Pacific Northwest Cooperative Ecosystem Studies Unit Task Agreement J8W07060008:

Botanical Surveys in Parks of the North Coast and Cascades Network 2006-2011

FINAL REPORT

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Objectives

The original Task Agreement for this project states the following:

"The National Park Service's (NPS) primary mission is to conserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment of this and future generations. Inventory, documentation, and monitoring of plant species and communities are key components of the North Coast and Cascade Network's Inventory and Monitoring Program. The basic goals of this project were as follows: 1) to establish a collaboration between the NPS and the University of Washington Herbarium (*WTU) at the Burke Museum of Natural History and Culture to improve understanding of the distribution and abundance of plants in North Coast and Cascade Network parks, and 2) to provide park managers, the public, and the scientific community with comprehensive, scientifically based information about the nature and status of these resources."

One method of accomplishing these goals is by conducting field surveys, here referred to as "botanical forays", to develop species lists based on botanical specimens (vouchers). To the scientific community, a voucher represents tangible scientific evidence that a given species occurred in a particular place at a certain time. Plant lists supported by vouchers are far more valuable to resource managers and to conservation efforts because the identity of each specimen has been confirmed by one or more knowledgeable botanists. All too often plant lists are generated for land parcels on the basis of field identifications and observations. The primary limitation of this approach is that field identifications cannot be confirmed or rejected by anyone else. Also, observation data often lacks specific locality information. The problem of verifying field identifications becomes particularly important for those taxa that are rare and/or belong to taxonomically challenging groups (e.g., some Asteraceae and fern genera).

Voucher specimens have intrinsic value beyond the scope of documenting diversity and its distribution. They can also be used by a wide range of researchers in fields such as taxonomy, population genetics, ecology, pollination biology, and invasive species management. Taxonomy and populations biology researchers often employ molecular techniques for resolving evolutionary relationships on the basis of DNA extracted from leaf tissue. The accuracy and efficiency of these efforts are enhanced with the use of contemporary voucher specimens where the DNA contained in the leaf tissue has undergone little or no degradation. Specimens collected from field work are stored in herbaria, where they are available to researchers on site or through loan programs among research institutions.

This report covers a total of nine (9) forays held between 2006 and 2011 at the North Cascades National Park Complex (NOCA; Fig. 1), which includes North Cascades National Park, Ross Lake National Recreation Area (ROLA), and Lake Chelan National Recreation Area (LACH), and at Mount Rainier National Park (MORA; Fig. 2).

* Herbaria worldwide are identified by an acronym. WTU stands for Washington Territory University. The University of Washington Herbarium was founded in 1882 when Washington was still a Territory.

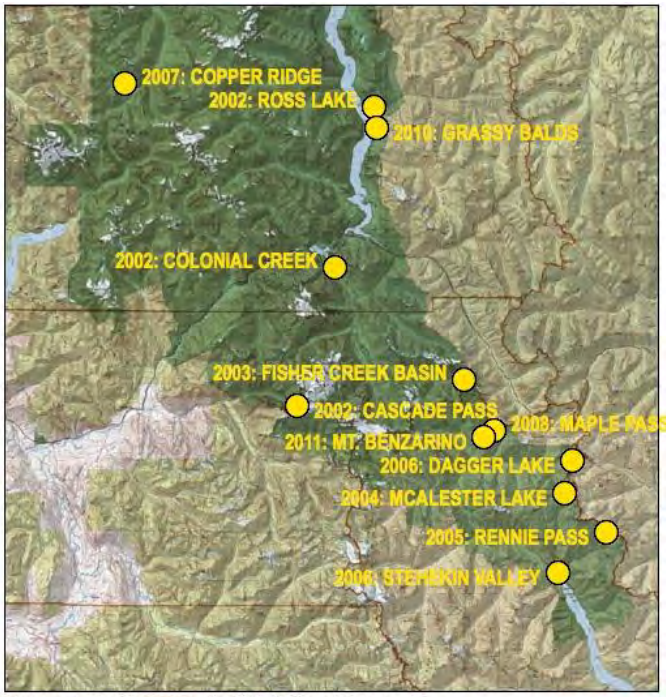


Figure 1. Map showing locations of NOCA forays 2002-2011. The area in green represents lands included within NOCA.

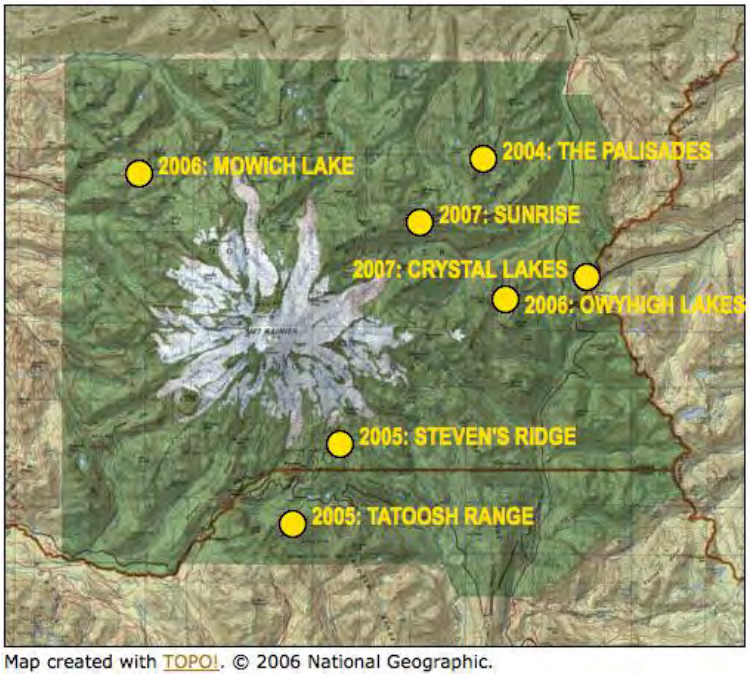


Figure 2. Map showing locations of Mount Rainier National Park forays 2004-2007. The area in green represents MORA lands.

