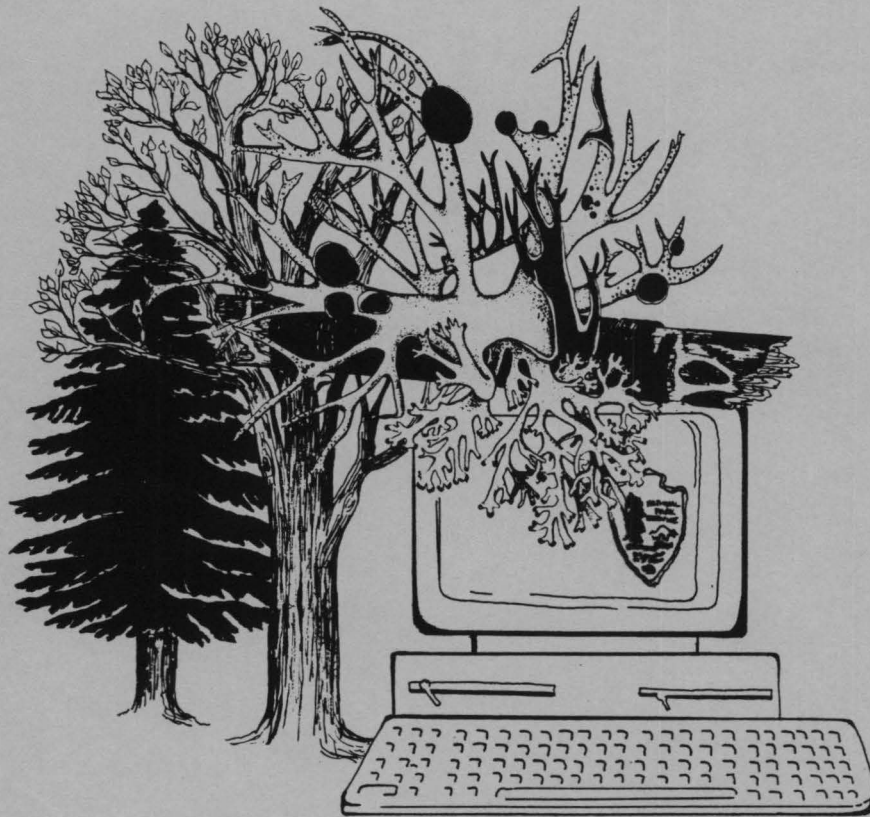


Working copy

NPLICHEN: A National Park Service Lichen Data Base

FINAL REPORT



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Table of Contents

Preface	3
Abstract	4
Introduction	5
Methods	5
Results and Discussion	6
Recommendations	7
Literature Cited	9
Appendix 1. Index of NPS Units with Some Known Lichens	10
Appendix 2. Lichens Excluded from NPLICHEN	14
Appendix 3. Procedures and BASIC Programs Developed to Process NPLICHEN Files	23
Appendix 4. Computer Data Files Submitted With This Report	24
Appendix 5. Reports of Lichens in National Park Units	25

Preface

Lichens are important species of park vegetation whose values are often overlooked because of their small size. Knowledge of lichens in national parks is fairly limited and of varying degrees of completeness. These two facts point to an information deficit in national parks regarding these types of plant resources. This is unfortunate because they are no less important than any other natural resource.

Lichens are some of the best plant organisms for biomonitoring air pollution entering national parks. This is because they have no outer coverings over their tissues, thus allowing everything in the atmosphere to be absorbed directly into the tissues. Heavy metals and sulfur compounds accumulate in the tissues until they reach toxic levels and kill the plants. Sampling lichens for anthropogenic elements and measuring distribution and abundance patterns of sensitive species are very effective ways of studying air pollutants in parks. Because of this, efforts were begun over ten years ago by the Air Quality Division of the NPS to determine what lichens were present in parks. Lichen studies have shown air pollution effects in several parks, including Indiana Dunes National Lakeshore, Cuyahoga Valley National Recreation Area, Delaware Water Gap National Recreation Area, and others.

Lichens have other values as well. They are good bioindicators of other types of disturbance, including off-trail and/or sand dune trampling, climate change, accumulation of toxics in food chains, and roadway effects. Lichens can also be detrimental to cultural resources, e.g. growing on grave stones and roofs of historic buildings. Knowing what lichens are present in a park can enable the park manager to deal with these issues in a knowledgable way.

In 1990 an effort was begun with funding from the Air Quality Division to create a national list of lichens of the national parks. Such a list can be useful for selecting species for inventorying and monitoring, in determining how representative national parks are of their regions, and if species are disappearing. The list would also help identify areas that need new lichen work because of incomplete or missing surveys. This report describes the results of this project to date.

Data on lichen species from 93 national park units have been entered into a computerized database named NPLICHEN. All names have been standardized to a national list to allow comparisons to be made. The database is currently operational on personal computers at the Universities of Minnesota and Wisconsin. Searches can be made by contacting the operators at any time. If sufficient demand exists, the database will be implemented on a national computer for access by all. At some time in the near future it is anticipated that the database will be incorporated into the National Park Service Inventorying and Monitoring Program.

Abstract

Many lichen species are very sensitive to some air pollutants and can be used to monitor these air pollutants in the National Parks. It is therefore desirable to know what lichens are present in different park units. This report describes a project undertaken to create computer files of lists of species known to occur in the National Park Service (NPS) units for loading into a computer database. Information was obtained from the literature, from internal NPS reports, and from the University of Minnesota Herbarium. Ninety-three park units out of 360 have some lichen records. The literature search found 288 papers reporting lichens from 87 units. All lichen names were standardized to Egan's Checklist of North American Lichens. Files were produced for each park and were processed with several custom-written computer programs. The 93 park files listed the lichen name, the reference to its occurrence in the park, and whether the name was first described from the park. There are numerous natural area park units with poorly known lichen floras which are recommended for future study. Other recommendations are for periodic updates of the data base, for the production of a user manual for the database, and for the protection of the type localities in the parks.

