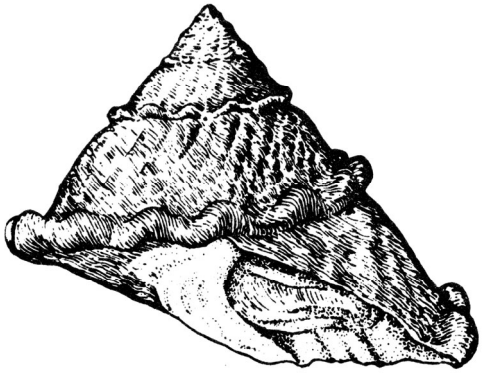
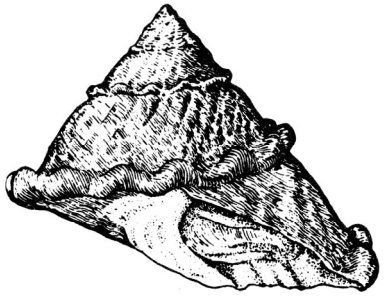


THE WESTERN SOCIETY OF MALACOLOGISTS

Annual Report For 2013

Volume 46
January 2016

Abstracts and papers from the 46th annual meeting of the Western Society of Malacologists held at the Courtyard by Marriott, San Diego, California, June 23-26, 2013



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Student Grant Awardees

José Francisco Domínguez Contreras

Marine connectivity of the octopus *Octopus bimaculatus* in the northwest Mexican Pacific Ocean

Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN) La Paz, B.C.S. México.

Michele Larson

Influence of conductivity and calcium concentrations on the density and species richness of native and invasive gastropods in the Greater Yellowstone Ecosystem

Department of Zoology, University of Wyoming

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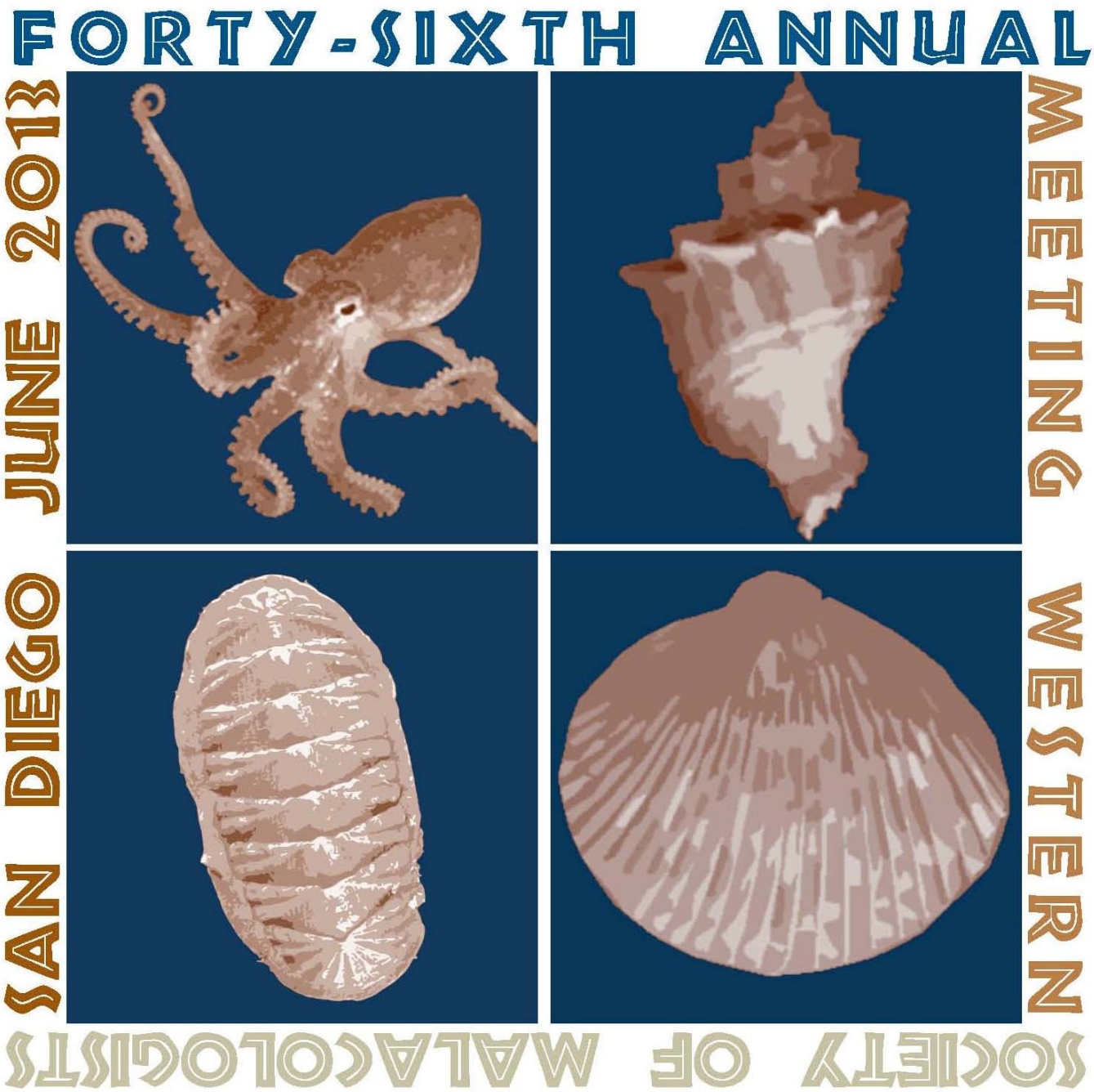


PROGRAM

Symposia, Contributed Papers and Poster Session

Sunday June 23rd

Time	Author	Title
9:30	Welcome/Opening remarks	
9:40	Paul Tuskes	Mollusks of Mission Bay, San Diego, California.
10:10	Paul Valentich-Scott, Eugene V. Coan and Diego G. Zelaya	Bivalvian Triptych: Bivalve Seashells of Western South America
10:30	BREAK	
11:00	Erica Clites, Mark Goodwin and Charles Marshall	Rehousing and Digitizing the USGS Menlo Park Invertebrate Collection into the University of California Museum of Paleontology
11:20	George Kennedy	Additions to the Middle Pleistocene Marine Record of Downtown San Diego, Southern California
11:40	LUNCH	**Executive Meeting**
13:10	Susan Kidwell	Evaluating Human Impacts on Coastal Ecosystems Using Dead Shell Assemblages and Very Young Fossil Records
13:50	Kristen Jenkins Voorhies, Sarah Henkel and Susan M. Kidwell	Historical Benthic Assemblages Support Both Stability and Moderate Ecological Change in Nearshore Environments in Newport, Oregon
14:10	Jill Leonard-Pingel, Susan Kidwell and Adam Tomasovych	Changes in Bivalve Communities on the Palos Verdes Shelf Before and After the Clean Water Act Based on Sediment Cores
14:30	Katie L. Cramer, Jeremy BC Jackson, Christopher V. Angioletti, Jill Leonard-Pingel and Thomas P. Guilderson	Historical Anthropogenic Change in Reef Coral and Molluscan Communities in Caribbean Panama
14:50	BREAK	
15:20	Matthew Bizjack and Susan Kidwell	The Trouble with Dribbles: Detecting Offshore Dumping of Dredged Nearshore Material Using Dead Mollusk Shells
15:40	María Moreno-Alcántara, Gerardo Aceves-Medina and Orso Juan Angulo-Campillo	Holoplanktonic Mollusks of the Mexican Pacific and its Surroundings: A Review
16:00	Carlos E. Gómez-Hernández, Carlos J. Cáceres-Martínez and Alma Sobrino-Figueroa	Biomonitoring of *Pteria sterna* (Gould, 1851) Under Culture at Two Locations in Bahia de La Paz, Baja California Sur, México
16:20	Brian Urbano and Martha Reguero	With a Little Help From Our Friends…Three Years of an Optional Course on Malacology: A Critical Review
19:00	**Social Hour:** Silent Auction - Shells and Books	

Monday June 24th

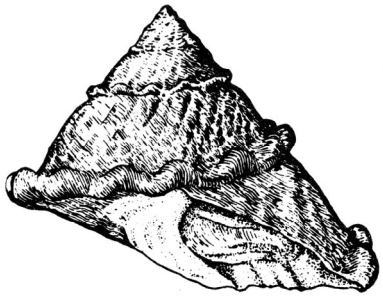
Time	Author	Title
9:00	Opening Remarks	"Opisthobranchia Symposium"
9:10	Ángel Valdés, Jennifer Alexander, Dieta Hanson and Samantha Cooke	Alien Sea Slugs and Ecosystem Change
9:35	Samantha Cooke	Alien Species Found in San Francisco Bay, Identity Still Unknown
10:00	Jermaine Mahguib, Hans Bertsch and Ángel Valdés	Molecular Reevaluation of the Phylogenetic Position of the Enigmatic Species *Tritonia papalotla* Bertsch et al. 2009 (Mollusca: Nudibranchia)
10:25	BREAK	
10:55	Jessica Goodheart and Ángel Valdés	Biogeography, Cryptic Diversity and Evolution Within the Sea Slug Genus *Pleurobranchus* (Notaspidea: Pleurobranchidae)
11:20	Vanessa Knutson and Terrence Gosliner	Will the Real *Gymnodoris alba* Please Stand Up? Systematics and Taxonomy of the Nudibranch Genus *Gymnodoris*
12:00	LUNCH - **PICTURE**!!	
13:30	Carissa Shipman and Terrence Gosliner	The *Doto coronata* Species Complex, Elongate Dotos, and the Molecular Systematics of the Dotidae
14:10	Terrence Gosliner and Claire Gonzalez	New Insights into Cephalaspidean Evolution: The Phylogeny of the Philinacea (Gastropoda, Opisthobranchia)
14:35	Jeffrey H. R. Goddard	Name Changes in Northeastern Pacific Dendrodoridídae
15:00	BREAK	
15:30	Hans Bertsch	Provincial and Community Comparisons of Nudibranch Feeding Biogeography
16:10	Michael Miller	It's a Small, Small World in Bali, Indonesia!
16:25	Michael Miller	The Case of the Missing Slug
19:00	**Poster Session**; Reprint Sale	

Tuesday June 25th

Time	Author	Title
9:00	Opening Remarks	"Mollusks and the Indigenous Californians"
9:10	Carlos Figueroa-Beltrán, Antonio Porcayo-Michelini and Juan Martín Rojas-Cháves	Culture and Environment in a Lost Paradise: The Mollusks of Prehistoric Laguna Percebu, Baja California
9:50	Mayra del Carmen Robles Montes and Miguel Agustín Téllez Duarte	Late Holocene Shell Midden La Jovita, Baja California: Mollusk Exploitation from $\delta^{18}O$ Isotopic Records
10:30	BREAK	
11:00	Harumi Fujita	Early and Middle Holocene Pearl Oyster Fishhooks on Espíritu Santo Island, Baja California Sur
11:40	Carlos J. Cáceres Martínez and Alfonso Rosales López	Ancient Californian Mother-of-Pearl Ornaments from Magdalena Island, Baja California Sur, México
12:20	LUNCH	
13:50	Hans Bertsch	Uses and Trades Routes of Abalones by the Indigenous Californians
14:30	Kari Eckdahl and Danielle Zacherl	Determining Black Abalone (*Haliotis cracherodii*) Density and Habitat Availability in Southern California
14:50	Miguel A. del Rio-Portilla, Fabiola Lafarga-De La Cruz, Cristian Gallardo-Escárate, Andrea Aguilar-Espinoza, Carmen E. Vargas-Peralta and Carmen Paniagua-Chávez	Population Genetic Analysis of the Red Abalone Cultured in Baja California Using Microsatellites Derived From Next Generation Sequencing
15:10	BREAK	
15:40	Roberto Cruz-Flores, Jorge Cáceres-Martínez, Rebeca Vásquez-Yeomans and Yanet Guerrero-Renteria	Distribution, Prevalence and Intensity of *Xenohaliotis californiensis* Parasite of Abalone, *Haliotis fulgens* and *Haliotis corrugata* in the Peninsula of Baja California, México
16:00	Oscar Efraín Holguín Quiñones, José Luis Sánchez Lisazo and Esteban F. Felix Pico	Affinities Between Mollusks and Physiographic Features in the Gulf of California and the Western Mediterranean Sea
16:20	Brian Urbano and Michel Hendrickx	Mexican Pacific Cephalopods: A First Approach.
16:40	Closing Remarks/**Business Meeting**	
19:00	Banquet	

Posters

AUTHOR	TITLE
Norberto Capetillo-Piñar, Arturo Tripp-Quezada and José Espinosa Saez	Taxonomic Distinctness of Soft Bottom Malacofauna of the Gulf of Batabanó (Cuba) as an Indicator of Environmental Degradation
David Guzmán-Lerma, Ananda Navarro-Barrera, Rebeca Vásquez-Yeomans, Jorge Cáceres-Martínez and Yanet Guerrero-Renteria	Experimental Infection With *Perkinsus marinus* of the Japanese oyster *Crassostrea gigas* Cultured in Bahía de Todos Santos, Ensenada, BC México
Malcolm Henshaw, Omar Alazzawi, Christoph W. Baysdorfer, Shoko Furuya and Christopher L. Kitting	Limited Genetic Variability in *Cornu aspersum* (=*Helix aspersa*), Historically Introduced Brown Garden Snails, at Nearby and Distant Sites Around San Francisco Bay
Michele D. Larson and A. Ross Black	Density and Genera Richness of Native Gastropods and the Occurrence of the Invasive New Zealand Mud Snail (*Potamopyrgus antipodarum*) in the Lower Snake River and Three Tributaries
Alejandra López-Galán	Using Stylets from Permanent Preparations for Age Determination in *Octopus hubbsorum*
Edgar A. López-Landavery, Amelia Portillo-López, Cristian Gallardo-Escárate and Miguel A. del Río-Portilla	Validation of Housekeeping Genes as Internal Controls for Expression of Sex-Specific Genes in the Red Abalone *Haliotis rufescens*
Mauricio Ramírez-Rodríguez, Esteban Fernando Félix-Pico and Gustavo De la Cruz-Agüero	Rotating Fishing Areas for the Black Ark in the Ensenada de La Paz, Baja California Sur, México
Javier Cuervo Ventura, Angel Romero-Rodríguez, Jorge Cáceres-Martínez, Rebeca Vásquez-Yeomans and Roberto Cruz-Flores	Parasitic Load of the Eastern Oyster *Crassostrea virginica* in Three Coastal Lagoons of Tabasco, Gulf of México and its Implications for Production
Alma Sobrino-Figueroa and Carlos Cáceres-Martínez	Genotoxic Effect of Cadmium, Chromium and Lead on Japanese Oyster (*Crassostrea gigas)* Larvae
Alma Sobrino-Figueroa and Carlos Cáceres-Martínez	Oxidative Stress as a Tool to Assess Aquatic Heavy Metals Contamination using the Catarina Clam: *Argopecten ventricosus* (Sowerby, 1842)
Arturo Tripp-Quezada, Marcial Villalejo-Fuerte, Federico-García-Domínguez and Arturo Tripp-Valdez	Community Structure of Soft-bottom Mollusks at Isla San Francisco, Gulf of California, México



Abstracts

Alphabetical by First Author

Provincial and Community Comparisons of Nudibranch Feeding Biogeography

Hans Bertsch (hansmarvida@sbcglobal.net)

Instituto de Investigaciones Oceanológicas, UABC, Ensenada, BC, México

Timed nudibranch-density studies were performed at eleven communities in four different central and eastern Pacific zoogeographic provinces: Hawaiian (HA), Oregonian (OR), Sea of Cortez (SC) and Mexican (MX). Densities and relative percentages of species and specimens observed were compared with all known species recorded from each faunal province to determine the functional structures of nudibranch community networks.

Comparing provinces, there is no correlation between numbers of species and numbers of specimens among bryozoan feeders; however they are positively correlated among sponge and cnidarian feeders (more known species = more observed specimens). The Hawaiian sites showed lower numbers of both known species and observed specimens of bryozoan and cnidarian feeders than in the three other provinces.

The H' and evenness diversity indices show different correlation patterns for cnidarian and sponge feeders. Cnidarian predators showed a positive correlation between these indices with percent of specimens found (the increasing effect was spread across many species, not just a few super-abundant). Sponge predators, reflecting the extreme abundance of a single or a few species, exhibited a negative correlation between the diversity indices and the percent of specimens found.

On the community level within provinces, there are significant variations in density, abundance and diversity (both H' and evenness) based on feeding preferences.

For the species of sponge feeders in HA, observed specimens ranged from 84.5–98.4% of the observed specimens at the three sites. At Makua, *Glossodoris rufomarginata* represents 71.1% of all nudibranch specimens observed, 51.5% at Pupukea, and less than 0.1% at Kewalo/Magic Island. The overwhelming abundance of this species at Makua is reflected in the lowest H' of the three sites, 1.354, contrasted with the 2.002 and 2.087 at the others. In SC, at Bahía de los Ángeles, *Doriopsilla bertschi* represents 35.6% of all specimens at Gringa/Cuevitas, but 0.0% at Islands. However, its extreme abundance at Cuevitas and relative scarcity at Gringa cancel out its influence on the diversity values at these sites.

