

***NPLichen*: A Database of Lichens in the U. S. National Parks**

2005 Final Report

James P. Bennett
U. S. Geological Survey
Nelson Institute for Environmental Studies
University of Wisconsin
Madison, WI 53706

Clifford M. Wetmore
Department of Plant Biology
University of Minnesota
St. Paul, MN 55108

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Summary

This report describes the history of the development of *NPLichen*, a database of lichens of the U. S. National Parks, followed by a description of the steps taken to upgrade the database. Since beginning this project in 1992, we have increased coverage by adding more parks, species, and references. The new version is now available as a live database on the internet. A summary of statistics on each park is provided, as well as a discussion of potential errors in the data. Finally, disclaimers on the use of the data are provided, and suggestions for updates and recommendations for future work.

Introduction

The first version of *NPLichen* (NPL) was made available in 1992. To produce that database most of the lichen literature prior to, and including 1991 was searched for references to lichens in the U.S. National Parks. Queries were also sent to most of the natural resource parks (cultural resource parks were not queried) asking for reports of lichens in their parks. The literature search included all issues of *The Bryologist*, *Lichenologist*, *Mycotaxon*, and *Bibliotheca Lichenologica*, and all of the lichenological reprints in C. Wetmore's library. Other references cited in these publications were also checked. In addition, all of the lichens collected in parks that were deposited in the University of Minnesota Herbarium were included.

The first version of NPL consisted of text files, which were produced by writing programs in BASIC. These files were then accessed on-line by file name links. The final report (Wetmore & Bennett 1992) gave a summary of the content, a table of the estimate of completeness of lichen knowledge in the parks, and all the references used in preparing the data files.

The original NPL listed lichens from 93 of the then 360 park units. There were 288 papers cited reporting lichens from 87 park units. (Six parks were included with no data from papers, but from the Minnesota herbarium or park lists.) Lichen names were standardized to the Egan checklist (1987, 1989, 1990).

During the past thirteen years, much change has occurred in lichenology and our knowledge of the lichens in the parks. New parks have been added to the National Park system, more collecting has occurred in the parks, and many monographic and floristic studies have been done that cited lichens from parks. In addition, many of the older genera and species have been split into smaller units and there have been many name changes in the literature. Another big change has been in the availability of more sophisticated computer software and hardware. In 2002 we began to update the data. One thing lacking in the first version of NPL were linked references for the occurrences in each park for every species. These linked references were added to the new version because of many requests for this information. This necessitated taking a whole new approach to the database structure. A database version of NPL was also created on the world wide web for easy access.

Methods

For the second version of *NPLichen*, we conducted a literature search similar to the earlier search, but for 1990 through 2004. In addition, many more lists from parks were included as a result of contacts between the authors and park staff, and a request for park data on the lichen list server.

Microsoft *Access* was used for the updated database. Data were stored in seven tables using a relational database structure (Appendix 1, which shows the relationships between the core four tables).

The first step in updating the database was to create a look-up table to produce current names from the North American Checklist. We downloaded the March 2004 version of the North American Checklist (Esslinger 1997) and edited it to form an *Access* table. Some outdated synonyms needed for some taxa were added to this table. This table also included the authorities for all names, which are used in the retrieval reports.

Then the lichen lists and literature from the first version of NPL were converted into *Access* tables and as the literature was searched taxa names and references were added to these tables. The new retrievals from the University of Minnesota Herbarium database and the lichen lists from *NPSpecies*, the official National park species list (*NPSpecies*), were added to the species table.

Data recorded in the species table included the lichen name (without authority), the park code, the reference code, whether the concept of the species was described from a specimen collected in that park (type), and whether the record had been verified within the boundaries of that park. In some cases the same lichen was reported from a park by numerous references or sources. For records from lists received from the parks or from *NPSpecies*, the reference was given as *Park List*. For records from the University of Minnesota Herbarium, the reference was given as *MIN Herbarium*.

