



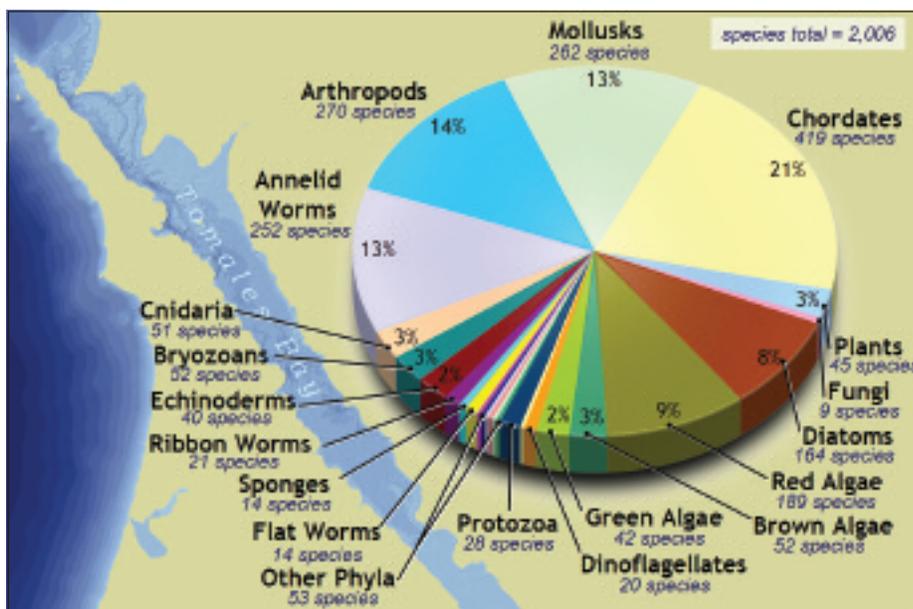
Coastal Science Review

Tomales Bay Biodiversity Inventory Update

The 3rd year of the Tomales Bay Biodiversity Inventory (TBBI) has brought with it many exciting and notable results. A new species to science, a beta-version water quality database for the Tomales Bay Watershed Council, native oyster restoration experiments, algae and invertebrate inventories, and the most complete freshwater invertebrate inventory of Lagunitas Creek in 25 years! Add on to this the numerous scientists working on green crab removal, invasive tunicate monitoring, and eelgrass health, and the TBBI is helping to provide the research needed to understand and protect Tomales Bay into the future.

Tomales Bay Species Diversity

In the Fall of 2003, the Tomales Bay Biodiversity Inventory had documented 1,623 species in the Tomales Bay area. A year later that number had grown to 2,006 species documented and the prediction from two years earlier that "it is expected as further investigation and discovery of microscopic or otherwise obscure organisms takes place, the percentages of less well represented phyla will grow and the 'slice of the pie' for larger groups will shrink" has come true. Diatoms exemplify this perfectly. A year ago, diatom observations had made up only a portion of the percentage of "Other Phyla." Within that time an effort to sample and identify diatoms resulted in 189 species added to the catalog of observations, claiming eight percent of the species now confirmed to live in the bay. Also in that time, species unknown to science have been described such as *Nebalia kensleyi*, a shrimp like crustacean called a leptostracan.



Diversity of species in Tomales Bay, California by Phyla group

Someday our observations will peak and annual fluctuations in species totals based on effort should dampen. Unfortunately, around the world, both extinctions and invasive species introductions continue to play an alarming role in reshaping entire ecosystems. Thus, many new species found in the bay are likely to be recent invaders.

Didemnum lahillei

Students from the Tomales Environmental Learning Center at Tomales High School monitored *Didemnum* (an invasive tunicate that overgrows native biodiversity) regrowth from removal plots at Nick's Cove during the Spring of 2005. To their surprise after thick and rapid growth during January-March, almost all of the tunicate disappeared during

the late spring! This dieback was likely due to the above average sea temperatures this year, as well as additional rain that may have reduced the salinity of Tomales Bay. While this temporary dieback is a welcome reprieve, our consultations with experts have carried the warning: "It will be back!"

Nebalia kensleyi

Since our last issue of Coastal Science Review, the new species of crustacean found in the eelgrass beds of Tomales Bay has been given an official scientific name and been described in the *Proceedings of the Biological Society of Washington*. The lead author, Todd Haney, has named the species *Nebalia kensleyi*, in memory of a recently deceased friend.

