoethnobotany);
31. provide context for accompanying library and other bibliographic resources (library sciences, general research, taxonomy, etc.);
32. serve as an archive for related material (field notebooks, letters, reprints, etc.);
33. provide information on common names and local uses of plants (anthropology, linguistics, ethnobotany, economic botany);
34. provide insect collections that have been incidentally collected along with the plants (entomology,

ecology);
35. serve as a means of locating rare or possibly extinct species via recollecting areas listed on label data (conservation biology, environmental impact statements, endangered species, etc.);
36. provide information on plant predators (e.g., leaf miners, leaf-cutter ants; entomology, ecology);
37. establish the presence and distribution of plant diseases (e.g. anther-smut);
38. track introduction and spread of invasive species (ecology);
39. document CO2 change over past 10,000 to 10,000,000 years, a more precise proxy for this than ice core data (climate change);
40. provide information for foliar physiognomy studies of leaf form as it is related to climate change (paleoecology);
41. to document polyploid populations that occur naturally by leaf and epiderml stomatal complex size (phylogeography, paleoecology);
42. to document fungal/vascular plant symbionts;
43. to document biogeography of past plant distributions including regional extinctions (paleobiogeography);
44. document the evolution of major groups of vascular plants (paleobotany);
45. document minor cycles in climate (paleoecology);
46. provide carbon isotope ratios (e.g., Lewis and Clark specimens from 200 years ago have increased C12) (climate change);

Education & Training

47. provide material for teaching (botany, taxonomy, field botany, plant communities; ethnobotany; agriculture; dendrology, forestry);
48. promote appreciation of botanical diversity by making specimens available for viewing by students, researchers, and the public.
49. provide internship and job opportunities for undergraduate and graduate students
50. provide opportunities for students and young scientists to meet more established scientists;
51. expose students to systematic research;
52. train local volunteers for specimen handling, scanning, and databasing etc.;
53. run education courses for the public (e.g. local plant families);

Outreach

54. serve as an identification center for all kinds of plants parts for many different groups of individuals, e.g., samples for the identification of plants that may be significant to criminal investigations (forensics);
55. serve as an educational tool for the public (garden clubs, school groups, etc.);
56. provide a focal point for botanical interactions of all types (lectures, club meetings, etc.);
57. provide samples for museum and educational exhibits;
58. provide a location for government and state agencies to work on specimens, i.e., USDA, USGS, NPS;
59. provide a home for long-term initiatives (e.g. Smokey Mt. NP ATBI);
60. provide a home for global, regional or local studies;
61. help establish new museums;
62. foster good international relations (e.g. sister institutions, joint field tribs);
63. provide material for the public (e.g. accurate illustrations);
64. provide inspiration for painters;
65. interact with the local people to form volunteer groups for conservation efforts;
66. maintain websites for dispersing specimen information, databases, images, public service information;
67. repatriate data and images from collections to the country where they were collected (international relations);
68. help artists prepare accurate drawings for children's books;
69. provide information on the wild relatives of cultivated plants;
70. facilitate international exchanges of field expeditions;

Money Making Ventures?

71. organize photographs of plants associated with voucher collections;
72. help design natural history products for sale in gift shops (e.g. old illustrations for note cards).

At the US National Herbarium, in order to make maximum use of our substantial resources, we have the following goals: additional compacterization of collections to increase storage space, processing of the backlog of unmounted specimens so all material is available, continuing to photograph the type specimens so our most important collections will be available on the web, and data-basing and geo-referencing the specimen label information so it can be efficiently used and be made available on line. I am sure other herbaria have similar goals, we must all work together to stress the importance of herbaria and preserve our collections for the future. Indeed the "working together" has already started. A recent NSF sponsored workshop addressed some of the problems that are facing collections and discussed possible solutions. The "Workshop to Produce a Decadal Vision for Taxonomy and Natural History Collections" (held in Gainsville, Florida, organized by Larry Page) involved 61 people from institutions of all sizes. A report will be produced for NSF and a more general public version will also be available. The website for that meeting has some information posted and more will be available in the near future (Page, 2003).

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