THE WESTERN SOCIETY OF MALACOLOGISTS

ANNUAL REPORT
For 2007

Volume 40

Abstracts and Papers from the 40th Annual Meeting of the Western Society of Malacologists Held in La Paz, Baja California Sur, México, July 25- 28, 2007

August,2008

Officers of the Western Society of Malacologists for 2007

President:	Carlos Cáceres Martínez
First Vice President:	Charles Powell
Second Vice President:	Michael Vendrasco
Members-at-Large:	Kirstie Kaiser and Hans Bertsch
Treasurer:	Victor Smith
Secretary:	Victor Smith
Webmaster:	Douglas J. Ernissee
Editorial Board:	Nora Foster (Editor)
	Hans Bertsch
	Rosa del Carmen Campay

TABLE OF CONTENTS

GENERAL SESSION

HISTORICAL MALACOLOGY SESSION

Organized by Harumi Fujita

John Steinbeck, Edward F. Ricketts, Molluscs and the Sea of Cortez

Hans Bertsch
Los Angeles County Museum of Natural History
192 Imperial Beach Blvd. #A, Imperial Beach, CA 91932
hansmarvida@sbcglobal.net

During March–April 1940, Steinbeck and Ricketts journeyed throughout the Sea of Cortez on the Monterey purse seiner *Western Flyer*. Normally fishing for sardines along the central California coast, the 76-foot *Western Flyer* was equipped with a 165 horsepower Atlas Imperial diesel engine, and carried 20' and 10' skiffs. It also carried a mobile marine biological laboratory.

Accompanying them on the so-dignified expedition were Tony Berry (Captain), Tex Travis (Engineer), Sparky Enea (Seaman and Cook), Tiny Colletto (Seaman), and Carol Steinbeck.

They found 2 species of Scaphopoda, 42 Bivalvia, 87 Prosobranchia, 14 Opisthobranchia, 13 Polybranchia and 5 Cephalopoda. For each group, they give extensive general and specific references to the published literature, and taxonomic lists based on the systems in use in 1941. It is interesting to compare their biogeographic data with modern studies. They summarized the known distributions of 79 species of the Prosobranchs they had collected. "It is highly probable that careful and extended collecting would show that individuals of species of a very respectable proportion of the total Panamic fauna could be found in this tiny world" [in reference to Puerto Escondido]. Comparison with modern data (Bertsch, 2007) from a related group, the 183 species of opisthobranchs, indicates the progress in our knowledge of the Sea of Cortez in over 55 years of research efforts by Mexican and US scientists.

Table 1. North–South Provincial Level Relationships.

	Prosobranchia	Opisthobranchia
	Steinbeck and Ricketts data	Bertsch data
# Restricted to Sea of Cortez	17 (21.5%)	11 (6%)
Occurring Sea of Cortez and South	42 (53%)	142 (77.6%)
Sea of Cortez and North	20 (25.3%)	97 (53%)
Sea of Cortez and both North and South	18 (22.8%)	66 (36%)

Table 2. East–West Provincial Level Relationships.

Prosobranchia (Steinbeck and Ricketts, 1941): No species occurred elsewhere
Opisthobranchia (Bertsch , 2007): Sea of Cortez species occurring in other faunal provinces:

Japan	9
Circumtropical	13
Indo–Pacific	23
W.Atl–Carib	10

Several recurring themes of the book include nonteleological thinking and conservation issues. Their comments about overcollecting of pearl oysters, shrimp by Japanese trawlers, etc., are especially relevant in view of today's emphasis on sustainability. It remains true that, "The shores of the Gulf, so rich for the collector, must still be fairly untouched" (Steinbeck & Ricketts, 1941: p. 168). However, "biodiversity in the Sea of Cortez is threatened by reduction of freshwater inflow, pollution from agriculture and urban areas, coastal habitat destruction, uncontrolled eco-unfriendly tourism, inadequate fisheries regulation and historical over-fishing, and lack of reliable scientific data" (Brusca, 2004: p. 8).

As members of the whole ecosystem, we are enmeshed in the complex interrelationships of the Sea of Cortez. It is a leisurely journey we have embarked upon, fraught with consequences and responsibility.

John Steinbeck, Edward F. Ricketts, Moluscos y el Mar de Cortés

Hans Bertsch

Entre Marzo y Abril de 1940, Steinbeck y Ricketts se embarcaron en una dilatada travesía del Mar de Cortés a bordo del buque *Western Flyer*, de Montery CA. El *Western Flyer*, de 76 piés y que normalmente pescaba sardinas por la costa central de California, venía equipado con un motor a diesel Atlas Imperial de 165 caballos de fuerza y portaba esquifes de 20 y de 10 pies. También llevaba a bordo un laboratorio portátil para biología marina.

En tan digna expedición los acompañaban Tony Berry (Capitán), Tex Travis (Ingeniero), Sparky Enea (Marinero y Cocinero), Tiny Colletto (Marinero), y Carol Steinbeck.

Encontraron listas taxonómicas basadas en los sistemas empleados en 1941. Es interesante comparar sus datos biogeográficos con los estudios modernos. Compendiaron las distribuciones conocidas de 79 especies de prosobranquios que colectaron. "Es altamente probable que una colecta cuidadosa y extensa muestre que individuos de una respetable porción del total de fauna Panámica se encuentren en este pequeño mundo" [en referencia a Puerto Escondido]. La comparación con datos modernos (Bertsch, 2007) de un grupo relacionado, 183 especies de opistobranquios, indica los progresos en nuestro conocimiento del Mar de Cortés en más de 55 años de esfuerzos de investigación por científicos mexicanos y estadounidenses.

Tabla 1. Relaciones a nivel provincial Norte–Sur.

	Prosobranchia	Opisthobranchia
	Datos de Steinbeck and Ricketts	Datos de Bertsch
# Restringido al Mar de Cortez	17 (21.5%)	11 (6%)
Ocurren en Mar de Cortez y Sur	42 (53%)	142 (77.6%)
Mar de Cortez y Norte	20 (25.3%)	97 (53%)
Mar de Cortez y tanto Norte y Sur	18 (22.8%)	66 (36%)

Tabla 2. Relaciones a nivel provincial Este–Oeste.

Prosobranchios (Steinbeck and Ricketts, 1941): No ocurren especies en otra parte.
Opisthobranquios (Bertsch, 2007): Especies del Mar de Cortés que ocurren en otras provincias faunales:

Japón	9
Circumtropical	13
Indo–Pacífico	23
Oeste Atl–Carib	10

Varios temas recurrentes en el libro manifiestan un pensamiento noteleológico, así como cuestiones sobre conservación. Sus comentarios relativos a la sobrepesca de perlas, camarón por los palangres japoneses, etc., son especialmente relevantes a la luz del énfasis actual en la sustentabilidad. Sigue siendo cierto que "Las costas del Golfo, tan ricas para el recolector, deben permanecer más bien intactas" (Steinbeck y Ricketts, 1941: p. 168). Sin embargo, "la biodiversidad en el Mar de Cortés está amenazada por la reducción del flujo de agua dulce, la contaminación de la agricultura y aguas urbanas, destrucción del hábitat costero, turismo anti-ecológico sin controles, reglamentos pesqueros inadecuados y un histórico exceso de pesca, así como por una falta de datos científicos confiables" (Brusca, 2004: p. 8). Como miembros del ecosistema en su conjunto, estamos entramados en las complejas interrelaciones del Mar de Cortés. En efecto, nos hemos embarcado en una dilatada travesía, cargada de consecuencias y de responsabilidad.

Agradezco a Rosa del Carmen Campay por asistencia técnica.

Shellfish Remains From the Mink Island XMK 030 Site, Katmai National Park, Alaska

Nora R. Foster
2998 Gold Hill Road Fairbanks, Alaska 99709 USA
swamprat@mosquitonet.com

Excavations at Mink Island in Katmai National Park, Alaska, during the 1997-2000 field seasons afforded the opportunity to increase knowledge about human presence in the Shelikof Strait area. Extensive and deep shellfish middens at two loci indicate that the site was occupied at two different time periods and that clams, chitons, and snails gathered from the nearby intertidal zone were a consistently used food resource. Shells from a column sample from the younger locus and more extensive samples from the lower locus were analyzed to determine spatial distribution abundance and species richness. The bivalves *Saxidomus gigantea* and *Mytilus trossulus*, the chiton *Katharina tunicata*, and gastropods, *Nucella lamellosa* and *Littorina sitkana* were found most consistently throughout the levels in both loci. Within the lower locus, the quantity, species richness, species composition and spatial distribution of shell and fragments varied among excavation levels.

Meaning of the Presence of Shells in the Archaeological Sites of the Cape Region, BCS, México

Harumi Fujita
Centro INAH, B. C. S., México
fharumi@prodigy.net.mx

Introduction

Ever since their arrival in southern Baja California Sur, molluscs have played an important role in the lives of the Indians. Shells provide evidence of diet and the use of shell as utensils, tools and ornaments. Based on Keen's classification (1971), 122 species of molluscs remains were identified (61 bivalves and 61 gastropods) in the archaeological sites in the Cape Region. The majority of the sites contain shellfish remains, principally as product of human consumption. The shell middens of the Cape Region are characterized by a large diversity of mollusc species. The habitats which surround them vary from sandy substrates located in protected bays to rocky bottoms in the open sea. The Indians of this region used different strategies to harvest molluscs, and counted on coordination between the crew members for successful harvests.

Large, complete shella of the lion's paw scallop (*Lyropecten subnodosus*), rocl oyster (*Ostrea fisheri*), and thorny oyster (*Spondylus princeps*) are very common, other species occur less frequently even in the sites far away from the coast, where they were probably used as plates. Shell was also utilized as raw material to manufacture tools, replacing bone used by other hunting and gathering societies.

For various reasons at some localities we can find shells whose habitat is not close to the site. The pearl oyster's (*Pinctada mazatlanica*) shell was used for ornaments and

flesh was consumed for food. This species was also considered an identity symbol or object among the Cape Region Indians. Horse Conch (*Fasciolaria princeps*) shells with openings in their interior lips, also found were widespread throughout the Cape Region. These marine snails could be used as a whistler for ceremonial or daily use.

Geography and Weather of the Cape Region of Baja California Sur

The State of Baja California Sur has a 2705 km coastline and is surrounded by sea except at the northern limit with the State of Baja California. The sea has been part of life in South Baja California from the arrival of the first inhabitants till now and into the future. As the creation God Niparaja in the Pericú mythology shows, there are two seas which surround almost all his creation, the peninsular desert. One corresponds to the Pacific Ocean, considered an ocean with giant and frozen waves, the other to the Gulf of California, characterized as a pleasant sea with gentle and warm waves. The predominant weather in the coastal area of the Cape Region is hot and dry, while in the mountain area the weather is more comfortable and slightly more humid. The rainy season in summer coincides with the tropical storm season.

Archaeological Sites of the Cape Region

An archaeological site is a place in which evidence of human presence in the past is found, specifically in México, before the Spanish Conquest in 1517. The archaeological evidence could be manufactured items or food remains discarded by a prehispanic group. Archaeological evidence has a relation of space, time and function. Archaeological sites may also include prehispanic human burials.

In the Cape Region seven types of archaeological sites have been identified: Open air campsites, caves or rock shelters used for habitation, shell middens, lithic quarries and workshops, pictograph sites, and burial caves. Between 1991 and 1998, field work was carried out to record the Cape Region coastal sites including Espíritu Santo, La Partida and Cerralvo Islands. In 2000, a survey was conducted on the hills situated in the northeast of La Paz. All together, 486 sites were recorded in the Cape Region. The most common site is the shell midden, followed by habitational cave sites, open air campsites, pictograph sites, burial caves and lithic quarries and workshops. Responding to tourist development projects in the coastal areas in the Cape Region, various rescue and salvage archaeological works have been done, which permitted research on prehispanic life in each occupational periods. Between 2001 and 2007 four seasons of field studies were conducted on Espiritu Santo Island, realizing intensive and extensive excavations in various sites to understand better the chronology of human occupations and the life style in each period (Fujita 2006).

In the coastal zone of Baja Clifornia Sur, shell middens are the predominant archaeological site, places characterized by the presence of shells collected and discarded by the ancient habitants of the region. The majority of these places were temporary campsites. There are evidences of making fire, making ornaments from shell and other materials, human burial, and activities peculiar to each community. Four hundred fourteen sites among 486 recorded archaeological sites in the Cape Region contain shellfish remains as a result of gathering and consumption of molluscs in the past.

Meaning of the Presence of Shells in the Archaeological Sites

A. Consumption of Shellfish

According to historical sources, the principal subsistence activity of the prehispanic Indians in the Cape Region was fishing. However, it is more common to find shellfish remains (bivalves and gastropods) in a coastal site because shell is conserved better than bone in an archaeological site. In addition, shell in an archaeological site reflects the decision making of the Indians, based on the availability of different species, the size of each species to be collected, and the roles of women in the culture. Women gathered shellfish in the more protected settings, and men gathered deeper water species by diving or from rafts. On the other hand, a shell sample can suggest the age of the human occupation by radiocarbon dating analysis, and seasonality can be determined by by O^{18} analysis and growth line analysis. Fracture patterns can be used to determine the ways people used to open bivalves. We can also determine the method used to open bivalves and remove the edible part by examining fractures on the shells and evidence of the use of fire to open bivalves.

B. Shells as Receptacles or Plates

Some large and flat shells such as *Lyropecten subnodosus*, *Ostrea fisheri*, *Codakia distinguenda*, and *Spondylus princeps* were used instead of ceramic plates.

C. Tools

1. Some hard shells such as *Chione californiensis*, *Chione undatella*, *Glycymeris multicostata*, *Megapitaria squalida*, and *Codakia distinguenda* have retouching or use wear marks in the dorsal or lateral edges. These marks indicate that the shell may have been used as a scraper, or are the result of opening the shell.
2. Some pearl oysters are worked in the form of a spoon.
3. Large and thick bivalves, such as *Glycymeris gigantea* and *Dosinia ponderosa* were used as scrapers: *Glycymeris gigantea* without modifying the shape and *Dosinia ponderosa* retouching the lateral part.
4. Hammer, awl and polisher were made of giant eastern Pacific conch (*Strombus galeatus*).
5. The columellas of some gastropods, *Strombus granulatus*, *Strombus gracilior*, *Fasciolaria princeps* and *Fusinus dupetitthouarsi*, for example, were modified to make have a point which would have been served as puncher, awl or spear for fishing.
6. The apex of some gastropods were used as hammer or awl: *Strombus galeatus*, *Strombus granulatus* and *Strombus gracilior*.
7. Some pearl oysters and lion's paw scallops have artificial openings in the center of the shell which might be both ornaments and amulets.

D. Ornaments

Pearl oysters and *Olivella* sp. were used as ornaments. Complete and fragmented pearl oyster ornaments, retouched and polished were plentiful in some sites on Espíritu Santo Island and in Ensenada de los Muertos. These seem to be ear ornaments. In

Médano of Cabo San Lucas and in El Conchalito some pearl oyster chest ornaments were discovered associated with human burials. Totally or partially fluted pearls were recovered from some northern Cape Region sites. Fluting provided a groove in the surface of the pearl for fiber cords to make necklaces and bracelets. There are several chronicles that mention the presence of fluted pearls on Espíritu Santo Island. In 1633 Capitan Francisco de Ortega, in one of the first expeditions, was in the southern part of the island in which he exchanged pearls for axes, knives and other objects with the Indians. During the archaeological excavations carried on in the Babisuri rockshelter and in the Ensenada de los Muertos small unmodified pearls were also found.

E. Symbolic Value (Identity, Faith, Desire for Abundance and Security in Fishing and Mollusc Capturing)

Some species of shell have other symbolic meanings. The pearl oyster was exploited principally for food and obtained a symbolic value as an identity object among the Indians of the Cape Region since the Early Holocene (10,000 b.p.). This concept flourished in the late period (A.D.1000-1700). It is probable that the worked pearl oysters are considered as amulets to ensure abundance of marine resources and security during offshore fishing. Chest ornaments made of pearl oysters are the most frequent objects in the burial caves of the Las Palmas tradition and in the shell middens of El Médano de Cabo San Lucas, El Conchalito and La Ensenada de los Muertos. This suggests that the pearl oyster was also considered as a religious object to express the desire for a happy afterlife. Historical sources describe the Indians wearing necklaces and bracelets of fluted pearls, pearl oyster pieces, marine shells, fruits and seeds. In the Babisuri rockshelter on Espíritu Santo Island more than 20 pearl oyster ornaments, likely ear ornaments and four fluted pearls were found. In the shell middens of Ensenada de los Muertos, similar pearl oyster artifacts were discovered. Since the pearl oyster beds are concentrated in the southern Gulf of California, the pearl oyster is exclusive and highly valued by the Cape Region Indians. In contrast, in the central and northern part of the peninsula's Pacific coast abalone was used similarly for food and as a decorative and religious object.

An arrangement composed of five *Laevicardium elatum* shells and two pearl oysters found in the back of the Babisuri rockshelter may have a religious significance, as a kind of altar, because the *Laevicardium* shells are uncommon in the site. Three valves were piled vertically and two horizontally and two worked pearl oysters were embracing the five *Laevicardium* shells.

Horse Conch shells (*Fasciolaria princeps*) with openings in their interior lips also were spread throughout the Cape Region. These marine snails could be worked as a whistler for ceremonial or daily use. In El Médano of Cabo San Lucas a group of five complete and fragmented pieces of this large marine snail were found, for that reason in this case we can assume that they are ceremonial objects. This artifact is something common among the Indians of the Cape Region. In another use of snails, necklaces traditionally made of *Olivella* shells have been reported from California and throughout the peninsula of Baja California.

F. Samples Most Used for C^{14} Dating

Among the organic materials in the Cape Region, shell is most frequently used for C^{14} dating because of its occurrence in the different stratigraphic levels in the coastal sites.

Distribution of Diverse Mollusc Species in the Archaeological Sites in the Cape Region

In contrast to shells found in natural beds, shellfish remains in the archaeological sites can be found associated with other food remains such as animal bones or with lithic artifacts and on occasion, worked wood, bone, shell and cord. Artifacts and animal remains are generally mixed with grey sand colored by ash and charcoal. Frequently the shellfish remains present in the archaeological sites were collected near the site, although some do not correspond to the nearest marine habitat. It is very common to find fragmented and burnt shells, resulting from efforts to open the shells by fire or mechanical force. We can also observe that the consumed shellfish remains are larger in size and do not contain small specimens. On the other hand, in the natural shell beds, there are molluscs of different sizes and the frequency of the young individuals is higher than in the archaeological sites. In these natural environments, there are some valves that have never been opened.

Coastal sites in the Cape Region are divided into four geographical areas within which there are characteristic mollusc species (Figure 1). Other factors, such as the proximity of the site to protected bays influence the composition of mollusc remains within the site.

The first area is from La Paz Bay to Buena Vista, including Espíritu Santo, La Partida and Cerralvo islands. In this area large bivalves such as pearl oyster, rock oyster (*Ostrea fisheri*) and frondose jewel box (*Chama frondosa*), sometimes accompanied by giant eastern Pacific conch (*Strombus galeatus*), predominate. In the sites near estuaries and protected bays, the frequency of California venus clams (*Chione californiensis* and *C. undatella*), bay scallop (*Argopecten circularis*), many ribbed ark (*Anadara multicostata* and *A. tuberculosa*), Mexican cockle (*Trachycardium panamense* and *T. consors*), and eastern Pacific fighting conch and granulated conch (*Strombus gracilior* and *S. granulatus*) is very high. Mangrove oyster (*Ostrea palmula* and *O. conchaphila*) is abundant near mangroves in the sites in the protected bays. In some locations, Pacific turban (*Turbo fluctuosus*) and *Nerita scabricostata* snails are abundant.

The second area corresponds to Buena Vista and Punta Gorda in the southern part of the Gulf of California. Rock oyster (*Ostrea iridescens*) appears in increments replacing *Ostrea fisheri*. The other predominant species are speckled bittersweet clam (*Glycymeris maculata*) and the limpet *Collisella discors*. The pearl oyster and frondose jewel box are also present, however in smaller quantity. The Byron tivela (*Tivela byronensis*) is found in this area.

The third area extends from Punta Gorda to Cabo San Lucas. In this most southern area of the Baja California peninsula, characterized by heavy waves on an open rocky coast, there are more gastropod remains than bivalve. The size of these gastropod species is medium or small and they are hard and resistant to this maritime condition. The predominant species in the archaeological sites are: *Collisella discors*, *Astraea olvacea*,

Purpura pansa, *Thais planospira*, *Thais kiosquiformis*, *Thais speciosa*, *Muricanthus nigritus* and *Nerita scabricostata*. Bivalves most frequently found are *Ostrea iridescens* and *Chama mexicana*. It is worth mentioning that the high frequency of sea urchin and barnacle remains indicate that these were important food resources.

The fourth area corresponds to the Pacific Ocean coast between Cabo San Lucas and Todos Santos. The wave energy is extremely severe, so there is little evidence of prehistoric shellfish gathering. Shellfish remains include species that attach to the rocks in the intertidal zone. We can imagine that the Indians would not have gone offshore to collect molluscs. The most common species is *Thais biserialis*.

Prehispanic Activity Patterns in the Coastal Zone in the Cape Region

The prehispanic subsistence activities in the coastal zone of the Cape Region can be divided into three patterns based on the density of archaeological materials and food remains (Figure 2).

1. The capture of marine resources (fish, molluscs, crustaceans, sea urchins and marine mammals) was the primary subsistence activity on Espíritu Santo, La Partida and Cerralvo islands and between La Paz Bay and Punta Gorda.
2. The capture of marine resources (fish, molluscs, crustaceans, sea urchins and marine mammals) and plant gathering were the principal subsistence activities between Punta Gorda and Cabo San Lucas.
3. Plant gathering was the most important subsistence activity between Cabo San Lucas and Todos Santos.

The difference in these three patterns is closely related to maritime conditions such as the wave energy or exposure that determines the ease or difficulty of gathering the marine resources, as well as establishment of temporary or more stable settlements. It is obvious that within the northern part of the Cape Region, the area around La Paz Bay is the most protected within the Gulf of California. On the contrary, the western coast of the Cape Region receives the violent waves of the Pacific Ocean. In addition, the Pacific Ocean side receives the effects of hurricanes and other tropical storms more severely. This security factor is reflected in the presence and duration of prehispanic occupations in the archaeological sites.

Chronology in Each Subarea

According to the excavations in diverse sites in the Cape Region, the following points can be made. In the majority of the excavated sites, the density of archaeological material and shellfish remains are low in the lower strata and high in the upper strata. This might be due to two conditions. One, that in the early period, the population was low and the other is that the duration of the stay in one site was short, so we can imagine a nomadic life style. Meanwhile the population size was larger and the duration of the stay in one site was longer in the late period than early and medium periods (Table 1). The early period in the Cape Region varies according to the site, although it corresponds to more than 10,000 years b.p. or to the late Pleistocene. Until now, there is only one site that probably dates from this period. The site is Babisuri rockshelter on Espíritu Santo Island, although this issue is still under discussion. The middle period dates between

10,000 and 1,000 years b.p., which covers the early and middle Holocene. The middle Holocene can be subdivided into early middle (10,000 to 5,000 b.p.) and late middle periods (5,000 to 1,000 b.p.). The late period corresponds to between AD 1,000 to 1,700. During the middle period, in La Paz Bay and Espíritu Santo and La Partida Islands, the molluscs such as *Chione californiensis*, *C. undatella*, *Ostrea palmula*, *Strombus gracilior*, *Strombus granulatus* that live in estuaries, mangroves and protected shallow bays were collected. In the late period, large and thick molluscs such as *Pinctada mazatlanica*, *Ostrea fisheri*, *Chama frondosa* which live in rocky beds in offshore were the main targets. In the excavated sites in Los Cabos Region, the first occupation does not exceed 5,000 years, and only the quantity difference of archaeological material and shellfish remains between the lower and upper levels was observed without noting any significant differences in the collected mollusc species.