Coastal Biophysical Inventory Nears Completion

In 2002, Point Reyes National Seashore GIS Biologist Dave Schirokauer and University of California-Davis graduate student Rhea Presiado began an ambitious effort to rapidly inventory the geomorphology, algae and invertebrates of the entire outer coasts of Point Reyes National Seashore and Golden Gate National Recreation Area. This information will be critical for assessing any damage caused by oil spills or other catastrophic events that threaten the California coastline. By 2005 about 50% of the coastline was completed and entered into a spatial database (designed by Pacific Coast Science and Learning Center GIS Specialist Joe Kinyon) for rapid query in case of catastrophe. The database received its first test when a wayward ship, the *Christopher M*, ran aground at Bolinas Point in May. The database quickly revealed the range of algae and invertebrate life that might be affected by the wreck.

The final survey work will occur over the next two years through a grant from California Department of Fish and Game (Office of Spill Prevention and Response) and will be performed in partnership with marine ecology experts from the University of California-Santa Cruz.



The database can quickly deliver habitat types, algae, and invertebrate species found along each color coded transect (Bolinas Point, CA).

Pacific Coast Science and Learning Center Works with Tomales High School Mapping Project

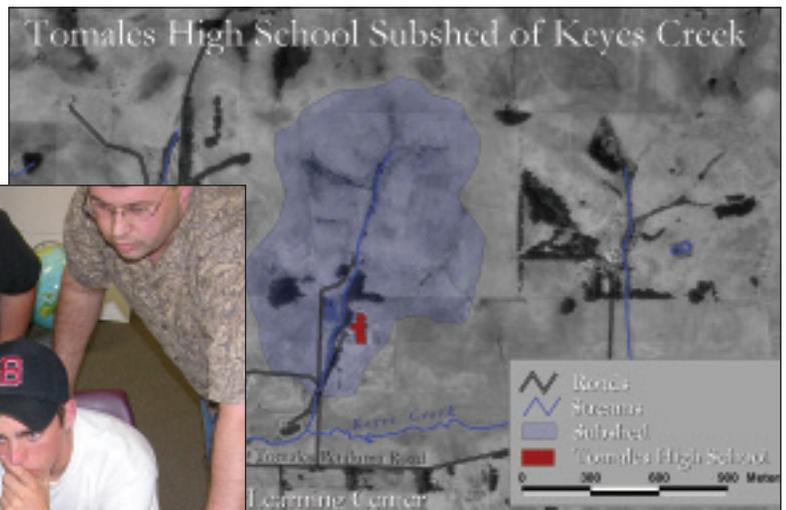
The Pacific Coast Science and Learning Center (PCSLC) collaborated with the Tomales Environmental Learning Center (TELC) at Tomales High School to educate students about using GIS (Geographic Information Systems) and GIT (Geographic Information Technology) in characterizing their local watershed for future water quality analysis projects in the community.

Over a three month period, six students met weekly with the GIS database manager of the PCSLC and worked independently during another weekly session. The students focused their studies on the interrelationship between people, software, hardware, methodologies and data in a GIS project. Their project goal was to map the watershed of a tributary of Keyes Creek (a major tributary in the Tomales Bay watershed) which includes the Tomales High School Campus. In order to complete the task, the students built a foundation of GIS knowledge including ESRI's ArcView 3.3 GIS analysis and hydrology modeling tools, GPS (Global Positioning Systems), and handheld mapping software. They walked

and photographed the perimeter of the watershed twice and established features in the landscape not revealed in the original map files. The result was a final map of their local sub-watershed map that included their high school campus.

In addition to using GIS and GPS software and hardware, the students learned basics of GIS project management, fundamental principles of geography, cartographic skills and a visceral appreciation for the transformation of field collected data into a computer map display. Bill McMillon, director of TELC, had this to say about their experience, "The students worked diligently under the direction of Joe Kinyon, and learned material that will be helpful to them in the future as they explore other disciplines, in addition to gaining a better understanding of their local watershed."

The students' work is documented in an online project log at <http://tomaleshigh.kinyon-gis.com/index2005.html>.



Tomales Environmental Learning Center students work with Joe Kinyon to process field data and learn fundamental GIS lessons necessary to build a map of their local watershed.