Introduction

Lichens are symbiotic plants composed of fungi and algae. The plant body (thallus) is not covered with an epidermis and the components of the thallus are relatively open to free air exchange with the atmosphere. Lichens are sensitive to air pollutants and are killed by low levels of sulfur dioxide (LeBlanc et al., 1972), nitrogen oxides, or other strongly oxidizing compounds (Ross & Nash, 1983). Lichens have been used in numerous studies to monitor the air quality. The methods used in many of the National Parks include a comparison of the lichen flora with historical records, and elemental analyses of selected species (Wetmore, 1988). When this method is used, considerable effort is needed to search the literature for lichen records from the park being studied. This project was designed to consolidate the literature searches for all parks in one study and make the data available in a database for use in future studies.

Methods

Computer files of lichen records were created for each park. The sources of park records included published literature, unpublished research reports to NPS, and collections in the University of Minnesota Herbarium. The literature searched covered most of the major lichenological works from 1872 to 1991. These covered all of the taxonomic revisions and monographs, regional lichen floras, field trip reports that included park areas, and several lichen journals. Computer text files were created for each park in ASCII format and included the lichen name, the reference to the report, and a special symbol if the name was described from the park (type locality; see below). These preliminary files were entered as given in the source, without correction to current taxonomic standard names (which was done in a later step). The only reference that was not included in these files was *The Lichens of the Class 1 Parks* (Wetmore, 1983) because this was a secondary reference derived from a smaller literature search.

In addition, the NPS Air Quality Division requested lists of lichens from internal reports from every park unit. The lichen names from the 22 responses received were entered into park files with the reference given as "Park List." No voucher specimens were checked and the listed names were not verified because that would have required visits to many herbaria or borrowing many specimens, which was outside the scope of work for this project. Species given for any park with a Park List reference should therefore be regarded as unconfirmed identifications.

The lichen herbarium at the University of Minnesota (MIN) contains lichens from 58 park units. The label data have been completely computerized and species lists from the NPS units were easily retrieved. Although collections from park units may exist in other herbaria, no other herbarium is completely computerized and it would be beyond the scope of this project to request species lists from them. Computer retrievals were obtained for all park units represented in MIN and the names added to the park files with the reference given as "MIN HERB."

Egan's Checklist of North American Lichens (Egan, 1987, 1989, 1990) was selected for a standard list of names because it is the only list available. However, two problems will occur as a result of using this list. First, Egan's checklist is only a nomenclatural reference list and includes all of the most recently published taxonomic opinion. It does not represent a consensus of all lichenologists. It is unlikely that any lichenologist would accept all of the "accepted" names in the checklist. Therefore, lichenologists using park lists standardized to Egan's list may disagree with some of the names.

Second, Egan's checklist does not include species from the Caribbean area or Hawaii. In the Caribbean and Hawaiian parks there may be 50-100 species that are not in the checklist. In addition, including these parks in a total NPS list for comparison with Egan's 3,500 taxa would be misleading because they are not included in Egan's count. Conversely, Egan's list includes Canada, where there are about 20-30 species that only occur there and not in the United States. These would have to be subtracted from Egan's total count to compare with a total NPS count for United States parks. Such comparisons are necessary to determine how representative parks are of the national flora.

The park files were processed with several computer programs (Appendix 3) to produce a final file for each park (Appendix 4). The names in these park files were standardized to Egan's checklist by a computer program. Other programs removed duplicate names and combined the references to produce one file for each park unit that included all names and all references. These park files also had a symbol by any accepted name that had been described from that park. If no information was available for a park unit, no park file was produced and it was not included in Appendix 1.

For each park an estimate was made of the completeness of the knowledge of the lichen flora. Those parks where a thorough lichen flora had been done were assigned a value of 95-98% because no lichen field study will find all species present. For the remaining parks an estimate was made based on the number of species in the park list and the potential number according to the geographical area and other regional studies. These estimates may be off by as much as 25% for some parks. The potential lichen flora was obtained by dividing the number of known lichens from the park by the percent completeness estimate. This will allow park managers to determine what priority to assign to new work on lichen floras.

Results and Discussion

Of the 331 park units initially considered for this project, there were lichen records for 93 units. Of the requests sent to the parks, 22 provided species lists, although no report was requested for the 15 parks where Wetmore had recently done studies. There were 288 literature reports from 87 units and Minnesota Herbarium had records for 58 units. The literature references are provided in Appendix 5 of this report and in a computer file called "REFER." Of the 83 natural area parks with some known lichens, 34 lack adequate lichen studies (those with less than 70% known). There are additional natural area parks with unknown lichen floras that are not included in these counts.

The potential lichen floras vary from about 40 species to over 500 species. The potential lichen floras will depend on ecological conditions (units in moist areas will have more species), substrate availability (some units have few or no rocks and will have fewer species), geographical location (those in the mountains or arctic or tropics will have more species), and disturbance (units in or near cities or agricultural areas will have fewer species).

The park lists for units without thorough studies may not accurately represent the true lichen floras. Some collectors have only collected the larger and more obvious lichens and ignored the crustose forms. The species lists from some parks will lack reports of crustose lichens because they are harder to identify. Some other groups of lichens are notoriously difficult to identify and may not be included in reports. There are also many unidentified lichens from parks in the University of Minnesota Herbarium.

A national list of threatened and endangered lichens is currently being prepared by the Smithsonian Institution but was not available at the time this project was done. When that list becomes available, the data could be included in this database.

Type localities are very important in systematics. When a species new to science is found, a description must be published based on a study of several specimens. A single specimen collected at a specific locality (holotype) must be designated and the locality where it was collected is called the type locality. The type locality is important because, if the holotype is lost or destroyed, taxonomists will be able to go back and collect another specimen to serve as a type (known as a neotype). If the type locality has been destroyed or damaged, it will be much more difficult to select a neotype. In some of the older literature the type locality is not mentioned, or is stated in such general terms that it is difficult to tell exactly where it is. For example, the description of the new species *Lecidea deminutula* from Great Smoky Mountains National Park gives the type locality as "Great Smoky Mts., near Alum Cave, on a shady rock about 1500 m." In such cases it would be quite difficult to determine what area should be protected.

There were 17 parks with type localities of 46 species (some parks have several type localities). There were a few additional names with type localities listed in Appendix 2 but not counted in Appendix 1 because the names are not accepted in Egan's checklist and the names are not in the database park files.

Appendix 1 lists all NPS units with any lichen records and indicates the sources of lichen records for each unit, the number of accepted names described from the park, the total records from each unit, the estimated percent completeness of the lichen flora, the potential total lichen flora, whether it was considered a natural area park, and an indication of the need for a lichen study.

