MARINE LABORATORY
UNIVERSITY OF GUAM

University of Guam Marine Laboratory Strategic Plan 2023-2027

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Cover Photo:
Former UOG Marine Lab students David Benavente and Jessica Deblieck-Graydyan conduct fish surveys in Chuuk State, Federated States of Micronesia as part of the regional coral-reef monitoring program conducted between regional partner and the lab of Dr. Peter Houk.

Photo taken by Simon Lorenz and used with permission in this report.

Message from the President

Håfa Adai! The University of Guam Marine Laboratory has been an important, prolific center for excellence in marine research in our island and region for over 50 years.

Established in 1970, the Marine Lab is guided by the University's mission of Ina, Deskubre, Setbe – To Enlighten, To Discover, To Serve. Over the years, Marine Lab faculty have mentored undergraduate and graduate students through biology and environmental science courses.

These students contributed to research on the biology of our marine organisms in our region, and to the conservation and management of marine resources. And many of the students stayed in the region or returned to the University as faculty and researchers to continue that work. The Marine Lab also provides environmental assessments, produces technical reports and educational materials, hosts public lectures, and partners across agencies and industries to develop strategies to protect our coral reefs and other marine resources from natural and anthropogenic threats.

The work of the Marine Lab has been significant, engaging with other organizations such as the government of Guam on coral reef conservation, to participating in marine science expeditions with National Geographic, to serving as a local contact for James Cameron's Challenger Deep Expedition to the Marianas Trench in 2012.

The Marine Lab is now preparing for the future with a reimagined strategic plan. Its initiatives include creating an amazing place to study marine science, providing modern research facilities, achieving sustained support for research and education excellence, engaging stakeholders, and making the Marine Lab a great place to work.

The Marine Lab has my full support and the support of the University's administration as it pursues these new strategic initiatives. I am looking forward to our exemplary Marine Lab faculty, staff, and students propelling forward together over the next five years.

Tulos Mo'na!
Biba UOG!

Anita Borja Enriquez, DBA
President

A birds-eye view of University of Guam, with the Marine Lab in the lower left.

The University of Guam Marine Laboratory

The University of Guam Marine Laboratory was established in 1970 as a research unit of the university. The lab was created, in part, to address pressing issues of the day.

Guam coral reefs were being attacked by an exploding population of crown-of-thorns starfish, and there was growing concern about the effect of sewage, petrochemical and power plant discharges.

More than half a century later, coral reefs are under threat from rising sea temperatures and coral bleaching, extreme weather, sedimentation from runoff, oceanic acidification and overfishing.

At the Marine Lab, researchers are trying to understand how activities on land affect life in the sea. They are studying the stressors that affect reef organisms, and how organisms respond to those stressors.

The lessons learned can help communities on Guam, and throughout the Pacific and the world, make informed decisions about resource management, pollution controls and strategies for mitigating threats to reefs.

Marine Lab students have the opportunity to be a part of that research. They learn about marine science not just by studying it in a classroom, but by living on an island where the reef provides food, economic well-being and recreation.

They also have a chance to be part of the solution, discovering new ways to protect a fragile ecosystem. Some of the current Marine Lab faculty started out as students, and have returned to teach the next generation of scientists and leaders.

A diver surveys the reef using stereo-video technology.
Brett Taylor photo.

Aerial view of the Marine Lab, the Pacific Ocean and Pago Bay.
Tom Schils photo

Vision

Diverse, sustainable, and resilient tropical marine environments.

Mission

Advancing marine science and building capacity for Micronesia and beyond through innovative research, excellence in education, and collaborative networks.

Shared Values

Scholarship
We conduct innovative, creative, and collaborative research to produce transformative science.

Integrity
We act with uncompromising honesty and hold ourselves accountable for our actions.

Work Ethic
We lead by example in the classroom, laboratory, and field.