Bryozoan feeders in eastern Pacific sites caused significant community differences. In the OR North Cove, Cape Arago, they represented 61.8% of the total fauna (the two species *Janolus fuscus* and *Triopha catalinae* accounting for 43.1%), but only 4.5% at Middle Cove. The H' values were, respectively, 2.522 and 2.795. In SC, they accounted for 77.2% of the fauna at the Islands (*Tambja abdere* and *Tambja eliora*, 73.5%), but only 4.9% at Gringa/Cuevitas. In MX, Bahía de Banderas, they were 30.6% of the fauna at Grupo 1 (*T. abdere*, 24.9%), but only 3.4% at Grupo 2. Both SC and MX sites with abundant *Tambja* presence showed lower H' values (1.907 and 2.891) than at the adjacent rare *Tambja* sites (2.538 and 3.406), showing the influence of a few highly-abundant predator species.

Uses and Trade Routes of Abalones by the Indigenous Californians

Hans Bertsch (hansmarvida@sbcglobal.net)

Sociedad de la Antigua California, Ensenada, Baja California, México

[Full paper contributed to annual report; see page 35]

The Trouble with Dribbles: Detecting Offshore Dumping of Dredged Nearshore Material Using Dead Mollusk Shells

Matthew Bizjack and Susan Kidwell

Dept. of Geophysical Sciences, University of Chicago

Imaging of the seafloor off the coast of southern California has indicated the possible presence of dredge spoils dumped outside the site radius of a federally designated offshore dump site. Many studies have shown that harbor sediments are significantly enriched in pollutants that impact marine communities of organisms. It is therefore important to determine if dredge spoils are being dumped outside of designated areas. Researchers have shown that seafloor assemblages of dead shells contain significant information about a location's natural and human-impacted environmental history. To determine if dead shell assemblages can be used to detect dredge spoil without recourse to chemical assays, we analyzed a set of continental shelf sediment grabs drawn from both inside and outside a suspect area on the San Diego continental shelf. We used the Bight '03 regional survey of living communities and other sources to determine which species are known to live only on the open shelf in waters 60 to 90-m depth, which species live both at depth and in shallow bays and harbors, and which species live only in bays and harbors. We used the latter group as 'signal species' of dredge-spoil dumping: if these species occur dead on the deep shelf seafloor inside and not outside suspected areas, then they have likely been transported there by dredge-spoil barges. In order to develop this as a relatively low-cost method, we evaluate the sample sizes needed to detect signal species, the effect of sieve size (can signal species be detected using a coarser sieve than 1 mm?), and the effect of taxonomic level (is identification of dead shells to genus- or family-level sufficient?).

Ancient Californian Mother-of-Pearl Ornaments from Magdalena Island, Baja California Sur, México

Carlos J. Cáceres Martínez[1] (ccaceres@uabcs.mx) and Alfonso Rosales López[2]

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In 2009, Hurricane Jimena caused great destruction on Isla Magdalena, Baja California Sur. During the rebuilding of houses in 2011, the islanders found a skeleton. The Instituto Nacional de Antropología e Historia, performing salvage archaeology, found a funeral system of five burials. The bones were numbered according to their discovery chronology; the first was in the primary burial, 1.2 m deep; an adult male (25–30 years). The second, in the secondary burial, was a woman (20–25 years), also 1.2 m deep. The third skeleton was a child (2–3 years), accompanied by a *Haliotis sp* shell, in the primary burial at a depth of 0.9 m. The fourth was a male adult (25–30 years) in the secondary burial, at a depth of 1.4 m. The skeleton had a necklace of three strands of mother-of-pearl ornaments composed of 49 pieces of finely-worked shells of *Pinctada mazatlanica*; two strands were placed around the neck and the third in the front of the skull. The fifth was a male individual (25–30 years) associated with two valves of *Laevicardium elatum*, at 1.35 m deep. All funerals were deeper than reported so far for the funerary customs of the ancient Californians. Morphometric analyses were done only on ornaments carved from shells of *P. mazatlanica*. All ornaments studied showed evidence of having been cut, carved and pierced. The dominant form was pear-shaped (799 ± 272 mm^2, $n = 36$), with a conic perforation at the top (two differentiated groups of perforated surfaces, 5.5 ± 5.4, $n = 34$, and 20.8 ± 4.3 mm^2, $n = 4$), made by the use of stone tools. The techniques used were percussion, carving and swiveling to drill a hole. Just as in the regions of the South and the communities by the coast of the Gulf of California, mother-of-pearl shells stand out in the elaboration of ornaments and are associated with activities of daily living. This burial system presents two distinctive features: absence of association with midden mounds or human settlements and greater depth of burials. The locality seems to be a cemetery of the ancient Californians dating to the pre-conquest period, between 400 to 1,200 years B.P.

Taxonomic Distinctness of Soft Bottom Malacofauna of the Gulf of Batabanó (Cuba) as an Indicator of Environmental Degradation

Norberto Capetillo-Piñar[1] (norbertcap@yahoo.com), Arturo Tripp-Quezada[1] and José Espinosa Saez[2]

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[2]Instituto de Oceanologìa, La Habana, Cuba

The objective of this study is to evaluate the applicability of the indexes of average taxonomic distinctness on base of presence/absence of data (Delta+) and variation in taxonomic distinctness (Lambda+) of the soft bottom molluscs of a sector of north coast of the Batabanó Gulf. Two inventories of species were used based on historical surveys: one in 1980 and another in 1998. To check the robustness and effectiveness of these indexes as indicators of environmental stress, were carried out correlations with the species richness and environmental variables. For the period evaluated were registered 110 species distributed in three classes: (Bivalvia, Gastropoda and Scaphopoda), 16 orders, 53 families and 91 genera. In 1980 surveys the Delta+ and Lambda+ values evidenced that the environmental conditions were favorable for the maintenance a high taxonomic diversity without detected environmental stress. In 1998 survey the values of these indexes diminished evidencing lost of taxonomic distinctness fundamentally in the class Bivalvia. Both indexes gave evidences of environmental stress in some places of this area for this year demonstrating to be effective and robust to be used as biological indicator of human disturbances.

Rehousing and Digitizing the USGS Menlo Park Invertebrate Collection into the University of California Museum of Paleontology

Erica Clites[1] (eclites@berkeley.edu), Mark Goodwin[1] (mark@berkeley.edu) and Charles Marshall[1, 2] (crmarshall@berkeley.edu)

[1]University of California Museum of Paleontology
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The University of California Museum of Paleontology (UCMP) is currently rehousing, curating, and digitally imaging the orphaned U.S. Geological Survey (USGS) Menlo Park collection of invertebrate fossils donated to UCMP in 1997 with support from the National Science Foundation (NSF). For about half a century, the USGS staff at Menlo Park built a unique and irreplaceable collection of 170,000 fossils from ca. 20,000 localities from western North America. With earlier NSF support, 1998–2000, the Alaskan and Arctic portion of the USGS collection was integrated into the UCMP collection in the Valley Life Sciences Building on the Berkeley campus. The remaining two thirds of the collection, which consists largely of Neogene mollusks from California, Washington and Oregon, and select Mesozoic faunas, were moved again and are now accessible in a secure, conditioned off-site UC museum collections facility. The original USGS wooden cabinets housing the fossils are old and due to multiple moves and less than ideal storage conditions, the doors went missing and many wooden drawers were damaged or not in their original location. Archival materials stored in the museum drawers were rapidly deteriorating. In April, 2013, sixty custom fabricated steel museum cabinets were installed, and work is underway to reorganize the specimens, and place them into cabinet trays with fossils from the same general locality, time period and formation. All specimens will be curated, the locality records added to the UCMP database (http://ucmpdb.berkeley.edu/) and will include the physical location of the specimens, permitting quick access. Specimens rehoused into acid-free paper trays are first photographed in a LED-lit light box using a digital SLR camera. The light box facilitates rapid processing of high-resolution photographs taken by undergraduate students and volunteers. Images are added to CalPhotos (http://calphotos.berkeley.edu/) and linked to the records in the UCMP database in real time as curation proceeds. A preliminary review of the archival materials contained within the collection has been completed, and the irreplaceable original reports and field notes placed in archival sleeves to ensure their preservation. Even when it was virtually inaccessible, this collection was utilized

in diverse research studies including hydrothermal vent paleoenvironments, deep-sea whale-fall communities, systematic paleontology and geological mapping projects. We expect that the improvement in accessibility and digitization of specimens and records will promote an increase in research requests and visits to the UCMP, now the permanent home to the former USGS collection of invertebrate fossils previously held in Menlo Park, CA.

Alien Species Found in San Francisco Bay, Identity Still Unknown

Samantha Cooke

California Academy of Sciences, San Francisco, California

Melanochlamys diomedea is a species of gastropod sea slug found in the Pacific coast of North America, eastern Russia, and Japan. Specimens collected recently in San Francisco Bay were found to be genetically distinct from other *M. diomedea* in this region, as well as from other localities in California and the Pacific Northwest. These specimens are also distinct from other *M. diomedea* by examination of the reproductive system morphology, yet externally they are indistinguishable. Since this species of *Melanochlamys* is only found in San Francisco Bay, it is hypothesized to be non-native. Therefore the objective of this project is to determine the origin of this species by comparing it with *M. diomedea* from Japan and other species of *Melanochlamys* from Australia, South Africa and New Zealand.

Historical Anthropogenic Change in Reef Coral and Molluscan Communities in Caribbean Panama

Katie L. Cramer[1] (katie.cramer@gmail.com), Jeremy B.C. Jackson[1], Christopher V. Angioletti[2], Jill Leonard-Pingel[3] and Thomas P. Guilderson[4]

[1]Smithsonian Institution
[2] Scripps Institution of Oceanography- UCSD
[3]University of Chicago
[4]Lawrence Livermore National Laboratory

Caribbean reefs have declined precipitously since the 1980s due to regional episodes of coral bleaching, coral and urchin disease, and algal overgrowth, but the extent of earlier degradation due to localized historical disturbances such as land clearing and overfishing remains unresolved. We analyzed coral and molluscan fossil assemblages from reefs near Bocas del Toro, Panama to construct a timeline of ecological change from the 19th century–present. We report large changes before 1960 in coastal lagoons coincident with extensive deforestation, and after 1960 on offshore reefs. Striking changes include the demise of previously dominant staghorn coral *Acropora cervicornis* and oyster *Dendrostrea frons* that lives attached to gorgonians and staghorn corals. Reductions in bivalve size and simplification of gastropod trophic structure further implicate increasing environmental stress on reefs. Our paleoecological data strongly support the hypothesis that Caribbean reef degradation predates coral bleaching and disease outbreaks linked to anthropogenic climate change.

Distribution, Prevalence and Intensity of *Xenohaliotis californiensis* a Parasite of the Abalone s *Haliotis fulgens and Haliotis corrugata* in the Peninsula of Baja California, México

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Ensenada, Baja California, 22800. México

Withering syndrome (WS) is a lethal disease of abalone species (*Haliotis spp*) caused by *Xenohaliotis californiensis,* a rickettsia-like prokaryote (RLP). This bacterium has been detected in some areas of the Peninsula of Baja California, México by conventional histology, Polymerase Chain Reaction (PCR), and *in situ* hybridization in black abalone (*H. cracherodii*)*,* green abalone (*H. fulgens*), pink abalone (*H. corrugate*), and red abalone (*H. rufescens*) (Cáceres-Martínez et al*.* 2011). However, its presence and distribution in the main fishing zone remains unknown. With the objective of determining the distribution, prevalence and intensity of *X. californiensis* in green abalone and pink abalone in the main production zone of the Peninsula of Baja California, México, samples were taken from seven cooperatives that engage in the commercial capture of abalone. Two samplings were conducted in 2012; the first was directed towards abalone that presented external signs of WS. The second was done randomly from commercial capture. A total of 318 abalone (159 green abalone and 159 pink abalone) were obtained. Each abalone was visually analyzed to record its external appearance. After that, samples from gills; posterior esophagus and rectum were fixed in ethanol for DNA analysis. The remaining digestive gland was fixed in formalin for conventional histology. An average prevalence of 91.8% and an average infection intensity of 258 RLP inclusions per organism were found in green abalone from the first sampling. Pink abalone from this sampling presented an average prevalence of 71.4% and an average infection intensity of 321 RLP inclusions per organism. Green abalone from the second sampling had an average prevalence of 80.7% and an average infection intensity of 75 RLP inclusions per organism. An average prevalence of 47.5% and an average infection intensity of 26.6 RLP inclusions per organism were found in pink abalone from the same sampling. Preliminary PCR analysis shows that detection sensitivity depends on infection intensities as well as tissue analyzed. These results show that *X. californiensis* is widely distributed in the main fishing area and its prevalence and intensity seems to be greater in abalones with external signs of WS than those without those signs. An analysis of these data is provided for its relationship and importance to the fishery.

References

Cáceres-Martínez, J., Vásquez-Yeomans, R., Flores-Saaib, R., 2011. Intracellular prokaryote *Xenohaliotis californiensis* in abalone *Haliotis* spp from Baja California, México. Ciencia Pesquera, 19(2): 5-11.

Parasitic Load of the Eastern Oyster *Crassostrea virginica* in Three Coastal Lagoons of Tabasco, Gulf of México and its Implications for Production

Javier Cuervo Ventura[1], Angel Romero-Rodríguez[1], Jorge Cáceres-Martínez[2,3] (jcaceres@cicese.mx), Rebeca Vásquez-Yeomans[2,3] (vasquezr@isamx.org) and Roberto Cruz-Flores[2] (rocruz@cicese.edu.mx)

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A study on the parasitic load of the Eastern oyster *Crassostrea virginica* was carried out in three coastal lagoons from Tabasco, México (El Largo, El Shisal and Boca Grande). A sample of 30 adult oysters per month was obtained from July 2012 to December 2012. During samplings, salinity (psu), temperature (°C), dissolved oxygen (mg/l) and turbidity (cm), were determined. Oysters were analyzed using conventional histology and specific PCR for *Perkinsus marinus*. Results showed that salinity, temperature and dissolved oxygen follow a similar pattern in the three coastal lagoons; however, turbidity was different. Histological analysis showed the presence of Rickettsia-like prokaryotes, *Ansistrocoma*-like and *Sphenophrya*-like ciliates, *Nematopsis* sp, *Perkinsus marinus*, *Urastoma*-like turbellarians, and the cestode *Tylocephalum* sp. Additionally, some encapsulations of crustaceans and hemocyte infiltration in connective tissue of the digestive gland, were observed. The identity of *P.*

marinus was confirmed by PCR analysis. Parasitic loads were similar in all localities but their intensities were different. *P. marinus* and *Tylocephalum* sp are the most important parasites due their negative effect on the host. Prevalence and intensity values of *P. marinus* indicate that infection remains at subclinical levels and there were no records of unusual mortalities during the study. Prevalence and intensity of *Tylocephalum* sp indicate a major concern in Boca Grande and these values seem to be related to turbidity conditions. These data constitute base line information for the establishment of a sanitary survey and regulation of oyster production in Tabasco.

Determining Black Abalone (*Haliotis cracherodii*) Density and Habitat Availability in Southern California

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Black abalone (*Haliotis cracherodii*) were once abundant in the rocky intertidal zone of southern California, but overfishing and Withering Disease drastically reduced populations on both the mainland and the Channel Islands. In 2009 *Haliotis cracherodii* was listed as an endangered species; the National Marine Fisheries Service is currently creating a federal recovery plan for black abalone. The current geographic range of black abalone is from Point Arena, CA, USA to Bahia Tortugas, México; however, since the mid-1990s, black abalone have been rare south of Point Conception on the California mainland coast. In recent years black abalone populations on the Channel Islands have experienced recruitment, but the current state of black abalone on the southern CA mainland has remained unknown. We are conducting black abalone surveys in rocky intertidal areas from Point Conception to San Diego to determine if recruitment is occurring on the mainland and, if found, to estimate population density. We are also conducting habitat assessment surveys to document the availability of good black abalone habitat. In preliminary surveys, black abalone are present but rare along the southern CA coast. The majority of abalone found are of a similar size class (75–95 mm) and may correspond to a single recruitment pulse. Preliminary habitat assessments indicate some remaining areas with good black abalone habitat. However, other good habitats are dominated by sessile organisms that may prevent abalone recruitment.

Culture and Environment in a Lost Paradise: The Mollusks of Prehistoric Laguna Percebú, Baja California

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Laguna Percebú is a coastal lagoon located south of San Felipe in the upper Gulf of California. Although Percebú is a natural paradise, the lack of potable water and the harsh weather have constrained economic development and have also been the main reasons for the isolation of this region, but perhaps not for any longer. The acquisition of more than 100,000 hectares of beachfront lots by wealthy entrepreneurs and new changes to the Mexican Constitution have opened the door to ambitious tourism developments that will threaten the natural and cultural heritage of what has been called "the world's aquarium."

With this background, archaeological excavations were conducted in the fall of 2012 in Laguna Percebú as part of an INAH rescue project regarding the official permits for the development of the Marina Azul Golf & Resort. The excavations and further analysis of marine faunal remains revealed which resources sustained prehistoric human settlement, and in what proportions.

The data presented here, along with a review of other archaeological reports within the same

region, are intended to deepen the discussion on the availability of the intertidal resources in prehistoric times, how they have likely been affected by anthropogenic and natural forces through time, and the current challenges to mollusks in light of Mexican economical and political scenarios.

