



OceanBights

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Submissions. The magazine may publish submitted articles that pertain to our mission statement. Contact the e-mail address below for more information.

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Pinniped Parade to Paramountcy

An adjacent article discusses the rescue of stranded sea lions. Although a sick or starving sea lion is a sad sight to behold, the large number of strandings reported is actually a symptom of success. Especially for sea lions, there are indications that the population has increased to that which can be just supported by our local ocean. Hence, if there is a marginal decrease in the food supply, as may happen during El Niños, expect large mortalities. But to have large mortalities, there must be a large population, and the pinnipeds have been steadily increasing in number.

Before I was a Californio, I remember visiting San Francisco and watching the beginnings of the sea lion takeover of the docks near Pier 39. As a diver, the rookery on Santa Rosa was well known, especially for the stench. There was the rumored sea lion takeover of the lagoons at Pt. Mugu. Since the 1990s harbor seals have hauled

out at Children's Beach in La Jolla and the angry interaction between seal lovers and beach lovers has become legendary as the beach became unusable to people because of the seals. I was seal bombed (with underwater fire crackers used to drive off seals) diving nearly under the squid boats netting off Vets park as large number of pinnipeds were gobbling up the squid. Diving at Santa Barbara Island made literal the expression crap diving, courtesy of the lions. Then the elephant seals exploded on the beach near Hearst Castle causing traffic jams and development to handle the number of people stopping to view them.

➔ see *pinnipeds*, page 8

Two Island Ecologies

I often think of the ocean as a pathway that brings the world to my door, or at least to my beach. Not only are unusual items carried to our shore from quite far away, but the hope of seeing strange and wondrous animals is also realized from time to time. However, the ocean can be an in-

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surmountable path for most marine fauna when the distances, dangers and their feeding requirements are considered. So we are unlikely to see tropical

remote places and why. This understanding will often induce a loving response to our own locations as we realize how exotic they must appear to people who are unfamiliar with them, just as other places appear exotic to us.

Today I will compare Santa Catalina and Palau, Micronesia. Maps of both are shown to the left and we can see they are of similar size. I can run off a series of facts detailing differences between them, such as the major town on Catalina, Avalon has a population of 3,000 while Koror, the corresponding one on Palau has a population

of 20,000. The greater population may signify that marine life on the tropical island may suffer more anthropomorphic pressure. Palau consists of either volcanic rock (Catalina not so much) or uplifted limestone, while Catalina is also uplifted but with little to no limestone. Both have foxes that are similar in size with Catalina having the island fox and Palau having the flying fox (free advice: **don't get the bat soup**). Somewhat surprisingly, Catalina may have been populated much earlier than Palau. The

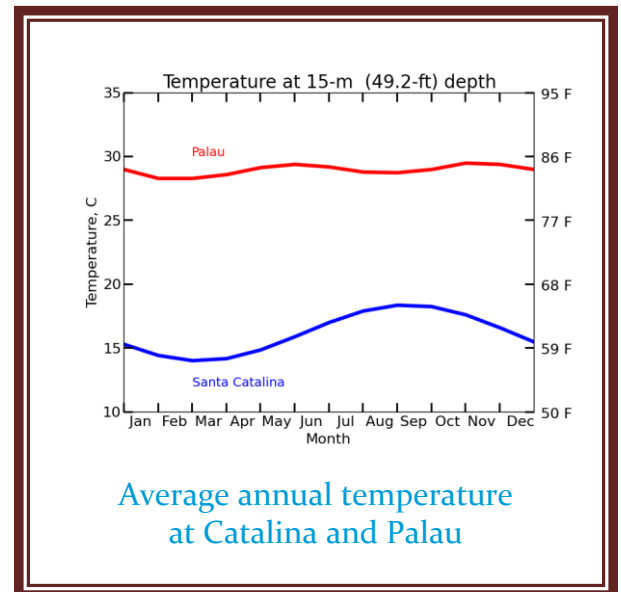
prehistory on Palau is poorly known. However, the original pioneers for both islands probably originated in Asia and hugging the coast in a small boat from Asia, around Alaska and down to Catalina over generations may have been much easier than making an open-ocean trip from Asia to Palau. Hence, Catalina ecology probably has been shaped by humans for a much longer time than Palau ecology.

