

## Lichens of the U. S. National Parks

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**Abstract.** Over 26,100 records of lichens present in 144 U.S. national park units were assembled from various sources into a database and analyzed. Within these 144 park units 2,435 species and 375 genera are reported, representing 63% and 74% of the North American flora, respectively. The park units are located in 41 states and Washington, D.C. The average number of species in a park is 104, but the median is 60, indicating there are many parks with a small number of species and a few with high numbers. Isle Royale National Park has the most species, 611, and twelve parks have only one species reported. The number of records of lichens present ranged from one for 25 parks, to 1,623 for Isle Royale. *Physcia aipolia* is the most frequently observed species, being found in 65 parks. One fourth of the park units are classified cultural resource parks, while the remainder are considered natural resource parks. This study was based on 453 sources, including literature citations, park reports and collections in the University of Minnesota Herbarium.

**Keywords.** Databases, lichen distributions, lichen floras, national parks, North American Lichen Checklist, *Physcia aipolia*, type localities.

### INTRODUCTION

Lichens have been collected in national parks in the United States probably as long as there have been national parks and lichenologists willing to do it. Anyone going through folders in a lichen herbarium comes across specimens collected in national parks or from localities that became national park units at a later date. It is likely there are hundreds, perhaps thousands, of specimens from national park lands in herbaria across this country and throughout the world. Some of these specimens are recent, while others date back many decades. This represents a resource for documenting lichen diversity over space and time at a national scale, but very few of these specimens are documented in publications or in computerized databases to make them accessible. Lichen distributions range from global to continental to national to regional and finally local in scale, and only some of these are documented. The recent book *Lichens of North America* (Brodo et al. 2001) included small distribution maps for almost 800 species. The 388 national park units in the United States are distributed across the nation, and are useful for mapping biodiversity.

Lichen distributions also change through time, and two species have been listed on the federal endangered species list (*Cladonia perforata* and *Gym-*

*noderma lineare*, <http://endangered.fws.gov/wildlife.html#Species>). Several states also maintain rare and endangered lichen lists, e.g., Minnesota: <http://www.dnr.state.mn.us/ets/lichens.html>; Wisconsin (Bennett & Wetmore 2004); and Michigan (Fryday & Wetmore 2002). Documented occurrences of lichens over time are useful for determining trends in diversity.

National park units are protected areas containing natural and/or cultural resources that are protected from destruction and development on a national scale. Generally national parks are protected more than national forests and wildlife refuges, although wilderness areas wherever they are provided the highest level of protection. Parks therefore represent a resource for documenting biodiversity nationally. This paper details the results of an effort to document the lichens of U.S. national park units for this purpose. Hopefully our efforts will stimulate more collecting and cooperation with the national parks.

In 1992 we made available a database of lichens of the national parks on the world wide web called NPLichen (NPL) (Wetmore & Bennett 1992). To produce that database we searched most of the lichen literature up to 1991 for references to lichens in the U.S. national parks. Queries were also sent to most of the natural resource parks (cultural re-

source 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 the lichenological reprints in C. Wetmore's library. Other references cited in these publications were also checked. In addition, all the lichens collected in parks that were deposited in the University of Minnesota Herbarium were included. The original NPL listed lichens from 93 of the then 360 park units. There were 288 papers cited reporting lichens from 87 park units. Lichen names were standardized to the Egan (1987, 1989, 1990) checklists of North American lichens.

During the past twelve years much has changed in lichenology and our knowledge of the lichens in parks. New parks have been added to the national park system, more collecting has been done 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 the availability of more sophisticated computer software and hardware. In 2002 we began to update the data from the original NPL. In the first version of NPL linked references for the occurrences in each park for every species were lacking. We added these linked references to the new version because of many requests for this information. The resulting database, which is now available on the world wide web (<http://www.ies.wisc.edu/nplichen>; Bennett & Wetmore 2005a,b), is now much larger, contains more data, and has more functionality. We describe in this paper the results of analyzing the new database. For more information on size and the classification of the U.S. national park units please visit the National Park Service website at <http://www.nps.gov>.

#### METHODS

For the second version of NPL the same search was done of the literature from 1990 to the end of 2004. In addition, many more lists from parks were included as a result of contacts between the authors and park staffs, and a request for park data on the lichen list server.

Microsoft *Access* was used to construct and populate the database. Data were stored in seven tables using a relational database structure (FIG. 1).

The first step was to develop a way to deal with synonyms and to standardize names. We created a look-up table of the current names by downloading the March 2004 version of the North American lichen checklist (Esslinger 1997) and edited it to form an *Access* table. Some old synonyms needed for some taxa and some corrections were added to this table. This table also included the authorities for all names, which are used in the retrieval reports. All names in our database are standardized to the North American lichen checklist, whether or not we agreed with the nomenclature included there.

