Lichen Inventory for the Southwest Alaska Network

Final Technical Report
12 October 2017

Cooperative Agreement No.: H8W07110001

Cooperator: Oregon State University

OSU Technical Lead: Bruce McCune, Department of Botany and Plant Pathology, Cordley 2082, Oregon State University, Corvallis, OR 97331-2902 USA

NPS Technical Lead: Amy Miller, Southwest Alaska Network, 240 W 5th Ave., Anchorage, Alaska 99501; amy_e_miller@nps.gov.

Project Participants:

Ulf Arup (Ulf.Arup@biol.lu.se) – Lund, Sweden
Othmar Breuss (obreuss@bg9.at) – Vienna, Austria
Ted Esslinger (Ted.Esslinger@ndsu.edu) – Fargo, North Dakota
Bruce McCune (Bruce.McCune@science.oregonstate.edu) – Corvallis, Oregon
Jolanta Miadlikowska (jolantam@duke.edu) – Durham, North Carolina
Lucia Muggia (lucia_muggia@hotmail.com) – Trieste, Italy
Peter Nelson (peterrossnelson@gmail.com) – Fort Kent, Maine
Roger Rosentreter (roger.rosentreter0@gmail.com) – Boise, Idaho
Matthias Schultz (matthias.schultz@uni-hamburg.de) – Hamburg, Germany
John Sheard (John.Sheard@usask.ca) – Saskatoon, Saskatchewan
Kaleigh Spickerman (spickerk@onid.orst.edu) – Corvallis, Oregon
Tor Tønsberg (Tor.Tonsberg@um.uib.no) – Bergen, Norway
James Walton (James_Walton@nps.gov) – Anchorage, Alaska

McCune Laboratory Assistants
Elisa Di Meglio (technician)
Joe Di Meglio (student)
Leon Rogers (student)

NPS Field Assistants
Evan Heck
Lisa Schomaker

Abstract
We inventoried lichens in Lake Clark (LACL), Katmai (KATM) National Parks and Preserves, and Kenai Fjords National Park (KEFJ) in a collaborative effort by the National Park Service (NPS) and Oregon State University (OSU). As part of this project, NPS and OSU (1) completed field inventories in LACL, KATM, and KEFJ based on collection gaps identified by NPS and OSU; (2) compiled the taxonomic data into an MS Access database and associated geospatial data in the form of a site lookup table linked to the specimen database, and (3) provided supplementary information regarding species' functional traits. The primary objectives of the inventory were to deliver a set of lichen collections for LACL, KATM, and KEFJ and to compile an ecologically annotated species list for each park that is representative of the major habitats in the park. The inventories are represented by two core manuscripts, plus a number of spinoff publications with new species or other records of interest.

Completed field tasks (sites visited are listed in Table 2)

1. Field inventory in KATM: July, 2013 by Bruce McCune, Lucia Muggia, Peter Nelson, Kaleigh Spickerman, and Tor Tønsberg, and led by James Walton. Sites visited are in Table 2.
2. Field inventory in LACL: July, 2014 by Bruce McCune, Peter Nelson, Roger Rosentreter, and Tor Tønsberg, and led by James Walton. Sites visited are in Table 2.
3. Field inventory in KEFJ: July, 2015 by Bruce McCune, Matthias Schultz, Roger Rosentreter, and Tor Tønsberg, and led by James Walton. Sites visited are in Table 2. We were unable to visit more than one alpine site because of weather restrictions on flying.
4. Alpine sites in KEFJ: July, 2016 by James Walton, Amy Miller, and Bruce McCune.

Completed herbarium studies of earlier collections

1. Hundreds of specimens sent by NPS to OSU and other experts have been checked, annotated, and added to the database.
2. Bruce McCune visited University of Wisconsin herbarium (WIS) to study specimens collected by US FWS (Talbot) in the Tuxedni Wilderness, Chisik Island, off of the coast of LACL. These had been identified by John Thomson, and published in Talbot et al. (1992). Many specimens were examined and revised. A subset was borrowed for more study at Oregon State, annotated, added to the database, and returned to WIS.

Published papers with new species and notable records from SWAN lichen inventory

Arup, U. J. Vondrák & M. G. Halici. 2015. *Parvoplaca nigroblastidiata*, a new corticolous lichen (Teloschistaceae) in Europe, Turkey and Alaska. Lichenologist 47:379–385.