Conclusions

Archaeological investigations conducted in the Cape Region of Baja California in the last 25 years reveal that the prehistoric Cape Region Indians of this region collected molluscs from diverse habitats principally for consumption, as well as for tools, utensils or plates, ornaments according to the characteristics of each shell. The majority of complete, large, plain and hard shells seemed to be used as plates, such as *Lyropecten subnodosus*, *Ostrea fisheri*, *Spondylus princeps*, *Codakia distinguenda*. The Du Petit spindle (*Fusinus dupetitthouarsi*) was manufactured to make a puncher. *Olivella* beads were components of ornament in the Cape Region, although they have been reported from California and various locations throughout the peninsula of Baja California. The giant horse conch (*Fasciolaria princeps*) with opening in their interior lips is found throughout the Cape Region which might have served as a whistle.

The pearl oyster and the pearl were the preferred material for ornaments. This shell seemed to have symbolic and religious value to assure the abundance of marine resources and safety of fishing and collecting molluscs in offshore, as well as an object to express a desire for a happy life after death and also as an identity object for the ancient inhabitants of the Cape Region. Although in a great number of hunting gathering sites in the world, bone and wood were the important materials besides stone, shell played an important role in the Cape Region of Baja California Sur.

References

Fujita, Harumi
2006. "Cape Region," in: The Prehistory of Baja California: Advances in the Archaeology of the Forgotten Peninsula, pp.82-98, University Press of Florida, Florida.

Keen, Myra
1971. Sea Shells of Tropical West America. Second Edition, Stanford University Press, California.

	Early Period	Early Middle Period	Late Middle Period	Late Period
Antiquity	> 10,000 b.p.	10,000 - 5,000 a.p.	5,000 – 1,000 b.p.	1,000 – 300 a.p.
Epoch	Late Pleistocene	Early Holocene	Middle Holocene	Late Holocene
Density of archaeological materials	Middle	Low and middle	Middle and high	Very high
Localities in the Cape Region	Espíritu Santo Island	Northeast of la Paz and Espíritu Santo Island	Los Cabos, Espíritu Santo Island, and the north of Buenavisa in the North Gulf	Throughout the Cape Region

Table 1.

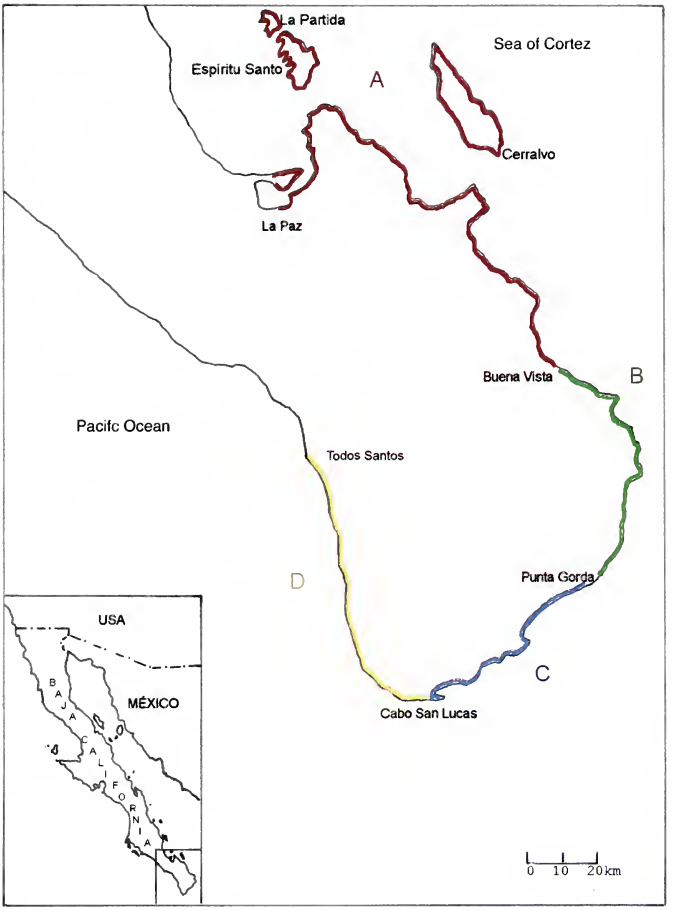

Figure 1. Geographical areas in the Cape Region.

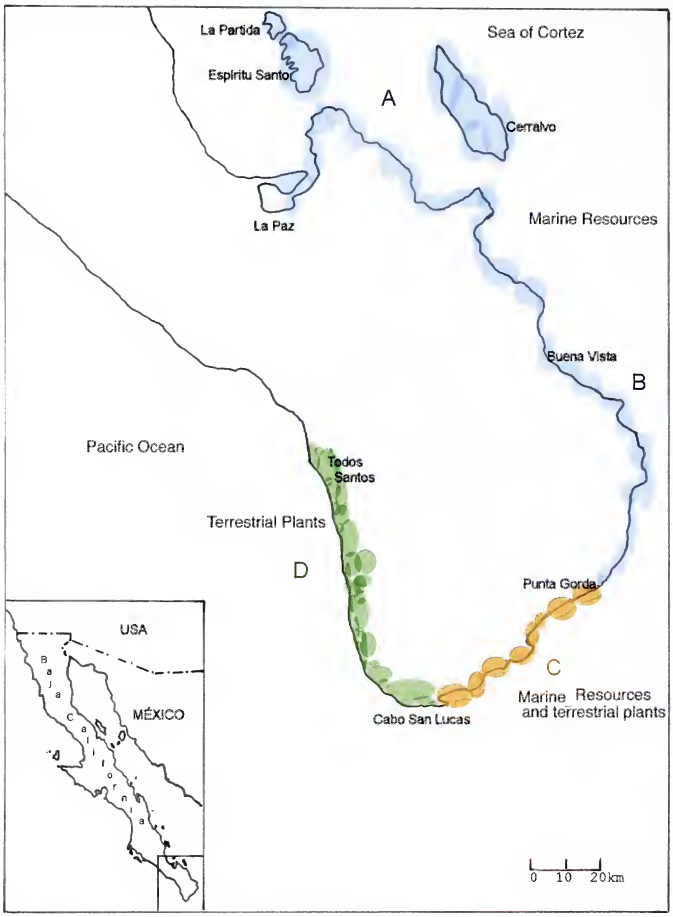

Figure 2. Subsistance resources in the Cape Region.

El Significado de la Presencia de Concha en los Sitios Arqueologicos de la Region del Cabo, B.C.S., México

Harumi Fujita

En la presente ponencia quiero mostrar el importante papel que jugó la concha en la época prehispánica en la región del Cabo, Baja California Sur, en donde los recursos marinos fueron la fuente de alimentos más importantes junto con los de origen terrestre propio del desierto para los cazadores recolectores y pescadores de esta región. Por lo general una concha en un sitio arqueológico puede ser evidencia de la dieta. Sin embargo, las investigaciones arqueológicas realizadas en las últimas dos décadas en la región del Cabodesde La Paz a Cabo San Lucas incluyendo las Islas Cerralvo, Espíritu Santo y La Partida revelan que también hay conchas trabajadas y utilizadas para herramienta y para ornamento. Algunas valvas grandes y planas fueron aprovechadas para plato. Por último, hay conchas que tenía otro valor ideológico entre los grupos indígenas de la región del Cabo. La madreperla (*Pinctada mazatlanica*) fue considerada como símbolo u objeto de identidad entre estos grupos sureños de la península de Baja California además de que fue consumida.

Molluscan Faunas of the Tepetate Formation (Late Paleocene-Late Eocene) in Baja California Sur, México

Priscila Morales-Ortega and Gerardo González-Barba
Museo de Historia Natural, Área Interdisciplinaria De Ciencias Del Mar,
Departamento de Biología Marina, Universidad Autónoma De Baja California Sur.
Carretera al Sur Kilómetro 5.5, C. P. 23080,
La Paz, Baja California Sur, México
prisortega@gmail.com

This report documents the occurrence of Tepetate Molluscs, from the late Paleocene to the late Eocene (Thanetian to Bartonian Age), in the Pacific margin of the isthmus of La Paz, Baja California Sur, México. Most of the Tepetate molluscs found were from the early Eocene age, corresponding to the Capay stage (Pacific Coast Molluscan Stages). The following gastropods have been recorded from the: Naticidae, *Gyrodes* sp. Conrad, 1860; Neritidae, *Velates perversus* (Gmelin, 1791), and *Velates batequensis* Squires and Demetrion, 1990; Fasciolariidae, *Clavilithes* sp., Seraphaidae, *Paraseraphs erracticus* (Cooper, 1894); Strombidae, *Platyoptera pacifica* Squires and Demetrion, 1990, *Ectinochilus* sp., and *Strombus* sp., cf. *S. peruanus* Swainson, 1823; Campanilidae, *Campanile* sp. Xenophoridae, *Xenophora stocki* Dickerson, 1916; Turritellidae, *Turritella* sp., *Turritella merriami* Dickerson, 1913 and *Turritella uvasana* subsp. *T. uvasana applinae* Hanna, 1927; Bullidae, *Bulla* sp.; Volutidae, *Lyrischapa lajollaensis* (Hanna, 1927); Bursidae, *Olequbia domenginica* (Vokes, 1939), *Olequahia* sp.; Harpidae, *Eocithara* sp.; Cylichindae, *Cylichnina tantilla* (Anderson and Hanna, 1925); Architectonicidae, *Architectonica (Stellaxis) cognata* Gabb, 1864. The following bivalves are present: Cardidae, *Nemocardium linteum* (Conrad, 1855) and *Acanthocardia (Agnocardia)* sp., aff. *A. (A.) sorrentoensis* (Hanna, 1927); Pectinidae, *Pecten* sp. and *Batequeus mezquitalensis* Squires and Demetrion, 1992; Plicatulidae, *Plicatula* sp. and *Nayadina (Exputens) batequensis* Squires, 1990; Spondylidae, *Spondylus batequensis*

(Squires and Demetrion, 1990); Limidae, *Lima kennedyi* Squires and Demetrion, 1992; Gryphaeidae, *Pycnodonte (Phygraea) pacifica* Squires and Demetrion, 1990), *Pycnodonte (Phygraea) cuarentaensis* Squires and Demetrion, 1994 and *Fimbria pacifica* Squires, 1990; Ostreidae, *Cubitostrea mezquitalensis* Squires & Demetrion, 1990; Pinnidae, *Pinna llajasensis* Squires, 1983 and Teredinidae, undetermined. In addition, one undetermined nautilid (Order Nautilida) was found. The sedimentary sequence from which specimens were collected corresponded to slope, platform and shallow water facies. Most of the molluscs correspond to shallow water, but were found in storm deposits, intercalated with mudstones and siltstones from a middle platform setting. Most specimens correspond to internal molds, although some preserve the shell. The fossil molluscs are mainly associated with the Tethys Current, with tropical and subtropical conditions.

Registro de las Asociaciones Faunisticas de Invertebrados de la Formación Tepetate (Paleoceno Tardio – Eoceno Tardio) en Baja California Sur, México

Priscila Morales Ortega y Gerardo González-Barba,

En el presente estudio se reportan catalogan los conjuntos faunisticos de invertebrados marinos fósiles con un intervalo de edad del Paleoceno Tardío (60 millones de años) al Eoceno Tardío (37 millones de años), encontrados en la Formación Tepetate, que aflora sobre la vertiente del Océano Pacífico en la región centro-sur del Estado de Baja California Sur. La mayor parte de la fauna de invertebrados pertenece al Eoceno Inferior, correspondiente al Piso Capay de Moluscos de la Costa Pacífico de Norteamérica. Hasta la fecha se llevan registrados, del Phyllum Mollusca, Clase Gasteropoda las familias Naticidae *Gyrodes* sp.; Neritidae *Velates perversus* (Gmelin, 1791) y *Velates batequensis* Squires y Demetrion, 1990; Fasciolariidae *Clavilithes* sp.; Seraphaidae *Paraseraphs erracticus* (Cooper, 1894); Strombidae *Platyoptera pacifica* Squires y Demetrion, 1990, *Ectinochilus sp.* y *Strombus* sp., cf. *S. peruanus* Swainson, 1823; Campanilidae *Campanile* sp.; Xenophoridae *Xenophora stocki* Dickerson, 1916; Turritellidae *Turritella* sp., *Turritella merriami* Dickerson, 1913 y *Turritella uvasana applinae* Hanna, 1927.; Bullidae *Bulla* sp.; Volutidae *Lyrischapa lajollaensis* (Hanna, 1927); Bursidae *Olequhia* sp., *Olequabia domenginica* (Vokes, 1939); Harpidae *Eocithara* sp.; Cylichindae *Cylichnina tantilla* (Anderson y Hanna, 1925); Bursidae y Architectonicidae *Architectonica (Stellaxis) cognata* Gabb, 1864. Mientras que de la Clase Bivalva las familias encontradas son Cardidae *Nemocardium lineum* (Conrad, 1855) y *Acanthocardia* (Agnocardia) sp., aff. *A. (A.) sorrentoensis* (Hanna, 1927); Pectinidae *Pecten* sp. y *Bateqeus mezquitalensis* Squires y Demetrion, 1992; Plicatulidae *Plicatula* sp. y *Nayadina (Exputens) batequensis* Squires, 1990; Spondylidae *Spondylus batequensis* Squires y Demetrion, 1990; Limidae *Lima kennedyi* Squires y Demetrion, 1992.; Gryphaeidae *Pycnodonte (Phygraea) pacifica* Squires y Demetrion, 1994, *Pycnodonte (Phygraea) cuarentensis* Squires y Demetrion, 1994, y *Fimbria pacifica* Squires, 1990; Ostreidae *Cubitostrea mezquitalensis* Squires y Demetrion, 1990; Pinnidae *Pinna llajasensis* Squires, 1983 y Teredinidae indet. Rafinesque, 1815. Además de un representante de la familia Nautiloidea . Algunos de estos fósiles tienen la característica de presentar un gran tamaño en comparación a los organismos actuales, o lo contrario. Esta fauna se encuentra relacionada con la corriente del Mar Tetis, la cual

presentaba condiciones de aguas cálidas (de tropicales a subtropicales) y que coincide con una elevación del nivel del mar que se registro globalmente, asociada a un efecto de invernadero sin formación permanente de casquetes polares. Algunos géneros encontrados en la Formación Tepetate se introducieron a la Costa Pacifica durante el Eoceno Inferior. El principal propósito de estudiar esta formación es porque la fauna de invertebrados que se encuentra ahí es la más diversa y abundante de toda la Cuenca del Pacífico, correspondiente al menos a la época del Eoceno.

Evidence for an Early Holocene/Late Pleistocene Shoreline North of the Present Ice Margin of the Bering Glacier, Alaska

Ann D. Pasch[1] and Nora R. Foster[2]
[1]Professor Emerita, University of Alaska Anchorage, Anchorage Alaska 97661
Wandering Drive, Anchorage, Alaska 99502 USA
ahadp@uaa.alaska.edu
[2]2998 Gold Hill Road Fairbanks, Alaska 99709 USA
swamprat@mosquitonet.com

A host of mollusc and other invertebrate shells have been retrieved from Holocene deposits adjacent to the ice margin of the Bering Glacier in south-central Alaska. The rapid retreat of the 1994-95 glacier surge margin provided unusual conditions in which invertebrate skeletons were deposited on outwash surfaces as entire valves or as fragments of delicate parts. A total of 110 species of molluscs, bryozoans, arthropods, echinoderms, polychaetes and a single protozoan have been identified from shells and fragments. Conventional radiocarbon dates of 29 bivalves from moraine deposited in 1968 and an outwash plains formed in 1995-2005 range in age from 7,190 ± 140 to 13,050 ±70 years BP. Analysis of depth, habitat and feeding class for species found at 4 major separate collecting sites shows consistent differences among them. One site is dominated by benthic infaunal organisms, whereas the other 3 are dominated by intertidal or shallow subtidal species characteristic of mixed substrates. The variations in ancient fauna would be compatible with an irregular shoreline with a variety of substrates, depths and organisms clearly had to be transported south from points of origin to the north. Therefore, the Bering Glacier must have been in a retracted position 7 – 13,000 years ago and marine conditions prevailed 30 or more kilometers north of the present coastline.

Late Oligocene (Chattian) Molluscan Fauna of the San Juan Member (El Cien Formation) from Baja California Sur, México

Diego Vera-Dimas and Gerardo González Barba
Museo de Historia Natural, UACBCS
apony_diego_rvd@hotmail.com bgerardo@uabcs.mx

The El Cien formation is exposed to the west and northwest of La Paz, in the southern Baja California Peninsula, Mexico. The unit has a thickness of about 125-175 m and the formation is composed of two units: the basal San Juan component, mainly composed of marine sediments that were deposited during the late Oligocene (Chattian age), and the upper composed of lagoonal and terrestrial deposits from the early Miocene

era. The objective of the work reported here was to study the late Oligocene molluscan fauna of Baja California Sur because only a few studies have been carried out in the subject area. Preliminary results suggest that the lowermost part of the section of the San Juan component is composed of a conglomerate followed by a sandstone above that was deposited in a shallow water environment and that is rich in bivalve fossils like *Pecten* sp., *Crassostrea* sp. and *Anadara vanderhoofi* (Durham, 1950), from the Families Pectinidae, Ostreidae and Anomiidae respectively. The gastropod *Turritella* sp. is also very abundant in this section. The middle part of the deposit indicates a general deepening of the depositional basin and is composed of fine-grained sediments related to an open shelf environment with a water depth proposed to have been of about 100 m. A few gastropod and bivalve fossils such as *Thyarisa* sp., Family Thyasiridae, exist in this area. A limestone bed is found in this part of the section with numerous impressions of *Macoma* sp., Family Tellinidae, a few *A. vanderhoofi* impressions and *Idasola* sp. fossils. Numerous granular phosphorite beds are also intercalated in the middle part of the San Juan component which are rich in pectens assigned to *Argopecten* sp., although other fossil are present such as *Mytilus* sp., Family Mytilidae, and the gastropod Family Turbinidae. These granular phosphorite beds are interpreted as event-deposited strata, mainly formed by storm-driven gradients. Thus, the fossils found in the phosphorite beds are allochthonous fossils and they also originate from a shallow-water environment. Near the top of the San Juan compnent, some tidal flat or lagoonal deposits are intercalated. A thick coquina of *Natica sp.*, Family Naticidae, and a few *Mactra* sp., Family Mactridae, at San Juan de la Costa, is interpreted as a backshore deposit. The biostratigraphic affinities have not been studied yet.

Diversidad de Moluscos del Oligoceno Tardío en Baja California Sur, México

Diego Vera-Dimas y Gerardo González Barba

La Formación El Cien aflora al oeste y noroeste de La Paz, Baja California Sur en el área de San Juan de la Costa y El Cien. Se encuentra constituida por 125-175m de limos, areniscas fosfáticas, conglomerados y tobas. La formación está formada por dos unidades: en la base se encuentra el Miembro San Juan que está constituido por sedimentos que fueron depositados en ambientes marinos durante el Oligoceno tardío y en la parte alta el Miembro Cerro Colorado que se encuentra constituida por sedimentos costeros y continentals depositados durante el Mioceno temprano. El presente trabajo se centra en el estudio de la diversidad de moluscos del Oligoceno tardío en Baja California Sur, ya que en la actualidad pocos trabajos existen al respecto. Hasta el momento solo se tienen resultados preliminares los cuales muestran que el Miembro San Juan, en su base, está formado por un conglomerado y arenisca basal que fueron depositados en un ambiente intermareal y que es rico en fósiles de bivalvos donde se encuentran las familias Pectinidae, Ostreidae y Anomiidae y el gasterópodo de la familia Turritellidae, estas familias que se encuentra representadas respectivamente por *Pecten* sp., *Crassostrea* sp., *Anadara vanderhoofi* y *Turritella* sp. La parte media del miembro está constituido por limonitas y fangolitas en las que se encuentran algunos escasos bivalvos y gasterópodos de aguas más profundas correspondientes a la plataforma interna continental, como lo es *Thyasira* sp. que perteneciente a la familia Thyasiridae. En esta parte del miembro

también podemos encontrar algunas capas de areniscas fosfáticas con abundantes pectinidos atribuidos a *Argopecten* sp., *Mytilus* sp., pertenecientes a Mytilidae, y gasterópodos de la familia Turbinidae, estos son sedimentos aloctonos ya que no fueron generados in situ en el lugar sino que fueron arrastrados hasta su depositación durante un fenómeno de tormenta. De igual forma, en la parte media del miembro encontramos una capa de calizas que se cree que fueron despositados a 200 m de profundidad, en estas calizas se encuentran numerosas impresiones del género *Macoma* sp. aunque también se encuentran algunas impresiones de *A. vanderhoofi y Idasola* sp. En la parte superior del miembro se presentan algunas capas de coquinas del gasterópodo de la familia Naticidae y género *Natica* sp. con poca presencia del género *Macta* sp. perteneciente a Mactridae, lo cual es interpretado como un ambiente de depositación en una costa en retroceso.

MALACOLOGY AND ECOLOGY SESSION

Organized by
Esteban Felix-Pico

Tools and Perspectives of Environmental Education for the Sea of Cortez: A Conservation Ethic

Hans Bertsch and Rosa del Carmen Campay
Proyecto Fronterizo de Educación Ambiental, Tijuana, BC, México
hansmarvida@sbcglobal.net

The goals of scientific research (discovery, dissemination, and use) form a nexus of human cultures within a global ecosystem. Inherent to science, like all other human disciplines, are ethical imperatives operative within all three goals. Simply put, one cannot do bad science, neither lie about nor misrepresent the results, nor ignore and not act upon the consequences. The right to do science depends upon our responsibility to do it well, benefitting the interrelationships of all earth's ecosystems.

Environmental education is synonymous with science education. Environmental education depends on good science, well taught, and properly applied. The waters, islands, shorelines, adjacent peninsula and mainland territories, and denizens of the Sea of Cortez form a significant worldwide heritage ecosystem that demands the highest standards of environmental education. Overfishing, aquaculture infringement on wetlands, habitat loss, commercial and residential developments, marinas, species extinctions, and marine reserves are major issues that require clear exposure of excellent science to the local, state and federal communities and agencies (including ejidos, cooperatives, environmental, ecotourism, business and governmental), so that appropriate ecologically-sound decisions are made and actions taken.

Especially important in this context are comprehensive field guides to the marine organisms of the Sea of Cortez. Decades old examples include Sea of Cortez: A Leisurely Journal of Travel and Research (Steinbeck & Ricketts, 1941), Sea Shells of Tropical West America: marine Molluscs from Baja California to Peru, 2nd edition (Keen, 1971), Common Intertidal Invertebrates of the Gulf of California, 2nd ed. (Brusca, 1989). Four recently published books are major contributions in this area: Guía de Campo de las Babosas Marinas del Pacífico Este Tropical (Camacho-García, Gosliner & Valdés, 2005),

Eastern Pacific Nudibranchs: A Guide to the Opisthobranchs from Alaska to Central America (Behrens & Hermosillo, 2005), Opistobranquios de México: Guía de Babosas Marinas del Pacífico, Golfo de California y las Islas Oceánicas (Hermosillo, Behrens & Ríos Jara, 2006), and Sea of Cortez Marine Invertebrates, 2nd edition (Kerstitch & Bertsch, 2007). We do science for the reward of discovery, and for the good that science can do. These invaluable field guides provide information for the advocacy and preservation of the ecosystems and inhabitants around and in the Sea of Cortez. We are a part of, not apart from, the world-life. In our search for the understanding, appreciation and conservation of life's beauty, let us collaborate in teaching and living an effective conservation ethic: To develop and use a sustainable management plan of life, which conserves, protects and maintains biodiversity for the health and well-being of all members of the global ecosystem.

Herramientas y Perspectivas de Educación Ambiental por el Mar de Cortés: Una Ética de Conservación

Hans Bertsch y Rosa del Carmen Campay

Las metas de la investigación científica (descubrimiento, diseminación y aplicación) crean un nexo entre las culturas humanas dentro del ecosistema global. Como en todas las disciplinas humanas, son inherentes a la ciencia los imperativos éticos que operan dentro de sus tres metas. Sencillamente no podemos hacer mala ciencia, ni mentir o desviar sus resultados, como tampoco ignorar las consecuencias sin hacer nada al respecto. Nuestro derecho de hacer ciencia depende de nuestra responsabilidad de hacerla bien, beneficiando las interrelaciones de todos los ecosistemas del planeta.