Methods

Each foray involved a multi-day field trip to specific locations within NOCA and MORA. WTU and NPS botanists selected the destinations on the basis of whether the sites were either previously uncollected, botanically diverse, or both. Determining which areas had received prior visitation required plotting all databased specimens from the MORA, NOCA and WTU herbaria that had geocoordinates, and then visually examining where the sampling gaps occurred (Fig. 3). Potential botanical diversity was inferred through NPS botanists' familiarity with regions within the respective parks and by identifying habitat features that were either undersampled (e.g., subalpine wetlands) or uncommon (e.g., north-facing moist seeps).

The feasibility of access to potential sites was also evaluated because not all desirable areas for collecting can be reached with a reasonable amount of effort. Across the nine forays described here, access included day-hiking in and out from a car accessible parking areas, overnight backpacks in which all collecting supplies were carried in by support staff (Fig. 4), overnight backpacks in which collecting supplies were carried by stock support organized by NPS staff, and overnights staged at an established NPS campground accessed by motorized boat.

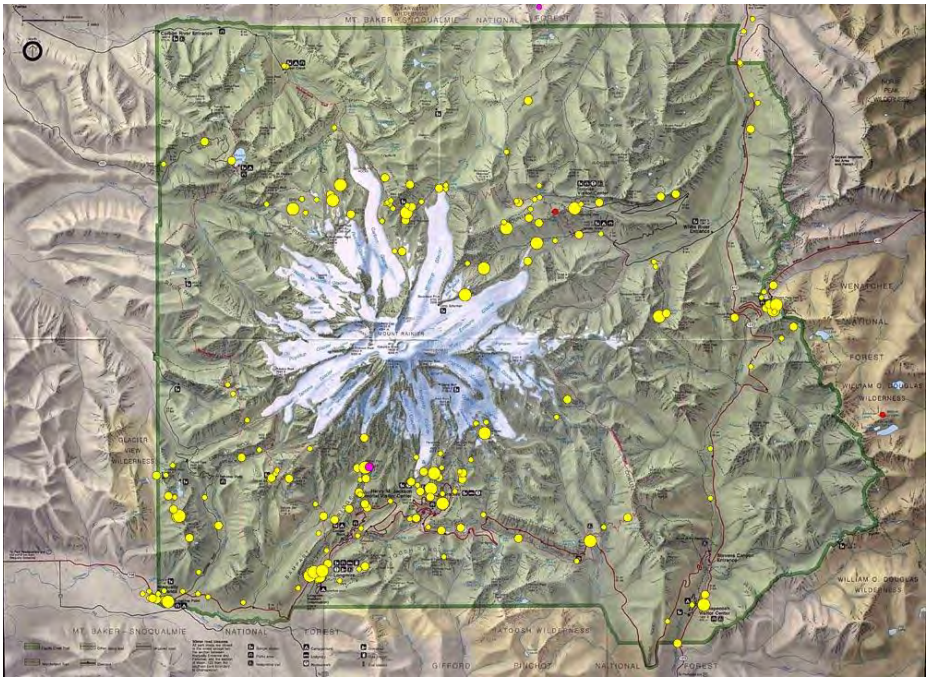
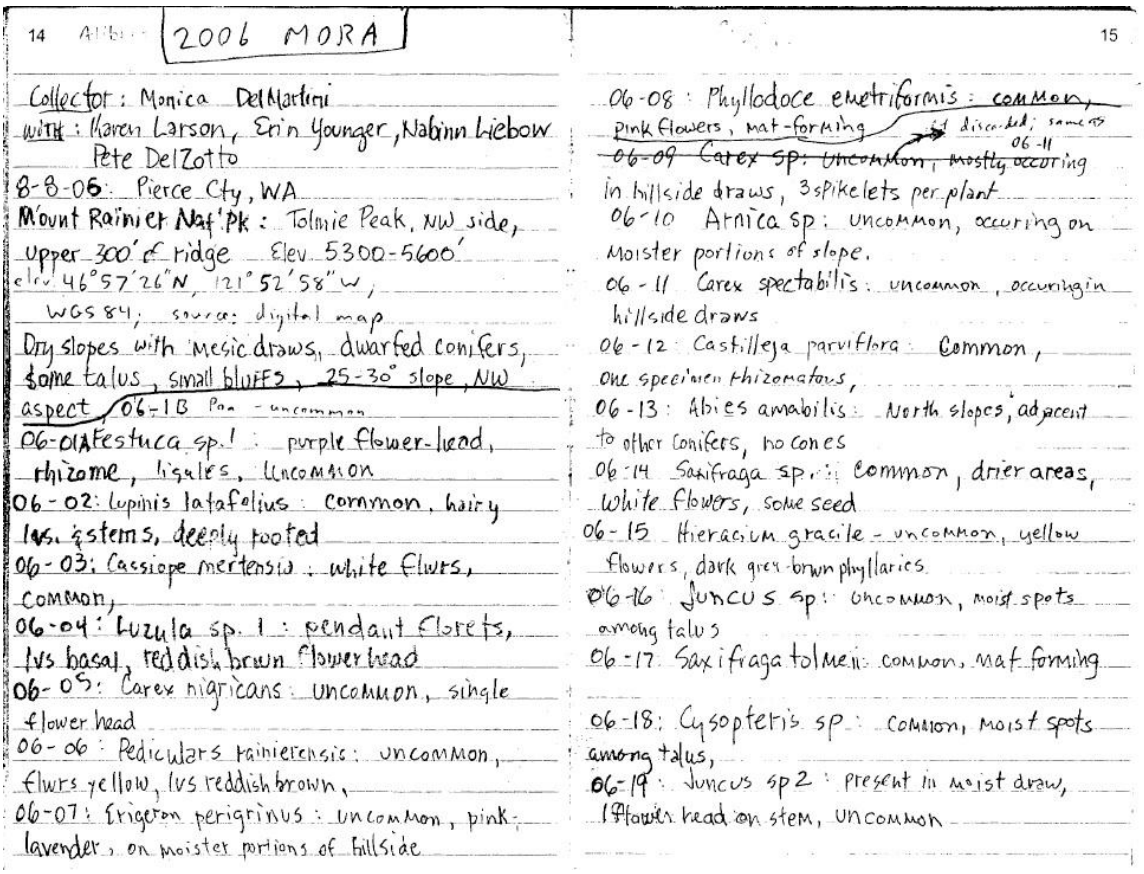