Appendix 2 lists the names that were rejected from the park lists, arranged in alphabetical order by NPS unit, with the reporting reference. The names in this appendix were those that were not in Egan's checklist as accepted names for North America. Names were placed on this list for several reasons. First, several names have been reported in the literature but never validly published and therefore have no taxonomic standing. Second, in some of the older literature lichen names were used that have since been split into several different names. It is impossible to determine the present correct names for these without examination of the vouchers. Third, some reported names have since been determined not to be in North America. Fourth, a few names were included in reports but have not been described or the publication date was after that of Egan's second supplement (Egan, 1990). These last will be included in future updates (see below). Hawaii Volcanoes National Park is included in the database and is therefore is an exception to this. Many species reported from this park do not occur in the continental United States and Canada and thus were not in Egan's checklist. Fifth, for park units in Minnesota many of the vouchers have been restudied and the identifications corrected so erroneous old names were added to this list. This is only true for specimens in the University of Minnesota Herbarium.

Recommendations

1. New names should be added to the taxonomic name file of the database with every revision of Egan's checklist (usually every 2-3 years).

Many of the literature reports are based on old identifications that should be confirmed by a new study of the original vouchers, where available. The knowledge of the lichens in North America is rapidly changing. New collecting is being done and more monographs are being written every year. The nomenclature is dynamic and subject to change. Therefore, some of the names reported for these parks will change. As new versions of Egan's checklist are published, names will be added, deleted or changed. New records for the parks will appear in the published literature and in unpublished park reports. New records for some park units will be added to the Minnesota Herbarium as more unidentified material is processed. In order to maintain the accuracy of the data base, it is essential that frequent updates be run. These updates should be done according to the following schedule.

2. New literature reports should be added to the database every five years as additional monographic and floristic work is published.
3. New or revised records from the University of Minnesota Herbarium should be added every five years. Every year about 5,000 new specimens are added to this herbarium and many of these may be from NPS units.
4. Errors and omissions in the database should be corrected every 2-3 years. Users of the database would be asked to report any errors and omissions as they are found.

5. High priority should be given to lichen flora studies in the parks with the highest need as soon as possible.

Many NPS units (at least 266) have no lichen reports. Some of these are very small units, such as historical units, and may not have significant lichen floras present. At least 38 of the major natural area parks also are poorly known or completely unknown lichenologically. Some of these major parks are in critical areas ecologically or floristically. Some units may be exposed to high levels of air pollutants and need lichen impact studies. In Appendix 1 the major parks that are in need of a thorough lichen study are indicated along with a ranking of the importance of the need.

6. A user's manual should be prepared and distributed to all park units to aid in obtaining information from the database. Procedures should be outlined in this manual for recording new information and reporting corrections to the database when it is made accessible to park users.
7. Park units with type localities should determine the locations in the parks and develop a protection plan for them. The plan would include the locations, species, types of activities in the park that might impact the type locality, and procedures for alerting park staff. Expert help should be sought in developing the plan.

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Appendix 1. Index of NPS Units with Some Known Lichens

This appendix summarizes the data available for all NPS units with any known lichens. The column headings are:

- PARK - Name of the park (alphabetical order)
- LIT - Number of names from published literature
- PKLST - Internal (unpublished) park reports
- MIN - "+" = specimen(s) in Univ. of Minn. Herbarium
- TOTAL - Sum of names from LIT, PKLST, and MIN
- COMPL - Estimate of completeness of lichen flora (%)
- POT - Estimated potential total lichen flora
- NEED - Urgency for study
- NAT - Natural area park
- TYPE - Number of type localities in park

In the PKLST column, a "+" indicates that a list of lichens from internal unpublished reports was received from the unit and a "0" indicates a reply was received but no lichens were known. A "+" in the MIN column indicates there are specimens in the Univ. of Minnesota Herbarium from that park. In the NEED column, the more "+"s present the greater the need for lichen work in that park. In the TYPE column the number of type localities in the park does not include those in Appendix 2 because they are not in Egan's checklist as accepted names.

In some cases the TOTAL number is less than the number listed under LIT. The smaller number is the result of the removal of synonyms and rejected names that were in the preliminary literature lists.

None of the parks where recent detailed lichen studies have been done were designated as needing studies. High priority for study should also be assigned to natural area parks not included in this table.

PARK	LIT	PKLIST	MIN	TOTAL	COMPL	POT	NEED	NAT	TYPE
Acadia NP	427		+	397	95	417		+	0
Apostle Islands NL	271		+	272	95	286		+	0
Arches NP	12		+	22	10	220	+	+	0
Badlands NP	73	+	+	72	70	102		+	0
Bandelier NM	273	+	+	214	85	251		+	0
Bering Land Bridge NP	32			31	7	442		+	0
Big Bend NP	200	+	+	228	95	240		+	0
Big Cypress NP	8	+		8	3	266	+	+	0
Big Thicket NP	101	+	+	95	40	237	+	+	0
Black Canyon of Gunnison	8		+	10	5	200	+	+	0
Blue Ridge Parkway	18		+	19	9	211	++	+	0
Cape Cod NS	3	+		2	2	100		+	0
Cape Krusenstem NM	75			75	17	441		+	0
Capulin Volcano NM	10	+	+	39	25	156		+	0

PARK	LIT	PKLIST	MIN	TOTAL	COMPL	POT	NEED	NAT	TYPE
Canyonlands	1		+	40	25	160	+	+	0
Chaco Culture NHP	133	+	+	125	75	166			1
Chicasaw NRA				21	12	175		+	0
Chiricahua NM	10		+	100	50	200	++	+	0
Channel Islands NP	33			29	10	290		+	1
Colorado NM	10		+	61	35	174		+	0
Crater Lake NP	55	+	+	55	20	275	++	+	1
Craters of Moon NM	4	+		4	2	200	+	+	0
Cuyahoga Valley NRA	67		+	66	95	69		+	0
Denali NP	124		+	144	35	411		+	0
Devils Tower NM	59		+	89	95	93		+	1
Death Valley NM	2		+	8	10	80	+	+	0
Delaware Water Gap NRA	218		+	213	95	224		+	0
Dinosaur NM	3		+	15	6	250		+	0
El Malpais NM	5	+		3	2	150			0
Everglades NP	128	+	+	118	30	393	+++	+	0
Florissant Bed NM	1			1	1	100		+	0
Fort Frederica NHS			+	42	95	44			0
Gates of Arctic NP	347		+	322	80	402		+	2
Gateway NRA	3	+		2	5	40			0
Glacier NP	290		+	287	95 75	425 382		+	0
Glacier Bay NP	53		+	64	15	426		+	0
Glen Canyon NRA			+	10	6	166		+	0
Golden Gate NRA	2			2	5	40			0
Grand Canyon NP	90		+	96	45	213	++	+	3
Great Sand Dunes NM	9			9	25	36	+	+	0
Great Smoky Mts. NP	312		+	298	95	313		+	19
Grand Teton NP	18			18	5	360	++	+	0
Guadalupe Mts. NP	1	0		1	0.5	200	+	+	0
Harpers Ferry NHP	1			1	0.5	200	+	+	0
Hawaii Volcanoes NP	14			14	4	350	+++	+	0
Hot Springs NP	87	+	+	89	40	222			0
Illinois Mich. Canal	50			50	30	166			1