The species table was then processed with the Checklist look-up table to produce a list of only the current names. Those names that were not in the Checklist look-up table were moved to

two other tables and excluded from the table of accepted names. Some of these excluded names were recently described species or recently reported for the first time from North America and were not in the Checklist. These were placed in a separate table of species new to North America. Other names have been shown by lichenologists not to occur in North America or were assumed to be misidentifications and were placed in a table of misidentified species.

The final tables in the database are:

MISIDENTSPECIES - excluded species that are misidentified or known not to occur in North America

NEWNASPECIES - species that are published but are not yet in Esslinger's checklist

PARKS – four-letter acronym for each park, the complete park name, and the state(s) in which the park is located

REFERENCES – the reference code used in the SPECIES table and the full citation

SPECIES – records of species from every park with a reference code for each occurrence

SPLOOKUP – accepted names, synonyms and authorities for North America, based on Esslinger's checklist

SUMMARY – a table listing the parks by acronym and summarizing relevant information about each park including the number of records, taxa, and types, and an estimate of how well each park is known

Results

Database statistics

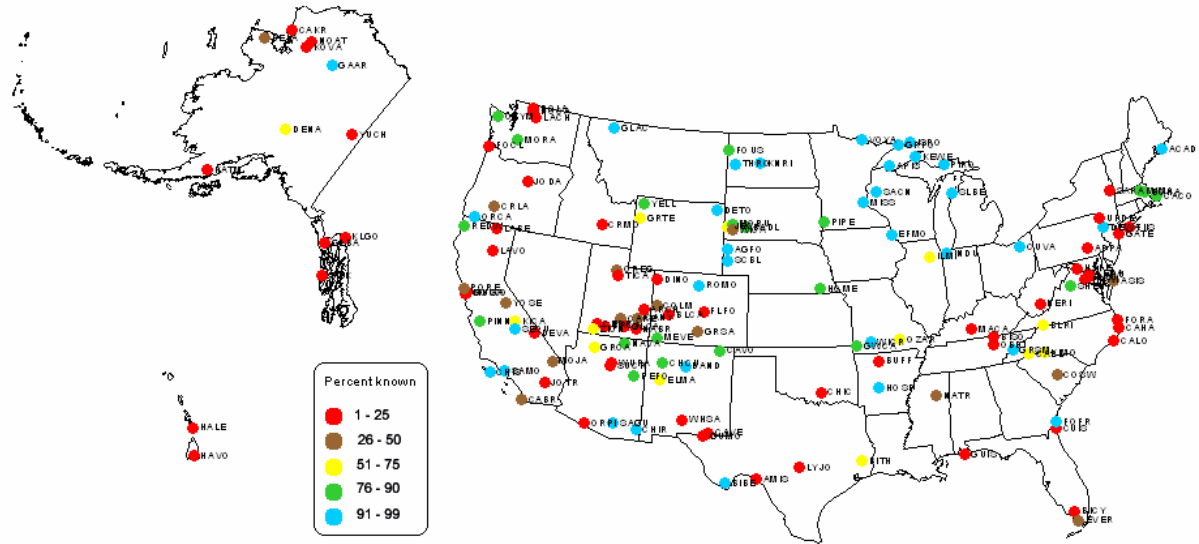
As of this writing, the database contains 25,995 records of lichens in 144 National Park units from the SPECIES table. The number of records of lichens from the new to North America table is 161, for a total of 26,156. These records include multiple occurrences of a species in some parks because more than one reference has reported presence of species. Consequently, the number of species in parks records (including new to North America) without these duplicate references is 14,986. Our table of misidentified taxa contains 307 records.

The number of genera in the database is 375, and the number of taxa (species + infra-species) is 2435. This represents roughly 74% and 68% respectively of the North American flora. There are 6655 taxa in the species lookup table constructed from the North American checklist, including synonyms.

The total number of references cited in the database is 453. The number of references per park ranged from 1 (several parks) to 66 (Isle Royale) and averaged 8.5.

