



U.S. Fish and Wildlife Service

Humboldt Bay National Wildlife Refuge
Humboldt County, California

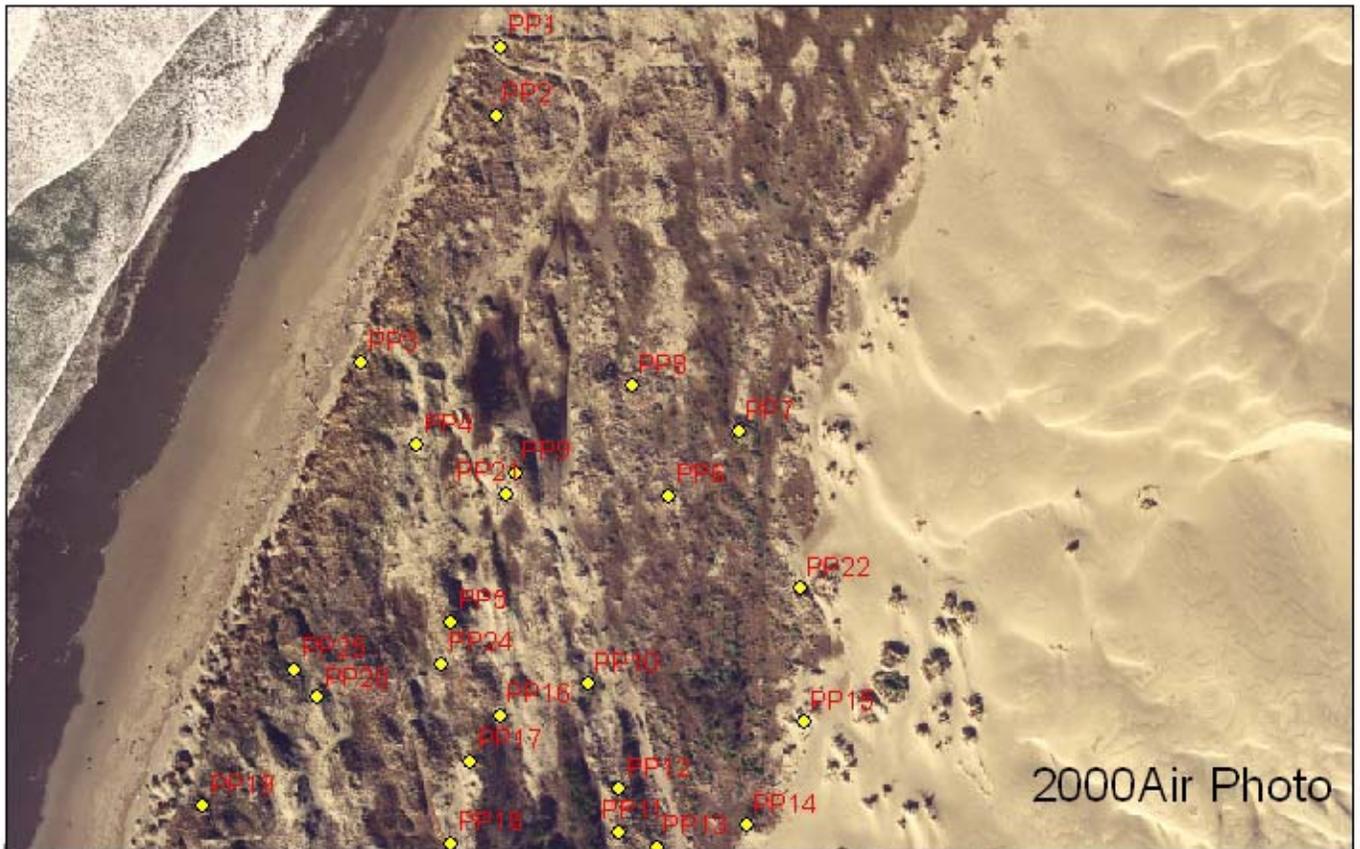
Ma-le'l Dunes Restoration Photodocumentation