Grand Portage

Bratt

0.6.67

PARK	LIT	PKLIST	MIN	TOTAL	COMPL	POT	NEED	NAT	TYPE
Indiana Dunes NL	63		+	62	95	65		+	0
Isle Royale NP	613		+	562	98	573		+	2
Jewel Cave NM	57		+	56	30	186		+	0
Joshua Tree NM	4		+	5	10	50	+	+	0
Katmai NP				7	2	350		+	0
Kings Canyon NP	98		+	96	50	192	+	+	1
Kobuk Valley NP	48			48	12	400		+	0
Lava Beds NM	4		+	5	2	250	+	+	0
Lake Chelan NRA	21			21	7	300		+	0
Lassen Volcanic NP	2	+	+	5	2	250	+	+	0
Lyndon Johnson NHP	3	+		3	4	75			0
Mammoth Cave NP	2	0		43	15	286	+	+	0
Mesa Verde NP	51		+	49	30	163	+	+	0
Mt. Rainier NP	131		+	132	40	330	+	+	5
Mt. Rushmore NM			+	1	0.6	166		+	0
Natural Bridges NM			+	1	0.7	142		+	0
Natchez Trace Parkway	40	+		40	20	200		+	0
Navajo NM	100			100	95	105		+	0
Noatak NP	59			59	15	393		+	0
North Cascades NP	63	+		63	20	315	+	+	0
Olympic NP	268	+	+	242	60	403	+	+	1
Organ Pipe Cactus NM	6		+	9	5	180	+	+	0
Pinnacles NM	96			93	90	103		+	0
Pipestone NM	66			66	95	69		+	0
Pictured Rocks NL	249		+	247	95	260		+	0
Point Reyes NS	5		+	7	3	233	+	+	0
Redwood NP	40			40	15	266	+	+	0
Rocky Mt. NP	336		+	326	75	434		+	1
St. Croix NSR	47		+	283	95	297		+	0
Saguaro NM	254		+	254	95	267		+	0
Saratoga NHP	10	+		10	8	125			0
Sequoia NP	212		+	213	95	224		+	0
Shenandoah NP	196		+	188	70	268		+	3

PARK	LIT	PKLIST	MIN	TOTAL	COMPL	POT	NEED	NAT	TYPE
Sitka NHP	21			18	10	180		+	0
Sleeping Bear Dunes NL	184		+	183	95	192		+	0
Sunset Crater NM	4			4	2	200		+	0
Theodore Roosevelt NP	208		+	212	95	223		+	0
Voyageurs NP	446			460	95	484		+	0
White Sands NM	3	+	+	4	10	40		+	0
Wind Cave NP	38		+	38	30	126	+	+	0
Wupatki NM	16	+		16	10	160			0
Yellowstone NP	236		+	215	65	330	+	+	1
Yosemite NP	83		+	81	30	270	+	+	2
Yukon Charley NP	17		+	17	4	425		+	0
Santa Monica Mts. NRA	10			10	5	200	++	+	1
Zion NP	169		+	173	60	288	+	+	0
Number of Parks	87	44	58	93			38	94	*

*Type Localities: 46 Total species
17 Parks with types

Appendix 2. Lichens Excluded from NPLICHEN

This appendix lists names reported in the literature or on park lists that were excluded from the database for several reasons. Some of the species are currently thought to be new to science and have not yet been published. These are marked "INED". Other species are obvious misidentifications for North American collections and these are marked "misident." Some species have been recently reported from the park as new to North America but are not yet in Egan's checklist. These are marked "NEW NA". A few names are in the literature but were never validly published. These are indicated by "NOM NUD". In a few cases (with specimens in the Univ. of Minnesota Herbarium), corrected identifications were available and the incorrect names are listed here, but usually no restudy of the original vouchers was attempted. The names are listed alphabetically by park unit and the references to the reports are given. Species marked by an asterisk are described from the park, but not listed as accepted names in Egan's checklist. Names with none of these codes are not in Egan's list and the names are unknown.

ACADIA NP

Lecanora thysanophora :MIN HERB, Sullivan, 1990, INED
Ochrolechia pseudopallescens :MIN HERB, Sullivan, 1990, INED
Pyrenula nitida :Plitt & Pessin, 1924, misident.
Ramalina calicaris var. *canaliculata* :Plitt & Pessin, 1924
Rhizocarpon petraeum :Plitt, 1927, misident.
Rinodina magnusonii :Sullivan, 1990, INED

APOSTLE ISLANDS NL

Lecanora thysanophora :MIN HERB, Wetmore, 1988c, 1990b, INED
Ochrolechia mexicana :MIN HERB, NEW NA

ARCHES NP

Staurothele dispruinosa :MIN HERB, INED
Staurothele elenkinii :MIN HERB, NEW NA

BADLANDS NP

Staurothele elenkinii :PARK LIST, NEW NA

BANDELIER NM

Buellia cinereoglauca :PARK LIST
Lecanora quartzitica :PARK LIST, INED
Lecanora subradiosa :PARK LIST
Leptogium papillosum :PARK LIST, misident.
Parmelia pulvinaria :PARK LIST
Peltigera mauritzi :PARK LIST
Placynthium lubricum :PARK LIST
Ramalina landroensis :PARK LIST
Usnea barbata :PARK LIST, misident.

