

Using Traditional Ecological Knowledge to Model the Effects of Climate Change and Sea-Level Rise on Coastal Cultural Resources at Tolowa Dunes State Park, Del Norte County, California.

**Project Leaders responsible for completion of project:**

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Elk Valley and Smith River Rancherias are federally recognized as Tolowa and their partnership in this endeavor is instrumental in obtaining Traditional Ecological Knowledge (TEK) through subcontracts of this proposed project.

**Project Summary:** The primary goals of this ongoing project are to obtain information regarding past catastrophic events such as tsunamis; TEK through oral history interviews with Tolowa elders regarding the effects of climate change and tsunamis on traditional smelt fishing camps; generate a Geographic Information Systems (GIS) model of coastal inundation due to sea level rise and overlay that with known archaeological and ethnographic resources; and generate a final report with detailed information of past tsunami events, and modeling the potential effects of climate change and sea level rise on archaeological and ethnographic Tolowa sites using TEK and GIS based upon the results of this study.

**Project Proposal:**

The California Department of Parks and Recreation (State Parks) has recently developed draft guidance document for resource managers in regards to sea level rise and storm surges in coastal state parks (DPR 2011). The effects of climate change and sea level rise on archaeological and ethnographic cultural resources in California is getting a lot of attention by land management agencies as of late (Newland 2012, Russell and Griggs 2012). In continuance of this research paradigm and management issue, State Parks proposes to conduct similar studies at Tolowa Dunes State Park (TDSP) on the North Coast of California in Del Norte County within Tolowa ancestral territory.

TDSP contains a number of known archaeological and ethnographic sites, many of which are encompassed by two large archaeological districts which are listed on the National Register of Historic Places (NRHP): the Yontocket Historic District (Listing #73000400) and the Point St. George Site (Listing #76000481). Recent

research has recorded archaeological evidence of large seasonal fish camps associated with these NRHP listed districts within 200 meters of the current surf zone (Tushingham 2006; Burns and Rohde 2009). Additionally, there have been recent stabilization efforts and evidence of processing of Surf smelt (*Hypomesus pretiosus*) and night smelt (*Spirinchus starksii*) at Point St. George and the Sweetwater site (Whitaker and Tushingham 2011; Tushingham and Bencze n.d.; Tushingham, Spurling, and Carpenter n.d.). This proposal reflects three separate but related studies: 1) obtaining TEK from our tribal partners on fish camps, tsunamis, earthquakes, and floods; 2) a geologic study of the extent of past tsunami and earthquake events on TDSP and; 3) generating a GIS model to determine the effects of climate change and sea level rise on known cultural resources at TDSP and new resource knowledge obtained as a result of TEK oral histories.

The physiography of (TDSP) reflects a complex interaction of dune, beach, fluvial, estuarine, tsunamigenic and tectonic processes. There are two to three active faults that bracket or bisect the park and a rich cultural overprint within this dynamic landscape. The goal of the project is to interweave Tolowa oral traditions and geomorphic research to improve assessments of erosional or burial risk to cultural sites and to target the assessment based on projected risk to the site from climate-driven sea level rise. Exotic vegetation removal is ongoing on several publicly owned coastal dunes in Northwestern California and Southern Oregon. Data from this proposal could also improve understanding of the potential geomorphic response to the removal of exotic European beach grass at TDSP, in part to restore habitat for western snowy plover. The data can be extrapolated to answer similar landscape scale questions within the NPLCC.

For example, there are published oral traditions among the Yurok and Tolowa that relate to tsunami and earthquakes and these have been used in southern Oregon and northwestern California to help guide the location of tsunami research and to help corroborate the effects of earthquake events (Carver 1998). It is State Parks' intent to obtain additional oral histories regarding tsunamis, earthquakes, and floods as part of this proposed project. At TDSP, we have encountered anomalously large cobble fields in the lee of the foredune that have been provisionally assigned a tsunamigenic origin. Similar, though not as extensive, cobbles have been observed at Lanphere Christiansen Dunes, near Humboldt Bay (Leroy et al. 2009). If these cobbles are indeed tsunamigenic, their recognition could be used as a tool for characterizing tsunami throughout the NPLCC, which generally coincides with the Cascadia Subduction Zone, the likely source of tsunami capable of producing the cobble deposits. One of the proposed tasks is to assess the cultural areas at risk for future marine incursions, either storm surge or tsunami, as well as areas that might be excluded from research due to the likelihood of past damaging events. Estimated increases in tsunamigenic run up due to climate change will be incorporated into the assessment.