But perhaps more importantly, many of the differences are determined by locations and especially latitude (Palau: 7.51° N, 134.58° E; S. Catalina: 33.39° N, 118.42° W). Tropical Palau is known for its biodiversity, one of the most marine diverse places on the planet. As there is a global lati-



Maps showing relative sizes of the islands

fauna around our temperate location. Nevertheless, I can pretend. When visiting Santa Catalina, I often relate the marine fauna I see to those that may be seen elsewhere around the globe. For although particular species found at distant locations may differ significantly from those found at our islands, they may have an evolutionary relationship and certainly an ecological role that makes them quite similar to Catalinians. Realizing this enables us to take an exotic vacation by just going underwater, for an animal I see in the Avalon Harbor may trigger an image of a similar one found off a tropical island. It also helps us understand how our islands differ from other



tudinal gradient in the diversity of species (highest number of species is near the equator), we can expect great diversity there. It also forms a vertex of the coral triangle, which includes

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much of Indonesia. Catalina is also known for its high level of marine biodiversity, one of the highest in California. And that diversity is derived from being at the junction of the Northern and Southern provinces, such that it receives cold-water-loving species from the north and the warm-water-loving species from the south.

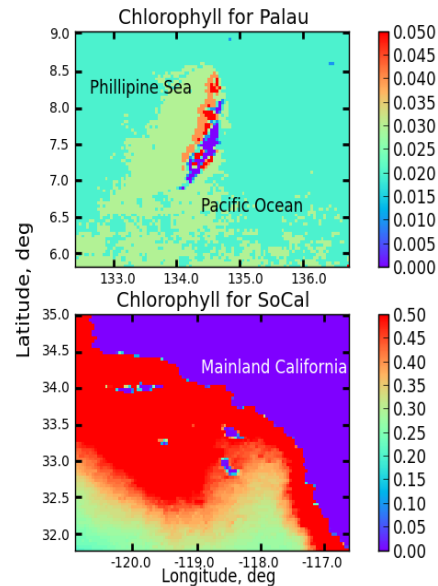
To see how this latitude difference is further manifested, we plotted ocean temperature for the two islands for an interesting diving depth of 15-m (42 ft). In the figure on the previous page you can see an obvious difference; the mean temperature at Palau is 83° F (23° C) while at Catalina it is 60° F (15.6° C). Reef-building corals like mean temperatures between 20° C and 32° C, so that leaves Catalina out in the cold regarding coral reefs and subsequent uplifted limestone. There are other interesting facts found in the temperature graph. For instance, the temperature at Palau peaks twice during the calendar year, first in May/June and then in November. These times correspond to decreases in the local wind speed as the winds alternate from trade winds to monsoonal flows. When the wind speed is smaller, there is less mixing of colder water from depth into the surface layers, with the symptom of warmer surface waters. Since the change occurs twice a year, there are two maximums.

The phenomenon is realized around Santa Catalina in a somewhat different form. We

have winter storms that mix well the surface waters with water at depth, and we also have

ues obtained from satellite remote sensing. Satellite sensors essentially measure how green

the ocean appears. And over time, scientists have correlated the color intensity with the amount of chlorophyll present. We had to adjust the color scales so that some structure could be ascertained in the Palau data. The Palau data are



Chlorophyll at Palau and Southern California, mg/m³. Note the factor of 10 difference in the color scales.

decreased solar energy deposition during the winter, allowing our waters to cool then. During the spring and summer we get increases in solar energy and less wind, so the surface warms and we get one maximum in late summer at 15-m depth. The increased mixing also replenishes the surface nutrients, which typically are found in higher concentrations at depth. This leads to a winter/spring phytoplankton bloom that is a seasonal phenomenon unknown in Palau. To illustrate the difference in those tiny plants, we show the mean chlorophyll val-

clear when compared to Catalina data, there is almost no chlorophyll in the water column at Palau. Not only are the data clear, but of course, so is the water, with diver visibility often exceeding 100 ft because there is little phytoplankton to obscure the view.

But phytoplankton is known to be the base of the food chain. How can Palau have such biodiversity if there are so few of these microscopic plants with which to nourish life? The zeroth-order answer is that Palau is biodiverse (i.e., with many different species) but bi-

Adopt-A-Thermograph Program

The CMS is seeking donors and site managers for its Adopt-A-Thermograph program. These sponsors will extend and complete the David Tsao Thermograph Array that is currently under development. For more details, contact Karen at karen@catalinamarinesociety.org or Craig at craig@catalinamarinesociety.org.

omass is not abundant. Still, that biodiversity must eat.

