URBAN MARINER

USC Sea Grant's Urban Ocean Report
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Ship to Shore: Linking Science to Policy

Do you know the stingray shuffle?

Southern California is known for its world-class surf and beaches, but few people know that it is also one of the world's most renowned locations for stingray related injuries. In fact, one beach in particular, Seal Beach, just south of Long Beach, has earned the name "Ray Bay." Seal Beach lifeguards report between 200 and 300 stingray injuries per year, significantly more than neighboring beaches just half a mile in either direction.

Professor Chris Lowe and his graduate students from California State University, Long Beach study Urobatis halleri, or the "round stingray," which lives in shallow, sandy or muddy bays and shorelines ranging from Northern California to Panama, South America. The round stingray, like other stingrays, uses its spine as a defense mechanism against predation. On popular, crowded beaches like Seal Beach, this defense mechanism is often used against human feet, which inadvertently step on the rays.

So why do the stingrays love Seal Beach? Dr. Lowe has found that the round stingray has benefited from a unique situation at Seal Beach at the mouth of the San Gabriel River. Two electric-generating stations located two km up the river from Seal Beach use seawater as a generator coolant and discharge the warmed seawater into the river, resulting in noticeably higher temperatures at the mouth of the river along Seal Beach. Additionally, the beach is bordered to the east and west by jetties, which have reduced the warm water dissipation as well as wave exposure, causing fine sediments deposited by the river to accumulate along shore. In essence, Seal Beach has become an urban alternative to natural estuarine habitat, much of which has been lost or severely impacted by coastal development in southern California over the last century. Through his research, Dr. Lowe has found not only that these warm water conditions may serve as a reproduction cue for male stingrays, but also that warmer temperatures may benefit females during times of gestation.

Round stingray (Photo Credit: Phyllis Grifman)

Surfer at Seal Beach Looking at the Stingray Educational Signage (Photo Credit: Phyllis Grifman)

Unfortunately, these same conditions – warm water, gentle waves, and soft sediment –are loved by stingrays and people alike. This is why one quarter to one third of all ray-related injuries in the coastal United States occurs along this stretch of beach. The problem is so extreme that USC Sea Grant has supported the concerted efforts of Dr. Lowe and his team of graduate students to improve the overall understanding of the habitat preferences, migratory patterns and physiological adaptations of the stingray. In the past, local officials have attempted to reduce human injuries at the beach by culling and ray-fishing competitions, but both ecologically unsound tactics were unsuccessful in reducing injuries.

Dr. Lowe conducted a study to measure the natural spine replacement rates, population size, and site fidelity of the Seal Beach rays, to determine if seasonal spine clipping would be an efficient management measure to reduce injuries. (continued on page 3)

At the Helm: From USC Sea Grant

Welcome to the third edition of the Urban Mariner: USC Sea Grant's Urban Ocean Report.

Phyllis Grifman, Associate Director, USC Sea Grant

Professor Chris Lowe's research encapsulates one of the main goals of USC Sea Grant: to fund research which explores issues unique to the urban ocean environment that can bridge the gap between science and policy, allowing science to be applied to real world ocean management. Not only has Dr. Lowe's research shed light on the often-misunderstood stingray, but it has led to an effective management strategy and education program used by Seal Beach lifeguards (and other coastal managers around the world) to reduce human injuries.

Dr. Lowe's research has now moved on to the larger issues of habitat use and loss for the Southern California round stingray. Research has shown that the stingrays use the warm, shallow waters of Seal Beach for reproduction. As Bolsa Chica and other southern California estuaries are gradually restored to more natural and healthy conditions, Dr. Lowe is very interested to see whether we will see a shift in round stingray populations from artificial, urban ray habitats like Seal Beach to the more natural and traditional estuarine habitats. Will this lead to a decrease in stingray related injuries in the artificial habitats like Seal Beach? Perhaps. We look forward to Dr. Lowe's continued research on stingray genetics, reproduction, growth, habitat use, and movement patterns so that we can continue to have good science inform urban coastal management and planning—a critical step to ensuring healthy Southern California's coastal ecosystem.

Please contact us with your comments and suggestions: (seagrant@usc.edu).

Beach seining for sting rays (Photo credit: Phylllis Grifman)

Scientist's Quarters: About the Researcher

Dr. Chris Lowe

Dr. Chris Lowe (Photo Credit: Phyllis Grifman)

If you were ever stranded on a tropical island, it would be great to have Dr. Lowe along. Dr. Lowe both teaches and runs the CSULB Shark Lab, established in 1969 under the direction of Dr. Donald R. Nelson. The CSULB Shark Lab is dedicated to the study of the physiological and behavioral ecology of sharks, rays, and other economically important gamefishes. Its mission is to advance our understanding of the ecology of marine fishes, train future marine scientists at the undergraduate and graduate levels, and disseminate information to resource managers and the general public to improve conservation of marine fishes.

