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CALIFORNIA BEACH HEALTH: EVALUATION OF GRUNION AS AN INDICATOR SPECIES

Karen Martin
Pepperdine University
Department of Biology
kmartin@pepperdine.edu

Hypotheses

1) California Grunion spawning runs vary in space and over time across their range.
2) California Grunion spawning runs may be rigorously documented using trained observers to examine the size of the population and its distribution throughout the species range.
3) Success at several different life history stages may be assessed to evaluate the quality of the spawning habitat in different areas.
4) Aspects of California Grunion life history may be used as indicators for ecological health of sandy beaches.

Goals and Objectives

On sandy beaches throughout California, we evaluated three stages of the life cycle of the grunion *Leuresthes tenuis* for their potential as possible indicators of local ecological health and condition. We examined spawning runs of the adults, embryonic development of the terrestrially incubating eggs, and the viability of hatchlings from multiple spawning runs and beaches over three years. We looked for characteristics that lead to strong runs and high embryo survival on grunion beaches and at changes over time through the season. Using this unique long-term dataset we may be able to assess the strength of the population of this species for the first time over its entire range. We predicted that assessment of differential success of grunion reproduction can provide new indicators for ecological health of sandy beaches. In addition we intend to provide increased scientific justification for establishing best management practices for sandy beaches, to restore and protect the sandy beach habitat for the benefit of wildlife and human visitors.

Methodology

We developed a rubric for observation of grunion runs including assessment of several biological and physical parameters. We created a web interface that allowed volunteers to submit their observations instantaneously online to a database housed at Pepperdine University. We held multiple workshops and trained hundreds of citizen scientists each year as volunteer "Grunion Greeters." Volunteers signed up for a specific beach and time to monitor the spawning populations of the California grunion throughout its range. Reports were ground-truthed by the scientific team by monitoring nesting sites throughout the field season, and by comparisons between different observers at the same runs.

Grunion eggs incubate in beach sand, completely out of water for the entire embryonic period. We developed a reliable method for culturing grunion embryos in the laboratory that yields a high percentage of hatching success for a control. We collected naturally fertilized grunion eggs from spawning sites identified by the Grunion Greeters throughout the habitat range, following large runs. We collected from multiple beaches each year, from at least two runs during each spawning season. Some embryos were collected shortly after fertilization to develop in the laboratory. Others were collected after developing *in situ* for comparison from many different sites.

We examined the developing embryos by microscope. We described and photographed a detailed staging series for California Grunion to allow comparisons between different ages and to observe gross developmental defects or presence of parasites. Alterations in timing or morphology of developing grunion embryos were photographed and described.

California Grunion are unique in that they require an environmental trigger to hatch. Thus the time of hatching can be controlled and synchronized by the experimenter. After the embryos reached hatching competence, we quantified the percentage of hatching success of embryos sampled from multiple beach locations, incubation conditions, and run series for comparison. Dead or damaged eggs were examined microscopically for possible causes.

In addition we carried out several experiments examining basic biological questions. We compared three disjunct spawning populations using genetic data from microsatellites and mitochondrial DNA. We examined the effects of different salinities on terrestrially incubating grunion embryos. We are continuing to characterize the hatching process biochemically and histologically.

Progress and accomplishments toward meeting goals & objectives.
Each year we observed grunion spawning runs on multiple beaches. Starting in 2005 we worked only in southern California, from San Diego to Pt. Conception. By 2008 we had volunteers from nearly the entire range of the species, including a Grunion Greeter-mediated discovery of a range extension to Tomales Bay and trained Greeters in Baja California, Mexico. With the help of the citizen scientist volunteers we have followed a new population of grunion in San Francisco Bay, and runs in Monterey and on the Channel Islands. Over 4 seasons we have trained approximately 1600 citizen scientists and received over 2400 data reports.

We compared relatedness of grunion populations from coastal southern California and San Francisco Bay using molecular genetics, with microsatellites and mitochondrial DNA. This study is the first to isolate and compare nuclear DNA of California Grunion from different populations.

We described a staging series of early development of embryos, and archived photomicrographs. Then we compared embryology of grunion from southern California to San Francisco Bay grunion.

We examined the effects of differing salinities on early development to predict possible outcomes of desalination plants and ocean outlets on developing grunion embryos. Using our staging series we could identify abnormalities in development for this experiment as well as wild-collected specimens.

We characterized run strength, developmental anomalies, and hatching success for grunion from many different locations and run series over several years. In our field studies, embryos survival ranged from less than 10% to nearly 100%. We are in the process of developing criteria for beach habitat assessment using these data.

We communicated our findings frequently with beach managers and coastal workers, regulatory agencies, and the press to encourage positive changes in beach management to protect incubating grunion eggs. We organized a Working Group to explore beach management in ecologically sensitive areas.

Project modifications
We modified research plans to add more study sites that were farther away than expected when new populations were discovered to the north. We identified a northern range extension to Tomales Bay. Ancillary research topics were comparisons of the newly discovered spawning population in San Francisco Bay with coastal populations of grunion in terms of early development and genetic relatedness. Efforts to study these populations meant that very little time was spent on the Channel Islands.

Because this species can not be assessed by traditional fisheries methods we faced a sometimes overwhelming demand for information about run locations, strengths, and management implications. We answered numerous queries and made numerous trips to assist in evaluation and management of beach sites for local managers, and we responded to many requests for information and assistance from regulatory agencies. We studied the effects of different salinities on early development after receiving numerous queries about possible impacts of desalination plants on grunion.

An additional challenge was the amount of time required to manage the volunteer program to obtain run data. This coincided with the field season for data acquisition. While this program provided unprecedented access to field sites it also consumed a great deal of time during the very limited period of peak spawning.

Project outcomes
New Monitoring Method: Traditional fisheries methods do not work for assessment of California Grunion populations. We developed the Walker Scale for assessment of grunion runs and then incorporated it into a web-based interactive questionnaire that incorporated additional biological and physical data. Trained volunteer citizen scientists report their data electronically so it is available instantaneously in a database at the home institution. This method was described in two peer-reviewed journal articles and is now used by many environmental consultants as well as the California Department of Fish and Game and the National Marine Fisheries Service. The data form is available freely to the public, consultants, and researchers for use or download on the project web site, www.Grunion.org.
Database: A comprehensive electronic database of grunion run reports from the entire habitat range is archived at Pepperdine University. This database is by far the most extensive record ever made for this species over time. Reports from 2002 to 2008 are stored and data are shared with researchers, consultants, managers, and regulatory agencies. Data have been provided to California State Parks, Santa Monica Bay Restoration Commission, California Department of Fish and Game, California Coastal Commission, the National Marine Fisheries Service, the California Marine Life Protection Act, and others.
Physical Collections: Specimens of California Grunion adults have been collected and are housed in the Fish Collections of the Smithsonian Institution and Scripps Institution of Oceanography. From the population in San Francisco Bay, the only preserved grunion specimens in existence are housed at SIO.
Citizen Scientist Training Methods: We created a training workshop to prepare members of the public to make scientific observations that are reliable, objective, and consistent. We developed a series of educational materials including a handbook for participating organizations that provides explicit, easy to

follow information. We also developed a web site and use e-mail and the social network Facebook for frequent communications. The training workshops were scheduled and publicized through local environmental organizations, aquaria, and educational institutions and have been made available at no cost to interested volunteers, beach workers, educators, and biological consultants.