The next answer is that primary production, the generation of energy from sunlight and carbon dioxide, is not performed in the water column by free-living plants, but rather by plants (e.g., dinoflagellates) held captive by the reef-building corals. These plants are called zooxanthellae in recognition that they are no longer drifters, or plankton. Although these zooxanthellae provide the calories needed to power the reef, other nutrients, especially usable forms of nitrogen and phosphorous, are required for life. On Catalina, these are diffused upward from reservoirs at depth created by dying, sinking and decomposing surface life. Although the dying, sinking and decomposing acts occur at Palau, the return trip produced by upward diffusion

does not provide many nutrients because of the lesser mixing (and higher near-surface temperatures). How do the corals cope?

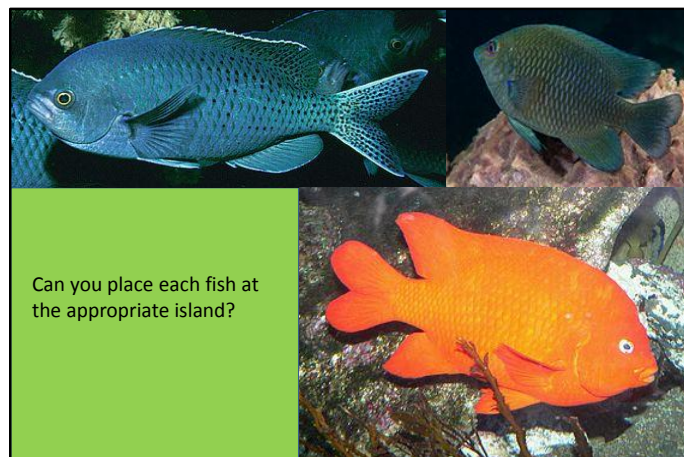
Conservation! Nutrients such as nitrogen are recycled between the zooxanthellae and the coral polyp. This recycling is no doubt aided by the complete enclosure of the dinoflagellates by the body of the coral

polyp. Of course, there are nutrients upwelled or perhaps advected by currents, or even derived from terrestrial sources, but as the figure shows, there is little chlorophyll in the water column so most of the action must be on the reef with the captured dinoflagellates.

These zooxanthellae are temperamental and if the temperature is not quite right, either too hot or too cold, the symbiotic relationship goes to pot and the zooxanthellae are expelled, forced to live in the water column and make do with their own resources. The polyps, without their colorful captives, now look white or bleached. The narrow temperature range, which is outside the

range of temperatures at Catalina, is one of the reasons coral doesn't appear at Catalina. Another may be the relatively poor light levels due to the large amount of phytoplankton in the water column.

One can now easily understand some fundamental differences between Catalina and Palau. For Catalina, primary production is in the water column and the energy pathways must flow from the



Damselfish, Palau and Catalina

water column to the marine fauna we observe. From phytoplankton, to zooplankton, then forage fish, on up the chain. Although we say we have a kelp ecology, actually the amount of primary production produced by kelp, confined to the margins of land, is miniscule compared to that produced by the phytoplankton through Southern California Bight. However, divers prefer diving the kelp beds, so that is what influences our ideas on the island.

In contrast, off Palau, **primary production is in the coral**. Fish graze on the coral, and fish graze on fish, on up the chain. This is not to say that there are no phytoplankton grazers off Palau (think giant manta rays, *Manta alfredi*), but there are fewer calories to be gained living off the water

column.

The resulting differences in biomass are evident in types of economic activity. Palau has mostly subsistence fishing (particularly if you subsist in local restaurants), while Southern California has near industrial-scale fishing, think market squid and sardines. Indeed, the harbor with the most landings, Channel Islands/Ventura, secures most of its take in our Northern Channel Islands and off Santa Catalina.



Coral and kelp

Volunteer for our Depth-Profiling Program

Can you deploy a 7-lb instrument from a boat or kayak? CMS has an active program to measure ocean chemistry around Santa Catalina Island and we could use your help. Contact us for more information.

We see the foundations of the islands' marine ecologies are very different. However, we can find familiar life in both seas. The iconic Catalina fish is the Garibaldi, *Hypsypops rubicundus*. This is a damselfish, known to be territorial and to tend algal gardens to form nests. Another damsel fish is the blacksmith (*Chromis punctipinnis*). These are not territorial and can often be found in large schools in the water column, snapping up zooplankton. There

are similar-looking damselfishes in Palau, the lagoon damselfish *Hemiglyphidodon plagiometopon* and Reid's damselfish *Pomacentrus reidi*. The males of both species also tend algae nests like the Garibaldi, but look surprisingly like our blacksmith. Of course, both damselfishes would have a difficult time feeding in the water column due to the dearth of zooplankton as discussed above.