He has studied the biology, ecology and movement patterns of many of the oceans top predators, such as tiger and scalloped hammerhead sharks in Hawaii, black tip reef sharks at Palmyra Atoll in the Pacific, and leopard sharks and stingrays in southern California. In addition, Dr. Lowe is working on critical research on physiological and behavioral responses of California sheephead to sport and commercial catch & release fishing; the fidelity of rockfish to deepwater oil rigs being considered by the State for decommissioning; the movement patterns and home range sizes of gamefishes in marine reserves; and the movement patterns and habitat use of large sharks and other apex predators.

Dr. Chris Lowe received his B.A. in Marine Biology in 1985 from Barrington College in Rhode Island, his M.S. in Biology from California State University, Long Beach (CSULB) in 1991, and his Ph.D. in Zoology at the University of Hawaii at Manoa in 1998. Dr. Lowe became a professor at CSULB in 2004 and was recently promoted in 2007 to full professor.

For more information on Professor Chris Lowe, his lab, and publications, please visit: http://www.csulb.edu/labs/sharklab/ index.shtml

Do you know the stingray shuffle?

(cont'd from pg. 1)

Because the spines of stingrays lack nerves (like human nails), they can be clipped without causing pain; this technique is used by public aquaria to reduce human injury. However, through a 2.5-year clipping, tagging, and recapturing study, Dr. Lowe found that not only do the rays naturally shed and regrow their spines every year, but also the Seal Beach stingray population is large and highly mobile. Individual rays only remain at the beach for several weeks, mostly in the summer, and then move on. Therefore, due to the large transient population and quick spine-regeneration time, spine-clipping as a management tool was not effective in reducing the frequency of stingray injuries.

Ultimately, Dr. Lowe's research proved that the most effective, efficient and ecologically-sound method to prevent ray-related injuries is to do the "stingray shuffle," a simple shuffling (or sliding) of your feet along the bottom as you enter the water that warns the ray of your presence and causes them to swim away. According to Dr. Lowe, "the findings from our Sea Grant funded stingray research has made Seal Beach a worldwide model on managing the effects of stingrays on beachgoers. Information gained has been applied to public education in the form of beachside posters, public aquaria displays, public web-pages, and K-12 education."

This research allowed the public to get an up close experience and gain an appreciation for a species that has often been vilified because of its potential to cause injury. Between the contact with beachgoers and our association with the Seal Beach Lifeguards, I knew the information we were learning about these rays was getting out to the public and hopefully making their beach going experience a bit safer.

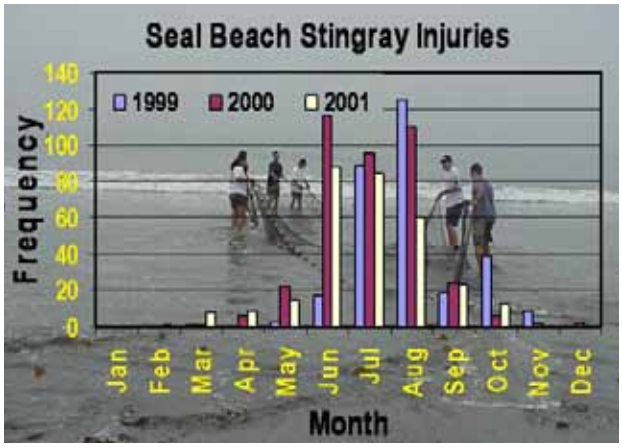
–Jeremy Vaudo, previous CSULB student

This research has shed valuable light on this previously mysterious creature and given public managers a good understanding of how to best reduce injuries in a popular place like Seal Beach. However, despite his success in helping managers at Seal Beach, Dr. Lowe has continued his research, keeping his focus on the bigger picture of natural habitat restoration for rays and other predators that are critical in the balance of these coastal ecosystems.

In Depth: About the Research

In order to determine the spatial and temporal distribution, abundance and density of the round stingray, Professor Chris Lowe and his students used various techniques such as diver visual surveys, seine-net sampling, tagging and tracking with active acoustic telemetry, and seafloor temperature monitoring. They determined that stingray densities at Seal Beach are in fact significantly higher than neighboring beaches where water temperatures are not as high and waves are larger. Out of more than 2,000 stingrays caught, tagged and whose spines were clipped, only 13 (or < 0.1%) were recaptured over a three-year period. The telemetry tracking showed that the rays aggregate at Seal Beach during the summer and fall months from May to November; however, individual rays typically remained in the warm waters near the San Gabriel River outfall for a few weeks at a time, and then they dispersed in the fall. This demonstrated that the population using Seal Beach was very large and mobile.