Figure 3. MORA map showing historic collecting locations (yellow dots). Pink dots show localities of *Pedicularis rainierensis* (Mt Rainier lousewort) and *Castilleja cryptantha* (obscure Indian-paintbrush).

Figure 4. Tim Rogers and Jesse Sorrells after hiking presses in to Silesia Camp along Copper Ridge during 2007 foray (Photo by D. Giblin).

All forays except the final NOCA outing in 2011 were co-led by botanists from both NPS and WTU. Prior to the forays, volunteers familiar to WTU staff were solicited on the basis of backcountry experience or familiarity with field collecting techniques. Broad advertisement for participation in the forays was not pursued because of the inherent physical demands of the trips, which typically included backpacking and extensive off-trail travel. We attracted between three to eight volunteers per trip. Volunteers received instructions from NPS and WTU staff regarding how to properly collect plants during each foray. Specifically, volunteers were requested to follow the 1 in 20 rule (only collect a plant of a taxon if there were at least 20 other individuals of that taxon in the area), asked to make replicate collections when population sizes allowed, and were instructed on how to label each replicate with collector name, date, and genus of the taxon collected. Plants were harvested using hand digging tools and occasionally with hand pruners.

Where possible, WTU staff served as field note writers due to their familiarity with the type of information required to make a good voucher specimen. Because the voucher collection information is entered into a database and ultimately made available online, field note accuracy is essential (Fig. 5).


14 2006 MORA

Collector: Monica DelMartini
with: Karen Larson, Erin Younger, Nabinn Liebow
Pete DelZotto
8-8-06: Pierce Cty, WA
Mount Rainier Nat'l Pk: Tolmie Peak, NW side,
upper 300' of ridge Elev. 5300-5600'
elev. 46°57'26"N, 121°52'58"W,
WGS84; source: digital map
Dry slopes with mesic draws, dwarfed conifers,
some talus, small bluffs, 25-30° slope, NW
aspect, 06-18 Poa - uncommon
06-01 Festuca sp.1: purple flower-head,
rhizome, ligules, uncommon
06-02: Lupinis latafolius: common, hairy
lvs. & stems, deeply tooted
06-03: Cassiope mertensia: white flwrs,
common,
06-04: Luzula sp. 1: pendant florets,
lvs basal, reddish brown flowerhead
06-05: Carex nigricans: uncommon, single
flower head
06-06: Pedicularis rainierensis: uncommon,
flwrs yellow, lvs reddish brown,
06-07: Erigeron perigrinus: uncommon, pink-
lavender, on moister portions of hillside

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06-08: Phyllodoce emetriformis: common,
pink flowers, mat-forming → discarded; same as 06-11
~~06-09 Carex sp: uncommon, mostly occuring~~
in hillside draws, 3 spikelets per plant
06-10 Arnica sp: uncommon, occuring on
moister portions of slope.
06-11 Carex spectabilis: uncommon, occuring in
hillside draws
06-12 Castilleja parviflora: common,
one specimen rhizomatous,
06-13: Abies amabilis: North slopes, adjacent
to other conifers, no cones
06-14 Saxifraga sp.: common, drier areas,
white flowers, some seed
06-15 Hieracium gracile - uncommon, yellow
flowers, dark grey-brown phyllaries
06-16 Juncus sp: uncommon, moist spots
among talus
06-17 Saxifraga tolmei: common, mat forming

06-18: Cysopteris sp: common, moist spots
among talus,
06-19: Juncus sp 2: present in moist draw,
1 flower head on stem, uncommon

Figure 5. Image of page from field notebook from 2006 MORA foray that included the Tolmie Peak area.

All collection localities were assigned a GPS coordinate based on a single point taken in the general vicinity in which one or more collections were made. A general description of the habitat of each location was also recorded (e.g., grassy bald on west-facing slope with scattered *Pinus contorta* trees to 10 m high; *Poa secunda* ssp. *secunda* and *Balsamorhiza sagittata* common and abundant). A collection comprised one or more replicates of a taxon, and each collection was assigned a collector name and number. Every participant on each trip had some collections assigned to their name, with other trip participants listed as associated collectors. Collector name and number is the best way to create a unique identity for each collection regardless of how many replicate collections made. Detailed notes were made for each collection (e.g., flowers yellow; plants to 50 cm high; common).