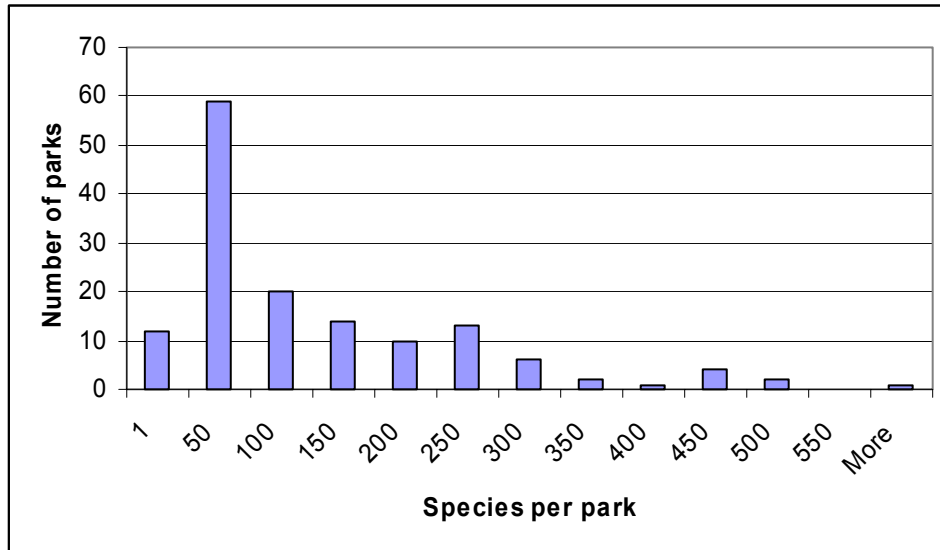
The 144 parks in the database are found in 43 states and Washington, D.C. (Fig. 1) The seven states with no lichen data in National Park units are Connecticut, Delaware, Louisiana, Nevada, New Hampshire, Rhode Island and Vermont. Kansas has no park marked in the figure but does contain part of the Oregon Trail.

Figure 1. Map of locations of 144 parks in *NPLichen*. Color of dot indicates the percentage of lichens documented occurring or estimated to occur (park codes appear in Table 1).



The average number of lichen species per park is 104, while the median is 60. This high average compared to the median is due to the distribution of species per park being skewed to the right, there being a small number of parks with large numbers of species (Fig 2). Lichens in most parks are not well known.

Figure 2. Frequency distribution of number of species per park.



Our database contains 1,318 unverified species/park occurrences, which is only 5% of the total number of records. There are 115 records of type localities in 29 park units. Great Smoky

Mountains has the most number of types (25), followed by Channel Islands (18) and Santa Monica Mountains (16).

Internet version

This version of NPL is available on the world wide web as a live database (www.ies.wisc.edu/nplichen) instead of static text files. The *Access* database tables are converted to an SQL database using *MyDbConverterPro*. These files are then delivered to a network server at the University of Wisconsin. The website is composed of ten files written in *HTML* and *PHP*, the latter a general-purpose server-side scripting language for website development, which displays the introductory page and the query options to visitors, as well as running the specific database queries (below). The opening page contains a brief description of the database, credits, queries, contact information, and a website visit counter.

Three queries are available at the website. The first displays a list of parks in the database in a drop down box. After selecting a park, the visitor must select if they want the species list of or the list of references for that park using clickable bullets. Then the visitor clicks a submit button to submit the park name and a report is generated displaying the list of lichens in that park or the reference list. The species list includes three parts: a list of accepted names, a list of taxa not in the North American Checklist, and a list of misidentified taxa. Tallies of the total number and the number of references are also given. The date of the report is given at the bottom with an appropriate credit. Each species list displays the name of the taxon, the authority, the reference code for the citation, whether or not it is a type, and whether or not it has been verified in the park (see above). The reference list simply lists all the references for the park selected in one list, along with a tally of how many references there are and a footer giving the date the report was run.

The second query displays a drop down box of the species, and after the visitor submits a name, the resulting report displays the parks in which that species is found. The park name is displayed, followed by the same columns of reference code, type, and whether it has been verified or not, as in the previous report. Tallies are also given. Parks in which the species has been listed wrongly (i.e., misidentifications) are not included in this result set.