Early and Middle Holocene Pearl Oyster fishhooks on Espiritu Santo Island, Baja California Sur

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Recovery and analysis of 43 pearl oyster (*Pinctada mazatlanica*) artifacts and associated shell-processing tools from middle and basal levels of Covacha Babisuri, a rockshelter on Espíritu Santo Island, Baja California Sur, provide evidence of early and middle Holocene fishhook production along the California coast. Accelerator mass spectrometry ^{14}C analysis of a fishhook preform recovered from the lowest stratum of the rockshelter returned a date of 8380 ± 50 radiocarbon years before present (Beta -236254) or 8793–8436 calculated years before present (BP), making this artifact one of the earliest known shell fishhooks in the Americas. An additional pearl oyster artifact was found in a deeper level dating closer to 10,000 BP, suggesting that the fishhook may date to this earlier period.

Name Changes in Northeastern Pacific Dendrodoridídae

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Ten species of dendrodoridids are currently known from the northeastern Pacific Ocean and Gulf of California. Based on a reexamination of the morphological and anatomical evidence, including from materials in the James Lance collection at the California Academy of Sciences, *Dendrodoris behrensi* Millen and Bertsch, 2005 is a junior synonym of *Dendrodoris nigromaculata* (Cockerell in Cockerell and Eliot, 1905), which in turn is the name sometimes erroneously applied to *Doriopsilla rowena* Marcus and Marcus, 1967. Like other members of the genus, *Doriopsilla rowena* has an off-center anus, a densely spiculate dorsum, stiff mantle margin, and dorsal papillae. Its scattered brown flecks and larger concentrations of opaque white (the latter often in a pair of mid-lateral, longitudinal series) distinguish it dorsally, and notal spicules include rods and forks. Its spiculate dorsal papillae are minute. *Dendrodoris nigromaculata* has a centered anus, a smooth dorsum lightly spiculate with rods only, and a delicate wavy mantle edge. It is distinguished by its translucent white to cream ground color and chocolate brown blotches, typically clustered into three or four groups centered along the mid-line, along with smaller, irregular spots of the same dark color scattered toward the edges of the mantle. Both species are small as adults (10 and 20 mm total lengths, respectively) and have ametamorphic direct development. *Doriopsilla rowena* has been found in La Jolla and throughout the Gulf of California south to Costa Rica. *Dendrodoris nigromaculata* is known from the Monterey Peninsula south to the San Benitos Islands, Baja California.

Biomonitoring of *Pteria sterna* (Gould 1851) Under Culture at Two Locations in Bahia de La Paz, Baja California Sur, México

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A study of three biomarkers in *Pteria sterna* cultivated at two locations in the Bay of La Paz, BCS, México was conducted in order to determine the influence of xenobiotics resulting from navigation activities and runoff from the city of La Paz. The frequency of micronuclei (MN) and nuclear aberrations in gill tissue, the activity of the enzyme acetylcholinesterase (AchE) in foot tissue and the lipoperoxidation in gill tissue were determined for *P. sterna* grown from October 2011 to December 2012 in an area of direct anthropogenic influence, La Marina La Paz, and from a commercial culture farm located at Pichilingue. Monthly growth and survival were recorded. Analyses were performed December 2011, June 2012 and December 2012 on 7–15 specimens to determine the activity of AchE, the degree of lipoperoxidation and the frequency of MN. Results indicated that the more sensitive biomarkers in La Marina La Paz were: lipoperoxidation with levels of 9.41 ± 4.73 to 24.7 ± 3.01 mM MDA/mg tissue and frequencies of MN with values of 0.048 ± 0.003 to 0.0117 ± 0.006 and nuclear aberration frequencies of 0.0038 ± 0.004 to 0.0162 ± 0.007; finding differences at 9 months of exposure ($P < 0.05$). In Pichilingue, the biomarker which indicated differences was the activity of the enzyme AchE with 5.33 ± 2.23 to 13.98 ± 3.78 ηM protein actc·min/min·mg 15 months after exposure ($P < 0.05$), the frequencies of MN and nuclear aberrations with 0.0034 ± 00022 to 0.0104 ± 0.0038 and of 0.0041 ± 0.002 to 0.0074 ± .00022 with significant differences after 9 months of exposure ($P < 0.05$). When we compared the results between areas at each date we found differences in December 2011 in frequency of MN ($P < 0.05$) and for December 2012 in the activity of AchE and lipoperoxidation ($P < 0.05$). In June 2012, no differences were found. These differences were associated with storm water drainage in the vicinity of the Bay of La Paz, which occurred in November 2011 and from July to October 2012. Evaluation of biomarkers such as lipoperoxidation and the frequency of MN and nuclear aberrations could be a useful tool to infer the influence of xenobiotics, which generates a stressful situation during storm water flow in the area of Marina La Paz.

Biogeography, Cryptic Diversity and Evolution Within the Sea Slug Genus *Pleurobranchus* (Notaspidea: Pleurobranchidae)

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This study focuses on the Opisthobranch genus *Pleurobranchus*, characterized by an internal shell and a gill exclusively on the right side of the body. Species in this genus are commonly found worldwide, but there is a substantial amount of confusion regarding the ranges and identification of individual species. Difficulties in phylogenetic reconstruction and identification of pleurobranchids using morphological traits has resulted in complex classification schemes, with several species having disjunct ranges across physical and biogeographic barriers (including the tropical Indo-Pacific, the eastern Pacific and the Atlantic). Molecular phylogenies have been constructed using the mitochondrial genes Cytochrome Oxidase 1 (CO1) and 16S and the nuclear gene H3 and morphological data for each species will be included to address these issues. Preliminary data indicate some discrepancies in the current identification of many species in *Pleurobranchus*, and morphological work still needs to be conducted in order to match the previously described species with our molecular phylogeny.

New Insights into Cephalaspidean Evolution: The Phylogeny of the Philinacea (Gastropoda: Opisthobranchia)

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The only previous molecular phylogeny of Philinidae included species from a single clade within *Philine* and with limited outgroup sampling. Recent shallow and deep-water surveys of Indo-Pacific waters in the Philippines provided material for additional study of the diversity and phylogeny of the Philinacea. Anatomical and molecular studies reveal the presence of six additional undescribed taxa. Morphological characters, including anatomical details of the shell, radular morphology, gizzard plates and male and hermaphroditic reproductive systems are entirely congruent with the molecular differences found. Four of these taxa are members of the *Philine aperta* clade, while two taxa are members of a more basal lineage. This study reinforces the view that the diversity of the Indo-Pacific Philinacea still remains incompletely sampled. Both morphological and molecular data support the phylogenetic position of these taxa. The more basal members have small gizzard plates or entirely lack them and have a simple penis, while species in the *Philine aperta* clade have plates with pores or slits and have a complex penis and prostate. In sampling broader outgroup relationships, some members of Philinidae cluster with species of Aglajidae, suggesting that Philinidae, as traditionally constructed, does not constitute a clade, but represents a paraphyletic assemblage. These relationships need to be further studied with more extensive taxon sampling of philinaceans, but are suggestive that further systematic revision is required to develop a classification consistent with the phylogeny of the Philinacea.

Experimental Infection with *Perkinsus marinus* of the Japanese oyster *Crassostrea gigas* Cultured in Bahía de Todos Santos, Ensenada, BC México

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Due to some reports of infections of *Perkinsus marinus* in *Crassostrea gigas* associated with mortalities in Sonora, México, a corroboration of the susceptibility of *C. gigas* to *P. marinus* in laboratory conditions was carried out. Oysters were obtained from an aquaculture facility located in Bahía de Todos Santos, where it is known that *P. marinus* is not present. The parasite was obtained from the pleasure oyster *Crassostrea corteziensis* from Nayarit where the parasite is well established. The parasite was induced to the hypnospore stage using thioglycollate medium and separated from the oyster tissue by filtration and centrifugation. Twenty adult oysters (11 ± 3 cm, shell length) were infected with 400 hypnospores per oyster (400/150 µl), injected directly into the adductor muscle. As a control, 20 were injected with sterile seawater. The oysters were kept per duplicate in aquariums of 40 L, 10 oysters per aquarium, with constant aeration. Oysters were fed with microalgae paste (Isochrysis 1800) and maintained at room temperature (23 ± 2°C). Oysters were sacrificed (subsampled) at 15, 68 and 95 days. Polymerase chain reaction (PCR), histology and tissue incubation in thioglycollate were used to follow the infection. The parasite was detected in only one of the infected oysters after 95 days by incubation of tissue in thioglycollate medium. The results corroborate that *C. gigas* has a defense mechanism that prevents the proliferation of the parasite or even avoids infection at low doses. These results and previously known information about the resistance of *C. gigas* to *P. marinus*, invite us to be especially cautious in associating Japanese oyster mass mortalities with the possible presence of this parasite.

Limited Genetic Variability in *Cornu aspersum* (= *Helix aspersa*), Historically Introduced Brown Garden Snails, at Nearby and Distant Sites Around San Francisco Bay

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European brown garden snails (*Cornu aspersum* = *Helix aspersa*) reportedly were introduced to California, from Europe, in ~1850. These common pulmonate snails have been significant pest species for agriculture and ornamental plants, and have been eradicated from parts of Florida. Comparing variable segments of DNA among individual specimens, we hypothesized that these snails would show more similar genetics in close proximity, within 10 or 500 m, or on the island of Alameda in San Francisco Bay, compared with sites across San Francisco Bay, > 100 km distant along the Bay shore.

One of the two sequenced segments of DNA, the gene for mitochondrial Cytochrome B, showed almost no differences among the > 40 individuals sampled. But the mitochondrial 16s rRNA gene showed two well supported clades, one common and one rare. The common clade included many snails with identical sequences, plus another group with similar but not identical sequences.

However, no clear association with location appeared in any these sequences. Even identical sequences were shared among each of the locations, and the clades did not tend to be tied to particular sites, far nor near from other sampled sites.

Even on the island of Alameda (connected to the mainland by three short bridges plus a tunnel) DNA appeared just as similar to the other sites as it was to individuals within ~100 meters. Similarly, specimens from within 10 meters of each other showed no extra similarity in their DNA. These snails appear to be well mixed, genetically, among sites, but may be generally less variable than are many other populations, or this snail species in its native Europe. The latter results suggest few successful introductions/source populations for this now-common species around San Francisco Bay. Such few introductions of a species might be halted more easily, even in the future, than if multiple introductions and multiple sources were typical.

Affinities Between Mollusks and Physiographic Features in the Gulf of California and the Western Mediterranean Sea

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The Gulf of California and the Mediterranean Sea are ecosystems considered as spots of high marine biodiversity. Both regions are comparable from various physiographical and climatic perspectives. Both are enclosed seas characterized by a negative hydrological balance derived from high evaporation rates that are partially offset by the inflow of surface oceanic currents and, to a lesser extent, by precipitation and freshwater discharges from rivers; as a result, these seas are saltier than oceans. The Gulf of California, however, has a broad communication with the Pacific Ocean and is bordered by the coasts of a single country (México), in contrast with the Western Mediterranean, which connects with the Atlantic Ocean through the Gibraltar Strait and involves the territories of six countries (Spain, France, Italy, Tunisia, Algeria and Morocco), which share a complex centuries-long history of coastal settlements and exploitation of marine resources. These two basins are regarded as having a high biological diversity and share a similar number of marine mollusk species (2113/2193). It is worth noting that, when the surfaces covered by these basins are compared, the Gulf concentrates this high biodiversity within a small area. Furthermore, considering that studies focused on the Gulf of California are scarce, it is estimated that the number of faunal records in the area will double as investigative works progress. Of the 293 families of marine mollusks reported in the literature reviewed for both basins, at least 120 share between one and four genera. This study aims to compare the Mediterranean Sea and the Gulf of California in terms of physiographic features, the diversity of mollusks inhabiting both basins by

family, genera and number of species represented, and the role of these organisms as commercially exploited fisheries.

Additions to the Middle Pleistocene Marine Record of Downtown San Diego, Southern California

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Pleistocene marine invertebrate assemblages older than those of the ~120,000 year old Bay Point Formation (*s.s.*) were first recognized in the downtown area of San Diego in 1981. The composite assemblages were referred to as the "Broadway fauna." Subsequently, the faunas, which had distinctive assemblages, were shown to represent two distinct periods of deposition and correlated with the interglacial sea level highstands that occurred about 330,000 and 405,000 years before present, during marine oxygen isotope Stages 9 and 11, respectively. Continuing construction activities in downtown San Diego in the ten years since 2003, when the first results were presented, have greatly increased our knowledge of the diversity and distribution of the "upper" and "lower Broadway" faunas.

Evaluating Human Impacts on Coastal Ecosystems Using Dead Shell Assemblages and Very Young Fossil Records

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Human impacts on coastal ecosystems are increasingly well appreciated by both professionals and the public; these stresses include sediment and nutrient runoff, harvesting of fin- and shell-fish, the introduction of alien species, and industrial pollution. However, it is difficult to assess mitigation and restoration efforts without knowing what these coastal systems looked like under fully natural conditions: in most regions the collection of quantitative data on seafloor communities began only the 1970s. This symposium describes some of the ways that paleontologists and geologists are using present -day dead-shell assemblages – such as you would gather from a beach or sieve from a seafloor grab-sample -- and very young fossil records (cored from the top ~meter of the sedimentary record) to test for recent ecological changes, evaluate human versus natural drivers of those changes, and, in some instances, reveal pre-human conditions that can inform recovery efforts. Here, I'll explain our confidence in molluscan death assemblages – this arises from many 'live-dead' comparisons conducted around the world and from geological age-dating of individual shells, and establishes that death assemblages are time-averaged summaries of local living populations. These data plus new information taking advantage of wastewater input to the urban continental shelf of southern California show that dead shell assemblages can detect km-scale environmental gradients and retain a memory of decadal-scale change in community composition, despite the perils of shell preservation. I will also describe the design of a new core-based project that will test how, if at all, the temporal acuity and biological fidelity of shell assemblages are modified with burial, using southern California as a test case.

References

Kidwell, S.M., 2001. Preservation of species abundance in marine death assemblages. Science 294: 1091-1094

Kidwell, S.M. 2007. Discordance between living and death assemblages as evidence for anthropogenic ecological change. Proc. Nat. Aced. Sci. USS. 104(45): 17701-17706

Kidwell, S.M. 2013. Time-averaging and fidelity of modern death assemblages: Building a taphonomic foundation for conservation paleobiology. Paleontology 44

Will the Real *Gymnodoris alba* Please Stand Up? Systematics and Taxonomy of the Nudibranch Genus *Gymnodoris*

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Gymnodoris is a unique genus of dorid nudibranchs consisting mostly of opisthobranch predators, including cannibals and one species that feeds on the fins of goby fishes. Originally established by Stimpson in 1855, the genus today contains approximately 35 described species distributed throughout the Indo-West Pacific. Many of these are older descriptions with insufficient details to associate names with living specimens, and overall the group is a taxonomic mess in need of review and synthesis. Preliminary sampling indicates that *Gymnodoris* is far more diverse than what the existing literature suggests, a truly taxonomically neglected group with tens of undescribed species. Based on the molecular mitochondrial markers 16S, cytochrome oxidase subunit I (COI) and the nuclear markers histone 3 (H3) and 28S, we present a preliminary phylogeny and discuss some of the challenges in the taxonomy of this group. Ultimately, a phylogeny of *Gymnodoris* will bring more attention to this previously neglected clade of nudibranchs and serve to help us understand the evolution of the specialization of feeding in this group.

Density and Genera Richness of Native Gastropods and the Occurrence of the Invasive New Zealand Mud Snail (*Potamopyrgus antipodarum*) in the Lower Snake River and Three Tributaries

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The New Zealand mud snail, *Potamopyrgus antipodarum*, is an invasive gastropod that can impact native gastropods in the United States. However, limited knowledge on the native snail community prior to invasion by *P. antipodarum* makes assessing these impacts difficult. A baseline survey was conducted to determine the density and genera richness of gastropods in four rivers near Lewiston, Idaho that are downstream of the current invasion area of *P. antipodarum*. We hand-collected gastropods from rocks in quarter meter plots and collected data on abiotic factors and periphyton biomass for each site.

A total of nine genera from five families were found among the fifteen sites surveyed including *P. antipodarum*. Sites ranged from zero to seven genera of gastropods with a mean gastropod richness of 2.9 genera per site. Average site densities ranged from zero to 625.3 snails per m^2 with the highest river mean density found in the Grand Ronde River with 251.7 gastropods per m^2. *P. antipodarum* was found at low densities (less than one snail per m^2) at two adjacent sites. Gastropod density was positively correlated with ash free dry mass ($p = 0.002$) and calcium ion concentration ($p = 0.008$) and accounted for 54.8% of the variation in gastropod density among sites ($p = 0.003$, $F = 9.488$, $r^2 = 0.548$). Temperature ($p = 0.001$), pH ($p = 0.016$), chlorophyll *a* ($p < 0.001$) and calcium ion concentrations ($p = 0.002$) were significantly different among rivers and may account for differences in gastropod density between rivers.

Changes in Bivalve Communities on the Palos Verdes Shelf Before and After the Clean Water Act Based on Sediment Cores

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Nutrient pollution has varied greatly over the past century in southern California's coastal ocean, increasing with urbanization and then decreasing since enactment of the Clean Water Act (CWA) in 1972. Monitoring efforts starting about then document significant increases in macrobenthic species richness with improved water treatment, but it is difficult to evaluate whether benthic communities have fully recovered in the absence of pre-CWA observations. We are using newly acquired sediment cores of the Palos Verdes shelf (Line 10) to test whether shells extracted from successive down-core increments can detect: (1) known changes in bivalve assemblages since the CWA, (2) presumed deterioration of ecological conditions leading up to that point, (3) the composition of fully "natural", pre-urban communities, to serve as restoration targets. Preliminary data show that bivalve species richness has changed little through time, but the relative abundances of key bivalve species and overall nature of communities have changed significantly, concordant with known history. The pollution-tolerant lucinid bivalve *Parvilucina* peaks in relative abundance at 10 cm sediment depth, whereas less pollution-tolerant nuculanid bivalves show abundance lows there; nuculanids dominate death assemblages both in the core top and at deeper levels. In the deepest core levels, suspension-feeding infauna (*Nemocardium*, *Compsomyax*) and epifauna (*Leptopecten*) dominate, implying that pre-urban seafloors had less mud, less nutrients, and more holdfasts than today. Although absolute age-dating is only now getting underway, these results indicate that bivalve death assemblages are correctly tracking known changes in benthic communities, and thus that fuller down-core analyses will provide us with robust data on pre-urban seafloor conditions.