Brodo, I. M. & B. McCune. 2017. *Ochrolechia brodoi*, a new lichen for North America from Alaska, with updates to the key of corticolous North American species. Evansia (in press).

Esslinger, T. L., B. McCune & D. L. Haughland. 2017. *Physconia labrata*, a new species from western North America and Asia. Bryologist (in press).

Fryday, A. M. & T. Tønsberg. 2015. *Ameliella* – a bryicolous lichen genus rediscovered in North America after 50 years. Evansia 32:171–175.

Magain, N., E. Sérusiaux, M. P. Zhurbenko, F. Lutzoni & J. Miadlikowska. 2016. Disentangling the *Peltigera polydactylon* species complex by recognizing two new taxa, *P. polydactylon* subsp. *udeghe* and *P. seneca*. Herzogia 29:514-528. (*P. polydactylon* subsp *udeghe* from Katmai NP).

McCune, B., E. Timdal & M. Bendiksby. 2016. *Rhizocarpon quinonum*, a new anthraquinone-containing species from the Alaska Peninsula. Lichenologist 48:367-375.

Sheard, J. W., B. McCune & T. Tønsberg. 2014. A new corticolous species of *Rinodina* (Physciaceae) and two interesting range extensions for species collected from Katmai National Park, Alaska. Bryologist 117:253-258.

Spickerman, K. 2015. Lichen Functional Trait Variation Along an East-West Climatic Gradient in Oregon and Among Habitats in Katmai National Park, Alaska. MS Thesis, Oregon State University. http://hdl.handle.net/1957/56394

Stone, D. F., J. W. Hinds, F. L. Anderson & J. C. Lendemer. 2016. A revision of the *Leptogium saturninum* group in North America. Lichenologist 48:387-422. (Type collections for *L. cookii* and *L. compactum*, both from Lake Clark National Park.)

Tønsberg, T. 2016. *Jamesiella scotica* new to North America from USA, Alaska. Folia Cryptogamica Estonica 53:23–24.

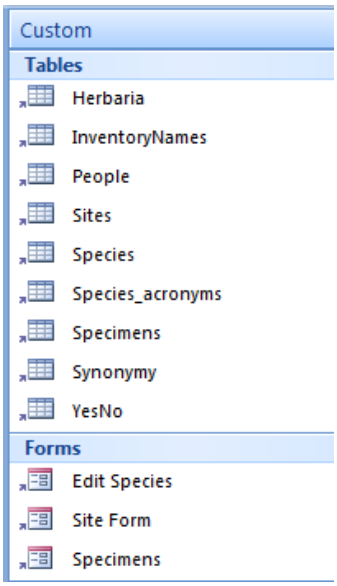
Draft Manuscripts, core work

McCune, B., U. Arup, O. Breuss, E. Di Meglio, J. Di Meglio, T. L. Esslinger, N. Magain, J. Miadlikowska, A. E. Miller, L. Muggia, P. R. Nelson, R. Rosentreter, M. Schultz, J. Sheard, T. Tønsberg & J. Walton. 2017. Biodiversity and Ecology of Lichens of Katmai and Lake Clark National Parks and Preserves, Alaska. Manuscript.

McCune, B., U. Arup, O. Breuss, E. Di Meglio, J. Di Meglio, T. L. Esslinger, J. Miadlikowska, A. E. Miller, R. Rosentreter, M. Schultz, J. Sheard, T. Tønsberg & J. Walton. 2017. Lichens of Kenai Fjords National Park, Alaska. Manuscript.

Database products

We compiled a database in Access that contains information on historical lichen data, new collections that have been gathered at sites in the three parks. Specimens sent by NPS to OSU and other experts have been checked, annotated, and added to the database. This database is continuously being updated as study of the specimens progresses.