Beach Management Working Group: Having developed a method for protecting incubating grunion embryos on shore, we began reaching out to beach managers and coastal workers throughout California. We formed a new Working Group for beach managers and workers that meets twice a year and communicates by e-mail on a regular basis. This group shares contact information so that we can phone or e-mail one another throughout the year regarding topics of ecologically sensitive beach management. This group is in the process of incorporating as a non-profit organization.

Impacts of project

This project has already had important impacts for habitat monitoring on sandy beaches and for the involvement of a variety of stakeholders in management practices. The California Grunion is now considered a Species of Special Concern and the sandy beach is considered Essential Fish Habitat according to the Magnussen-Stevens Act, as interpreted by the National Marine Fisheries Service and the California Department of Fish and Game.

Citizen scientists from coastal California have been trained and have provided extensive data for an understudied species, and their commitment has extended beyond this one species to a sense of stewardship for the coastal habitat. The National Marine Fisheries Service- Southwest Region, Habitat Conservation Division has funded Grunion Greeter monitoring efforts in 2008 and plans to continue the work in future years.

New management practices are in place throughout the habitat range of the grunion as a result of this work. The PI has evaluated habitat concerns for numerous agencies including California Coastal Commission, National Marine Fisheries Service, California Department of Fish and Game, Los Angeles Beaches and Harbors, California State Parks, the Goleta Beach restoration for the County of Santa Barbara, and ocean outlets in the County of Orange.

Our data were used in the assessment of the effects of the Cosco Busan fuel spill in San Francisco Bay.

Numerous environmental organizations including Surfrider Foundation, Heal The Bay – Santa Monica, Santa Barbara Channel Keepers, and the Audubon Society are involved in grunion studies. Aquariums including Cabrillo Marine Aquarium, Birch Aquarium at Scripps Institution of Oceanography, the Roundhouse Aquarium in Manhattan Beach, the Aquarium of the Pacific in Long Beach, and the Ty Warner Sea Center of the Santa Barbara Museum of Natural History have grunion displays and programs as part of their mission. Several State Parks have initiated new public programs for grunion runs at their sites, including San Elijo State Beach, Bolsa Chica State Beach, Doheny State Beach, and Crystal Cove State Beach.

Based on the efforts of the Working Group for beach managers and field operators, we are initiating the formation of a non-profit organization. The focus will be to develop and disseminate best practices for beach management to balance wildlife conservation and recreation.

Benefits, commercialization and application of project results

The monitoring method we developed is in use by numerous environmental consulting agencies, including Chambers Group, Entrix, ECorp Consulting, MBC Consulting, Bonterra Consulting, Littoral Ecological & Environmental Services, and San Marino Environmental Associates. The County of Orange uses our methods with their staff to monitor areas when ocean outlets are opened or maintained during grunion season.

Our data is in use for long term resource assessment by the Santa Monica Bay Restoration Commission and the South Coast Regional Group of the Marine Life Protection Act of California.

Our protocol for beach grooming during grunion season is in effect at local city, county, and state agencies on sandy beaches throughout California.

Our data and observations have supported enforcement actions by the California Coastal Commission in several situations.

Our data and evaluations have been used by the California Department of Fish and Game and the National Marine Fisheries Service in developing environmental guidelines and permits for construction projects and beach activities.

Economic benefits

Many private biological consultants are now being hired to monitor beach sites for grunion runs during construction projects as a result of the designation of sandy beaches as Essential Fish Habitat and grunion as a Species of Special Concern. Most use our monitoring methods and report their observations to our database.

Interest in the non-consumptive enjoyment of watching California Grunion runs is increasing. Public programs for grunion at aquariums and State Parks draw large crowds and benefit from admission fees. On a recent evening at Cabrillo Marine Aquarium, over 4,000 people paid to attend the educational grunion run program.

California Grunion may support eco-tourism, as many people plan visits to California and to the beaches around predicted grunion runs. Many beach communities advertise their grunion runs as part of their appeal.

Issue-based **forecast capabilities** to predict the impacts of a single ecosystem stressor, developed and used for management (i.e., climate change, extreme natural events, pollution, invasive species, and land resource use).

We know that mechanized maintenance and construction on beaches are harmful to grunion nesting areas.

We are working on developing protocols for the use of our data from California grunion runs to monitor for pollution effects on sandy beach biota.

Our methods and database can be used to follow the impacts of unusual events such as oil spills.

Tools, technologies and **information services developed**

We are developing a GIS map for grunion run locations to be used in the Marine Life Protection Act process in the South Coast Region.

We developed educational materials to train volunteer citizen scientists to take data. These are updated annually.

We developed a handbook for cooperating organizations.

We developed an informative web site for greeters and the public that includes general information, data acquisition capability, a bibliography, and many links.

We developed a group page on Facebook.com so volunteers could communicate with one another and share stories, tips and photos easily.

We developed information services for beach managers where none previously existed. We now have a network of interested professionals from all over the coast of California on an e-mail list and we meet twice a year to discuss issues involving beach management in ecologically sensitive areas.

Publications

Conference papers, proceedings, symposia

Title: Grunion Greeters in California: Beach Spawning Fish, Coastal Stewardship, Beach Management and Ecotourism.
Authors: K. Martin, A. Staines, M. Studer, C. Stivers, C. Moravek, P. Johnson, and J. Flannery.
Date: September 2007
Conference Title: 5th International Coastal & Marine Tourism Congress: Balancing Marine Tourism, Development and Sustainability.
Location: Auckland, New Zealand

Title: Grunion Greeters: Citizen Science on the Beach.
Authors: M. Studer and K. Martin
Date: June 2007
Conference Title: Citizen Science Toolkit Conference
Location: Cornell University, Ithaca, NY.

Title: Future of Fishery Science: Stock Assessment with Citizen Scientists on the Internet.
Authors: K. Martin, M. Studer, B. Cupp, C. Stivers, P. Johnson, C. Moravek, and J. Matsumoto.
Date: February 2007.
Conference Title: American Institute of Fishery Research Biologists 50th Anniversary Symposium: The Future of Fishery Science in North America.
Location: Seattle, WA.