Relationships for NPLichen  
Friday, February 18, 2005

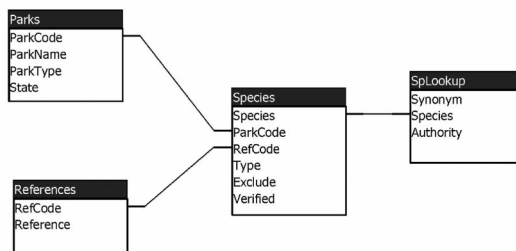


FIGURE 1. Relationships of *NPLichen* tables in *Access*.

Then the lichen lists and literature from the first version of NPL were brought into *Access* tables and as the literature was searched their names and references were added to these tables. The new retrievals from the University of Minnesota Herbarium (MIN) database, in addition to lichen lists from NPSPECIES, the official National Park Service species list (<http://science.nature.nps.gov/im/apps/npspp>), 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 many 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 updated by the North American lichen checklist look-up table with a specially written query to produce a list of only the current names. Those names that were not in the look-up table were moved to two other tables and excluded from the table of current 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 2004 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. All these tables are viewable in reports generated at the database website.

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 or annotated by authorities in MIN, but are not yet in Esslinger's 1997 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

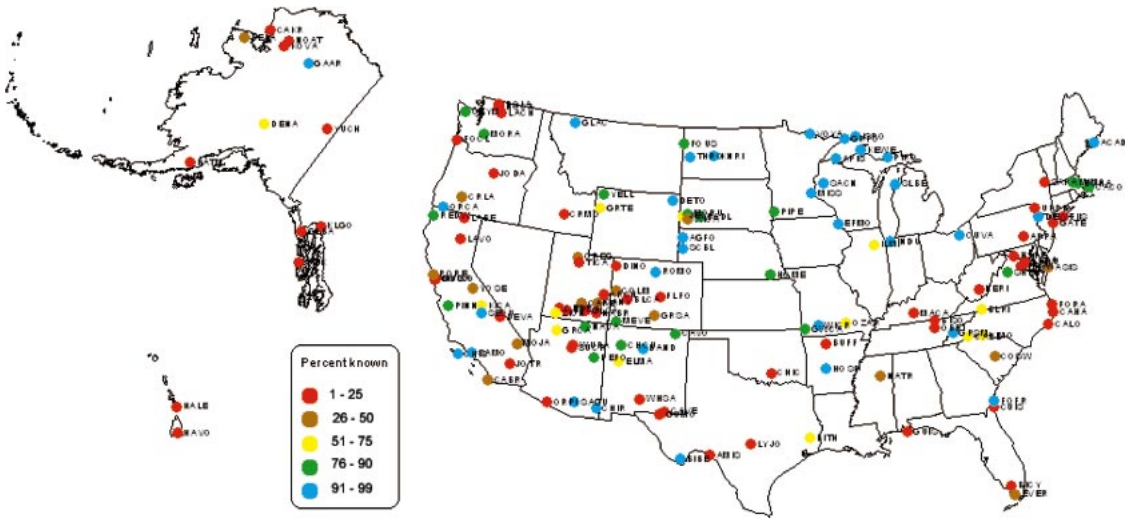


FIGURE 2. Map of locations of 144 parks in NPLichen. Color of dot indicates how well the lichens are known (see legend; park codes appear in Table 1).

RESULTS

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 the species present. Consequently, the number of species in parks records (including new to North America) without