The MS-Access database is fully populated with all known records, but numerous additions and revisions are anticipated as the specimens are studied more (KatmaiLakeClark_database9Oct2017.mdb). The core tables and forms are shown at right. Key relationships among the tables are shown below

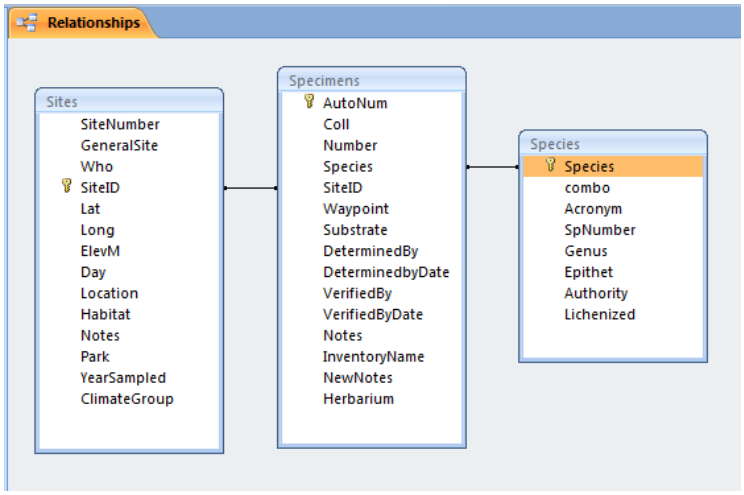


Photo products

Many specimens from the SWAN lichen inventory have been photographed through a microscope by McCune. As part of the digital archive as a companion for *Microlichens of the Pacific Northwest* (McCune 2017a, b), numerous photos from the SWAN lichen inventory have been posted on the Oregon Digital website associated with the OSU library.

The photos can be viewed or freely downloaded from:
http://oregondigital.org/sets/lichens-pnw

To find specimens from the SWAN parks, expand the "Region" panel on the left side of the main page. For example, click on the link for Kenai Fjords below.

Specimens

Most specimens newly collected for this project have been curated, identified, and entered into the database, but many interesting or otherwise difficult specimens remain to be completed. The total number of new specimens is summarized in Table 1.

Currently the database holds 1098 taxa at the species level or below.

Table 1. Current status of lichen data sources for Katmai, Lake Clark, and Kenai Fjords. Numbers of collections are based on database entries as of 16 January 2017.

Source	Katmai	Lake Clark	Kenai Fjords	Near by	Identified by	Notes
SWAN vouchers, coll. by NPS	1634	1081	364	-	Walton + some by lichen group	NPS and Walton databases; specimens at NPS in Anchorage
Lichen team, 2013, 2014, and 2015	1260	1831	1715	-	Group	Access database for all new observations transferred to NPS
NPS Southwest Area Network long-term vegetation monitoring	34	64		-	Field ID (Walton/ Miller)	NPS Monitoring Program database (Walton/Miller; most not included here because based on field IDs)
Cahalane (1959)	6				V. Cahalane	
Dillman (2003)	-	19		-	K. Dillman, K. Glew	Specimens at WTU or NPS in Anchorage
Schindler (1990)	68	-		-	Schindler	Added to Access database from publication rather than specimens; specimens in KR)
Harriman Expedition (Kukak Bay, near Katmai; specimens in MO, NY and elsewhere; Cummings 1904)	-	-		6	Coll. Kincaid, Coville, and Kearney, det. Clara Cummings	Partially in Consortium of North American Lichen Herbaria; lichen names in Cummings (1904) are in a broad sense, difficult to apply here.
Consortium of North American Lichen Herbaria (CNALH)	6	4		23	misc.	Few in the Parks; not verified, therefore not included here; Tuxedni records listed separately
Gunther (1986, 1987, b)	-	-		-	A. J. Gunther	Names used in broad sense; not verified and not included in database.
NPLichen	7	0			V. Cahalane	Katmai records are based on Cahalane repors; not duplicated in database
Talbot et al. (1992) Tuxedni Wilderness Area, Chisik Island	-	-	-	486	J.W. Thomson	Re-examined many of these specimens at Univ. of Wisconsin, Fall 2015
Totals	3015	2999	2079	515		

Distribution of Project Products

To facilitate the distribution of electronic project products they will be posted on Google Drive and the recipients listed below will be invited to download any components that they wish. In addition, according with item 3, two paper copies will be sent to Nancy Hori at the address indicated.

Recipients

1. One electronic copy of the final report and all relevant GIS data and other data in Access to the ATR at the following address: Amy Miller, Southwest Alaska Network, 240 W 5th Ave., Anchorage, Alaska 99501; amy_e_miller@nps.gov.