Using Stylets from Permanent Preparations for Age Determination in *Octopus hubbsorum*

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The stylets are two paired structures that are inside the mantle of the octopuses at the height of the gills. These have been recently used for direct age determination by counting growth increments. However, one of the main problems with these structures is to make permanent preparations.

The octopus fishery in the Mexican Pacific is mainly represented by *Octopus hubbsorum*. In this study, monthly samples of this species were taken from 2011 to 2012 from the artisanal fishery in Puerto Ángel, Oaxaca, México. The octopuses were measured, sex and maturity stage were established, and stylets were removed and stored in 70% ethanol. Using a stereoscopic microscope with a micro-metric ocular, measurements of each stylet were made for the following parameters: rostral length (RL), post-rostral length (PRL), maximum width (MW) and total length of the stylet (TLS). Following the methodology of Barrat & Allcock (2010), permanent preparations were made in triplicate of 20 stylets belonging to maturity stages I, II, III, and IV for males and I, II, III, IV and V for females. Subsequently, pictures were taken of the preparations viewed at 10x and 20x, and counts were made three different times by the same reader without knowing the sex or maturity stage. To corroborate the counts, estimates were made of the average percent error for each stylet (APE), the index of average percent error for all stylets (IAPE), the coefficient of variation (CV) and the precision index for each stylet (D).

Mantle length (ML) ranged from 50 to 90 mm, while total length (TL) ranged from 220 to 790 mm and total weight (TW) ranged from 87 to 1750 g. The length-weight relationship in terms of LT-TW more adequately explained the variability in the observed data ($R^2 = 0.75$) than the relationship in ML-TW. Indirect estimated growth by coefficients from these equations showed negative allometric growth in both cases ($b < 3$). Between all stylets and octopuses measured there was a positive

correlation. However, TW had the greatest correlation value with the four stylet measurements ($\rho < 0.7$). According to the multivariate analysis of variance, all the measurements showed significant differences ($p < 0.05$) by sex and by stages of maturity, but not by the interaction of the two variables. Including replicates from the same stylets, twenty-three permanent preparations were the most adequate for reading. Excluding replicates, these preparations belonged to fourteen different organisms: two female I, one female II, two female IV, two female V, two male II, one male III and four male IV. The interval for APE was from 1.22 to 10.27%, CV was from 15.94% to 30.58% and D was from 0.092 to 0.187. The total CV for the 23 preparations was 28.32% and IAPE was 4.05%. For almost all the preparations with replicates, the differences between the mean age was less than 10, but in three preparations the maximum differences were 15, 27 and 61 rings. With these values, it is possible to say that the technique is adequate to count growth increments in the stylets, but one of the main problems is to count the first several increments near the pre-hatch core.

Validation of Housekeeping Genes as Internal Controls for Expression of Sex-Specific Genes in the Red Abalone *Haliotis rufescens*

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The red abalone *Haliotis rufescens* is the most important species for aquaculture in Baja California, and despite this few studies on reproduction and induction of maturation to the transcriptomic level have been performed. In this sense, reverse transcription and quantitative polymerase chain reaction are two powerful tools for the analysis of gene expression in different fields of aquaculture. However, for reliable analysis it is necessary to identify and validate housekeeping genes that permit suitable normalization of the genes of interest, which in our case are related to gonadal tissue. Therefore, nine housekeeping genes (ACTB, BGLU, TUBB, CY, GAPDH, HPRTI, RPL5, SDHA and UBC) were evaluated in different tissues of the red abalone (gonad, gill, cephalic tentacle, mixture of all three tissues and mix gonads). The evaluation of the standard curve using serial dilutions of cDNA (100, 25, 6.25 and 1.56 ng cDNA/reaction) showed efficiencies for these genes between 0.95 and 0.99 with $r^2 = 0.99$. The analysis performed with geNorm and NormFinder showed that RPL5 and CY were the most stable genes considering all tissues. However, for the mixture of gonads, RPL5 and TUBB were the most stable with geNorm, whereas SDHA and HPRTI were with NormFinder. Furthermore, the analysis with BestKeeper revealed that through all tissues CY and GAPDH were the most stable genes. Based on these previous results, we selected RPL5 as a candidate for an internal control. The variability analysis using RPL5, gonadal tissue and the RotorGene 6000 thermal cycler (Corbett Research) indicated high repeatability intra-assay and inter-assay with a standard deviation of 0.09 and 0.24, respectively. Also, the coefficient of variation intra-assay was 0.58% and 1.63% inter-assay. In conclusion, RPL5 was the most suitable housekeeping gene to be used as an internal control in expression studies with gonadal tissue from the red abalone.

Molecular Reevaluation of the Phylogenetic Position of the Enigmatic Species *Tritonia papalotla* Bertsch et al. 2009 (Mollusca: Nudibranchia)

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Tritoniidae (Nudibranchia: Cladobranchia: Dendronotidae) is a group of benthic sea slugs known to feed on a variety of octocorals, including soft corals, gorgonians and sea pens. The taxonomy of the Tritoniidae has long been mired in controversy, in large part due to a lack of standardization regarding

use of morphological traits (both external and internal) in estimation of evolutionary relationships between established species and newly discovered ones. *Tritonia papalotla* is a recently described species found in Baja California and mainland México that is unusual in its morphology and feeding behavior. It is the first tritoniid nudibranch found feeding on a zoanthid anthozoan, an undescribed species of the genus *Epizoanthus*. *Tritonia papalotla* also has retractable respiratory structures, prominent dorsal vessels and several other traits not found in any other species within the Tritoniidae. In the current literature these unique features of *T. papalotla* are considered autoapomorphies, and the species has been tentatively placed within *Tritonia* based on a morphological phylogenetic analysis. The purpose of the present study is to test the phylogenetic placement of *Tritonia papalotla* within Tritoniidae based on molecular data. Constructed phylogenies show *T. papalotla* as separate from *Tritonia*, which is monophyletic with a high support value. *Tritonia papalotla* appears to be separate from tritoniids, and the unique external and internal morphological traits identified in the literature could be viewed as support for what the molecular data are saying.

It's a Small, Small World in Bali, Indonesia!

Michael D. Miller

Video presentation of recent trip to the enchanted sea slug island of Bali! Video will focus on the world of slugs that few divers ever see. Taking images of slugs that are 5 mm or less is a real challenge for still photographers, so you can guess what the videographer is up against.

The Case of the Missing Slug

Michael D. Miller

A video presentation on the continuing investigation as to why *Felimare (Hypselodoris) californiensis* has virtually disappeared off the California coast.

Holoplanktonic Mollusks of the Mexican Pacific and its Surroundings: A Review

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Holoplanktonic gastropods are members of the superfamily Pterotracheoidea (Heteropods), and the clades Thecosomata and Gymnosomata (Pteropods). They are found worldwide, mainly in tropical and subtropical waters, as important components of the food chain and it has been observed that shelled holoplanktonic mollusks contribute significantly to the carbon cycle. In the eastern Pacific there are few studies regarding the distribution and abundance of these organisms. Nevertheless, there are records of

29 species of heteropods, 31 thecosomes and 13 gymnosomes from San Francisco, USA, to Costa Rica's Pacific coast, which represent 78%, 55%, and 72%, respectively, of the world records. With our most recent studies done in México, there are 6 new records for the American Pacific, 55 range extensions and 3 new species. These findings change the status of at least three species often considered as indicators of water masses: *Limacina helicina* (polar and subpolar waters), *Carinaria japonica* and *Atlanta californiensis* (California Current). Despite what earlier studies thought about their distribution being related to water temperature and salinity, we observed that it is also determined by the topography and hydrography of the area, as well as food availability.

Rotating Fishing Areas for the Black Ark in the Ensenada de La Paz, Baja California Sur, México

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In order to explore the potential strategy of rotating fishing areas for the black or pustulose ark, *Anadara tuberculosa* (Sowerby 1833), an experiment to estimate density recovery after intensive fishing was performed in two mangrove swamps, El Conchalito and El Mogote, at Ensenada de La Paz, México. In each swamp, one fishing and one repopulation area were delimited. Black ark density (individuals m^{-2}) in each area was estimated between October and November 2010 and from February 2011 through April 2013. Seven sample areas were examined in each zone to record ark densities as well as sizes of individuals. Average density at El Conchalito was 1.05 individuals m^{-2} (± 0.21 s.d.) with a minimum of 0.70 individuals m^{-2} and a maximum of 1.30 individuals m^{-2}. The effect of fishing was clearly observed during the first and second bimonthly periods with densities of 0.93 individuals m^{-2}. Recovery to near initial density levels (1.3 individuals m^{-2}) took seven months. At El Mogote, average density was 1.52 individuals m^{-2} (± 0.71 s.d.), with a minimum of 0.76 individuals m^{-2} and a maximum of 2.52 individuals m^{-2}. The effect of fishing was also evident with values of 0.8 individuals m^{-2} in the following ten months; recovery of initial density levels (around 2.0 individuals m^{-2}) took eighteen months. At the repopulation areas, densities increased from 0.83 to 1.32 individuals m^{-2} in El Conchalito and ranged from 1.0 to 3.0 individuals m^{-2} in El Mogote. Length frequency analyses of black ark showed a decrease in the number of large individuals and the recruitment of smaller ones during the winter months. However, the cause of this is not well understood as black ark reproduction and recruitment behavior is not well known.

Population Genetic Analysis of the Red Abalone Cultured in Baja California Using Microsatellites Derived from Next Generation Sequencing

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The red abalone is the most important cultured abalone in México. At present there is no breeding program. In order to set the basis for a selective breeding program it is necessary to estimate the available genetic variability at the abalone farms. We use microsatellites derived from pyrosequencing (next generation sequencing) in order to estimate the genetic variability of three cultured populations in México and compared them with a cultured population from Chile. Although a higher genetic variability was found in Mexican populations than in the Chilean population, these variability values were low in comparison with wild abalones. We show the population genetic analysis and

propose probable bases for a genetic breeding program in México.

Late Holocene Shell Midden La Jovita, Baja California: Mollusk Exploitation from $\delta^{18}O$ Isotopic Records

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Coastal shell middens are the most common archaeological feature in Baja California. Molluscan composition and abundance provide a valuable source of information on the subsistence strategies, ecological changes and environment where ancient humans lived. In addition, mollusk shell growth lines provide a climatic archive of physical and chemical conditions of the surrounding waters, such as temperature and salinity. Geochemical methods, mainly oxygen isotopes, are a new approach used for climatic trends assessment and determinations of prehistoric seasonal shellfish collecting. Accordingly, short-lived bivalve growth lines are faithful monitors of paleoweather extremes. At the prehistoric late Holocene archaeological site La Jovita, in northern Baja California, shellfish collecting was an important subsistence activity focused on three intertidal species: *Mytilus californianus, Lottia gigantea* and *Haliotis cracherodii,* whose exploitation was variable across the stratigraphic profile, but preferably on *M. californianus*. Isotope analysis on *Mytilus californianus* shell´s edge was used to evaluate if aboriginal people exploited marine coastal resources seasonally. $\delta^{18}O$ results show a wide range of values, ranging from -0.10‰ to 1.46‰, suggesting that molluscan collecting probably occurred all year round.

The *Doto coronata* Species Complex, Elongate *Dotos*, and the Molecular Systematics of the Dotidae

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The nudibranch family Dotidae requires substantial taxonomic and systematic work. It contains an unknown number of cryptic species complexes, many undescribed species, and is unassigned to a higher clade. This is the first molecular systematic study for this family and encompasses 28 taxa from the North Atlantic and 29 from the Indo-Pacific. The mitochondrial genes, 16S, COI, and the nuclear gene, H3, were sequenced for 50 individuals and Bayesian and RaxML concatenated analyses were run. The Dotidae is monophyletic, with the elongate Indo-Pacific taxa forming a basal clade. Seventeen out of the 29 Indo-Pacific taxa are distinct species based on their COI pairwise distances and sixteen of these are undescribed. Contrary to the cryptic complexes observed in the North Atlantic, some of the undescribed Indo-Pacific species exhibit more than one color morph. Individuals within the *D. coronata* complex were incorporated since this species represents the type species for the genus *Doto*. Based on the molecular data, there are three separate species given the name *D. coronata*. The first is amphi-Atlantic and the second contains three individuals with the names *D. dunnei*, *D. millbayana*, and *D. coronata*, collected from three different hydroids. The third is a specimen collected from South Africa.

Genotoxic Effects of Cadmium, Chromium and Lead on Japanese Oyster (*Crassostrea gigas)* Larvae

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The Japanese oyster is an introduced species that grows in the Mexican Pacific coastal systems. Because of its economic importance we performed an evaluation of the genotoxic effects of the metals: cadmium (Cd), chromium (Cr) and lead (Pb) on Japanase oyster larvae. Bioassays, lasting 72 hours, were carried out with five concentrations of each metal and its mixture (1:1). Lethal concentration 50 (LC_{50}) were determined in the assays, and an evaluation of genetic damage was performed on surviving organisms by means of a unicellular electrophoresis technique (comet assay) on a tissue sample. For this analysis, the frequency of cells with damage (tails) as well as their lengths were calculated on samples of 300 to 500 cells. The toxicity of metals and its mixture, based on the LC_{50} calculated was (high to low effect): Cd > Cr > Pb. The Kruskal-Wallis test indicated that significant differences exist between the level of DNA damage in organisms exposed to different metals and the control. The metal with major genotoxic effect was cadmium followed by chromium. Lead showed the lowest genotoxic effect. It is important to continue research and monitoring to detect responses that indicate possible damage to oyster populations by the action of different stressors, to prevent irreversible deterioration of the stocks in the medium and long term.

Oxidative Stress as a Tool to Assess Aquatic Heavy Metals Contamination Using the Catarina Clam: *Argopecten ventricosus* (Sowerby 1842)

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The Catarina scallop is an important fishery resource in the State of Baja California Sur, México, where 95% of national production is obtained. Since the 1970s, the fishery has declined up to 86%, apparently caused by over exploitation. Due to a lack of environmental studies related to any alternative cause, we initiated this study to examine oxidative stress on the gill tissue of Catarina scallops in the presence of toxic substances and evaluate the use this biomarker as a reliable tool in environmental biomonitoring studies. Adult clams (5.0 ± 0.5 cm) from the UABCS aquaculture were collected in summer and winter during 1998, 1999 and 2000 in the bed located near Pichilingue Harbor. Gill tissue samples were disintegrated and oxidative stress was determined as malondialdehyde (MDA) concentrations. For each sampling period 15 to 20 specimens were analyzed. The results indicated that significant differences exist in the oxidative stress between the organisms collected in summer versus winter. The organisms collected in summer of 1998 presented a higher grade lipid peroxidation (42.7 nM MDA) in comparison with those obtained in winter of 2000 (9.07 nM MDA). These results correspond with the pollutant levels observed where the clams were collected, since the highest concentrations of heavy metals occurred in summer. It is evident that this biomarker is a good tool in environmental biomonitoring studies.

Community Structure of Soft-Bottom Mollusks at Isla San Francisco, Gulf of California, México

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We analyzed the composition and community structure of soft-bottom mollusks of Isla San Francisco (24°48' N, 110° 34' W) and its possible relation to some environmental variables. We selected 18 sampling sites during the summer of 2012 and collected 36 samples, 18 biological samples and 18 sediment samples. Temperature, depth, sediment type, and organic matter were used as environmental indicators. Ecological descriptors included the abundance and diversity of the malacological benthic community. In total, 2773 specimens were collected belonging to 35 species of bivalve distributed in 12 families and 5 orders. The gastropods were the most represented group with 44 species distributed in 25 families and 6 orders. The highest values of richness and abundance were found south of the island in shallow water with carbonate coarse sand. The most abundant bivalves were *Tellina eburnea* with an average size of 5 mm, followed in importance by *Gari helenae*. The most abundant gastropod was the micromollusk *Cystiscus politulus*. The species with the highest frequency of occurrence (≥ 50%) were: *Laevicardium substriatum* (58%), *Crepidula aculeata* (58%), *Gari helenae* (50%) and *Lucina undatoides* (50%). The mean diversity index was 2.7 bits/individual Evenness was high (> 0.8) in most of the sample sites with the minimum value of 0.65 influenced by the abundance of the bivalve *Tellina eburnea,* the dominant species. We found a strong association of mollusks with deposits of calcareous algae, pieces of coral and echinoderms.

