Wetlands on proposed notch loop

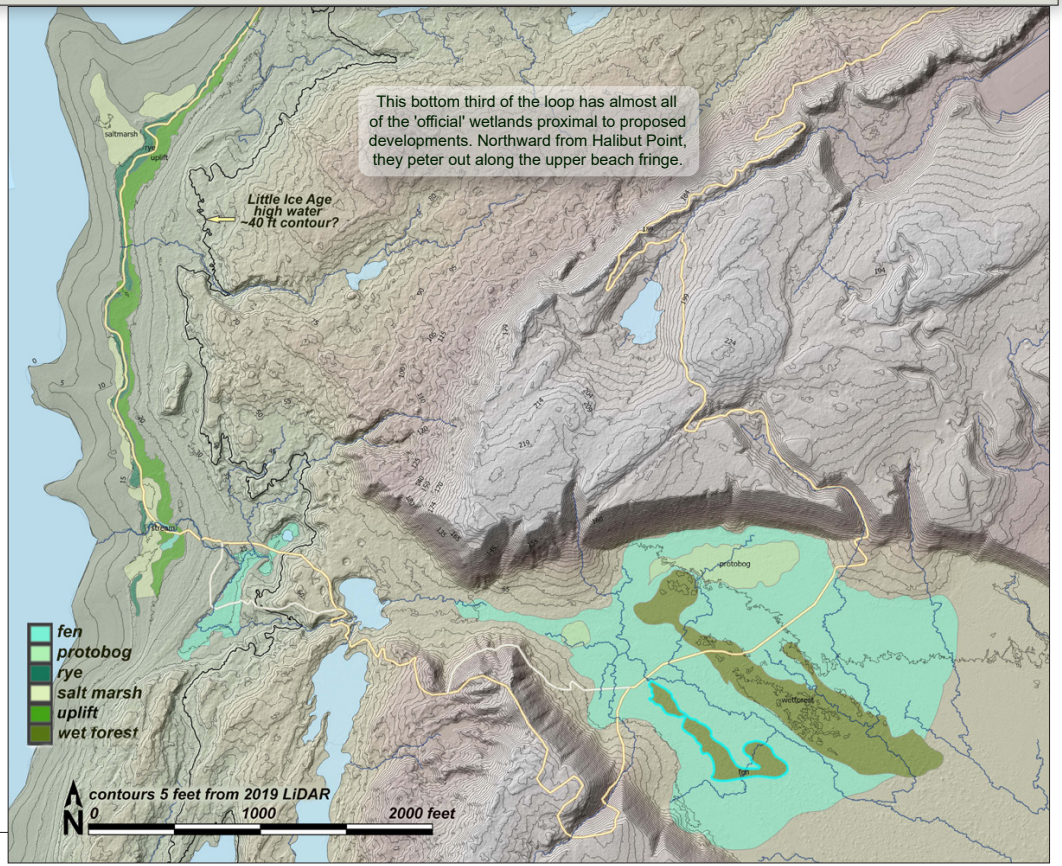
This section is being inserted at end of our 2024 season while Koren and I are trying to make sense of the terrestrial and tidal habitats of Sandhill Cove. It didn't belong in the mostly pre-field *Introduction*, although I noted in a *Habitats* subsection *PS* that we'd selected 7 types for 'polygoning' (6, excluding the stream channel type).

Nor does it fit in *Daily journals*, because it's a post-field synthesis. And it seems too central to the project to be relegated to mere *Appendices*. So here we are, in, *dunt-dunha duhhhhh,* **Results**.

Aside from invasives and rare plants, which are more of a point-mapping chore (next section, the cartographic component Koren's assignment from NPS was a wetlands polygon map. Additional comments & interpretive suggestions from Bosworth team would be helpful, we were told, but not, at this point, necessary to map.

For now, I'm grateful not to tackle subdivisions of the ***non-wetland*** habitats of our Inner Project Area. [1] We can share some interesting observations from field and GIS perusal, but it'd probably be premature to map them, at least at the scale of the IPA.