Palau is fortunate to have many sea turtles, with the most common being the green turtle. Surprisingly, green turtles are seen (rarely) off Catalina. Sightings are getting more common off the mainland as we have recently reported in *OceanBights*; we verified a minor turtle colony in the San Gabriel river. This is a non-breeding colony. But there are small breeding colonies in the northern and southern sections of Palau. Perhaps the next time I see a green turtle surface across from the San Gabriel power plants, I'll think of its cousins (perhaps actual cousins) in Palau.

Of course, there are so many differences between the two islands. Palau experiences rain; it has rivers. These nourish mangroves, and there are crocs and dugongs giant clams and the corals, Oh, the corals. And marine lakes with those zillions of jellies. But understanding an overarching theme that governs island behavior enables one to appreciate and enjoy the differences among the islands to a great degree.■

Society News

CMS plans to be at Aquarium of the Pacific's Citizen Science Symposium (March 4, 2017) and have tables at both the Aquarium's Diver Day (March 11, 2017) and the Long Beach SCUBA Show (May 6-7, 2017). If you attend these

Northrop Grumman gives CMS Community Service Grants

events, please stop by and chat.■

Ocean Acidification Presentation

CMS has an ocean acidification presentation intended for ocean lovers such as divers and boaters. We presented to Deep Blue in Long Beach, the SOCDC in Laguna and will be at the American Legion Yacht Club, Newport Beach, in July. We hope to make ocean lovers aware of current trends in our ocean and what the ramifications are likely to be. There have been several articles in *OceanBights* the last couple of years exploring the issue.

If your group desires an evening's entertainment, contact us for dates.■

Wave Radiation

Whenever I come to a shore, any shore, I listen and watch the waves. The waves tell one a lot about a body of water. Standing on the shore of Big Bear Lake one hears a soft sound and short cadence: swish, 1, 2, swish, 1,2, swish, whereas standing on the beach in Malibu the sounds are: CRASH, 1, 2, 3,

4, 5, 6, 7, 8, 9, 10, CRASH, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, CRASH. The CRASH is the information coded by a distant storm

thousands of miles away, blowing several days before. There is information in both the loudness of the surf and the time between breakers.

Waves on the ocean are almost completely analogous to radio waves, that magic which we detect on our cell phone radios. The ocean transmitters are any phenomena that disturb the water, including boats, breaching animals, tidal forces, earthquakes and wind, especially storm winds. The size and frequency of the wind waves are determined by the fetch or size of the body of water in which they are generated and how far they propagate from their place of origin. Wind blowing over a long distance and for a long time produces large and long waves in addition to the small ones. Larger wavelength waves (wavelength is measured from crest to crest) travel faster than smaller wavelength waves. The largest wavelength waves that can be produced in the fetch correspond to those that travel at about the wind speed. They can also travel further before dissipating, so far, if fact, that they can traverse an entire ocean. The time to cover large distances sorts the waves according to wavelength with the larger wavelengths leading the pack. When we have swell from

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the southwest, we may be receiving information from Australia; if from the northwest, then we have evidence for an Alaskan storm.

Unlike radio waves, however, water waves interact fiercely among themselves. When two waves come together, the resulting height of the surface and speed of the water molecules may not be supportable and the waves break, the top spilling down the forward face of the wave resulting in white-caps and the generation of smaller waves. Therefore, breaking waves diminish in stature, producing smaller waves, in both height and wavelength. Fortunately, radio waves do not interact in this manner. If they did they would be far less effective in transmitting → *see waves, page 13*

→ *pinnipeds*

Their latest beachhead is La Jolla Cove. We saw this



La Jolla seals, Children's Beach

coming as every time we went

to the cove we saw more sea lions than on the previous visit. A couple of years ago, I was interviewed by SD6 as I exited the cove after a dive. The topic: sea lions! Topical because a couple of people recently were attacked when holding fish. Was I afraid of sea lions? Of course not! At the time, I thought little of them. But now they own the beach. If their barking and approaching is not unnerving enough, people are being bit by sea lions and their feces make using the beach uncomfortable.