BIG BEND NP

Lecanora chloroleprosa :MIN HERB
Lecanora nashii :MIN HERB, INED
Mycoglaena wetmorei :MIN HERB, INED
Ochrolechia pseudopallescens :MIN HERB, INED
Ochrolechia subsidiata :MIN HERB, INED
Rhizoplaca subdiscrepans :MIN HERB, NEW NA
Rinodina lignicola :MIN HERB, INED

CAPE COD NS

Usnea barbata :PARK LIST, misident.

CHACO CULTURE NHP

Dermatocarpon leptophyllum :Nash, et al., 1983, misident.

Dermatocarpon vellereum :Nash, et al., 1983, misident.

Lecanora conferta :Nash, et al., 1983, misident.

Pyrenula nitida :Rudolph, 1953, misident.

CHIRICAHUA NM

Staurothele effigurata :MIN HERB, INED

Usnea herrei :Weber, 1975, NOM. NUD.

CHANNEL ISLANDS NP

**Caloplaca brattiae* :Weber, 1988, INED

**Caloplaca stantonii* :Weber, 1988, INED

Niebla ceruchoides :Weber, 1988, INED

**Toninia pacifica* :Weber, 1988, INED

CRATER LAKE NP

Alectoria jubata :PARK LIST, misident.

Umbilicaria polaris :MIN HERB, NOM NUD

**Umbilicaria torrefacta* var. *pachydermata* :Llano, 1950

CUYAHOGA VALLEY NRA

Thelidium parvulum :MIN HERB :Wetmore, 1986b, 1989

DENALI NP

Alectoria nana :Krog, 1968, NOM NUD

Cladonia cornuta var. *groenlandica* :Krog, 1968

Cladonia gracilis var. *dilatata* :Krog, 1968

Parmelia omphalodes subsp. *arctica* :Schindler, 1987

Rhizocarpon frigidum :Schindler, 1987

Rhizocarpon geographicum subsp. *arcticum* :Schindler, 1987

DEVILS TOWER NM

Acarospora smaragdula :Wetmore, 1967, misident. = *A. americana*

Bryoria glabra :Wetmore, 1967, misident. = *B. trichodes*

Ochrolechia androgyna :Wetmore, 1967 = *O. arborea*

DELAWARE WATER GAP NRA

Cetraria islandica :Tuckerman, 1882, Britton, 1889, Wood, 1914 = *C. arenaria*

Lecanora thysanophora :MIN HERB, Wetmore, 1987b, INED

Lepraria neglecta :Wetmore, 1987b = *L. lobificans*

Mycobilimbia hypnorum :Wetmore, 1987b, misident.

Ochrolechia pseudopallescens :MIN HERB, Wetmore, 1987b, INED

Pertusaria pertusa :Nash, 1972, misident.

Plagiocarpa hyalospora :Wetmore, 1987b, misident.

EL MALPAIS NM

Anaptychia mexicana :PARK LIST
Xanthoria elegans var. brachyloba :PARK LIST

EVERGLADES NP

Anisomeridium macrosporum :PARK LIST, INED
Dirinaria aegialita :PARK LIST, misident
Laurera phaeomelodes :PARK LIST
Leptotrema bahainum :PARK LIST
Leptotrema conpunctum :PARK LIST
Ocellularia chionostoma :PARK LIST
Polymeridium exasperatum :PARK LIST
Pyrenastrum auswalum :PARK LIST
Pyrenastrum microcarpum :PARK LIST
Pyrenastrum thelomorphum :PARK LIST
Ramalina scrobiculata :PARK LIST
Thelotrema paralbidum :PARK LIST

GATES OF THE ARCTIC NP

Ionaspis euphotica var. arctica :Thomson, 1979
Rhizocarpon geographicum subsp. arcticum :Moser et al., 1979
*Stereocaulon glareosum var. brachyphylloides :Llano, 1951
*Stereocaulon paschale var. erectum :Llano, 1951
Umbilicaria aprina var. diomedensis :Llano, 1950

GATEWAY NRA

Usnea barbata :PARK LIST, misident.

GLACIER NP

Cladonia gracilis subsp. alpina :DeBolt, 1985
Umbilicaria hirsuta :Llano, 1950; DeBolt, 1985 = U. vellea

GRAND CANYON NP

Lecidea parasema :McDougall, 1947, ident. uncertain
Staurothele elenkinii :MIN HERB, NEW NA

GREAT SMOKY MTS. NP

Coccocarpia pellita :Degelius, 1941, misident.
Lasallia papulosa f. lacerata :Degelius, 1941
*Lecidea gyrodes :Degelius, 1941 = Fuscidea sp.
*Lecidea helvola var. longispora :Degelius, 1941
Lecidea latypea :Degelius, 1941, misident.
*Lecidea olivacea var. inspersa :Degelius, 1941 = Lecidella sp.
Ochrolechia yasudae :Degelius, 1941, misident.
Parmelia digitata :Kurokawa, 1969, misident.
Pertusaria multipuncta :Degelius, 1941, misident.
Pyrenula brunnea :Degelius, 1941, misident.
Rinodina novoconfragosa :MIN HERB, INED

ILLINOIS MICHIGAN CANAL NATIONAL HERITAGE CORRIDOR

Collema flaccidum :Calkins, 1896 = *C. subflaccidum*

Parmelia tiliacea :Calkins, 1896 = *P. galbina*

Rinodina sophodes :Calkins, 1896, misident.

Xanthoria parietina :Calkins, 1896, misident.

INDIANA DUNES NL

Cladonia pyxidata :Wetmore, 1986a, 1988d, erroneous report

Lecanora thysanophora :MIN HERB, Wetmore, 1986a, 1988d, INED

ISLE ROYALE NP

Arthonia convexella :Hedrick & Lowe, 1936

Lasallia pustulata :Hedrick & Lowe, 1936, ident. uncertain

Lecanora thysanophora :MIN HERB, Wetmore, 1983c, 1985a, INED

Lecidea parasema var. *theioplaca* :Hedrick & Lowe, 1936, ident. uncertain

Lecidea parasema :Hedrick & Lowe, 1936, ident. uncertain

Ochrolechia trochophora :MIN HERB, INED

Pertusaria multipuncta :Hedrick & Lowe, 1936, misident.

Pertusaria pertusa :Hedrick & Lowe, 1936, misident.

