Indicator	Alpine Community Structure
Measure(s)	• Plant community structure • Invasive plants
Justification	As the climate warms, the accepted future scenario is that treeline climbs up in elevation. This protocol will measure the speed of this and other changes to broad alpine functional groups (grasses, forbs, shrubs, trees, moss, bare ground).
Description	Permanent transects are established from just below present treeline to just above the transition from vegetation to rock (or ridgeline, whichever comes first). A 50cm X 50cm quadrat is sampled at regular intervals along the transect.
Measurement Frequency	Alpine plant changes do not happen quickly. Remeasurements will be at 4 year intervals.
Sampling Strategy	Exact locations along a fixed transect ensure that resampling is in the same place each time.
Protocol Source	This protocol is modified from the alpine sampling protocol developed by Dr. Brian Starzomski, University of Victoria
Unit(s) of Measure	% foliar cover
QA/QC	Teams of 2 help to identify species and estimate cover
References	Bakker, N. P. Jorgenson and T. Thomas. 2011. *Best Management Practices for Invasive Plants in Parks and Protected Areas of British Columbia*. Province of BC and Invasive Plant Council of BC. http://www.bcinvasiveplants.com/iscbc/images/stories/documents/otherpublications/BC-Parks-IP-Guide_web_sm.pdf IAPP: http://www.for.gov.bc.ca/hra/Plants/application.htm MacKinnon, A., J. Pojar and R. Coupe. 2005. *Plants of Northern British Columbia, 2nd Edition*. Lone Pine Publishing. Parish, R., R. Coupe, D. Lloyd. 2006. *Plants of Southern Interior British Columbia.* Lone Pine Publishing. Pojar, J. and A. MacKinnon. 2004. *Plants of the Pacific Northwest Coast, 2nd Edition*. Lone Pine Publishing. Pojar, J. and A. MacKinnon. 2013. *Alpine Plants of the Northwest: Wyoming to Alaska*. Lone Pine Publishing.

Detailed Protocol

Equipment:

- iPad with LTEM app or grassland data file loaded (optional)
- Digital camera or iPad
- GPS or iPad
- Permanent pins (for initial set up) – rebar for the transect ends and long galvanized nails (or equivalent) for the plot corners
- Plant identification guide for your area
- Tailored field guide for your site (after the first year)
- List/photos of potential invasive species – BC Parks Invasive Species Guide (2011)
- 100 metre tape(s)
- Compass
- Quadrat frame (50 cm X 50 cm with 5 cm markings along the side)
- Datasheets or iPad
- Small cards labeled with transect and plot number for picture id (or iPad with LTEM app)

Instructions:

Locate and establish the transect

Choose a location that is accessible enough to be visited every 4 years. Locate the transects in an area that does not get regular human traffic -- away from standard routes and trails. Permanent transects are established perpendicular to the slope somewhere between treeline and the transition from vegetation to rock (or ridgeline, whichever comes first). Establish 2 transects, one on each of 2 aspects. Usually a 100 m tape is used to establish the transect, but a longer transect can be established by running the tape twice or more. Mark the beginning and end with a permanent pin and record the GPS location so that it can be found again. Leave the tape in place while you sample. At regular intervals along one side of each transect a 50cm X 50cm plot frame (quadrat) is examined for plant cover. The interval will be anything from 10 – 25 m depending on the length of the transect. Make sure all the plots are on the same side of the transect, to avoid standing in any of the plots. Record the side of the transect where the plots are located. A minimum of 10 plots is required. If the transect is greater than 250 meters, place the quadrats at equal intervals along the transect. Record the interval between sampling plots. Mark two opposite corners of each plot with inconspicuous pegs or nails so that the exact same plot is sampled in subsequent years. Note the location of the pegs and keep the same configuration throughout the transect if possible (upper right, lower left or the opposite). If it is not possible to place the pegs or nails, switch the location of the pegs and note that change. If it is still not possible, move the plot along the transect until the pegs will go in. Make a note of the position along the transect where the plot frame is positioned.

Monitoring

Record the % foliar cover for each of the following:

- Each plant species including identifiable mosses and lichens. Record the taxonomic level that is known. Species is ideal, but if necessary record the genus, family, class or even phylum. (See Appendix A)
- Bare ground
- Litter
- Rock
- Scat

Foliar cover is defined as the area shaded by a species. Use the marks on the side of the plot frame to help estimate cover. One 5 cm X 5 cm square is 1% of the plot area. If the area covered by a species is less than 1%, choose the closest of 0.5%, 0.2% or 0.1%.

Catalog all invasive species in the invasive species database – Invasive Alien Plant Program (IAPP) (see instructions in the BC Parks Invasive Species Guide).

Photomonitoring

Standing at the beginning of the 2 transects, take a picture along each transect.
Take a picture of each plot. Stand on the transect for each picture so that they are always oriented in the same direction. Put a small numbered card just outside the corner of the frame to identify the transect number and the number of the plot (TxPx). If you are using the LTEM app, this is not necessary. Make sure the entire frame is in the picture and the camera is as close to directly above the plot as possible.

Appendix A.

Kingdom: Plantae

Ideally we identify the species (Genus species), but often that will not be possible. Identify as closely as possible. Use this chart to help.

Use the taxonomic label that is the most accurate you can figure out. I.E. If you know you have a moss but don't know the species, then put BRYOPHYTA (or moss) if it is a lichen put ASCOMYCOTA (or lichen).

Phylum	**Class**	**Common Families (there are many others)**	**Common Genuses**
ANTHOPHYTA angiosperms *flowering plants including deciduous trees and shrubs, grasses and grass-likes*	MONOCOTYLEDONEAE monocots *parallel veins in leaves; leaves tend to be long and thin*	POACEAE grasses	Poa Festuca
		CYPERACEAE sedges	Carex
		ORCHIDACEAE orchids	
		JUNCACEAE rushes	
		LILIACEAE lilies	
	DICOTYLEDONEAE dicots *branched veins in leave; leaves are round,* *oval, lobed, compound, fern-like* *and much more*	ASTERACEAE asters	
		ERICACEAE heathers, blueberries, etc.	Vaccinium
		ROSACEAE roses	Rosa
		RANUNCULACEAE buttercups	
		BRASSICACEAE rockcress	
		FABIACEAE pea, vetch	
		BETULACEAE birches	Betula
		COMPANULACEAE bell flowers	
		SCROPHULARIACEAE paint brush, louseworts	Castilleja
		SALICACEAE willows	Salix
CONIFEROPHYTA conifers	PINOPSIDA	TAXACEAE yew	Taxa
		CUPRESSACEAE cedars, junipers	Juniperus, Thuya
		PINACEAE everything else	Abies
			Pinus
			Larix
			Tsuga
			Pseudotsuga
			Picea
FILICINOPHYTA ferms			

ASCOMYCOTA lichens			
BRYOPHYTA mosses	BRYOPSIDA most mosses SPHAGNOPSIDA sphagnum mosses ANDREAEOPSIDA		
LYCOPHYTA quillworts, clubmosses, spike mosses			Isoetes
		Selaginellaceae	Selaginella
HEPATOPHYTA liverworts			
SPHENOPHYTA horsetails			Equisetum