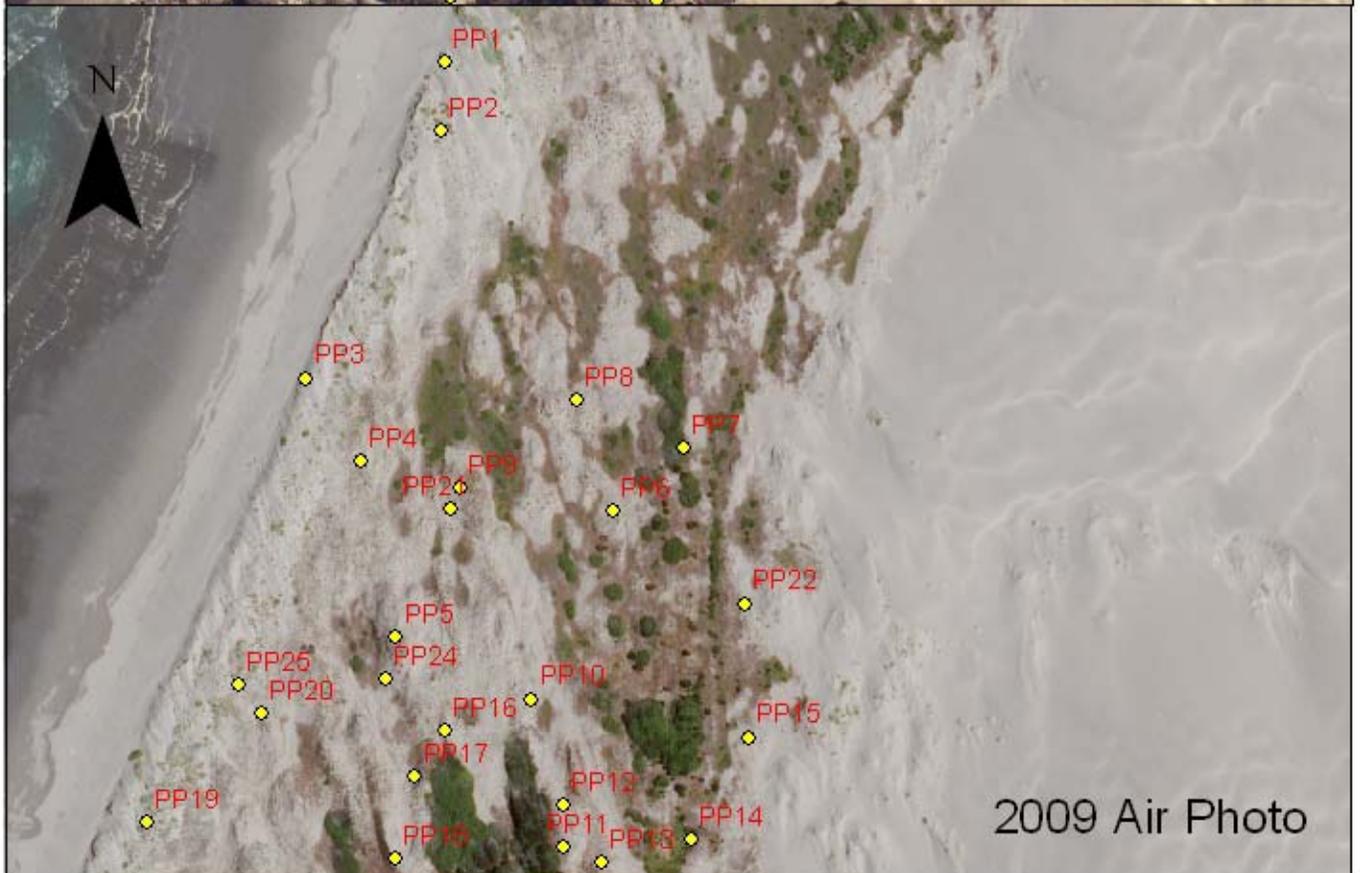
August 2011

Humboldt Bay National Wildlife Refuge
6800 Lanphere Rd.
Arcata, CA 95521

Location of Photopoints



2000 Air Photo



2009 Air Photo



Note that some photopoints were discontinued or added so the number of points is not equal to the number of photos shown.