2. One electronic copy of the final report to the NPS PNW CESU Research Coordinator at the following address: Chris Lauver, SFR, Box 352100, University of Washington, Seattle, WA 98195; chris_lauver@nps.gov.

3. Two paper copies and one electronic copy to Nancy Hori, NPS PW Regional Librarian, National Park Service, Pacific West Regional Library, 168 S. Jackson, Seattle, WA 98104, Nancy_Hori@nps.gov.

4. One electronic (pdf) copy of the final report to Carol Simpson, Technical Information Center, Denver Service Center, National Park Service, P.O. Box 25287, Denver, CO 80225-0287, carol_simpson@nps.gov.

Acknowledgments
We thank Amy Miller and Michael Shephard and the National Park Service in Anchorage, and Chris Lauver and the Cooperative Ecosystem Studies Unit in Seattle, for sponsoring this project under Cooperative Agreement H8W07110001 with Oregon State University. We thank Elve Arvebakk, Astri Botnen, Irwin Brodo, Alan Fryday, Per Magnus Jørgensen, Helmut Mayrhofer, Toby Spribille, Einar Timdal, and Tim Wheeler for providing identifications, advice, and specimens for comparison, and Joe Ammirati for identifications of conks. Leon Rogers and Dongling Niu assisted with thin-layer chromatography and DNA extraction, PCR, and sequencing. Lisa Schomaker and Evan Heck ably assisted in the field.

References

Cusick, J. 2001. Foliar nutrients in black cottonwood and Sitka alder along a soil chronosequence at Exit Glacier, Kenai Fjords National Park, Alaska. Masters thesis, University of Alaska, Anchorage.

Dillman, K. 2003. Lichens of Rock Art Sites from Lake Clark National Park. Unpublished report. 19 pp.

Gunther, A. J. 1986. Report to the National Park Service on Research Performed Under Contract at Katmai National Park, Alaska, During the Summer of 1986. Univ. California, Berkeley. 11 pp.

Gunther, A. J. 1987. Nitrogen Cycling in a Subarctic Alaskan Watershed: The Role of Lichens and the Potential Effects of Acid Deposition. PhD Dissertation. University of California, Berkeley. 456 pages. (*done near Malone Lake, where we visited*).

Gunther, A. J. 1987. Nitrogen Fixation by Lichens in a Subarctic Alaskan Watershed. Bryologist 92: 202-208.

McCune, B. 2017a. *Microlichens of the Pacific Northwest*. Volume 1: Key to the Genera. Wild Blueberry Media, Corvallis, Oregon, U.S.A. iv + 218 pages.

McCune, B. 2017b. *Microlichens of the Pacific Northwest*. Volume 2: Key to the Species. Wild Blueberry Media, Corvallis, Oregon, U.S.A. iv + 755 pages.

Nelson P. R., J. Walton, H. T. Root & T. Spribille. 2011. *Hypogymnia pulverata* (Parmeliaceae) and *Collema leptaleum* (Collemataceae), two macrolichens new to Alaska. North American Fungi 6:1-8

Schindler, H. 1990. Beitrag zur Flechtenflora von Alaska (Pribilof-Insel St. Paul; Kenai- Halbinsel; Katmai Nat. Park und Denali Nat. Park). Herzogia 8: 335 –356.
Talbot S. S., Talbot S. L. & J. W. Thomson. 1992. Lichens of Tuxedni Wilderness Area, Alaska. Bryologist 95:20-30.

Table 2. Group collecting sites visited in summer 2013, 2014, 2015, and 2016.