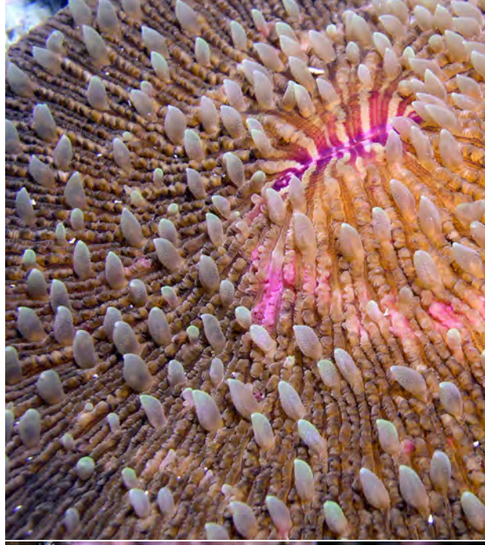
Inclusion
We foster inclusion, equity, and diversity in all its forms to promote opportunities for everyone.

Respect
We value Indigenous knowledge and commit to inclusive science.

We commit to understanding and promoting careful stewardship of our natural heritage.

We make commitments with care and live up to them.

Community
We promote scientific literacy within our communities to support resilience and sustainability.



UOG Marine Lab Strategic Initiatives 2023-2027

I. To create an amazing place to study marine science

II. To provide modern research facilities

III. To achieve sustained support for research and education excellence

IV. To engage our stakeholders

V. To create and maintain a great place to work

STRATEGIC INITIATIVE I:
To create an amazing place to study marine science

GOAL 1: To better balance the representation of local/regional faculty and students

Objective 1: Increase the number of enrolled local/regional students from 33% to 50%
- **Action 1:** Conduct a third-party survey with local undergraduate seniors, graduates and alumni.
- **Action 2:** Undertake an active effort to attract more local/regional students.

Objective 2: Increase the number of graduate local students graduating with a master's degree from 70% to 80%.
- **Action 1:** Conduct a third-party study with local graduate students and alumni.
- **Action 2:** Undertake an active effort to increase graduation rates of local students to 80%.

Objective 3: Increase faculty diversity (especially local/regional and female)
- **Action 1:** Recruit local/regional faculty and women

GOAL 2: To have an updated and top-notch master's curriculum

Objective 1: Update the master's program.
- **Action 1:** Meet and design the new master's curriculum based on the program review

GOAL 3: To broaden the range of learned research skills.

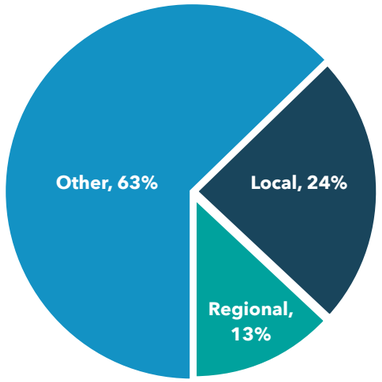
Objective 1: Broaden student research experience.
- **Action 1:** Regular research seminars across labs – every lab must present every semester/year.
- **Action 2:** Improve the work and social infrastructure at the lab (i.e. library/student offices), lab space, social spaces.

GOAL 4: Finding linkages with other universities and have students enter a PhD program

Objective 1: Broaden student experiences and options.
- **Action 1:** Increase number of faculty with adjunct positions with other universities from four to eight.
- **Action 2:** Explore needs and resources for a PhD program.