Mollusks of Mission Bay, San Diego, California

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Mission Bay was established as an aquatic park by the city of San Diego in the late 1940s. Modifications to the marine habitat have significantly increased both bivalve and gastropod diversity. Currently 192 species have been identified in the Bay and based on sampling efforts it is believed that the numbers of both Polyplacophora and Opisthobranchia are under-estimated. A total of 122 species of gastropods, 63 bivalves, 1 cephalopod, and 6 Polyplacophora were identified. Panamic species include *Anadara multicostata, Barbatia reeveana, Spathochlamys vestalis, Pteria sterna, Laevicardium* sp*, Mexacanthina lugubris,* and *Mitra fultoni*. Unique local species include *Latiaxis oldroydi, Forreria belcheri, Pteropurpura trialata, Mitra catalinae, Mitra idae, Simnia barbarensis, Bursa californica,* and multiple species of *Haliotis*. Only three invasive species were found: *Crassostrea gigas, Musculista stenhousia,* and *Venerupis philippinarum.* For information regarding the habitat, depth, and abundance of each species see: Tuskes, P. 2012. Survey of Mission Bay Mollusks, San Diego, California. The Festivus, XLIV(2): 14–19.

Mexican Pacific Cephalopods: A First Approach

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The class Cephalopoda contains 43 families and its richness is evaluated at between 650 and 1000 species (Jereb and Roper 2005). Since the 1950s, a huge effort to better know this group has been made worldwide, focusing mainly on commercial species (Roper et al. 1984). The first global analysis of this group of mollusks was performed in 1973, but it soon became obsolete because of sustained growth in the cephalopod fishery, the availability of numerous new records, and the description of new species (Voss 1973, Roper et al. 1983). Recent contributions have pointed out the need for an extensive review of Mexican cephalopods (see López-Urirate et al. 2005). As in other regions of the world, most works in

the Mexican Pacific have been aimed at aspects directly related to fisheries (Sánchez, 2003), to selected species (Alejo-Plata et al. 2009) or to Gulf of California species (Zamorano and Hendrickx 2011). As a general rule, the deep-water cephalopod fauna is poorly studied (Zamorano and Hendrickx 2009) and most studies made during the last decade were generally motivated by the shift of fishery activities from shallow coastal waters to deep-water habitats (Landsell and Young 2006). The aim of this study is to generate a base line analysis for Cephalopoda including aspects related to their taxonomy, systematics and zoogeography in Mexican waters. The first part of this study is to elaborate a check list of the Mexican Pacific species using three major information sources: bibliography, biological collections and recent field collections. As a result of this effort, 621 records belonging to 144 species were compiled. North American collections contain most of the available records. The genera *Octopus*, *Loligo* and *Argonauta* are the most common. The northern part of México (the Baja California Peninsula and the Gulf of California, including the area off Sinaloa) is the most studied area. In most cases, however, a large proportion of samples deposited in collections have not been properly identified.

References

Alejo-Plata, M. del C., Gómez-Márquez, J. L., Carrillo, S. R. and J. E. H. Galindo. 2009. Reproducción, dieta y pesquería del pulpo *Octopus (Octopus) hubbsorum* (Mollusca: Cephalopoda) en la costa de Oaxaca, México. Revista Biología Tropical, 57: 63-78.

Lansdell, M. and J. Young. 2006. Pelagic cephalopods from eastern Australia: species composition, horizontal and vertical distribution determined from the diets of pelagic fishes. Reviews in Fish Biology and Fisheries, 17(2-3): 125-138.

López-Uriarte, E., E. Ríos-Jara and M. Pérez-Peña. 2005. Range extension for *Octopus hubbsorum* (Mollusca: Octopodidae) in mexican Pacific. Bulletin of Marine Science, 77(2): 171-175.

Jereb, P. and C.F.E. Roper. 2005. Cephalopods of the world an annotated and illustrated catallogue of cephalopods species known to Date. Volume 1. Chambered Nautiluses and Sepioids (Nautilidae, Sepiidae, Sepiolidae, Sepiadariidae, Idiosepiidae and Spirulidae). FAO-ONU. Roma, Italia, 270 pp.

Roper, C.L., M. J. Sweeney and C.E. Nauen. 1984. Species Catalog. Vol 3. Cephalopods of the world. An Annotated and Illustrated Catalogue of species of interest to fisheries. FAO Fisheries Synopsis.

Sánchez, P. 2003. Cephalopods from off the Pacific coast of México: Biological aspects of the most abundant species. Scientia Marina, 67(1): 81-90.

Voss, G.L. 1973. Cephalopod resources of the world. FAO Fisheries Circircular. 149: 75 pp.

Zamorano, P. and M. Hendrickx. 2009. Análisis latitudinal y batimétrico de la comunidad de moluscos de mar profundo en el Golfo de California, México. Brenesia, 71-72: 41-54.

Zamorano, P. and M. Hendrickx. 2011. State of knowledge about the community of mollusks on both sides of the Baja California Peninsula, México: A comparative analysis. Cahiers de Biologie Marine, 52: 13-22.

With a Little Help from Our Friends…
Three Years of an Optional Course on Malacology: A Critical Review

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In 2008, three undergraduate and two graduate students accepted the challenge proposed by an

academic advisor to design an optional course on Malacology and fight for it to be opened as part of the curriculum of the degree in Biology offered by the Facultad de Ciencias of the Universidad Nacional Autónoma de México (UNAM). In 2010, after two years of bureaucracy, the course was approved and started with 25 students officially enrolled. From the earliest days, the Laboratory of Malacology of the Instituto de Ciencias del Mar y Limnología, UNAM and the Colección Malacológica of Dr. Antonio Garcia-Cubas (COMA) deposited there became the operations center and the source of study materials for the course members, respectively.

In this period, the group has received six awards for papers presented at national and international conferences, five students have completed their graduate theses and dissertations, and a similar number is now in preparation. The group members have participated, so far, in four meetings in which we presented 10 oral papers and five posters.

To date, we have conducted six semester courses integrating teaching and research on mollusks. We have developed innovative teaching methods for Malacology, asking students to design a research project that would be presented to their classmates and applied during the field practice we schedule for them during each six-month period. This exercise has been very successful, helping to promote scientific creativity and interest in the study of mollusks that sometimes has resulted in thesis topics.

Today, however, we believe it is necessary to review the course content, the literature and the methods used in the laboratory and field practices. So, in the forum of this meeting, the Malacology teaching staff and the academic advisor want to show the results of three years of work to our colleagues, Malacologists, to receive their opinions, suggestions and academic criticism.

Alien Sea Slugs and Ecosystem Change

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Several species of sea slugs have become invasive worldwide having various ecological and economic impacts. Our lab has investigated the population genetics of two recent invasions in Mediterranean Sea: *Aplysia dactylomela* and *Haminoea japonica*. Both cases involve the rapid range expansion of non-native species in costal ecosystems, but the similarities end here. *Aplysia dactylomela* is a conspicuous species, easy to identify and its spread into the Mediterranean is well documented. On the contrary, *H. japonica* is morphologically similar to other native species and its spread remained largely undetected until molecular data became available. Our research has revealed that *H. japonica* has spread through human-mediated vectors, but *A. dactylomela* has dispersed naturally into the Mediterranean for unknown reasons. We hypothesize that recent ecological changes in the Mediterranean have facilitated both invasion processes.

Bivalvian Triptych: Bivalve Seashells of Western South America

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The marine bivalve mollusks from Arctic Alaska, U.S.A., to northern Perú have been the subject of our two previously published books. We have begun research on a third eastern Pacific Ocean bivalve monograph, to be entitled *Bivalve Seashells of Western South America*. The study region originates at Punta Aguja, Piura, Perú (5.8°S), and continues south to the southern tip of Isla Chiloé, Los Lagos, Chile

(43.4°S). As with the previous monographs, we will cover species that occur from the intertidal zone to the deep sea.

As we have reviewed the literature for the Perú-Chile Province, we have noted a marked decrease in bivalve diversity compared with similar northern latitudes. In the Alaskan, Oregonian and Californian Provinces, we have documented over 470 bivalve species, in the Panamic Province 892 species, whereas we currently only have records for 217 species from the Perú-Chile Province. The decrease in the number of species present in the southern region may be a function of under-sampling, or may represent a much lower diversity, or a combination of both factors.

Historical Benthic Assemblages Support Both Stability and Moderate Ecological Change in Nearshore Environments in Newport, Oregon

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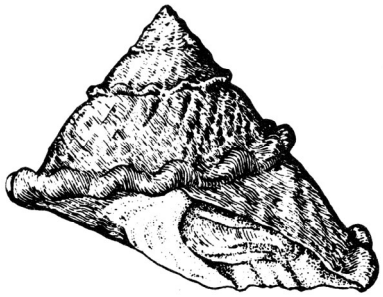
Historical baselines allow us to understand the change and variation in modern day environments. Where it exists, long-term monitoring or historical observations provide these baseline data. However, where historical data are lacking, workers may have trouble discerning significant changes from existing long-term variation in modern living assemblages (LAs). A possible source for historical data is death assemblages (DAs), the dead remains of formerly living communities, which can provide reference conditions for various species. To test this baseline in soft-bottom marine habitats, we compared bivalves of modern LAs to historical DAs in Newport, Oregon. Modern and historical samples are strongly and positively correlated in the community traits of taxonomic composition and rank abundance structure across all depths but are strongest at deeper sites. DAs represented good historical baselines when we could eliminate possible biases from sampling or taphonomy and identify results driven by time averaging. While sampling and taphonomic biases do exist, they are not found consistently across all samples and do not erase depth gradients recorded by historical samples. Depth gradients represent a taxonomic shift at 50 m, which correlates with local dominant storm wave base. Additional results include: taxa proportionally more abundant dead than alive at shallow depths (Mactridae, Veneridae, and Thyasiridae) and consistently poor live-dead concordance at a known dump-site. We conclude that historical samples suggest ecological stability at 60–70 m and moderate ecological change at 30–50 m. Moderate changes at shallower depths could reflect a deep-water refugium, predation by sea ducks or dungeness crabs, or exposure of fossil material.



Contributed Paper

On Some Uses and Trade Routes of Abalones by the Indigenous Californians

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There is a holy water font in Mission San Luis Rey, California, made from half an abalone shell. A shower stall in Hotel El Morro, Santa Rosalia, Baja California Sur, uses an abalone shell as a soap dish. Abalone necklaces, earrings, and even opera purses (the whole shell is hinged to a flat piece of silver) form attractive accouterments for today's stylish women. From the sacred to the profane, abalones have been and are a part of human culture.

Humans have used or eaten abalones for at least 100 millennia. Shells of *Haliotis midae*, dated to over 100,000 years old, were recently discovered in Blombos Cave, South Africa (Henshilwood et al. 2011). They were filled with an ochre-rich pigment mixture, a powder ground from red or yellow iron-oxide rocks. Since then, where there are abalones, humans have used and traded them. Where archaeologists find the abalones, strata of human history are revealed.

How were abalones used and where were they taken to by the native Californians? Let me recount some of the ways and by-ways.

Midden Mounds

A major source for information on usage patterns and trade routes of molluscan shells are midden mounds, or "trash dumps with a view" (Bertsch 2010). "The Indians liked to camp on ridge tops or other commanding points while away from home, and this would explain the locations of some of the shell heaps" (Meigs 1935). These piles of discarded shells represent millennia-long time sequences of resource use by people around the world. Before modern constructions covered or destroyed them (Téllez Duarte 2008), midden mounds could be found along numerous stretches of the Pacific coastline of Baja California (BC) and southern California and its Channel Islands.

At Cardwell Bluffs, San Miguel Island, *Haliotis rufescens* shells have been found in midden mounds dating 11,500-12,000 years BP. Shells of other molluscan food items found included *Cryptochiton stelleri*, *Mytilus californianus*, and *Chlorostoma funebralis* (Erlandson et al. 2011). Isotope dating of shells from midden mounds in the El Rosario-San Quintin region of Baja California indicate human habitation (and abalone use) from 7,000 years BP (Moore 2001). These late Holocene sites show semi-permanent settlement patterns, typical of the hunter-gatherer-fisherman life style of these coastal people.

Midden mounds of Baja California show that resource collection was locally expedient, *i.e.*, molluscan assemblages at sites reflect immediately available resources (Moore 2001). There is no "representative" midden mound. Each coastal midden is a direct response to the various marine ecosystems at different sites. Sandy sites such as at La Salina, mainly contain burrowing clams such as *Tivela stultorum*. Sites adjacent to rocky promontories are dominated by *Mytilus californianus* and *Haliotis* species. I have seen abalone shells in mounds high on the slopes of Mesa San Carlos, and on the ocean cliffs of Jatay. Exceptions to this rule are inland midden sites miles from the coastline. These indicate that the pre-contact nomadic populations moved across the BC peninsula, carrying with them

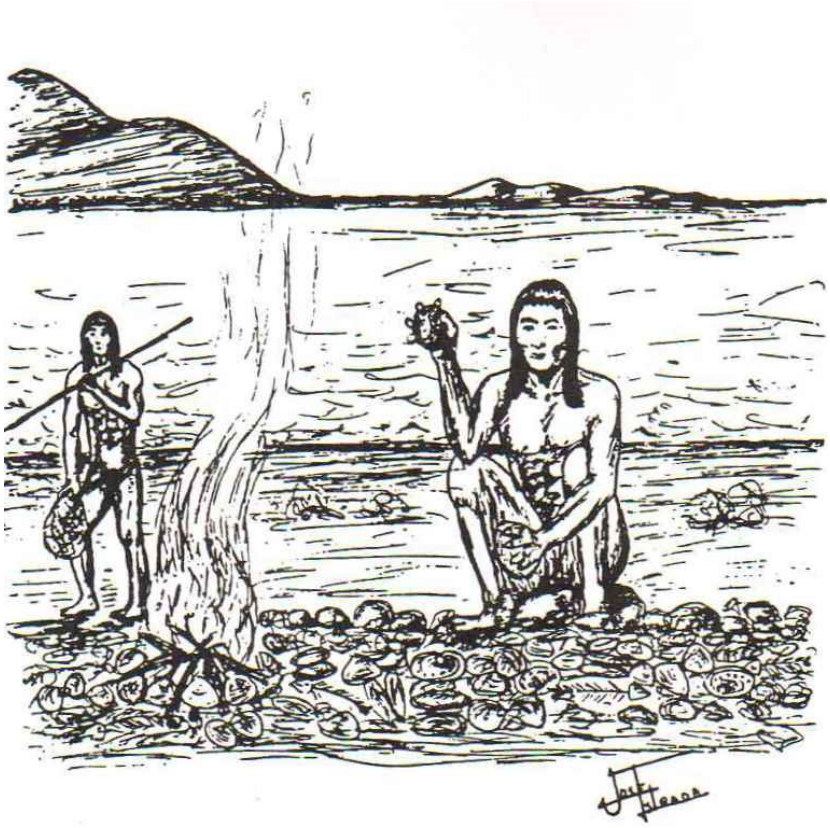


Figure 1. Abalone beach cookout, indigenous people of northern Baja California. Drawing by José Estrada of Ensenada.

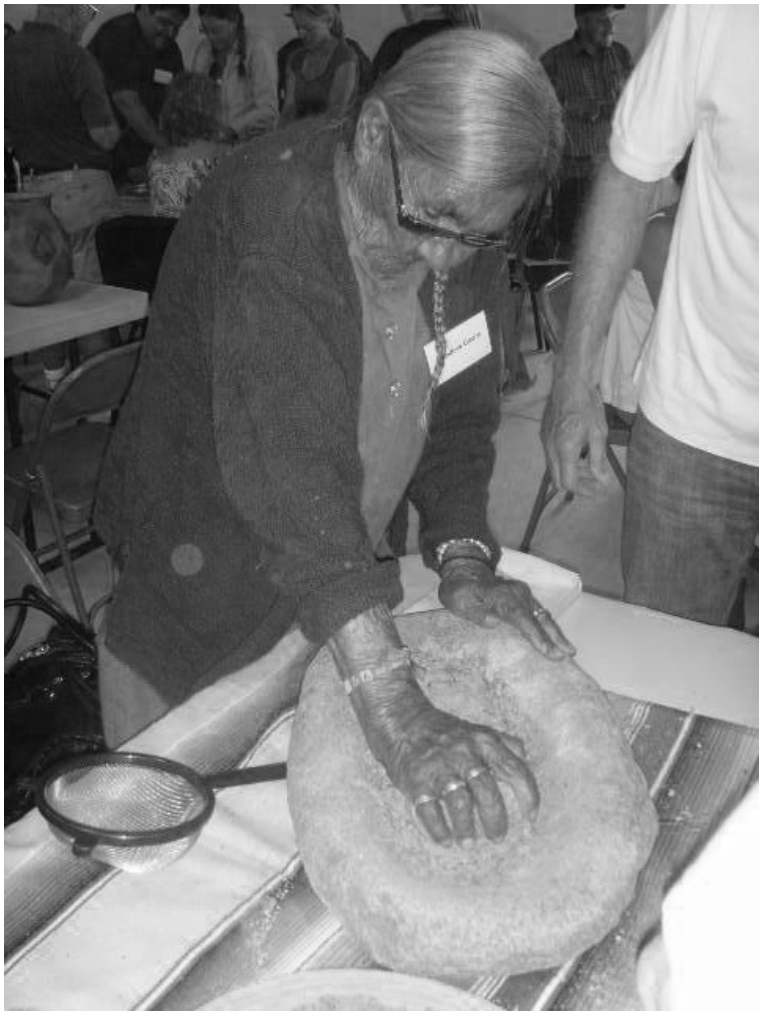


Figure 2. Doña Teodora Cuero, oral tradition keeper for La Huerta, making *atole de bellota*. Photo from Figueroa-Beltrán 2013: Figure 8, page 15.

molluscan food resources (e.g., *Mytilus californianus* and *Trachycardium panamense* respectively) from both the Pacific Ocean and the Gulf of California (Moore 2001).