Moreover, the cobbles have been locally exploited by Native Americans for cooking and other activities (Burns and Rohde 2009; Tushingham, Spurling and Carpenter n.d.). We are currently documenting the extent and character of the cobbles to help define the processes involved in their distribution. One of the methods to help define the source of the cobbles is to date associated deposits and compare that with the timing of dated earthquakes and related tsunamis in the region. There are also extensive dune fields that could reflect sedimentation related to upwatershed, earthquake generated sediment and/or exposure of nearshore areas during related coastal deformation; this would also provide another data point in understanding Cascadia processes and/or climate driven sedimentation. State Parks has obtained <sup>14</sup>C dates from several sites in the park and plan to map an actively eroding stream bank in the summer of 2012 to help place some of the dates in

proper stratigraphic context, which is crucial to understanding the environment during the Tolowa occupation period and to define where we might expect to find intact cultural evidence, either at depth or in map view, throughout the park. While the  $^{14}\text{C}$  dates are useful, they are generally quite young (less than 1000 years before present, California State Parks, unpublished data) and have multiple solutions due to dendrocorrection limitations. They therefore do not fully capture the rate of dune migration, fully limit the ages of the cobbles or define possible geomorphic interpretations. To address this deficiency we propose to perform Optically Stimulated Luminescence Dating (OSL) of the dune and beach sands, either through sampling of natural exposures or drilling cores. OSL has an effective range of about 200 to more than 100,000 years before present ( $\pm 10\%$ ) - the technique measures the rate of accumulation of ionizing radiation as measured by electrons trapped in crystal irregularities in quartz and feldspar since a sand grain was buried (or effectively shut off from light); dune and beach sands are ideal mediums for application of this dating technique. This will be particularly useful to constraining the age of a Native American cemetery on a dune ridge, which is thought to be the center of the Tolowa universe, and from where Tolowa oral traditions imply their people survived past tsunami inundation. We will corroborate this data with previous diatom (Hemphill-Haley 2012) and palynological/dendrochronological analysis (Bicknell and Austin 1991), research in the park by students from University of Washington regarding bolide-related tsunami, and use 1 meter LiDAR base maps (2007 and 2011 flights) to understand the interaction of climate, ground deformation and marine incursion throughout the park.

The proposed data collection sites and NRHP listed cultural resources are all largely at risk of loss due to climate change. About 90% of the cobble field is within the zone subject to coastal erosion due to sea level rise by the year 2100 (Phil Williams Associates 2008). The  $^{14}\text{C}$ -rich river bank that we plan to map has been eroding at about 15 feet per year over the last 60+ years (Smelser 2008). The aforementioned cemetery and a nearby massacre site could be at risk by the year 2100 or sooner at current river bank erosion rates; the erosion rates are likely to be, or may have already been, accelerated by sea level rise in the estuary that influences the river bank. It is hoped that TEK can be used to help guide or augment the geomorphic research and this in turn can be extrapolated to understanding recent paleoclimatic and paleoseismic conditions within the NPLCC in addition to studying the effects of sea level rise on these irreplaceable cultural resources.

**Objectives:** While this proposal would continue ongoing work at California State Parks and is closely intertwined with an ongoing project at Redwood National Park, the ultimate objective of this project is to prepare an extensive report containing information regarding the age of sand dunes; the extent of damage from past tsunami events as a model for resource protection for future events; map the extent of coast sea level rise due to global climate change in order to plan for the protection of coastal archaeological and ethnographic resource gathering sites at TDSP using Traditional Ecological Knowledge.

**Methods:** Surf smelt (*Hypomesus pretiosus*) and night smelt (*Spirinchus starksii*), are mass harvested by the Tolowa in late summer fish camps that are set up along the sandy beaches where the fish swarm to spawn and lay their eggs and have been for hundreds of years (Tushingham, Spurling and Carpenter n.d.). Tribal elders take part in these fish camps and are present for weeks at a time, making this the prime opportunity to obtain TEK through oral history interviews in the fall of 2012 and summer and fall of 2013. The oral history interviews will take place via subcontracts with the federally recognized Smith River and Elk Valley Rancherias.

Geologic coring to obtain samples for OSL dates will take place in the fall of 2012 using funding from this project. OSL dating samples will be submitted as soon as they are collected and processed however, in order to obtain the maximum number of OSL dates in a cost effective manner the samples can take up to 12 months to process.

Oral history TEK interviews will be transcribed over the winter of 2013 and interpreted in the Spring of 2014. GIS modeling of the effects of climate change and sea level rise at TDSP will take place concurrently.

**Geographic Extent:** TDSP encompasses over 5000 acres of beach and sand dunes along approximately 5 miles of coastline from Point St. George to the mouth of the Smith River in Del Norte County, California.

**Timeline of Schedules, Products and Outcomes:** We propose to publish the results of this work in California State Parks cultural journal. To accomplish this and maximize data collection we propose a 27 month schedule. We can cut the cost of OSL dating in half by using a 12 month turn-around on the dating, and thus double the number of dates that we can obtain. Fish camp gatherings begin in the summer months, before a contract between the NPLCC and California State Parks is likely to be in place in 2012. Although some preliminary TEK work may occur in the late summer of 2012 the bulk of the TEK interviews will occur in the summer and fall of 2013. We will need to the subsequent 9 months to interpret and publish the data.