Each collection replicate was placed within a sheet of newsprint, placed between two cardboard sheets, and placed into a plant press. Participants tightened adjustable straps around each plant press to apply pressure to the replicates in order to flatten them for drying (Fig. 6).

Figure 6. 2006 foray participants pressing plants on slopes of Mt. McGregor in the Stehekin Valley (Photo by D. Giblin).

Upon trip completion the presses were driven back to WTU where they were placed in drying cabinets at approximately 45˚C for four to five days. Once completely dried, the specimens were placed in a freezer at -10˚C for two days to kill any insect or fungal pathogens, and upon removal were placed in a storage cabinet for subsequent identification.

All specimens were identified by WTU and NPS staff using dissecting microscopes and relevant contemporary floras (e.g., *Flora of North America*, *Illustrated Flora of British Columbia*, *Jepson Manual*, and *Flora of the Pacific Northwest*). Once identified, the specimens were databased using FileMaker Pro software, labels created from the database and inserted into each replicate, and the replicates sorted by destination herbarium (e.g., #1 to NOCA herbarium, #2 to WTU, #3 to collection to be determined). Each replicate also received a small label containing the name of the Park from which the specimen was collected, the NPS accession number for the project, and the NPS catalog number for that replicate. NOCA and MORA specimens were mounted at WTU, sent to the respective NPS herbarium for storage, and the full data set for each trip was ultimately sent to NPS curatorial staff. WTU replicates were also mounted and stored in cabinets at WTU where they are available to students, staff, faculty, and botanical researchers from around the world. The ultimate destination of any third or more replicate has not been resolved due to uncertainty regarding NPS policy on specimen distribution beyond project partner institutions.

Results

The six forays to NOCA generated 1041 collections of 873 unique taxa, of which 54 (6%) represented new vouchered records for the Park Complex (Table 1.). Of these 54, 15 represented new taxa to the NOCA vascular plant inventory list (Table 2). At MORA, the three forays generated 352 collections of 308 unique taxa, of which 45 (15%) represented new vouchered records for the Park (Table 3). Of these 45, 22 represented new taxa to the MORA

vascular plant inventory Table 4. The average number of collections made per foray at NOCA was 174, and at MORA it was 117, with an average of 146 and 103 unique taxa, respectively. Volunteer participation at both park locations was high, with 16 volunteers on the NOCA forays contributing 612 hours, and 12 volunteers at MORA contributing 328 hours. Combined volunteer time totaled 950 hours. Summaries for each NOCA foray can be found in Appendix A, and in Appendix B for each MORA foray.

Table 1. General summary for all six (6) NOCA forays conducted between 2006-2011*. Two forays were held in 2006.

Year	Collections	Specimens	Unique Taxa	Volunteers	Volunteer hours	New Park Records
2006	468	1070	396	6	240	34
2007	175	465	118	3	120	4
2008	174	471	153	4	144	0
2010	128	241	115	3	108	10
2011	96	176	91	0	0	6
TOTALS	**1041**	**2423**	**873**	**16**	**612**	**54**

* No foray was held in 2009 due to inclement weather during proposed dates.

Table 2. List of new additions to the NOCA vascular plant species list on the basis of collections made during the 2006-2011 forays. To clarify, these are names that previously did not occur on the NOCA species list. * indicates non-native species.

Scientific Name	Family Name
Botrychium simplex var. *compositum*	Ophioglossaceae
Diphasiastrum alpinum X sitchense	Lycopodiaceae
Sanicula bipinnatifida	Apiaceae
Saxifraga integrifolia var. *claytoniaefolia*	Saxifragaceae
Symphoricarpos albus var. *laevigatus*	Caprifoliaceae
**Cardamine hirsuta*	Brassicaceae
**Hordeum vulgare*	Poaceae
**Poa pratensis ssp. angustifolia*	Poaceae
**Prunella vulgaris* var. *vulgaris*	Lamiaceae
**Taraxacum erythrospermum*	Asteraceae
Antennaria alpina	Asteraceae
Carex lasiocarpa	Cyperaceae
Festuca rubra var. *commutata*	Poaceae
Penstemon subserratus	Scrophulariaceae
Vulpia microstachys	Poaceae

Table 3. General summary for all three (3) MORA forays conducted between 2006-2007. Two forays were held in 2006.

Year	Collections	Specimens	Unique Taxa	Volunteers	Volunteer hours	New Park Records
2006	225	570	208	9	250	43
2007	127	332	100	3	78	2
TOTALS	**352**	**902**	**308**	**12**	**328**	**45**

Table 4. List of new additions to the MORA vascular plant inventory from the 2006-2007 forays. To clarify, these are names that previously did not occur on the NOCA species list. * indicates non-native species.

