The Smilodon

The Newsletter of the Southern California Academy of Sciences

May 2, 2018

NASA Schedules First West Coast Mars Mission Launch for May 5

Accessed from NASA.gov May 2, 2018

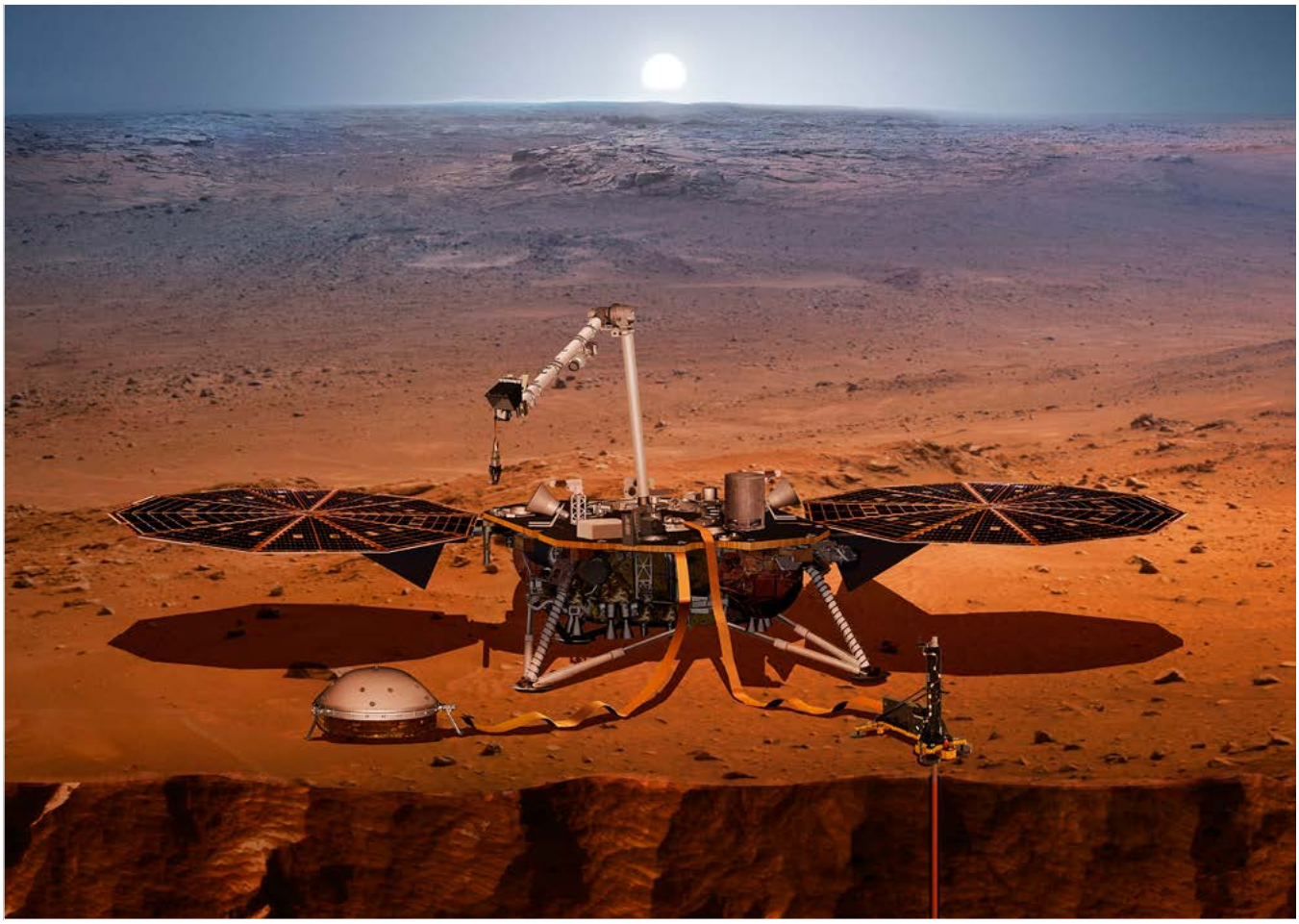


Illustration of NASA's Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight). Credit: NASA

NASA's next mission to Mars, Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight), is scheduled to launch Saturday, May 5, on a first-ever mission to study the heart of Mars. Coverage of prelaunch and launch activities begins Thursday, May 3, on NASA Television and the agency's website.