Title: Forever young: Developmental Staging of California Grunion in Normal and Extended Incubation.
Authors: K. Martin, J. Flannery, C. Moravek, A. Walker, and S. Bolan.
Date: July 2006.
Conference Title: Symposium on Fish Eggs and Early Life History, International Congress on the Biology of Fish
Location: St. John, Newfoundland, Canada

Title: Rapid acquisition of citizen scientist data across large distances: Grunion Greeters and the internet along the California Coast.
Authors: K. Martin, B. Cupp, C. Stivers, M. Studer and D. Simmons.
Date: May, 2006.
Conference Title: Symposium on Volunteer Monitoring, sponsored by the Society for Environmental Toxicology and Chemistry and the Southern California Academy of Sciences.
Location: Malibu, California.

Title: Effects of altered salinity during incubation on California grunion, *Leuresthes tenuis*.
Authors: J. K. Matsumoto and K. L. Martin.
Date: May 2006.
Conference Title: Annual Meeting of the Southern California Academy of Sciences.
Location: Malibu, California.

Title: Citizen scientists assess populations of an elusive, charismatic fish.
Authors: K. L. Martin, P. B. Johnson, C. Moravek, R. Ashley, J. Matsumoto.
Conference Title: Annual meeting of the Society for Integrative and Comparative Biology,
Location: San Diego, California.
Date: January 2006.

Title: The greatest grunion hunt in 50 years: California grunion sightings across the season and along the coast in 2004.
Authors: K. Martin, B. Cupp, and P. Johnson.
Date: May 2005.
Conference Title: Annual meeting of the Southern California Academy of Sciences.
Location: Los Angeles, California.

Title: California Beaches as Grunion Habitat.
Authors: K. L. M. Martin
Date: 2005
Conference Title: Symposium on Beach Ecology, 2005 Headwaters to Ocean (H2O) Conference of the California Coastal Coalition
Location: Huntington Beach, California.

Peer-reviewed journal articles and book chapters
Title: Microsatellite and Mitochondrial Genetic Comparisons Between Northern and Southern Populations of California Grunion (Leuresthes tenuis).
Authors: P. B. Johnson, K. L. Martin, T. L. Vandergon, R. L. Honeycutt, R. S. Burton, and A. Fry,
Date: 2009
Journal Name: Copeia
Page Numbers: (in press).

Martin, A. Staines, M. Studer, C. Stivers, C. Moravek, P. Johnson, and J. Flannery.
Date: 2009
Book Name: M. Lück; A. Gräupl; J. Auyong; M. L. Miller, & M.B. Orams (eds.): Proceedings of the 5th International Coastal & Marine Tourism Congress: Balancing Marine Tourism, Development and Sustainability. Auckland, New Zealand: New Zealand Tourism Research Institute.
Page Numbers: Pp. 73-86

Title: Lethal and sublethal effects of altered sand salinity on embryos of beach-spawning California Grunion.
Authors: J. K. Matsumoto, and K. L. M. Martin
Date: 2008
Journal Name: Copeia
Issue/Page Numbers: 2008: 483-490.

Title: Grunion Greeters in California: Beach spawning fish, coastal stewardship, beach management and ecotourism.
Authors: K. Martin, A. Staines, M. Studer, C. Stivers, C. Moravek, P. Johnson, and J. Flannery.
Date: 2007
Book Name: M. Lück; A. Gräupl; J. Auyong; M. L. Miller, & M.B. Orams (eds.): Proceedings of the 5th International Coastal & Marine Tourism Congress: Balancing Marine Tourism, Development and Sustainability. Auckland, New Zealand: New Zealand Tourism Research Institute.
Page Numbers: Pp. 73-86

Title: First record of the occurrence of the California Grunion, *Leuresthes tenuis*, in Tomales Bay, California; a northern extension of the species.
Authors: D. Roberts, R. N. Lea, and K. L. M. Martin.
Date: 2007
Journal Name: California Fish & Game
Issue/Page Numbers: 93:107-110.

Title: Non-Tidal Rhythms.
Author: Martin, K. L. M.
Date: 2007
Book Name: M. Denny and S. Gaines (eds.), Encyclopedia of Tidepools. University of California Press.
Page Numbers: Pp. 467-468

Title: Does beach grooming harm grunion eggs?
Authors: K. Martin, T. Speer-Blank, R. Pommerening, J. Flannery, and K. Carpenter.
Date: 2006
Journal Name: Shore & Beach
Issue/Page Numbers: 74: 17-22.

Title: Intertidal fishes.

Authors: M. H. Horn, and K. L. M. Martin.

Date: 2006
Bok Name: L. Allen, M. Horn, and D. Pondella (eds.), Ecology of California Marine Fishes. University of California Press.
Page Numbers: Pp. 205-226

Brochures, fact sheets
Title: Grunion Greeters: Citizen Science on the Beach
Authors: K. Martin and M. Studer
Date: 2007, 2008 (revised)

Title: Bienvenidos al Grunon
Authors: K. Martin and M. Studer, Spanish Translation by A.-E. Escandon
Date: 2008

Title: Grunion Grooming Protocol at a Glance
Authors: K. Martin
Date: 2005, 2006, 2007, 2008 (revised annually)

Title: Introduction to Grunion Biology
Authors: K. Martin
Date: 2006

Electronic publications
Title: Web site www.Grunion.org for outreach and data acquisition
Authors: K. Martin and C. Stivers
Date: Developed in 2003, updated constantly

Title: DVD about Grunion Greeters
Authors: K. Martin, M. Murrie
Date: 2005

Title: Data acquisition software for web interface
Authors: B. Cupp and K. Martin
Date: 2004, updated constantly
Interface at http://arachnid.pepperdine.edu/grunion/sighting.asp

Title: Facebook page for Grunion Greeters
Authors: M. Studer, Grunion Greeters
Date: 2008

Title: Web site www.SanDiego.com
Authors: Entertainment Staff
Date: Updated annually
http://www.sandiego.com/seasonal/grunion/what-is-a-grunion

Maps, charts, atlases
Title: GIS map for MLPA process in South Coast Region
Authors: Colin Ebert, Evan Fox, Karen Martin
Date: in progress 2008

Title: Map of grunion spawning locations in San Francisco Bay for follow up after Cosco Busan fuel spill
Authors: K. Martin
Date: November 2007
Title: Map of grunion habitat range and sightings in California
Authors: K. Martin and A. Martin
Date: July 2008

Title: Map of locations for population genetic studies of grunion
Authors: P. B. Johnson
Date: 2005

Title: Maps of monitoring sites for Grunion Greeters
Authors: M. Studer
Date: 2005 - 2008

Handbooks, manuals, guides
Title: Workshop Materials for Grunion Greeters
Authors: M. Studer, K. Martin
Date: 2005, 2006, 2007, 2008 (revised annually)

Title: “The Grunion Greeter Project: A Manual for Partnership Organizations”
Authors: M. Studer
Date: 2006. Written with support from NFWF.

Theses, dissertations
Title: Microsatellite and morphological investigation of an apparently disjunct northern population of California grunion (*Leuresthes tenuis*).
Authors: P. B. Johnson and K. L. Martin.
Schools: Pepperdine University (Undergraduate Senior Honors Thesis).
Date: April 2007.