Anemone multifida var. *saxicola*	Ranunculaceae
Arabis furcata var. *furcata*	Brassicaceae
Arabis hirsuta	Brassicaceae
Arceuthobium abietinum	Santalaceae
Arceuthobium tsugense	Santalaceae
Arnica ovata	Asteraceae
Botrychium minganense	Ophioglossaceae
Carex aquatilis var. *aquatilis*	Cyperaceae
Carex scirpoidea ssp. *stenochlaena*	Cyperaceae
Carex utriculata	Cyperaceae
Draba lonchocarpa var. *lonchocarpa*	Brassicaceae
Epilobium lactiflorum	Onagraceae
Epilobium latifolium	Onagraceae
Epilobium oregonense	Onagraceae
Equisetum fluviatile	Equisetaceae
Eriogonum ovalifolium var. *nivale*	Polygonaceae
Gymnocarpium disjunctum	Dryopteridaceae
Huperzia haleakalae	Lycopodiaceae
Juncus ensifolius var. *ensifolius*	Juncaceae
Osmorhiza chilensis	Apiaceae
Polystichum imbricans ssp. *imbricans*	Dryopteridaceae
Saxifraga occidentalis var. *occidentalis*	Saxifragaceae

Collections made during the nine forays covered in this report included several taxa tracked by the Washington Natural Heritage Program due to their rarity in Washington. The taxa located at NOCA (Table 5) and at MORA (Table 6) are summarized in the tables below.

Table 5. List of rare taxa collected at NOCA with rarity designation according to the Washington Natural Heritage Program's 2011 Natural Heritage Plan.

Scientific name	State Rank	State Status	Federal Status	Year Collected
Agrostis borealis (A. mertensii)	S1S2	Threatened	N/A	2006
Botrychium hesperium	S1	Threatened	N/A	2011
Carex rostrata	S1	Sensitive	N/A	2006
Carex scirpoidea var. *scirpoidea*	S2	Sensitive	N/A	2011
Erigeron salishii	S2	Sensitive	N/A	2008
Saxifraga cernua	S1S2	Sensitive	N/A	2008
Utricularia minor	S2?	Review Group 1	N/A	2006

Table 6. List of rare taxa collected at MORA with rarity designation according to the Washington Natural Heritage Program's 2011 Natural Heritage Plan.

Scientific name	State Rank	State Status	Federal Status	Year Collected
Castilleja cryptantha	S2S3	Sensitive	N/A	2006
Microseris borealis	S2	Sensitive	N/A	2006
Pedicularis rainierensis	S2S3	Sensitive	N/A	2006, 2007

Specimen data from all forays is available online to researchers and the general public through WTU's online database (http://biology.burke.washington.edu/herbarium/collections/vascular/search.php), and the Consortium for Pacific Northwest Herbaria portal (http://www.pnwherbaria.org) (Fig. 7). We also created a series of Web pages on the WTU site for each trip that includes a trip summary, photos, map of the area visited, a list of the new taxa added to either the NOCA or MORA herbaria, and a downloadable list of all specimens collected from each foray (except those taxa included on the Washington Natural Heritage Program's list of rare taxa). Access to those pages, along with introductory project information, can be found here: (http://biology.burke.washington.edu/herbarium/research/nps.php). All of WTU's database data are exported for presentation through the Global Biodiversity Information Facility (http://www.gbif.org), another online resource used by researchers worldwide.

Figure 7. Displayed results from Consortium of Pacific Northwest Herbaria online portal for query on year = 2010, locality = Ross Lake. All 128 specimen records are available for viewing and downloading, and the collection localities are indicated by orange boxes in the map insert

Conclusions

By all measures the 2006-2011 North Cascades National Park Complex and 2006-2007 Mount Rainier National Park forays were extremely successful. Along with documenting 54 new taxa at NOCA and 45 at MORA, respectively, the trips created citizen science opportunities that are rather unique within the National Park System. Having members from the public, the "owners" of the Park, contribute their time, effort, and expertise to the documentation of biodiversity within these parks is a model that would be wonderful to replicate elsewhere. Moreover, the Web pages created for the foray program provides the public with valuable insights into the nature and process of ongoing research within the National Park Service.

From a scientific point of view, the forays generated a tremendous amount of novel diversity and distribution data for both parks and the Pacific Northwest floristic region. For example, *Antennaria alpina* (alpine pussytoes; Asteraceae) was previously thought to not occur within Washington according to the recent treatment for this genus in the *Flora of North America* series. This species is distinct from the much more common *Antennaria media* (also known as *A. alpina* var. *media*). The NOCA forays generated some of the only known populations of *A. alpina* in Washington, and extended the known distribution of this species further south than previously expected. The NOCA forays also resulted in the collection of nearly a dozen *Botrychium* (moonwort; Ophioglossaceae) taxa. Ongoing taxonomic research into this challenging species complex will benefit greatly from the specimens collected on these forays.

Despite over a century of botanical exploration and the publication of several floras, the MORA forays generated several species previously undocumented from within the Park. This general finding alone underscores the benefit of having teams of volunteers led by knowledgeable botanists journey to previously unsampled areas to document vascular plant diversity within NPS lands.

The initial rounds of NOCA and MORA forays began in 2002 and 2004, respectively. For NOCA, the forays through 2011 have added approximately 10% more vouchered taxa to the NOCA species list. In all but one year new taxa were added to the NOCA list, and we are confident that additional forays will continue to yield additional new taxa. At MORA the percentage is somewhat lower in part because the flora is smaller and the history of collecting is so much more extensive. In short, the forays have added significantly to the documented vascular plant diversity within both parks, and evidence suggests that additional forays will yield further additions to the lists for each Park.