Protoblastenia siebenhaariana :MIN HERB :Wetmore, 1985a, NEW NA

Pyrenula leucophaea :Hedrick & Lowe, 1936

Ramalina calicaris var. *canaliculata* :Hedrick & Lowe, 1936

Rhizoplaca subdiscrepans :MIN HERB, NEW NA

Rinodina trevisani :MIN HERB :Wetmore, 1985a, INED

Schismatomma decolorans :MIN HERB :Wetmore, 1985a, NEW NA

JEWEL CAVE NM

Verrucaria sphinctrinella :Wetmore, 1967

JOSHUA TREE NM

Bryoria glabra :Wetmore, 1967, misident. = *B. trichodes*

Collema tenax var. *expansum* :Wetmore, 1967, misident.

KINGS CANYON NP

Candelariella reflexa :MIN HERB, Wetmore, 1986c, NEW NA

MESA VERDE NP

Physconia grisea subsp. *lilacina* :Weber, 1990

Rinodina lignicola :MIN HERB, INED

MT. RAINIER NP

Lecidea contigua :Howard, 1937, 1950, ident. uncertain

Pertusaria multipuncta :Hedrick, 1941; Howard, 1950; PARK LIST, misident.

**Stereocaulon tomentosum* var. *simplex* :Riddle, 1910

NAVAJO NM

Xanthoria parietina :Flowers, 1963, misident.

OLYMPIC NP

Alectoria jubata :PARK LIST, misident.
Cetraria tuckermanii :PARK LIST, misident.
Cladonia bellidiflora var. coccocephala :Hedrick, 1941
Cladonia carneola var. prolifera :Hedrick, 1941
Cladonia fimbriata var. simplex :Hedrick, 1941
Cladonia foliacea :PARK LIST, misident.
Cladonia yunnana :PARK LIST, misident.
Cornicularia tenuissima :PARK LIST
Haematomma puniceum :PARK LIST
Lecidea enteroleuca :Hedrick, 1941
Lepraria lanuginosa :PARK LIST
Parmeliella corallinoides :Hedrick, 1941, ident. uncertain
Pyrenula nitida :PARK LIST, misident.
Stereocaulon tomentosum var. simplex :Riddle, 1910; Hedrick, 1941

PINNACLES NM

Candelariella zahlbruckneri :Smith, 1990
Lepraria caesioalba :Smith, 1990

PIPESTONE NM

Buellia pullata :Fink, 1899 = Buellia sp.
Buellia spuria :Fink, 1899 = Lecidella stigmatea
Cladonia fimbriata :Fink, 1899 = C. acuminata
Lecanora cinerea :Fink, 1899 = Aspicilia caesiocinerea
Lecanora rubina var. heteromorpha :Fink, 1899 = L. opiniconensis
Parmelia conspersa :Fink, 1899 = Parmelia taractica
Parmelia olivacea var. proluxa :Fink, 1899 = P. substygia
Physcia caesia :Fink, 1899 = P. halei & Phaeophyscia sciastra
Physcia tribacia :Fink, 1899 = P. dubia & Phaeophyscia endococcina
Ramalina polymorpha :Fink, 1899 = R. intermedia
Rhizoplaca subdiscrepans :MIN HERB, NEW NA
Rinodina sophodes var. tephraspis :Fink, 1899 = R. pachysperma

PICTURED ROCKS NL

Alectoria jubata :Hedrick, 1939, misident.
Lecanora thysanophora :MIN HERB, Wetmore, 1988b, 1990a, INED
Ochrolechia mexicana :MIN HERB, NEW NA
Ochrolechia pseudopallescens :MIN HERB, INED
Ochrolechia pseudopallescens :Wetmore, 1988b, 1990a, INED
Usnea florida :Hedrick, 1939, misident.

POINT REYES NS

*Cladonia pulvinella :Hammer, 1991, INED

ROCKY MOUNTAIN NP

Caloplaca adnexa :Weber, 1990, NEW NA
Candelariella reflexa :MIN HERB, NEW NA
Catapyrenium daedaleum :Thomson, 1989
Ephebe perspinulosa :Weber, 1990, NEW NA

Gongylia muscorum :Weber, 1990, NEW NA
 Lecanora submersa :MIN HERB
 Lecidea caesioalbescens :Anderson, 1964
 *Lecidea coloradensis :Anderson, 1964, INED
 Lecidea kieneri :Anderson, 1964, INED
 Lecidea recessa :Anderson, 1964
 *Lecidea saximontana :Anderson, 1964, INED
 *Lecidea saxosa :Anderson, 1964, INED
 Micarea elichista :Weber, 1990, NEW NA
 Peltigera erumpens :Weber, 1990, NEW NA
 Porpidia andersonii :MIN HERB, INED
 Porpidia thomsonii :Gowan, 1989, INED
 Rhizocarpon santessonii :Weber, 1990, NEW NA
 Rinodina lignicola :MIN HERB, INED
 Xylographa minutula :MIN HERB

SAINT CROIX NSR

Biatora myriocarpoides :Fink, 1898 = Lecidea erratica
 Buellia petraea var. montagnaei :Fink, 1898 = Rhizocarpon grande
 Buellia spuria :Fink, 1898 = B. stigmatea
 Cladonia fimbriata :Fink, 1898 = C. rei
 Cladonia macilenta :Fink, 1898 = C. bacillaris
 Cladonia rangiferina var. alpestris :Fink, 1898 = Cladina mitis
 Collema flaccidum :Fink, 1898 = C. subflaccidum
 Collema pulposum :Fink, 1898 = C. bachmanianum
 Endocarpon hepaticum :Fink, 1898 = E. pusillum
 Lecanora cinerea var. laevata :Fink, 1898 = Aspicilia cinerea
 Lecanora hagenii :Fink, 1898 = L. dispersa
 Lecanora rubina :Fink, 1898 = L. muralis
 Lecanora subfusca :Fink, 1898 = L. cenisia
 Lecanora thysanophora :MIN HERB, Wetmore, 1991, INED
 Lecanora varia var. symmicta :Fink, 1898 = L. dispersa
 Lecanora varia :Fink, 1898 = L. mutabilis
 Leptogium chloromelum :Fink, 1898 = L. cyanescens
 Pannaria lanuginosa :Fink, 1898 = Lepraria lobificans
 Parmelia borneri :Fink, 1898 = P. rudecta
 Parmelia caperata :Fink, 1898 = P. baltimorensis
 Parmelia crinita :Fink, 1898 = P. rudecta
 Parmelia perforata :Fink, 1898 = P. reticulata
 Parmelia saxatilis :Fink, 1898 = P. hypoleucites
 Peltigera canina :Fink, 1898 = P. rufescens
 Peltigera pulverulenta :Fink, 1898 = P. elisabethae
 Peltigera rufescens :Fink, 1898 = P. elisabethae
 Pertusaria communis :Fink, 1898 = P. pertusa
 Physcia caesia :Fink, 1898 = P. halei
 Physcia obscura :Fink, 1898 = Phaeophyscia adiastrata
 Physcia pulverulenta :Fink, 1898 = Physconia detersa
 Physcia stellaris :Fink, 1898 = P. phaea
 Physcia tribacia :Fink, 1898 = P. dubia
 Placodium aurantiacum :Fink, 1898 = Caloplaca vitellinula