La educación ambiental es sinónimo con educación científica. Educación ambiental depende de buena ciencia, bien enseñada y debidamente aplicada. Las aguas, islas, costas, terrenos adyacentes a península y golfo y todos los habitantes del Mar de Cortés forman un ecosistema de patrimonio mundial que exige altos estándares de educación ambiental. La sobrepesca, transgresión de humedales por acuacultura, pérdida de habitats, desarrollo comercial y residencial, marinas, extinciones de especies y reservas, son temas importantes que deben exponerse con clara y excelente ciencia ante comunidades y agencias locales, estatales y federales (incluyendo ejidos, cooperativas, ecoturismo, ambientales, comerciales y gubernamentales), para tomar decisiones y acciones apropiadas y ecológicamente sensatas. La voz de la ciencia debe ser fácilmente accessible para la ciudadanía.

En este contexto, son especialmente importantes las guías de campo más completas sobre los organismos del Mar de Cortés. Hace décadas que incluyen Sea of Cortez: A Leisurely Journal of Travel and Research, Sea Shells of Tropical West America: Marine Molluscs from Baja California to Peru, Common Intertidal Invertebrates of the Gulf of California, and Reef Fishes of the Sea of Cortez. Recientemente se han publicado 4 libros muy importantes: Guía de Campo de las Babosas Marinas del Pacífico Este Tropical, Eastern Pacific Nudibranchs, Opistobranquios de México, y Sea of Cortez Marine Invertebrates, 2nd Edition.

Hacemos ciencia por la recompensa del descubrimiento y por el bien que hace la ciencia. Estas invaluables guías de campo proveen información para avanzar y preservar los ecosistemas y sus habitantes, alrededor y dentro del Mar de Cortés. Somos parte de,

no ajenos, a la vida global. En nuestra búsqueda para el entendimiento, aprecio y conservación de la belleza de la vida, colaboremos en la enseñanza de una ética de conservación efectiva: Desarrollar y usar un plan de manejo sustentable de la vida, que conserve, proteja y mantenga la biodiversidad para la salud y bienestar de todos los miembros del ecosistema global.

Handcrafts from Pearl Oyster Shells for the Families of Fishermen in the Gulf of California, México, as an Alternative for Extra Incomes to Make a Contribution to Alleviate the Poverty

Carlos Cáceres-Martínez, Alfredo Torres-Benítez and Hernán Ramírez-Aguirre
Universidad Autónoma De Baja California Sur, Carretera al Sur Km 5.5, Col El Mezquitito, La Paz, 23080, México
ccaceres@uabcs.mx, www.uabcs.mx

Communities that depend on fishing in the Gulf of California live in conditions of poverty due to the reduction in fish landings, and the overexploitation of different marine resources. Given these conditions, all alternatives that can contribute to their economic recoverery will be analyzed. Recently the use of shells from the pearl oyster *Pteria sterna* for handcrafts offers an opportunity to members of fishermen's families to have an occupation and to generate a complementary income. For a long time, nacreous shells have been used for handcrafts in different areas in the world. Locally made casual jewelry such as as earrings, rings, necklaces, marketed to tourists in Gulf of California, provides a new economic opportunity. A simplified aquaculture technique was applied to establish a productive unit with the capacity to produce 25 shells per week. We planned a training program in three steps; first presentation and adoption of the opportunity, second establishing aquaculture formation and training local people, and finally teaching techniques to cut, carve, and sculpture the shell. Two training courses were offered (2006-2007) in the community of "El Cardonal" located at Km 134 south of La Paz, trained a dozen women in shell handcraft techniques.

Chiton Phylogeography and New Species Discovery along the Baja California Peninsula

Douglas J. Eernisse
Department of Biological Science, California State University, Fullerton, CA 92834-6850 USA
deernisse@fullerton.edu

As part of a broader phylogenetic and comparative phylogeographic series of studies of the chiton fauna of western North America, my collaborators and I have been studying the chiton fauna along both sides of the Baja California Peninsula (Baja California and Baja California Sur) with a combination of morphological and molecular comparisons. This has revealed a species-rich fauna with a high degree of endemism. We have also discovered probable new species, each related to but genetically distinct from more northern recognized species as follows: *Leptochiton rugatus, Lepidozona scrobiculata, Chaetopleura lanuginosa,* and *Mopalia phorminx*. Compared with finding relatively little evidence of interrupted gene flow between San Diego and Alaska, to the

south we have found several cases of highly structured phylogeographic patterns. This could be due to the lack of genetic connectivity between populations, perhaps due to historical barriers to dispersal. Alternatively, there might be at least occasional larval dispersal but selection acts to eliminate the reproductive success of those larvae dispersing out of their normal range, perhaps due to the lack of physiological or ecological adaptations to those non-native localities, or perhaps because they are out-competed by better adapted native fauna. We are employing comparative phylogeography methods to see if genetic breaks correspond in time and space when genetic patterns are compared across multiple species. If so, this would imply a shared history of genetic isolation that might be due to barriers to dispersal.

Chitons Collected by David and Margaret Mulliner in the Northern Gulf of California

Douglas J. Eernisse[1] and Anthony Draeger[2]
[1]Department of Biological Science, California State University, Fullerton, CA92834-6850 USA
[2]Kensington, CA USA
[1]deernisse@fullerton.edu [2]orthopagurus@ix.netcom.com

For more than three decades, the late David Mulliner and Margaret Mulliner collected many interesting chitons along the shores of the northern Gulf of California, especially in the vicinity of Bahía de los Ángeles. Besides their many intertidal collections, the Mulliners were innovative and adventurous in sampling the Baja Califoenis subtidal molluscan fauna, using small-scale bottom trawls and scuba to sample many localities for the first or only time. David Mulliner and the late Paul Skoglund, aware that the molluscan fauna of offshore habitats of the northern Gulf of California was both rich in endemic species and very poorly known, innovated trawling techniques that could be operated with limited resources by only two operators in a small boat. The Mulliners then used these techniques on their visits to the Gulf over many years and later, in the 1980s, they donated their chiton specimens to the University of Michigan Museum of Zoology. We recently borrowed these for study and found several surprises compared to what one of us (DJE) has seen from more limited intertidal and shallow subtidal study. Our presentation displays selected species that are of particular interest for their rarity or for their comparisons with Pacific coast populations of the same or possibly distinct species. One species the Mulliners obtained by trawling not only appears to be undescribed but is probably also a new record of this genus for the eastern Pacific. David Mulliner was also renowned for his macrophotography of tiny snails, using bellows and specially selected lenses to push the optical limits of depth-of-field at high magnifications.

Our presentation features a digital composite high-resolution image technique as explored by one of us (AD) to even further overcome such depth-of-field constraints.

Improvised, Improved Close-Up Imaging of Mollusca and Microhabitats in the Lab and Field, as High-Resolution Non-Destructive Sampling Through Time, In Memory of David Mulliner

Christopher L. Kitting
Shore Lab, Biological Sciences, California State University East Bay, Hayward CA 94542 USA
chris.kitting@csueastbay.edu

We all lost a very valuable pioneer in ultra-close imaging of Mollusca: David K. Mulliner. Dave taught many of us how valuable and effective close-up photography can be, in field and lab illustrations, especially for live specimens that do not preserve well. Such photographic documentation has become even more important, as populations or entire species become depleted, sometimes protected by law from conventional sampling (disallowing collection or removal). Standardized field imaging of standardized surface areas can be "nondestructive" sampling, quantified later as much as necessary, until trends or differences through time become clear. The results can become well documented, instructive, and convincing, as "a (good) picture is worth 1000 (good) words." Such comparative environmental monitoring has become critical for detecting longer-term changes than in a traditional ~3-year research project. The author has maintained such standardized wide (low power) and close photographic sampling on rocks at Hopkins Marine Station Marine Preserve for over 27 years. Wide photographic records of that shore go back 100 years, showing little change in the granite, but sometimes major changes in animals and plants.

Rugged, reliable (and backed-up) imaging equipment is important. In the field, plastic bags around equipment, with desiccant, help shield the gear from salt spray or worse. Modern digital cameras evidently are more vulnerable than old, non-electronic film cameras, and need careful protection. Or digital cameras become disposable. Digital cameras provide valuable, instant feedback. Careful framing and review with the LCD panel benefits from a medium-large loupe magnifier placed over the panel, as a viewfinder shade and magnifier. It can be held in place with black hook and loop fastener strips.

Dave Mulliner illustrated what became the famous "Two Rules of Photography": (1) Get closer to the subject. (2) Get STILL closer. Some of Dave's favorite close-up optics are no longer available. Yet even with a compact point-and shoot digital camera, ultra-close field photography is convenient and effective with an accessory "macro ring" (male to male threads) to reverse a normal or wide (higher-power) lens in front of a zoom or telephoto lens, particularly for video (almost always lacking interchangeable lenses). A video's sound track is useful for narration, other data, feeding sounds of Mollusca, and other sounds.

Inexpensive or other modern software for digital images allows sharp panoramas (even in murky water), very extended, sharp depth-of-field, and extended dynamic range (shadow and highlight detail). The resulting images can be virtually as magnificent as the subject itself. As Dave Mulliner showed us throughout the past few decades, one can see more in a good photograph than live in the field. And the specimen can live to see another day in the field, and be seen and sampled again by us, too.

In Memoriam:
Some Personal Thoughts in Honor of David K. Mulliner

Mike Miller
4777 Ladner St., San Diego, CA 92113
mdmiller@cts.com

Dave Mulliner was a friend and colleague, who enjoyed the company of family and friends at home and under distant seas. We remember him as a gentle man, whose life was the epitome of devoted service to others. Presented are two videos: one with clips of Dave in the Philippines and of three nudibranchs named for him, and the other a "Bali in Dance" tribute. We thank him for his kindness and patience, enjoy his memories, and miss him very much.

Biodiversity of Molluscs Associated with Nontropical Carbonate Shelf in San José Island, Gulf of California

Arturo Tripp-Quezada[1], Jochen Halfar[2], Lucio Godínez[1] and José Borges Souza[1]
[1]Departamento de Pesquerías y Biología Marina IPN-CICIMAR. A.P. 592
La Paz, Baja California Sur, México
atripp@ipn.mx
[2]Department of Chemical and Physical Sciences of the University of Toronto at Mississaauga

Introduction

The diversity and abundance of benthic malacological communities associated with carbonate sediments was studied in sixteen sites near San José Island (25° N). At each site, sediment samples were taken, and temperature, depth, chlorophyll **a**, transparency, salinity and sediment texture were used as environmental indicators. The abundance and diversity of the benthic malacological communities were utilized as ecological descriptors and the growth of most important species was considered as indicator of carbonate production.

Results

Mollusc shells were the main component of the biogenic carbonates. The most abundant species were *Chione californiensis* (22%) *Tivela byronensis* (13%), and *Megapitaria squalida* (8%) (Fig. 1).

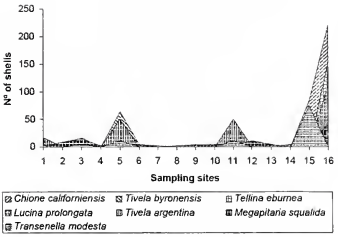

Fig. 1 Distribution of the most abundant molluscs (>5%) of the carbonate sediment from San José Island.

The maximum value of the Shannon-Wiener diversity index was 2.9 bits/indiv. In 50% of the sampling sites the median value was 2.4 bits/indiv., and the lowest value (1.2 bits/indiv.) was found in just one site (Fig. 2)

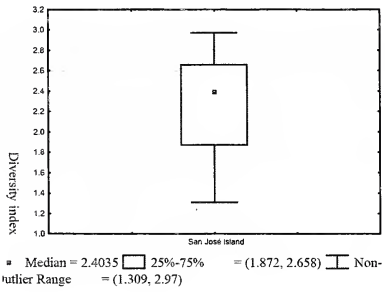

Fig. 2 Diversity of molluscs in San José Island.

Calcareous shells and skeletons of a wide variety of invertebrates and plants become biogenic carbonate sediments upon the death of those organisms. The increment of the sediment layer is due to the rate at which shells and skeletons are being produced by the communities living in the marine environment. The growth of most important species was considered as indicator of carbonate production (Fig. 3).

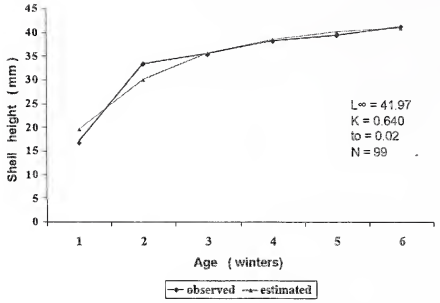

Fig. 3 Growth curves of *Chione californiensis* from external growth bands.

Discussion

After rhodoliths, molluscs are the principal components of the sediments of carbonates off San José Island, followed in importance by the corals. Carbonate sediments are found in shallow water from 2 to 15 m depth in medium-coarse sand. In geological terms Isla San José presents mesotrophic conditions that are favorable to the formation of non-tropical carbonate environments.

The composition of long-lived molluscan communities, slow growth rate and the high and intermediate diversity values in this site, indicates an ecological succession that allows the enrichment of the carbonates sediments. South of San José Island, carbonate sediments are transported and deposited by dominant winds and waves, the low rate of clastics deposition is attributed to these physical processes. The clam *Chione californiensis*, is useful as an indicator of the sedimentary sequence of the carbonates. It is estimated that at the age of three years *Chione californiensis* supplies 15 g of $CaCO_3$ to the sediment.

GENERAL SESSION

Organized by
Hans Bertsch

Biogeography of Northeast Pacific Opisthobranchs from Point Conception, California, USA, to the Galápagos Islands, Ecuador: Comparative Faunal Province Studies of the Sea of Cortez

Hans Bertsch
Los Angeles County Museum of Natural History
192 Imperial Beach Blvd., # A, Imperial Beach, CA 91932
hansmarvida@sbcglobal.net

In the northeast Pacific, between Point Conception, California, USA (34° 27' N; 120° 28' W), and the Galápagos Islands, Ecuador (0° 10' S; 87° 45' W), there are four marine faunal provinces or zones: the Californian, Sea of Cortez (SC), Mexican and

Panamic (sensu Briggs, 1974). There are 396 species of opisthobranchs (including 82 undescribed species) reported from these areas: Calif, 211; SC, 183; Mex, 158; and Panam, 220. Nudibranchs form the majority of the species in these regions: Calif, 135 (64%); MC, 116 (63.4%); Mex, 116 (73.4%), and Panam, 137 (62.3%).

The opisthobranchs of the Sea of Cortez show species-level relationships with the adjacent N–S temperature regions. Of 183 species of opisthobranchs reported from the Sea of Cortez, 97 (53%) also occur northward in the Californian province, 142 (77.6%) south along the coast of México and the southern portion of the Panamic Province, and 66 (36%) occur in both northerly and southerly regions.

Their E–W provincial relationships include 13 (7%) circumtropical species, 10 (5.5%) Atlantic-Caribbean, 23 (12.6%) Indo-East-Pacific, and 9 (4.9%) species in Japan. Dispersion barriers appear more significant than temperature barriers. Water temperatures in the Sea of Cortez fluctuate widely during the course of a year, permitting seasonal occurrences of warmer and cooler water species. In Bahía de los Ángeles, BC, *Chromodoris norrisi, Phidiana lascrucensis* and *Discodoris ketos*, of southern Panamic occurrence, are common from July to September (periods of high water temperatures), but species which occur in southern California, *Doriopsilla albopunctata, D. gemela,* and *Aeolidiella chromosoma,* are more common from November to March. Endemism in the SC is extremely low (10 species, 5%, e.g., *Hypselodoris ghiselini, Conualevia marcusi*, and *Dendrodoris stohleri*). It is possible that this level will become lower with more studies. Note that *Aglaja regiscorona* and *Bornella sarape*, known originally only from Las Cruces, BCS, were only reported from other sites in southern México and Costa Rica more than 30 years later.

The trophic structures of opisthobranch communities vary greatly between and within regions. Comparisons of 2 sites each in two regions, BLA and Bahía de Banderas (Jalisco-Nayarit), show different abundances by feeding preference (Br=bryozoans; Cn=cnidarians; Sp=sponges; He=herbivores):

BLA Islas: Br 65.6% Sp 8.8% Cn 7%

BLA Gringa/Cuevitas: He 36% Es 34.7% Cn 18.9% Br 2.8%

BB Islas/BahíaSW: Cn 40% Br 26.5% Sp 23% He 4%

BB EastProtectedBahía: Cn 51% Sp 30.5% He 5.5% Br 2.8%

Analysis and long-term faunal monitoring of marine invertebrates are needed to provide information for establishing guidelines of biodiversity, conservation, and sustainable development of the resources of the Sea of Cortez.

Biogeografía de Opistobranchia del Noreste Pacífico desde Point Conception, California, USA, hasta Las Islas Galápagos, Ecuador Estudios Comparativos de la Fauna Provincial del Mar de Cortés

Hans Bertsch

En el noreste Pacífico, entre Point Conception, California, USA (34° 27' N; 120° 28' O), y las Islas Galápagos, Ecuador (0° 10' S; 87° 45' O), hay cuatro provincias o zonas faunales marinas: Californiana, Mar de Cortés (MC), Mexicana y Panámica (sensu Briggs, 1974). Existen 396 especies de Opistobranquios (las cuales incluyen 82 no descritas científicamente) reportadas de estas zonas: Calif, 211; MC, 183; Mex, 158; y Panám, 220. Los nudibranquios forman la mayoría de las especies en las zonas: Calif,

135 (64%); MC, 116 (63.4%); Mex, 116 (73.4%); y Panám, 137 (62.3%).

Los Opistobranquios del MC demuestran relaciones a nivel especie con las adyacentes regiones temperaturales N-S. De 183 especies de opistobranquios reportadas en el MC, 97 (53%) también ocurren al norte, en el sur de California, 142 (77.6%) al sur a lo largo de la costa Pacífica Mexicana y en la porción austral de la Provincia Panámica, y 66 (36%) occurren en ambas regiones al norte y sur.

Sus relaciones provinciales E-O incluyen 13 (7%) especies circumtropicales, 10 (5.5%) Atlántico-Caribeñas, 23 (12.6%) en del Pacífico Oeste-Índico, y 9 (4.9%) en Japón. Las barreras de dispersión parecen más significativas que las barreras de temperatura. Las temperaturas del agua en MC fluctúan anualmente, permitiendo casos temporales de especies de agues más tibias y más frías. En Bahía de los Ángeles, BC, *Chromodoris norrisi, Phidiana lascrucensis* y *Discodoris ketos*, de ocurrencia austral panámica, son comunes de Julio a Septiembre (altas temperaturas del agua), pero especies que ocurren en el sur de California, *Doriopsilla albopunctata, D. gemela* y *Aeolidiella chromosoma*, son más comunes de Noviembre a Marzo. El endemismo en el MC es extremadamente bajo (10 especies, 5%, p.e., *Hypselodoris ghiselini, Conualevia marcusi,* y *Dendrodoris stohleri*). Es posible que este nivel bajará con más estudios. Nótese que *Aglaja regiscorona* y *Bornella sarape*, conocidas originalmente sólo de Las Cruces, BCS, sólo fueron reportadas en otros sitios hasta 30 años después en Costa Rica y Panamá. Las estructuras tróficas de comunidades opistobranquias varían mucho entre e intra regiones. Las comparaciones de 2 sitios de ambas regiones, BLA y Bahía de Banderas (Jalisco-Nayarit), muestran diferentes abundancias por preferencia alimenticia (Br=briozoarios; Cn=cnidarios; Es=esponjas;
He=herbívoros):
BLA Islas: Br 65.6% Es 8.8% Cn 7%
BLA Gringa/Cuevitas: He 36% Es 34.7% Cn 18.9% Br 2.8%
BB Islas/SOE Bahía: Cn 40% Br 26.5% Es 23% He 4%
BB Este Protegida: Cn 51% Es 30.5% He 5.5% Br 2.8%

Se necesitan análisis y monitoreos faunales a largo plaza de los invertebrados marinos para proveer información que permita establecer lineamientos sobre la biodiversidad, conservación de hábitats y desarrollo sustentable de los recursos del Mar de Cortés.

Agradezco a Rosa del Carmen Campay por asistencia técnica.
Datos y material suplementario en línea:
www.slugsite.us/hans/Hans_Page_01.htm

Opisthobranchia (Gastropoda) Collected by Steinbeck and Ricketts during the *Western Flyer* Expedition to the Sea of Cortez, March—April 1940

Hans Bertsch[1] and Rebecca Johnson[2]
California Academy of Sciences
875 Howard St., San Francisco, CA 94103
192 Imperial Beach Blvd. # A, Imperial Beach, Ca 91932
[1] hansmarvida@sbcglobal.net, [2]rjohnson@calacad.org

John Steinbeck and Edward F. Ricketts (Sea of Cortez: A Leisurely Journal of Travel and Research, 1941) found 14 species of opisthobranchs during their voyage along

the shores of the Sea of Cortez. They reported: *Bulla gouldiana, Haminoea strongi*, undetermined bubbleshells, *Tethys californica, Notarchus (Aclesia) sp., Dolabella californica, Tridachiella diomedea, Berthella plumula, Pleurobranchus digueti*, a small white form (Pleurobranchidae), small white *Cadlina*-like dorid, large seal-brown nudibranch, *Aegires sp.*, and *Chioraera leonina*.

We describe and update the taxonomy, natural history and biogeography of these species.

Opistobranquios (Gastrópodos) Colectados por Steinbeck y Ricketts Durante la Expedición al Mar de Cortés a Bordo del *Western Flyer*, Marzo—Abril 1940

Hans Bertsch y Rebecca Johnson

John Steinbeck y Edward F. Ricketts (Sea of Cortez: A Leisurely Journal of Travel and Research, 1941) encontraron 14 especies of opistobranquios durante su travesía por las costas del Mar de Cortés. Reportaron: *Bulla gouldiana, Haminoea strongi,* conchas burbujas indeterminadas, *Tethys californica, Notarchus (Aclesia) sp., Dolabella californica, Tridachiella diomedea, Berthella plumula, Pleurobranchus digueti,* una pequeña forma blanca (Pleurobranchidae), un pequeño dórido blanco (tipo *Cadlina*), un nudibranquio grande café oscuro, *Aegires sp.,* y *Chioraera leonina*.

Describimos y actualizamos aquí la taxonomía, historia natural y biogeografía de esas especies.

Agradecemos a Rosa del Carmen Campay por asistencia técnica.

Egg Mass Production of the Milk Conch *Strombus costatus* (Gmelin) Using Enclosure Areas in the National Park Contoy Island, Isla Mujeres, Quintana Roo, México

Daniel Blanqueto Cordova, Luis Alfonso Rodríguez Gil, Carlos Francisco Reyes Sosa,
Ramiro Alpizar Carrillo and Iván Rene Rivas Ruiz
Instituto Tecnológico de Mérida,
Departamento de Ingeniería Química y Bioquímica,
Laboratorio de Aprovechamiento de Recursos Marinos
luis_rdzgil@hotmail.com

In the peninsula of Yucatán, México, the conch fishery was permanently closed in 1987 because of overexploitation and the possibility that the conch could become extinct in the state of Yucatan. In the state of Campeche the fishery is not closed, but is regulated by size. In Quintana Roo the conch fishery is separated into three zones: north, central and south. The north and central zones are permanently closed due to overexploitation. In the southern zone the management plan revolves around the closed season, using a monthly quota during the end of the season. Both hookah and scuba diving are prohibited; the fishery is open only to free diving. The resource has not recovered from overexploitation, which has resulted in a decreased income for the fishermen.

Although fishing regulations are a way to help an overexploited population recover, mariculture is an important alternative. Conch mariculture depends on a brood stock to produce dependable egg masses, either from a natural bank or from conch held in

an enclosed area. Our study is intended to demonstrate the use of enclosures to produce a reliable production of egg masses from the conch *Strombus costatus*. We quantify the density-dependent factors that control reproduction in enclosed areas.

The experimental design consisted of two variables (area and male:female sex ratio), with areas of 20 m^2 and 40 m^2 and male:female ratios of 2:5, 2:10 and 2:15, with two replicates each. There were 12 experimental units (enclosures) within a total aea of 360 m^2. From May to August, the total production of the enclosures was 521egg masses and an estimated 102 million larvae. The male:female ratio of 2:15 in the 20 m^2 area produced the best results, with 145 egg masses and an estimated 27 million larvae.

The main predator was the cephalopod *Octopus maya*.