At NOCA, areas of prioritization for future forays include the grassy balds in the Newhalem area, the complex of grassy balds on the southeast corner of Ross Lake and those at Pumpkin Mountain at the mouth of the Big Beaver Creek drainage, the Monogram Lake area, and the area around Purple Pass above Stehekin. Each of these areas contains habitats that have been poorly sampled in the forays to date. Finally, Whatcom Pass is a priority area for visitation due to its westward location within the NOCA boundaries and its well known, but poorly documented, vascular plant diversity. At MORA priority should be given to the Golden Lakes area, due to its relative isolation and absence of past collecting activities. Moreover, undocumented alpine species such as *Polemonium viscosissimum* are likely to be found in the high elevation areas on the north side of the park where exposures can have lower temperatures and perhaps support alpine species more commonly encountered further north.

APPENDIX A. Trip by trip summary for all six (6) NOCA forays conducted between 2006-2011, including list of previously unvouchered taxa.

6/27/06-6/30/06: Stehekin Area, LACH, NOCA
(http://biology.burke.washington.edu/herbarium/research/noca_2006_stehekin.php)

Volunteers	Friday	Saturday	Sunday	Monday
Diane Doss	Stehekin Airport	McGregor Mtn.	McGregor Mtn.	Gravel pit, orchard
Dale Blum	Stehekin Airport	Purple Ck. Trail	McGregor Mtn.	Gravel pit, orchard
Barbara Smith	Stehekin Airport	Purple Ck. Trail	Coon Lake	Gravel pit, orchard

Staff	Friday	Saturday	Sunday	Monday
Steve Hahn (NOCA)	Stehekin Airport	McGregor Mtn.	Coon Lake	Gravel pit, orchard
Vicki Gempko (NOCA)	Stehekin Airport	--	McGregor Mtn.	Gravel pit, orchard
Jennette Timmer (SCA)	Stehekin Airport	Purple Ck. Trail	Coon Lake	Gravel pit, orchard
Tricia Downey (SCA)	Stehekin Airport	Purple Ck. Trail	Coon Lake	Gravel pit, orchard
Cheryl Lowe (SCA)	Stehekin Airport	McGregor Mtn.	McGregor Mtn.	Gravel pit, orchard
Anders Huseth (SCA)	Stehekin Airport	McGregor Mtn.	McGregor Mtn.	Gravel pit, orchard
Ben Legler (WTU)	Stehekin Airport	Purple Ck. Trail	Coon Lake	Gravel pit, orchard
David Giblin (WTU)	Stehekin Airport	McGregor Mtn.	McGregor Mtn.	Gravel pit, orchard

Volunteer hours: **120**
Total number of collections: **300**
Total number of specimens: **720** (most collections have more than one replicate)
Total number of unique taxa: **254**
Total number of new taxa to NOCA Herbarium: **23 (* indicates non-native taxon)**

Amelanchier alnifolia var. *cusickii*
**Bromus japonicus*
Carex lasiocarpa
Claytonia rubra ssp. *rubra*
Cryptantha affinis
Festuca rubra var. *commutata*
Festuca viridula
Galium bifolium
Gnaphalium palustre
Heuchera cylindrica var. *alpina*
**Hordeum vulgare*
**Logfia arvensis*
Penstemon subserratus
**Poa pratensis* ssp. *angustifolia*
Polygonum polygaloides ssp. *kelloggii*
**Prunella vulgaris* var. *vulgaris*
Saxifraga integrifolia var. *claytoniaefolia*
Saxifraga occidentalis var. *allenii*
Symphoricarpos albus var. *laevigatus*

Utricularia minor
Utricularia vulgaris
**Vicia cracca*
Vulpia microstachys

7/28/06-7/31/-06: Dagger Lake, Stilleto Lake, Hock Mountain, NOCA
(http://biology.burke.washington.edu/herbarium/research/noca_2006_dagger.php)

Volunteers	Friday	Saturday	Sunday	Monday
Maria Gerace	Hike in, Dagger Lk	Stiletto Lake	Hock Mtn.	Hike out
Charlie Baughman	Hike in, Dagger Lk	Stiletto Lake	Dagger Lake	Hike out
Myria Rodeman	Hike in, Dagger Lk	Stiletto Lake	Dagger Lake	Hike out

Staff	Friday	Saturday	Sunday	Monday
Steve Hahn (NOCA)	Hike in, Dagger Lk	Stiletto Lake	Hock Mtn.	Hike out
Heather (horse wrangler)	Pack in supplies	--	--	Pack out supplies
Nathan Walker (SCA)	Hike in, Dagger Lk	Stiletto Lake	Hock Mtn.	Hike out
Matt Lee (SCA)	Hike in, Dagger Lk	Stiletto Lake	Hock Mtn.	Hike out
Ben Legler (WTU)	Hike in, Dagger Lk	Stiletto Lake	Hock Mtn.	Dagger Lk, Hike out

Volunteer hours: **120 hours**
Total number of collections: **168**
Total number of specimens: **350** (most collections have more than one replicate)
Total number of unique taxa: **153**
Total number of new taxa to NOCA Herbarium: **11 (* indicates non-native taxon)**
Antennaria media
Callitriche palustris
Carex jonesii
Eleocharis suksdorfiana
Elymus elymoides ssp. *californicus*
Epilobium palustre
Ligusticum canbyi
Oryzopsis exigua
Packera streptanthifolia
Platanthera dilatata var. *leucostachys*
Saxifraga adscendens var. *oregonensis*

8/2/07-8/5/07: Hannegan Pass – Copper Ridge, NOCA
(http://biology.burke.washington.edu/herbarium/research/noca_2007.php)

Volunteers	Thursday	Friday	Saturday	Sunday
Peter Zika	Hike in	Copper Lake	Copper Ridge	Hike out
Dale Blum	Hike in	Copper Ridge	Copper Ridge	Hike out