Title: Early development in the grunion: a comparison of phenotypes from northern and southern California populations of *Leuresthes tenuis*.
Authors: C. L. Moravek and K. L. Martin.
Schools: Pepperdine University (Undergraduate Senior Honors Thesis).
Date: July 2006.

Title: Effects of altered salinity during incubation on California grunion, *Leuresthes tenuis*.
Authors: J. K. Matsumoto and K. L. Martin.
Schools: Pepperdine University (Undergraduate Senior Honors Thesis).
Date: May 2007.

Bibliographies, directories
Title: Grunion Scientific Literature, link on web page for www.Grunion.org
Date: Ongoing

Media coverage
Name of publication: San Francisco Examiner (newspaper)
City: San Francisco
State: CA
Date of publication/broadcast: July 17, 2008
Headline or topic: “Cosco Busan’s Impact Still Not Entirely Clear”
http://www.examiner.com/a-1492490~Cosco_Busan_s_impact_still_not_entirely_clear.html

Name of TV station: San Diego Living, Channel 6 (TV news)
City: San Diego
State: CA
Date of publication/broadcast: July 2, 2008
Headline or topic: “On your mark, get set, grunion run” interview with Melissa Studer
http://www.sandiego6.com/content/news/review/day.aspx?content_id=7712948c-0e9d-490b-a948-3e5d6d5fe510

Name of publication: San Diego Union-Tribune (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: May 3, 2008
Headline or topic: “Biologists Shake Bushes for Wildlife”
http://www.signonsandiego.com/uniontrib/20080503/news_1m3bio.html

Name of TV station: MyFoxLA (TV news), story shown nationally
City: Los Angeles
State: CA
Date of publication/broadcast: April 21, 2008
Headline or topic: “The grunion return to southern California” interview with Karen Martin
http://www.myfoxla.com/myfox/pages/News/Detail?contentId=6362477&version=1&locale=EN-US&layoutCode=VSTY&pageId=3.2.1

Name of publication: Los Angeles Times (newspaper)
City: Los Angeles
State: CA
Date of publication/broadcast: April 15, 2008
Headline or topic: “Making a Grunion Run for Science”
http://www.latimes.com/news/local/la-me-grunion15apr15,1,7007824.story

Name of publication: North County Times (newspaper)
City: Oceanside
State: CA
Date of publication/broadcast: April 8, 2008
Headline or topic: “Storming the Beach: Armed with Flashlights and Sandals, Enthusiasts Seek Elusive Grunion”
http://www.nctimes.com/articles/2008/04/08/news/sandiego/9bfeba18aa696505882574250062fd08.txt

Name of publication: Laguna Beach (regional magazine)
City: Laguna Beach
State: CA
Date of publication/broadcast: Spring 2008
Headline or topic: "Eco Report: Magical Mysterious Grunion"

Name of publication: Malibu Times (newspaper)
City: Malibu
State: CA
Date of publication/broadcast: April 9, 2008
Headline or topic: "Greeting Grunions in Malibu"
http://www.malibutimes.com/articles/2008/04/11/news/news6.txt

Name of publication: North County Times (newspaper)
City: Oceanside
State: CA
Date of publication/broadcast: April 5, 2008
Headline or topic: "Run, Grunion, Run: Humans Happy to Join the Spawning Brigade"
http://www.nctimes.com/articles/2008/04/06/go/a29f0c0235c0f5d5882574200074a4eb.txt

Name of publication: Bay Nature (regional magazine)
City: San Francisco
State: CA
Date of publication/broadcast: April 2008
Headline or topic: "The Grunion's One Night Stand in the Sand"
http://baynature.org/articles/apr-jun-2008/the-grunions-one-night-stand-in-the-sand

Name of publication: Coastal Living (national magazine)
City: Tampa
State: FL
Date of publication/broadcast: March, 2008
Headline or topic: "Fish Out of Water"
http://www.coastalliving.com/coastal/living/environment/article/0,14587,1705794,00.html

Name of publication: Beach and Bay Press (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: March 14, 2008
Headline or topic: "Volunteers Get Ready to Greet Grunion"

Name of publication: Beach and Bay Press (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: March 13, 2008
Headline or topic: "Volunteers get ready to greet grunion"
http://www.sdnews.com/vnews/display.v/ART/2008/03/13/47d874695309b?in_archive=1

Name of publication: Daily Pilot (newspaper)
City: Costa Mesa
State: CA
Date of publication/broadcast: August 17, 2007
Headline or topic: "On the Water: Native Fish Spawn on Local Shores"

Name of publication: Point Reyes Light (Newspaper)
City: Point Reyes Station
State: CA
Date of publication/broadcast: July 26, 2007
Headline or topic: "Grunion Trek North Along the Coast to Spawn in Tomales Bay"

Name of publication: Today's Local News/San Diego Union-Tribune (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: April 12, 2007
Headline or topic: "Grunion come ashore on Oceanside beaches to spawn"
http://www.signonsandiego.com/uniontrib/20070412/news_lz1mc12spawn.html

Name of publication: The Graphic (Newspaper)
City: Malibu
State: CA
Date of publication/broadcast: April 5, 2007
Headline or topic: “Grunion Grace Malibu Beaches”
http://graphic.pepperdine.edu/news/2007/2007-04-05-grunion.htm

Name of publication: LA Broowaha (Online Newspaper)
City: Los Angeles
State: CA
Date of publication/broadcast: February 19, 2007
Headline or topic: “Greet the Grunion: The only place you can do it”
http://losangeles.broowaha.com/article.php?id=778

Name of publication: San Diego Union-Tribune (Newspaper)
City: San Diego
State: CA
Date of publication/broadcast: February 4, 2007
Headline or topic: “Sharing the Shoreline: Beach Grooming Stirs Ecological Controversy”
http://www.signonsandiego.com/uniontrib/20070204/news_1m4beach.html

Name of TV station: Del Mar Pulse, Channel 66, Del Mar TV Foundation (public television)
City: Del Mar
State: CA
Date of publication/broadcast: July 5, 2006
Headline or topic: “Grunion Greeters”. Segment produced by Grunion Greeter Lori Marlett and interview with Melissa Studer.