Monitoring Northern Spotted Owls in Marin County

Since 1998, Point Reyes National Seashore has monitored the federally threatened northern spotted owl (*Strix occidentalis caurina*) population in Marin County, California as part of a long-term vital signs monitoring program. Marin County represents the southern limit of the northern spotted owl's range which extends from British Columbia into Northern California. The objectives of this program are to determine long-term trends in occupancy and productivity of spotted owls through monitoring known spotted owl sites on federal, state, county, and water district lands. Partners in the joint monitoring program include locations where northern spotted owls occur throughout Marin County (Point Reyes National Seashore, Muir Woods National Monument, Golden Gate National Recreation Area, PRBO Conservation

Science, Marin Municipal Water District, and Marin County Open Space District).

Although the occupancy of northern spotted owls at historic nesting sites in Marin County has remained constant (at approximately 90% at the 46 long-term monitoring sites since 1998) this southern population of spotted owls face a unique set of threats. While the Marin County spotted owl population does not face large scale habitat alterations more common in the Pacific Northwest as a result of commercial logging, the spotted owl habitat of Marin County is under continual pressure from urban development along open space boundaries, intense recreational pressures, and the spread of diseases such as Sudden Oak Death. In addition, possible genetic isolation, West Nile Virus, and the continued range expansion of the barred owl

(*Strix varia*) which displaces spotted owls, are all biological threats to the continued existence of Marin County's spotted owl population.

Data collected during the 2005 breeding season show that 63% of the northern spotted owl pairs attempted nesting in Marin County. Sixty-eight percent successfully nested, yielding a total of 21 offspring at the 13 successful spotted owl nest sites. The 2004 breeding season generated similar results with a total of 21 offspring produced at 12 successful nests. The long-term northern spotted owl monitoring program in Marin County continues to provide valuable information for environmental reviews for resource management, maintenance, and fire management projects.

Partnering Education and Science To Save Threatened Species

Since 1995, Point Reyes National Seashore and PRBO Conservation Science have been implementing a recovery project for the breeding western snowy plover (*Charadrius alexandrinus nivosus*) population within the Seashore. The snowy plover is a federally threatened species with diminishing numbers; it is estimated that only 1,300 western snowy plovers breed along the Pacific Coast.

After locating a nest on the beach, field biologists construct a protective enclosure around the nest to protect it from predation and disturbance. The birds' nesting success is monitored and individual histories are documented. A total of 17 nests were exclosed during the 2005 breeding season (mid-March through mid-September), with 12 successful nests producing 31 chicks. Approximately 28 days after hatching, chicks are able to fly and are considered "fledged." In 2005, 15 chicks survived to fledge from Point Reyes beaches.

In conjunction with this recovery program,

coastal dune restoration efforts at Abbotts Lagoon were initiated to expand the range of endangered plants and increase nesting habitat for snowy plovers. Since 2001, nonnative European beachgrass (*Ammophila arenaria*) and iceplant (*Carpobrotus edulis*) have been removed from nearly 50 acres of critical dune habitat. In 2005, 11 snowy plover chicks were raised in the restoration area, with some chicks traveling up to 2 miles from a more southern nesting location to this new habitat. Beginning in 2007, the Park Service will restore 300 additional acres of critical habitat.

Since 2001, the snowy plover recovery program has included a significant volunteer education effort with funding support from Point Reyes National Seashore Association. These "Snowy Plover Docents" frequent Seashore beaches on weekends and holidays, providing snowy plover education to nearly 2,000 visitors annually. Far fewer chicks are being lost on weekends and holidays compared to weekdays, suggesting that docent

presence and education efforts are playing a critical role in sustaining snowy plover breeding populations on Point Reyes beaches.



PRBO Conservation Science



Kent Essex

Snowy Plover docents frequent Point Reyes National Seashore beaches on weekends and holidays.

Minigrants Awarded

The Pacific Coast Science and Learning Center is pleased to announce the 2005 recipients of our annual minigrant competition (see below). We received many more requests than we are able to fund, but we do attempt to accommodate all applicants with other forms of support, including housing, office space, logistical aid, and field assistants. These 14 scientists, along with over 100 other researchers who work in Bay Area National parks each year, provide critical insight into the functioning and preservation of these complex ecosystems.