Steve Walker	Hike in	Copper Ridge	Copper Ridge	Hike out

Staff	Wednesday	Thursday	Friday	Saturday	Sunday
Steve Hahn (NOCA)	Hike plant presses in	Hike in	Copper Ridge	Copper Ridge	Hike out
Kelly Oneil NOCA		Hike in	Copper Lake	Copper Ridge	Hike out
Lily Hickenbottom (NOCA)		Hike in	Copper Lake	Copper Ridge	Hike out
Jesse Sorrels (SCA)	Hike plant presses in	Hike in	Move presses	Move presses	Hike presses out
Tim Rogers (SCA)	Hike plant presses in	Hike in	Move presses	Move presses	Hike presses out
Megan Jensen (WTU)		Hike in	Copper Ridge	Copper Ridge	Hike out
David Giblin (WTU)		Hike in	Copper Lake	Copper Ridge	Hike out

Volunteer hours: **120**
Total number of collections: **175**
Total number of specimens: **465** (most collections have more than one replicate)
Total number of unique taxa: **118**
Total number of new taxa to NOCA Herbarium: **4**

Antennaria alpina
Diphasiastrum alpinum X *sitchense*
Juniperus communis var. *depressa*
Sorbus sitchensis var. *sitchensis*

8/15/08-8/17/08: Heather Pass Area, NOCA
(http://biology.burke.washington.edu/herbarium/research/noca_2008.php)

Volunteers	Friday	Saturday	Sunday
Maria Gerace	Hike in	Collect at Horsefly Pass	Hike out; collect at Thunder Lake
Cheryl Lowe	Hike in; collect at Maple Pass	Collect at Horsefly Pass	Hike out; collect at Thunder Lake
Bay Renaud	Hike in; collect at Maple Pass	Collect at Black Peak	Hike out; collect at Thunder Lake
Tim Stetter	Hike in; collect at Maple Pass	Collect at Black Peak	Hike out; collect at Thunder Lake

Staff	Thursday	Friday	Saturday	Sunday
Mignonne Bivin (NOCA)		Hike in	Collect at Horsefly Pass	Hike out; collect at Thunder Lake
Lily Hickenbottom (NOCA)		Hike in; collect at Maple Pass	Collect at Black Peak	Hike out
Steve Hahn (WTU)	Hike plant presses in	Hike in	Collect at Black Peak	Hike out; collect at Thunder Lake
David Giblin (WTU)		Hike in; collect at Maple Pass	Collect at Horsefly Pass	Hike out; collect at Thunder Lake

Volunteer hours: **144**
Total number of collections: **174**
Total number of specimens: **471**
Total number of unique taxa: **153**
Total number of new taxa to NOCA Herbarium: **0**

2009 – NO FORAYS DUE TO INCLEMENT WEATHER

5/11/10-5/13/10: Lightning Creek Campground Area, ROLA
(http://biology.burke.washington.edu/herbarium/research/noca_2010.php)

Volunteers	Tuesday	Wednesday	Thursday
Ben Legler	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.
Russ Holmes	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.
James Duemmel	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.

Staff	Tuesday	Wednesday	Thursday
Mignonne Bivin (NOCA)	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.
Becky Peace (NOCA)	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.
David Giblin (WTU)	Transport gear from vehicles to boat launch site at Ross Lake Dam; boat ride to Lightning Creek; plant collecting.	Plant collecting.	Plant collecting; boat ride to Ross Lake Dam boat launch; transport gear up trail to vehicles; return commute.

Volunteer hours: **108**
Total number of collections: **128**
Total number of specimens: **241**
Total number of unique taxa: **115**
Total number of new taxa to NOCA Herbarium: **10 (* indicates non-native taxon)**

Athysanus pusillus
**Cardamine hirsuta*
Cardamine pensylvanica
Carex lenticularis var. *lipocarpa*
Eriophyllum lanatum var. *lanatum*
Montia linearis
Ranunculus glaberrimus var. *ellipticus*
Sanicula bipinnatifida

**Taraxacum erythrospermum*
Veronica peregrina var. *xalapensis*

9/7/11-9/9/11: Horsefly Pass to Mt. Benzarino, NOCA
(http://biology.burke.washington.edu/herbarium/research/noca_2011.php)

Volunteers	Wednesday	Thursday	Friday
N/A			

Staff	Wednesday	Thursday	Friday
David Giblin (WTU)	Commute Seattle to Heather Pass Trailhead; hike to small lake on north side of Mt. Benzarino, collecting plants along the way.	Plant collecting from small lake to northern edge of Mt. Benzarino summit, to Last Chance Pass, back to lake.	Hike back to vehicle; plant collecting from small lake to Horsefly Pass; commute back to Seattle.
Ben Legler (WTU)	Commute Seattle to Heather Pass Trailhead; hike to small lake on north side of Mt. Benzarino, collecting plants along the way.	Plant collecting from small lake to northern edge of Mt. Benzarino summit, to Last Chance Pass, back to lake.	Hike back to vehicle; plant collecting from small lake to Horsefly Pass; commute back to Seattle.

Volunteer hours: **0**
Total number of collections: **96**
Total number of specimens: **176**
Total number of unique taxa: **91**
Total number of new taxa to NOCA Herbarium: **6**

Names of new taxa to NOCA Herbarium:
Asplenium trichomanes-ramosum
Botrychium lanceolatum var. lanceolatum (yet to be described red form)
Botrychium montanum
Botrychium simplex var. *compositum*
Orobanche fasciculata
Phacelia hastata var. *compacta*

APPENDIX B. Trip by trip summary for all three (3) NOCA forays conducted between 2006-2011, including list of previously unvouchered taxa for the North Cascades National Park Complex.