Now there is the takeover of one of the nicer places on earth from us selfish humans, perhaps forever. Quite frankly, I am not sure how I feel about this. For



La Jolla sea lion thugs, the cove

years, when business brought me to La Jolla, I would bring gear along and either SCUBA dived or snorkeled. I saw my first lobster there and have been maintaining informal surveys of the rebounding abalone population. However, with the lions, underwater use of the marine park will probably end. Although I know this represents a victory for conservationists and indicates a healthy ocean, and I am intellectually pleased, I am also saddened by the loss of a precious location taken by a gang of sea thugs that is but an insignificant fraction of the total Southern California sea lion population. But onward with more cerebral → *seal & lions pg 14*

The Plight of California Sea Lions, Part 2: Rescue, Rehabilitation, Release

Mary Ann Wilson

This is the second part of a two-part series about the recent unusual mortality events of California sea lion (*Zalophus californianus*) pups. The first article investigated the reasons why thousands of emaciated pups have been stranded on California beaches. This article highlights the work of nonprofit organizations dedicated to rescuing and rehabilitating them.

Rescue

A network of rehabilitation centers take in sick and injured marine mammals along California's coast. All centers handle their own rescues except for Marine Mammal Care Center Los Angeles (MMCC). Along with local Animal Control agencies, MMCC relies on Peter Wallerstein, the director and founder of Marine Animal Rescue, which is an organization entirely devoted to the rescue of marine mammals. Their authorized territory extends as far south as Long Beach, west to Catalina Island, and north to Pacific Palisades. Of the 4500 marine mammals they've rescued since 1985, 90 to 95 percent are California sea lions. Wallerstein estimated that of the 395 rescues they've done this year, 30 to 40 were elephant seals, followed by a few harbor seals, fur seals, dolphins, and



Michele Hunter, Wendy Leeds and author Mary Ann Wilson

sea turtles. Why so many sea lions? One reason may be sheer numbers: Compared to the 300,000 sea lions in California, there are just 39,000 harbor seals and probably a similar number of elephant seals.

The organization's busiest time of the year is usually from January to June, when starving sea lion pups that cannot find enough food, lose their fat, become weak and strand on the beach. However, in an ominous Facebook post on November 4, 2016, they showed two pups rescued within the last 24 hours and the caption: "Starting early this year."

The problem begins with the collapse of the food chain, perhaps brought about by an El Niño. Fat- and calorie-rich fish like anchovies, sardines, and mackerel that live in the upper water column become depleted. Nursing mothers are forced to dive much deeper than usual to retrieve fat- and calorie-poor fish

such as short belly rockfish generally found deeper in the water column. As a result, their pups are small and unhealthy. The malnourished, weaned pups must contend with the same forage fish shortage, resulting in more strandings.

Since **the public plays a big part in rescues** of not just stranded sea lions but entangled or beached whales, dolphins, seals, and even sea birds, Peter Wallerstein offered some guidelines for beach-goers who spot a sea lion or any marine mammal in need of assistance.

The first thing to do, he said, is call the Marine Animal Rescue on their 24-hour, toll-free hotline at 1 (800) 39-WHALE anytime day or night, 365 days a year. I told Wallerstein that I had called the center



Peter Wallerstein

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in Malibu two different times after I found stranded pups, and each time they said they didn't have enough room to take care of them. The second time they came and posted signs warning the public to stay away, and then left.

"We try to bring them in even if they don't have a place for them," Wallerstein replied. "We'll bring them to another quiet beach where they can be left alone, and then we'll keep an eye on them. What's helpful for that is when we do relocate it, we tag it, and if that animal

comes back on the beach, that's a re-strand and that gives us more power to try to force the center's hand."

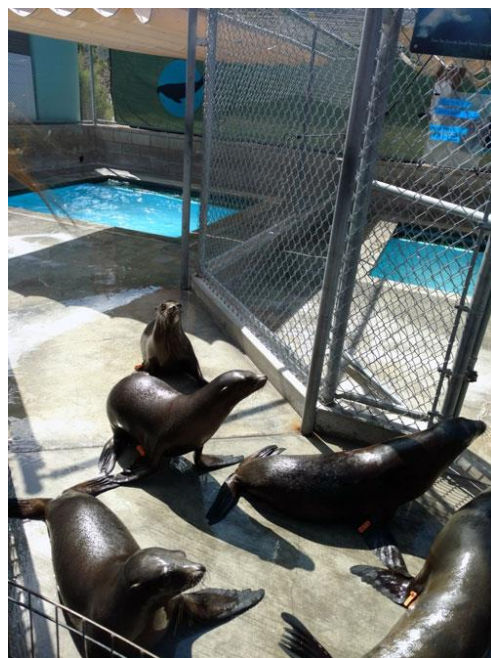
I found out later that the California Wildlife Center can take only 25 sea lion pups, so the response you get depends on where you happen to be and of course, the number of stranded pups there are.