Foredune

The foredune is the one of the most altered dune features when invasive plants overstabilize the dunes. It becomes higher and steeper, and stops movement of sand inland, causing the middunes to become sand starved and the deflation plain to widen as it migrates eastward behind the moving dunes. When an European beachgrass-dominated foredune is restored, its height is lowered and the slope becomes more gentle. Vegetation shifts to a diversity of species, often including the native dunegrass *Leymus mollis*. This species was planted in a number of places on the foredune during the restoration process, and has been expanding. After restoration, there are more areas of blowing sand in the foredune and middunes. Over time, these will become more stable as pioneering vegetation gives way to later successional species. However, the native foredune will never be as continuous and stable as the beachgrass-built foredune it replaces. Blowouts will naturally occur, and sand will move through the sparser native vegetation into the middunes, rather than becoming trapped in the dense European beachgrass.

Another change that can be observed is that a new, incipient foredune has developed in some places since restoration began. This is a lower ridge in front of the foredune. It is possible that the restoration process allowed this feature to form, since under natural conditions the foredune acts a storing house for sand, both receiving it from and returning it to the beach in different seasons, but also moving some sand into the back dunes as well. The incipient foredune tends to be dominated by native dune grass and other pioneering species such as yellow sand-verbena. This feature may not be permanent, reacting to storm waves and changes in sediment supply.



Yellow sand-verbena and native dunegrass on the restored foredune.

Photopoint 3 (175)



Dense, monotypic European beachgrass in the pre-restoration photo is replaced by a mix of species including native dunegrass and yellow sand verbena. Both photos are taken in summer when the beach is wider, but the “after” photo shows a much better vegetated upper beach that is beginning to coalesce into an incipient foredune.

Photopoint 19 (6)



The dense oversteepened beachgrass foredune has been transformed into a gently sloping foredune covered with diverse vegetation including beach sagewort, yellow sand-verbena, beach bursage, beach bluegrass, and native dunegrass.

Photopoint 3 (12)



The top photo of European beachgrass shows particularly well the “nebka” topography formed by this species, forming many individual, high peaks. Clearly, there is no sand moving inland. The lower photo features a more natural, lowered foredune. Although there is a fair amount of sand moving in this photo, the native dunegrass will continue to spread, resulting in less movement of sand, but enough to nourish the middle dunes.

Middune Ridges

The middle dunes, found just behind the foredune, are formed when blow-outs in the foredune create small parabolic moving dunes that move inland over the pre-existing topography. Sometimes these ridges move over low-lying wetlands, over time building up a “ridge and trough” topography of alternating ridges and valleys. Before restoration of the Ma-le’l Dunes, the middunes still supported some native dune mat, although other areas had been invaded by European beachgrass and iceplant. The middunes are particularly susceptible to invasion by annual grasses like rattlesnake grass and ripgut brome. The ridges of the middunes are prime habitat for the endangered Humboldt Bay wallflower and beach layia. Both of these species will be reintroduced to restored areas from nearby populations now that restoration is complete.



The pattern of parallel dune ridges can be seen in this photo of restored middunes at Ma-le’l. The intervening bands of green are wetland swales vegetated with willows and rushes.

Photopoint 4 (194)

2005



2011



This view shows an area in the foreground that was in good condition when restoration started. However, European beachgrass covered the ridges in the right rear (shown circled in white), now restored to dune mat. The high beachgrass ridges in the left rear are located on the adjoining BLM property. These represent stabilized areas of moving dunes that are planned for restoration to forest.