Additionally, because the aggregations at Seal Beach of both male and females coincide with the stingray mating season, Dr. Lowe has hypothesized that the urban alterations to the Seal Beach environment—warm water, reduced waves, fine sediments—may serve as cues to round stingrays to locate mating grounds. These conditions are similar to the natural conditions of shallow protected bays and estuaries in which stingrays are known to mate and pup. Dr. Lowe and his students spent two years completing the first concurrent assessment of testes morphology, spermatogenesis and steroid hormones throughout the entire reproductive cycle of male round stingrays. They found that males have a clear annual reproductive cycle, and that water temperature seems to play an important role in the regulation of testosterone.



Getting Underway: Young Researchers

In addition to funding and facilitating research and developing partnerships to address some of the critical issues facing the Los Angeles' urban ocean environment, USC Sea Grant places great importance on developing the next generation of scientists, policymakers, and educators. Below we feature two of Dr. Lowe's students, Jeremy Vaudo and Lori Hale, both of whom were influenced by the opportunities for collaboration and policy applications of the Sea Grant funded research in Dr. Lowe's lab.

Jeremy Vaudo, M.S.
Doctoral Candidate, Florida International University

Jeremy Vaudo

Jeremy Vaudo received his B.A. from the University of California, Santa Barbara in 2000 and his M.S. in Biology with Dr. Chris Lowe at CSULB in 2004. With Dr. Lowe, Jeremy researched the movement patterns of the round stingray at Seal Beach. Using acoustic telemetry, he found that actively tracked stingrays (individuals followed continuously over the course of a few days) tended to show limited movements, most often staying within the warm waters of the San Gabriel River mouth. However, Jeremy also found the rays showed a seasonal movement pattern to and from Seal Beach. Individuals left Seal Beach during autumn and returned the following spring.

Despite finishing his work with Dr. Lowe in 2004, Jeremy did not stop working with rays.

Students measuring round stingrays (Photo Credit: Phyllis Grifman)

He immediately entered a Ph.D. program in Biology at Florida International University, studying the feeding ecology and habitat use of a ray community in Shark Bay, Australia. His goal was to understand how the interactions of these mid-level predators with both their predators and their prey influence the greater community structure. While in Australia doing his research, Jeremy also helped the Australia Department of Environment and Conservation with several of their public outreach programs, giving weekly seminars on the Shark Bay ecosystem. Jeremy feels that his work on the Seal Beach project has had a huge influence on his current and future research plans:

Jeremy feels that his work on the Seal Beach project has had a huge influence on his current and future research plans. *"What I learned during my Seal Beach research has formed the foundation for my current and future research questions, and I continue to use the skills and techniques that I learned studying rays at Seal Beach. One aspect of the Sea Grant projects that was really appealing was the public interaction it allowed, and I believe having that experience has played a big role in getting me to where I am today."*

Beach seine net being used to capture round stingrays at Seal Beach (Photo Credit: Phyllis Grifman)

Lori Hale, M.S.
Observer Coordinator, Bottom Longline Observer Program, NOAA Southeast Fisheries Observer Program

Lori Hale in front of the Seal Beach Stingray Education

Lori Hale completed her Master's of Science at CSULB with Dr. Chris Lowe in 2005. Her research focused on age and growth analysis of the round stingray at Seal Beach, both important analyses for examining the age structure of a population and the growth rates of a species - critical pieces of information for proper management of the species. Lori's research was one of the first studies to demonstrate the use of a new technology (laser ablation inductively coupled plasma mass spectroscopy) in studying the spatial distribution of calcium and phosphorus deposits in round stingray cartilage. This data could be used to determine age and growth rate, similar to counting the growth-rings in a tree.

Since graduating, Lori moved to Panama City, Florida, and for the last four she years has been the Observer Coordinator of the Shark Bottom Longline Observer Program run out of the NOAA Fisheries Panama City Laboratory. Observers are independent specialists who ride-along on commercial fishing vessels and collect data on catch composition, bycatch, and gear-usage. Observers provide critical information for the proper management of marine resources.

Lori says that her *"Sea-Grant funded graduate work with Dr. Chris Lowe definitely influenced [her] career choice by fueling [her] desire to educate the public about science."*

A large part of her current position, she says, *"is to communicate with commercial fishermen and act as an advocate for government-funded observers in commercial fisheries…The work that I did with Sea Grant was very eye-opening. Sea Grant allowed me to interact with the public as a scientist and learn valuable communication skills. Interacting with different groups of people with different levels of scientific knowledge is a skill that has translated to my career now."*

Lori also maintains and analyzes the observer data in a database and participates in such research efforts as age and growth analysis, diet composition, and reproductive studies.

Students measuring a round stingray (Photo credit: Lori Hale)

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