If you spot one and call the nearest center, Wallerstein asked that you stay in the area and maintain contact by phone with the rescuers. "It's pretty difficult searching both sides of a crowded jetty a quarter mile long to find an animal," he said.

But keep your distance. "Not only are they federally protected animals, they also bite ten times harder than a dog," he said. "If they have domoic acid (a neurotoxin that causes amnesic shellfish poisoning), they might have seizures on the beach, or chase lifeguards and trucks."

If they're on land, don't try to get them back to the water. "Once you bring it back into the water, it's almost a one hundred percent chance they're going to die," he said. "If they're on land, we're going to

come get them and we're going to bring them to the rehab cen-



Pacific Marine
Mammal Center

ter. If they go back in the water, then they have absolutely no hope."

On the other hand, "If they're trying to get back to the water, never cut off their path. Do not pull it into the water. If it's weak and emaciated, it won't survive."

Don't feed them. "About a month and a half ago, we found one guy spoon feeding a sea lion," he said. "Luckily the animal was hypothermic because as soon as it warmed up, it got extremely aggressive. And you don't want to give sea lion pups that are starving food right away. They need to be hydrated first. You can tell if a sea lion is hydrated by their eyes –



Mitchell Fong

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if they're runny, they're hydrated. You can't tell if they are malnourished because they may be bloated and look fine to you, but that might be a belly full of parasites." Sea lions are like fish in that they get their fresh water from the food they eat, so the starving pups are also dehydrated. When rescuers transport a pup, they, surprisingly, give them a dog bowl filled with freshwater, which can determine if they live or die. But they don't give them food.

In addition to MMCC, other rehabilitation centers and their jurisdictions include: Sea World, serving the San Diego area; Marine Mammal Care Pacific Marine Mammal Center, Orange County; Marine Mammal Care Center Los Angeles, Los Angeles and Long Beach; California Wildlife Center, Malibu; Channel Islands Marine Wildlife Institute, Santa Barbara and Ventura Counties; The Marine Mammal Center, San Luis Obispo through Mendocino counties; and Northcoast Marine Mammal Center, Humboldt and Del Norte Counties.

Rehabilitation

Mitchell Fong, a volunteer with the Marine Mammal Center in Northern California for the past thirteen years, explained that some of the emaciated pups are half or less their normal weight. As with humans, when pups are that malnourished, their digestive sys-

tem can shut down making it impossible for them to digest food. "We often don't even of-



Katie

fer fish initially," Fong said. "What we're doing is while we're tube feeding them, we're checking as a volunteer to make sure that the animal is truly digesting the food; so if liquid starts coming out of the tube and we see its undigested formula, we know that their stomach is not able to digest the last meal we gave them."

When starving animals arrive at their facilities, they are often given electrolytes for their first few feedings to help hydrate them. The most severely emaciated sea lions can have the longest progression toward being fed fish. That progression could include first electrolytes, then Emeraid, a formula containing amino acids, protein, vitamins, minerals, and water. The next step is fish smoothies without salmon oil, then fish smoothies with salmon oil, then

whole fish. The fish they use is sustainably harvested herring.

Since I live in Southern California, I visited the Pacific Marine Mammal Center (PMMC) in Orange County in early September to take a look at their facility. Established in 1971, this was the first rehabilitation center for marine mammals in California. They're also one of the smaller ones and can hold 135 pups comfortably. They have just thirteen paid staff (some are part-time), but 188 volunteers.

As soon as the patients arrive, they're weighed. That helps the animal care and veterinarian staff determine medication as well as food intake, since sea lions need to consume up to ten percent of their body weight each day. A physical exam follows. Critical care patients stay in one of two heated pens — where even the floors are heated and blankets are provided.

"When these guys come in, they're emaciated, they have no fat layer," said Lead Rescue Coordinator Wendy Leeds, who has worked for the center since 1996. "It's the fat that's keeping them warm. So any food that we actually give them, they burn off all those calories just trying to stay warm."