The third query retrieves either the full citation for any reference code in the database or the full species list from that reference, using clickable bullets. After the visitor selects the reference code from the drop down box, the resulting report simply displays the full citation or the list of species from that reference. Multiple citations are not displayed.

Some reports are generated immediately, while others take longer. This is because parks with large numbers of species take longer to compile the report. The queries operate on multiple tables and then merge the results into the final report. A summary table of the numbers of taxa in each park, the number of references, how many taxa are verified, and other data is included as a link on the website (see Table 1 below).

Formatted reports can be printed directly from the web page using the visitor's browser print command. If different formats are desired, the user can cut and paste the report content into a client word processing program for this purpose.

Other links on the website include a link to Esslinger's North American Checklist website, a link to the National Park Service website, a link to the United States Geological

Survey website, a link to this report in the form of a PDF, and links to the new to North America and the misidentified species tables.

The website has been designed to conform with the University of Wisconsin website accessibility policy. University websites are required to conform to the Guidelines of the World Wide Web Consortium (W3C) and the standards of the Federal Rehabilitation Act (Section 508) as the standards for World Wide Web accessibility and compliance with the Americans with Disabilities Act. The website was manually checked against the standards listed above and was also tested using *Bobby*, <http://bobby.watchfire.com>, a web accessibility software tool that can be used to test a website's compliance with accessibility guidelines.

Discussion

Knowledge status, assumptions, and definitions

The status of lichen knowledge of each park is shown in Table 1. This was based only on the verified reports and an estimate of the potential total lichen flora of that park. We determined the potential lichen flora of a park from parks in the same region of the country that have been well studied, and from our working knowledge of lichens across the country. We then grouped these estimates into five ranges: 1 - 25, 26 - 50, 51 - 75, 76 - 90 and 91 - 99% known. These are not precise numbers, only estimates.

Table 1. Summary statistics on lichens in 144 national park units.

Park code	Park name	Number of references	Total number of taxa	Percent known	Park location unverified	Park location verified	Total number of records	Number of types
ACAD	Acadia	35	429	91 - 99	6	909	915	
AGFO	Agate Fossil Beds	4	69	91 - 99		133	133	
AMIS	Amistad	1	1	1 - 25		1	1	
APIS	Apostle Islands	12	324	91 - 99		994	994	
APPA	Appalachian	1	2	1 - 25		2	2	
ARCH	Arches	6	26	1 - 25		42	42	
ASIS	Assateague Island	1	37	26 - 50		37	37	
BADL	Badlands	8	178	76 - 90		336	336	
BAND	Bandelier	3	208	91 - 99		211	211	
BELA	Bering Land Bridge	1	146	26 - 50		146	146	
BIBE	Big Bend	39	277	91 - 99		515	515	3
BICY	Big Cypress	4	11	1 - 25		19	19	
BISO	Big South Fork	1	1	1 - 25		1	1	
BITH	Big Thicket	8	114	51 - 75		248	248	
BLCA	Black Canyon of the Gunnison	4	10	1 - 25		10	10	
BLRI	Blue Ridge	13	236	51 - 75	3	323	326	
BOHA	Boston Harbor Islands	4	173	76 - 90		181	181	
BRCA	Bryce Canyon	3	3	1 - 25		3	3	
BUFF	Buffalo	1	18	1 - 25		18	18	
CABR	Cabrillo	1	43	26 - 50		43	43	