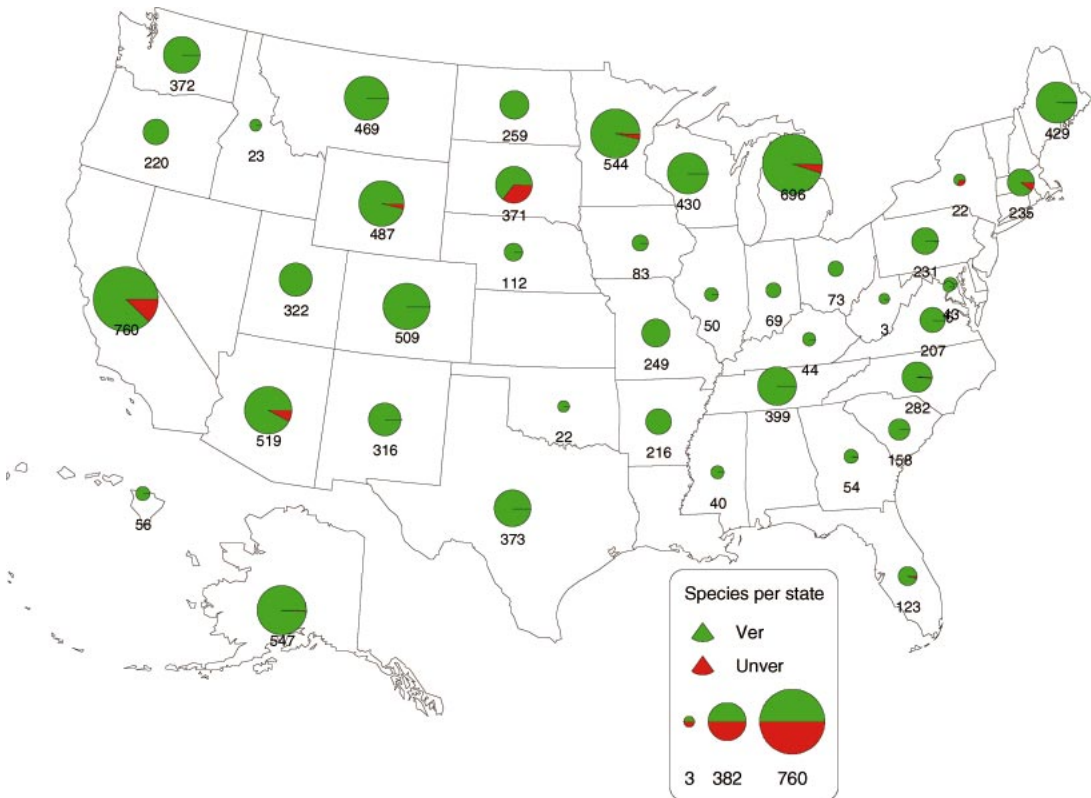


FIGURE 3. Number of lichen species by state, broken down by verified or unverified in park boundaries.

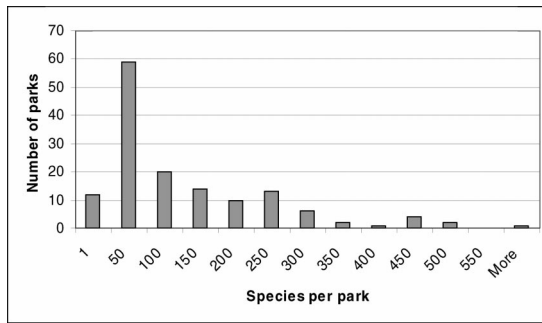


FIGURE 4. Frequency distribution of number of species per park.

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 species is 2,435. This represents roughly 74% and 63% respectively of the North American flora (509 genera and 3,876 lichen species tallied from Esslinger's Checklist, not counting non-lichenized fungi and parasites). There are 6,655 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 one (48 parks) to 66 (Isle Royale) and averaged 8.5.

The 144 parks in the database are found in 41 states and Washington, D.C. (FIG. 2) The nine states with no lichen data in national park units are Alabama, Connecticut, Delaware, Louisiana, Nevada, New Hampshire, New Jersey, Rhode Island and Vermont. Kansas has no park marked in the figure but does contain part of the Oregon Trail. The number of lichen species per state was determined by aggregating the park lists and deleting duplicates (FIG. 3). The large percentage of unverified species in some states is due to parks with unverified lists, including Keweenaw in Michigan, Santa Monica Mountains in California, and the Black Hills parks in South Dakota. It is interesting to note that the total number of species in some states is a large percentage of the known state flora: 88%, 70% and 65% for Michigan, Minnesota and Wisconsin, respectively (Bennett & Wetmore 2004), and 76% for California (Hale & Cole 1988).

The average number of lichen species reported per park is 104, while the median is 60. This is because the distribution of species per park is skewed to the right, there being a small number of parks with large numbers of species (FIG. 4). The lichen floras of many parks are not well known. Isle Royale has the most number of species, 611, followed by Voyageurs (496), Glacier (469), Gates of

TABLE 1. Lichen species occurring in 40 or more national parks units.

Species	Number of parks
<i>Physcia aipolia</i>	65
<i>Cladonia chlorophaea</i>	60
<i>Parmelia sulcata</i>	55
<i>Amandinea punctata</i>	53
<i>Physcia stellaris</i>	53
<i>Cladonia pyxidata</i>	52
<i>Candelaria concolor</i>	51
<i>Xanthoria elegans</i>	51
<i>Dermatocarpon minutum</i>	50
<i>Flavoparmelia caperata</i>	48
<i>Acarospora fuscata</i>	47
<i>Candelariella vitellina</i>	47
<i>Peltigera canina</i>	47
<i>Cladonia coniocraea</i>	46
<i>Lecanora muralis</i>	46
<i>Peltigera rufescens</i>	46
<i>Caloplaca cerina</i>	45
<i>Cladonia fimbriata</i>	44
<i>Physconia detersa</i>	44
<i>Xanthomendoza fallax</i>	43
<i>Aspicilia cinerea</i>	42
<i>Xanthoria polycarpa</i>	42
<i>Diploschistes scruposus</i>	41
<i>Punctelia rudecta</i>	40