Moving roughly from tidelands up into the Notch,



1 ***Non-wetland*** is used here to avoid use of *upland*. In some contexts, upland serves as the opposite of wetland, but in others it contrasts with lowland, or beach, meaning anything above tidal habitats. NPS scoping documents for this project refer to "lowland forest" and "upland forest," which introduces yet another, rather nonstandard, dichotomy. Beyond our wetland types, I'll try instead to at least verbally, if not graphically, describe some more locally-meaningful "dryland" forested habitats.

here are our 6 wetland types. A few, such as the variably wet uplift meadows, may stray slightly from more formal types of wetlands definitions, but do get lumped into some systems. [2] Bear in mind also that this is a rapidly evolving landscape. Some communities may exit or even enter wetland status (think Klinger-Lawrence & paludification) as their substrate dampens or dessicates. And some lack diagnostic species found on older landscapes throughout the archipelago.

2 In wetlands mapping for CBJ, Bosworth Botanical in consultation with WESPAK author Paul Adamus broke out all units between HTL (20.6ft) and 32 feet as *uplift meadow*, because they were tidal at peak Little Ice Age. Only a small portion of that elevation band merited wetland status because coarse substrate quickly shifted communities to species such as lupine, fireweed and umbelliferae.

● **Salt marsh** Select, low-diversity community of salt-tolerant vascular halophytes. Elsewhere subdivided into sedge-low marsh and grass-high marsh, but these haven't had time to differentiate at Sandhill Cove so we're lumping. Judging from LiDAR-generated contours, between ~14 and 18 feet in the IPA. In Cowardin, mapped as PEM1.

Tallest, darkest green tufts on left are *Triglochin,* over *Puccinellia* & succulent mix of *Plantago, Glaux, Atriplex*.

● **Beach rye** Slightly discontinuous, but surprisingly successful at Sandhill Cove, in view of the rather patchy nature of salt marsh there. Elsewhere, *Leymus mollis* is only one of several mildly tolerant halophytes dominating upper

While descriptions in this section climb from lowest tidal to highest types in the Notch, the key is stacked high to low,

edges of the grassy high marsh. In a mature tidal series, belts step predictably upward from low marsh to high marsh to uplift meadow. But our IPA wetlands map has some 'flipped' units with salt marsh actually up-beach from the dense rye strips.

● **Uplift meadow** Raised former tideland to edge of spruce or alder. Not actually wetland where sediments are coarse and well drained—above examples labeled *uplift dry.*

Typically, well-drained uplift meadow is lush and diverse, waist- to chest-high, like the example above right. In contrast, much of the narrow band leading down to Halibut Point sees moderate human and **bear** traffic. Meadow plants are only ankle-height here. At several times heavier passage, this band would turn to mud. So hardening (gravel-'turnpike'?) will be necessary.

In places, raised tideland has fines near the surface and habitats are still legitimate wetland. Example on right was formerly a back-berm swale, maybe briefly a blackwater lagoon. It hosts emergent buckbean and will probably resist drying out with further uplift. Floristic

distinction from our 'fen' type may be insignificant, so our 'wet uplift meadow' may be considered more of a landform than community classification.

● **Fen** Rich incipient peatland. Shallow depth to inorganic substrate due to extreme youthfulness. In Cowardin, this *and bog* are lumped PEM1, one of several inadequacies of NWI for our region. Technically, we might better have called this protofen, as with the following more sphagnum-dominated type. But ecologists are more 'generous' with the fen label, and the mere couple centuries since deglaciation have been sufficient for a diverse albeit 'teenaged' fen to evolve.

● **Protobog** Some aerials show a duller tint surrounding the wet forest patches. There were more low woody species such as *Ledum* here. We're guessing that succession will procede to *Sphagnum* bog in a millennium or two, although the odds seem a little less good as of mid-November, 2024.

● **Wet forest** In Cowardin PFO1. Slightly raised islands in the Notch matrix of fen and protobog. *Equisetum* understory scene above, or mosses (RHLO-HYSP) as in photo 33 on 0717. Spruces are restricted to raised mounds, with. Leaders and canopy height model indicate slow growth compared to upland moraines and sandhills. We're not positive about trajectories, but for now it's legitimate wetland.