InSight, the first planetary mission to take off from the West Coast, is targeted to launch at 4:05 a.m. PDT from Space Launch Complex-3 at Vandenberg Air Force Base in California aboard a United Launch Alliance (ULA) Atlas V rocket. Depending on weather conditions, the Atlas V rocket's pre-dawn flight out of Earth's atmosphere could be visible across much of southern California

InSight will be the first mission to peer deep beneath the Martian surface, studying the planet's interior by measuring its heat output and listening for marsquakes, which are seismic events similar to earthquakes on Earth. It will use the seismic waves generated by marsquakes to develop a map of the planet's deep interior. The resulting insight into Mars' formation will help us better understand how other rocky planets, including Earth, were and are created.

For additional information on the InSight Mission, visit https://www.nasa.gov.

President's Corner...

With the annual meeting just around the corner, this is always an exciting time for SCAS as we look forward to meeting new people, catching up with old friends, and sharing new ideas. The research, scholarship, and professional development opportunities offered by the Academy can benefit students at all levels of their academic career.

I would like to invite you to attend this year's annual meeting, which will be held on Friday, May 4 at Cal Poly Pomona. We'll kick off the 2018 meeting with 3 concurrent symposia focused on Desert Sciences, Kelp Aquaculture, and Parasitology. Immediately following these sessions, our plenary speaker, Dr. Greg Rouse from Scripps Institution of Oceanography at UC San Diego will discuss his research in a talk titled, "Deep Discoveries in the 2000s: Bone-Eaters, Green Bombers, Ruby Seadragons and More." In the afternoon, contributed paper presentations will cover a variety of topics ranging from physiology and ecology to conservation biology and environmental change. And, finally, we will finish the day with an evening poster session that will once again include our Junior Academy members enrolled in the Research Training Program.

As the President of the SCAS Board of Directors, and on behalf of the Board, I would like to take this opportunity to thank all of the members, past and present, for your support of the Academy. I would also like to thank the Natural History Museum of Los Angeles County who hosts both our website and archives; we are grateful to the museum, and we hope to continue our longstanding relationship.

Finally, this is your newsletter, and I want you to be part of it. I invite you to submit short articles, announcements, pictures, and any other sorts of information relevant to the Academy. If you have scientific papers to publish, the SCAS Bulletin publishes papers by members without page charges. One of the primary goals of the Academy is to report on research activities of SCAS members, scientific research conducted in southern California, and research that is of interest to the membership.

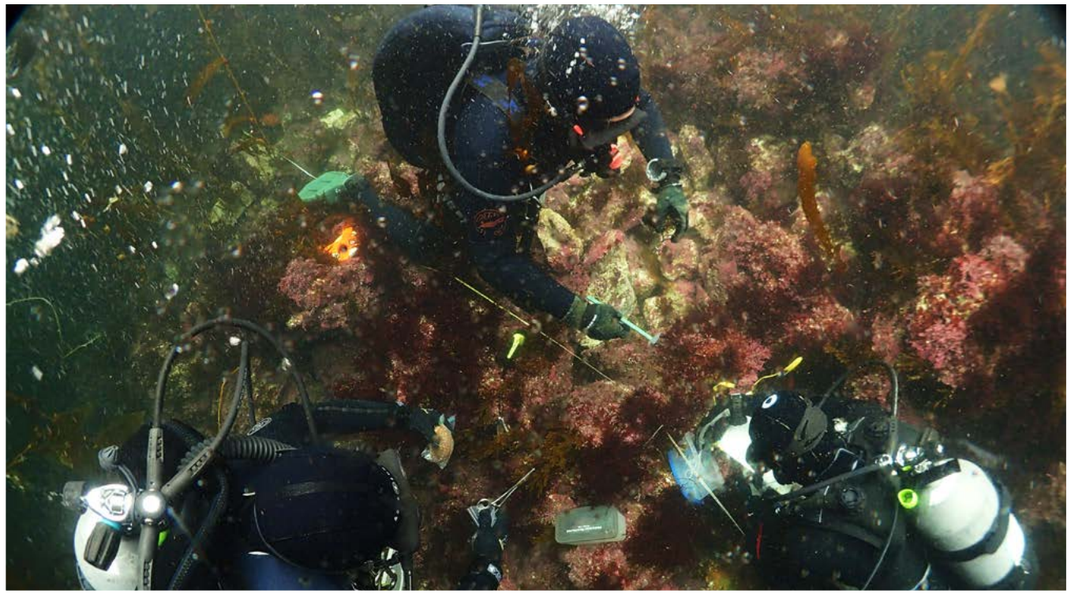
Thank you for your continued participation and support, and I look forward to seeing you at the May 4, 2018 meeting in Pomona.