Name of publication: Del Mar Times (newspaper)
City: Del Mar
State: CA
Date of publication/broadcast: June 9, 2006
Headline or topic: “Grunion hit the moonlit beaches in all their slippery glory”
www.delmartimes.net/archives/articles060906.html

Name of publication: San Diego Ranch Coast News (newspaper)
City: Del Mar
State: CA
Date of publication/broadcast: May 25, 2006
Headline or topic: “Grunion Greeters work Del Mar beaches”

Name of publication: Ventura County Star (newspaper)
City: Ventura
State: CA
Date of publication/broadcast: May 16, 2006
Headline or topic: “Grunion run is On: Fish Flop on Area Beaches to Spawn”

Name of publication: San Diego Union-Tribune (Newspaper)
City: San Diego
State: CA
Date of publication/broadcast: April 22, 2006
Headline or topic: “Bird Watchers Breeding Interest in Grunion”
http://www.signonsandiego.com/uniontrib/20060422/news_m1m22tfoside.html

Name of publication: North County Times (newspaper)
City: Oceanside
State: CA
Date of publication/broadcast: April 14, 2006
Headline or topic: “Grunion Run Here, and Nowhere Else”
http://www.nctimes.com/articles/2006/04/15/science/17_56_494_14_06.txt

Name of publication: San Diego Magazine
City: San Diego
State: CA
Date of publication/broadcast: April, 2006
Headline or topic: “Go Fish”

Name of publication: La Jolla Light (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: April 4, 2006
Headline or topic: “Resident volunteers sought to count silver grunion under the full moon”
http://www.lajollalight.com/news/227683-resident-volunteers-sought-to-count-silver-grunion-under-the-full-moon

Name of publication: Scottish Newspaper, not sure which (newspaper)
City:
State: Scotland
Date of publication/broadcast: September 23, 2005
Headline or topic: “Angus Beach Boy Causes Ripples in California Surf”

Name of publication: California Coast & Ocean (magazine)
City: Oakland
State: CA
Date of publication/broadcast: August, 2005
Headline or topic: “Grunion in San Francisco Bay”

Name of publication: Der Spiegel (international news magazine)
City:
State: Germany
Date of publication/broadcast: August 1, 2005
Headline or topic: “Umarmung im Sand: In Kalifornien hupfen Fische an den Strand, um sich dort zu paaren. Die Verhaltensforscher stehen vor einem Ratsel.”

Name of publication: Contra Costa Times (newspaper)
City: Oakland
State: CA
Date of publication/broadcast: June 30, 2005
Headline or topic: “Life is a Mystery: Grunion Back in S. F. Bay”

Name of publication: Santa Barbara News-Press (newspaper)
City: Santa Barbara
State: CA
Date of publication/broadcast: June 21, 2005
Headline or topic: “Grunion Offer Sexy Spectacle in the Sand”

Name of publication: Los Angeles Times (newspaper)
City: Los Angeles
State: CA
Date of publication/broadcast: June 9, 2005
Headline or topic: “Battle Over Broad Beach Takes New Turn, With Earthmoving Equipment”

Name of publication: Los Angeles Times (newspaper)
City: Los Angeles
State: CA
Date of publication/broadcast: May 31, 2005
Headline or topic: “Runnin’ With the Grunion: To Ichthyologists, They’re a Mystery. To the Rest of Us, They’re the Best Show on the Beach”

Name of publication: Ventura County Star (newspaper)
City: Ventura
State: CA
Date of publication/broadcast: May 27, 2005
Headline or topic: “Guests of Honor Late for Grunion Greeting Event”

Name of publication: La Jolla Village News (newspaper)
City: La Jolla
State: CA
Date of publication/broadcast: April 22, 2005
Headline or topic: “Pieces of Silver: Grunion hit the Beach”
http://arachnid.pepperdine.edu/grunion/grunionnewsLaJolla.pdf

Name of publication: Orange County Register (newspaper)
City: Orange Co.
State: CA
Date of publication/broadcast: April 15, 2005
Headline or topic: “Greeters Prowl Coast to Count Grunion”
http://arachnid.pepperdine.edu/grunion/GreetersProwlCoastToCountGrunion.pdf

Name of publication: North County Times (newspaper)
City: Oceanside
State: CA
Date of publication/broadcast: April 16, 2005
Headline or topic: “Volunteers Observe Annual Arrival of Grunion”
http://www.nctimes.com/articles/2005/04/17/special_reports/science_technology/12_05_344_16_05.txt

Name of publication: San Diego Union-Tribune (Newspaper)
City: San Diego
State: CA
Date of publication/broadcast: April 13, 2005
Headline or topic: “Citizen Scientists a Valuable Species: Grunion watchers part of nature-tracking trend”
http://www.signonsandiego.com/uniontrib/20060422/news_m1m22tfoside.html

Name of publication: Beach and Bay Press (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: April 7, 2005
Headline or topic: “Grunion Running to the Beach”

Name of publication: San Diego Weekly Reader (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: March 31, 2005
Headline or topic: “Midnight on the Beach”
http://www.sandiegoreader.com/news/2005/mar/31/midnight-beach/

Name of broadcast: KOCE-TV Real Orange (television)
City: Huntington Beach
State: CA
Date of publication/broadcast: March 29, 2005
Headline or topic: “Surfrider Foundation and Grunion Greeters”. Interview with Nancy Hastings and Melissa Studer.

Name of publication: The Coast News (newspaper)
City: San Diego
State: CA
Date of publication/broadcast: March 25, 2005
Headline or topic: “Grunion, beach health link to be studied”

Name of publication/broadcasts: San Diego Union-Tribune, North County Times, San Diego Weekly Reader, La Jolla Village News, Beach and Bay Press, Peninsula Beacon, La Jolla Light, Coronado Eagle and Journal, Village and Valley News, Imperial Beach Eagle & Times, The Coast News, Malibu Times, Malibu Park News, UCSD Guardian Online, San Diego.com, Sign On San Diego.com, Cox.net, NBC San Diego,com, KUSI.com, KFMB.com, CA Outdoors.com. 927 Jill FM (radio).
State: CA
Date of publication/broadcast: Various from 2005-2008
Headline or topic: Published postings to advertise training workshops and volunteer recruitment.

Workshops and presentations
Martin, K. L., K. Hieb, P. B. Johnson, D. Roberts, C. Moravek, and S. Moore. Platform talk, 88th Annual Meeting, American Society of Ichthyologists and Herpetologists, Montreal, Quebec, Canada, July 2008. Audience of 35 scientists. "Range-wide population assessment of California Grunion, *Leuresthes tenuis*."

Martin, K. Invited presentation, Orange County Working Group for the Marine Life Protection Act, Ocean Institute, Dana Point, California, July 2008. Audience of 20 stakeholders and community members. "California Grunion and Sandy Beaches: Considerations for the MLPA."

Martin, K. Seminar, Southern California Ecosystems Research Program, CSU- Fullerton, June 2008. Audience of 26 professors, undergraduates, and graduate students. "What California Grunion Can Tell Us About Human Impacts on Sandy Beaches."

Martin, K. Keynote speaker, "Changing Your Latitude, Changing Your Attitude," Young Round Square of the Americas Conference, Catalina Island, April 2008. International gathering of 95 educators and middle school students. "Making a Difference: Citizen Scientists Impact Policy on California Beaches."