Procedures are done in the lab, which houses an x-ray machine, a portable ultrasound machine, and an infrared camera that allows them to see deeper abscesses. Emaciated

animals are hydrated via subcutaneous injection (subq for short) in which electrolytes are injected right underneath a layer of skin, rather than intravenously, to hydrate them. Depending on the situation, they are also tube fed: while the animal is restrained, a biter is placed inside its mouth, and the tube goes through the biter and then down into its stomach. This way staff can pour or push the formula into its belly, starting them with what they call Formula A, a combination of unflavored Pedialyte, Karo syrup and Nutri-Cal.

Formula B consists of fish added to electrolytes. Each pup has their own individualized formula and the amount of fish added depends on where the pup is at in its recovery process. By the time a pup can handle medium-thick formula, they're weaned to fish. They start with capelin, a small and lean forage fish which is neither oily nor fatty, followed by herring, which is a lot more oily and fatty. It's the herring that's bulks them up. Michele Hunter, the director of animal care who has worked there since 1989, said, "In our busy season we go through 800 pounds of fish a day, yeah and it's roughly a dollar a pound so that's over eight hundred dollars we're going through in fish a day." But, she said, "We always want the highest quality of fish for these animals, because they're sick animals."

As they get healthier, the pups are moved to different

pens. Each pen has heated floors and can be closed if it gets too cold and windy. The animals that can eat but are still pretty thin are placed in pens with no access to a pool, though they can be brought to a pool on an individual basis. They start eating from bowls of fish. If two animals start eating at the same pace, a shallow pool is placed in the pen and fish are added. It's a good sign if they start competing together, because ultimately they have to compete for their fish. The goal is for them to graduate to bigger pools with five or ten other animals, throw all their fish in there and let them swim around and compete for fish. If they continue to steadily gain weight, they're likely to be successful out in the wild.

California sea lions stay with their mothers from six months to a year before they're weaned. They learn everything from them, including social cues and how to swim. Before bringing in a newborn pup, PMMC staff make sure the mother has not left it on the beach to go out and forage. Because most newborns need to be hand-reared, they come to depend on human interaction and bond with their caregivers who guide them and even teach them to swim. **They will not be successful out in the wild, so they are placed in a zoo or aquarium.**

The rest are kept wild; staff members and volunteers don't talk to them, and any kind of interaction is kept to a mini-

mum. The majority of pups are born mid-June, and since the rescues start around January or February, they are already weaned and have eaten fish. Unless the pup has an injury that will prevent them from being released, their chances of being returned to the wild are high.

Case Study: Katie

Katie was spotted on June 21, 2016 at Pirate's Cove, a beach in San Luis Obispo County. A male sea lion pup, he was named by his rescuer who at the time didn't know his gender. Katie suffered from ataxia (lack of muscle coordination), a swollen jaw, an open wound on his chin, and malnutrition. His body weight was low but not terrible being around 20 kg (44 lbs.).

The Marine Mammal Center, which serves San Luis Obispo through Mendocino counties, has a full-service veterinary hospital in Sausalito, but they also have field offices in San Luis Obispo, Monterey, and Mendocino counties. Katie was brought to the San Luis Obispo office, where they injected subq fluids.

At the same time, they tube-fed him fish mash. They figured he could digest protein since he was not severely emaciated, and his swollen jaw and wound most likely inhibited him from eating fish. They also had to decide whether he could make the four and a half hour drive to their hospital in Sausalito. Based on their observations,

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they took him first to their office in Monterey Bay and obtained a fecal sample, which allows them to look for things like parasites and diseases.

The next day they transported Katie to the hospital in Sausalito, where the veterinarian staff examined the wound to see what caused it and if the wound was causing other problems. To examine him for structural damage, they anesthetized

hunger.

The facility in Sausalito, in contrast to the one in San Luis Obispo, has some deep pools of water so sea lions can swim and go after the fish, rather than eating the fish in small, shallow pools of water. Soon after getting there, they were able to transition Katie from being tube-fed to eating fish. By the time he was released about a month later, his

as they were let out of their individual cages, they touched noses and waddled to the ocean, as volunteers held boards and made a path for them. As soon as they hit water, one of them jumped up and it looked like it had immediately caught a fish. I was moved to tears. ■

Waves → information as they would become garbled and constantly shift frequency.