Placodium cerinum :Fink, 1898 = Caloplaca sideritis
Placodium vitellinum :Fink, 1898 = Candelariella aurella
Ramalina calicaris var. farinacea :Fink, 1898 = R. intermedia
Rinodina arenaria :MIN HERB :Wetmore, 1991, INED
Rinodina sophodes :Fink, 1898 = Buellia alboatra & B. punctata
Rinodina verrucosa :MIN HERB :Wetmore, 1991
Stereocaulon condensatum :Fink, 1898 = S. paschale
Strangospora pinicola :MIN HERB :Wetmore, 1991
Teloschistes concolor :Fink, 1898 = Candelaria fibrosa
Usnea barbata var. florida :Fink, 1898, misident.
Usnea barbata var. rubiginea :Fink, 1898, misident.

SAGUARO NM

Ochrolechia mexicana :MIN HERB, NEW NA
Ochrolechia subisidiata :MIN HERB, INED
Rinodina verrucosa :MIN HERB :Wetmore, 1987a

SEQUOIA NP

Bryoria fuscescens :Smith, 1980, misident.
Heterodermia leucomela :Smith, 1980, misident.
Hypogymnia enteromorpha :Herre, 1946, Smith, 1980, misident.
Lecanora pseudomellea :MIN HERB, INED
Lecanora sierrae :MIN HERB
Lecidea saxosa :MIN HERB :Wetmore, 1985b, INED
Lepidoma demissum :Wetmore, 1985b, misident.
Leptogium burnetiae :Smith, 1980, misident.
Leptogium saturninum :Smith, 1980, misident?
Porpidia thomsonii :Gowan, 1989 :MIN HERB, INED
Staurothele areolata :MIN HERB, NEW NA

SHENANDOAH NP

Cladonia subapodocarpa :Lawrey, 1980
Lecidea diminutula :Forman & Sierk, 1970
Ochrolechia mexicana :MIN HERB, NEW NA
Ochrolechia yasudae :Lawrey, 1980, misident.
Peltigera canina var. ulorrhiza :Forman & Sierk, 1970
Pertusaria multipuncta :Forman & Sierk, 1970, misident.
Pyrenula nitida :Forman & Sierk, 1970, misident.
Rhizoplaca subdiscrepans :MIN HERB, NEW NA
Usnea herrei :Forman & Sierk, 1970; Lawrey, 1980, MIN HERB, NOM NUD

SITKA NHP

Alectoria delicata :Krog, 1968, NOM NUD
Parmelia saxatilis var. divaricata :Krog, 1968
Usnea glabrescens subsp. glabrella :Krog, 1968

SLEEPING BEAR DUNES NL

Lecanora thysanophora :MIN HERB, Wetmore, 1988a, 1988e, INED

THEODORE ROOSEVELT NP

Leptogium byssinum :Sierk, 1964, = *Collema coccophorum*
Rhizoplaca subdiscrepans :MIN HERB, NEW NA
Rinodina lobulata :MIN HERB :Wetmore, 1983a, 1985c, INED
Rinodina riparia :MIN HERB :Wetmore, 1983a, 1985c
Rinodina rivula :MIN HERB :Wetmore, 1983a, 1985c
Staurothele elenkinii :MIN HERB, NEW NA

VOYAGEURS NP

Alectoria jubata :Fink, 1903 = *Bryoria trichodes*
Arthonia lecideella :Fink, 1903 = *A. caesia*
Arthonia radiata var. *swartziana* :Fink, 1903 = *A. radiata*
Biatora hypnophila :Fink, 1903 = *Lecidea botryosa*?
Biatora myriocarpoides :Fink, 1903 = *Lecidea myriocarpoides*?
Biatora querneae :Fink, 1903 = *Protoblastenia querneae*?
Buellia alboatra var. *saxicola* :Fink, 1903, misident.
Buellia saxatilis :Fink, 1903
Cetraria ciliaris :Fink, 1903 = *C. halei*?
Cetraria lacunosa :Fink, 1903 = *Platismatia tuckermanii*
Collema flaccidum :Fink, 1903 = *C. subflaccidum*
Evernia prunastri :Fink, 1903 = *E. mesomorpha*
Lecanora rubina var. *heteromorpha* :Fink, 1903 = *L. opiniconensis*
Lecanora thysanophora :MIN HERB, INED
Lecidea enteroleuca var. *flavida* :Fink, 1903 = unkn.
Lecidea enteroleuca :Fink, 1903 = unkn.
Lecidea lapicida :Fink, 1903 = *L. lapicida*?
Ochrolechia catilliformis :MIN HERB
Ochrolechia pseudopallescens :MIN HERB, INED
Pannaria lanuginosa :Fink, 1903 = *Lepraria* sp.
Parmelia olivaces var. *prolixa* :Fink, 1903 = *P. pulla*?
Parmelia perlata var. *ciliata* :Fink, 1903, = unkn.
Pertusaria communis :Fink, 1903, misident.
Physcia hispida :Fink, 1903 = *P. tenella*?
Physcia pulverulenta :Fink, 1903 = *Physconia detersa*
Ramalina calicaris var. *farinacea* :Fink, 1903 = *R. intermedia*
Ramalina calicaris var. *fraxinea* :Fink, 1903 = *R. fraxinea*?
Ramalina polymorpha :Fink, 1903 = *R. polymorpha*?
Ramalina pusilla var. *geniculata* :Fink, 1903 = *R. geniculata*?
Rhizoplaca subdiscrepans :MIN HERB, NEW NA
Rinodina arenaria :MIN HERB, INED
Rinodina granulans :MIN HERB
Rinodina lecanorina :Fink, 1903 = *R. ocellata*?
Rinodina magnussonii :MIN HERB, INED
Rinodina siouxiana :MIN HERB, INED
Rinodina sophodes :Fink, 1903, misident.
Rinodina verrucosa :MIN HERB
Sticta amplissima :Fink, 1903 = *Lobaria quercizans*
Sticta quercizans :Fink, 1903 = *S. weigelei*
Usnea barbata var. *ceratina* :Fink, 1903, misident.
Usnea barbata var. *florida* :Fink, 1903, misident.