Producción de Puestas de Masas de Huevos del Caracol Lechoso *Strombus costatus* Gmelin, 1791, Usando Encierros en el Parque Nacional de Isla Convoy, Isla Mujeres, Quintana Roo, México

Daniel Blanqueto Cordova, Luis Alfonso Rodríguez Gil, Carlos Francisco Reyes Sosa, Ramiro Alpizar Carrillo y Iván Rene Rivas Ruiz

En la Península de Yucatán México, el recurso caracol se encuentra en veda permanente desde 1987 como resultado de su sobreexplotación y ante el peligro de su extinción en el estado de Yucatán. En el estado Campeche, no existe veda y se regula por tamaño. En el Estado de Quintana Roo para efectos de su pesquería se encuentra dividido en tres zonas: Norte, Centro y Sur. La Norte y Centro se encuentra en veda permanente también como resultado de su sobre explotación y en la zona Sur el plan de manejo ha sido respecto a la estación de veda, cuota de pesca por mes durante el cierre de la veda y limitación en el arte de pesca el cual no permite el buceo con compresora, ni autónomo, solamente el buceo libre. Hasta la fecha, el recurso no se ha podido recuperar, repercutiendo en menores ingresos a los pescadores.

Esfuerzos de diferentes disciplinas se han enfocado a la práctica de la maricultura como una alternativa para recuperar el recurso aunado a una regulación pesquera existente. Una de las etapas de la maricultura es contar con los progenitores del caracol para tener la disponibilidad de las puestas de masas de huevos, garantizando una buena reproducción, esto es posible lograrlo dentro del estudio de un banco natural o controlado como es el uso de encierros. En el presente trabajo a pesar de que la regulación pesquera es uno de los medios de recuperar las poblaciones explotadas, la maricultura es una alternativa muy fuerte que debe considerarse y dentro de esta practica está la creación de encierros que funciones en la época de reproducción.

Por lo que, el propósito de este trabajo es el de cuantificar los mecanismos denso-dependientes que controlan la reproductividad en encierros marinos en los caracoles de la especie Strombus costatus Gmelin, 1791. El diseño experimental consistió de dos variables (área y relación macho:hembra) con áreas de 20 m^2 y 40 m^2 y relaciones macho:hembra de: 2:5, 2:10, 2:15 respectivamente con dos réplicas, resultando 12 unidades experimentales (encierros) en un área total de 360 m^2. Los resultados comprendidos entre el periodo de Mayo-Septiembre en cuanto a la productividad total de los encierros es de un total de 521 puestas y un número estimado de 102 millones de

larvas. La relación macho:hembra de 2:15 en el área de 20 m^2 resultó el mejor en este trabajo con 145 puestas y un estimado de 27 millones de larvas.

El principal depredador resultó ser el pulpo *Octopus maya.*

Species Differentiation in the Venerid Bivalve Genus *Transennella*

Lillian E. Bloch, Michael P. Russell and Todd R. Jackman
Villanova University Mendel Science Center G74 Villanova PA USA
lillian.bloch@villanova.edu

W.H. Dall renamed the bivalve *Venus tantillus* (Veneridae) to *Transennella tantilla* in 1883 and it took nearly 100 years for the second California species, *T. confusa*, to be described as distinct from *T. tantilla* in 1982. Morphologically the two species are nearly cryptic, but distinguishable on subtle differences in shell color and shape, as well as siphon morphology. The two species inhabit the same sandy areas of protected bays along the Pacific coast of North America and are integral to nearshore community structure. Here we present molecular data on the timing of the speciation event as well as a hypothesis for the maintenance of reproductive isolation. Both species undergo direct development within a brood chamber of the female. Males release spermatozeugmata – sperm aggregates consisting of a central modified cell or mass of acellular membranes that the sperm heads are attached to. Reproduction occurs during the same time of year and males expel spermatozeugmata into the water column. Either spermatozeugmata or individual spermatozoa must enter the mantle cavity of the female via the inhalant siphon to fertilize eggs.

We sequenced both mitochondrial and nuclear DNA for both *T. tantilla* and *T. confusa* and have confirmed Gray's differentiation of these two species. For the mitochondrial cytochrome oxidase I (COI) region the two species have an average base pair difference of 13.8% suggesting a divergence time of 16.5 million years. This is a particularly long period especially for two species that are morphologically so similar and live sympatrically. The nuclear H3 histone gene shows a similarly large divergence between the two species with a base pair difference of 3.5%.

In order for these species to remain separate, there must be some physiological or chemical mechanism that females use to distinguish interspecific from intraspecific sperm. One potential mechanism is the surface of the gills because bivalve gills have been shown to discriminate ingested food particles. We propose the hypothesis that *T. confusa* and *T. tantilla* females differentiate sperm and/or spermatozeugmata based on morphology using the same mechanism of particle sorting on the surface of the gills. Spermatozeugmata likely play a key role in sperm protection and have not been reported previously in Venerids.

Estimation of Relative Fecundity in *Atrina maura* (Mollusca: Pinnidae)

Carlos Cáceres-Martínez and Daniela Barrios-Ruiz
Universidad Autónoma de Baja California Sur, Carretera al Sur Km 5.5, Col El Mezquitito, La Paz, 23080, México
ccaceres@uabcs.mx
dbarrios@uabcs.mx

Advances in the use of image analysis provide the opportunity to use images for the study of reproduction in invertebrates, particularly the molluscs. *Atrina maura* were sampled monthly from Laguna San Ignacio, BCS, México (2002-2003). From the gonads, sixteen serial histological slides of 7 µm thickness were obtained using classical paraffin embedded techniques, and stained with Hematoxilin-Eosine. The slides were digitalized and analyzed using Corel® and Sigma Scan® software to select and follow one follicle. In the case of females the number of oocytes was recorded and their surface area was measured, as was the area of empty follicles. In the case of males the follicle surface was measured and the content of empty spaces. These values allowed the estimation of the number of cells per unit volume, in the case of oocytes, their measures were directly used and in the case of males, we used a scanning microscope analyses for the volume estimation of spermatozoa. The values were compared with the total tissue volume estimations done by Barrios-Ruiz (2005) to calculate relative fecundity. During the reproductive period for females we found 1,500 x106 potentially fecund eggs in the females and 15,000x109 potential spermatozoa per male.

Are Toxic Dinoflagellates Harmful to Bivalves?

Norma A. Estrada[1], Felipe Ascencio[2] and Rubén G. Contreras[1]
[1]Departamento de Fisiología, Biofísica y Neurociencias, Centro de Investigación de Estudios Avanzados (Cinvestav), México, D.F., México
rcontrer@fisio.cinvestav.mx
[2]Departmento de Patología Marina, Centro de Investigaciones Biológicas del Noroeste (CIBNOR), La Paz, B.C.S., México
ascencio@cibnor.mx

Bivalve molluscs are filter feeders, principally of microalgae. Among the microalgae, some are toxic and have some of the most potent poisons found in nature. Some toxic microalgae are responsible for red tides and have adverse effects on many animals. Molluscs ingest these toxic microalgae by filtration and accumulate the toxins in several tissues. Little attention has been given to the effects toxic microorganisms on the molluscs. Some authors state that these toxic microalgae have little effect on filter feeders, despite the frequent exposure of bivalves to these toxins. This work determined several effects caused by the dinoflagellate *Gymnodinium catenatum*, a well-known producer of paralytic shellfish poisons (PSPs) on one mollusc, the Pacific lion's-paw scallop *Nodipecten subnodosus*. These PSPs inhibit the action potential in excitable membranes. Juvenile *N. subnododus* were exposed by feeding *G. catenatum* and by

injection with an extract of its paralyzing toxins. During feeding experiments at high concentrations of this dinoflagellate, production of pseudofeces, partial closure of the shell valve, reduced feeding rates, melanization, and hemocyte aggregation occurred. The decreasing order of toxin accumulation in this scallop was digestive gland > labial palps > intestine > gills > mantle > adductor muscle; the total contribution of toxin in the viscera was more than 80% of the total body burden. Juvenile scallops exhibit no apparent detrimental physiological responses in a long-term feeding experiment; however in a short-term feeding experiment, several enzymes related to the defense system are affected. In general, the adductor muscle is least affected; in the digestive gland, the presence of some enzymes could be the result of defensive and digestive processes. Also, there is a marked effect on the gills and mantle tissue, probably because these sites respond first to the presence of toxic dinoflagellates, leading to the idea that proteolytic cascades could be involved. Severe stress was caused by injection of sublethal doses of the crude PSP preparation, where there was mantle retraction and incapacity for shell closure; these specimens subsequently recovered over the next 2 to 3 days and continued to filter normally. It seems that *N. subnodosus* experienced periods of immuno-suppression during the first 24 h with a clear effect on hemocytes, such as vacuole formation and apoptosis processes. The subsequent recovery was clearly reflected in the total hemocytes count and in the various lysosomal enzymes measured from samples of the hemolymph.

Parasites of the Renal Sacs from *Octopus hubbsorum* Berry, 1953, in Bahía de La Paz, BCS México

S. Castellanos-Martínez[1], Ma. C. Gómez- Del Prado Rosas [2] and F.G. Hochberg[3]
[1]Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional, Apdo. Postal 592, La Paz B.C.S. 23000 México. scastellanosm@ipn.mx
[2] Universidad Autónoma de Baja California Sur. Área Interdisciplinaria de Ciencias del Mar. Departamento de Biología Marina. Carretera al Sur. Km 5.5 C.P.23080 LaPaz, B.C.S. mcgomez@uabcs.mx
[3]Department of Invertebrate Zoology, Santa Barbara Museum of Natural History. 2559 Puesta del Sol Road, Santa Barbara, California. 93105-2936 fghochberg@sbnature2.org

Parasites are not usually found in the renal sacs of their hosts. However, the enigmatic organisms of the phylum Dicyemida live attached inside the renal sacs of benthic cephalopods, feeding on nutrients rich in nitrogen and carbohydrates existing in the host urine. *Octopus hubbsorum* Berry, 1953, is the main species caught in the Gulf of California and it sustains the fishery in the Mexican Pacific. The objective of this research is to know if *Octopus hubbsorum* found in Bahía de La Paz harbor dicyemids. Each week during October and November, 2003, and February and May, 2004, renal sacs from two to five hosts were obtained from local fishermen. The renal sacs were fragmented in small pieces and 15 smears were made for each host. Smears were fixed in Bouin for 24 h, preserved in 70% ethyl alcohol and stained with Hematoxylin-Eosin. A total of 53 hosts were collected and only 13 were infected (24%). Parasites belong to the genera *Dicyema* von Kölliker, 1849, and are characterized by 22 somatic cells, with their respective vermiform embryos and infusoriform larvae. These represent the first record of

dicyemids from *Octopus hubbsorum* and the first time that parasites have been found in this cephalopod.

Paralytic Shellfish Toxins in the Lion's-PawScallop *Nodipecten subnodosus* in Bahía de los Ángeles in the Gulf of California

Ismael Gárate-Lizárraga[1], Marcial Arellano-Martínez[1]
Bertha Patricia Ceballos-Vázquez[1], José Bustillos-Guzmán[2],
David Javier López-Cortés[2] and Francisco Hernández-Sandoval[2]
[1]Centro Interdisciplinario de Ciencias Marinas-I.P.N, Apartado Postal 592, La Paz, B.C.S. 23000, México
igarate@ipn.mx
[2]Centro de Investigaciones Biológicas del Noroeste, Apartado Postal 128, La Paz, B.C.S. 23000, México

To detect the presence as well as the toxin profile of paralytic shellfish poisons (PSP) in the lion's-paw scallop *Nodipecten subnodosus*, ten specimens were collected from a natural bed of these scallops on the shore of Bahía de Los Ángeles (~29°N, ~113.5°W). Scallop samples were taken monthly from February to December 2006. Net (20 µm) and bottle samples were collected to identify and count toxic phytoplankton species. About 200–250 mg of shellfish tissue was homogenized and stored at 4 °C. Toxins were extracted by adding 2 ml acetic acid (0.03 N) to 0.20 g scallop tissue. A 150-µl aliquot of clarified extract was used for hydrolysis with 37 µl HCl (1 M). Ten µl of both extracts (with and without hydrolysis) were injected into an HPLC system with a post column oxidation and fluorescence detection method. Toxicity values were detected throughout the year except in September and October. Levels of toxicity ranged from 3.1 (December) to 54.0 µg/STXeq/100 g (February). These levels of PSP are below the limits established by the FDA (80 µg/SAXeq/100 g). Toxin profiles include nine saxitoxin analogues: STX, GTX2, GTX3, dcSTX, dcGTX2, dcGTX3, C1, C2, and B1. The toxin profile observed in our samples is quite similar to those found in molluscs from other coastal lagoons around the Gulf of California.

Gymnodinium catenatum was the only PSP-producing dinoflagellate identified in the phytoplankton samples throughout the study and should be considered the main source of PSP in molluscs. *G. catenatum* occurred from February through October in moderate and low concentrations. This dinoflagellate usually formed four-to-six cell chains and sometimes 12-to-18 cell chains. Highest nutrient concentrations were determined when highest abundance of *G. catenatum* proliferates. This species was found in a temperature range from 16 to 26 °C. This suggests that environmental conditions were sometimes appropriate for its proliferation. Highest concentrations of *G. catenatum* occurred from February through April, coinciding with the highest toxicity levels.

This study represents the first report of *G. catenatum* and PSP from the Bahía de Los Ángeles. As part of the ongoing monitoring program in this bay, we recorded proliferation of the dinoflagellates *Akashiwo sanguinea* and *Heterocapsa* sp. and recently (May 2007) *Ceratium furca/Ceratium balechii*. Others blooming species, such as *Amylax triacantha, Gonyaulax polygramma, Lyngulodinium polyedra, Noctiluca scintillans, Prorocentrum minimum, P. micans,* and *Scrippsiella trochoidea* were observed. The dinoflagellates *Dinophysis acuminata* and *D. forthii*, producers of okadaic acid, occurred throughout the year. Some diatoms, producers of domoic acid, including *Pseudo-*

nitszchia fraudulenta were also present. We are still monitoring for toxic phytoplankton and paralytic toxins in other molluscs bivalves of commercial importance.

Paralytic Shellfish Toxin in Marine Molluscs from the Southwestern Region of the Mexican Coasts (1992-2006)

Ismael Gárate-Lizárraga[1], Jesús Díaz-Ortiz[2], Mario Alarcóntacuba[2], Beatriz Pérez Cruz[2], Alejandro Torres-Jaramillo[2], Mario Alberto Alarcón-Romero[2] and Saúl López-Silva[2]
[1]Centro Interdisciplinario de Ciencias Marinas (CICIMAR-IPN), Avenida Politécnico S/N, Col. Playa Palo de Santa Rita, La Paz, B.C.S. 23090, México
igarate@ipn.mx
[2]Laboratorio Estatal de Salud Pública Pdr. Galo Soberón y Parra, Boulevard Vicente Guerrero Esq. Juan R. Escudero S/N, Cd. Renacimiento, Acapulco, Guerrero 39715, México
lesp_guerrero@prodigy.net.mx

Paralytic shellfish poisoning in Mexico is generally associated with consumption of shellfish from the coastal regions. Paralytic toxins are present in several species of toxic algae which proliferate to form massive blooms. Harmful algal blooms have occurred for more than 100 years along the Pacific coast. However, in the southwestern region of México only a few events have been documented. This study presents a time-series (1993-2006) of harmful dinoflagellate blooms and paralytic shellfish poisoning that have occurred in several species of molluscs of commercial importance. As a part of a monitoring program for determining the toxicity of poisons, several species of marine bivalves were collected at sampling sites from the state of Guerrero, mainly near Acapulco and Oaxaca. These species include violet oyster (*Chama mexicana*), silvered oyster (*Crassostrea* sp.), queen clam (*Chione purpurissata*), Margarita scallop (*Spondylus princeps*), Lion's-paw scallop (*Nodipecten subnodosus*), Chinese snail (*Muricanthus princeps*), and mejillón tichinda (*Mytella arciformis*). Phytoplankton collections were also made to identify the species that produce paralytic toxins. As a result of the monitoring program, the blooms were mainly caused by *Gymnodinium catenatum, Pyrodinium bahamense* var. *compressum, Cochlodinium polykrikoides*, and *Akasiwo sanguinea*. Of these, two species produce paralytic toxins—*G. natum* and *P. bahamense* var. *compressum*. Fourteen blooms of *G. catenatum* were observed between 1993-2006 and they reached densities of 2.5–3.3 x 106 cells l^{-1}. Seven blooms of *P. bahamense* var. *compressum* occurred in the study area. Levels of toxins in marine bivalves ranged from 20.65 to 7309 µg STXeq 100 g^{-1}. The highest value of toxicity was found in November 2001 at Las Palmitas, Acapulco, in the violet oyster (*Chama mexicana*). Highest levels of toxicity occurred between 1999 and 2001. Blooms along the Oaxaca coast to the southeast were also caused by *G. catenatum* and *P. bahamense* var. *compressum* with levels of toxicity ranging from 24–1456 µg STXeq 100 g^{-1}. This highest value occurred in November 2001 at Corralero, Pinotepa Nacional, Oaxaca in the mejillón tichinda. Monitoring programs of toxic species of algae and paralytic poisoning are continuous because outbreaks would cause significant economic and public health problems.

Mortality Rate of the Intertidal Purple Snail *Plicopurpura pansa* after Being Removed from the Rocks

Jorge A. López-Rocha[1] and Ludwig Naegel[2]
Centro Interdisciplinario de Ciencias Marinas (CICIMAR IPN) A. P. 592, La Paz, Baja California Sur, Mexico
[1]lopezr@ipn.mx, [2]lnaegel@ipn.mx

Introduction

The endangered purple snail *Plicopurpura pansa* (Gould 1853) (Prosobranchia: Muricidae) lives strongly attached on rocks hit by high impact waves in the intertidal zone of the tropical east Pacific from the south of the peninsula of Baja California to northern Peru and the Galápagos Islands (Keen 1971 and Paredes *et al.* 1999). The hypobranchial gland secretes a purple pigment ("Tyrian Purple"), which can be obtained without hurting the animals (Ríos-Jara *et al.* 1994 and Naegel 2005). In Mexico and Central America, the pigment has been used for centuries by indigenous people to dye cotton yarns, which are subsequently woven into ceremonial dresses. It is interesting however, to observe in reports that the exploration of purple snail for its pigment caused drastic declines of the snail population (Nuttall 1909 and Turok & Acevedo 2000). It has been suggested that one of the major reasons for the mortality of the snails after the collection of the "ink" could be explained by the effect of removing the snails from the rocks (Naegel 2005, and Naegel & López-Rocha 2006). Mortality rates of purple snail of two rocky beaches in the southern of peninsula of Baja California were analyzed by tagging experiments. During recaptures, each tagged snail was detached from the substrate to verify the mark and then returned onto the rock. Two causes for mortality are considered in the analysis: a) natural mortality (M) and b) mortality rate caused by detaching the snails from the substrate (D). During considerations about the management, conservation and recuperation of endangered snail populations it is important to determine their rate of mortality and to suggest ways for their recovery.

Material and Methods

The tagged-recapture experiments with purple snails were done at two rocky beaches: at Playa Cerritos on the Pacific (23°19'54" N, 110°10'38" W) and at Punta Perico in the Gulf of California (24°01'54" N, 109°45'21" W). Between February and November 2001 five tagging-recapture experiments were performed. All snails were collected in a transect of 2 x 50 m in the meso-supertitoral zone. The snails were marked on top of their shells with numbered and colored plastic tags, as used in beekeeping. Monthly attempts were made to recapture the animals, which were removed to determine the tag number and afterwards replaced on the rocks. At Playa Cerritos an additional experiment was done from November 2004 until May 2005. During this experiment 431 tagged snails were used, these has been previously maintained in the laboratory and had their sex determined by the presence/absence of a penis.

Mortality rate of the animals was determined by tagging-recapture model (Lebreton *et al.* 1992). Since hat the removal of the snails from the rocks causes a loss of animals (Castillo-Rodríguez and Amezcua-Linares, 1992 and Naegel & López-Rocha 2006), in this study the determination of the total mortality (Z) includes natural mortality (M), mortality due to the detachment of the snails (D), and the loss of tags (L): Z = M+D+L. The probability that a tagged snail might be recaptured (Pt) can be described with the following formula: $Pt = Qt\,(M + D + L)^{-1}\,(1 - e^{-(M+D+L)Qt})$
Where the probability of survival (Qt) and tag retention can be express as follows:
$Qt = e^{-(M+R+L)t}$. Parameter estimation was done with a maximum likelihood function and likelihood profiles were used to obtain confidence intervals of the parameters (Hilborn & Mangel 1997).

Estimations of Z include the effect by lost tags (L), but it was not possible in the field tests to determine the number of lost tags. However, laboratory experiments with the same type of tags showed few tag losses. Additionally a simulation was applied with some possible rates of tag losses to obtain an estimation of this effect in the values for the total mortality (Z).

Results

In the six experiments a total of 1,161 snails were tagged and 530 (46%) were recaptured (Table 1). In the first three tag-recapture experiments at Playa Cerritos 472 animals were tagged and 161 (34%) recaptured. In the experiment with sexed animals 226 males and 155 females were tagged, and 157 (48%) males and 155 (31%) females were recaptured. At Playa Perico in two experiments 258 animals were tagged and 190 (74%) snails could be recaptured (Table 1).

Table 1. Number of tagged and recaptured snails, days to recapture and mean length of purple snail, *P. pansa*, in six tagging experiments in the southern peninsula of Baja California, México s. d. = standard deviation.

Tagging experiment	Number of tags	Number of recaptured snails	Percentage of recaptures	Number of recaptures	Mean Length (mm) ± s. d.
1 Cerritos	197	68	35	7	25.94 ± 5.78
2 Cerritos	176	57	32	5	29.05 ± 6.28
3 Cerritos	99	36	36	3	29.88 ± 6.52
4 Punta Perico	159	121	76	7	31.38 ± 7.05
5 Punta Perico	99	69	70	4	31.04 ± 5.89
6a Cerritos (males)	226	127	48	4	27.90 ± 4.04
6b Cerritos (females)	155	51	31	4	30.36 ± 5.54

Mortality rates of snails at Playa Cerritos varied from 6.34 to14.23 year $^{-1}$, which were higher than the estimates from Punta Perico (5.04-7.79 year $^{-1}$) (Table 2). Mortality rates for males were lower with 5.70 year $^{-1}$ (5.25 - 6.19 year $^{-1}$ confidence intervals of likelihood profile) than for females 7.29 year $^{-1}$ (6.53 - 8.14 year $^{-1}$ confidence intervals of likelihood profile) (Table 2). To determine the effects of tag losses, loss rates of 0.1 year $^{-1}$ and 0.3 year $^{-1}$ were simulated which mean a loss between 5 and 28% and 13 and

62% respectively. The results show that the loss of tags has only a very small effect in determining the total mortality.

Table 2. Total mortality rate ($year^{-1}$) estimations of purple snail, *P. pansa* in six tagging experiments in the southern peninsula of Baja California, México. Minimum and maximum values corresponds to 95% likelihood profiles confidence intervals.

Tagging experiment	Z	Z (min)	Z (max)
1 Cerritos	6.86	6.34	7.41
2 Cerritos	9.13	8.24	10.14
3 Cerritos	11.71	9.54	14.23
4 Punta Perico	7.20	6.71	7.79
5 Punta Perico	6.04	5.04	7.16
6a Cerritos (males)	5.70	5.25	6.19
6b Cerritos (females)	7.29	6.53	8.14

Discussion

It has been recognized that removing the snails from the substrate and the long time needed to reattach could be an important cause of mortality because of the animals' high vulnerability to the wave action (Naegel 2005 and Naegel & López-Rocha 2006). Also, physiological injures to the pedal muscle by removal of the snails from the rocks have been reported (Castillo-Rodríguez & Amezcua-Linares 1992). Therefore, it is reasonable to assume that a significant mortality during the experiments was caused by the removal of the snails from the substrate to verify the marks. Mortality estimates at Playa Cerritos were higher than at Punta Perico, which can be related to the higher impact of the waves in Playa Cerritos. Two experiments from Playa Cerritos are of special interest. One was carried out from February 6 until November 15, the warm season, whereas the other took place from November 11, 2004 to May 13, 2005 during the cold season. During the cold season the snail mortality was lower, which could be explained by a decreased incidence of desiccation after being removed from the substrate. Estimations of the mortality related to the sex of the animals showed a higher mortality rate among females than among males. The larger size of the females (Ramírez-Rodríguez & Naegel 2003) and the higher mortality could be related to diminished possibility of protection against the high impact waves (Denny *et al.* 1985).