Site group	Waypoint cluster	Latitude	Longitude	Elev. m	Location	Habitat
					Katmai NP	
1	97	58.68126	-156.66905	12	Near National Park Service bunkhouse in King Salmon	Picea glauca - Salix - Alnus forest with boggy openings
2	103	58.55116	-155.77743	18	Near Brooks Camp, S of Brooks River, along road and trail toward viewing platforms	Picea glauca forest and edge of fen
2	103	58.55120	-155.78620	18	Near Brooks Camp, S of Brooks River, along road and trail toward viewing platforms	Picea glauca forest with moss undergrowth and minimal woody understory
2	114	58.55748	-155.77822	14	near shore of Naknek Lake, N of Brooks Camp	Betula - Picea forest
2	120	58.56411	-155.75843	12	Shoreline of Naknek Lake on peninsula NE of Brooks Camp	Noncalcareous rock outcrops and boulders
2	127	58.56264	-155.77521	18	Shore of Naknek Lake, bay just north of Brooks Camp, below crumbling outcrops	Populus forest with occasional Salix
2	133	58.54612	-155.78578	30	Near gravel road between Naknek Lake and Lake Brooks	Picea glauca forest with sparse undergrowth and thick moss layer
3	138	58.86171	-155.13988	494	Alluvial flats near camp on east side of Hammersly Lake	dwarf shrub tundra and *Salix* thickets, with frost boils and pits
3	144	58.86259	-155.11619	740	Alpine ridge above Hammersly Lake	dwarf shrub tundra
3	150	58.85312	-155.09909	700	West slope not far below ridge above Hammersly Lake	Outcrops, boulders, solifluction lobes, and seeps on moderate slope in tundra
3	152	58.85334	-155.10410	ca. 620	Midslope below ridge above Hammersly Lake	Shrub thickets and dwarf shrub tundra
3	157	58.86253	-155.14459	489	Shoreline near camp on east side of Hammersly Lake	noncalcareous cobble beach
4	164	59.24367	-154.72680	542	gentle slopes approaching low rocky ridge NE of Mirror Lake	Dwarf shrub tundra with rocky areas
4	167	59.24350	-154.72287	565	Low rocky ridge NE of Mirror Lake	Coarse talus, boulders, and bedrock
4	172	59.24038	-154.76293	393	Shoreline near camp on north side of Mirror Lake	Noncalcareous cobble and boulder beach
4	173	59.24231	-154.75955	409	ca. 200 m north of Mirror Lake camp	Frost boils and streamlet in dwarf shrub tundra
4	182	59.24524	-154.75138	455	ca. 600 m north of Mirror Lake camp	Gentle slopes with dwarf shrub tundra, boulders, and willow thickets along streams
5	188	58.26275	-155.88651	1126	Ridgetop west of Contact Creek	Very rocky alpine fellfield and outcrops
5	200	58.26553	-155.88390	1140	North end of ridge west of Contact Creek	Cliffs and alpine fellfield
7	998	58.683403	-156.34218	11	S shore Naknek Lake near 1.3 km S of Gull Island	habitat? Collections only by Peter Nelson
7	999	58.690129	-156.37639	11	S shore Naknek L. near Grandma's Rock about 5.1 km from boat launch	habitat? Collections only by Peter Nelson
6	203	58.39735	-156.15277	85	Camp at west end of Malone Lake	lichen woodland with scattered Picea and Betula