Verrucaria viridula var. *subfuscella* :Fink, 1903 = *V. viridula*?

WIND CAVE NP

Bryoria glabra :Wetmore, 1967, misident. = *B. trichodes*

Parmelia aspera :Wetmore, 1967 = *P. subolivacea*

YELLOWSTONE NP

Cladonia elongata f. *intermedia* :Robbins, 1931

Parmelia conspersa :Nelson, 1900, misident.

Usnea barbata :Tuckerman, 1872, misident.

YOSEMITE NP

Collema veruciforme :Hasse, 1913, misident.

ZION NP

Dermatocarpon leptophyllum :Nash & Sigal, 1981; Rushforth et al., 1980, 1982; St. Clair et al., 1991

Heterodermia neoleucomelaena :Rushforth et al., 1980, 1982; St. Clair et al., 1991

Physconia detersa f. *isidigera* :Nash & Sigal, 1981; Rushforth et al., 1980

Appendix 3. Procedures and BASIC Programs Developed to Process NPLICHEN Files

Park lists were processed through a series of steps to produce computer files usable for the database. The steps used BASIC programs written specifically for this application and commands in the WORDSTAR® word processing program. All computer work was performed on an Epson Equity II personal computer. The following narrative is meant to describe the steps for those not familiar with using computers to prepare textual data. The BASIC programs themselves (listed below in capital letters) and the word processing commands are not listed or provided at this time because they have no usefulness beyond the application to NPLICHEN.

1. Files for each park were obtained from the Univ. of Minnesota Herbarium database (in System 2000® [S2K]) with PLIST. These files ended with the necessary Zs (the end of file mark) and were named by the park acronyms. Each PLIST file had to be unique. The S2K files were processed with S2KCLN.BAS to remove extra spaces and duplicate names, decapitalize all except the first letter of the genus name, and add "MIN HERB" as a reference. An end of record symbol "@" was also added. The output files had the extension ".S2K" and the necessary Zs. These files were then in the same format as the literature files. In the word processor the S2K files were appended to the end of the literature files. The resulting file names had no extensions.
2. A program ASORT.BAT was developed to alphabetize the combined files. The extension ".COL" was added to the sorted files. The BASIC program COMDUP.BAS was then run on the .COL files. The output files had the extension ".COR". This program removed duplicates and combined the references.
3. EGANLOOK.BAS was then run on the .COR files. This program looked up the names in the Egan checklist file and converted them to the Egan checklist names. The output file names were given an ".STD" extension.
4. PSORT.BAT was then run on the .STD files. This program alphabetized the names and assigned the extension ".SOR".
5. The .SOR files were processed with REMDUP.BAS to remove duplicates and combine references. The output files were given an ".RED" extension.
6. The .RED files were reviewed with the word processor to fix unknowns and to perform final checks.
7. FXFIL.BAS then converted the .RED files to fixed-length field files. The output file names were given the extension ".FIN".
8. With the word processor, names were finally converted to all caps, the colon before the first reference was removed, and " ;" converted to ";".

Appendix 4. Computer Data Files Submitted With This Report

This appendix lists all of the files submitted and a description of their contents.

Taxa files:

GENERA.GEN - an alphabetical list of all accepted genera
TAXA.VSP - an alphabetical list of all accepted genera and species
SUBNAMES.VAR - an alphabetical list of all accepted subspecies and varieties

Checklist lookup files: (lists synonyms with corrected names as given in Egan's checklist)

ELIST1 - A-B
ELIST2 - C-K
ELIST3 - L-O
ELIST4 - P
ELIST5 - R-Z

Park files: (contains all accepted taxa and references)

ACAD.FIN	DENA.FIN	ILMI.FIN	PINN.FIN
APIS.FIN	DETO.FIN	INDU.FIN	PIPE.FIN
ARCH.FIN	DEVA.FIN	ISRO.FIN	PIRO.FIN
BADL.FIN	DEWA.FIN	JECA.FIN	PORE.FIN
BAND.FIN	DINO.FIN	JOTR.FIN	REDW.FIN
BELA.FIN	ELMA.FIN	KATM.FIN	ROMO.FIN
BIBE.FIN	EVER.FIN	KICA.FIN	SACN.FIN
BICY.FIN	FLFO.FIN	KOVA.FIN	SAGU.FIN
BITH.FIN	FOFR.FIN	LABE.FIN	SAMO.FIN
BLCA.FIN	GAAR.FIN	LACH.FIN	SARA.FIN
BLRI.FIN	GATE.FIN	LAVO.FIN	SEQU.FIN
CACO.FIN	GLAC.FIN	LYJO.FIN	SHEN.FIN
CAKR.FIN	GLBA.FIN	MACA.FIN	SITK.FIN
CAMO.FIN	GLCA.FIN	MEVE.FIN	SLBE.FIN
CANY.FIN	GOGA.FIN	MORA.FIN	SUCR.FIN
CHCU.FIN	GRCA.FIN	MORU.FIN	THRO.FIN
CHIC.FIN	GRSA.FIN	NABR.FIN	VOYA.FIN
CHIR.FIN	GRSM.FIN	NATR.FIN	WWSA.FIN
CHIS.FIN	GRTE.FIN	NAVA.FIN	WICA.FIN
COLO.FIN	GUMO.FIN	NOAT.FIN	WUPA.FIN
CRLA.FIN	HAFE.FIN	NOCA.FIN	YELL.FIN
CRMO.FIN	HAVO.FIN	OLYM.FIN	YOSE.FIN
CUVA.FIN	HOSP.FIN	ORCA.FIN	YUCH.FIN
			ZION.FIN

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