- Environmental Compliance and Contracting: Summer 2012
- Geologic coring: Fall 2012
- Submission of samples for OSL dating: Winter 2012 (12 month turnaround)
- Preliminary TEK Oral History Interviews and preparation: Late Summer and Fall 2012
- TEK Oral History Interviews: Summer and Fall 2013
- Oral History Interview Transcription: Winter 2013
- Interpretation of OSL data, tribal elder interviews, and GIS modeling: Winter 2013 – Spring 2014
- Project Completion: Spring 2014
- Final Report (executive summary, description and methods, recommendations): Summer 2014
- Publication of paper in California State Parks cultural journal: Fall 2014

**Disclaimer regarding Data Sharing:** Confidentiality of the locations of archaeological and ethnographic sites is of the utmost importance to California State Parks. California Government Code, Sections 6253, 6254, and 6254.10 authorize state agencies to exclude archaeological site information from public disclosure under the Public Records Act. In order to comply with California state law, it is essential that specific archaeological site locations are not disclosed to the public. Working with the Tolowa descendants, State Parks will take the utmost care to not publish any information deemed sensitive or confidential to our tribal partners.

## References:

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- 1991 *Lake Earl Pre-settlement Vegetation; Final Report, Prepared for the California Department of Parks and Recreation, Interagency Agreement 4-100-8401*. Report on file at the North Coast District Office of California State Parks, Eureka, CA.

Burns, Jennifer and Jerry Rohde

- 2009 *A Phase I Cultural Resources Investigation of the Tolowa Dunes State Park South Restoration Project Located in Del Norte County, California*. Report on file at the North Coast Redwoods District Office, Eureka, CA.

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- 2011 *Sea Level Rise and Storm Surge Guidance Document for California State Parks*. Draft report on file at the North Coast Redwoods District Office, Eureka, CA.

Carver, D.H.

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Hemphill-Haley, E.

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Leroy, T., Vaughan, P., and Patton, J.R.

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Newland, Michael

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Russell, Nicole and Gary Griggs

- 2012 *Adapting to Sea Level Rise: A Guide for California's Coastal Communities*. University of California, Santa Cruz. Report prepared for the California Energy Commission.

Smelser, M.G.

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Tushingam, Shannon

- 2006 *Management Plan of Cultural Resources Located in Tolowa Dunes State Park*. Proposal . submitted to California State Parks and prepared by Smith River Rancheria, Smith River, CA.

Tushingam, Shannon and Jennifer Bencze

- n.d. Macro and Micro Scale Signatures of Hunter-Gatherer Organization at the Coastal Sites of Point St. George, Northwestern California. (manuscript in review with *California Archaeology*).

Tushingam, Shannon, Amy Spurling and Timothy R. Carpenter

- n.d. The Sweetwater Site: Archaeological Recognition of Surf Fishing and Temporary Smelt Camps on the North Coast of California (manuscript in review with *Journal of California and Great Basin Anthropology*).

Whitaker, Adrian and Shannon Tushingam

- 2011 *Archaeological Boundary Testing and Site Stabilization Plan at the Point Saint George Management Area, Del Norte County, California*. Report on file at the North Coast Redwoods District Office, Eureka, CA.

**Budget:**

OSL dating, 7 samples at \$400 each, 12 month delivery-----	\$2800
Drilling, geoprobe, 1.0 day at \$2,000/day-----	\$2000
Miscellaneous sampling materials, OSL tubes, caps, hammers-----	\$200
Environmental Scientist	
Environmental compliance documentation, 15 hrs@\$45/hr.-----	\$675
Environmental Services Intern	
GIS and database management, 7 hrs@15.55/hr. -----	\$109
Archaeological Aid	
GIS modeling of Sea Level Rise, 120 hrs.@\$10.75/hr. -----	\$1290
Transcription of oral history interviews, 120 hrs.@\$10.75/hr. -----	\$1290
Transcription of note and report preparation, 120 hrs.@\$10.75/hr. -----	\$1290
Accounting Technician – 20 hrs.@\$26.42/hr. -----	\$529
Contract Officer – 20 hrs.@ \$36.61/hr. -----	\$732
Native American monitor, 40 hours @\$40.00/hr -----	\$1600
Oral History Interviews regarding TEK (Contract with Tribes) -----	\$10000
Administrative Overhead (13.38% for Federal Grants) -----	\$3479
<b>Total</b>	<b>\$25,994</b>

**In-kind and Matching Funds:**

Engineering Geologist

Mapping, interpretation and contract management, and preparation of final report  
250 hrs@\$69.36/hr: \$17,340

Associate State Archaeologist

Preparation of documents for compliance with the California Environmental Quality Act California Public Resources Code 5024, et seq., California Executive Order W-26-92, and Section 106 of the National Historic Preservation Act (36 CFR Part 800), tribal consultation, consultation with the State Historic Preservation Officer, interpretation of data, contract management and preparation of final report.  
450 hrs@\$44.75/hr: \$20,137