A look at Marine Lab students, 2000-2023

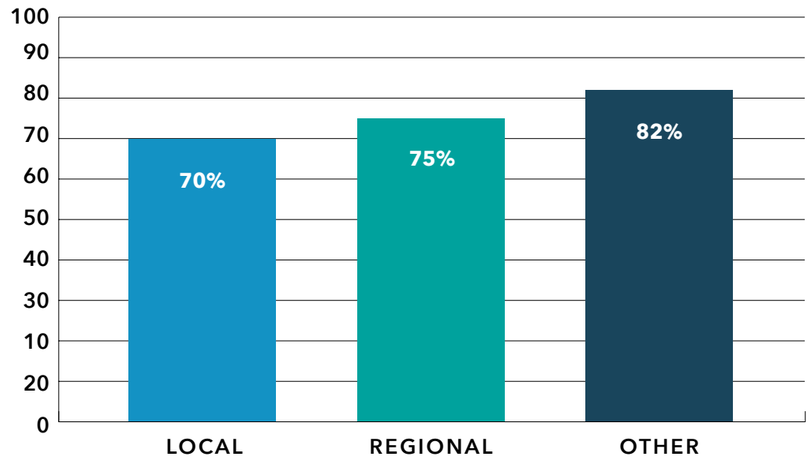
Origin of Marine Lab Students



LOCAL: Guam, CNMI
REGIONAL: Micronesia, Asia, Pacific
OTHER: U.S. mainland, Europe, Americas

Of the 125 Marine Lab students from 2000-2023, there were:
30 from Guam and the Commonwealth of the Northern Mariana Islands, with 21 graduates.
16 from Micronesia, Asia and the Pacific Islands, with 12 graduates.
79 from the United States mainland, the Americas and Europe, with 65 graduates

Graduation Rates by Origin



Creating an amazing place to study marine science

Traditionally, the University of Guam Marine Laboratory has attracted high-caliber students from around the world who want the adventure of living on a tropical island and the experience of studying marine science in the middle of a vast ocean.

Dr. David Combosch, Assistant Professor of population genetics, said for those who want to study marine science, Guam is "a fantastic place. The marine environment out here is just absolutely phenomenal. And it is, by far the best coral reef under U.S. jurisdiction."

The reef is at the foot of the university campus, so the real-world examples of the classroom lectures are always easily accessible. "We're definitely the only university that has that kind of field access, and that's just unique and fantastic and fabulous."

"Our students go diving a lot, every weekend," he said. By spending more time in the water, they see the reef under different conditions, and "there's a huge appeal for people coming from the mainland, to have that sort of exposure."

Since 2000, students from the continental United States, Europe and Central and South America have accounted for 63% of the enrollment at the Marine Lab. They have the highest graduation rate of any group at the Marine Lab, with 82% finishing their programs.

Students from Guam and the Commonwealth of the Northern Mariana Islands make up the the next largest group of students, with 24% of enrollment. They have the lowest graduation rate, at 70%.

David Combosch and Leya Wang inspect corals in the lab.
David Combosch photo.

Regional students, from Micronesia, Asia and other parts of the Pacific, make up 13% of students. They have a graduation rate of 75%.

Among the goals of the Marine Lab: Raising the enrollment rate of local and regional students to 50% of total enrollment, and raising the local graduation rate to 80%.

Combosch studies fundamental questions about the evolution of marine invertebrates. His students learn how the smallest building blocks of life work together to create beautiful ecosystems.

For local students, that means developing a deeper understanding of the ocean they've known all their lives.

"You can only protect what you understand, what you love, what you know. More than anything, in order to protect it, you need to understand," he said.

"I always had the impression that there's a huge desire on island to protect the natural resources. People are very, very attached to the land and the water and the reef and their place. They do want to protect it, but you need to know and understand it order to protect it."

Dr. Tom Schils, Professor of marine biology/phycology, said the Marine Lab is known for its contributions to Guam and Micronesia, from early research on the crown-of-thorns starfish to more recent projects undertaken by faculty.

"It's regarded to be a well esteemed institute, I would say, in the public mind and in Guam."

But it's the Marine Lab's current work, not just its legacy, that attracts students today.
Students working with Schils have discovered new species of crustose calcifying red algae. The algae, which is sometimes mistaken for coral, is abundant here. Guam has the highest diversity of calcifying red algae in the world, Schils said.

"We're actually at the forefront of changes that that have manifested themselves already here in Guam, and that are now happening elsewhere in the Pacific," Schils said.

He noted that Marine Lab Director Dr. Laurie Raymundo has studied overall degradation of coral reefs, specifically bleaching events and how coral cover and coral diversity is decreasing.

The loss of coral on the reef creates an opportunity for the algae.

The calcifying algae "fill that niche that has been created by the coral. So these calcifying algae are taking over in certain areas," he said.