Dryland forests

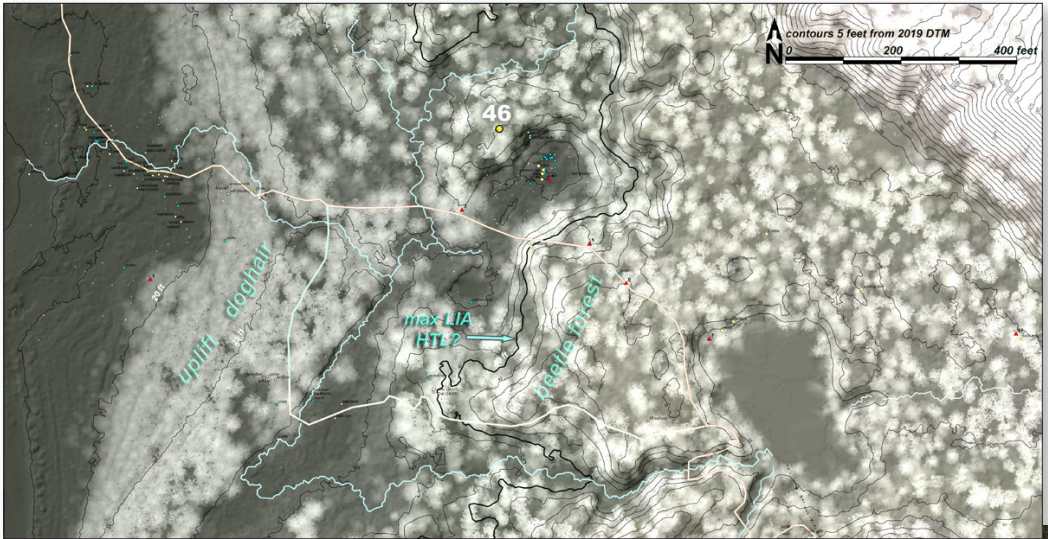
Preceeding footnote #1 explains my reasons for retiring the confusingly multi-meaning term "upland." Of course, "Dry," in the northern rainforest, is always relative. But these forest types are on till, sandhills, or raised tidal surfaces pretty good at getting rid of water, at least to the point of resisting the progression toward high water tables and wetland communities.

Studying Shorezone obliques of coastal portions of the loop, I anticipated that we could distinguish a tight-canopied younger forest on sorted marine sediments from a gappier type upslope. That's indeed the most obvious structural difference in forest type, but it doesn't seem to correspond with any substrate differences that I can detect on the LiDAR bare earth. The LiDAR **point cloud** is more forthcoming, as we'll explore in the next few pages.

● **Uplift doghair** What did show on Shorezone obliques was a tight-canopied forest extending back

Small diameter losers in the race for light litter the forest floor. Barkless ones are decay class III, and the recently flallen one beyond, still unsettled, is class II. These won't provide the long-lasting habitat that beetle-killed logs upslope contribute.

100 to 200 feet from the beach. On our first field day, Sara pointed out dead leaners at several stages of decay. Foresters call this the *stem exclusion* phase of succession, when competition for light leads to quick reduction in stand density. I can't remember what this frontal band looked like during our mapping of the beetle forest in the 1980s & 90s. But it was probably a pre-mortality phase, with more lower branches, less pleasant to walk through.



The canopy height model (CHM) shows closed-canopy doghair forest only up to the 25-foot contour. Between that level and 40 feet, where we currently think highest tides reached at peak Little Ice Age, you step right into an open, gappy beetle forest. This continues to the moraine crest and beyond.

Although substrate changes are profound at that 40 foot line—sorted tidal fines below, and boulder till above—I can find no obvious change in forest structure above and below it. At least not on this map view. Following profiles suggest a few differences.

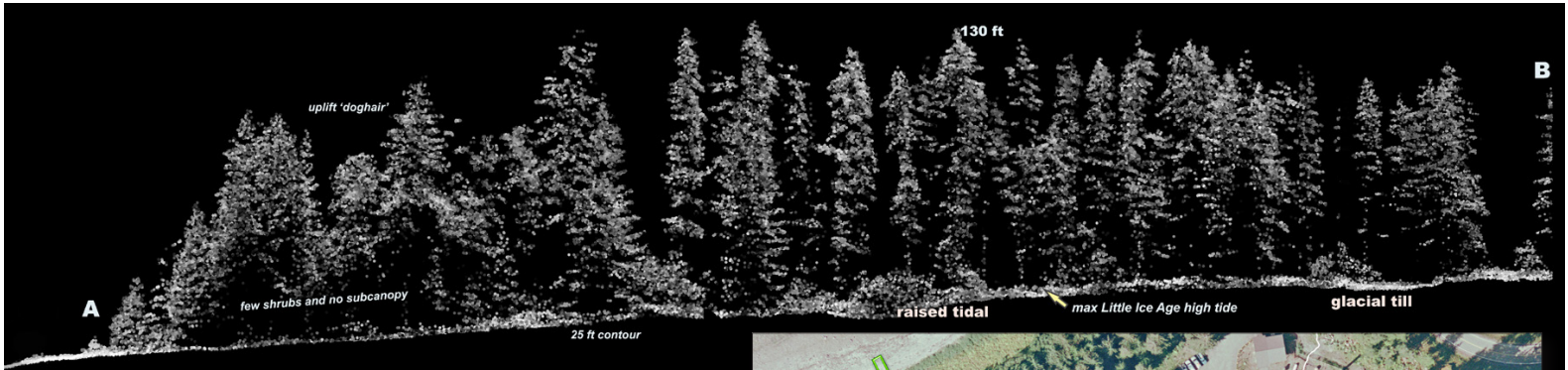
First impressions from those profiles suggest slightly taller spruces on both marine substrate and sandhills than on glacial till, but only more ground-truthing, coring, and study of the pointcloud will be necessary to see if these patterns prove widespread throughout Sandhill Cove.