Michel-Morfín *et al.* (2000) estimated by applying different estimation methods, natural mortality rates (M) for purple snail from 0.21 to 1.79 $year^{-1}$. In the present study, estimated total mortality rates (Z) ranged from 5.04 to 14.23 $year^{-1}$. These higher values indicate that the removal of the snails from the substrate could be one important reason for the high mortality.

Michel-Morfín and Chávez (2000) mentioned that for the exploitation of the purple snail the animals should be handled not only carefully but also that a period between each "milking" should be observed. However, Naegel (2005) could show that periodically "milking" to obtain "Tyrian Purple" does not increase the mortality of the snails and the results of the present study show that the careful displacement of the snails does not guarantee a low impact on the populations of the purple snail. For the conservation of the endangered purple snail a strict enforcement of the prohibition to

collect purple snail for its "ink," is therefore needed. Yes, even the removal of snails from the crevices of wave swept rocks should not be allowed.

Acknowledgements

J.L. thanks for a doctoral fellowship (No. 2005578) from CONACYT. The Instituto Politécnico Nacional funded this project (COFAA and EDI).

References

Castillo-Rodríguez, Z. G. & F. Amezcua-Linares F.
1992 Biología y aprovechamiento del caracol morado *Plicopurpura pansa* (Gould, 1853) (Gastropoda: Neogastropoda) en la costa de Oaxaca, México. An. Inst. Cienc. del Mar y Limnol. Univ. Nal. Autón. Méx. 19(2):223-234.

Denny, M. W., T. L. Daniel & M. A. R. Koehl.
1985. Mechanical limits to size in wave-swept organisms. Ecol. Monogr. 55:69-102.

Hilborn, R. & M. Mangel.
1997. The ecological detective. Confronting models with data: Monographs in Population Biology, Princeton Academic Press. 315 pp.

Keen, A.M.
1971. Sea shells of tropical West America: Marine molluscs from Baja California to Peru. Stanford, California: 2nd. ed. Stanford Univ. Press. 1064 pp.

Lebreton, J. D., K. P. Burnham, J. Clobert & R. D. Anderson.
1992. Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies. Ecol. Monog. 62:67–118.

Michel-Morfin, J. E. & E. A. Chavez.
2000. Effect of repetitive dye extraction over yield and survival rate of the purple snail *Plicopurpura pansa* (Gould, 1853). J. Shellfish Res. 19(2):913-917.

Michel-Morfin, J. E., E. A. Chavez & V. Landa.
2000. Population parameters and dye yield of the purple snail *Plicopurpura pansa* (Gould, 1853) of west central Mexico, J. Shellfish Res. 19(2):919-925.

Naegel, L.
2005. The effect of periodically "milking" to obtain Tyrian Purple from *Plicopurpura pansa* (Gould, 1853) on the frequency of expulsion and mortality. J. Shellfish Res. 24(1):85-90.

Naegel, L. & J. A. López-Rocha.
2006. Can the collection of "Tyrian Purple" from *Plicopurpura pansa* (Gould, 1853) (Prosobranchia, Muricidae) be blamed for its declining population? J. Shellfish Res. 25(2):395-398.

Nuttall, Z.
1909. A curious survival in Mexico of the use of the purpura shellfish for dyeing In: Putnam Anniversary Volume. Cedar Springs, Iowa: The Torch Press. pp. 3566-384.

Paredes, C., P. Huamán, F. Cordoso, R. Vivar & V. Vera.
1999. Estado actual del conocimiento de los moluscos acuáticos en el Perú. Revista Peruana de Biología 6(1):5-47.

Ramírez-Rodríguez, M. & L.C.A. Naegel.
2003. Growth of the purple snail *Plicopurpura pansa* in Baja California Sur, México. Ciencias Marinas 29(3):283-290.
Rios-Jara, E., H. G. León-Alvarez, L. Lizárraga-Chávez & J. E. Michel-Morfín.
1994. Producción y tiempo de recuperación del tinte de *Plicopurpura patula pansa* (Neogastropoda: Muricidae) en Jalisco, México. Rev. Biol. Trop. 42(3):537-545.
Turok, M. & J. Acevedo.
2000. Protection of the colorful Mixteca and Nahoa indigenous dye traditions in Mexico: the saga of the *Plicopurpura pansa* snail. In: Use of incentive measures for conservation and sustainable use of biological diversity. The Hague, Netherlands: United Nations Environmental Program (UNEP). pp. 131-157.

Brominated Compounds in the Secretion of the Hypobranchial Gland of *Plicopurpura pansa* (Gould, 1853) (Prosobranchia: Muricidae)

Jesús I. Murillo-Álvarez[1], Ludwig C.A. Naegel[1] and Cormac D.Murphy[2]
[1]Interdisciplinary Center for Marine Sciences (CICIMAR/IPN), La Paz, B.C.S. México
lnaegel@ipn.mx, murillo@uabcs.mx
[2] School of Biomolecular and Biomedical Science, University College Dublin,Ireland.
cormac.d.murphy@ucd.ie

We have previously investigated, using simple analytical methods, some of the biological and chemical properties of the secretion of the hypobranchial gland of the intertidal purple snail *Plicopurpura pansa* (Gould, 1853) (Prosobranchia: Muricidae). In this study we used gas chromatography coupled to a mass-spectrometer (GC-MS) to find out the origin and formation of the precursors of "Tyrian Purple" in the secretion. Adults of the intertidal purple snail were kept in the laboratory in inverted glass carboys with cut-off bottoms, each filled with 15 liters seawater (30-34 ‰) and maintained at 21-23 °C in a 12 h light/dark cycle with daily water exchanges. The animals were fed daily to satiation with squid. The expulsion of the secretion was stimulated by slightly pressing the operculum. The secretion was collected under a nitrogen stream and monochromatic red light, and to stop enzymatic reactions, an ice bath, alcohol, or a sand-bath (160 °C) was used. The secretion was frozen at -60 °C, subsequently freeze-dried, obtaining a yellowish/light greenish powder. The brominated compounds in the freeze-dried secretion were determined, after trimethylsilylation, by GC-MS. Samples were injected on a HP-1 column (12 m x 0.25 mm x 0.33 µm) with helium as the carrier gas (1 ml/min) and the oven held at 120 °C for 2 min then raised to 300 °C at 10 °C/min. Since the biosynthesis of indigoids commences with tryptophan and the enzyme bromoperoxidase is present in the hypobranchial gland the metabolites of tryptophan 6-bromoindol, 6-bromoindoxyl, and 6 bromoindoxylsulfate were expected to be found in the samples Astonishingly not one of these compounds could be detected, suggesting that a novel biochemical pathway may be used by muricids, bypassing indole and converting tryptophan directly into indoxyl sulfate esters. The chromatogram showed three major peaks obtained after 7,460, 9,437 and 11, 458 minutes and some minor peaks as well. The peak obtained at 7,460 minutes had a fragmentation pattern that was consistent with non-

derivatized tyrindoleninone. The second major peak at 9, 437 minutes showed fragments at m/z 498, 456, 401, 372, 314, 224, 184, 134 and 110. This mono-brominated compound appeared to be very abundant in the secretion, but it was not possible to assign to it a chemical structure. The peak with a retention time of 11, 458 minutes and a fragmention pattern (m/z 403, 388, 373, 307, 208, 147) seems to be trimethylsilyl derivatized tyrindoxyl, which may be originated from tyrindoxyl sulphate during the trimethylsilylation reaction. Furthermore, tyrindoleninone and 6-bromoisatin were detected by GC-MS analysis of a chloroform/methanol extraction of the secretion.

Brominated Compounds in Egg Capsules of the Intertidal Purple Snail *Plicopurpura pansa* (Gould, 1853) (Prosobranchia: Muricidae)

Ludwig C.A. Naegel [1], Cormac D.Murphy[2] and Jesús I. Murillo-Alvarez[1]
[1]Interdisciplinary Center for Marine Sciences (CICIMAR/IPN), La Paz, B.C.S. Mexico.
lnaegel@Ipn.mx , murillo@uabcs.mx
[2]School of Biomolecular and Biomedical Science, University College Dublin, Ireland.
cormac.d.murphy@ucd.ie

Adults of the intertidal purple snail *Plicopurpura pansa* (Gould, 1853) (Prosobranchia: Muricidae) were kept in the laboratory in inverted glass carboys with cut-off bottoms, each filled with 15 liters seawater (30-34 ‰) and maintained at 21-23 °C in a 12 h light/dark cycle with daily water exchanges. The animals were fed daily to satiation with squid. The date of capsule deposition was marked on the carboy and capsules were removed at determined intervals, frozen at – 60 °C and freeze-dried. The brominated compounds in the capsules were determined, after trimethylsilylation, using gas chromatography coupled to a mass spectrometer (GC-MS). Samples were injected on a HP-1 column (12 m x 0.25 mm x 0.33 µm) with helium as the carrier gas (1 ml/min). During embryonic development (day 0 until 48) undamaged capsules contain only the yellowish brominated indoles tyrindoxyl and two unidentified compounds, which are most likely isomers based on their fragmentation patterns. The biological source and biosynthesis of these brominated indoles, as well the biological benefits for the eggs and the developing embryos of the snails, is not yet known. Only a multi-disciplinary effort can answer these questions. Undamaged capsules have a yellowish brownish color, however when injured and exposed to oxygen a chemical chain reaction starts forming the orange colored tyrindoleninone, which is toxic to both marine and human pathogens at a concentration of 1 mg/ml. Upon exposure to light the green brominated indole tyriverdin, bromoisatin, and finally "Tyrian Purple" (6,6'-dibromindigo) are formed. The generation of "Tyrian Purple" in egg capsules is generally accepted as a diagnostic feature of embryonic mortality in muricids.

Gene Flow of Queen Conch *Strombus gigas* in the Mexican Caribbean

R. Perez-Enriquez[1], G. Mendoza[1], F.J. Garcia-Rodriguez[2], and T. Gutierrez[1]
[1] Centro de Investigaciones Biológicas del Noroeste, S.C., Mar Bermejo 195, Col.Playa Palo Santa Rita, La Paz, B.C.S. 23090, México
rperez@cibnor.mx
[2] Centro Interdisciplinario de Ciencias Marinas-Instituto Politécnico Nacional (CICIMAR-IPN), A. P. 592, La Paz, B.C.S. 23000, México

The economic importance of queen conch *Strombus gigas* fishery requires detailed information about the biology of its population. Knowledge of the gene flow along the distribution area of the species is particularly important due to the possibility that the fishery resource is shared among several countries along the Caribbean Sea. In this study, a population genetics analysis of *S. gigas* was performed in three locations of the Mexican Caribbean: Banco Chinchorro, Cozumel and Arrecife Alacranes. The study was based on two mtDNA regions through two methodological approaches: RFLPs of Cytochrome Oxidase subunit I (COI) and direct sequencing of Cytochrome b(Cyt-b).

The results, using both methodologies, revealed medium to high genetic diversity at the three locations, indicating that overfishing has not yet caused a significant loss of the genetic diversity. The analysis of haplotypic frequencies and population differentiation showed non-significant values of Fst. Specific associations between sequences and locations in a Neighbor Joining dendrogram were not found. These findings mean gene flow is enough to avoid population differentiation; therefore, there is no evidence to indicate that the Mexican Caribbean queen conch population is subdivided. However, a gradient in the haplotypic frequencies of both COI and Cyt-b coincident with the geographic position of the study sites was observed, indicating a probable isolation-by-distance trend. The implications of these findings in the management of the fishery in both México and the rest of the Caribbean are discussed.

Biochemical Biomarkers as a Tool to Assess Aquatic Heavy Metals Contamination Using the Catarina Scallops, *Argopecten ventricosus* (Sowerby, 1842)

A. Sobrino-Figueroa[1] and Carlos Cáceres-Martínez [2]
[1]Laboratorio de Ecotoxicología. Uam-Iztapalapa. Av. San Rafael Atlixco # 186 Col. Vicentina, Delegación Iztapalapa, C. P. 09340 México D.F.
coco@xanum.uam.mx
[2] Laboratorio de Cultivo de Moluscos UABCS Unidad Pichilingue Carretera A Pichilingue Km 18. La Paz, B.C.S. México.

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 1970's, apparent over-exploitation has caused the fishery to decline up to 86%. Due to a lack of environmental studies related to any alternative cause, this study is an evaluation of 2 biomarkers: oxidative stress and genetic damage. Gill tissues from catarina scallops,

raised in the cultivation nursery of UABCS, were examined to detect the presence of toxic and genotoxic substances. The use of this biomarker as a reliable tool in environmental biomonitoring studies was evaluated. Adult scallops (5.0 ± 0.5 cm) were collected in summer and winter during 1998, 1999 and 2000, in the sea culture bed, located near the Pichilingue harbor. Tissue gill samples were disintegrated; oxidative stress was determined as malondialdehide (MDA) concentrations; and genetic damage based on the single cell gel electrophoresis technique. Between 15 and 20 specimens for each year's station (summer and winter) were analyzed. The results indicated that significant differences exist in the degree of oxidative stress and genetic damage between the organisms collected in summer and winter. The organisms collected in summer (1998) presented a higher degree of lipid peroxidation (42.7 µM MDA) and the biggest number of damaged cells (24%) and the size in the tails (91.4 µm). In comparison those obtained in winter (2000) showed lipid peroxidation value of (9.07 µM MDA), and lower values for damage cells (15.8% and 32 µm). The previous results agree with the pollutant levels registered in the place where the scallops were collected, since the highest concentrations of heavy metals is in summer it is evident that this biomarker is a good tool in environmental biomonitoring studies.

Identification of *Vibrio harveyi* Using PCR Amplification Method in Cryopreserved Samples of Sperm of Red Abalone *Haliotis rufescens*

Alberto M. Velasco[1], John T. Buchanan[2] and Carmen G.Paniagua-Chávez[1]
[1]Department of Aquaculture. Centro de Investigación Científica y de Educación Superior de Ensenada (Cicese) Ensenada, Baja California, México 22800
eco.alberto@gmail.com
[2]Department of Pediatrics and Infectious Diseases. University of California, San Diego (UCSD) La Jolla, CA. 92093, USA.
jtbuchan@ucsd.edu

Cryopreservation of sperm of important aquatic species is useful for genetic studies, artificial breeding, and conservation. However, an important issue that must be considered in the conservation of genetic resources is the possibility of microbiological cross-contamination in sperm samples stored in the germplasm banks. Biosecurity is an important issue and several approaches to reduce the risk of pathogen transfer need to be developed for aquatic species. The *Vibrio harveyi* strains are pathogenic to a wide range of marine fish and shellfish, having a significant negative economic impact on aquaculture worldwide. Thus, a reliable and rapid method of detecting *V. harveyi* is necessary. We applied the PCR molecular method to determine if pathogenic bacteria *V. harveyi* are present in sperm samples of red abalone *Haliotis rufescens* before and after cryopreservation. Samples for the identification of *V. harveyi* were based on using the luxN gene as a taxonomic marker. The PCR technique is considered as a rapid, reliable and reproducible procedure that is based on established protocols. The results of the PCR, revealed positive amplification of the luxN gene fragment in *V. harveyi* strains. The PCR was specific and sensitive, enabling the identification of *V. harveyi*. Detection of the presence of the luxN gene could therefore serve as a suitable detection marker of *V. harveyi* isolating potentially pathogenic to fish and shrimps.

MOLLUSC AQUACULTURE AND FISHERIES SESSION

Organized by Carlos Cácares Martínez

Effect of Temperature on Growth and Survival of *Crassostrea corteziensis* Spat During Late-Nursery Culturing at the Hatchery

Jorge Iván Cáceres-Puig, P. E. Saucedo and F. Abasolo-Pacheco
Centro de Investigaciones Biológicas del Noroeste, Mar Bermejo 195, Col. Playa
Palo de Santa Rita, La Paz, BCS, México 23090
http://www.cibnor.mx, jcaceres@cibnor.mx, psaucedo04@cibnor.mx

Nine temperatures (16, 18, 20, 22, 24, 26, 28, 30, and 32°C) within the natural range of distribution of the Cortez oyster *Crassostrea corteziensis* were tested to determine the optimal temperature for growth and survival. Based on these results, a second study assessed two temperatures above this range (34 and 36°C) to determine upper median lethal temperature for the species. Thirty, 5-mm shell height juveniles were maintained in triplicate 20-L plastic containers within individual black plastic bags. They were fed a 1:1 ratio of microalgae *Isochrysis galbana* and *Chaetoceros gracilis* once a day. Greater growth of specimens was observed in the medium-range temperatures (24, 26, 28 and 30°C), while lower growth was noticed at the lowest (22°C) and highest (32°C) temperatures. The lower tolerance of the species appears far from the lowest value tested (16°C). In contrast, the upper tolerance temperature was near 32°C, since 100% spat mortality occurred within 96 h at 34 and 36°C, suggesting that metabolic stress is more pronounced at warmer than at colder temperatures. Regression of growth data by minimum squares and analysis of confidence limits showed that optimal growth response of spat lie within 26.5 and 27.9°C, where growth rate was 0.52 mm/day. Morphometric analysis indicated that spat showed an isometric growth for the height-length and height-weight relationships. Our results demonstrate that the species was thermo-tolerant between 16-32°C, grew faster and larger at 24 to 30°C, and had optimal growth at 27-28°C. These results are being used to develop a protocol for large-scale hatchery culture of the species in México, aimed to increase spat vigor through better hatchery conditions during late nursery care. This task is important to prepare stocking of juveniles in the field under conditions of high density and low temperature without causing serious physiological damage, yet allowing rapid recovery and growth.

Genetic Certification of Mollusc Species and Hybrids Using Molecular Markers (Allozymes, Microsatellites and Lysinsscp): The Case of Abalone Species (*Haliotis* spp.) in Mexico

P. Cruz-Hernández, A.M Ibarra-Humphries, R. Pérez-Enríquez., N.K Hernández-Ibarra, S.Ávila-Álvarez, F.Aranceta-Garza, R. M.Morelos-Castro, C.E. Galindo-Sánchez, J.L.Rámirez-Arce and G.Ponce-Díaz
CIBNOR, Laboratorio de Genética y Mejoramiento Animal Acuícola
Mar Bermejo 195 Col. Playa Palo Santa Rita, La Paz B.C.S. México 23090
pcruz@cibnor.mx, aibarra@cibnor.mx, rperez@cibnor.mx

With the advent of molecular technologies today it is possible to discriminate among sibling species utilizing genetic markers. In molluscs certain taxonomic criteria are based on shell traits, but when the shell is removed, species identification is impossible. Among abalone (*Haliotis* spp.), there are several reports of hybridization between sympatric species both in nature and in hatcheries, but these are only supported by the examination of shared external shell traits. Sometimes environmental effects and the interaction with the genotype can affect the shell's phenotype, making the identification of the hybrids difficult and scientifically unsound. Abalones (family Haliotidae) are ecologically and economically important worldwide. In México the most representative species are red abalone (*H. rufescens*), green (*H. fulgens*), and pink abalone (*H. corrugata*). Red abalone are distributed from Isla de Cedros, BC, to southern Oregon. Green and pink abalone are sympatric species distributed along the Northwestern coast of the Baja California Peninsula. In our laboratory at CIBNOR we have developed molecular tools to genetically certify these species and their hybrids using different approaches. First, we defined five allozyme loci with species-specific alleles in green and red abalone, and used them for the certification of putative hybrids produced in a commercial hatchery. From a presumed group with 100% hybrids, only 25% were true hybrids. The main disadvantage of allozymes in species/hybrid certification is that larvae and canned products cannot be assessed by that method. However, DNA can be extracted from larvae as well as from processed "meat" in canned products. Therefore, we defined three microsatellite DNA markers that allowed the unequivocal distinction between the three abalone species based on b –unique-diagnostic alleles. These microsatellite markers have been applied in determining the success of hybridization between red and green abalone in induced laboratory matings evaluated at early stages of development (larvae). Finally, in order to identify the true species in canned products we utilized one of the three microsatellite markers developed (Hful369), and a newly defined marker, a 150bp fragment of the lysine gene. Both markers applied agreed in the identification of the species in all canned samples analyzed, finding *H. fulgens* (Hf), *H. corrugata* (Hc) or a mixture of both species within cans. A can with an unexpected wild hybrid (Hc x Hf) was also detected, confirming that hybridization occurs in the wild. All markers proved to be useful tools in the genetic certification of species and hybrids for both ecological and experimental studies in larval and adult stages. Furthermore, all of the DNA markers can be applied in the future as forensic markers supporting the authentication or origin of this important fisheries and aquaculture resource.

Socioeconomic Aspects of the Commercial Utilization of Mano de León (*Lyropecten subnodosus*) in Mulegé's Municipality in Baja California Sur, México

Martha Claudia de la Garza Montaño
Instituto Nacional de la Pesca
Centro Regional de Investigación Pesquera en La Paz, B. C. S.
Km. 1, Carretera a Pichilingue, Colonia Esterito, La Paz, B. C. S., C. P. 23020 México
claudelagarza@hotmail.com

In Baja California Sur, México, the mano de león clam (*Lyropecten subnodosus*) has been collected for commercial purposes since the beginning of the last century. Today the local, regional and national commercialization of that clam means higher demand for fishing permits. Unrestricted exploitation of the mano de león clam has been ruled out by the Instituto Nacional de la Pesca and now the challenge is to reach a balance between the clam extraction and the eager market. As a contribution for the mano de león clam's fishery management, a socioeconomic questionnaire was designed in order to interview the people involved with that fishery in the Mulegé's municipality (Laguna Ojo de Liebre y Guerrero Negro) of Baja California Sur, México. Those areas are located within one protected zone, the El Vizcaíno Biosphere Reserve.

Scallop Fisheries and Aquaculture of the West Coast of America

Esteban F. Felix-Pico, Oscar E. Holguín-Quiñones
and Mauricio Ramírez-Rodríguez
Centro Interdisciplinario de Ciencias Marinas-Ipn. Av. Instituto Politécnico
Nacional S/N Col. Playa de Santa Rita, La Paz, B.C.S., Ap 592, C.P. 23096.
efelix@ipn.mx

The west coast of America, defined here as extending from Alaska to coastal southern Chile, is an extensive area that appears to have considerable habitat suitable to support large scallop populations. Much of the coastal area is mountainous and considerable parts of the coast fall to deep depths within a few km of shore. Scallop landings from this area have never been large and in 2004 there were only 46,000 t, less than 3% of world landings for that year. Twenty-five common species of the family Pectinidae occur in this area and fourteen have been utilized in commercial fisheries and five species in culture. The west coast of North America has seven species: *Patinopecten caurinus, Mizuhopecten yessonensis, Crassadoma gigantea, Chlamys rubida* and *C. hastata*. The Pacific calico scallop, *Argopecten ventricosus*, was harvested in southern California but been protected since 1954, as is *Chlamys behringiana*. The area produced 3,181 t in 1997. In the coasts of Baja California, México, to Peru there are twelve species and three are currently utilized: *Argopecten ventricosus, Nodipecten subnodosus* and *Euvola vogdesii*. The landings were around 15,000 t in 2006. There is a small production by aquaculture. Along the coast of Peru to southern Chile four species *Argopecten purpuratus, Zygochlamys patagonica, C. vitrea* and *C. amandi* are both fished and raised in culture. As a result the start of scallop aquaculture production had reached 24,577 t in 2004.