Park code	Park name	Number of references	Total number of taxa	Percent known	Park location unverified	Park location verified	Total number of records	Number of types
CACO	Cape Cod	3	112	76 - 90	92	23	115	
CAHA	Cape Hatteras	1	1	1 - 25		1	1	
CAKR	Cape Krusenstern	1	75	1 - 25		75	75	
CALO	Cape Lookout	3	27	1 - 25		29	29	
CANY	Canyonlands	7	40	26 - 50		52	52	
CARE	Capitol Reef	5	37	26 - 50		43	43	
CARL	Carl Sandburg Home	1	73	51 - 75		73	73	
CAVE	Carlsbad Caverns	1	2	1 - 25		2	2	
CAVO	Capulin Volcano	5	40	76 - 90		48	48	
CEBR	Cedar Breaks	1	3	1 - 25		3	3	
CHCU	Chaco Culture	8	126	76 - 90		154	154	1
CHIC	Chickasaw	5	22	1 - 25		26	26	
CHIR	Chiricahua	20	247	91 - 99	183	123	306	4
CHIS	Channel Islands	43	209	91 - 99		312	312	18
COLM	Colorado	13	67	26 - 50		71	71	
COSW	Congaree Swamp	1	81	26 - 50		81	81	
CRLA	Crater Lake	13	65	26 - 50		88	88	1
CRMO	Craters of the Moon	2	23	1 - 25		24	24	
CUIS	Cumberland Island	1	15	1 - 25	1	14	15	
CUVA	Cuyahoga Valley	5	73	91 - 99		136	136	
DENA	Denali	23	254	51 - 75		440	440	
DETO	Devils Tower	3	130	91 - 99	65	79	147	1
DEVA	Death Valley	4	11	1 - 25		13	13	
DEWA	Delaware Water Gap	25	229	91 - 99	1	513	514	
DINO	Dinosaur	14	23	1 - 25		27	27	1
EFMO	Effigy Mounds	6	83	91 - 99		162	162	
ELMA	El Malpais	4	87	51 - 75		88	88	
EVER	Everglades	13	112	26 - 50		157	157	
FIIS	Fire Island	2	12	1 - 25	7	5	12	
FLFO	Florissant Fossil Beds	1	1	1 - 25		1	1	
FOCL	Fort Clatsop	1	4	1 - 25		4	4	
FOFR	Fort Frederica	2	45	91 - 99		86	86	
FORA	Fort Raleigh	1	1	1 - 25		1	1	
FOUS	Fort Union Trading Post	2	42	76 - 90		82	82	
GAAR	Gates of the Arctic	13	438	91 - 99		954	954	2
GATE	Gateway Arch	1	2	1 - 25		2	2	
GLAC	Glacier	36	469	91 - 99		897	897	
GLBA	Glacier Bay	10	69	1 - 25		118	118	
GLCA	Glen Canyon	1	10	1 - 25		10	10	
GOGA	Golden Gate	2	3	1 - 25		3	3	
GRCA	Grand Canyon	28	248	51 - 75		420	420	6
GRPO	Grand Portage	7	197	91 - 99		555	555	
GRSA	Great Sand Dunes	6	10	26 - 50		10	10	
GRSM	Great Smoky Mountains	54	397	91 - 99		749	749	25
GRTE	Grand Teton	9	221	51 - 75		247	247	
GUIS	Gulf Islands	1	10	1 - 25	5	5	10	
GUMO	Guadalupe Mountains	1	1	1 - 25		1	1	