Dave Ginsburg, President

Researchers from The Bay Foundation examine abalone in their San Pedro laboratory (see accompanying story on page 3). Credit: The Bay Foundation

SCAS Member Project Update: TBF Abalone Research and Restoration

by Parker House, Marine Programs Coordinator, The Bay Foundation



TBF researchers surveying abalone off the coast of southern California. Credit: The Bay Foundation

The Bay Foundation (TBF), a research based environmental non-profit and affiliate of Loyola Marymount University's Coastal Research Institute (CRI), constructed a laboratory for abalone research and restoration projects in 2016. This research lab allows TBF to conduct controlled experiments to better understand abalone broodstock conditioning and spawning behavior.

The "Ab Lab" is located at the Southern California Marine Institute (SCMI) in San Pedro where TBF's research vessel (R/V Xenarcha) is berthed. This location provides easy access to the nearby Palos Verdes Peninsula where TBF's kelp forest restoration sites are established, and is the region spawned abalone larvae and reared juveniles will be outplanted. Likewise, the lab will serve as a southern California hub for endangered white abalone (*Haliotis sorenseni*) research and restoration activities.

The Ab Lab's many successes over the past several years include:

- wild adult broodstock of red (*Haliotis rufescens*) and green (*Haliotis fulgens*) abalone have been collected and well-maintained in the lab
- spawning trials of captive red abalone have taken place monthly with success in producing veligers and recent juveniles
- method development from quarterly deck spawning trials of wild abalone off the Channel Islands has provided new findings
- juvenile green abalone have increased ten-fold within our 2015 outplant site

Within the next year, a second laboratory is to be constructed to house white abalone.

Just a few years into TBF's abalone programs, various projects have shown positive results in broodstock husbandry, spawning experiments, outplanting efforts, and juvenile rearing. They are confident this will continue and hopefully aid in the recovery of abalone species off the coast of the Santa Monica Bay and surrounding waters.

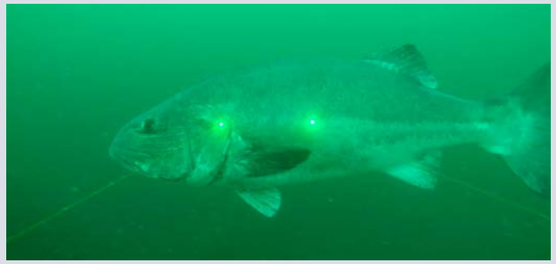
SCAS 2018 Student Grant Recipients

The Southern California Academy of Sciences provides annual grants to graduate and undergraduate students. The winners present their research at the following year's Annual Meeting. Grant award winners are announced during the Annual Meeting. A summary of each award winner's research is provided below. Please join us in congratulating our award winners!

Alyssa Clevenstine

Project Title: Aggregation patterns and site fidelity of giant sea bass (*Stereolepis gigas*) at Santa Catalina Island, California

Summary: Certain species are more susceptible to exploitation than others due to their life history traits and reproductive characteristics (Coleman et al., 1996). Species that form spawning aggregations, for example, are more vulnerable to exploitation than those that do not (Carter et al., 1994). Spawning aggregations tend to form predictably at the same place and time annually, making aggregating species easy to target en masse (Sala et al., 2003; Hamilton, 2005; Sadovy de Mitcheson and Domeier, 2005; Sadovy de Mitcheson and Erisman, 2012). In California, giant sea bass were over- fished during the mid-1900s, likely attributed to their aggregating behavior, evidenced by a 95% decline in commercial landings in California from 1932-1980 (Domeier, 2001). Such dramatic declines led the State of California to enact a moratorium on recreational fishing for giant sea bass in 1982 and limited commercial in take in 1994 to allow the incidental catch and sale of only one individual per trip.