Martin, K. L., K. Hieb, P. B. Johnson, D. Roberts, C. Moravek, and S. Moore. Platform talk, American Fisheries Society- California-Nevada Chapter Meeting, Lake Tahoe, California, April 2008. Audience of 45 scientists. "Range-wide population assessment of California Grunion, *Leuresthes tenuis*."

Martin, K. and D. Simmons. Field Day for beach professionals, Ocean Beach, San Diego, California, May 2008. Audience of 18 beach workers, coastal scientists, and agency people. Speakers included D. Simmons, K. Martin, and M. Studer on topics including management issues involving dogs, habitat restoration, community relations, and beach trash.

Martin, K. and M. Studer. Workshop presentations for Grunion Greeter volunteers, Birch Aquarium at Scripps Institution of Oceanography; Aquarium of the Pacific in Long Beach, Santa Monica Pier Aquarium, Santa Barbara Channel Keepers and UCSB, Orange County Surfrider Chapter, Pepperdine University; Buena Vista Audubon Society, Port of Oakland, Tijuana River Estuarine Research Reserve. March – May, 2008. Audience totaled over 400 volunteers from the community and all walks of life.

Martin, K. and D. Simmons. Winter symposium for beach professionals, Pepperdine University, Malibu, California, January 2008. Audience of 40 beach workers, coastal scientists, and agency people. Speakers included K. Martin, T. Ryan, R. Grove, and D. Simmons on topics including management issues involving grunion, snowy plovers, kelp, and sand.

Martin, K. Workshop on Marine Interpretation, 5th International Coastal & Marine Tourism Congress: Balancing Marine Tourism, Development and Sustainability. Audience of 40 scientists and professional environmental educators, Auckland, New Zealand, September 2007. "Citizen Scientists as Docents Impact Policy."

Martin, K., K. Hieb, A. Jahn, C. Moravek, P. Johnson, and J. Matsumoto. Platform talk, 87th Annual Meeting, American Society of Ichthyologists and Herpetologists, St. Louis, Missouri, July 2007. Audience of 40 scientists. "Grunion in San Francisco Bay: Northern ecotype of a southern California icon."

Moravek, C. L., J. A. Flannery and K. L. Martin. Platform Talk, Annual Meeting of the Southern California Academy of Sciences. Audience of 30 scientists, Fullerton, California, May 2007. "An embryonic staging series for the California grunion, *Leuresthes tenuis*."

Martin, K., D. Simmons, and D. Lees. Field Day for beach professionals, Mission Beach, San Diego, California, May 2007. Audience of 25 beach workers, coastal scientists, and agency people. Speakers included D. Simmons and D. Lees on topics including management issues involving beach grooming, grunion protection, and invertebrate communities on beaches.

Johnson, P. B., T. L. Vandergon, R. L. Honeycutt, and K. L. Martin. Platform Talk, Annual Meeting of the Southern California Academy of Sciences. Audience of 30 scientists, Fullerton, California, May 2007. "Microsatellite and morphological investigation of an apparently disjunct northern population of California grunion (*Leuresthes tenuis*)."

Martin, K. Invited presentation, Malibu Watershed Council, Calabasas, California, April 2007. Audience of 16 council members. "Conserving California Grunion."

Studer, M. Invited presentation, Laguna Hills Audubon Club, April 2007. Audience of 45 Audubon Society Members. "Grunion: California's Most Charismatic Fish."

Martin, K. and M. Studer. Workshop presentations for Grunion Greeter volunteers, Birch Aquarium at Scripps Institution of Oceanography; Cabrillo Marine Aquarium, Santa Monica Pier Aquarium, Santa Barbara Channel Keepers, Orange County Surfrider Chapter, Pepperdine University; Buena Vista Audubon Society, Port of Oakland, Tijuana River Estuarine Research Reserve. March – May, 2007. Audience totaled over 400 volunteers from the community and all walks of life.

Martin, K., B. Hoffman, L. Plauzoles, and E. Hochberg. Winter symposium for beach professionals, Pepperdine University, Malibu, California, January 2007. Audience of 40 beach workers, coastal scientists, and agency people. Speakers included K. Martin, B. Hoffman, L. Plauzoles, and E. Hochberg on topics including management issues involving grunion, snowy plovers, Humboldt squid, and sand disturbances.

Martin, K. Invited presentation, Technical Advisory Committee, Santa Monica Bay Restoration Commission, June 2006. Audience of 20 scientists. "Human Impacts on Sandy Beaches in California."

Johnson, P.B., T. Vandergon, and K. Martin. Platform talk, Annual Meeting, Southern California Conference on Undergraduate Research, Occidental College, California, November 2006. Audience of 35 professors and undergraduate students. "Microsatellite investigation of population genetic structure in California grunion (*Leuresthes tenuis*)."

Martin, K. Invited presentation, Docent Day, County of Orange, October 2006. Audience of 60 docents, park rangers, teachers, and naturalists. "Biology of Grunion."

Martin, K., D. Simmons , and B. Barker. Field Day for beach professionals, Doheny Beach, Dana Point, California, May 2006. Audience of 40 beach workers, coastal scientists, and agency people. Speakers included D. Simmons, K. Martin and B. Barker on wildlife habitats on beaches, including nesting birds, native plants, and grunion spawning sites.

Martin, K. Seminar, Department of Biological Sciences, California State University, Long Beach, April 2006. Audience of 75 college students and professors. "Beach spawning fishes, terrestrial eggs, and air breathing."

Studer, M. Invited presentation, Buena Vista Audubon Club, April 2006. Audience of 30 Audubon Society Members. "California Grunion: The Fish that Spawns on our Beaches."

Martin, K. and M. Studer. Workshop presentations for Grunion Greeter volunteers, Birch Aquarium at Scripps Institution of Oceanography; Cabrillo Marine Aquarium, Santa Monica Pier Aquarium, Santa Barbara Channel Keepers, Orange County Surfrider Chapter, Pepperdine University; Mira Costa College, Long Beach Aquarium of the Pacific, Port of Oakland, Tijuana River Estuarine Research Reserve. March – May, 2006. Audience totaled over 400 volunteers from the community and all walks of life.

Martin, K and J. Dugan. Winter symposium for beach professionals, Pepperdine University, Malibu, California, January 2006. Audience of 38 beach workers, coastal scientists, and agency people. Speakers included K. Martin, M. Studer, and J. Dugan on topics including management issues involving grunion greeters, beach management, and the ecological role of kelp and wrack communities on sandy beaches.

Matsumoto, J. and K. Martin. Platform talk, Annual meeting, Southern California Conference on Undergraduate Research, University of California at Riverside, November, 2005. Audience of 20 professors and undergraduates. "Effects of salinity during incubation on California grunion, *Leuresthes tenuis*."

Studer, M. Invited presentation, Explorations in Marine and Ocean Sciences (EMOS) Symposium at Scripps Institution of Oceanography, November 2005. Audience of 100 parents of students attending symposium organized by Scripps' Center for Educational Outreach Connections (CEOC), California Sea Grant and the Center for Talented Youth (CTY) at Johns Hopkins University. "Grunion: California's Most Charismatic Fish."

