DUNES CLIMATE READY STUDY

Overview of the Feb. 15, 2017 - Public Presentation and Listening Session

On February 15, 2017, Andrea Pickart, Ecologist for the Humboldt Bay National Wildlife Refuge, gave a presentation at the Humboldt Coastal Nature Center on the Dunes Climate Ready Study. The presentation was divided into four main sections: 1) Background and introduction, 2) Overview of beach and dune transect surveys including some early results, 3) Lanphere Dunes demonstration adaptation site, and 4) Other components of the project including the Eel River adaptation demonstration site and the propagation site. After each section of the presentation, there was a five-minute facilitated question period when people were encouraged to ask questions pertaining to the topics that had just been discussed. Attendees were given sticky notes and a pen at the beginning of the evening so they could jot down questions/notes during the presentation.

At the end of the presentation a formal listening session was held. There were four stations dispersed around the Humboldt Coastal Nature Center, each with a different topic; beach and dune surveys, adaptation site, misc. questions/comments, and what people were interested in learning more about. At each station there was a poster to write down questions/comments or attach sticky notes. Representatives from the US Fish & Wildlife Service and Friends of the Dunes helped facilitate answering questions and recording those that couldn't be answered, as well as comments people wanted recorded. The listening session lasted about half an hour. The following comments and questions pertaining to the Dunes Climate Ready Study were gathered that evening from the listening session. Questions from the public listening session held in February 2016 have also been incorporated below.

<u>Comments</u>

- Thank you for sharing information about the project and teaching us about our coastal dunes, vegetation, geomorphology, climate change, etc.
- I would like to learn more about adaptations measures in the Eel River Area

<u>Questions</u>

Q1: At what sea level elevation do you anticipate regular breaches of Humboldt Bay?
A: The climate ready study is designed to gather data in order to make informed predictions about the behavior of our dunes as sea level rises. We hope to continue the monitoring for a minimum of five years, which will require additional funding. Equipped with these data we can embark on modeling sea level rise and responses to extreme events in Humboldt Bay. At that point we can make predictions, based on empirical data, as to whether, where, and when we expect breaching of the North and South spits to occur, and under what conditions. Foredune overtopping and/or breaching are most likely to occur as the direct result of storm surges and wave energy, rather than one specific threshold of sea level.

Q2: On the adaptation site; why did they choose to use small less [than] 8 [inches] more likely 4" woody material instead of logs to stabilize the foredune?
A: At the Eel River adaptation site, available driftwood that could be moved by hand or dragged with an ATV was used. We hope to use larger driftwood in future experiments.

Q3: What reason(s) are there for not using Humboldt Bay channel dredge material (sediment/sand) for beach replenishment? Where are dredged materials from the bay currently deposited? Can they be used to build up the dunes?
A: The use of sand-sized dredged material from Humboldt Bay for either beach nourishment or dune augmentation has been proposed in a conceptual way through the Draft Eureka Littoral Cell Sediment Management Plan which was released by the Army Corps of Engineers in 2017. Beach nourishment and dune augmentation have been used elsewhere with success, but it is important to note that these are only temporary fixes when used in a sediment-deprived system. The climate ready study is examining which parts of the Eureka littoral cell have adequate or surplus sediment supply and which have sediment deficits. Beach nourishment and dune augmentation could be tested in future adaptation demonstration projects, depending on cost and feasibility. However, this possibility is not currently being supported by the U.S. Army Corps of Engineers (USACE). The recently released "Humboldt Bay Harbor and Bay Operations and Maintenance Dredging Environmental Assessment and FONSI (Finding of No Significant Impact) for Fiscal Years 2017-2020" eliminated as potential alternatives the use of beach nourishment or dune augmentation for dredge spoil, evaluating only alternatives that assume all disposal of dredge material (up to 12.8 million cubic yards) at the existing deepwater disposal site known as "HOODS," HOODs has been operational since 1995 and results in all sediment being removed from the littoral cell and therefore unavailable to the beaches and dunes. The justification for dropping these alternatives were: 1) the lack of a nearshore placement site, and 2) the need for retrofitting of the USACE dredge(s) to have the capability to pump dredged material to upland sites. The Corps states that non-deepwater disposal alternatives should be reconsidered if a nearshore site becomes available and/or the dredge is retrofitted. Although the comment period for the EA closed March 10, the California Coastal Commission, which must issue a consistency finding, is expected to hear a request for this project in June in our area. Humboldt Baykeeper will be following this issue (humboldtbaykeeper.org)

Q4: Are the markers moving or being buried? Have they been measured/used?
A: Assuming you are referring to the benchmarks used in this study, they have all been measured and are being used. Since they are of a known elevation, if they are moved we can tell, and they are replaced with a new measured benchmark. This would also be done if they were buried (that has not yet occurred).