Photopoint 4 (338)



While the foreground in this photo was uninvaded and remains remarkably similar six years later, the European beachgrass in the background (circled) has been removed, resulting in a more open, semistable habitat that is vegetating with native species. Without restoration, the new beachgrass in the lower right portion of the circle would likely have filled the open area.

Photopoint 5 (142)



An extensive area of European beachgrass has been eliminated, resulting in the characteristic spotty pattern of native vegetation in the middunes. Notice the growth of the willow in the swale seen in the foreground.

Photopoint 17(347)



Almost the entire area captured in this photo has been restored. Middune ridges were cleared of European beachgrass and bush lupine and now support naturally sparse native plants. In the background, the rear side of the foredunes have been released from the hold of beachgrass. And in the lower right beachgrass and duff removal have caused fresh growth of willows.

Photopoint 20 (8)



European beachgrass had completely covered the foredune and was spreading over the middune ridges when restoration began. Note the presence of native beach sagewort, not present in the pre-restoration photograph even in uninvasion areas.

Deflation Plain and Swales

To the east of the middune ridges is an expansive, relatively flat area formed at the trailing edge of the large parabolic moving dunes. The moving dunes are deflated as the sand moves eastward, until the surface of the sand reaches the summer water table. The moisture prevents additional deflation, and nourishes many species of seasonal wetland species. In winter, the reversal of prevailing winds can blow sand back into the deflation plain, causing localized topography. In particular, a small ridge often forms at the east end of the deflation plain during the winter. These upland areas are targets for invasion by European beachgrass, but also yellow bush lupine and annual grasses. Many of the Ma-le'l swales were dense stands of intermixed bush lupine and coyote brush; the latter, although native, is not a natural constituent of this plant community. Restoration here focused on the removal of beachgrass, lupine, and annual grasses, but also involved scraping away the layer of "duff" that had accumulated as the result of the presence of large, short-lived, nitrogen-fixing bush lupines. The presence of the duff impedes the return of native species adapted to low nutrient conditions and can cause weedy species to persist.



A swale formerly dominated by coyote brush, with yellow bush lupine in higher areas, now supports a lush growth of native birds foot trefoil and sea thrift. European beachgrass was removed from the low ridge at right that formed when winter winds blew sand back towards the swale.

Photopoint 7 (86)

2005



2011



This view is from the deflation plain looking east over the moving dunes. In the foredune, the seasonal wetland has been cleared of duff, and willows have replaced the weedy species that were present. In the middle ground, hummocks of European beachgrass had formed in an area that would otherwise have supported moving sand with occasional small hummocks formed by native species. Sparse native dune mat vegetation now grows on these lowered features. The forest visible in the background has been slowly disappearing over the past decades as the moving dunes bury and kill the trees as the migrating dunes approach the Mad River Slough.

This is a natural process that managers will be following with interest.

Photopoint 10 (66)



Although the dune mat in the foreground did not require restoration, the swale in the middle ground in the upper photo shows dense yellow bush lupine, coyote brush and annual grasses. After removal of the shrubs and underlying duff, native rushes and sedges occur among new growth of native willows.

Photopoint 14 (308)



The higher areas in this swale were crowded by dying bush lupine and coyote bursh. When the shrubs and duff were cleared, the native pines and willows rebounded.

Photopoint 26

July 2004



July 2011



These two photographs are excellent illustrations of how process is restored when invasive plants are removed. With the European beachgrass and yellow bush lupine removed from the intervening high areas, sand was able to migrate slowly, causing an expansion of the wetlands in the deflation plain. In this seven year period willows colonized much of the wetland.

Photopoint 4KW



Despite the beauty of the yellow bush lupine, which is native to southern California dunes, it is difficult not to appreciate the improved aesthetics after the removal of bush lupine and its associated weeds, including several “weedy” natives (coyote brush and California bee plant) and true invasives including pampas grass and ripgut brome.