Estimating size of a giant sea bass using length calibrated parallel lasers.

Tagging giant sea bass at an aggregation site using a modified pole spear with an attached acoustic transmitter (V13-1H, Vemco Ltd.).

Within the last decade, aggregations of 7-23 individuals were recorded at Catalina Island, CA, indicating signs of population recovery and return of aggregation behavior (House et al., 2016). For this project, acoustic receivers (VR2W, Vemco Ltd.) and coded acoustic transmitters (V13-1H, Vemco Ltd.) are being used to determine aggregation sites and spawning behaviors of giant sea bass as they may have changed since exploitation. Additionally, SCUBA surveys are being conducted to estimate aggregation size and fish abundance across 13 sites. From June-August 2017, 34 mature giant sea bass (115-200 cm TL) were tagged along the leeward side of Catalina Island, coinciding with spawning. Giant sea bass exhibited diel movement patterns during spawning season which did not continue across seasons. Tagged individuals were detected more than twice as much at a previously unknown aggregation site (338,861) than a historic aggregation site (148,203). This suggests the species may be selecting new spawning sites in light of decades of overfishing. Of the 34 tagged giant sea bass, 4 definitively left the acoustic array at Catalina Island after the 2017 spawning season, moving northeast (35-85 km) or southeast (53 km). All tagged fish utilized multiple aggregation sites during spawning season. Temporal scale of site use was measured using the average number of hourly detections. One aggregation site had three times the average detections during daylight hours (0700-1800) than at night. A second aggregation site had three times the detections at night (1800-0700) than during the day, and six times the number of detections overall than the other aggregation site. Distance traveled varied across tagged giant sea bass, with movements of up to 12 km in 24 hours, 31 km in 48 hours, and 85 km in 96 hours. Data will continue to be collected through October 2018 to assess site fidelity and aggregation behavior.

SCAS 2018 Student Grant Recipients

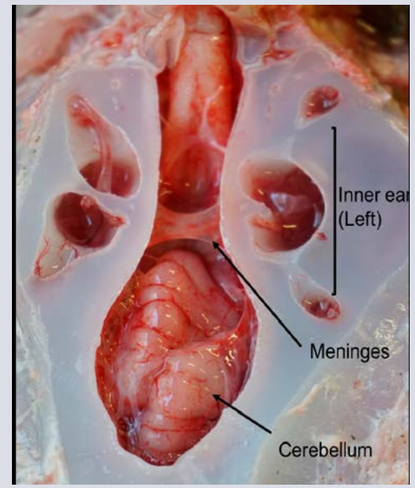
Laura Martinez-Steele

Project Title: Assessing *Carnobacterium maltaromaticum* pathogenesis in stranded sub-adult common thresher sharks (*Alopias vulpinus*)

Researchers: Laura Martinez-Steele[1], Mark S. Okihiro[2], Renaud Berlemont[1], Jesse Dillon[1], Christopher G. Lowe[1]
[1]California State University Long Beach, Biology Department
[2]California Department of Fish & Wildlife

Summary: Common thresher sharks (*Alopias vulpinus*) and salmon sharks (*Lamna ditropis*) have been periodically stranding along the West Coast of North America. The cause of these stranding has been attributed to disorientation resulting from massive brain and inner ear infection caused by *Carnobacterium maltaromaticum*. Yet how and why these sharks are becoming infected is unknown. In this study, we aimed to better understand the pathogenesis process in stranded common thresher sharks. For that purpose, we collected and compared the gut microbial community, brain and inner ear tissue of five stranded sharks with *C. maltaromaticum* infection, eleven healthy sharks caught by fishers and two stranded sharks that had no signs of infection or *C. maltaromaticum* presence. The gut microbiota has recently gained attention for the role it plays in the overall health of the host, such as that, an unregulated microbial community can be sign of disease. We were able to distinguish a core microbiome common to all sharks, nonetheless the microbiome in infected sharks was characterized by a significant increase in the presence of Vibrio strains, which have previously shown to be pathogenic in sharks, indicating an alteration of the gut microbiome in infected sharks. The microbial presence in the areas of infection (brain, ear and endolymphatic ducts) was also determined using Illumina sequencing, and showed high *C. maltaromaticum* presence in infected sharks while no bacteria present in healthy sharks. To determine the health status of the shark, histology was used to assess the level of inflammation and infection in the brain and inner ear of all sharks, elucidating how *C. maltaromaticum* is potentially accessing the inner ear and brain through the endolymphatic ducts. The microbial community of eight embryos and the uterine fluid of two pregnant females were also investigated to determine if infected sharks could be acquiring *C. maltaromaticum* while in utero during the period when females flush their uterus with seawater to remove metabolic waste. Unexpectedly, the uterine environment showed to be dominated by one bacterial strain of the genus Mycoplasma, and *C. maltaromaticum* was found present at very low levels. Lastly, we analyzed the whole genome of nine *C. maltaromaticum* strains isolated from the inner ear and brain of stranded thresher and salmon sharks. This analysis exposed virulent genes unique to these strains, indicating which genes are aiding in the infection process. Although there is need for more research to better understand this periodic shark stranding phenomenon, this study was able to use the microbiome as a tool the measure shark health which can aid to predicting the health status of sharks in future studies.