Q5: Are there other ways to combat sea level rise other than vegetation?
A: We assume you are asking if there are other ways to respond to sea level rise than by planting dunes with particular vegetation. Many different techniques have been used around the world. Possible responses include those that resist sea level rise, such as building or raising dikes and erecting barriers to storm surges at entrances to bays. Other methods are geared at adapting to sea level rise where possible, such as through the use of "living shorelines" like salt marshes or dune systems that are able to buffer extreme events and/or migrate with sea level rise (this approach may use vegetation as one component). A third approach is "managed retreat," which involves the strategic relocation of important infrastructure inland over time.

Q6: Can you explain the Littoral Cell?
A: A littoral cell (littoral means nearshore) is a stretch of the coast with a sediment cycle that is isolated from adjacent coastal reaches. Theoretically, a littoral cell has its own sediment sources (such as river mouths or eroding coastal bluffs or dunes) and sinks (submarine canyons, or dune systems where sediment is primarily being moved out of the littoral zone into the upland dune system, or dredging of bays and estuaries when dredge spoil is deposited outside the littoral zone). Isolation of a littoral cell from adjacent cells is typically caused by protruding headlands, submarine canyons, inlets and some river mouths that prevent littoral sediment from one cell to pass into the next. Littoral cells are frequently models that are based on our best understanding of sediment movement, due to the difficult nature of measuring all inputs, outputs, and sediment movement. The Eureka littoral cell is believed to extend from Trinidad to False Cape. Its major sediment sources are the Mad, Little, and Eel Rivers, as well as sediment from Humboldt Bay watersheds and those eroded from bluffs and headlands. Major sinks identified for the Eureka littoral cell include the Eel River submarine canyon and the continued removal of more than one million cubic yards of sediment through dredging of Humboldt Bay channels. This sediment is deposited in a deepwater disposal site located outside the littoral cell (see Q2). Sediment transport direction in the ELC is not completely understood (this study should increase our understanding). We know that we have bi-directional transport, which is generally south in summer and north in winter when river inputs to the littoral cell are highest.

Q7: How does the foredune vegetation affect the backdunes?
A: In this area we have both incipient and established foredunes. Incipient foredunes are younger, shorter, less stable features than established foredunes. They may, over time, become established foredunes or they may erode away before this happens. Vegetation on either type of foredune will influence the movement of sand from the beach to the foredune, and from the foredune to the dune forms found behind it. Waves carry sand to the top of the intertidal "swash zone" at high tides, where, during low tides, it dries out and can be carried by wind to the upper beach (or "backshore") and beyond. The presence of vegetation on the upper beach and beyond causes "drag," slowing the wind and causing sand to be deposited. You can see this in the form of "sand shadows"—little mounds of sound forming downwind of an obstacle such as a piece of driftwood or a plant. The taller and denser the vegetation, the more drag is created. It takes a much higher windspeed to transport sand along and over the top of stable, vegetated foredune than one that is characterized by lower or sparser vegetation. The native backdune plant community, known as "dune mat," is adapted to disturbances including sand erosion and deposition. When the foredune becomes overstabilized by invasive European beachgrass, the backdune vegetation changes. Species that could not become established in a more dynamic environment (both native and invasive) become abundant and add more nutrients to the system. Eventually, the original native plants are no longer competitive because the traits they evolved to exist in the original, harsher conditions, no longer confer benefits in the more stable environment. These "early successional" native species include two federally listed endangered plants, beach layia and Menzies' wallflower.

Q8: Are wood surveys being collected?
A: The climate ready surveys include measurement of wood in plots. The elevation of the wood is recorded, and its contribution to cover in the plot.

Q9: How will the bay be affected by sea level rise and foredune erosion?
A: A separate but similar effort to the Dunes Climate Ready project has been looking at sea level rise effects inside the bay resulting from tidal inundation through the mouth of the bay (http://humboldtbay.org/humboldt-bay-sea-level-rise-adaptation-planning-project). On the ocean side of the North and South spits, foredune erosion in particular, and erosion of the dune barriers in general, could have a profound effect inside Humboldt Bay if it results in frequent overtopping (waves that overtop the dunes and reach the bay) or overwash/breaches (waves that erode through the dune barrier, Overtopping has an ephemeral effect because the foredune barrier is not damaged. Breaches/overwashes actually erode away the foredune, so that the area becomes repeatedly overwashed during the highest tides. The goal of the Dune climate ready study is to measure sediment movement, erosion and deposition along beaches and foredunes in order to provide quantitative data that can be modeled, leading to predictions that could help answer this question.