Martin, K. Invited talk, luncheon seminar, headquarters of the National Oceanic and Atmospheric Administration, Silver Springs, Maryland, October 2005. Audience of 20 NOAA staff. "Monitoring California Grunion Populations with Citizen Scientists: Beach Management Implications."

Martin, K. Seminar, Southern California Ecosystems Research Program, CSU- Fullerton, June 2005. Audience of 20 professors, undergraduates, and graduate students. "Monitoring California Grunion on Sandy Beaches: Science and Outreach."

Martin, K., D. Simmons, A. Staines, and D. Pryor. Field Day for beach professionals, Doheny Beach, Dana Point, California, May 2005. Audience of 35 beach workers, coastal scientists, and agency people. Speakers included D. Simmons and A. Staines on topics including international perspectives on management issues involving beaches, and K. Martin and D. Pryor on protection of wildlife habitats on beaches.

Martin, K. Invited talk, American Institute of Fishery Research Biologists quarterly meeting, Long Beach, California, April 2005.

Martin, K. Seminar, Marine Biology Research Division, Scripps Institution of Oceanography, April 2005. Audience of 54 students and faculty. "California Grunion Adaptations for Terrestrial Incubation of Embryos."

Martin, K. Invited talk, Orange County Coastal Coalition, April 2005. Audience of 45 community members. "Assessing Grunion Habitat With Citizen Monitors on California Beaches."

Martin, K. and M. Studer. Workshop presentations for Grunion Greeter volunteers, Birch Aquarium at Scripps Institution of Oceanography; Cabrillo Marine Aquarium, Santa Monica Pier Aquarium, Santa Barbara Channel Keepers, Orange County Surfrider Chapter, Pepperdine University, Mira Costa College, Long Beach Aquarium of the Pacific, Port of Oakland. March – May, 2005. Audience totaled over 400 volunteers from the community and all walks of life.

Martin, K. Invited talk, Ventura County Coastal Coalition, March 2005. Audience of 24 community members. "Assessing Grunion Habitat With Citizen Monitors on California Beaches."

Dissemination of results

GLOW event, Santa Monica, California, July 2008. All-night art fair with 75,000 attendees took place on the night of a predicted grunion run at Santa Monica Pier. We organized volunteers and beach workers to protect the grunion in the area of the run and to provide educational interpretation for this public art event.

"Environmental Education Fair" participant, Orange County Coastal Coalition, June 2008. Booth and presentation for audience of 50 participants.

"Doheny Beach 50th Anniversary Event" participant, Dana Point, California, May 2007. Booth and presentation for thousands of visitors.

"Spring Egg-Stravaganza," Birch Aquarium at SIO, public program for families, March 2007.

"Chance for Children" evening program about grunion with hands-on activities for child campers, July 2006 and 2007, Malibu, California.

"Pt. Mugu State Park Whale Festival" exhibitor, March 2005. Booth and family activities for beach festival, hundreds of families participating.

Web site www.Grunion.org has been linked to by many other sites including those of the Surfrider Foundation, National Wildlife Federation, Surf.com, California Department of Fish and Game, National Fish and Wildlife Service – Southwest Region, National Geographic Magazine, Los Angeles Times, Cabrillo Marine Aquarium, Birch Aquarium at Scripps Institution of Oceanography, SharkResearch.com, and others.

E-mail: Many people send e-mails with general questions about grunion to the PI through the web site contact information, and via messages forwarded by California Department of Fish & Game throughout the year. All receive a personal response.

Cooperating organizations
Federal
National Marine Fisheries Service: Southwest Region, Habitat Conservation Division provided financial support for beach management group and Grunion Greeter volunteer monitoring in 2008 and publicized new permitting requirements for sandy beaches involving grunion season.

US Fish and Wildlife Service provided data from monitors in sandy beach areas in southern California.

National Parks Service, Golden Gate National Recreation Area provided research access, permits, and volunteer monitors for grunion runs in San Francisco Bay at Chrissy Field.

Cordell Banks National Marine Sanctuary and Pt. Reyes National Seashore provided volunteer monitors, data, advice about beach monitoring, research collaboration, and access to remote locations for monitoring.

Local and state
California Coastal Coalition provided meeting space for a field day for beach managers and contact information for local beach managers in Orange County. The Ventura County Chapter sponsored a public program for grunion observation at Ormond Beach.

California Coastal Commission provided publicity for Grunion Greeters as stewards of natural resources on the coast and used Grunion Greeter data in enforcement actions.

California Coastal Conservancy provided volunteers and data for the program.

California Department of Fish and Game provided trawl data for San Francisco grunion and produced the schedules for predicted grunion runs. They requested data for permitting issues and used our methods for monitoring grunion activity.

California State Parks provided access to beaches at night, programs led by interpretive rangers at several sites, volunteer monitors, campsites, and locations for field demonstrations for beach managers. They incorporated the Grunion Grooming Protocol into beach maintenance.

City of Huntington Beach allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

City of Imperial Beach provided volunteers and data with political support for grunion monitoring. They allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

City of Long Beach allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

City of Malibu provided funds for an educational sign about grunion to be placed in the new interpretive area of Malibu Lagoon.

City of Newport Beach allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

City of Oxnard incorporated the Grunion Grooming Protocol into beach maintenance.

City of Santa Barbara allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance. They leave a buffer well above the wrack line during grunion season.

City of San Clemente allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance. They provided some monitors and data.

City of San Diego allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance. Beach Manager Dennis Simmons was instrumental in organizing the Working Group for beach management. The city hosted several field days for beach management. Our work was supported by the City Council and posted on their web pages.

City of Santa Monica allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance. They cooperated with us during the GLOW festival in 2008 and provided parking during the festival.

City of Ventura incorporated the Grunion Grooming Protocol into beach maintenance.

County of Orange allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

County of Santa Barbara allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance.

East Bay Regional Parks District allowed access by volunteers to the beach at night in San Francisco Bay, provided research permits, and incorporated the Grunion Grooming Protocol into beach maintenance.

Los Angeles County Beaches and Harbors allowed access by volunteers to the beach at night and incorporated the Grunion Grooming Protocol into beach maintenance. They provided a field site and operators for a demonstration day for beach maintenance.

Nongovernmental organizations
Activist San Diego publicized workshops and recruit attendees in 2005, 2006, 2007 and 2008.

Audubon Society provided a venue for workshops in 2007 and 2008 (Buena Vista Chapter) and volunteers and data (BV, Los Angeles, and Santa Monica Bay chapters). They provided speakers for two of our beach management seminars.

Doheny Beach Interpretive Association provided space for an exhibit at the 50th anniversary festival and a venue for field day demonstrations for beach workers in 2005 and 2006. Their interpretive rangers lead an annual public program on grunion.