Stranded thresher shark infected with Carnobacterium maltaromaticum



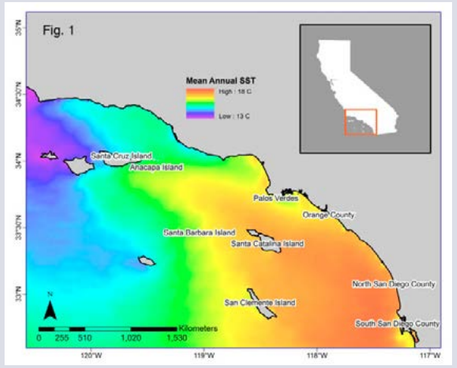
Open chondocranium of a stranded thresher shark, showing brain and inner ear infected with Carnobacterium maltaromaticum

SCAS 2018 Student Grant Recipients

Chelsea Muñoz-Williams

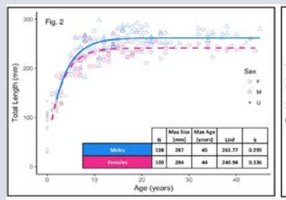
Project Title: Determining impact of spatially explicit environmental and ecological factors on growth and longevitiy of the protected garibaldi (*Hypsypops rubicundus*)

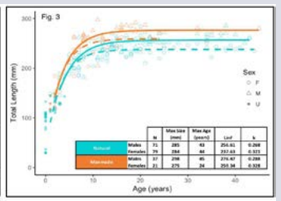
Summary: The Garibaldi (*Hypsypops rubicundus*) is a marine damselfish native to the shallow reefs of California and Baja Mexico. As the State Marine Fish of California, this species has been fully protected since 1995. Marine fish life history patterns (i.e., allocation of resources to competing demands of growth, reproduction, and survivorship) not only provide insight into population and community-level processes and ecological patterns but can also clarify responses of species and communities to exploitation and climate and ocean changes. Recent studies conclude that varying ecological and environmental processes (e.g., temperature, habitat, productivity, fishing pressure, and density-dependent interactions) introduce spatial variation in marine fish life-history characteristics. The Southern California Bight (SCB), has a unique current circulation pattern which, when coupled with the complex bathymetry, results in strong abiotic gradients and diverse microhabitats. In addition, a variety of man-made structures (i.e., break walls, jetties, artificial reefs, and oil platforms) around the area also provide an artificial source of hard-substrate habitats for many reef-associated fishes. By focusing on a historically protected species, we can determine how spatially explicit environmental and ecological factors are shaping patterns in growth and longevity, without the impact of fishing.

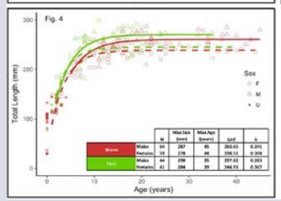


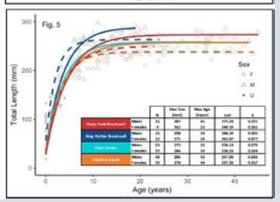
For this study, I will use otolith-based ageing to assess if Garibaldi growth patterns vary by location, reef type (natural/manmade), and/or sex within the SCB. I will also validate the annual formation of growth increments in otoliths to confirm that growth rings are in fact formed annually rather than corresponding with other variation. Garibaldi will be collected from each of nine environmentally and ecologically distinct regions including five California Channel Islands and four mainland sites (Fig. 1). If feasible, paired natural and manmade habitats within a location will be sampled.