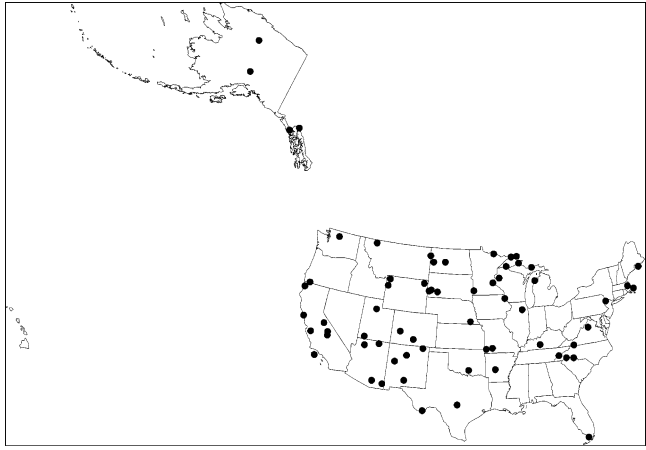
the Arctic (438), Acadia (429), Yellowstone (415) and Rocky Mountain (401). Twelve parks have only one species reported and many parks are not well known.

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).

The number of lichen taxa recorded per park ranged from one (25 parks) to 1,623 (Isle Royale) and averaged 181, with a median of 76.

The average number of parks a species is found in is 6.5 and the median is three, and ranges from one (25% of the species) to 65 for *Physcia aipolia*, which is not quite half the number of parks. Species that are found in 40 or more park units are listed in Table 1. The park distributions of *Physcia aipolia*, *Flavoparmelia caperata* and *Letharia vulpina* are shown in FIGURE 5. These distributions are remarkably close to those in Brodo et al. (2001). For *Physcia aipolia* it appears that the park occurrences have extended the distribution into Florida (Everglades) and the Great Basin since Brodo et al. (2001) was published.

The status of lichen knowledge of each park (Table 2) is 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



*Physcia aipolia*



*Flavoparmelia caperata*



*Letharia vulpina*

FIGURE 5. Distributions of *Physcia aipolia*, *Flavoparmelia caperata* and *Letharia vulpina* based on presence in national parks.



TABLE 2. 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	9-99		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	
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

TABLE 2. Continued.

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
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	
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		1,623	1,623	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
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	
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

TABLE 2. Continued.

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
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		1,142	1,142	2
WHTA	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	

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 estimates, only rough guesses.

Of the 144 park units, 34 (24%) are classified as cultural resource parks, while the remaining 110 (76%) are natural resource parks. There was virtually no difference between how well known on average the lichen floras are for cultural (50%) and natural (46%) parks.

#### DISCUSSION

The tabulation of parks by how well their lichen floras are known is shown in Table 3. Obviously about half the parks need further study and parks that are not in our database have not been studied at all. Only about one fourth of the 144 parks in our database are well known. Priority for future studies should be given to larger parks with significant natural resources in them that are in good to pristine condition. It is our experience that smaller parks rarely add many new taxa to the park system or the local area. However, if funding is available

TABLE 3. Frequency of parks by how well known the flora is.

How well the flora is known (range in %)	Number of parks	%
1-25	61	42
26-50	16	11
51-75	13	9
76-90	20	14
91-99	34	24

for smaller parks with natural resources in them certainly a lichen study would be appropriate.

In some parks, where most of or all 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 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, so 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 investigators collecting 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, published or not, are not identified correctly. Publishing the records of specimens often results in more correct identifications and better lists. If unpublished spec-



imens were included there would be an increased percentage of incorrect names listed for parks. This would result in more error in the lists which would diminish their usefulness.

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. We included MIN because there were 6,832 specimens from parks, and the data for them were computerized, making it easy to incorporate. In the future, as other herbaria become computerized, those with large numbers of park specimens can be incorporated into NPLichen.

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 park lichen 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 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 lichen checklist. Taxonomy is a matter of opinion, and there is no one absolute and "correct" name that everyone agrees with. The North American lichen 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

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 paper who knows of any new publications listing species in parks to please make us aware of this information. Updates to the database will be made periodically, depending on funding.

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.

#### 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 the parks in this study have been correctly identified. No specimens were examined for this purpose for the creation of the NPLichen database.

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.

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