The algae can have a positive contribution to reef growth after a bleaching event.

"This is something that actually has never been documented or witnessed elsewhere in the world," he said.

Because of the Marine Lab's location, and year-round access to the reef, students are able to regularly monitor the algae at different times.

"We have a rather intimate knowledge of the reef. And we actually see changes happening in front of our eyes."

Hyperspectral imaging is used to study the reef community. *Tom Schils photo.*

STRATEGIC INITIATIVE II:
To provide modern research facilities

GOAL 1: To have abundant space and resources to do excellent science.

Objective 1: Identify infrastructure needs
- **Action 1:** Assemble a group of people to build out the list.
- **Action 2:** Obtain and review building plans.

Objective 2: Move to WERI building
- **Action 1:** Assessment of needs and priorities.
- **Action 2:** Identify usage of available spaces.
- **Action 3:** Estimate renovation costs.
- **Action 4:** Secure funding for renovations.
- **Action 5:** Renovate and move.

Objective 3: Renovate outdoor ex situ labs
- **Action 1:** Needs assessment.
- **Action 2:** Identify funding sources.
- **Action 3:** Develop renovation plan and estimate costs (architect consultants).
- **Action 4:** Apply for funding.
- **Action 5:** Establish project management team.
- **Action 6:** Secure contractors.

Objective 4: Upgrade Marine Lab facilities
- **Action 1:** Assess current usage and needs.
- **Action 2:** Identify priorities for renovations.
- **Action 3:** Estimate renovation costs.
- **Action 4:** Secure funding for renovations.
- **Action 5:** Renovate.

Objective 5: Plan for the future
- **Action 1:** Assess future facility needs (boat house, biorepository).
- **Action 2:** Identify spaces for expansion.
- **Action 3:** Obtain architectural plans and cost estimates.
- **Action 4:** Identify and apply funding sources.

Experiments conducted in the lab can provide information useful in the real world. *David Combosch photo.*

Providing facilities for state-of-the-art research

While the waters around Guam provide a great classroom for marine science students, top-notch research can't be conducted without modern facilities.

An important goal of the Marine Lab Strategic Plan is to have "abundant space and resources to do excellent science."

The questions answered by that research can help not only the reef and the organisms that live on it, but also people who depend on the reef for sustenance and economic well-being.
Since arriving at the University of Guam Marine Laboratory seven years ago, Dr. Sarah Lemer, Associate Professor of marine invertebrate genomics, has worked to improve the genetics lab, replacing old equipment and expanding the facility.

"We doubled the space. We modernized it. And so now it's a fully functional genomics lab. It's actually a very good genomics lab for the region, compared to the other labs I've been to," she said. "It's as good as what we can find on the mainland."

Lemer and her students collect tissue samples in the field, either from around Guam or in the waters of neighboring islands.

"We extract the DNA. We sequence the DNA. And then we compare the genetic sequence of our different individuals. Then we compare those between the different populations. That's to have an idea of population connectivity, or population genetic differences," she explained.
Sometimes, the research results in the discovery of a new species or a cryptic species – a species that isn't new, but has been misidentified because it is morphologically identical to another species.

Experiments in the lab can yield information that is useful in the real world.

"We collect some corals on the reef, and we bring them here in our water system, put them in aquariums, and then we run experiments on them trying to simulate the ocean condition in the next 50 to 100 years," Lemer said. "We increase the temperature, or we increase sedimentation, so we make the water very turbid. And then we see how the corals react."

As the researchers run different simulations, they determine how different corals tolerate different stressors.

"Where is the tipping point? We increase the temperature slowly, and then we see once we reach this temperature, for a certain amount of time, that's when the coral cannot take it anymore. Sometimes, we find some coral colonies that seem to survive, or at least don't mind the stressor. And so when we find those, we are really interested. But understanding how the resistant ones function, that definitely can help us, in the future, think about ways to help the reef."