Pano 46 below was taken between the 25 and 40-foot contours—that is, in gappy beetle-killed large spruce forest with much larger down logs than preceding younger beach-frontal stand. Photopoint is enlarged on the CHM.

Adult bark beetles attack all spruces during an infestation but only kill the least vigorous ones with extremely narrow growth rings. The small frontal spruces probably pitched out the attacking adults and survived. It was shading from taller neighbors, not beetles, that eventually led to self-thinning.

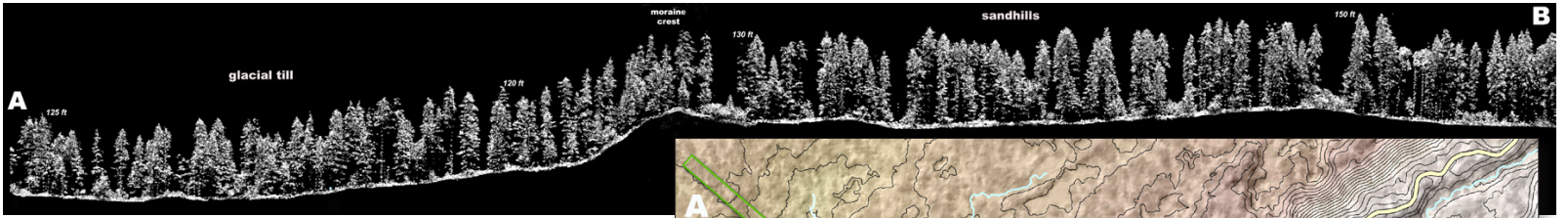
● **Beetle forest on raised tidal deposits** Climbing inland from the 25-foot contour we pass through 3 landforms of very different origin, but forest structural differences are subtle. All were fundamentally changed by the beetle infestation. My 'conclusions' about differences in these beetle forests are tentative and subject to revision on further examination.

The raised-tidal surface on right has only patchy shrub cover. Spruces may stand slightly taller than the ones on glacial till just upslope



● **Beetle forest on till**
Judging from this single profile, the survivors of beetle-thinning may have experienced a stronger 'release' than their neighbors on till. Crowns are fuller and deeper. By coring dozens of randomly selected spruces, we might notice thicker annual rings in the raised-tidal belt since beetles subsided in the 1990s.

'Doghair on CHM extends up to about 25-ft on this transect inland near NPS facilities. Crowns interlock so tightly there's empty black space beneath, and few vasculars in the understory. Moving inland crowns reach 130 feet but are more widely spaced from beetle-kill of up to 50% of dominant spruce.