6	207	58.39330	-156.15160	97	ca. 300 m S of W end of Malone Lake	Low, stony hill with scattered Picea and Betula
6	208	58.39216	-156.15153	95	ca. 600 m S of W end of Malone Lake	Moist depressions with Picea and shrub thickets
6	211	58.38925	-156.15284	112	ca. 800 m S of W end of Malone Lake	Lichen woodland with Picea clumps and exposed dead wood
6	215	58.38889	-156.15397	117	ca. 850 m S of W end of Malone Lake	Low gravelly hill with scattered Picea
6	221	58.38734	-156.16143	129	ca. 1 km SW of Malone Lake	lichen woodland with large granite boulders and clumps of Picea
6	224	58.38467	-156.17887	112	Headwaters Creek, SW of Malone Lake	Riparian forest with Populus, Betula, and Picea
6	231	58.40080	-156.15135	83	Near NW shore of Malone Lake	Lakeshore lichen woodland and eroding peaty shoreline
6	232	58.40167	-156.13250	80	NE side of Malone Lake	Picea - Betula forest and adjacent openings
6	234	58.39727	-156.15149	81	West shore of Malone Lake	Beach cobbles and eroding peaty bank
					Lake Clark National Park and Preserve	
9	485	60.19573	-154.29758	160	Trail to Tanalian Falls from Port Alsworth	Picea - Betula forest
9	478	60.18411	-154.26812	134	Tanalian Falls on Tanalian River SE of Port Alsworth	Open streamside Picea-Betula forest
9	483	60.18724	-154.27248	179	Near trail to Tanalian Falls from Port Alsworth	open bog with stony patches, surrounded by forest
10	497	60.80751	-153.99478	990	slopes and flats above Turquoise Lake	Alpine tundra with noncalcareous boulders and outcrops
10	510	60.80911	-154.00754	962	Small drainage on slope above NW side of Turquoise Lake	Riparian shrubs, rocky stream bed, and outcrops
10	512	60.78778	-154.00646	767	Near campsite at NW end of Turquoise Lake	Alpine tundra, shoreline rocks, and dwarf Betula thickets
10	527	60.78525	-154.01230	767	West side of Turquoise Lake	Alpine tundra and dwarf Betula thickets
10	997	60.78154	-154.01191	765	Near outlet of Turquoise Lake	Lakeshore boulders and stony, hummocky ground, alpine tundra
11	537	60.50132	-153.87719	450	Bay on SW side of Portage Lake	Cliffs and broken Picea forest near shore
11	994	60.50782	-153.88320	447	near west end of Portage Lake	Populus balsamifera forest
11	995	60.50717	-153.88783	444	200 m west of west end of Portage Lake	Picea glauca forest
11	996	60.50444	-153.88116	450	SW corner of Portage Lake	Lakeshore outcrops and broken Picea forest
12	552	59.94621	-154.75756	86	Near SW end of Pickeral Lake	Picea woodland and lakeshore
12	557	59.94497	-154.75343	86	Inlet at SW end of Pickeral Lake	broken Picea-Betula forest
12	561	59.94524	-154.74638	86	South end of Pickeral Lake	Gravelly moraine and wave-cut lakeshore
12	564	59.94460	-154.74130	95	Low ridge above inlet stream to Pickeral Lake	Isolated Picea grove and woodland on sand hill
13	567	60.24518	-154.21787	80	Camel's Hump on shore of Lake Clark ca. 10 km NE of Port Alsworth	Cliff face and lakeshore rocks
13	571	60.37672	-153.93924	80	Shore of Lake Clark ca. 30 km NE of Port Alsworth, W of Hatchet Point	Marble cliffs and talus by lakeshore
13	578	60.37572	-153.94480	80	Shore of Lake Clark, stop 2, W of Hatchet Point	Dark noncalcareous outcrops, lakeshore cliffs
15	583	60.08131	-152.62481	910	Summit of Slope Mountain, overlooking Tuxedni	Rocky ridge, alpine tundra

					Channel	
16	597	60.00000	-152.79253	655	Shoulder of basin on E side of Saddle Mountain	alpine tundra and shrub thickets
17	606	60.23806	-152.95673	600	Shoulder of mountain overlooking Tuxedni Bay	alpine tundra with noncalcareous outcrops and shrub thickets
18	619	60.15208	-152.94970	770	Saddle on ridge near headwaters of Johnson River	Alpine tundra, noncalcareous rock with small calcareous inclusions
14	620	59.87077	-153.09098	4	Near Chinitna Ranger Station on north side of Chinitna Bay	Picea forest on low bench above ocean
19	993	59.87423	-153.07143	4	near mouth of Horn Creek east of Chinitna Ranger Station	riparian Picea - Populus forest
20	629	59.88357	-153.03139	2	Shore of Chinitna Bay, ca. 4 km ENE of Chinitna Ranger Station	Sandstone boulders on shoreline
21	630	59.88044	-153.04927	8	Shore of Chinitna Bay, ca. 3 km ENE of Chinitna Ranger Station	Grove of twisted Populus balsamifera on sloped shoreline
22	634	59.87128	-153.09395	4	250 m NE of Chinitna Bay Ranger Station, near site of prehistorical pit houses	Picea - Betula forest
					Kenai Fjords National Park (2015)	
30	849	60.19452	-149.59635	93	Near Park entrance on Exit Glacier Road, floodplain of Resurrection River	Forested floodplain, with Alnus, Populus, and Picea
30	855	60.18989	-149.63200	150	North of Exit Glacier Visitor Center	Alnus - Populus forest, lower slopes with scattered shady noncalcareous metasedimentary boulders and outcrops
31	859	59.54119	-150.66486	4	West shore of Beauty Bay	Beach logs, snags, and noncalcareous metasedimentary outcrops, base of slope, with Picea
32	866	59.59340	-150.50545	3	North of Pilot Harbor on North Arm of Nuka Bay	Shoreline rocks and mouth of creek, with Picea and Alnus
33	873	59.56236	-150.52325	5	near North Arm Nuka Bay Public Use Cabin	Beach logs and old Picea forest near creek
34	878	59.48411	-150.33863	4	Bay on east side and south end of McCarty Fjord	Rocky granitic shoreline with scattered Picea
35	883	59.58354	-150.41823	3	Near mouth of creek at north end of James Lagoon	Snags and logs on tidal flats
35	887	59.58383	-150.41991	6	Near mouth of creek at north end of James Lagoon	Salix grove on alluvial flats
35	889	59.56481	-150.40473	3	North arm of spit across James Lagoon	Picea-shrub thickets with boulders on shore
35	893	59.56108	-150.40295	4	Spit across James Lagoon	Raised beach ridge of siliceous cobbles
36	894	59.74872	-149.84619	3	N end of Harris Bay, near opening to Northwestern Lagoon	Open alluvial flats with groves of young Picea
37	897	59.74435	-149.83691	4	NE end of Harris Bay, edge of estuary	Large exposed granitic boulders at edge of tidal flats
38	899	59.72886	-149.83996	6	East side of Harris Bay, steep chasm	Granitic cliffs and boulders at base of rocky chute
39	900	59.71454	-149.79123	6	Crater Bay off of Harris Bay	Cascading stream over granite outcrops just above ocean
40	902	59.70922	-149.74586	4	Verdant Cove, north side at shoreline	Shoreline granitic boulders with adjacent Picea forest
40	903	59.71122	-149.74828	20	Verdant Cove, hill above	Stunted open Tsuga mertensiana forest with ericaceous shrubs
41	904	59.88069	-149.61673	5	Coleman Bay, NE end, off Aialik Bay	Shoreline granitic boulders and outcrops, with Alnus thickets
41	905	59.88149	-149.61705	50	Coleman Bay, above NE end, off Aialik Bay	Steep, cascading creek with granitic boulders and Alnus thickets