Crecimiento de las Postlarvas del Abulón *Haliotis corrugata* Alimentadas con Diferentes Densidades de la Diatomea *Navicula incerta* en Dos Condiciones de Luz (Iluminación Constante u Obscuridad)

E. Gorrostieta Hurtado[1], Ricardo Searcy-Bernal[2] y Casandra Anguiano-Beltran[2]
[1] Universidad Michoacana de San Nicolás de Hidalgo Facultad de Biología
[2] Instituto de Investigaciones Oceanológicas Universidad Autónoma de Baja California
resarcy@uabc.mx; casandra@uabc.mx, egorrost@yahoo.com

La densidad de alimento y la intensidad de luz son factores que afectan el crecimiento de las postlarvas de *Haliotis fulgens* y *Haliotis rufescens*. No se sabe si estos factores actúan de la misma manera en *Haliotis corrugata*. Por lo anterior se realizó un experimento con postlarvas de *H. corrugata* de 4 días de edad, a las que se le proporcionó diferentes densidades de alimento (de 0 a 10,000 cél/mm^2) y que se mantuvieron en dos condiciones de iluminación (luz continua y obscuridad). Se evaluó la sobrevivencia, la tasa de pastoreo, la tasa de crecimiento, la posición de las postlarvas en las unidades experimentales y el crecimiento de *Navicula incerta* utilizada como alimento. No hubo diferencias significativas en la sobrevivencia de las postlarvas mantenidas en los diferentes tratamientos. La tasa de pastoreo aumentó significativamente con el incremento de la densidad de *Navicula incerta*. Con el factor de luz-obscuridad no se observaron diferencias significativas, aunque la tasa de pastoreo fue más alta en la obscuridad que en la luz (p.e. 196 cel/pl/hr en la obscuridad y 139 cel/pl/hr en la luz en una densidad de 8,000 cel/mm^2). La tasa de crecimiento fue significativamente mayor en las postlarvas cultivadas en la obscuridad. El crecimiento se llega a incrementar hasta 2.2 veces más en la obscuridad que en la luz (22 µm/d y 10 µm/d respectivamente). Arriba del 60 % de las postlarvas cultivadas en la obscuridad se encontraban en el fondo de la unidad experimental y menos del 60% de las postlarvas cultivadas en la luz se encontraban sobre el fondo de la unidad experimental al final del periodo experimental. Las mejores tasas de crecimiento para las postlarvas de abulón *Haliotis corrugata* se presentaron en densidades de *Navicula incerta* de 750 cél/mm^2 para postlarvas de 4 a 11 días y de 2,000 cél/mm^2 para postlarvas de 11 a 18 días. Se discuten estas diferencias considerando la posibilidad de que los abulones tienen hábitos nocturnos de alimentación desde la etapa postlarval.

Biological Control of Fouling in Mollusc Aquaculture

Yadira Trejo Hernández[1], Volker Koch[2], Francisco Sínsel[3] and Cesar Ruiz Verdugo[4]
Departamento de Biología Marina Universidad Autónoma de Baja California Sur,
La Paz, B.C.S. Cp. 23080, México
[1] moluscaya@hotmail.com [2]vokoch@balandra.uabcs.mx [3]sinsel13@hotmail.com [4] cruiz@uabcs.mx

Fouling is a major problem in bivalve aquaculture. Organisms like algae, sponges, sea squirts, bryozoans and barnacles, among others, reduce the water flow and compete for food, space and oxygen with cultured bivalves, thus reducing growth and survival and ultimately, profits of the enterprise. To evaluate the cleaning effect of snails and sea urchins as biological fouling controls, we conducted three experiments at two sites in Baja California Sur, México, one in the Gulf of California (El Pardito) and one on the

Pacific side (Estero San Buto, Bahía Magdalena. First, we evaluated the settling of fouling organisms in "Nestier" trays over a year. Major settling of fouling organisms occurred during spring at both sites, and Bryozoa were the dominant group throughout the year at both localities. This could be expected as spring is the season with major nutrient concentrations and productivity in the region. Secondly, we studied the effect of different densities of the sea urchin *Equinometra vanbrunti* (Gulf of California) and the snail *Turbo fluctuosus* (Pacific) on the development of fouling organisms in "Nestier" trays over a period of two months. Cleaner organisms had a significant effect on the density on fouling biomass. The urchin was seemingly more efficient than the snail, it reduced fouling biomass in comparison to the control treatment by 61%, 96% and 97.5% at two, four, and eight organisms / tray respectively, while the snail reduced fouling by 57.8%, 63.9% and 74.6 %. In addition it was observed that the urchin also feeds on the epibionts of the cultivated clams, the snail does not. Finally, we evaluated the effect of the cleaning organisms at different densities on growth and survival of cultured pectinid bivalves. In the Gulf, *E. vanbrunti* was used with Pacific calico scallop (*Argopecten ventricosus*), in the Pacific, the snail *T. fluctuosus* was used in lion´s paw scallop (*Nodipecten subnodosus*) culture. Scallops were cultured at 50% density in both cases; monthly measurements of growth and survival were conducted over a period of six months. No significant differences were observed between different treatments with either combination of cleaner and scallop species over the course of the experiment. We suspect that 50% density occupation of scallops in the trays during winter was rather low to demonstrate a positive effect of the cleaning organisms, because water temperature was low, oxygen concentration high, and food was abundant. At higher densities and during the summer months, it is likely that the presence of cleaning organisms has a positive effect on growth and survival of cultured bivalves.

Environmental Management Unit for the Culture of Calafia Mother of Pearl *Pinctada mazatlanica* in Bahía La Paz for the Production of Pearls

Leopoldo López-Contreras[1], Jorge Iván Cáceres-Puig[1], Javier Cortés-Salazar[1] and Carlos Cáceres Martínez[2]
[1] Perlas del Cortez, S. De R. L. Mi. Añuiti 4723 Col. Pericues, La Paz 23070, México, leolopezc@yahoo.com.mx , www.perlasdelcortez.com
[2] UABCS, Apartado Postal 49-B, La Paz, BCS, Mèxico 23080. ccaceres@uabcs.mx

The Calafia mother-of-pearl, *Pinctada mazatlanica*, is protected by Mexican laws, to permit the recuperation of natural populations. Any program that can contribute to the enhancement of the natural beds of this resource is welcomed. During the last eight years a commercial pearl oyster company established an aquaculture program to allow the collection of natural seeds (pediveliger larvae), protected and pregrown to reach 60 mm (dorsoventral) to be used in a nucleation and grafting program for the production of pearls. The program was prepared and established as Environmental Management Unit, including four operations: collection of seeds, pregrowth, grafting and culture. The global operation takes three years to permit the nacreous layers deposits thick enough on the artificial nuclei to guarantee the high quality of the produced pearls

Towards Development of Large-Scale Hatchery Cultivation of Larvae and Spat of the Pearl Oyster *Pinctada mazatlanica* in Mexico

Pedro E. Saucedo Lastra
Centro de Investigaciones Biológicas del Noroeste S. C.
Mar Bermejo 195, Col. Playa Palo de Santa Rita La Paz, BCS, México
psaucedo04@cibnor.mx

Pearl oysters have been cultivated in hatcheries since the 1970s. Therefore, successful protocols are now well established for the three main pearl producing species: *Pinctada fucata, P. maxima,* and *P. margaritifera*. In México, however, the scenario is different for the two species inhabiting the Gulf of California, since there is limited information on physiological and nutritional requirements of larvae and spat maintained at the hatchery. This is true for the winged pearl oyster *Pteria sterna*, but mostly for the mother-of-pearl *P. mazatlanica,* where availability of data related to pilot-scale larval runs is very scarce. The two available studies report low rates of survival for larvae (1.7 and 2.4%). Spat settlement is either delayed until day 38, or settlement at day 25 is followed by massive die-off of spat within the first days of field cultivation. Given these preliminary results, cultivation of *P. mazatlanica* larvae is still a bottleneck impeding continuous production of spat for supporting pearl oyster activities in México. Consequently, improvement of cultivation methods under hatchery conditions is crucial in the near future. The results of a series of pilot-scale runs with *P. mazatlanica* larvae from 2004 through 2006 are reported. Preliminary runs in 2004 and 2005 used broodstock collected in summer, when massive spawning of wild populations occurs naturally. However, results of larval development were very poor and failed to produce spat in both years. In 2006, ripe broodstock was collected in both the summer, and the spring seasons, based on the hypothesis that the gonads in spring were in better reproductive condition than in summer. Three larval runs were conducted in 2006: two in spring and one in summer. Larvae growth and survival greatly increased in both spring runs, ending with two successful productions of spat (~20 °— 103 and ~100 °— 103 juveniles). The summer larval run failed again to produce spat. Additionally, the first run of April 2006 refers to an experiment that evaluated two different larval culture conditions: constant temperature (27 °C) and low stocking density (3–4 larvae ml–1) versus variable temperature (24–28 °C) and high stocking density (8–9 larvae ml–1). The first trial significantly ($p<0.05$) increased larval survival and growth, which in turn resulted in greater numbers of settled spat, in comparison with the second trial, where survival, growth, and settlement of spat were significantly lower ($p<0.05$). Also in 2006, the quality of seawater used at the hatchery was evaluated with microbiological and chemical tests. The implication of these tests, together with results from all experiments are analyzed and discussed in terms of the potential development of large-scale hatchery cultivation of *P. mazatlanica* larvae in México.

Moluscos de Importancia Comercial en las Playas de Michoacán

José Luís Trujillo-Toledo y Eréndira Gorrostieta-Hurtado
Universidad Michoacana de San Nicolás de Hidalgo
Facultad de Biología Laboratorio de Invertebrados
egorrost@yahoo.com; gorrost@zeus.umich.mx

Se realizaron encuestas a los buzos de las cooperativas pesqueras de la costa de Michoacán con la finalidad de obtener datos sobre las principales especies de moluscos que se capturan con fines comerciales así como de aquellas que son utilizadas localmente. Los resultados muestran que la captura de mariscos en Michoacán se realiza principalmente en 3 especies de las cuales 2 (66%) son moluscos y corresponden a *Octopus* sp. y *Crassostrea prismatica*, los cuales llegan hasta el mercado Nacional. La costa de Michoacán esta integrada por tres municipios: Lázaro Cárdenas, Aquila y Coahuayana, la captura de pulpo y ostión se realiza principalmente en el municipio de Aquila por ser un municipio que tiene un mayor número de playas rocosas. El caracol chino (*Hexaplex regius* y *Muricanthus ambiguus*), es consumido y vendido a nivel local. *Spondylus calcifer* se extrae esporádicamente, al igual que el callo de hacha, pero no tienen un mercado tan establecido como el pulpo y el ostión. Como resultado de las encuestas, se encontró que el caracol *Plicopurpura pansa* a pesar de ser una especie con protección especial es utilizada no solo como productor de tinta sino que también se consume localmente por algunos pescadores. *Calyptraea spirata* es un gasterópodo que es consumido y conocido regionalmente como abulón tropical debido a la consistencia y sabor de su carne. La sobreexplotación en esta especie se ha reflejado en la disminución de las tallas y cambio en su distribución batimétrica. Tanto el ostión como el abulón tropical son especies las cuales necesitan ser estudiadas para lograr establecer a futuro un plan para conservación y que no desaparezcan o disminuyan como ha ocurrido con otras especies. Los pescadores reportan especies que hace 20 a 25 años representaban la captura principal como es el caso de la lapa *Ancistomesus mexicanus*, las capturas que ellos mencionan y corroborando con datos de la Secretaria de Pesca alcanzaban hasta más de una tonelada, las tallas que ellos capturaban eran de aproximadamente 20 cm o más. Actualmente este recurso es escaso y las tallas que se encuentran son muy pequeñas (menos de 10 cm). Otra de las especies que ya no se encuentra o es muy rara es la almeja chocolata *Megapitaria* spp. La almeja madre perla *Pinctada mazatlanica* es extraída solo por algunos pescadores y de manera esporádica, en el municipio de Coahuayana la reportan como abundante pero no es explotada. Los resultados de este estudio han mostrado la brecha de donde iniciar con los estudios de biología poblacional de los moluscos marinos de Michoacán como son las especies de *Crassostrea prismatica, Octopus* spp. *Ancistomesus mexicanus, Calyptraea spirata* para evitar la dismunición y en caso extremo la desaparición de la especie y de otras como *Pinctada mazatlanica* y *Atrina maura* para un futuro uso sostenible de la especie.

Species Identification of Canned "Abalone" Using FINS (Forensically Informative Nucleotide Sequencing)

Alberto Miranda Velasco[1], Cristian Gallardo Escárate[2] and Miguel Ángel Del Rio Portilla[1]
[1]Departamento de Acuicultura, Centro de Investigación Científica y de Educación Superior de Ensenada, CICESE, Ensenada, Baja California, México, C. P. 22800
miranda@cicese.mx
[2]Centro de Biotecnología, Departamento de Oceanografía, Universidad de Concepción, Chile

Correct labeling of seafood products depends on accurate identification of commercial species. Abalone, a valuable mollusc species, is sold mostly in cans. Some products are labeled as "abalone" to increase their value, but do not use *Haliotis* species. In the present study, we applied the molecular technique FINS (Forensically Informative Nucleotide Sequencing) to identify different species of canned products labeled as "abalone." This is done by amplifying the mitochondrial 16s rRNA gene fragment. Ten cans of different abalone species and products labeled as "abalone" were analyzed and identified by FINS. We follow the four components considered in FINS. First, DNA was isolated from processed food (in this case a canned product). Second, we amplified the 16S rRNA gene using universal primers and PCR. Third, we determined the nucleotide sequence of the amplified segment of DNA. Fourth, this nucleotide sequence was subjected to a phylogenetic analysis using sequences from GenBank from the NCBI database, and the most closely related species were used for identification. FINS is considered a rapid, reliable and reproducible procedure that is based on established techniques. We could find that some products labeled as "abalone" do not contain a *Haliotis* species. One product contained a species of Fissurellidae and another a Muricidae. Further analysis showed that the Fissurellidae was the giant keyhole limpet, *Megathura crenulata*, and the Muricidae corresponded to the "loco", *Concholepas concholepas*.

POSTER SESSION

Reproductive Cycle of the Flat Clam *Isognomon alatus* (Gmelin, 1781) in Veracruz

M. Montaño Palacios and F. Lango Reynoso
Technological Instituto of Boca del Río,
Highway Veracruz-Cordova Km12 94290 Boca del Río México, C. P.
alfazah.23@gmail.com

In México, harvest of commercially important molluscs has been regulated by size, gonadic maturity and age. This regulation has allowed established times of reproduction and harvesting of seed in order to to increase the yields in the cultivation regions. The state of Veracruz is the main producer of the oyster *Crassostrea virginica.*

However there are other species of regional importance whose reproduction or handling is not understood. The object of this paper is to contribute to the knowledge of the flat clam, *Isognomon alatus*. This study was conducted within the Lagoon of La Mancha, Veracruz, from June 2001 to June 2002, by selecting a bank and registering the physico-chemical parameters. Temperature and salinity were determined by use of YSI model 640-D sound. The organisms were collected by free diving. Sixty organisms were gathered and subsequently we determined their sex ratio, condition index and, for 30 individuals, we noted such things as seston solids in suspension. The data were analyzed with an ANOVA set at 95%. Through the period of study we observed a predominant ratio of males and hermaphrodites. In February of 2002 the percentage of males stood at 80% and in October at 86.6%.The percentage of hermaphrodites in June 2001 was 86.6%, and August 2002, 48.3%. The condition index showed a single egg-laying in April 2002 with an average of (4,96 ±2,19). The physico-chemical variables indiated that the salinity increased throughout the year, first in May and in June with 35% and 36.02% in 2001 respectively, and of January and April with 34.9% and 35% in 2002. The temperature remained constant through the year, with the highest temperatures occurring in May 2002 with 31.4°C. The seston and tryptone concentration in the month of October 2001 was of 0.3125 mg/lt each one and the plankton concentration reached two peaks: the lesser in the month of January 2002 at 0.0113 mg/lt and the greater in March 2002 at 0.0383 mg/lt. The maximum size for the males was of 97.87mm and 29.26 mm as minimum, and of 99.87 mm as maximum and 39.8 as minimum for the hermaphrodites.

Reproductive Aspects of *Octopus hubbsorum* (Berry, 1953) in the Bahía de Loreto National Park, Gulf of California, México

Myrna L. Bravo-Olivas, Marcial Villalejo-Fuerte, Marcial Arellano-Martínez, Dinorah Herrero-Perezrul and Agustín Hernández-Herrera
Centro Interdisciplinario de Ciencias Marinas, Instituto Politécnico Nacional (IPNCICIMAR), La Paz, Baja California Sur, México
myrnabravo@yahoo.com

Variations of the gonadic index, hepatosomatic index, condition index as well as the maturity size of *Octopus hubbsorum* in the Bahía de Loreto National Park were studied. A total of 279 organisms (144 male, 135 female) were captured monthly from February 2006 to January 2007. The sex ratio was 1:0.9 (male: female). The highest values of gonadic index were found in July (females) and June (males), hepatosomatic index in January for both sex and the condition index in June (females) and April (males). The size of maturity was of 58.2 cm. The high values of gonadic index in June and July suggest gametogenic activity in ovary and testis. On the other hand, the inverse relation between the gonadic and hepatosomatic index suggests the use of reserve substances stored in the liver that are probably transported to the gonad to be used during gametogenesis.

Description of the Embryological Development of *Pteria sterna* (Gould, 1851) (Bivalvia: Pteriidae)

S.de Las Heras-Saldaña, L.González-Rivera, T.Loeza-Quintana,
I. Sánchez Tapia, D.Zaleta-Pinet, J. I. Cáceres Puig and Carlos Cáceres Martínez
Universidad Autónoma De Baja California Sur, Carretera Al Sur Km 5.5, La Paz BCS,
México 23080
ccaceres@uabcs.mx

Given the economic importance of the mother-of-pearl, *Pteria sterna,* we observed and described its embryological development. We followed development from fertilization to the trochophore larvae. The first, second and third divisions were typical because of the formation of the polar lobe, these divisions were present at 26, 33 and 55 minutes. The fourth division was given at 1:18 h after the others. The morula appeared until 3:30h., mean while the esteroblastula was formed at 5:31 h. At last the gastrula was seen at 7:38 h. Temperature was the influencing factor to induce egg laying. The first three events occurred rapidly while the rest took longer to develop (half an hour to several hours). The development concluded at 15 h with the appearance of the trochophore larva.

Descripción del Desarrollo Embrionario de *Pteria Sterna* (Bivalvia: Pteridae) hasta la Aparición de Larva Trocófora

S.de Las Heras-Saldaña, L.González-Rivera, T.Loeza-Quintana,
I.Sánchez Tapia, D.,Zaleta-Pinet J. I. Cáceres Puig y Carlos
Cáceres Martínez

Los estudios de biología básica sobre la especie *Pteria sterna* por su capacidad de producir de manera natural e inducida perlas, han cobrado importancia. Con la finalidad de observar y describir su desarrollo embrionario empleando un cambio brusco de temperatura (12 grados Celsius) se indujo al desove adultos maduros provenientes de Bahía de La Paz, BCS, México, una vez que se obtuvieron los gametos estos fueron separados y tamizados (30µm). Se realizó una fertilización de huevos a razón de cinco espermatozoides por cada uno en una incubación a temperatura ambiente (29° C). Muestras de embriones a intervalos de tiempo regulares fueron conservadas en solución Karnowsky, en refrigeración para su inclusión en resina y corte histológico. Muestras en vivo fueron observadas y fotografiadas directamente usando un microscopio compuesto. Los cortes para el estudio histológico fueron de 1.5 µm de espesor y su observación y fotografías se realizaron con el mismo microscopio. A partir de la fecundación, la primera, segunda y tercera división se caracterizaron por la formación de un lóbulo polar, estas divisiones se presentaron a los 26, 33 y 55 minutos respectivamente, mientras que la cuarta división se presentó 1:18 h después. La aparición de la mórula tuvo lugar a las 3:30 h, la esteroblástula a las 5:31 h y por último la gástrula a las 7:38 h. Los primeros eventos embrionarios ocurrieron a mayor rápidez durante las primeras tres etapas de la segmentación; a partir de la cuarta segmentación el desarrollo se presentó cada vez más lento, pasando de media hora a varias horas antes de observar algún cambio en el embrión. El tiempo total del desarrollo fue aproximadamente de 15 horas hasta la aparición de la larva trocófora.

Tissue and Cellular Components of the Pearl Oyster *Pinctada mazatlanica* (Hanley, 1856) Associated with Reproduction: A Study of Digital Image Analysis

María Eliana Gómez Robles and Pedro E. Saucedo
Centro de Investigaciones Biológicas del Noroeste, S. C.Mar Bermejo No. 195, Col. Playa Palo de Santa Rita, Apdo. Postal 128; La Paz, BCS, México 23090
megomez04@cibnor.mx

In bivalves, certain tissues and specialized cellular elements participate in processes of storage and allocation of energy reserves (glycogen, lipids, and proteins) during gametogenesis. These processes are not well documented in the Pteriidae. This study is aimed to: (1) characterize cellular components of the gonad, digestive gland, mantle tissue, and adductor muscle throughout an annual cycle, and (2) determine seasonal changes in coverage area of some of these components through histochemistry and digital image analysis. Fifteen adult specimens (90 ± 110 mm shell height) were collected every three months during 2005-2006 in Bahía de La Paz. Water temperature, salinity, and chlorophyll a concentrations were recorded at the collecting site. Gonad samples were fixed in Davison's solution for 48 h, thin-sectioned (3µm) and stained with hematoxylin-eosine. Slides were examined under a compound microscope (20X, 40X, 60X, and 100 X) to identify sex and changes in gonad developmental stages, and size of oocytes. To identify the fine cellular structure of the gonad and remaining somatic tissues (digestive gland, mantle, and muscle), fresh samples were fixed in Davison's solution (48 h), sectioned at 3µm, and stained with two histochemical techniques: black Sudan B for lipids, and alcian blue-PAS for carbohydrates. During this study, water temperature recorded minimal and maximal values on February (19.6°C) and August (30°C), respectively. Variations in chlorophyll a concentration showed lower levels in summer (253.25 ng/L) and higher levels in winter (1367.48 ng/L). Histological analysis revealed a 0.4:1 (F/M) sexual ratio. Two reproductive peaks were detected in May (at 22 °C) and August (30 °C), associated with higher frequencies of ripe individuals and larger oocytes. Preliminary results concerning the characterization of cellular components will be presented at the meeting.

Biology of the Reproduction of the American Oyster *Crassostrea virginica* (Gmelin, 1791) in Natural and Experimental Conditions

Rubén Robles-Hernández[1,2], Fabiola Lango-Reynoso[1] and Marcel Le Pennec[1,2]
[1]Instituto Tecnológico de Boca del Rió, [2]Université de la Bretagne Occidentale
roblesrh@yahoo.com.mx

In 2003, the production of oyster in México was 51,372,00 metric tons, of which the American oyster *Crassostrea virginica* represented 93.2% of the national total (the FAO, 2006). However, the environmental deterioration of numerous coastal areas of the country, combined with poor harvest have been causing significant fluctuations in the oyster production for over a decade. This has caused a diminution in the population as well as the disappearance of the most important banks in almost all the lagoon systems of

the state of Veracruz, including the lagoon of Tamiahua, Pueblo Viejo, Laguna Grande, La Mancha and Alvarado, where the oyster resource is the base of the local economy. In spite of the great commercial and social importance of the resource, studies of its reproductive biology are scarce and limited to description. In addition most of these date back to the 70's. In light of the above, the purpose of the present investigation was to contribute to the knowledge of the reproductive biology of American oyster *C. virginica*, within the lagoon systems of Veracruz including Tamiahua, Vega de Alatorre, Mancha and Alvarado. We undertook a study of the gametogenic process, evaluating the gonad development, evaluating the ovary size and the proportion of sexes. We further evaluated the hydrobiological parameters in the four lagoon systems to establish its relation with its reproductive cycle. The important result of this study shows that this organism does not experience a period of sexual rest, rather there exists a continuous production of gametes during all the times of the year (rainy season, winter and summer). Nevertheless, it was observed that ideal conditions of salinity and temperature for egg-laying induction occur exclusively in the winter. When evaluating the maturation of *C virginica* in laboratory conditions using diets recommended for *C. gigas*, we observed that the organisms' survival aspect was greater than its growth or sexual maturation, which explains the low condition index obtained. The results of the histological study and the condition index of the sample collected in the lagoon systems, allowed us to observe the months in which massive egg-laying occurred (November in La Mancha, January in Alvarado, February in Tamiahua an Vega de Alatorre), in addition to four gametogenesis condition index larval stages (gametogenesis, growth, maturation and degeneration). This confirms the condition index in relation to the histological observations, since the organisms' survival was of prime concern and not growth or maturity. The presence of hermaphroditic organisms in the lagoon systems studied indicates a possible reproductive strategy as an answer to the disturbance of the environment at the time of reproduction, which occurs in the months from February to March in the four lagoons.