Golden Gate National Recreation Area

Julie Thayer, University of California-Davis and PRBO Conservation Science, "*Calming the Controversy: Pigeon Guillemot habitat enhancement, Reproductive ecology studies, and public outreach in relation to cultural resource preservation on Alcatraz Island*"

Brian James Walton, University of California-Santa Cruz and Predatory Bird Research Group: "*Peregrine Falcon Population Survey for Golden Gate National Recreation Area and Point Reyes National Seashore*"

Joshua Hull, University of California-Davis: "*West Nile Virus antibody prevalence among native raptors migrating through the Marin Headlands*"

Point Reyes National Seashore

Dr. Jeff Corbin, University of California-Berkeley, "*Practical restoration tools to increase native grass establishment in invaded habitats*"

Kabir Peay, University of California-Berkeley: "*Ecology and community structure of ectomycorrhizal fungi of Pinus muricata 10 years after the Vision Fire*"

Kyra Burraston and Dr. Tiffany Knight, Washington University (St. Louis): "*Role of interspecific interactions in the population dynamics of co-occurring rare, common and invasive Cirsium (Thistle)*"

Ryan Hechinger, University of California-Santa Barbara: "*Parasites as high-quality, inexpensive indicators of the diversity and abundance of benthic invertebrates, fishes, and birds in coastal wetlands*"

Harbor Seal Monitoring Update

The Point Reyes National Seashore Harbor Seal Monitoring Program conducts surveys at 6 sites throughout the seashore. These sites include Bolinas Lagoon, Duxbury Reef, Drakes Estero, Double Point, Tomales Bay and Tomales Point. The program relies heavily upon a dedicated group of twenty-five volunteers who completed 213 surveys from the beginning of March through the end of July. This schedule follows the pupping and molting seasons for harbor seals. Volunteers collect data on the number of adult seals and the number of pups hauled out at a site, as well as record any disturbances, human and nonhuman, that cause the harbor seals to react.

This season harbor seal pup numbers were slightly lower than usual, most likely because of warmer waters and less food availability. The maximum pup count this season was 1,103. This is 13% lower than 2004 season's maximum pup count of 1,267. Drakes Estero had the highest maximum pup count (332 pups) of any of the sites. The peak molt count for 2005 was 4,309 harbor seals. This peak count is 23% lower than 2004's maximum molt count of 5,633 but comparable to years

previous to 2004. Double Point (1,126 seals) and Drakes Estero (1,261 seals) had the highest number of seals hauled out to molt. Data on pup numbers allows the park to follow trends in the reproductive success of harbor seals.

Volunteers also documented disturbances to harbor seals such as a motor boat, hiker or a flock of birds, that causes a group of seals to raise their heads in alarm or flush into the water. This season 110 disturbances were recorded with the average number of disturbances per survey being 0.57. While Drakes Estero is currently the largest haul out and pupping site, it also has the highest disturbance rate (1.03 disturbances / survey). The second highest disturbance rate was at Bolinas Lagoon (0.89 disturbances / survey). Although the causes of disturbance varied by site, human disturbances, such as hikers and tidepoolers, were the largest source of disturbance, followed by non-motor boats, specifically kayaks, and aircrafts. These types of information collected by volunteers helps document changes in the population of this federally protected species.



Harbor Seal Monitoring Program volunteers collect data on harbor seals at various sites throughout the Seashore.

All San Francisco Area Parks

Drs. Janet Leonard and John Pearse, University of California-Santa Cruz: "*Identifying evolutionarily significant populations of Banana Slugs (Ariolimax spp.) in the San Francisco Bay Area National Parks*"

Tomales Bay Biodiversity Partnerships Funding

Andrew Chang, University of California-Davis: "*Consequences of functional diversity for the assembly and invasion resistance of estuarine fouling communities*"

Brittany Huntington, San Francisco State University: "*Is a macroalgal bloom threatening eelgrass survival? Response of eelgrass productivity to increased macroalgal dominance in Tomales Bay, CA*"

David Kimbro, University of California-Davis: "*Guiding the restoration of Olympia oysters in Point Reyes National Seashore: Measuring limits to population growth and consequences for estuarine biodiversity*"

Heidi Weiskel, University of California-Davis: "*Disturbance and mud snails in Tomales Bay and San Francisco Bay: Invasion facilitation at the community level?*"

Soundscape Monitoring Project

An intact and unimpaired natural soundscape may be as vital to an ecosystem as good water quality or clean air. The Pacific Coast Science and Learning Center, in conjunction with the National Park Service's Bay Area Inventory and Monitoring Network, has recently begun exploring the condition of the natural soundscape at Muir Woods National Monument and Point Reyes National Seashore. The ultimate goal of this pilot study is to understand the role that anthropogenic noises such as vehicles and aircraft play in park soundscapes. In addition, the National Park Service (NPS) hopes to create an inventory of natural sound and gather reference data against which future change can be compared.