From 2013-2017, 275 Garibaldi were collected from four sites (Santa Catalina Island [natural, warm], Dana Point Breakwall [manmade, warm], Palos Verdes Peninsula [natural, cool], King Harbor Breakwall [manmade, cool]) by scientific divers using pole spears at the Vantuna Research Group at Occidental College, Cal Poly Pomona, and Moss Landing Marine Lab. Otoliths were sectioned and read once by a single reader to determine age. Age and growth patterns were assessed by fitting the von Bertalanffy growth function ($L = L\infty [1 - e\text{-}k (t - t0)]$) using non-linear least-squares regression in R. Preliminary growth curves (solid line = males, dashed lines = females, t0 fixed at -0.5) indicate differences in life history patterns for Garibaldi by sex (Fig. 2), reef type (Fig. 3), temperature (Fig. 4), and at each site (Fig. 5). Once fish are collected from all nine regions, the level of evidence for effects of location, reef type, and sex on growth patterns will be assessed using AIC-based model selection procedures.









SCAS 2018 Student Grant Recipients

Darien Satterfield

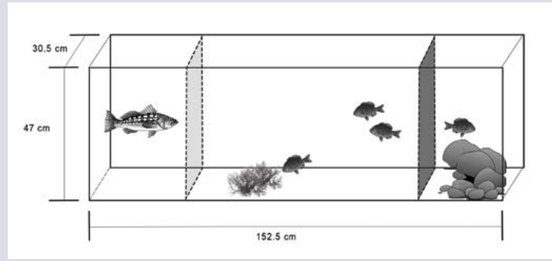
Project Title: Evaluation of heritable behavioral variations among black surfperch (*Embiotoca jacksoni*) populations relative to predation risk

Summary: Along the coast of California predatory fish species historically have been abundant. However, over last 40 years, heavy fishing has depleted populations of multiple species. Recent surveys indicate an approximately 85% decline of kelp bass (*Paralabrax clathratus*, KB) population density from 1980 to 2008 (Erisman et al. 2011), with particularly low densities reported for many fished populations. Surveyed locations within the bounds of a marine protected area generally have higher densities (data. reefcheck.us). These differences in predator densities can result in spatial differences in predation risk for populations of prey species.

Although behaviors may be flexible, behavioral tendencies (e.g., boldness, aggression) are heritable traits (e.g. Dall et al. 2004, Ariyomo et al. 2013) and it is conceivable that behavioral tendencies evolve in response to spatial differences in predator abundance. For example, bold and exploratory individuals may acquire food at a relatively high rate and thus have a fitness advantage. In contrast, exploratory tendencies may be selected against in high-predator environments where greater exposure may result in higher predation risk and decreased fitness (Biro et al. 2004). This study seeks to evaluate whether black surfperch (*Embiotoca jacksoni,* BSP) exhibit heritable variation in boldness and exploratory behavior. Specifically, this study will assess behavioral trends in reference to spatial variation in predation risk among populations.

Unlike most fishes, BSP give birth to fully formed juveniles which remain on their native reef (Bernardi 2000). BSP have a generation time of 2-3 years, suggesting populations have had 13-20 generations to evolve in response to changes in overall abundance of KB. Whether behavioral tendencies can evolve in BSP depends on the heritability of these traits. If a trait is heritable, (1) it will exhibit repeatability, and (2) offspring will resemble relatives. In a pilot study, repeatability of responses to predatory threats in three trials where compared. For 15 minutes BSP could explore a tank containing a rocky shelter and a KB behind a clear divider. Repeatability was found to be 77% for proportion of time spend in shelter, 71% for latency to leave shelter, and 66% for proportion of time spent nearest the predator. High repeatability may suggest heritability. Our ongoing studies use a 'common-garden' experiment to test whether lab-born fish from a low-predation environment (Palos Verdes) and a high-predation environment (Santa Catalina Island) exhibit heritable differences in behavior.