Heal The Bay, Santa Monica provides publicity for the program in its web site and publications, and a venue for volunteer workshops in 2006, 2007, and 2008.

Just Volunteers helped publicize workshops and recruit attendees in 2005.

L.A. Works helped publicize workshops and recruit attendees in 2008.

Muth Interpretive Center in Newport Beach provided a workshop venue for training volunteers in 2007 and 2008 and helped publicize workshops to recruit attendees.

National Wildlife Federation designated Grunion.org as one of its partners for National Wildlife Watch Week in April of 2007 and 2008. They provided publicity and links on their web site.

Ocean Institute at Dana Point provided a workshop venue for volunteers in 2006 and a meeting site for the beach management group in 2008. They provide volunteers and data every year.

Orange County volunteer Grunion Greeters in 2005, 2006, and 2007 and provided workshop space and support.

Ormond Beach Task Force developed and publicized a public grunion run program in 2005 and 2008.

National Geographic Society, Committee for Research and Exploration provided funding in 2007-08 for travel to San Francisco Bay and Tomales Bay, and photographic equipment.

National Fish and Wildlife Foundation provided funding in 2005 and 2006 for support of the volunteer monitoring effort.

San Diego Science Alliance helped publicize workshops and recruit attendees in 2006.

Santa Barbara Channel Keepers provided workshop space and support in 2005, 2006, 2007, and 2008. A staff person organized the volunteer Grunion Greeters for Santa Barbara. They provided publicity in their publications and on their web site.

Southwest Wetlands Interpretive Association provided a workshop venue and interpretive rangers involved in outreach and data acquisition.

Surfrider Foundation, National and Local Chapters provided publicity on their web site and in their publications, and provided volunteers and data. A staff person organized
Volunteer Match helped publicize workshops and recruit attendees in 2005, 2006, 2007 and 2008.

Tijuana River National Estuarine Research Reserve provided a workshop venue for volunteers in 2007 and 2008, and outreach to volunteer monitors across the border in Mexico.

Western Snowy Plover Working Group provided advice on beach monitoring and data.

Volunteer San Diego helped publicize workshops and recruit attendees in 2006 and 2007.

Industry
Beach Tech: North American Sales Representative Scott Merrill provided numerous contacts for the beach management working group and publicized the grunion work in their company newsletter.

Southern California Edison: Senior Scientist Bob Grove spoke at one of the beach management meetings and provided feedback for monitoring studies.

Port of Oakland provided a workshop venue, volunteers and data for the grunion in San Francisco Bay.

Environmental Consultants: biological consultants can attend our training workshops for free. Many do, and they monitor construction sites using our protocol, then provide data to our database. Participants include Chambers Group, Entrix, ECorp Consulting, MBC Consulting, Bonterra Consulting, Littoral Ecological & Environmental Services, and San Marino Environmental Associates, the County of Orange, and the City of San Clemente.

Academic Institutions
California State University, Channel Islands provided volunteers and data. Contact: Chris In.

California State University, Fullerton provided volunteers and data, and research collaborations. Contacts: Danielle Zacherl, Michael Horn, Kathryn Dickson.

California State University, Northridge provided volunteers and data, and research collaborations. Contact: Cheryl Hogue, Larry Allen.

Mira Costa College provided volunteers and data, and a venue for a workshop for Grunion Greeters in 2005 and 2006, and helped publicize workshops in 2007 and 2008. Contact: Jeanine Donley.

Palomar College provided volunteers and data, and a research project. Contact: Roy Wolcott.

Pepperdine University provided financial support for student research, release time for the PI, web hosting, office services, and a vehicle for field work, as well as volunteers, data, and a venue for Grunion Greeter workshops and Beach Manager Winter Symposia every year. Contact: Karen Martin, Chris Stivers.

Pomona College provided volunteers and data. Contact: Nina Karnovsky.

Scripps Institution of Oceanography, University of California, San Diego provided research collaboration, ongoing advice, and access to library resources. The Fish Collection houses our voucher specimens. Contacts: Richard Rosenblatt, Ron Burton.

University of California, Los Angeles provided a research collaboration, volunteers, and data. Contact: Don Buth.

University of California, Santa Barbara provided volunteers, data, and a venue for a workshop for Grunion Greeters in 2008. Contact: Milton Love.

University of California, Santa Cruz provided volunteers and data. Contact: Giacomo Bernardi.

University of Southern California, Wrigley Science Center provided access to field sites, transportation on Catalina Island, and data. Contact: Ellen Kelley.

Other organizations not listed above
Aquarium of the Pacific in Long Beach provided volunteers, data, and a venue for workshops for Grunion Greeters in 2005 and 2008.

Birch Aquarium at Scripps Institution of Oceanography provided volunteers, data, and a venue for workshops for Grunion Greeters in every year. They incorporated our methods into their public program for grunion observations. They provided publicity on their web site and publications.

Cabrillo Marine Aquarium provided volunteers, data, and a venue for workshops for Grunion Greeters in every year. They incorporated our methods into their public program for grunion observations. They provided publicity on their web site and publications, and contacts with media.

Lawson's Landing, Tomales Bay provided access to field sites and data.

Monterey Bay Aquarium Research Institute provided volunteers and data, and incorporated a grunion observation night into their summer internship program.

Roundhouse Aquarium in Manhattan Beach provided volunteers and data and incorporated a grunion observation night for Grunion Greeting into their spring program.

Santa Barbara Natural History Museum/ Ty Warner Sea Center provided volunteers and data, and a venue for a workshop for Grunion Greeters in 2006. They provided a speaker, Eric Hochberg, for one of our winter symposia for beach managers.

Santa Monica Pier Aquarium provided volunteers, data, and a venue for Grunion Greeter workshops in 2005, 2006, 2007, and 2008. They developed a temporary exhibit for grunion in 2008 using our educational materials and photographs.

Student volunteers involved in the project: 120

International implications
California Grunion habitat spans parts of northern Baja California, Mexico. In 2008 we recruited volunteers to observe runs in Mexico and received our first reports from that country. We have translated the brochure into Spanish and hope to translate additional educational materials over time.

Awards
Environmental Partnership Award, Presented to Karen Martin by the American Shore and Beach Preservation Association at its annual meeting, October 2006.

John D. Isaacs Undergraduate Scholar Research Award, California Sea Grant College, NOAA, summer 2006, to support research by Phillip B. Johnson.

Keywords
Beach, California, Coast, Ecosystem, Egg, Fish, Grunion, Reproduction, Sand, Spawning, management, citizen scientists

Notes
Two scientific papers are currently undergoing peer review in anticipation of publication. Additional data will be presented in at least two additional papers in preparation.

Because of a previous dearth of data on California Grunion, we became the de facto clearinghouse for all kinds of information for numerous management and regulatory organizations as well as the press and the public. The unexpected enormous expenditure of time in these important areas has delayed data analysis and publication of results.