Abalone Uses: Baja California Peninsula

Abalones were eaten, an obvious statement for all of us who have tasted them. I remember being put ashore on Isla Natividad late one afternoon by a *panguero* of the local fishing cooperative "*La Purísima*." We were hungry, on a restaurant-less island. A family in the small village invited us into their wind-protecting home and served us bowls of creamy rich abalone and potato soup, with quarter-inch thick tortillas. I thought back to the Cochimí thousands of years ago on the adjacent coastline who dined on roasted agave, abalone and freshly-trapped quail. The archaeological evidence is abundant.

Pieces of broken pottery have been found among the sand dunes in the Bahía Colonet region. These ceramics appear to be a similar style as that used by the present-day Pai-pai, and indicate that the cooking of food items was a practice associated with the preservation of food in the more recent period of the late pre-contact (Figueroa-Beltrán 2013). There are corroborative ethnohistorical accounts of this practice.

Doña Teodora Cuero, an authority in the oral traditions of the Yuman community of La Huerta, described coastal trips by her parents and grandparents in the second half of the 19th century. She states that during winter, families went down to the coast, from their community north of Valle de Ojos Negros, to collect abalones. At the coast, they would collect abalones, and then season them with herbs in ollas they had left hidden there (Figure 1). After a few days, they carried the seasoned and sun-baked abalones, strung onto thin poles like crowns, back to their community, where each member of the community was given an abalone, which was threaded on an agave string, in the form of a collar. When the traditional *atole de bellota* (a gruel made from acorn flour) was prepared (Figure 2), it was consumed along with the abalones (related by Figueroa-Beltrán 2013).

At Mesa San Carlos, abalone shells are abundant in the midden mounds at the foot of the petroglyph-covered basalt rim (Figure 3), 500 meters above, and some three kilometers inland from, the ocean below. Also present are water sources (vernal pools and seeps) and caves. The dark gray soil in the caves, indicating numerous fires, suggests seasonal habitation or ceremonial sites. These cliff-top sites are a four-hour hike over rough terrain from the rock circle habitation sites near the coastal terrace.

One rock art panel at the mesa rim is particularly interesting (Figure 4). At the summer solstice, sunlight interacts uniquely with some of the petroglyphs. Around 9 o'clock in the morning, a swath of sunlight moves and wiggles around a face-like motif (the Owl Man) carved onto the basalt surface (Figure 5). Later in the morning, the "sun is in his house." Inside a house-like triangular carving are seven horizontal lines and a vertical rectangular doorway shape (Figure 6). Note that thatched houses built by the northern Baja Californian Kiliwa and Tipai people are similar to this house-like petroglyph (Michelsen 1968, 1977). Slightly before midday, a splash of sunlight moves across this panel, and disappears as a final glowing spot inside the doorway of the house (Robin and Ewing 1989 and Ewing 1990 describe and illustrate both of these events).

Robin & Ewing (1989) have interpreted these carved images within a complex of myths: the sun in his house of seven sacred lines, with a possible reference to the seven daughters of Owl Man (whose face is carved on the basalt panel near the house image). Pai-pai elders (with rancherias some 240 km north of Mesa San Carlos) told Baja Californian author and historian Mike Wilkens that to avoid the flirtatious advances of the sons of Coyote, the seven daughters of Owl Man fled to the sky, where they became the seven stars of the Pleiades (Ewing 1990).

The tremendous accumulation of abalone-laden midden mounds near the petroglyph-covered rim, suggests ritual activity (Christian and Cordy-Collins 1986). It seems reasonable to conclude that abalones were consumed during the solstice ceremonies of the ancestral Kiliwa/Paipai.

Figure 3 (above). Abalone shell midden mounds, at base of basalt rim, Mesa San Carlos. Photo by author, April 1983.

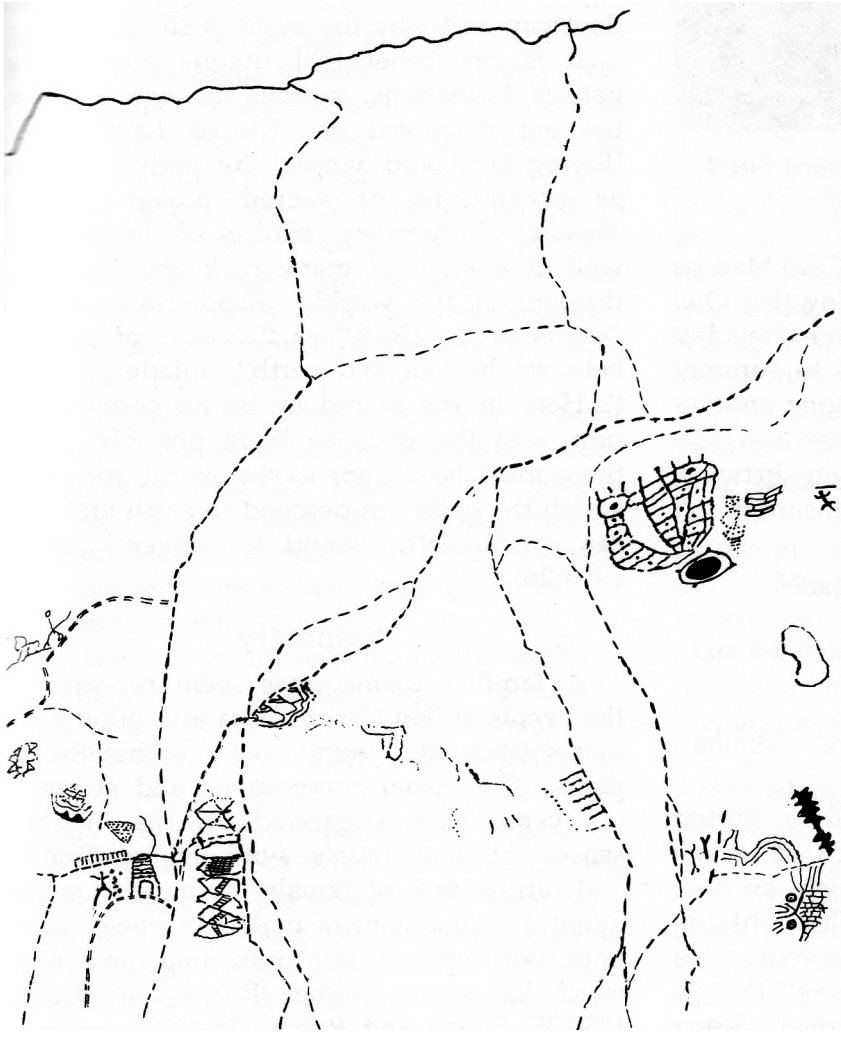


Figure 4. Rock art panel, Mesa San Carlos, showing locations of house and owl man petroglyphs. Drawing from Ewing 1990: Figure 5B, page 29.

Figure 5. Owl man petroglyph, Mesa San Carlos. Photo by author, April 1983.

Figure 6. House petroglyph, Mesa San Carlos. Photo by author, April 1983.

Abalone Uses: "Alta" California

For over ten millennia, a subsistence maritime culture based on the gathering of shellfish characterized the indigenous Californians (Erlandson et al. 2011). Even with the acquisition or development of the fishhook and sea-going plank canoes, yielding a more diversified subsistence base, abalone and other shellfish continued to maintain a position of paramount importance to coastal native dwellers until cultural and economic disruption were brought about by European settlers, soldiers and missionaries in the late 18th and 19th centuries (Mitchell 1984).

The abundance of abalone shells in southern California coastal middens indicates that these coastal dwellers had a strong dependency upon abalone as a major nutritional source. Mitchell (1984) suggested that easy access to the abalone during intertidal periods was influential in settlement patterns of the indigenous along coastal regions of southern California and northern BC, and that the presence of abalones is considered one of the reasons why the southern California coastline had more persons per mile than any other coastal shoreline in North America.

Abalones could be eaten year-round, since they were not affected by the summer/fall buildup of paralytic shellfish poison toxins occurring in the plankton-feeding clams. The indigenous people would often eat, smoke or dry the mollusk's flesh at the beach.

Abalone shells were the major raw industrial material for California coastal natives. The ornamental and ceremonial objects manufactured from the abalone shell are numerous. No other shell was made into as many diverse forms as the abalone (Mitchell 1984). The popularity of the abalone was due to its versatility: size, thickness, natural form, beauty and iridescent brilliance. The thickness of the shell made the manufactured item sturdy and less susceptible to cracking or chipping. Because of its sharpness and strength, Chumash men building a *tomol* (a planked canoe) used an abalone shell to scrape the boat's hull and remove the surplus dried *yop* caulking of bitumen and pitch (Fagan 2003).

Haliotis shell ornaments have been excavated from sites throughout California, and across all recognized excavation Horizons—from the ~2,500 B.C.E. Early Windmiller Pattern, across the Middle Berkeley Pattern and through the recent pre-contact Late Augustine Pattern (Moratto 1984).

Inlay work was common among central and southern California coastal tribes. Artifacts inlaid with abalone include pipes, animal effigies, stone flutes, whistles, stone and wooden mortars and pestles, breast ornaments, bone and crab shell rattles, wooden and shell bowls, and wooden wands (Mitchell 1984).

Along the southern California coast, the red abalone (*Haliotis rufescens*) was the preferred species for ornaments (being the largest and thickest abalone available). Next was the green abalone (*abulón azul* or blue abalone in México; *Haliotis fulgens*), the most beautiful and iridescent. The preference was overridden somewhat by their availability: the environmental prerequisites of differing species dictated which species was locally available to the original collectors.

The shells of abalones have been used for money, ornaments, jewelry, and tools. Common ornaments and pendants include perforated discs or oval beads with rectangular, lozenge and teardrop, pentagonal, triangular and oval shapes. They were made into crescent-shaped hair ties. The Chumash wore pieces of the iridescent abalone in wide bands worn around the forehead and waist. They were used as tubular ornaments for the nose and ears, and adorned baskets, belts and necklaces (Mitchell 1984).

The curved rim with its wall rising at a right angle was probably used to manufacture tools. The distal end could also be removed, and the rim modified to a round, blunt, knife-like edge, suggesting use as a gouge or sweat scraper (Mitchell 1984). I am immediately reminded of the ancient Greek athletes, using a bronze strigil to scrape off body sweat after a contest (e.g., the *Apoxyomenos* sculpture by Lysippos of Sikyon, ca. 300 B.C.E.).

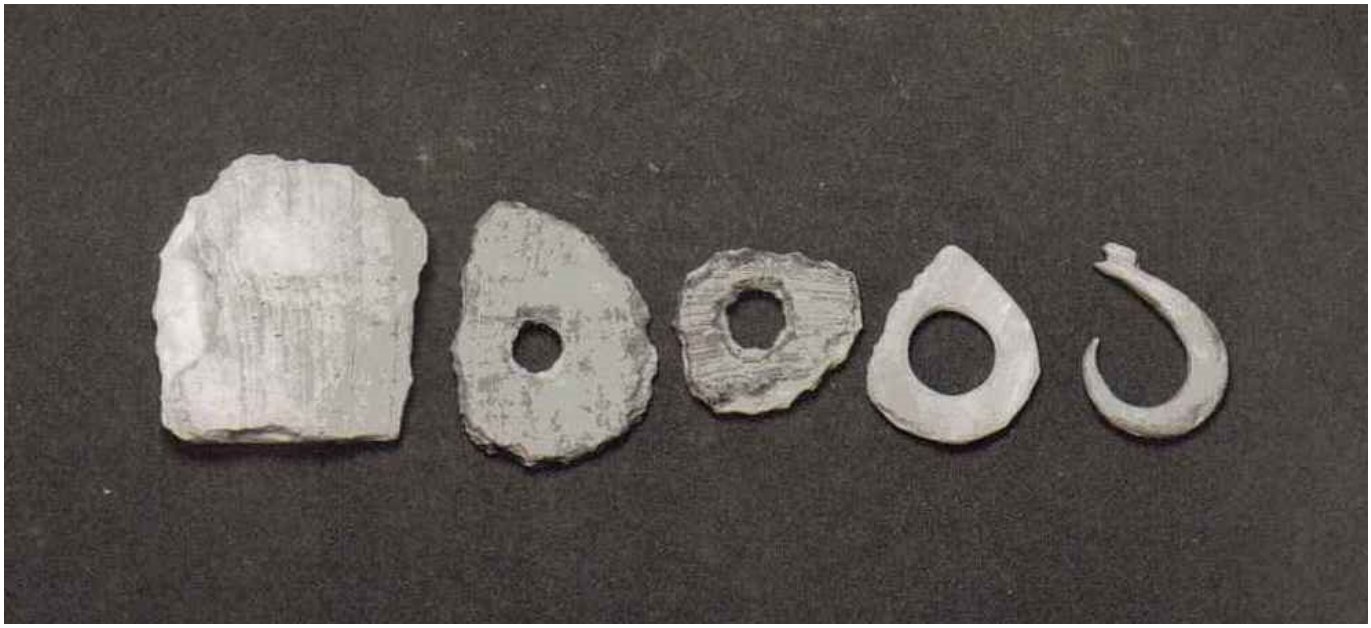


Figure 7. Abalone fishhooks in stages of manufacture. Photo from Mitchell 1984: Figure 8.

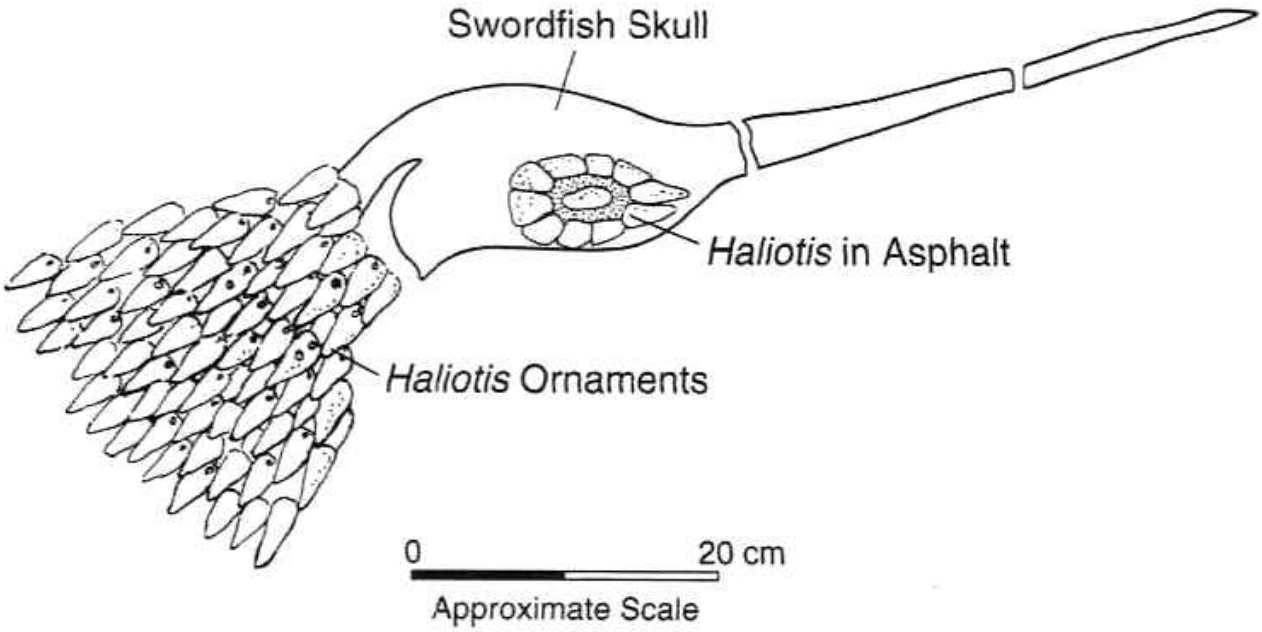


Figure 8. Swordfish helmet discovered in 2,000-year-old burial. Drawing from Fagan 2003: Figure 8.1, p. 181.

Figure 9. Map of California tribal territories, drawn by A. L. Kroeber. From Heizer and Elsasser 1980: Figure 1, p. 5.

Whole abalone shells were used as containers, bowls, or dishes. The apertures were filled with asphaltum, preventing leaks. Ethnographic accounts describe their use to bail out sea-going canoes (Mitchell 1984).

The fishhook was an early, important technological advance, facilitating a broader exploitation of the marine resources of southern California. Supplementing the year-round supply of abalones and other mollusks, the capture of fish further enables coastal tribes to remain sedentary within a resource-rich environment. Mitchell (1984) illustrates a sequence of artifacts that show the technique for manufacturing a fishhook (Figure 7). A hole was carved into a squarish piece of abalone shell and then enlarged. The outer edges were flaked off, forming a circular ring. A small portion of the ring was broken away, and then the finished hook was shaped. The iridescent quality of the shell probably had the same attraction to fish as modern multi-hued lures.

A number of uses of abalones in rituals have been recorded. Abalones were used as vessels for burning sage in religious and healing ceremonies, a tradition still practiced by present-day Chumash and the Kumeyaay of northern BC.