Q10: Why is rolling over of the foredune the desired response - is this an assumption?
A: "Rolling over" is a casual term used in place of the more correct technical term "translation," which is the movement both inland and upward of the foredune elevation. Translation will occur with sea level rise unless there is a very large sediment surplus allowing the foredune to remain in place and grow vertically and even oceanward with sea level rise. More commonly, the foredune will go through cycles of erosion and deposition while it slowly migrates both inland and upland. What is desired is that the foredune maintain its form and integrity during this process, so that it continues to serve as a buffer for wave energy. During large storms with high wave energy and elevated sea levels, waves remove sand from the beach and undercut the foredune, causing it to collapse and form cliffs or "scarps." During the summer, sand returns to the eroded beach, building its elevation back up. Scarps also may collapse, reducing their steepness. Eventually, an aerodynamic "ramp" is formed that allows the beach sand to reach the top of the foredune, which can help to move the foredune inland before it is once again colonized by vegetation. If there is not enough sand delivered to heal the scarp and form the ramp, then the foredune won't grow vertically or migrate (i.e. translate), and with repeated scarping may erode away entirely. This could lead to sand flowing unimpeded from the beach to the back dunes, smothering vegetation, and potentially to large scale destabilization of the dune field.

Q11: Are there other vegetation types being scrutinized to support vulnerable areas?
A: Because transects are located in all of the major vegetation types present in the study area, we will gain information on whether and how vegetation type affects vulnerability and resilience. The only vegetation types being actively experimented with in the adaptation sites are Dune mat, American dunegrass *(Elymus mollis)* and European beachgrass *(Ammophila arenaria).*

Q12: Are transect sites parallel with wind?
A: The linear transects are parallel with prevailing wind direction, which is also the direction of dune movement

Q13: What will be the frequency of dune overwash?
A: See answers to Q1 and Q9.

Q14: If south spit is lost, how does this affect Humboldt Bay?
A: See answers to Q1 and Q9.

Q15: Why are tides higher in the winter?
A: Take a look at an annual tide table and you will see that there are plenty of high tides in the summer months (7-8+ ft). "Spring" tides occur when the sun, moon, and earth are in alignment, twice a month during the new and full moons. "Perigeal tides" occur monthly when the earth and moon are closest. Although the solar component of tides is less than the lunar, when the earth is closest to the sun (in early January) the confluence of earth-sun distance, earth-moon distance, and earth-moon-sun alignment causes the highest tides of the year. "Close-enough" conditions occur in November and December for the highest monthly tides of these three months to be dubbed "King Tides." Remember that in winter, the effect of storms can be significant. Storm surges caused by low pressure and onshore winds can add up to a foot or more of sea level. Significant El Niño events also elevate sea level during the winter months due to increased ocean temperatures (water molecules expanding) and the reversal of tradewinds, which then pile up warm waters off the west coast. Coastal flooding and dune erosion can be most severe when there are additive effects of astronomical tides, storm surges, and a significant El Niño.

Q16: What is the relationship between sea level rise to the height and width of the dunes?
A: We'll assume you are asking about the influence of the height and width of the foredune on the effects of sea level rise. This is one of the questions that we hope to answer – for our local coastline – with this project. Foredune height has an obvious role, since a lower foredune will be more susceptible to overtopping by high tides. However, the influence of storms and wave energy makes this more complicated than the idea of a bathtub overflowing. Wave energy is dissipated in complex ways as foredunes erode and scarp. The width of a foredune will also have obvious implications since a breach is more likely to occur in a narrow foredune and in a foredune without significant backdune elevation. Slope of the foredune may also play a role. Modeling will attempt to address this issue as sufficient data are accumulated.

Q17: Will the analysis of the data ultimately support that the overall volume of the dunes (given adequate sediment supply in our littoral cell) resist and be resilient to rising seas?
A: Along this littoral cell there are many different conditions affecting dune behavior, such as differences in sediment supply (quantity and grain size), currents (including rip currents), beach and foredune slope, foredune height and width, vegetation, wave energy, winds, subsidence, embayments, the presence of river mouths and outflow, driftwood, and the presence of infrastructure (jetties). We will attempt to understand the role of as many of these variables as possible in determining resiliency. There is no assumption that resiliency will be constant along the entire littoral cell.

Q18: How applicable is this study to other geographic areas, such as the Mendocino Coast?
A: There are dune systems located on the Mendocino coast, which could benefit from this work. However, there are many differences in geologic setting, geomorphology, vegetation, littoral cell characteristics, etc. that would need to be considered in applying the results of this study.