In this experiment, pregnant fish will be brought into the lab where they will birth their young, so the babies have no experience in their wild environment. Thus, behavioral trends they exhibit will not be influenced by exposure to predation threat. If fish from low-predator environments are locally adapted to low predation risk, lab-born offspring are expected to display more bold and exploratory behaviors. In contrast, we expect offspring from high-predator environments to be shy and cautious. These locally adapted behavioral trends may limit flexibility in behavior, and thus the ability to adjust to rapid shifts in predator abundance. For example, BSP may face intensified mortality given fisheries restrictions on KB. Thus, this study may elucidate the necessity to consider behavioral adaptation for preservation of diversity in California's marine environments.



Behavioral tank. Predator (kelp bass) is separated by light grey divider; dark grey divider can be removed following acclimation period. Black surfperch can forage, shelter, or explore.

Housing tank containing a pregnant female black surfperch.

SCAS 2018 Student Grant Recipients

Milinda Thompson

Project Title: Effects of urban water supplementation on the physiological state of desert iguanas (*Dipsosaurus dorsalis*)

Researchers: Milinda Thompson (CSU Fullerton), Tracy Langkilde (Pennsylvania State University), Christopher R. Tracy (UC Riverside, Boyd Deep Canyon Research Center)

Summary: Maintaining water balance is critical to an animals' survival in arid environments. Water loss from evaporation or waste must be balanced with the limited water available to consume. Prolonged periods of water imbalance could result in dehydration and death if the water cannot be replaced. Animals can respond hormonally to physiologically stressful environments (i.e. water restriction) to reduce exposure to stressors and activate processes that might reduce the disturbance to homeostasis.

Corticosterone (CORT) is a hormone that is secreted by the hypothalamus-pituitary-adrenal (HPA) axis. While, CORT helps mobilize energy stores and suspend unnecessary activities and physiological processes, chronically elevated CORT can negatively impact fitness (e.g. suppression of the immune system could lead to disease). Identifying whether water imbalance is stressful to species has been poorly studied to date and warrants further research since climate models predict that the frequency and duration of droughts are to increase.

Desert iguanas (*Dipsosaurus dorsalis*) are an example of a xeric-adapted species and are faced with periods of seasonal and/or yearly drought. We predicted that populations of *D. dorsalis* from "natural" non-irrigated sites would have higher hematocrit (an indication of dehydration) and higher CORT concentrations than populations with access to supplemented water through urban irrigation. To evaluate this hypothesis, I surveyed two populations of *D. dorsalis*, one with and one without access to irrigation, in the Coachella Valley, CA during the driest part of the activity season, at the end of a five-year drought.

Hematocrit levels of lizards from the non-irrigated site were significantly higher than those from the irrigated site, indicating some dehydration, but CORT concentrations were not significantly different between sites. Smaller lizards showed higher CORT levels than larger lizards, however the effect of size was only significant in the non-irrigated site.

Study results suggested several additional hypotheses regarding *D. dorsalis* when experiencing water restriction. We hypothesize that small lizards in the irrigated site had lower CORT levels because the water lost from being surface-active could be easily replaced from food sources or through drinking. We also hypothesize that larger lizards increase time spent within burrows and reduce surface activity when dehydrated, allowing them to lower body temperatures and reduce evaporative water loss, as well as lowering the probability of encountering above ground stressors (i.e. predation, social conflicts).

Overall, our results suggest that the age (size) of *D. dorsalis* and accessibility to urban irrigation effects possible water stress levels. Further work in this and other systems on effects of water availability on both baseline and post-stressor CORT, and the effects of CORT on water-conserving behavior, would shed important light on the role of CORT in facilitating water conservation.

Tiny Sea Creatures Hold Secrets to Earth's Climate

edited by Denise Lineberry, NASA Langley Research Center (updated April 12, 2018)

Each new season brings change. Seasonal change on land is something that we're familiar with and adjust to regularly. But what happens to billions of plankton in the ocean each season? How do they adjust to changing sunlight patterns and mixing of the water column? And what impact do these tiny critters have on us, so far away on land?

To answer those questions and others, NASA's North Atlantic Aerosols and Marine Ecosystems Study (NAAMES) mission began its fourth and final deployment, making it the first research mission to conduct an integrated study of all four distinct phases of the world's largest phytoplankton bloom in the North Atlantic and how they impact the atmosphere.