Park code	Park name	Number of references	Total number of taxa	Percent known	Park location unverified	Park location verified	Total number of records	Number of types
GWCA	George Washington Carver	4	43	76 - 90		76	76	
HAFE	Harpers Ferry	1	1	1 - 25		1	1	
HALE	Haleakala	1	49	1 - 25		49	49	
HAVO	Hawaii Volcanoes	2	14	1 - 25		15	15	
HOME	Homestead	3	19	76 - 90		39	39	
HOSP	Hot Springs	6	212	91 - 99		431	431	
ILMI	Illinois & Michigan Canal	1	50	51 - 75		50	50	1
INDU	Indiana Dunes	6	69	91 - 99		200	200	
ISRO	Isle Royale	66	611	91 - 99		1623	1623	2
JECA	Jewel Cave	4	143	51 - 75	85	64	150	1
JODA	John Day Fossil Beds	1	2	1 - 25		2	2	
JOTR	Joshua Tree	6	7	1 - 25		8	8	
KATM	Katmai	2	7	1 - 25		8	8	
KEPA	Kenilworth	1	6	1 - 25		6	6	
KEWE	Keweenaw	3	245	91 - 99	323		323	
KICA	Kings Canyon	6	107	51 - 75		207	207	
KIMO	Kings Mountain	1	123	51 - 75		123	123	
KLGO	Klondike Gold Rush	2	16	1 - 25	6	10	16	
KNRI	Knife River Indian Villages	6	50	91 - 99		100	100	
KOVA	Kobuk Valley	1	48	1 - 25		48	48	
LABE	Lava Beds	3	6	1 - 25		7	7	
LACH	Lake Chelan	4	21	1 - 25		41	41	
LAVO	Lassen Volcanic	5	9	1 - 25		9	9	
LYJO	Lyndon B. Johnson	1	3	1 - 25		3	3	
MACA	Mammoth Cave	4	44	1 - 25		44	44	
MEVE	Mesa Verde	19	158	76 - 90		241	241	1
MIMA	Minute Man	1	102	76 - 90		102	102	
MISS	Mississippi	1	128	91 - 99	128		128	
MOJA	Mojave	1	39	26 - 50		39	39	
MORA	Mount Rainier	34	168	76 - 90		266	266	5
MORU	Mount Rushmore	3	208	76 - 90	200	14	214	
MUWO	Muir Woods	1	10	1 - 25		10	10	
NABR	Natural Bridges	2	3	1 - 25		3	3	
NATR	Natchez Trace	1	40	26 - 50		40	40	
NAVA	Navajo	8	99	76 - 90		246	246	
NERI	New River Gorge	1	2	1 - 25		2	2	
NOAT	Noatak	1	59	1 - 25		59	59	
NOCA	North Cascades	3	61	1 - 25		87	87	
OBRI	Obed	1	1	1 - 25		1	1	1
OLYM	Olympic	42	294	76 - 90		502	502	2
ORCA	Oregon Caves	1	186	91 - 99		186	186	
OREG	Oregon Trail	1	103	26 - 50		103	103	
ORPI	Organ Pipe Cactus	12	14	1 - 25		20	20	1
OXRU	Oxon Run	1	5	1 - 25		5	5	
OZAR	Ozark	6	184	51 - 75		200	200	
PEFO	Petrified Forest	4	111	76 - 90		116	116	
PINN	Pinnacles	10	102	76 - 90		109	109	1

Park code	Park name	Number of references	Total number of taxa	Percent known	Park location unverified	Park location verified	Total number of records	Number of types
PIPE	Pipestone	5	75	76 - 90		120	120	
PIRO	Pictured Rocks	9	264	91 - 99		734	734	
PISC	Piscataway	1	9	1 - 25		9	9	
PORE	Point Reyes	20	100	26 - 50		112	112	4
PRWI	Prince William Forest	1	1	1 - 25		1	1	
REDW	Redwood	4	165	76 - 90		200	200	
ROLA	Ross Lake	1	1	1 - 25		1	1	
ROMO	Rocky Mountain	58	401	91 - 99		713	713	3
SACN	Saint Croix	14	306	91 - 99		635	635	
SAGU	Saguaro	20	294	91 - 99		540	540	1
SAMO	Santa Monica Mountains	11	238	91 - 99	188	70	258	16
SARA	Saratoga	1	10	1 - 25		10	10	
SCBL	Scotts Bluff	8	74	91 - 99		142	142	
SEQU	Sequoia	26	250	91 - 99		588	588	1
SHEN	Shenandoah	25	207	76 - 90		430	430	3
SITK	Sitka	3	20	1 - 25		20	20	
SLBE	Sleeping Bear Dunes	6	195	91 - 99		393	393	
SUCR	Sunset Crater Volcano	1	4	1 - 25		4	4	
THRO	Theodore Roosevelt	23	251	91 - 99		467	467	2
TICA	Timpanogos Cave	1	1	1 - 25		1	1	
UPDE	Upper Delaware	1	1	1 - 25		1	1	
VOYA	Voyageurs	42	496	91 - 99		1142	1142	2
WHSA	White Sands	2	4	1 - 25		5	5	
WICA	Wind Cave	2	67	26 - 50	24	48	72	
WICR	Wilson's Creek	4	91	91 - 99		177	177	
WUPA	Wupatki	1	16	1 - 25		16	16	
YELL	Yellowstone	29	415	76 - 90		992	992	1
YOSE	Yosemite	33	95	26 - 50	1	150	151	5
YUCH	Yukon-Charley Rivers	2	17	1 - 25		18	18	
ZION	Zion	15	183	51 - 75		407	407	