7/18/06-7/20/06: Owyhigh Lakes, MORA
(http://biology.burke.washington.edu/herbarium/research/mora_2006_owyhigh.php)

Volunteers	**Tuesday**	**Wednesday**	**Thursday**
Diane Doss	Owyhigh Lakes	--	--

Staff	**Tuesday**	**Wednesday**	**Thursday**
Pete Del Zotto (MORA)	--	--	Tamanos Mtn
Arnie Peterson (MORA)	--	Governor's Ridge	--
Lindsey Koepke (MORA)	Owyhigh Lakes	--	--
Ben Legler (WTU)	Owyhigh Lakes	Governor's Ridge	Tamanos Mtn
David Giblin (WTU)	Owyhigh Lakes	Governor's Ridge	Tamanos Mtn

Volunteer hours: 10 hours
Total number of collections: 78
Total number of specimens: 174 (most collections have more than one replicate)
Total number of unique taxa: 72
Taxa added to MORA Herbarium (previously unvouchered within MORA): 18

Anemone multifida var. *saxicola*
Arabis furcata var. *furcata*
Arceuthobium abietinum
Arceuthobium tsugense
Botrychium minganense
Epilobium lactiflorum
Epilobium latifolium
Eriogonum ovalifolium var. *nivale*
Lycopodium sitchense
Monardella odoratissima ssp. *discolor*
Montia parvifolia ssp. *flagellaris*
Packera flettii
Polystichum imbricans ssp. *imbricans*
Polystichum lonchitis
Ranunculus eschscholtzii var. *eschscholtzii*
Saxifraga occidentalis var. *occidentalis*
Stenanthium occidentale
Tsuga heterophylla

8/7/06-8/9/06: Mowich Lakes, MORA
(http://biology.burke.washington.edu/herbarium/research/mora_2006_mowich.php)

Volunteers	Monday	Tuesday	Wednesday
Erin Younger	Mtn. Meadows	Tolmie Peak	Knapsack Pass
Navina Leibow	Mtn. Meadows	Tolmie Peak	Knapsack Pass
Cindy Gentry	Mtn. Meadows	Ipsut Pass	Knapsack Pass
Sharon Rodman	Mtn. Meadows	Ipsut Pass	Knapsack Pass
Lara Massey	Mtn. Meadows	Ipsut Pass	Knapsack Pass
Lucia Harrison	Mtn. Meadows	Ipsut Pass	Knapsack Pass
Karen Larson	Mtn. Meadows	Tolmie Peak	Knapsack Pass
Monica Delmartini	Mtn. Meadows	Tolmie Peak	Knapsack Pass

Staff	Monday	Tuesday	Wednesday
Pete Del Zotto (MORA)	Mtn. Meadows	Tolmie Peak	--
Ben Legler (WTU)	Mtn. Meadows	Ipsut Pass	Knapsack Pass

Volunteer hours: 240 hours
Total number of collections: 147
Total number of specimens: 396
Total number of unique taxa: ca. 136
Taxa added to MORA Herbarium (previously unvouchered within MORA): 25

Arabis hirsuta
Arnica ovata
**Bromus vulgaris*
Carex aquatilis var. *aquatilis*
Carex scirpoidea ssp. *stenochlaena*
Carex utriculata
Epilobium ciliatum ssp. *ciliatum*
Epilobium oregonense
Equisetum fluviatile
Erigeron peregrinus var. *peregrinus*
Eriophorum angustifolium ssp. *angustifolium*
Gymnocarpium disjunctum
Heuchera micrantha var. *diversifolia*
Huperzia haleakalae
Juncus ensifolius var. *ensifolius*
Montia parvifolia ssp. *parvifolia*
Phacelia nemoralis ssp. *oregonensis*
Platanthera dilatata var. *dilatata*
Polystichum andersonii
Sedum oreganum
Silene parryi
Spiraea x *hitchcockii*
Symphyotrichum foliaceum
Trichophorum cespitosum
Viburnum edule

8/12/07-8/14/07: Crystal Lakes – Mt. Fremont – Huckleberry Basin, MORA
(http://biology.burke.washington.edu/herbarium/research/mora_2007.php)

Volunteers	Sunday	Monday	Tuesday
Richard Ramsden	Travel to MORA	Crystal Lakes area	Mt. Fremont area; travel to Seattle
Vicki Weafer	Travel to MORA	Crystal Lakes area	Huckleberry Basin; travel to Seattle
Dan Paquette	Travel to MORA	Crystal Lakes area	Mt. Fremont area; travel to Seattle

Staff	Sunday	Monday	Tuesday
Judy Runge	N/A	N/A	Mt. Fremont area
Jessica Waite (MORA)	N/A	N/A	Huckleberry Basin
David Giblin (WTU)	Travel to MORA	Crystal Lakes area	Huckleberry Basin; travel to Seattle
Megan Jensen (WTU)	Travel to MORA	Crystal Lakes area	Mt. Fremont area; travel to Seattle

Volunteer hours: 78 hours
Total number of collections: 128
Total number of specimens: 332
Total number of unique taxa: 101
Taxa added to MORA Herbarium (previously unvouchered within MORA): 2

Draba lonchocarpa var. *lonchocarpa*
Osmorhiza chilensis