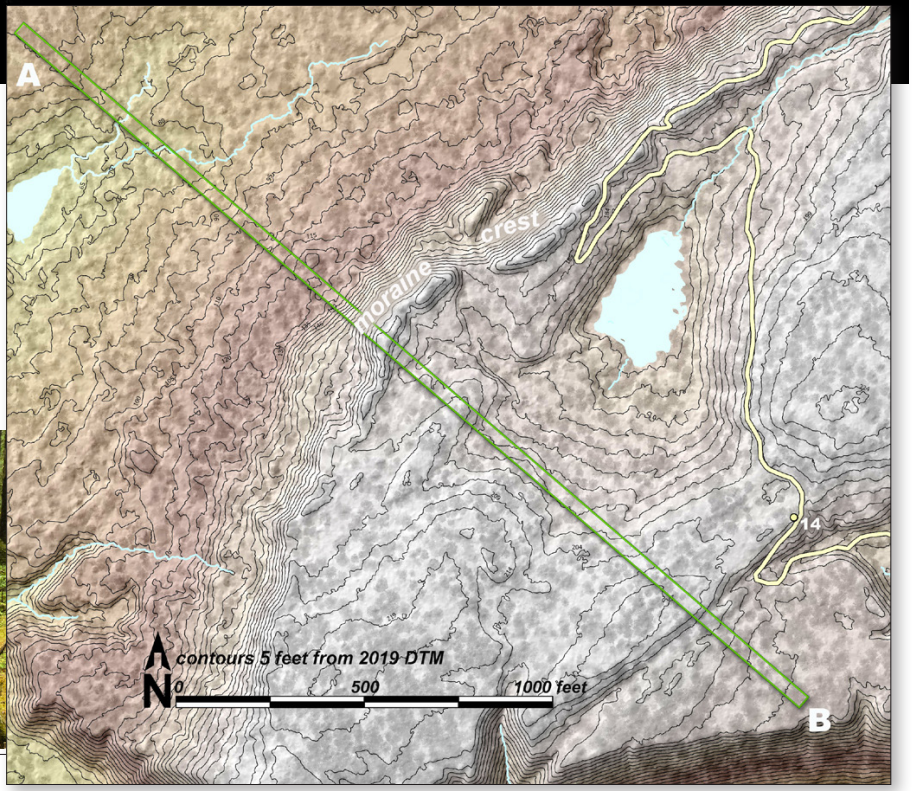
● Beetle forest on sandhills

Driving our 4-foot peat probe on the moraine crest we could rarely penetrate more than a foot before clinking on rock; in the sandhills I could always bury it. Comparing forest structure above, crowns are slightly taller and fuller—fewer scraggle-tops and more bullet-shaped. Crown depth is also greater on the sandhills.

On previous page the canopy height model uses a dark-to-pale spectrum for low-to-high forest strata. On right, I 'flipped' that spectrum so ~~darkest~~ crowns show dark—'freckles' on the bare earth hillshade.

Box A-B is a 30-foot-wide profile through the LiDAR point cloud, shown in side view above.

Photopoint for #14 is on proposed trail toward right side of the hill-shade. Ground slopes smoothly, free of the glacial boulders in Doug's preceding photo dw2



Left: *Malaxis monophyllos var. brachypoda.* Two locations on map at right. ● **Above**: General location of *Suaeda calceoliformis*. Point has been moved from camera position out to where our team is standing.