Microsatellites as Genetic Markers for Pink Abalone *Haliotis corrugata*

Noé Díaz-Viloria, Pedro Cruz Hernández, Giovanni Fiore Amaral, Ronald Burton and Ricardo Pérez-Enríquez
Centro de Investigaciones Biológicas del Noroeste (CIBNOR), Mar Bermejo 195 Col. Playa Palo de Santa Rita, La Paz, B.C.S., México 23090.
viloria04@cibnor.mx

Technological advances in molecular biology and biochemistry have led to the development of a variety of genetic markers that can be used to address questions of relevance to the management and conservation of species. Genetic markers have been applied in several fields such as stock structure analysis, aquaculture and taxonomy/systematics. The most common use of genetic markers in fishery biology is to determine if samples from natural populations are genetically differentiated from each other. The detection of differentiation would imply that source groups comprise different stocks and should be treated as separate management units. Microsatellite DNA are highly variable genetic markers made by tandemly repeated motifs of 1-6 bases, and are found in all prokaryotic and eukaryotic genomes. Microsatellites have proven to be an

extremely valuable tool for population genetics. Developing microsatellites in any species is the first step for the examination of the population structure, or its differentiation among species of the same genus. In the present study we describe the isolation of 43 microsatellites in pink abalone *Haliotis corrugata* and the cross-amplification of eight microsatellites designed in others species; six in *H. kamtschatkana* and two in *H. fulgens*. A total of 13 polymorphic microsatellites were successfully amplified in *H. corrugata*, which were evaluated and characterized in a wild population sample (N=49) from Isla Natividad, Baja California Peninsula. Genetic diversity was evaluated by the number of alleles, and expected and observed heterozygosities, which varied widely depending on the microsatellite. The number of alleles ranged from 2 to 57, and the observed and expected heterozygosities ranged from 0.104 to 0.939 and from 0.213 to 0.986, respectively. Significant deviations from Hardy-Weinberg equilibrium ($P<0.006$) were observed at four microsatellites. No linkage-disequilibrium was observed ($P<0.0006$). Nine of 13 microsatellites were suitable for population genetics studies and six of them are being used in a population analysis from four locations along pink abalone´s distribution range (southern Baja California to California).

Registration of Geographical Distribution of *Astraea turbanica* (Dall, 1910) (Gastropoda: Turbinidae) in the Western Coast of Baja California

José Remedios Turrubiates Morales and María Georgina Gluyas Millán
Centro Regional de Investigacion Pesquera La Paz, Instituto Nacional de La Pesca-Sagarpa
Carretera A Pichilingue Km 1 S/N, La Paz, Baja California Sur, México Cp 23020
gmillan@balandra.uabcs.mx

A revision of available information on the presence of the jumbo snail in the south eastern coast of the Baja California Peninsula (CSPBC) is presented. The available reports on the distribution of *Astraea turbanica* (Dall, 1910) (synonyms: *A. petrothauma* Berry, 1940; *A. rupicollina* Stohler, 1959) point out their presence in the Islas Coronados and San Geronimo, Todos Santos BC, and Bahía Magdalena BCS. During the last seven years the Instituto Nacional de la Pesca has sampled rocky reefs and areas of sand of 2 to 14 fathoms in the CSPBC. At Isla Natividad, snails were found at a density of 6.0 ind/m^2, and organisms reached a size of 170 mm in basal diameter. The density is less in the Bahía Tortugas area, Hidden Port ("The Reventadora"), and Isla Asunción. The snail was not found in samples from San Juanico and Isla Magdalena.

Individual and Joint Toxicity of Cadmium, Chromium and Lead on Physiological and Biomarker Responses of the Catarina Scallop, *Argopecten ventricosus* (Sowerby, 1842)

A. Sobrino-Figueroa[1] and Carlos Cáceres-Martínez [2]
[1]Laboratorio de Ecotoxicología. Uam-Iztapalapa, Av. San Rafael Atlixco # 186
Col. Vicentina. Delegación Iztapalapa, C. P. 09340 México D.F.
[2]Laboratorio de Cultivo de Moluscos UABCS, Unidad Pichilingue Carretera A
Pichilingue Km, 18. La Paz, B.C.S. México
coco@xanum.uam.mx

Argopecten ventricosus is a potentially useful species for environmental monitoring and toxicological studies. Because there have been no previous ecotoxicological studies on this species, an evaluation of the effect of cadmium, chromium and lead on juveniles and adults was undertaken. A series of bioassays with water changes, lasting 168 hours with each metal and its mixtures was carried out. CL50, the toxic units, the type of interaction between the mixtures and its magnification level, were determined. At the same time physiological processes such as respiration, excretion and the ratio of O:N (as stress indicator), and two biomarkers: oxidative stress and genetic damage were evaluated. Cadmium was shown to be the most toxic metal to juveniles and adults. Cadmium toxicity was eight times higher than chromium and two times than lead. The synergy observed in the mixtures of metals was of potenciation, with a magnification value of 2X for the mixture of Cd + Cr, Cr + Pb and Cd + Cr + Pb. 1X for Cd + Pb. The O:N relation was below 9 in most of the tests, indicative of stress state. Oxidative stress was higher in the organisms exposed to Cd (92.3 nM/g MDA) and Cr (99.2 nM/g MDA). The genetic damage evaluation showed cadmium, chromium and the mixture of Cd + Cr + Pb were the more deleterious agents. *Argopecten. ventricosus* is more sensitive to the metals in comparison with other organisms, the Japanese oyster, *Artemia nauplii* and juvenile *A. irradians,* for example. The toxic concentrations of the metals evaluated in this study, find between ten to thousand times for that registered in the waters of the systems present in the Mexican Pacific, but toxic effects were detected, in 10 a 50 µg/L metals concentrations.

Cadmium, Chromium and Lead Bioaccumulation in Catarina Scallops *Argopecten ventricosus* (Sowerby, 1842) in Ensenada de La Paz, BCS

A. Sobrino-Figueroa[1] and Carlos Cáceres-Martínez[2]
[1]Laboratorio de Ecotoxicología. Uam-Iztapalapa,. Av. San Rafael Atlixco # 186
Col. Vicentina. Delegación Iztapalapa. C. P. 09340 Mexico D.F.
[2]Laboratorio de Cultivo de Moluscos UABCS, Unidad Pichilingue Carretera A Pichilingue Km 18.
La Paz, B.C.S. México.
coco@xanum.uam.mx

The catarina scallop constitutes an important fishing resource in B.C.S., México.There are no previous sudies on metal levels in organisms. In this paper the seasonal variation in the heavy metals Cd, Cr and Pb was determined in bivalve tissues. Water samples and adults scallops (5.0 ± 0.5 cm) were collected in summer and winter

during 1998, 1999 and 2000 in the bed, located near the Pichilingue harbor. The quantification of elements was carried out by means of atomic absorption technique in graphite furnace (Cd and Cr) and in flame (Pb, Fe, Cu, Zn). The average concentrations the metals, Cd, Cr and Pb, registered in the scallops were from 0.515 ± 0.51, 0.087 ± 0.08, 0.93 ± 0.54 µg/g (wet weight) respectively. The year with the highest metal concentrations in the organisms and in the water was summer of 1998, possibly as a result of the "Niño" phenomenon. When comparing the metals levels in scallops with NOM (Norma Oficial Mexicana, 1993 031-SSA1) values for shellfish consumption (cadmium 0.5 µg/g and lead 1.0 µg/g), it was evident that the levels of cadmium and lead in these organisms exceed the maximum limit settled down by this NOM, indicates that their consumption implies a health risk that should be evaluated.

Depuration of the Oyster *Crassostrea virginica* of Commercial Size in the Laguna Boca del Rio Mandinga System Veracruz, México

María del Refugio Castañeda Chávez, Fabiola Lango Reynoso,
Violeta Pardío Sedas, Saraid Del Carmen Nogueira Montiel.
Instituto Tecnológico de Boca del Río, Carretera Veracruz-Córdoba Km 12 A. P. 68,
C.P.94290; Boca Del Río, Veracruz, México.
castanedaitboca@yahoo.com.mx

The oyster *Crassostrea virginica* is in demand and is of commercial importance world-wide. However, as a filter feeder, it is considered an infectious food because it is exposed to pathogenic microorganisms that are found in lagoon systems. Thus, eating this oyster can cause health problems. For this reason it is very import to establish a proper management system during the oyster production process to ensure good quality conditions product for sale and consumption, according the Mexican regulations set in NOM-031-SSA1-1993. In consideration of these regulations, we studied the depuration times for *Crassostrea virginica* coming from the lagoon systems Boca del Río-Mandinga, Veracruz, México. We used a filter, approved for eliminating pathogens, by the well-known European Institution IFREMER from France. Two treatments with different exposure times for *Vibrio cholerae* no-01by treatment A, whereas for treatment B a significant reduction with a final counting of 210 NMP/g was observed. The aerobic mesophylls decreased from an initial value of 5.2787 log UFC/g to 4.7403 log UFC/g for treatment A. During treatment B the initial count of 5.2304 log UFC/g was decreased to 4 log UFC/g showing a significant difference between treatments. It was found that aerobic mesophylls and *Salmonella* spp. were below the maximum limits allowed by the Mexican regulations.

Depuración de Ostión (*Crassostrea virginica*) de Talla Comercial del Sistema Lagunar Bocad el Río-Mandinga, Veracruz México

De los moluscos bivalvos el ostión *Crassostrea virginica* es un invertebrado de demanda e importancia comercial a nivel mundial. Por sus hábitos alimenticios es considerado como un alimento de tipo infeccioso que está sometido a la contaminación por microorganismos patógenos que se encuentran en los sistemas lagunares y que, aunado a la forma de consumo, genera enfermedades para el consumidor. Por lo que

resulta prioritaria la aplicación de técnicas que garanticen la calidad sanitaria para su venta y su consumo de acuerdo a la NOM-031-SSA1-1993. Considerando lo anterior, en este trabajo se determinaron los tiempos de depuración para el ostión (*Crassostrea virginica*) procedente del sistema lagunar Boca del Río-Mandinga, Ver., usando el fraccionador de espuma (Skim) el cual ha sido avalado para su comercialización como un equipo con la capacidad de eliminar la presencia de microorganismos patógenos, por la institución europea reconocida en esta línea de investigación IFREMER de Francia. Se establecieron dos tratamientos con diferentes tiempos de exposición: 3, 6, 9 y 12 horas, para *Vibrio cholerae* no-01, no se encontró diferencia significativa para ambos tratamientos. La cuenta inicial de 940 NMP/g de E. coli se logró reducir a 280 NMP/g para el tratamiento A, mientras que el tratamiento B presentó una disminución significativa con una cuenta final 210 NMP/g. Los mesófilos aerobios disminuyeron de un valor inicial de 5.2787 log UFC/g a 4.7403 log UFC/g parael tratamiento A, mientras que para el tratamiento B se redujo de una cuenta inicial de 5.2304 log UFC/g a 4 log UFC/g, lo que mostró una diferencia significativa entre los tratamientos. Los mesófilos aerobios y *Salmonella spp.*, se encontraron por debajo de los límites máximos permisibles que establece la norma mexicana referida.

Study of the Response of the Mother-of-Pearl Oyster *Pinctada mazatlanica* (Hanley, 1856) Larvae Cultivated under Different Seawater Sources

Fernando Abasolo Pacheco and Pedro E. Saucedo Lastra
Centro de Investigaciones Biológicas del Noroeste S. C.
fabasolo@cibnor.mx

Introduction

Larval culture of marine bivalves represents a bottleneck in many parts of the world due to high larval mortality rates during phases such as umbo and metamorphosis. Under hatchery conditions, there are several factors that affect the overall development of larvae and the settlement of spat. Temperature, food availability, and seawater quality affect the physiological condition, growth, and survival of larvae. At CIBNOR's hatchery, rearing larvae of the pearl oyster *Pinctada mazatlanica* has been difficult because the species is susceptible to massive die-offs caused by factors that larvae of other bivalves resist well at the hatchery, and that affect the quality of seawater used. Two factors have been detected to alter such quality: (1) the presence of pathogenic bacteria (*Vibrio* or *Pseudomonas*) and (2) the increase of levels of dissolved organic matter. Both factors have a stronger effect in summer. The present work assessed the response and condition of larvae of the species cultivated under different seawater sources. Apart from determining growth, survival, and biochemical content of larvae, some microbiological and chemical tests were used as indicators that measured changes in the infestations of the pathogenic *Vibrio algynoliticus* bacteria and specific macro- and micro-nutrients, respectively. These evaluations were done at the beginning and end of the experiments.

Objectives

Study the response and condition of *P. mazatlanica* larvae cultivated under different sources of seawater, during two different seasons of the year: spring and summer.

Materials and Methods

Ripe broodstock were collected during reproductive peaks in spring and summer. Spawning was induced with thermal shocks between 19 and 29 °C. Gametes were separated by sex and in vitro fertilization was done in duplicate 1500-L cylindrical tanks. In a first stage in 2006, the overall development of larvae was followed from the D-stage in triplicate 4000- mL culture systems. In a second stage (currently in course in 2007), larvae will be raised in 80-L fiberglass culture tanks. Four seawater sources were evaluated: (1) Filtered seawater (control), (2) Well-extracted seawater, (3) Pasteurized seawater, and (4) Sterilized seawater. In both stages, larvae were fed *Isochrysis galbana* and *Pavlova salina* at a 1:1 ratio and 20 x 103 cell/mL. Culture tanks were drained, washed, and filled with fresh, filtered seawater every third day.

Results

Larvae growth was greater (92mm) in the pasteurized seawater and poorer in the sterilized seawater (80mm), although these differences were not significant (P>0.05). At all treatments, 100% mortality was recorded 15 days after the culture started in spring and 18 days after in summer. The pasteurized seawater and sterilized seawater did not contain *Vibrio* or *Pseudomonas*, the well-extracted seawater did not contain *Pseudomona* but contain low concentration of *Vibrio* and the filtered seawater contained *Vibrio* and *Pseudomona*. An analysis is presented showing the macro- and micro- nutrients variations in each treatment.

Conclusions

The results presented are preliminary. One additional experiment is in progress and another experiment will be conducted in July-August 2007, evaluating synthetic seawater and a commercial probiotic.

Moluscos Bivalvos Contaminados por Brevitoxinas en El Municipio de Alvarado, Veracruz, México

M. R. Méndez Quintana , O. I. Barroso Aragon, R. Velasco Barragán, R. Hernández García y J.M. Escobar-Ramirez
Servicios de Salud de Veracruz. Jurisdicción Sanitaria No. VIII
charymequin@hotmail.com

Introducción

En el municipio de Alvarado se han presentado en 2001 brevitoxinas producidas por *Karenia brevis* (*Gymnodinium breve*) el cual es un dinoflagelado marino que

comúnmente produce mareas rojas en el golfo de México y en el caribe. Este genero produce distintas sustancias hemolíticas y neurotoxicas como la brevetoxina la cual provoca la muerte de peces y otras especies marinas y es causante del veneno neurotóxico moluscos en humanos.

Objetivos

Identificación y contenido cuantificación de brevetoxinas marinas en moluscos bivalvos, llevando a cabo las acciones necesarias para prevenir la salud de la población.

Se fijaron puntos de monitoreo, tomando muestras de moluscos bivalvos las cuales se transladaron al laboratorio con congelantes para la determinación de brevitoxinas, asi como muestras directas de agua de mar en frascos de 250 ml. Fijándolas con acetato de lugol. Para proceder a la identificación y cuantificación de los organismos que producen brevitoxinas con la ayuda de literatura especializada.

Resultados

En diciembre del 2001 se presento una marea roja nociva producida por el dinofleaelado *Karenia brevis*, existiendo cantidades hasta de 2 080 000 org/l . lo cual genero cantidades de brevitoxinas las cuales causaron la gran mortandad de varias especies de peces, algunos crustáceos e invertebrados como medusas y en el caso de los moluscos bivalvos como ostión se llegó a encontrar cantidades significantivas.

Ancient Gulf of California and its Faunal Affinities
Afinidad de la Fauna de Moluscos y su Evolución en el Antiguo Golfo de California

Judith Terry Smith
2330 14th St., N., #401, Arlington, VA 22201-5867 USA
redcloud1@earthlink.net

Tertiary-Caribbean marine molluscs from the ancient Gulf of California are under study within a newly published, detailed tectonic and stratigraphic context compiled by Carreño and Smith (2007, Bulletins of American Paleontology 371) for fourteen basins in the Gulf and Baja California peninsula. The poster includes a map of the Tertiary-Caribbean province and shows marine embayments in relation to boundaries between the Pacific, Cocos, North American, Caribbean, South American, and Nazca Plates. Many faunules from Baja California are associated with dated volcanic rocks that delineate three periods of ancient gulf history: a late Middle Miocene to Late Miocene protogulf (12.9 – ~ 9 Ma) containing Tertiary-Caribbean and to-be-determined species; a Late Miocene – Early Pliocene gulf (8 – 3.5 Ma) containing taxa of mixed affinities; and a Late Pliocene gulf (~3.3 – 2 Ma) inhabited by endemic species that lived there when the Baja California peninsula spread away from mainland west México. Taxonomic review of eastern Pacific and Caribbean synonyms is under way but would be best carried out by specialists conducting monographic studies. Representative species include *Anadara patricia* (Sowerby), *A. thauma* (Maury) [= *A. carrizoensis* Reinhart], *Dosinia grandis* Nelson [= *D. titan* Maury], *Spondylus falconensis* Hodson, Hodson and Harris, many pectinid genera and species, ostreine and pycnodontid oysters. Gastropods include *Conus bramkampi* Hanna and Strong [ancestral to *C. spurious* Gmelin?], *Murexiella (Subpterynotus) textilis* (Gabb), *Sthenorytis toroense* (Dall), *Strombus obliteratus* Hanna,

Turbo crenulatoides Maury, and multiple turritellid species. Many earliest Gulf molluscs also occur in the Valle Central near Turrúcares, Costa Rica, the Gatún Formation of Panamá, and other Miocene units in Colombia, Venezuela, and Trinidad.

Historical Mollusc Catch Trends in Bahía Magdalena, Baja California Sur, México

Mauricio Ramírez-Rodríguez, Esteban F. Felix-Pico and Agustín Hernández-Herrera
Centro Interdisciplinario de Ciencias Marinas-IPN.
Av. Instituto Politécnico Nacional s/n Col. Playa de Santa Rita, La Paz, B.C.S.
P.O. Box 592, C.P. 23096.
mramirr@ipn.mx

The assemblage of marine invertebrates at Bahía Magdalena-Almejas, on the southwestern Pacific coast of the Baja California Peninsula, consists primarily of a tropically derived fauna. Because this region is a transition zone, local species richness and diversity are very high. Temperate forms, though relatively rare, are not uncommon. This situation is well exemplified by the local mollusc fauna exploited by small-scale fisheries in the region, including species of Cephalopoda, Gastropoda and Bivalvia (Table 1).

Mollusc landings registered by fishermen during 1992-2005 at the government fisheries offices located in the San Carlos and Adolfo López Mateos ports (kindly provided by the National Fisheries and Aquaculture Commission) show large variations related with changes in catch composition. From 1992 through 2001 the mean total catch was 1,558 mt, excluding 1998. Since 2002 the annual catches have increased mainly because Pacific calico scallops began appearing as a very important resource in the area.

Regarding Cephalopoda, during 1998 the jumbo squid usually exploited in the Gulf of California was affected by the ENSO event and appeared at the Bahía Magdalena region in sizeable numbers, being heavily fished, with landings of 10,280 mt; during 2005 jumbo squid reappeared in the area and the catch amounted to 2,650 mt (Fig. 1). Octopus catch seems to follow a cyclic trend; it reached its maximum in 1999, and after a steep decline appears to be recovering since 2004.

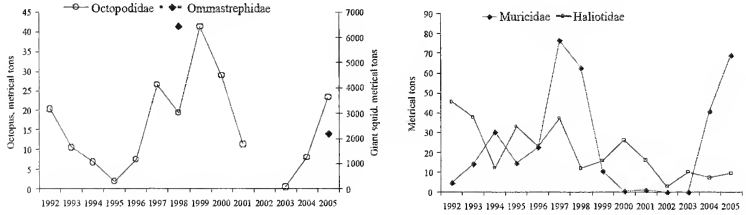

Figure 1. Catch trends of Cephalopoda (a) and Gastropoda (b) families in Bahía Magdalena.

The Gastropoda are represented by the families Haliotidae and Muricidae (Fig 1b). Abalone catch in Bahía Magdalena declined from 1992 through 2002, but since 2003 the catch stabilized around 9 mt per year. *Murex* snail landings, including two species, seem to be cyclical with maxima during 1997 and 2005, but no catches during 2000-2003.

The Bivalvia are well represented in the mollusc catch of Bahía Magdalena. Registered data show decreasing trends for Arcidae and Ostreidae, a notorious increase of the Pectinidae and a possible cyclic pattern for Veneridae.

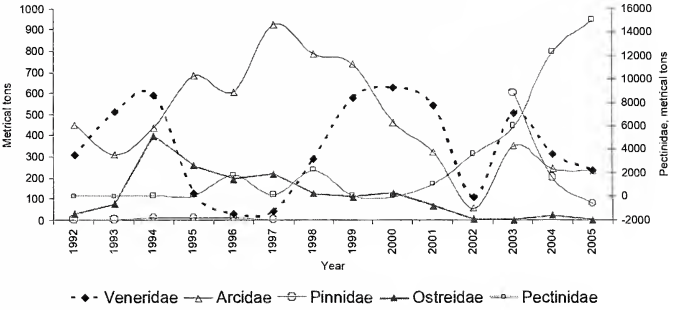

Figure 2. Catch trends of the Bivalvia families in Bahía Magdalena.

In general, there has been almost no information on mollusc fisheries in the study area, with the exception of the abalone fishery (Sierra-Rodríguez *et al.*, 2006), the scallop fishery (Félix-Pico, 2006), or the scarce data given in the National Fisheries Chart (SAGARPA, 2004). Our results show some evidence that environmental changes are forcing the trends in these fisheries, but overexploitation of some species should not be discarded.

Literature Cited

SAGARPA(Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca Alimentación). 2004. Actualización de la Carta Nacional Pesquera y su anexo. Diario Oficial, México, lunes 15 de marzo de 2004, (Segunda Sección): 1-112.

Sierra-Rodríguez, P., M. Muciño-Díaz, J.L. Gutiérrez-González and J.R. Turrubiates-Morales.
2006. La Pesquería de Abulón. In: Instituto Nacional de la Pesca (ed.) Sustentabilidad y Pesca Responsable en México. Evaluación y Manejo. Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación. México: 1-38.

Félix-Pico, E.F.
2006. Mexico: Fishery and Aquaculture, pp 1337-1367. En: S.E. Shumway y J. Parsons (Eds.) Scallops. Biology, Ecology and Aquaculture. Elsevier, Dev.Aquacult.Fish.Sci.

Table 1. Mollusc species exploited by fisheries in Bahía Magdalena-Almejas.