Decorative abalone shell pieces adorned the Chumash headdress used in the swordfish dance (Figure 8). The background involves the people's love of whale meat. Luisa Ygnacio related a tale from the Chumash oral tradition that Coyote once visited swordfish at his seashore house. After they went on a whale hunt together, swordfish proposed a fiesta. They put on their headdresses and feather skirts and danced. "The people venerated the swordfish because they sometimes chased whales ashore and thus the people had a lot of meat. They said that the *'eleywu'n* play ball with a whale tossing it around (Blackburn 1975: 191-192). There was an historic shamanistic cult and dance to bring "this great master of the sea within reach of fishermen and to persuade it occasionally to drive whales ashore, making their meat available" (Davenport et al. 1993). In the dance, a shaman would whirl and spin around. His headdress was a swordfish skull decorated with feathers and *Haliotis* ornaments! David Banks Rogers discovered the burial of a swordfish dancer, complete with headdress, dated to about 100 B.C.E. This chance discovery by Rogers near Santa Barbara in 1923 gave proof to the 2000-year history of this unique ritual, complete with abalone decorations.

Abalone shells have been found in several burials, ritually associated with the body. A Yokut (Central California Valley) burial was found with circular shell artifacts covering the skull's eyes, and rectangular bits of abalone shell covering the mouth opening (Mitchell 1984). The abalone most likely had been obtained through the east-west trade alliance with the Chumash (see Fagan 2003: 153, for a discussion of these alliances). A human fetus recovered from the Los Altos Site was interred between two abalone shells.

Trade Routes: Throughout California

"It's the economy, stupid," was a campaign slogan in Bill Clinton's 1992 successful bid for President of the United States. It is a succinct phrase, with Darwinian biological roots. The "economy of nature" incorporates ecology, evolution and economic theories (Ghiselin 1974, Ricklefs 2008), and sustainable use of earth's ecosystems (Daily and Ellison 2002). The wealth of nations is based on the wealth of nature. Cultures and civilizations rise and fall based on the exchange of their resources with those of others. The native nations of CA (Figure 9) had a rich and varied environment to exploit, with a multitude of mineral, plant and animal resources. Trade increased their choices and the diversity and quality of their lifestyles.

Within tribe trade occurred often in CA. Coastal Chumash traded abalone meat for acorns with their interior relatives. The southern CA coastal oaks (the coast live oak *Quercus agrifolia* and Engelmann oak *Quercus engelmannii*) produce the least palatable acorns. Preferred were the acorns of the black oak *Quercus kelloggii* which grows in the 3,000-4,000 foot elevations.

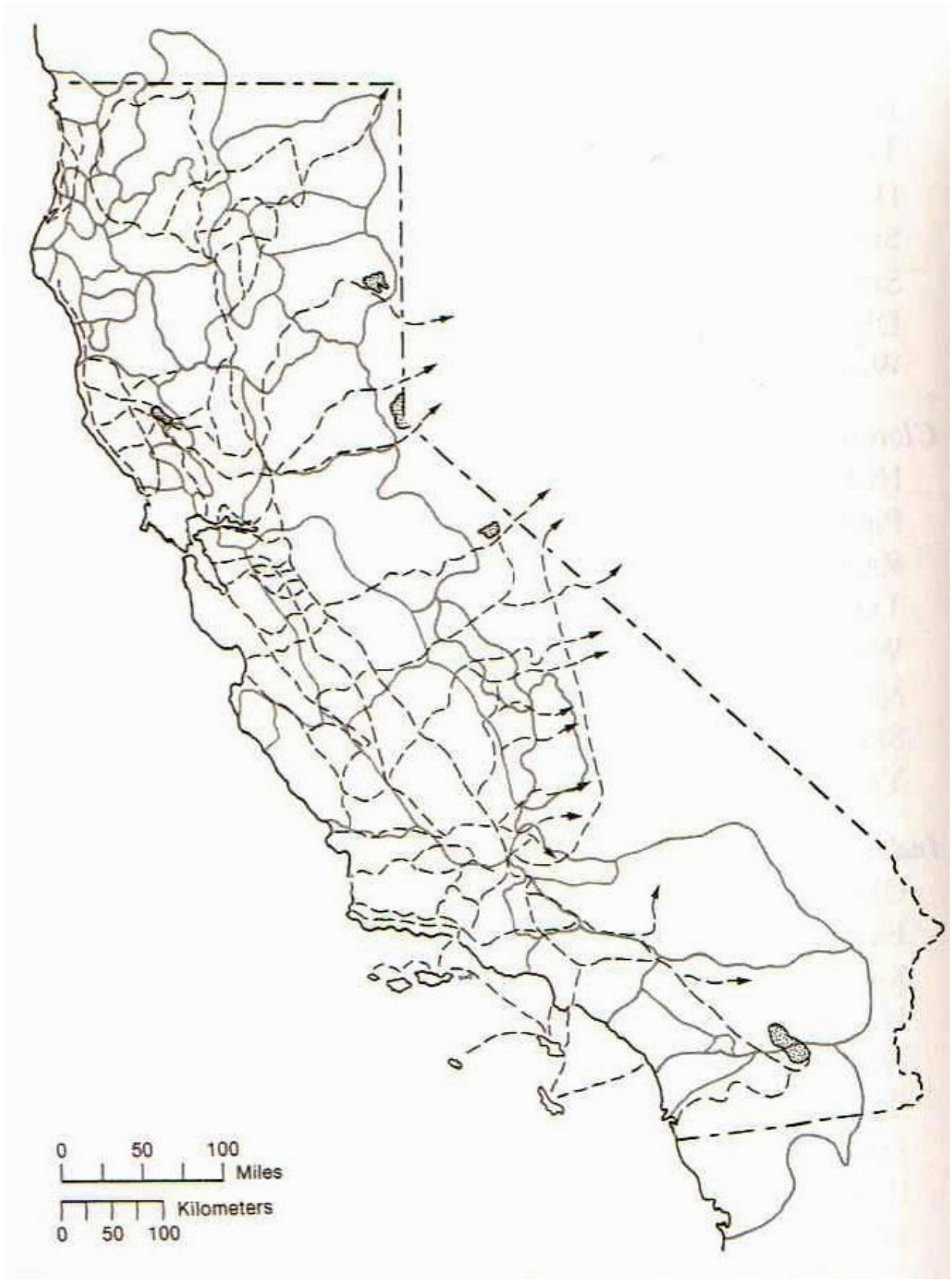


Figure 10. Native trade routes within California, drawn by James T. Davis. From Heizer 1978: Figure 1, p. 692.

Trade between adjacent tribes was significant for the same ecological reason. Each tribe lay in ecologically distinct zones that produced items desirable to a neighboring group that lacked them. The value of the trade items was determined by local differences in availability, craft specialization, ability to retrade with another neighbor, and local tastes and preferences.

Non-coastal natives would travel half the width of California to acquire the meat and shells of abalones. However, because of lack of archaeological evidence, the importance of meat as a trade item is not well understood. Abalone meat which was to be stored for future consumption and/or transport could be either sun dried or smoked. This allowed the meat to be carried further, since smoked or dried abalone meat is edible for approximately six months (Mitchell, 1984).

Central California coastal Costanoan traded abalone meat, shells and ornaments to Tulare and Northern Valley Yokuts in exchange for piñon nuts. Mainland Chumash traded wooden vessels inlaid with *Haliotis* shell to the Kitanemuk. The northern California Mattola traded abalone products to the Wiyot in exchange for grass for rope (Davis, 1974).

In the Central Valley Windmiller Site (ca. 2,500–500 B.C.E.), economic life revolved around acorns, hunting and fishing. Windmiller shellwork was well developed, and much of their finer technology was based on material acquired from afar. Abalone and *Olivella* shells and ornaments reached them from the coast, while they traded regularly for asphaltum, quartz crystals and alabaster from the Sierras (Fagan, 2003).

Trade routes were usually along trails that ran from village to village (Figure 10). In desert regions, they ran from one water container or spring to another. North-south trails in part run along the coast, but the main routes lie in the valleys of the Coast Ranges and the interior valley. East-west trails run from the Pacific shore across the Coast Ranges into the Central Valley, and across the Sierra Nevadas through the main passes into the Great Basin (Heizer, 1978). It should be noted that many of these original routes are now paved freeways and highways of modern California.

Long-distance travel was rare. Few people traveled great distances, but traded items within tribelet territories and between adjacent neighbors. For centuries, *Haliotis* and *Olivella* shells were exchanged hand-to-hand far into the desert interior and northeast into the great Basin. In the second millennium C.E., these shells were carried over the ancient Mojave Trail, which extended from southern Chumash territory, across the mountains, Lake Cahuilla and the Colorado River (see Trail 95, Figures 11 and 12), eventually reaching other routes deep into the Southwest.

Millions of seashells and beads were passed to Hohokam communities in the Southwest, through such middlemen as the Mojave and the Lower Colorado Yumans and Ancestral Pueblo Hakataya (Fagan 2003). For at least 2,000 to 3,000 years, the regular trade route networks for shells from southern and lower California crossed the mountains and deserts of southern California and the Colorado River, to the Pueblo peoples of present day Arizona and New México. From there, the trade routes continued by foot or along rivers across the Great Plains of Oklahoma, Texas and Kansas (Kozuch 2002).

Throughout the greater southwest, the most common Pacific coast shells in middens are *Haliotis cracherodii*, *H. fulgens* and *Olivella biplicata*. Abalone shell is found in archaeological remains from all cultural periods in the Southwest, from the Basket Makers to the Pueblo Cliff Dwellers (200 B.C.E. to 1,500 C.E.).

Southwest tribes valued abalone almost exclusively for ceremonial (receptacles for corn pollen) and ornamental purposes, rather than utilitarian (Mitchell 1984).

In south-central Arizona, along the banks of the Gila River, excavations at the Snaketown site (300 B.C.E.–1450 C.E.) revealed their Hohokam inhabitants as the “shell merchants of the southwest” (Haury 1976). All parts of Snaketown, whether house-fill or trash, regardless of age, are saturated with shell manufacturing residue of various kinds: raw, unmodified whole shells; specimens broken in the process of manufacture; waste or leftover bits from the manufacturing process; finished

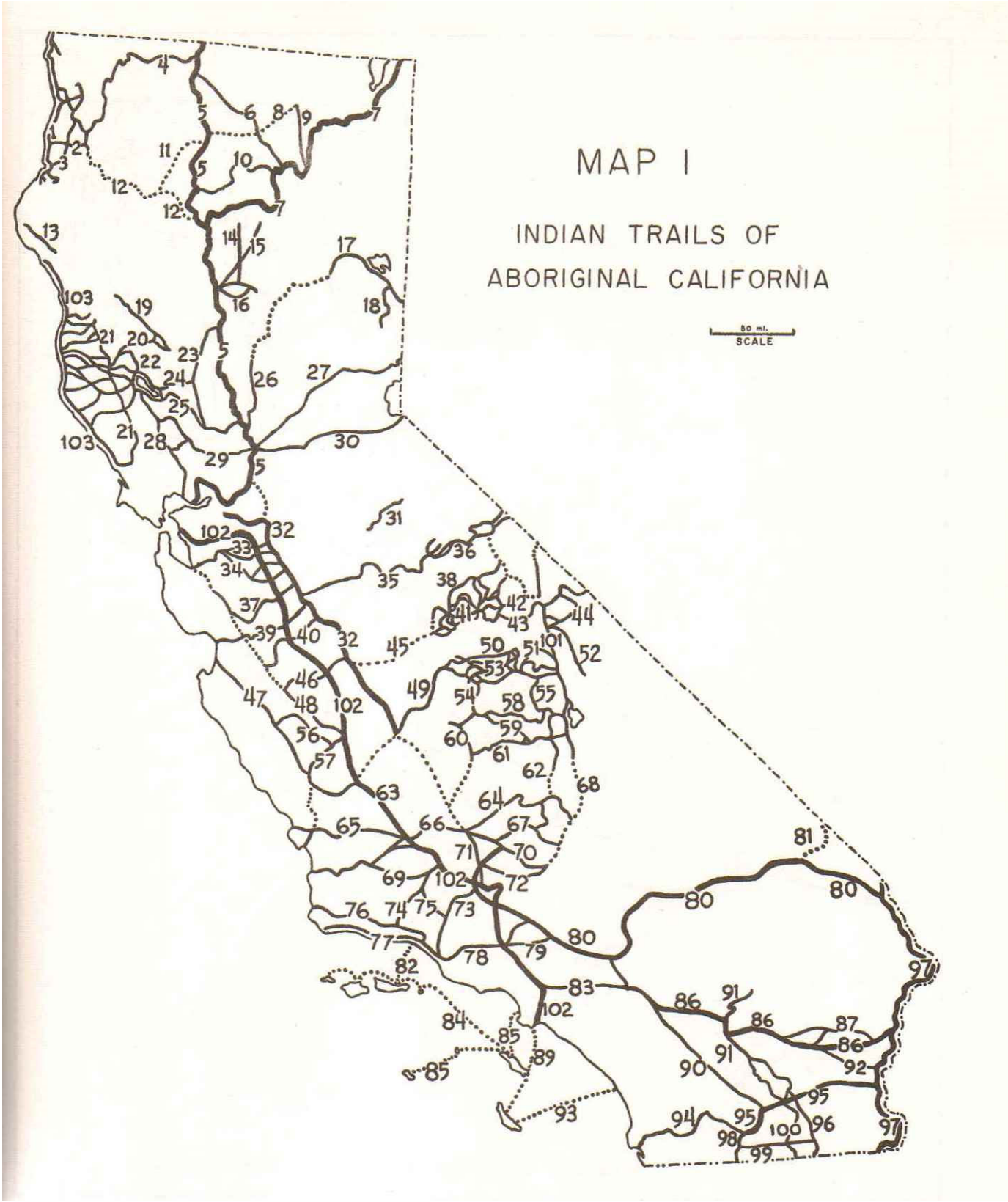


Figure 11. Trails of native Californians. From Davis, 1961: Map 1, p. 72.

products; and stone tools used in working shell (Haury, 1976). It was an industry in which many people in the society had a hand and in which some craftsmen seem to have achieved the level of specialists. Thirty-three species of shells (identifications by Leo G. Hertlein) were used by the Hohokam in Snaketown. The majority came from the Gulf of California. *Haliotis* (probably *cracherodii* and *fulgens*) was the only genus native to Pacific coast waters. Nacreous shell seemed to "have held a special attraction for the Hohokam....Of the three iridescent shells used, *Haliotis* was the most common and known from the Pioneer through Classic Periods" (Haury 1976).

Jesuits and Maps and A Modern Murder Mystery

California abalones are beautiful, impressive, useful and tasty. When the Jesuit missionary M. A. Kappus received some "blue shells" which Father Eusebio Francisco Kino had sent him, he wrote, "Estimo sobre mis ojos las conchas azules, y especialmente la grande, que verdaderamente es pieza rara" (September 1700).

When local Cocomaricopa and Pima gave Padre Kino abalone shells in the Sonoran desert, near the junction of the Gila and Colorado Rivers, he wondered how they had gotten there. He recognized them immediately as shells he had seen only on the Pacific Coast of Baja California some fifteen years previously (in late December 1684), but never in the adjacent Sea of California (Bertsch 2010). He convened the 1st International Conference on Abalone Biogeography in April 1700 at San Xavier del Bac (south of modern Tucson), inquiring where they had obtained the shells. When told, "from the distant sea, some ten to twelve days' walk," he realized Baja California was not an island (as previously believed and mapped), but a peninsula. After several expeditions to the head of what is now the "Gulf" of California to confirm such a land trade route for his gifted abalones, he remapped California as a peninsula (Bertsch 2011).

In a novel approach, mystery writer Tony Hillerman connects past traditions with present practices among the Navajos of the Four Corners region. He describes the fictional Sergeant Jim Chee of the Navajo Tribal Police examining a leather deerhide pouch (holding ceremonial items) among a murdered man's skeletal remains: "The leather broke apart under his fingernail. Inside there was a coating of yellow dust—what once had been sacred pollen. The pollen coated four small fragments of abalone shell, a gallstone taken from some small animal, two feathers, and a small stone amulet" (Hillerman 1980).

My Abalone for a Horse!

Abalone was the most used shell in the Californias. It was the shell traded from the Pacific coast of California into Arizona and New México. It was the most valued.

In 1876, Barber reported that after horses were introduced by the Spanish, one piece of abalone shell could be traded for one horse (Mitchell 1984).

Abalones may not play such an important role in today's synthetic society, but they should serve to remind us that we are still a part of, not apart from, earth's ecosystems. Using resources always comes with the responsibility to use them well: sustainably and respectfully, and with appreciation for their beauty.

Literature Cited

Bertsch, Hans. 2010. *Las conchas azules* (The blue shells): Father Kino, abalones and the island of California. The Nautilus, 124(4): 188-191.

Bertsch, Hans. 2011. The missionary explorer-scientist, Father Eusebio Francisco Kino, S.J.: Faith,

Figure 12. Adriana Ivette Cadena (author's granddaughter) alongside an indigenous trail, 11 miles north of Glamis, 33º 04.769' N; 114º 56.172' W. Photo by author, August 2013.