Obviously some parks need further study and some parks have not been studied at all. Priority for future studies should be given to larger parks with significant natural areas in them that are in good to pristine condition. It is our experience that examination of smaller parks rarely adds many new taxa to the park system or the local area. However, if funding is available for smaller parks with natural resources, certainly a lichen study would be appropriate.

In some parks, where most or all of the records are not verified, the estimate of completeness may be misleading because we are not sure if the species are actually in the parks. In addition, some park boundaries are unclear in some areas or are ambiguous because of partnership units, making it difficult to determine if localities are in parks or not. Some of these problem parks include Cape Cod, Chiricahua, Devils Tower, Jewel Cave, Keweenaw, Mississippi, Mount Rushmore, Oregon Trail, and Santa Monica Mountains.

We made a decision not to include herbarium records (from other herbaria than Minnesota) of species in parks for several reasons. First, the job of locating all the specimens from parks in the U. S. would take years. Very few herbaria in this country are computerized. Locating specimens from parks would require manually checking every specimen in many herbaria. In addition, we are aware of more specimens in herbaria in other parts of the world, particularly Europe. Many collectors in the U. S. are from European institutions and have deposited their specimens there.

Second, most collections in herbaria are not published in any form, and therefore they cannot be cited. Users would have no way to determine the validity of the specimen or the location without a reference. The presence/absence of species in parks needs to be documented in published form so they can be cited.

Third, some herbarium specimens that are unpublished are not identified correctly. If they were included there would be a significant percentage of incorrect names listed for parks. This would result in so much error in the lists that their usefulness would be diminished. Publishing records often results in more correct identifications and better lists.

However, the number of unpublished specimens from national parks in various herbaria around the world probably numbers in the thousands, and the number of taxa for the parks probably in the hundreds. It is unfortunate these cannot be included but it does not appear feasible at this time.

Related to this problem is our use of the term “verified” in our tables. This term refers not to species identity, but to whether or not the specimen location was verified to occur within the park boundaries. We were able to do this by checking some locations against park maps, contacting park officials, and checking the original sources. We chose to list species that were *probably* in the park as unverified if we could not determine the exact location relative to the park boundary but we knew it was in the vicinity; if the park boundary was undefined; or if a park provided the data but did not themselves know the location relative to the boundary. This was done to stimulate future searching for these species within park boundaries. In no way should this indication in the park reports be construed to have anything to do with nomenclature, species identification, or the checking of a voucher specimen.

Sources of error

The lists from this database are not to be regarded as final, definitive lists because of taxonomic and bibliographic problems that cannot be avoided. These include reference redundancies, group names, opinions about splits, and type specimens.

The counts of species from the lists retrieved from this database may not be entirely correct because, in some cases, one report listed a specimen that was later reidentified as a different species. Because all literature citations are included, both accepted names may be in the retrieved lists and only one is correct. This problem exists mostly for parks with more than one reference, and all of the reports are included in the database, e.g., Yellowstone, Big Bend, Isle Royale, and Voyageurs. We estimate about 5% of the records in the database have this problem of redundancy.

Some old names have been divided into one or more smaller species but the old name is still accepted. This means some old species records may be group names, e.g. *Physcia orbicularis* and *Xanthoria fallax*. We estimate that about 2% of the names have this problem.

Some lichenologists do not accept some of the smaller genera in the North American Checklist. Taxonomy is a matter of opinion, and there is no one absolute and “correct” list that everyone agrees with. The Checklist was used only as a point of reference. Therefore, these lists of names include newer generic names that will not be found in other publications on the parks. We estimate that about 1% of the records have this problem.

Where it is indicated that a type specimen was collected in the park, it often means that the type of a synonym was collected in the park and not the type of the older, correct name that is listed. A type of a synonym is just as important for taxonomic purposes as the type of the accepted name. We estimate that about 10% of the types in this database are for synonyms.