A view of the Atlantis, seaborne research vessel for the North Atlantic Aerosols and Marine Ecosystems Study. Credits: Photo courtesy of Nicole Estaphan

"Most scientists studying the bloom head to sea during its climax in late spring and early summer. We did that, but we also went out during the other seasons to fully capture the minimum and transitions of the bloom." said NAAMES Deputy Project Scientist Rich Moore.

"This thoroughness pays off as our ship-based scientists use these data to fully describe the entirety of the plankton bust/boom cycle," he said. "No one has done this before, and we're excited about the science findings that are beginning to trickle out now."

NAAMES research challenges traditional ideas about bloom dynamics and species succession. Findings from three deployments have already confirmed a distinct shift in the annual cycle of the phytoplankton bloom and researchers have noted a clear lack of larger-sized plankton during the peak of the bloom. The implication of these findings will be presented in a series of journal publications over the coming year.

During previous NAAMES deployments, researchers completed 220 research hours aboard an instrumented C-130 aircraft along specific tracks and maneuvers over the North Atlantic, including fly overs of the Woods Hole Oceanic Institute's (WHOI) Research Vessel Atlantis, which carries more than 50 researchers and crew members.

The ongoing ship deployment is currently collecting observations of ocean biological composition and stocks, aerosol measurements and optical properties of the North Atlantic study area.

Satellites such as CALIPSO, a joint NASA and CNES mission, also help to study the ocean and the atmosphere – from the depths of the phytoplankton bloom, to the clouds and atmospheric particles in the sky above.

This final NAAMES study researches the "ascending transition" of the bloom, which occurs after the phytoplankton minimum in February. In the March-April phase, the plankton are growing steadily, with their abundance in the water continuing to increase or accumulate toward the maximum of the bloom between May and July.

This bloom phase provides a unique opportunity for researchers aboard Atlantis to do experiments that study growth and decay of the phytoplankton population.

"For scientists watching the rates of growth, this is the exciting time, because the accumulation rate is expected to be going through the roof and stay high for the next few months," Moore said. Rates of phytoplankton accumulation are critical for understanding the ocean conditions that lead to phytoplankton growth and its timing, a key to unlocking the environmental drivers and controls of biological dynamics.

Because scientists are also interested in the link between the ocean, atmospheric particles and clouds, they've conducted meteorological balloon launches from the ship on a regular basis to capture information relevant to cloud formation processes.

By combining global data from NASA satellites with the ship, aircraft, and autonomous assets such as floats, along with laboratory research and balloon data, scientists are able to not only understand the current state of the atmosphere, but also how it is evolving over time.

"At this point in the study, we're using the logistical lessons learned from the first three deployments to execute what is needed to fill in the last piece of the science puzzle about what drives the accumulation phase for phytoplankton growth," Moore said. "Then the real fun starts," he said, referring to the ongoing analyses of the data and publication of findings in scientific journals.

The Last Word

In an effort to regularize the publication of this organ, the editorial board of the Smilodon (in consultation with the SCAS Board of Directors) have decided to revise the aforementioned publication's production schedule. The Smilodon will be published twice annually:

November and April

To facilitate this schedule, the following deadlines for receipt of articles/input/photographs/etc. will be adhered to.

Deadlines for November (Autumn) issue:

Receipt of articles/input:	October 15
Draft Smilodon to Board for review:	November 1
Board comments on Draft Smilodon to editor:	November 8
Smilodon distributed to membership:	on or near Nov. 15

Deadlines for April (Spring) issue:

Receipt of articles/input:	March 15
Draft Smilodon to Board for review:	April 1
Board comments on Draft Smilodon to editor:	April 8
Smilodon distributed to membership:	on or near April 15

If you have any questions or concerns about this schedule, or better yet, if you have content to provide (this can be an abstract of a paper or presentation you are working on, an idea you want to share or receive feedback on, an essay on a field experience that was singular and noteworthy, a particularly good photo you want to share...), please contact sgraff@psomas.com or bblood@psomas.com. Thank you!

produced by PSOMAS

Address correction requested

http://www.scas.nhm.org/
(213) 744-3384
Los Angeles, California 90007
900 Exposition Boulevard
Southern California Academy of Sciences

SCAS