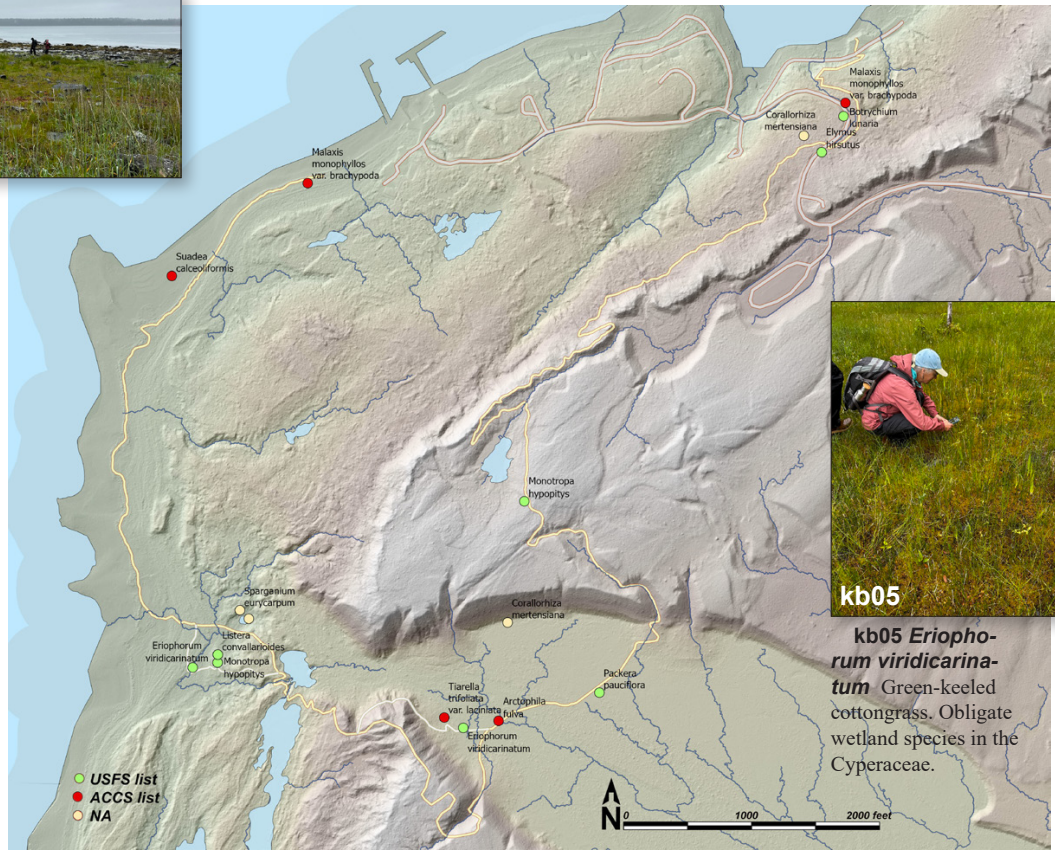
Rare plants

We've mapped rare plants mostly from EXIF lat-longs on photos. In some cases, such as the above *Malaxis* closeup, this gives quite accurate locations. In others, such as the photo of Halibut Point, we have no closeup *en situ*. These points could be off as much as 20 or 30 yards. I compensated in *rare-points.shp* by sliding the point from high beach where photo was taken, out to approximate position of plants. [1]

kb02 *Malaxis* Found in both beach fringe and roadside disturbed areas, faculative mycoheterotroph, Orchidaceae.

kb03 *Suaeda* On salt marshes of Áak'w Aaní we learned this plant as *S. maritima*. All Alaskan members

1 In the case of *Sueada* imprecision is of little import since the plant is actually widespread.



kb05 *Eriophorum viridicarinatum* Green-keeled cottongrass. Obligate wetland species in the Cyperaceae.

are now *S. calceoliformis*—and **not** actually rare! Perhaps it's less common moving northward into Alaska?

Clockwise from above:

kb06 *Monotropa hypopitys* Pinesap, obligate mycoheterotroph in Monotropoideae, subfamily of Ericaceae.

kb08 *Tiarella trifoliata var. laciniata* Cutleaf foamflower. Saxifragaceae. The species, TITR, is one of the commonest understory forbs in old growth Lingit Aani and a critical winter forage plant for black-tailed deer.

kb09 *Arctophila fulva* Pendant grass, obligate wetland species in Poaceae.

kb10 *Packera pauciflora* Alpine groundsel, Asteraceae.

kb11 *Botrichium lunaria* Moonwort on roadside disturbance. Ophioglossaceae.

kb12 *Elymus hirsutus* Northwestern wild rye, Poaceae. Pojar calls it hairy wild rye.

kb13 *Listera convallarioides* Broad-leaved twayblade, faculative mycoheterotroph. Orchidaceae

kb15 *Corallorhiza mertensiana* Spotted coralroot, obligate mycoheterotroph in Orchidaceae.

kb16 *Sparganium eurycarpum(?)* Giant burreed. Obligate wetlander in Sparganiaceae. Koren says:

> *"Without fruits I can't be certain of this species. Sparganium eurycarpum is disjunct to Washington State but this is the only Sparganium species that is emergent."*

Two lists were used for rare plants: by USFS and ACCS. I've color-coded points on preceding map to indicate whether the Forest Service or more current and selective Conservation Science list was used.

Two rare plant lists were used:
USFS US Forest Service Rare Plant List 2015

ACCS - Alaska Center for Conservation Science Rare Plant List 2024

Genus species	List
Arctophila fulva	ACCS
Botrychium lunaria	USFS
Corallorhiza mertensiana	
Elymus hirsutus	USFS
Eriophorum viridicarinatum	USFS
Iris setosa var. setosa	USFS
Listera convallarioides	USFS
Malaxis mono v brachypoda	ACCS
Monotropa hypopitys	USFS
Packera pauciflora	USFS
Pinus contorta v contorta	USFS
Sparganium eurycarpum	disjunct
Suaeda calceoliformis	ACCS
Tiarella trifoliata v laciniata	ACCS

Koren's report has background on the lists, and explanations of their strengths and weakness. There's actually little overlap for the rare plants we encountered at Sandhill Cove between AACS and USFS lists.