These incoming and locally-generated waves form a radiation field with a fascinating distribution of disturbances on the surface. When waves come ashore, the slope of the beach is a transducer that changes the ocean surface waves into an acoustic phenomenon crudely analogous to the way that circuitry in a radio receiver and speaker transform radio waves into sound. The wave's slower speed in shallow water cannot support the movement of water at its crest and the wave breaks. The quality of the surf depends on characteristics of the beach. Steep beaches can produce roaring surf sounds. However, shallow beaches, those where the offshore gradient is small, are conducive to breaking further offshore and perhaps breaking again on the beach. This multiple breaking decreases the height of waves before they break on the beach, leading to a softer, though more continuous sound.

The surf sound delivers to your ears the information conveyed by the waves. Waves that impinge on the Southern



Release!

him and did an x-ray. Luckily there wasn't any structural damage. They put him on antibiotics and pain medication for his swollen jaw and chin wound. While in Sausalito the ataxia cleared up and Katie became quite active. Wong surmised that the wobbling that was initially observed may have been due to either his injury or

weight was 37.5 kg – close to double his weight when he was admitted.

Release

In July 2016, I was fortunate to see Katie and three other rehabilitated sea lions released by the Marine Mammal Center in Morro Bay. As soon

OceanBights

California Bight from Alaska, Hawaii and the southern hemisphere can be thought of as bathing the Bight in radiation, a sort of water-wave skylight. Over time, this radiation comes

ated off Two Harbors, say by a boat, to be received at Terranea Resort on Palos Verdes. The wave sets could be coded to form a message (e.g., “Be home at 5.”). Of course, the energy

behaves, when observed carefully (i.e., with the right tools), like water waves and these observations led to great understanding of light’s properties. Because water waves need water to manifest themselves, past scientific thinking led to the hypothesis that there was a medium, the ether, existing throughout space, that manifested light. Proving that this is not the situation provides one of the great stories of science. But that story must be another article.

Seals & lions → thoughts. Have seals and sea lions an historical presence in La Jolla that matches the present one? Or, have they been displaced from other areas and are now forced to live in the high-rent district? What is interesting is that the two La Jolla pinniped species do not mix onshore; they are neatly separated between the two beaches. How have the little quiet seals manage to keep their small piece of paradise from the much larger and louder lions. Enquiring minds want to know. **Before the sharks come.**■



Radiation field meets the shore

from every seaward direction. Just as we can ascertain objects from their skylight shadow, we could ascertain the existence and size of the Channel islands from their wave radiation shadows, if we watched the waves long enough from various locations on the mainland. What a novel thought, native Americans doing wave tomography to figure out the locations and sizes of the Channel islands!

Theoretically, information could also be sent. A series of waves could be gener-

required to generate a wave that would survive passage across the San Pedro Channel would be prohibitive. However, divers with experience at the Avalon Dive Park often see and hear a series of waves at the entry steps reminiscent of boat wakes, though no boats visible are underway. So the waves must have propagated a significant distance before reaching the stairs.

Light waves, radio waves and water waves have much in common. Indeed, light

Upcoming Meetings

Citizen Science Symposium
Aquarium of the Pacific
March 4, 2017

Southern California Academy of Sciences, April 28, 2017, Santa Monica College

Catalina Marine Society Membership

Catalina Marine Society Members support the goals of the Society through their dues and also elect the Society's directors. Membership is described in the bylaws and is granted to those who: 1) agree with the mission statement; 2) pay the annual dues (currently \$20); and, 3) submit an application that is approved by the board. An e-application is available on

<http://www.catalinamarinesociety.org/CMSMembership.html>

Manual Membership Application

Please send the following required information to the Catalina Marine Society via e-mail or post to the address below.

Name, e-mail address, postal address, reason you wish to join the Society, and that you agree with our mission statement.

Dues can be paid through the "Donate" link or checks made payable to the "Catalina Marine Society" sent to the following address:

**Catalina Marine Society
15954 Leadwell Street
Lake Balboa, CA 91406**

If you are interested in contributing to the work of the Society in other ways, please let us know. Categories and examples of needed volunteer work are listed below.

Lab

Data analysis
GIS
Programming

Field

Boating
Diving
Instrument calibration
Hardware/Equipment fabrication and mounting

Office

Web design/programming
Graphics
Photography/Videography

Magazine/newsletter

Reporting
Publishing
Editing
Departments

Fund raising

Event planning
Event volunteer
Grant writing

Press/publicity

Public speaking
Newspaper articles