Updates and Recommendations

As of the date of this report, we are confident we have included almost all published records of lichen species in units of the National Park system. However, we are also aware of unpublished records in the form of specimens in various herbaria throughout the world. Several investigators have contacted us about these, but, as discussed above, they have not been included. However, whenever any records are published, we will include them in the database if they are sent to us. We ask that anyone reading this report who knows of any new publications listing species in parks to please make us aware of this information.

Likewise, if any parks generate new park lists as the result of new studies we will include those, even if not published, as *Park List* if they are made available to us.

Our lists can be used to determine future studies of park lichens. Obviously parks that are well known do not need intensive floristic work, but parks that are poorly known or not even listed should be studied soon.

NPLichen currently contains over 26,000 records of lichens occurring in National Park units. *NPSpecies*, the official NPS species database, currently contains almost 1,900 records. The nomenclature for *NPSpecies* taxa is not current for all records, and reference citations for the records are not provided for all records.

If lichen data from national parks is provided to us and we locate new data from the literature, we will enter the data in our *Access* database whenever it is thought appropriate. We anticipate updating the data once or twice annually depending on how much data become available. As a general rule, we anticipate updating when data for at least three new parks become available. New specimen data for existing parks will be updated annually, depending on funding.

In addition, if errors are reported to us we will update the *Access* database on an as-needed basis depending on the nature of the errors.

We will update the website annually or more often if more data are available. However, website updates are subject to constraints caused by software changes and updates, which can

cause complications. A change in software compilers can make the existing code not work, necessitating code changes, which take time. The code and database software will be monitored periodically for this problem.

Many other types of reports are possible with this database, but are not available at the website. We will respond to any reasonable requests for different analyses and reports, subject to time being available for the work. Any reports that are requested frequently will be developed into website queries whenever time permits.

Disclaimers

There is no guarantee given by the authors that data provided in NPL are proof that the taxa are actually present in any park unit. The data indicate only that the taxa are present as determined by the original sources. This database only contains secondary source material, and not original presence/absence specimen data. Users are encouraged to contact the original references for specimen data.

There is also no guarantee that the species listed for these parks have been correctly identified. No specimens were examined for this purpose for the creation of the *NPLichen* database. Any information about published corrections to species identities would be most appreciated by the authors.

Finally, the data and the website that serves the data are not in any way officially connected with the National Park Service (NPS). The NPS does not support this database in any official manner.

Literature Cited

- Egan, R. 1987. A fifth checklist of the lichen-forming, lichenicolous and allied fungi in the continental United States and Canada. *Bryol.* 90: 77-173.
- Egan, R. 1989. Changes to the "Fifth checklist of the lichen-forming, lichenicolous and allied fungi in the continental United States and Canada." Edition I. *Bryol.* 92: 68-72.
- Egan, R. 1990. Changes to the "Fifth checklist of the lichen-forming, lichenicolous and allied fungi in the continental United States and Canada." Edition II. *Bryol.* 93: 211-219.
- Esslinger, T. L. 1997. A cumulative checklist for the lichen-forming, lichenicolous and allied fungi of the continental United States and Canada. North Dakota State University: <<http://www.ndsu.nodak.edu/instruct/esslinge/chcklst/chcklst7.htm>> (First Posted 1 December 1997, Most Recent Update 2 March 2004), Fargo, North Dakota.
- NPSpecies: <<http://science.nature.nps.gov/im/apps/npspp>>
- Wetmore, C. and Bennett, J. 1992. NPLICHEN: A National Park Service Lichen Data Base. Final report submitted to National Park Service. 31 pp.

Suggested Citation for website:

NPLICHEN, A Database of Lichens in the U. S. National Parks. [fill in date] version. U. S. Geological Survey. <http://www.ies.wisc.edu/nplichen>. Accessed [fill in date]

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Appendix 1 – Relationships of *NPLichen* tables in *Access*

Relationships for *NPLichen*

Friday, February 18, 2005