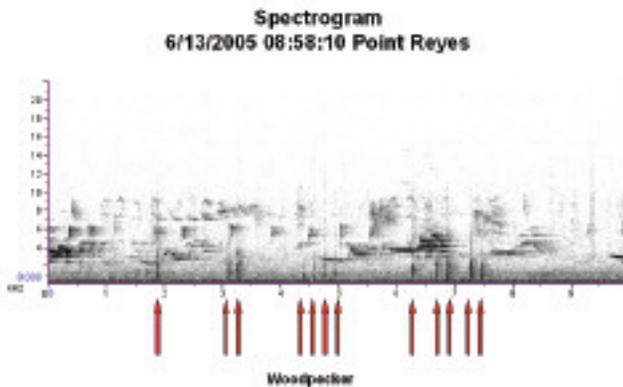
This project has three components, including a soundscape monitoring system which

records digital audio clips once every two minutes and also collects detailed decibel data averages every second. The data gathered from this device can be analyzed later and used to generate graphs or tables which describe detailed decibel and sound source information. Another part of the study draws on numerous NPS volunteers to perform attended logging sessions. Volunteers sit in five pre-determined locations for fifteen minutes each and log the sounds that they hear (such as bird, mammal, airplane, or vehicle) on personal digital assistants. The final component of the soundscape project is a visitor experience survey, conducted at Muir Woods. The survey asks visitors exiting the park to listen to sound clips with varying levels of anthropogenic intrusions. After listening to sounds, the visitors will be asked

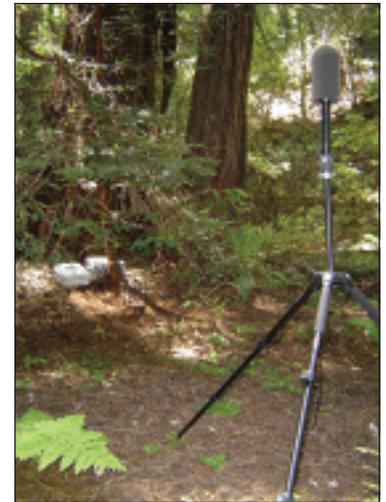
to identify what level of unnatural sound intrusions would compromise their experience, what sounds they found irritating, and what sounds they found pleasing. The NPS will use these data to craft soundscape management plans and as a reference for analyzing changes to the condition of the soundscapes of Bay Area National Park units.

NPS's Natural Sounds Program
www.nature.nps.gov/naturalsounds

Acoustic Ecology Institute
www.acousticecology.org



An amplified version of a ten-second sound clip gathered by the soundscape monitor. Each arrow points to the sound of a woodpecker's tap on a tree.



A soundscape monitor set up at Muir Woods National Monument. Note the microphone and tripod in the foreground. The white boxes in the background contain the computer (to capture digital sound data) and batteries to power the system.

Spotlight on Continental Divide Research Learning Center

Bighorn Sheep Survival Requires Volunteer Help

Bighorn sheep lambs on the east side of Rocky Mountain National Park have <24% chance of living to be yearlings. This poor survival rate threatens the long-term health of the herd. Past disease outbreaks reduced the herd to a relatively small size. Has inbreeding resulted in the accumulation of deleterious genes? To test this idea volunteers recruited by the Continental Divide Research Learning Center are collecting sheep pellets this summer. To ensure that the DNA is high quality, and that the collected pellets are from bighorn, the volunteers have to visually catch the sheep "in the act." Volunteers wait for the sheep to leave the area before collecting the pellets. Results from the study won't be known until fall, but we already know that the information from this effort will help us better understand the park's sheep population.



Volunteers collect bighorn sheep pellets to aid research study.



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U.S. Department of the Interior

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Coastal Science Review is published bi-annually to share research supporting science-based management and preservation of our coastal resources. The Pacific Coast Science and Learning Center is a part of the San Francisco Bay Area Network of parks and is located at Point Reyes National Seashore.

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Global Climate Modeling Research at Point Reyes National Seashore

It is only fitting that a site that used to bounce radio signals from North America to ships far out on the Pacific is now hosting a new research facility that bounces lasers and radar off clouds to understand the role that low coastal marine stratus clouds play in the earth's heat budget. The research has placed dozens of sensors that measure cloud heat budgets and the data is used by global climate modelers to predict patterns of global climate change due to greenhouse gases. The portable facility's next stop is in West Africa to study clouds in the rain forest. For more information, visit: www.arm.gov.

Volunteer and Docent Opportunities

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