Q19: Where are other dune studies like this happening?
A: Based on our searches of the internet and literature, and communications with organizations that focus on adaptation, there are no studies similar to our adaptation experiment examining the role of vegetation in resilience. Measurements of dune erosion based on dune profiles and/or LiDAR (elevation data collected from the air) are being carried out along many places on the west coast US, with a large gap in data collection between San Francisco Bay and Oregon. This research has tied dune erosion to significant El Niño events. Related studies include research being conducted out of Oregon State University, which is indirectly examining the relative influence of two different invasive beachgrasses (*Ammophila arenaria* and *A. breviligulata*) on foredune height and morphology and modeling vulnerability to wave runup and overtopping. This research has so far not addressed evolution of the foredunes over time, and focuses on coastal flooding prevention rather than long-term resiliency.

Following the public meeting held on February 15, 2017, Uri Driscoll submitted the following comments and questions via email.

Comment: As a condition of the grant, public meetings were to happen every six months. Obviously, they were not.
Response: The condition of the grant was to hold public listening sessions annually. Two listening sessions have now been held (2/2016 & 2/2017), meeting the grant agreement.

Comment: Request for transect locations were denied with no legitimate explanation.
Response: The following response was previously given to this commenter as to why transect locations were not made public: “The grant collaborators made the decision not to release the transect locations in order to minimize any risk of outside disturbance.”

Comment: There appears to be two different sets of quarterly reports. One for the pubic and one for the “collaborators”. It is not clear what is left out of the public report or why two different versions are being published.
Response: A more technical collaborators’ report is distributed to those individuals and agencies directly helping with and collaborating on the project. The quarterly update that is distributed to the public is intended to communicate information about the project in a way that is easily understood by the public.

Comment: At last year’s meeting we were told that we would be able to meet with staff involved in the Climate Ready project to discuss this project. Despite repeated attempts to do so our request was refused.
Response: There are many collaborators on this project. We are unsure what staff this comment is referring to. Staff from the US Fish & Wildlife Service has responded to questions and comments from this commenter, both in person and through email. However, FWS has not responded to the same questions worded in slightly different ways, which might be being interpreted by the commenter as “refused.”

Comment: Just after the last public meeting the herbicides glyphosate and imazapyr were sprayed on Lanphere dunes as a part of this project. A Cat Ex two days prior to the spraying justified the use stating that the Coastal Conservancy funded and gave legal support for using the highly controversial poison. The Conservancy has since denied funding or granting legal assistance contrary to the document signed by Mr. Nelson. Attempts to clarify the situation have been met with denials, conflicting statements, an absence of clarifying documents and deleted communication records. Neither the public nor project partners were noticed prior to the initial 1 ¼ acre herbicide application which was repeated again in October.

Response: The reasoning behind the use of herbicides was explained during the most recent update presentation, at the Humboldt Bay Symposium and via email to the commenter and other concerned citizens. The Conservancy did not fund the herbicide use, the US Fish & Wildlife did.

Comment: After the herbicide spraying was made public the original outreach coordinator resigned leaving us with an individual that has a long history of failing to respond to inquiries. This individual has continued that pattern.

Response: The current outreach coordinator for the project has responded to every email from this commenter regarding this study.

Comment: An "extremely rare" foredune overtopping occurred for the first time in decades in an area of the Ma-le'l dunes that had been stripped of the dune building and stabilizing beachgrass. This event was not included in the collaborator/public quarterly report.

Response: During the high tides produced by the storm surge in late January we observed wave overtopping of the incipient but not the established foredune, and wave run-up into (but not over) blowouts. We described this event as it affected the BLM *Elymus* propagation site in the January 2017 Quarterly Update. This storm appears to have been an example of a climate change-induced extreme event, and resulted in extensive scarping all along the littoral cell (also discussed in the Quarterly Report). Since we were in the process of our winter survey, we obtained both pre- and post-scarp profiles on some transects, and the effects of this event will be incorporated into our modeling. We also photo-documented effects.

Question: Do you feel that the ongoing lack of transparency has increased the mistrust that the public has for these dune projects? What specifically is being done to regain that trust and correct the lack of transparency?

Response: We do not agree that there has been a lack of transparency. To the contrary, there have been multiple public presentations/forums, field walks, and internet/website outreach associated with this project. The agencies acknowledge that the commenter has a long public disagreement with dune management by USFWS and others, despite much interaction. Sometimes, people have fundamental disagreements and just need to agree to disagree, and that is the case here.