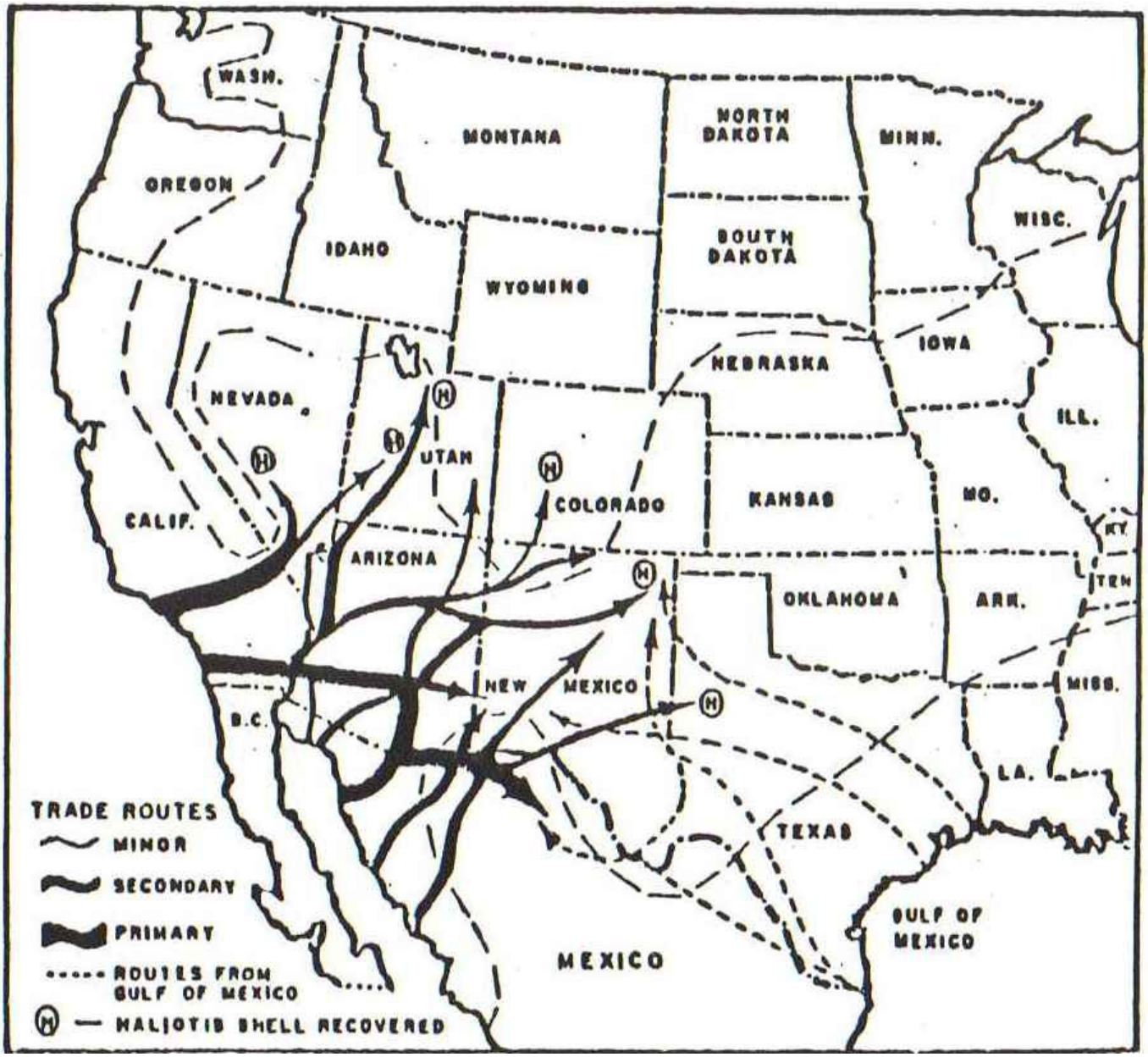


Figure 13. Abalone and seashell trade routes out of California throughout the southwest. From Mitchell 1984.

maps, sea shells and Mission San Xavier del Bac. Catholic Southwest, A Journal of History and Culture, 22: 68-85.

Blackburn, Thomas C. (ed.). 1975. December's Child. A Book of Chumash Oral Narratives Collected by J. P. Harrington. Berkeley, University of California Press. xxii + 359 pp.

Blake, Michael. 2004. Fraser Valley trade and prestige as seen from Scowlitz. In: Prentiss, William C. and Ian Kuijt (eds.). Complex Hunter-Gatherers. Salt Lake City, The University of Utah Press. pp. 103-112.

Christian, Charles Dennis, and Alana Cordy-Collins. 1986. Aboriginal occupation of a west coast rock art site in Baja California. Rock Art Papers, Volume 3 (San Diego Museum Papers No. 20): 75-90.

Daily, Gretchen C., and Katherine Ellison. 2002. The New Economy of Nature: The Quest to Make Conservation Profitable. Washington, Island Press. 260 pp.

Davenport, Demerest, John R. Johnson and Jan Timbrook. 1993. The Chumash and the swordfish. Antiquity, 67(255): 257-272.

Davis, James T. 1974. Trade routes and economic exchange among the Indians of California. Ballena Press Publications in Archaeology, Ethnology and History, 3: 71 pp.

Erlandson, Jon M., T. C. Rick, T. J. Braje, M. Casperson, B. Culleton, B. Fullfrost, T. Garcia, D. A. Guthrie, N. Jew, D. J. Kennett, M. L. Moss, L. Reeder, C. Skinner, J. Watts and L. Willis. 2011. Paleoindian seafaring, maritime technologies, and coastal foraging on California's Channel Islands. Science, 331(6021): 1181-1185.

Ewing, Eve Cochran. 1990. Summer solstice: New discoveries from San Carlos Mesa. Rock Art Papers, Volume 7 (San Diego Museum Papers No. 26): 23-32.

Fagan, Brian. 2003. Before California: An Archaeologist Looks at Our Earliest Inhabitants. Walnut Creek, California, Rowan & Littlefield/Alta Mira Press. xvi + 400 pp.

Figueroa Beltrán, Carlos. 2013. La prehistoria en el noroeste del Pacífico: Inferencias ambientales y etnoarqueológicas en la reconstrucción del pasado. In: Pérez-Taylor, Rafael, I. Z. Sáenz & C. González Herrera (eds.), Antropología del Desierto: Etnicidad e identidad. Instituto de Investigaciones Antropológicas, UNAM, México. p 47-61.

Ghiselin, Michael T. 1974. The Economy of Nature and the Evolution of Sex. Berkeley, University of California Press. xii + 346 pp.

Haury, Emil W. 1976. The Hohokam, Desert Farmers & Craftsmen: Excavations at Snaketown, 1964-1965. University of Arizona Press, Tucson. xii + 412 pp.

Heizer, Robert F. 1978. Trade and trails. In: Handbook of North American Indians, vol. 8, California. Smithsonian Institution, Washington, D.C. p 690-693.

Heizer, Robert F., and Albert B. Elsasser. 1980. The Natural World of the California Indian. University of California Press, Berkeley. 271 pp.

Henshilwood, Christopher L., F. d'Errico, K. L. Van Niekerk, Y. Coquinot, Z. Jacobs, S.-E. Lauritzen, M. Menu and R. García-Moreno. 2011. A 100,000-year-old ochre-processing workshop at Blombos Cave, South Africa. Science, 334(6053): 219-222.

Hillerman, Tony. 1980. People of Darkness. New York, Harper & Row, Publishers, Inc. 265 pp.

Kozuch, Laura. 2002. *Olivella* beads from Spiro and the Plains. American Antiquity, 67(4): 697-709.

Meigs III, Peveril. 1935. The Dominican Mission Frontier of Lower California. University of California Publications in Geography, 7. 231 pp.

Michelsen, Ralph C. 1968. A Tipai A-frame house built in 1963. Pacific Coast Archaeological Society Quarterly, 3(1): 1-2.

Michelsen, Ralph C. 1977. The construction of a Kiliwa house. Pacific Coast Archaeological Society Quarterly, 13(1): 21-27.

Mitchell, Michael H. 1984. Abalone as an aboriginal resource: a shell midden analysis. M.A. Thesis, California State University Long Beach. xiii + 96 pp.

Moore, Jerry D. 2001. Extensive prehistoric settlement systems in northern Baja California: Archaeological data and theoretical implications from the San Quintin—El Rosario region. Pacific Coast Archaeological Society Quarterly, 37(4): 30-52.

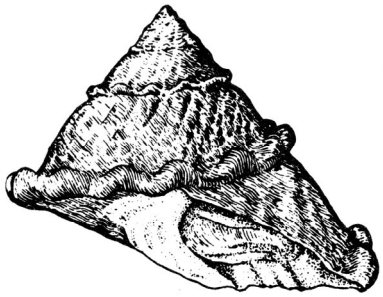
Moratto, Michael J. 1984. California Archaeology. Academic Press, Inc., Orlando. xxxvii + 757 pp.

Prentiss, William, and Ian Kuijt. 2004. Complex Hunters and Gathers: Evolutionary Origins of Prehistoric Communities.

Ricklefs, Robert E. 2008. The Economy of Nature, sixth edition. San Francisco, W. H. Freeman & Co. 620 pp.

Robin, Marc, and Eve Ewing. 1989. The sun is in his house: Summer solstice at San Carlos Mesa, Baja California Norte. Rock Art Papers, Volume 6 (San Diego Museum Papers No. 24): 29-36.

Téllez Duarte, Miguel Agustín. 2008. Arqueología costera de Baja California: perspectivas de conservación de un patrimonio amenazado. Centro INAH Baja California, Memorias de Balances y Perspectivas de la Antropología e Historia de Baja California, 2002-2004: 339-345.



Society Business

Minutes, Executive Meeting, Western Society of Malacologists
Forty-Sixth Annual Meeting
23 June 2013, San Diego

1. Called to order by President Wendy Enright at 12:05 pm. Present were Wendy Enright, Paul Valentich-Scott, Kelvin Barwick, Hans Bertsch, Esteban Félix Pico and Carlos Cáceres Martínez.

2. Read last year's minutes; motioned to accept by HB, seconded by PVS, unanimously accepted as read.

3. Treasurer's Report by Kelvin Barwick:

- Year's financial report
- EIN Number to file and pay taxes as corporation (explained 501-3 problems and resolutions underway, with the assistance of Susan Razzetto, CPA). Motion PS, 2nd WE, passed to do so.

4. Annual Report:

- Regarding some international postage costs, no worry. Give copies to Mexican colleagues at meetings. Option for electronic or print.
- Check for ISSN number. This included a discussion among KB, PVS and CCM.
- Annual Report 2011 is done and on-line, and is being mailed. AR-2012 is in production.

5. Membership discussion regarding international payment methods. Also talked about costs of meeting, differences between members vs. nonmembers.

6. Student Grant: 10 requests, two were funded.

7. Secretary's Report: group commended Chuck Powell for his unstinting labor and efforts. Motion, HB; 2nd KB.

8. Nominations. Discussed having a tentative slate of officers, because we don't know who'll be in line for 1st vice-president. Need to phone and discuss it with possible folks; table this (motion KB, 2nd HB), and re-meet Monday evening to report if we have found someone.

9. Next year's MOLLUSCA 2014, joint meeting in México City. PVS reported that preparations are doing great, have a web page as of Friday. Payment methods through PayPal account. Banking set up, with all fees going through the Mexican society.

10. Adjournment (motion, HB, 2nd PVS).

Respectfully submitted to President Paul Valentich-Scott, by Acting Secretary Hans Bertsch

17 June 2014

Minutes, General Business Meeting, Western Society of Malacologists

Forty-Sixty Annual Meeting

25 June 2013, San Diego

1. Called to order at 16:50 by President Wendy Enright. Four officers present, President WE, Treasurer Kelvin Barwick, 1st Vice-President Paul Valentich-Scott, and Acting Secretary Hans Bertsch. Twenty-three members in attendance. President Enright thanked everyone for their help in organizing and presenting this successful meeting, especially noteworthy for the high proportion of participation by our Mexican colleagues.

2. Minutes of last year's meeting read; motion to accept by HB, 2nd by PVS; passed.

3. Treasurer's Report by Kelvin Barwick. (See report following these minutes)

- KB presented several documents of money in-and-out, cash flow, etc. Cash on hand before this meeting (and its expenses and incomes) was $27,217.09 (US).

- He then gave a detailed and clear exposition of our tax situation, problems with our 501(3)c status and filing as charity. In a nutshell, we lost our non-profit status, so we are reapplying; this is still pending after a year. Need to file as a Corporation, and we are using Susan Razzetto, CPA, to help us to file properly to deal with the sometimes intransigent and confusing responses from the IRS. We had to pay last year's taxes, plus estimated taxes for this year and next year!

- Motion to accept report by PVS, 2nd by KB; so moved.

4. Membership. Forty-seven people attended this meeting. We have 51 regular members, and six institutional. Kelvin Barwick presented a graph of annual individual and institutional memberships from 1997 to 2013, showing a recent declining trend.

Discussions:

a) George Kennedy asked why so few institutions? Several California museums don't have copies of our Annual Report. We should get them to institutions, maybe even sending out gratis copies?

b) KB commented that there is a problem with the date when the Annual Report comes out (there have been some delays, but Editor Chuck Powell has assiduously worked to get us more up to date).

c) Should we eventually put the Annual Report on the internet? Maybe make immediately available the La Paz meeting report, so that all the Mexican colleagues can have access to their printed abstracts.

d) Need for advertising. Need to give reasons to be a member of our Society, such as our support for students, and building and establishing bridges among our international western malacologists (Canada, US, México and Central America). Several students commented about their feelings and appreciation. Also need to send out membership renewal information (to past members who aren't keeping up with their dues).

e) Motion about this topic, Carlos Cáceres Martínez, 2nd Paul Scott.

5. Secretary's Report. Acting-Secretary HB proposed a laudatory and congratulatory motion for Secretary Chuck Powell's great work; 2nd PS; passed.

6. Student Grant winners: Two were awarded.

José Francisco Domínguez Contreras (Centro Interdisciplinario de Ciencias Marinas, CICIMAR-IPN, La Paz, BCS), "Marine connectivity of octopus *Octopus bimaculatus* in the NW Mexican Pacific."

Michele Larson (University of Wyoming), "Influence of conductivity and calcium concentrations on the density and species richness of native and invasive gastropods in the Greater Yellowstone ecosystem."

7. Student Presentation Awards for the Meeting. All were excellent, but Benjamin Franklins were given to **Jessica Goodheart** for her presentation, "Biogeography, cryptic diversity and evolution within the sea slug genus *Pleurobranchus* (Notaspidea: Pleurobranchidae)," and to **Roberto Cruz Flores**, for his presentation, "Distribution prevalence and intensity of *Xenohaliotis californiensis* parasite of abalone, *Haliotis fulgens* and *Haliotis corrugata* in the peninsula of Baja California, México."

8. Society by-laws and description of officers. No change right now because the old format is being used for our IRS nonprofit status; after the IRS issues are resolved, then the by-laws will be updated. Moved HB, 2nd KB; passed.

9. Slate of Officers for 2013-2014.

President: Paul Valentich-Scott

1st Vice-President: Danielle Zacherl (Los Angeles, CA)

2nd Vice-President: Carlos Figueroa Beltrán (Ensenada, BC)

Secretary: Brian Urbano

Treasurer: Kelvin Barwick

Members-At-Large: Hans Bertsch and Arturo Tripp Quezada

Moved that nominations be closed, Terrence Gosliner; 2nd HB.

Move to accept the slate as presented, HB. 2nd Terrence Gosliner. Passed, and it is so.

10. Passing of the Presidential Gavel from Wendy Enright to Paul Valentich-Scott. PVS made a motion to thank Wendy for a spectacular meeting; 2nd KB.

11. MOLLUSCA 2014, next year's meeting will be an historical international joint meeting of the four American malacological societies: Western Society of Malacology (47th Annual Meeting), American Malacological Society (80th AMU meeting), Asociación Latinoamericana de Malacología (9th CLAMA), and the Sociedad de Malacología de México (12th RENAMAC). It will be held 23-27 June 2014, on the campus of the Universidad

Autónoma de México (UNAM), in Ciudad de México, Distrito Federal. The university is a city unto itself, with over 200,000 students! It will include pre-conference workshops and classes. A website has already been set up. Transportation between the Hotel El Diplomático and UNAM will be arranged.

12. Moved to adjourn, HB; 2nd Terrence Gosliner.

Summary respectfully submitted to President Paul Valentich-Scott by Acting-Secretary Hans Bertsch

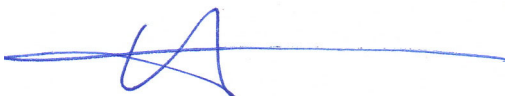
17 June 2014

Treasurer's Report

Members,

Below are the cash flows and balances for the 2013 fiscal year. Several things should be taken into account while reviewing these numbers.

- This does not include money received for the 2013 Conference in 2012.
- Tax payments cover both 2012 taxes due and estimated taxes for 2013. It should be noted that all taxes were refunded in 2014 upon reinstatement of our tax-exempt status.
- A total $5499.69 was available for student grants at the end of the fiscal year.



Kelvin Barwick
Treasurer

Income

Membership		$971.00	
Interest earned		$4.27	
2013 Conference fees		$3,530.00	
Student grant donations		$1,418.00	
501(c)(3) application refund		$100.00	
	Total Income	**$6,023.27**	

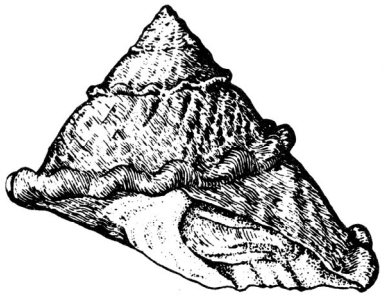
Expenses

2013 Conference expenses		-$8,703.86	
Office supplies		-$120.94	
Report preparation		-$1,493.00	
Student grant payments		-$2,000.00	
2012 tax preparation		-$500.00	
State Tax		-$1,624.00	
Federal Tax		-$1,273.93	
	Total Expenses	**-$15,715.73**	
		Net	**-$9,692.46**

Account balances 31 December 2013

Checking	$4,940.71	
Savings	$13,131.15	
	Total cash on hand	**$18,071.86**

Attendees of the 46th WSM Meeting



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