42	907	59.86686	-149.63518	4	headland between two arms of Coleman Bay	Damp noncalcareous metasedimentary cliffs, boulders, and Picea-Alnus forest fringe
43	909	59.76320	-149.60017	74	Peninsula into Three Hole Bay off Aialik Bay	Slope bog with scattered Tsuga mertensiana and granitic outcrops
44	911	59.78683	-149.60328	6	Near pond at north end of Three Hole Bay off Aialik Bay	Shoreline boulders of noncalcareous metasedimentary rock and adjacent of Picea - Tsuga mertensiana forest
45	913	60.18285	-149.65466	415	near Harding Icefield Trail en route to high cliffs	Shrub thickets on slopes
45	915	60.18281	-149.67134	770	near Harding Icefield Trail, ridge above Exit Glacier	Alpine tundra with scattered low shrubs and metasedimentary outcrops
46	926	60.19091	-149.61820	112	Exit Glacier Campground, near Exit Glacier Creek	Floodplain forest with cobble openings and thickets of Populus balsamifera, Alnus, and Salix. Floodplain surface dates from 1894-1899 according to Cusick (2001).
47	928	60.18732	-149.63124	135	south of Exit Glacier Visitor Center	Forested and brushy outwash flats below Exit Glacier
30	931	60.19607	-149.60212	104	West of Resurrection River and north of Exit Glacier Road	Floodplain forest with Populus balsamifera and Alnus
48	EGT1	60.18523	-149.64400	227	Harding Icefield Trail, lower slope	Metasedimentary outcrops on steep brushy slope, openings in Alnus-Populus-Picea forest
Kenai Fjords National Park, Part 2 (2016)						
91	-	60.1445	-149.8954	1420	Skilak nunatak within Harding Icefield, near northern boundary of park	Alpine tundra
92	-	60.0777	-149.7828	1360	Bear Glacier nunatak	Sparse, rocky alpine tundra with quartzite and argillite outcrops and talus and small stream below snow patch
93	-	59.4726	-150.3337	398	near National Park Service weather station, McArthur Ridge, Kenai Peninsula Borough	granitic ridgetop with alpine tundra and Tsuga mertensiana krummholz
94	-	59.7492	-149.8021	394	Alpine lake system on Harris Peninsula	Granitic outcrops and boulders with sparse alpine tundra
95	-	59.8877	-149.6218	610	Rocky alpine tundra NE of Coleman Bay	Granitic outcrops with sparse alpine vegetation