TAXONOMIC CLASSIFICATION	COMMON NAME
Class Cephalopoda	Squids, octopus (Calamares, pulpos)
Family Loliginidae	
Loligo opalescens Berry, 1911	Opalens squid (Calamar opalescente)
Family Onmastrephidae	
Dosidiscus gigas (Orbigny, 1853)	Jumbo or Humboldt squid (Calamar gigante)
Family Octopodidae	
Octopus bimaculatus Verrill, 1883	California two-spotted octopus (Pulpo manchado)
Class Gastropoda	Snails (Caracoles)
Family Fasciolariidae	
Falsifusus dupetitthouarsi (Kiener, 1840)	Du Petit's spindle snail (Chile blanco)
Family Haliotidae	
Haliotis fulgens Philippi 1845	Green abalone (abulón azul)
Haliotis corrugata Gray 1828	Yellow abalone (abulón amarillo)
Family Melongenidae	
Melongena patula (Broderip and Sowerby, 1829)	Pacific crown conch (caracol burro café)
Family Muricidae	
Chicoreus erythrostomus (Swainson, 1831)	
Muricanthus nigritus (Philippi, 1845)	Pink mouth murex (caracol chino rosa)
Family Turbinidae	Nigrite murex (caracol chino negro)
Astraea undosa (Wood, 1828)	Wavy turban (caracol panocha)
Class Bivalvia	Arks, scallops, clams, pens (Almejas)
Family Arcidae	
Anadara multicostata (Sowerby, 1833)	Ribbed ark (pata de mula)
Anadara tuberculosa (Sowerby, 1833)	Black ark (pata de mula negra)
Family Ostreidae	
Crassostrea columbiensis (Hanley, 1846)	Mangrove oyster (ostión de mangle)
Crassostrea palmula (Carpenter. 1857)	Palmate oyster (ostión de mangle)
Crassostrea gigas (Thunberg, 1793)	Pacific oyster (ostión japonés)
Undolostrea megodon (Hanley, 1846)	Megodon oyster (ostión uña de gato)
Family Pteriidae	
Pteria sterna (A.A. Gould, 1851)	Pacific wing oyster (concha nacar)
Family Pectinidae	
Argopecten ventricosus (Sowerby II. 1842)	Pacific calico scallop (almeja catarina)
Nodipecten subnodosus (Sowerby, 1835)	Lyon paw scallop (almeja mano de león)
Euvola vogdesi Arnold, 1906	Fly or concave scallop (almeja voladora)
Family Pinnidae	
Pinna rugosa Sowerby, 1835	Rugose pen shell (callo hacha larga)
Atrina maura (Sowerby, 1835)	Maura pen shell (callo hacha china)
Family Veneridae	
Chione californiensis (Broderip. 1835)	California venus (almeja roñosa)
Megapitaria squalida (Sowerby, 1835)	Squalid callista (almeja chocolata)
Family Hiatellidae	
Panopea generosa (Gould, 1850)	Pacific geoduck (almeja chiluda)

Mexican Gastronomy and Bivalve Molluscs

José Manuel Green Olachea
Universidad Autonoma de Baja California Sur Dept de Ingeniería en Pesquerías
jmgreen@uabcs.mx

Los antecedentes sobre el uso que el hombre ha dado a los moluscos bivalves datan desde tiempos ancestrales hasta la actualidad, existen vestigios de culturas antiguas que permiten conocer sobre hechos históricos relacionados con esta actividad.

Por su calidad como alimento para el hombre, los moluscos bivalvos son identidad, imagen y tradición de muchos pueblos del mundo, sus propiedades organolépticas y nutritivas permiten degustarlos eficazmente mediante diversas formas de consumo final, principalmente como alimento crudo, cocinado o transformados industrialmente. El presente trabajo pretende mostrar esa posibilidad de uso anteponiendo la necesidad de que este tipo de alimentos sean seguros para el consumidor. Son organismos filtroalimentadores que pueden acumular agentes dañinos para la salud del hombre y por su amplia posibilidad de uso, representan un riesgo sanitario para la salud del hombre.

Esta condición natural exige que estos organismos estén vivos antes de usarlos en cualquiera de sus formas de uso final, ya que al morir se descomponen muy rápido debido a la alta actividad bacteriana y enzimática, pero cuando están vivos también es recomendable disminuir esa carga de agentes patógenos a través de buenas prácticas de manejo, depuración e higiene, tanto en la fase productiva como en la preparación culinaria. Durante su producción, comercialización y preparación para el consumo es importante cumplir con la normatividad respectiva para regular su uso, pero antes que todo, es más importante acatar esas disposiciones legales por convicción antes que hacerlo por obligación.

Baja California Sur es la principal región molusquera de México y su principal actividad económica es el turismo. Los moluscos bivalvos son un producto acuícola de gran importancia para la cocina doméstica y comercial, su aprovechamiento con base en el consumo seguro es fundamental para promover el buen uso de este tipo de recurso marino. Las cualidades de un buen alimento van más allá de lo que representa su aporte nutritivo y organoléptico, también es esencial que el alimento esté sano y que mantenga estas condiciones hasta el momento de consumirlo. Socialmente deben ser accesibles para la población y no causar problemas de salud pública.

Sexual Maturity and Age of the Snail *Astraea undosa* (Wood, 1828) from Punta Eugenia, BCS, México

Maria Georgina Gluyas Millán, Pedro Sierra Rodríguez and Margarita Muciño Díaz
Centro Regional de Investigación Pesquera La Paz Instituto Nacional de La Pesca-Sagarpa
Carretera a Pichilingue Km 1 S/N La Paz, Baja Califronia Sur, México Cp. 23020
gmillan@balandra.uabcs.mx

Gonad maturation and the spawing cycle of the wavy snail, *Astraea undosa*, were determined for the region of Punta Eugenia, BCS, México. Data from the first seven months of monitoring are presented. From October 2006 to April 2007, 195 individuals were analyzed. The results of macroscopic observations based on changes in the appearance, size and color of the gonads, and age determed from growth marks on the opercula, indicated that the wavy snail is dioic, it exhibits a single gonad. During the maturation process and when they are mature, the gonad covers the hepatopancreas. Macroscopic observations done in November and April, indicated male and female with ripe gonads, green colored in females, and pale cream yellow color in males. In individuals >90 mm DB, from 3 to 8 years old the liberation of gametes was observed easily, indicating spawn. Estimates of the index gonadic and condition factor support the previous results.

Madurez Sexual y Edad del Caracol *Astraea undosa* (Wood, 1828) De Punta Eugenia, BCS, México

Maria Georgina Gluyas Millán, Pedro Sierra Rodríguez y
Margarita Muciño Díaz

Con el objeto de generar conocimiento del ciclo de madurez gonádica y la duración del periodo reproductivo del caracol *Astraea undosa*, se presenta un avance de resultados de los primeros siete meses de monitoreo de la especie en Punta Eugenia, BCS, México. Se analizaron 195 individuos de *A. undosa* de octubre de 2006 a abril 2007. Resultados de observaciones macroscópicas de la forma, tamaño, y color de gónadas, así como determinación de la edad en opérculos, previamente documentada su periodicidad anual de formación, indicaron que *A. undosa* es dioico, exhibe una sola gónada. Durante el proceso de maduración y cuando están maduras, las gónadas cubren el hepatopáncreas. Con base en observaciones macroscópicas de las gónadas, los individuos de noviembre y abril mostraron gónadas turgentes de color verde musgo y otras tonalidades de verde en hembras, y color crema-amarillo pálido en machos. En individuos >90 mm DB y entre 3 y 7 años de edad se observó fácilmente la liberación de gametos en ambos sexos, indicando desove. Estimaciones del índice gonadosomático y factor de condición apoyan los resultados señalados.

Abalone Fishery and Culture in Baja California: A Historic Perspective

Jorge Cáceres Martínez [1,2] ,Rebeca Vásquez-Yeomans[1],and José Guadalupe Gonzalez Avilés[3]
[1] Instituto de Sanidad Acuícola, A.C. Calle Novena y Gastélum 468, 13-14. Cp. 22800 Ensenada B.C. México
[2] Laboratorio de Biología y Patología de Organismos Acuáticos, Departamento de Acuicultura, Centro de Investigación Científica y de Educación Superior de Ensenada. Ap. 2732, Cp. 22800 Ensenada B.C. México.
[3] Sociedad de Producción Pesquera Pescadores Nacionales de Abulón. Ensenada, Baja California

The abalone fishery in Baja California is one of the most ancient and important economic activities for the area's inhabitants. The earliest "Californios," before the arrival of Spanish conquerors, gathered abalones for food, domestic, economic and ornamental utilization. The meat of abalone was used for food, while the shells were used for used as domestic tools, ornaments and money. Abalone shells have been found in tombs and old constructions of ancient Mexicans in the middle of México, far away from Baja California. Albalone shell has been found in the central United States. In modern times, the abalone fishery was conceded to Chinese and Japanese producers, opening the market in Asia. In the 20th century, exploitation of abalone returned to Mexicans and an important industry was established along the Baja California Peninsula. Over exploitation and diseases became new problems for producers. However, regulation, adequate sanitary practices for the fishery and the abalone culture, have allowed the abalone to remain an important product for the people of the Baja California Peninsula today.

Diagnostic Tools for Mollusc Diseases

Jorge Cáceres Martínez[1,2] Rebeca Vásquez-Yeomans[1] and Adrian Mauricio García Ortega[3]
[1] Instituto de Sanidad Acuícola, A.C. Calle Novena y Gastélum 468, 13-14. Cp. 22800 Ensenada B.C. México
[2] Laboratorio de Biología y Patología de Organismos Acuáticos, Departamento de Acuicultura, Centro de Investigación Científica y de Educación Superior de Ensenada, Ap. 2732, Cp. 22800 Ensenada B.C. México.
[3] Comité Estatal de Sanidad Vegetal de Baja Californa Km. 1.5 Carretera A San Felipe, Ex-Ejido Xochimilco, Cp. 22310, Mexicali, B.C. México

The discovery of *Thermus aquaticus* in 1969, opened the door to one of the most important biotechnological advances in the 20th century. The bacterium is a source of a thermo-stable DNA enzyme named Taq polymerase, which allowed the development of the Polymerase Chain Reaction (PCR) to obtain DNA copies from a single DNA fragment. Application of this technique to the identification of pathogens became widely recognized and it has a direct impact in the identification of infectious diseases around the world. An overvaluation of this technique pushes aside conventional diagnostic techniques such as analysis *in vivo*, classic bacteriology, parasitology and histopathology. This dependence solely on DNA analysis results in important diagnostic mistakes and economic losses in mollusc aquaculture.

There are different technical and human aspects to be considered in the use of

PCR for diagnosis of infectious diseases in molluscs that may result in false positive or false negative. Among them: target tissue, DNA quality and quantity, use of appropriate controls, replicates, and high contamination risk due to the sensitivity of the technique. It is fundamental to take into account the history of the sample population of molluscs, sampling criteria, the use of conventional techniques and a wide pathologist's criteria for an effective diagnostic. The powerful PCR technique for diagnosis of infectious diseases in molluscs is a great technological advance, but it has not replaced other techniques and criteria. Currently, the International Organization of Animal Health, takes into account more than one technique to validate a positive or negative result. Several inherent technical probabilities of PCR mistake will be reduced over time; however, it is only one more technique which increases the probabilities of a better diagnostic. A best diagnostic for molluscs or other organism's infectious diseases requires a joining of results from different techniques and wide pathologist's criteria and experience to arrive dependable results.

General Analysis of Pacific Oyster Mortalities in NW México

Jorge Cáceres Martínez [1,2] and Rebeca Vásquez-Yeomans[1]
[1] Instituto de Sanidad Acuícola, A.C. Calle Novena y Gastélum 468, 13-14 Cp. 22800 Ensenada B.C. México
[2]Laboratorio de Biología y Patología de Organismos Acuáticos, Departamento de Acuicultura, Centro de Investigación Científica y de Educación Superior de Ensenada. Ap. 2732, Cp. 22800 Ensenada B.C. México.

Inexplicable episodes of mortality among cultured Pacific oyster *Crassostrea gigas* have been recurrent since 1997 in the coastal lagoons and bays of Northwest México. Our studies about this matter began around this year. First results pointed to the presence of an iridovirus. Detailed studies using histology, electron microscopy and molecular tools revealed the presence of a herpesvirus, not an iridovirus. The presence of this herpesvirus helps us to explain some mortalities, mainly in larvae, seed and juveniles, but not in all cases. In early 2005, we detected a protozoan infecting the digestive gland of *C. giga* which we named, provisionally, Sporulated Protozoan X (PEX). Recent results shows that this protozoan does not have an important role in observed mortalities, but other tissue alterations suggest that environmental conditions or an unknown etiological agent could be affecting oyster populations under culture, resulting in significant mortality episodes. Inexplicable mortality episodes observed in oysters and other cultured organisms, comes from a complex interaction of biological, environmental, genetic, and husbandry practices which remain to be explained.

Trophic Ecology of *Octopus bimaculatus* Verril, 1883, in Bahía de los Ángeles, BC: Preliminary Results

Elisa Jeanneht Armendáriz Villegas, Marcial Arellano-Martínez,
Bertha Patricia Ceballos-Vázquez and André Abitiacárdenas
Centro Interdisciplinario de Ciencias Marinas-Ipn, Apdo. Postal 592, La Paz, B.C.S. México, C.P. 23000
jarmendarizv06@ipn.mx

Octopuses play an important role in marine environments, both as prey and as predator. Understanding and quantifying the trophic relationships of octopuses is key to understanding the structure and function of marine ecosystems. However, studying the feeding habits of octopuses is difficult because the gut content is highly fragmented and digested, which makes identification difficult. For this reason, octopuses have been studied by the analysis of refuse heaps outside their dens and through direct observation. The objective of this study is to determine the trophic spectrum of *Octopus bimaculatus* in Bahía de los Ángeles, BC. Monthly, from August to December 2006, 20 to 30 individuals together with the refuse heaps near their dens were collected. Prey were identified at the minimum possible taxa. The following indices were applied to gut content: quantitative, numerical, frequency of appearance, gravimetric, and relative importance. The study will also apply the ecological indices of trophic amplitude (standardized by Levin) and diet overlap (Morisita-Horn), comparing between sex, size, and season. At this time, 117 individuals have been collected. An advanced state of digestion has been found, as well as a large percentage of individuals with no remains of prey in the months of August and September. The discovered prey were classified into 35 categories (six phyla). Brachyuran crabs were the most important prey, followed by echiuroidean worms and bivalve molluscs. The months of September and October are noted for the presence of more bivalves. The females consumed more bivalves and echiuroidean worms, while the males consumed more crabs. Small individuals ate primarily small crabs and bivalves. *O. bimaculatus* is a specialized feeder, and despite gender differences, high overlap was found in its diet.

Scope of Growth of the Green Mussel *Perna viridis* at Constant and Variable Temperatures

D. Arrieche[1,2], A. N. Maeda-Martínez[2], V. Acosta[3], L. Freites[4] and C.Lodeiros[4]
[1]Instituto de Investigaciones en Biomedicina y Ciencias Aplicadas, Udo,Venezuela.
[2]Centro de Investigaciones Biológicas del Noroeste, México.
[3]Departamento de Biología, Udo, Venezuela.
[4]Departamento de Biología Pesquera, Iov-Udo, Venezuela

Scope for growth (SFG), describes the energy available to an animal for growth and reproduction. In previous studies, a significant increase in SFG was obtained in a temperate-tropical scallop (*Nodipecten subnodosus*) when exposed to oscillating temperatures, indicating an adaptation to large temperature fluctuations occurring in its natural habitat. In order to test if this increment is consistent in tropical species, normally exposed to minimum temperature fluctuations, SFG was determined in the green mussel

Perna viridis (Bivalvia: Mytilidae). According to the literature, this species has a seasonal and seston associated SFG, and its temperature dependence was only assumed associated to seasonal changes. In the present work, SFG of *P. viridis* was studied in closed continuous flow chambers (60 mL/min) with constant feeding with cultured *Isochrysis galbana*. Mussels were acclimatized in aerated filtered seawater (26 ºC; 40 psu; *I. galbana* 1.5x104 cells/mL/day), and were then subjected to 1 ºC/day change to reach 22, 26, 30 and 34ºC. Then, experimental treatments were applied in triplicate chambers, at the above constant temperatures and at a variable temperature treatment (30 ± 4ºC). Ingestion rate (IR), oxygen uptake rate (RR) and nitrogenous excretion rate (UR) were obtained every 3h during four days to calculate SFG with the equation SFG = IR*AE – (RR + TU) after the data were transformed to energy equivalents (J/g/h). Absorption efficiency (AE) was calculated according Conover (1966). Constant temperature experiments indicate that optimum temperature for growth in this bivalve ranges from 26 to 30 °C where highest SFG was obtained (26 °C = 1656 ± 382 J/g/h; 30 °C = 1938 ± 262 J/g/h). The SFG at oscillating temperatures showed an oscillating pattern which resembled that of temperature but with a 3h delay. The maximum SFG at oscillating temperatures was 1337 ± 122 J/g/h which indicates lower energy available for growth in comparison with that obtained at optimum constant temperatures, which contrast with the findings in *N. subnodosus*.

Influence of Physical, Chemical and Ecological Parameters on Distributions of Common San Diego Molluscs

Wendy E. Storms[1], Kelvin Barwick[2] and R. Nick Haring[1]
[1] City of San Diego Marine Biology Laboratory,
Metropolitan Wastewater Department, San Diego, CA
[2] San Francisco Public Utilities Commission Natural Resources Division,
San Francisco, CA
wstorms@sandiego.gov, kelvinbarwick@hotmail.com, nharing@sandiego.gov

The City of San Diego has conducted regional benthic surveys of the continental shelf and slope off San Diego since 1994. The main objectives of these surveys are: (1) to characterize benthic conditions for the coastal region off San Diego; (2) to characterize the ecological health of the marine benthos in the area; (3) to gain a better understanding of regional conditions in order to distinguish between areas impacted by anthropogenic or natural events. The study area ranges from northern San Diego County south to the US/Mexico border. During the summers of 1994 through 2006 randomly selected sites were sampled at depths ranging from 9 to 461 m. This program is part of a larger effort by the city to fulfill the requirements of their National Pollutant Discharge Elimination System (NPDES) permit. Several common members of the mollusc community were chosen for detailed study. Their distribution in relation to measured environmental factors including sulfides, organic material, and sediment grain size was examined. In addition, the organisms' feeding strategies, if known, were considered as part of the analysis. The bivalve species *Tellina cadieni, Tellina carpenteri, Tellina modesta, Parvilucina tenuisculpta,* and *Huxleyia munita*, and the gastropod species *Kurtzia arteaga, Kurtziella plumbea, Kurtzina beta,* and *Cylichna diegensis,* were compared using univariate and multivariate techniques.

Variation of the Mollusc Assemblage in Bahía Banderas, Nayarit, México

Mario A. González-Suárez and Adrian Maldonado-Gasca
Instituto Tecnológico de Bahía de Banderas.
Crucero a Punta de Mita S/N, La Cruz de Huanacaxtle, Nay. Cp 63732
suarezdolphin2@yahoo.com.mx, adrianmg@yahoo.com

Our objective is to identify the spatial and temporal variation patterns of the structure of the assemblage of the molluscs in the North zone of the Bahía Banderas, Nayarit, México. Two samplings were made (January and May of 2006), in four zones of study (Nuevo Vallarta, Banderas Coast, Punta de Mita and Marietas Islas) including between 3 and 5 sites by zone, in depths between 1 and 10 m. An each site, five randomly located quadrants of $1m^2$ were reviewed; we counted the total number of organisms of each species and we collected between one and three organisms of each species. The collected organisms were preserved dry, in 10%, formalin a or 70% alcohol and they were identified at the lowest possible taxonomic level. We registered 2,473 organisms of 64 species. Gastropoda were most abundant, 44 species representing 25 families, followed by the Pelecypoda, with 20 species in10 families. The Index of Biological Value determines that the most important species were: *Opeatostoma pseudodon, Thais kiosquiformis, Nerita funiculata, Littorina pullata, Tellina purpuria* and *Tagelus longisinuatus*. The richness and the Shannon diversity indices showed significant spatial variation between zones, whereas the Pielou evenness index showed significant temporal variation between months and significant space-temporal interaction. With cluster and PCA, we identify a space pattern in the Bay, with low levels of diversity in sites with sandy bottoms like Nuevo Vallarta, intermediate levels in rocky sites like Coast Flags and high diversity in coralline sites like Islas Marietas and Punta de Mita; we considered the type of substrate to be one of the main factors that determine the distribution of the molluscs in Bahía Banderas.

Stereological Study of the Rainbow Lip Pearl Oyster *Pteria sterna* at a Commercial Farm During a Year

Jorge Iván Cáceres-Puig[1], Carlos Cáceres-Martínez[2] and Pedro Saucedo-Lastra[1]
[1]Centro de Investigaciones Biológicas del Noroeste, Mar Bermejo 195, Col. Playa
Palo de Santa Rita, La Paz, BCS, México, 23090
jcaceres@cibnor.mx,
psaucedo04@cibnor.mx
[2]Universidad Autónoma de Baja California Sur, Carretera al Sur Km 5.5, La Paz BCS, México 23080
ccaceres@uabcs.mx

Pearls have been produced from cultured rainbow lip pearl oyster *Pteria sterna* since 1994, in the Gulf of California, México. For tissue and nucleus implantation the optimum condition for the grafting technique occurs after spawning when the animals' gonads are empty. However at this time, the oysters are energetically exhausted and becoming highly vulnerable to manipulation. In this work we studied the relationship of volume fractions of gonad, digestive gland, mantle and muscle tissues and total body

during a year in order to elucidate and recommend to the technicians the least vulnerable moment for implantation. Twenty adult oysters were sampled monthly at a commercial farm during a year. The oysters were dissected and the tissues from different organs were analyzed by a stereological method. Preliminary results show the volumetric variation in tissues. The results show a strong relationship for all tissues with the reproductive activity. As a consequence we observe a flux in energy between the somatic tissues to germinal tissues. We observe an inverse relationship between the gonad volume and digestive gland during the reproductive event. The reproductive activity is directly related with the availability of food coming directly from the digestive gland.

Reports of Society Business

Lacking formal minutes, these are notes compiled by the Editor from contributions from those who attended the meetings.

Executive Board Meeting

July 25, 2007, Hotel Perla, La Paz, BCS, México.

Participating were Carlos Cáceres Martínez, Hans Bertsch, Doug Eernisse, Nora Foster, and Charles Powell.

We thanked the La Paz meeting organizers, nominated board members to continue next year, discussed how we might be able to maintain student grant awards. Chuck Powell also described the WSM meeting plans for Menlo Park, CA, (on San Francisco Bay) for 2008.

General Membership Meeting

July 28, 2007, Convention Center, Universidad Autonoma de Baja California Sur, La Paz, BCS, México

Present were Carlos Cáceres Martínez, Hans Bertsch, Doug Eernisse, Nora Foster, and Charles Powell, and Christopher Kitting, as well as virtually all conference attendees.

The above agenda was repeated, and the slate of 2008 officers was approved.

We fondly remembered our recently deceased, founding president, Dave Mulliner, acknowledged with a dedication in our beautiful new Annual Report.

We discussed the present conference field trips (by boat) being quite expensive for the local students, and pledged to find ways to assist.

Chuck Powell presented information on the Menlo Park WSM Meeting for 2008, and we encouraged a van trip for Mexican participants to attend.

Hans Bertsch and his wife Rosa Campay kindly translated virtually all of the English into Spanish, for the broad audience. In thanking all the conference organizers and their programs, we also thanked their families, along with the numerous students active at the conference.

"As judged by Doug Eernisse, Chuck Powell and Chris Kitting, the best student paper presentations were given by José Alberto Miranda Velasco, 'Species identification of canned 'abalone' using forensically informative nucleotide sequencing'; Sheila Castellanos Martínez, 'Parasites of the renal sacs from *Octopus hubbsorum* Berry, 1953, in Bahía de La Paz, B.C.S., México'; and Lillian Bloch, 'Species differentiation in the venerid bivalve genus *Transennella*. ' Fittingly, Ms. Bloch was reporting on the research she accomplished as a recent recipient of a WSM Student Grant!

"The best student posters were presented by Diana Zaleta Pinet, 'Embryonic development description of *Pteria sterna* (Bivalvia: Pteriidae) until trocophore

apparition'; Noe Diaz Viloria, 'Microsatellites as genetic markers for pink abalone *Haliotis corrugata'*; and Jorge Ivan Cáceres Puig, 'Stereological study of the rainbowlip pearl oyster *Pteria sterna* at a commercial farm during a year.' Thanks to generous contributions by US members in attendance, the winners were awarded an expense paid Society field trip on Sunday. Those who had prior commitments received autographed copies of the newest, 2nd edition of *Sea of Cortez Marine Invertebrates.*"

From Hans Bertsch's description of the meeting in Festivus vol. 39(10): 98

Annual Meeting, Western Society of Malacologists, Group Photo:(l) (back row, l-r) Hans Bertsch, Mario Alberto González Suarez, Josafat Jehú Ojeda, Brian Urbano, Lillian Bloch, José Alberto Miranda, Ricardo Pérez, Enríquez, Noe Díaz Viloria, Ricardo Gluyas Millán, Dwight Arrieche, Arturo Tripp Quezada, Douglas Eernisse, Charles Powell, Nora Foster, Christopher Kitting (middle row, l-r) Mirna Bravo, Fernando Abasalo Pacheco, María Eliana Gómez Robles, Jorge Ivan Cáceres, Georgina Gluyas Milán, Esteban Félix Pico, Rosa del Carmen Campay, Sheila Castellanos, Norma Estrada, Judith Terry smith, Ivan Murillo (front row, l-r) Yadira Trejo, Eréndira Gorrostieta, Wendy Storms, Carlos Cáceres Martinez, Daniela Barrios Ruiz and baby Juliana Cáceres Barrios, Diana Zaleta