While Lemer and her students are looking at the makeup of the organisms that live on the reef, Dr. Atsushi Fujimura, Associate Professor of oceanography, studies marine biophysics - the conditions that will affect those organisms.

Water currents, light, temperature, nutrients and pollution all have the potential to influence life on the reef.

Precision instruments are needed to measure conditions in the field, and control for variables in the lab.

In a converted shipping container on the Marine Lab grounds, Fujimura is creating space to house a special tank for his experiments.

The tank will allow him to control water flow, light, temperature or different concentrations of nutrients. In the lab, he will be able to study the conditions that affect coral bleaching.

"If coral bleaches, and continues the bleaching for a long time, several months or a year, then coral dies eventually. That's a problem, because corals host a lot of organisms, including fish. That means that affects our local fishers, and us of course as consumers of the fish are affected by such phenomena. And of course, losing corals and fish means losing some of the tourists here."

This 2018 photo from Puwe, Chuuk, shows damage from coral bleaching. *Peter Houk photo.*

STRATEGIC INITIATIVE III:
To achieve sustained support for research and education excellence

GOAL 1: To have financial, friend, and political support from people and organizations, on island and beyond, who believe and understand the value of investing in the vision the UOG Marine Lab.

Objective 1: In 2025-2026, have a game plan for a comprehensive friend and fund-raising plan.

Attracting funding to support research and education

Agencies and organizations that support programs at the Marine Lab find their money goes further than it does at other institutions, according to Dr. Alex Kerr, Professor of marine biology.

"You get a lot more bang for your buck. We're a good investment. When you give us a grant to do something, we're not going to spend some giant fraction of it just traveling here and having it eaten up by per diem, because we live here," he said.

"It's all money for research. And we do this all the time."

The Marine Lab's location might make it ideal for studying coral reefs, but a small group of researchers on a remote island is at a disadvantage when competing against large, well-funded universities for research money.

Professor of ichthyology Dr. Terry Donaldson was serving as the director of the Marine Laboratory when he became the principal investigator and project director of Guam EPSCoR - the National Science Foundation's Established Program to Stimulate Competitive Research.

The program has allowed the university, and the Marine Lab, to hire faculty, purchase equipment and expand program offerings to better serve students and the community. Ultimately, it will help researchers at the lab attract funding from different sources.

In 2018, the university received a $6 million, five-year EPSCoR grant to evaluate how marine ecosystems and coral reefs respond and adapt to environmental and climate stressors. In 2021, the university received a $20 million five-year grant to expand on the work.

Dareon Rios works on population genetics of staghorn Acropora.
David Combosch photo

"This benefits the faculty, it benefits our graduate students, and it also increasingly - and this has not always been the case - it's really had a big impact on undergraduate students who don't normally take classes at the Marine Laboratory," Donaldson said.

Students have worked on projects involving DNA, mathematics, biology and other areas of research.

"They want to learn, and they want to have something that's attractive so they can get into postgraduate work," he said. "We've been able, through this grant and working with other initiatives, cooperating, working out of facilities with the Marine Laboratory, for the most part, we've been able to put students in positions where they actually produce published papers in good journals."

Students have been able to attend off-island science and technology conferences, where they are exposed to more research, ideas and opportunities.

"It's a big deal for us. We're very big with that," he said. "It gives the students a very strong background in terms of training and experience and makes them marketable."

The EPSCoR grants are designed to boost the research capabilities of the university and the Marine Lab, which will help get future grants.

"What they're really interested in doing is providing the basis for you to go out and get other money. National Science Foundation has a lot of funding opportunities, and a number of them are very underutilized. And that's a problem because you want the nation to have great science."

Karim Primov conducts a shallow-water coral survey in Malesso'.
David Combosch photo

Marine Lab researchers survey the impact of human activities on coral reefs throughout Micronesia. *Simon Lorenz photo.*

"Long term, this goes to sustainability, because you're providing circumstances for people on your faculty, or new faculty, to go out and get more money to keep everything going," he said.

Since joining the Marine Lab faculty in 2016, Bastian Bentlage, Associate Professor of bioinformatics, has served as a co-principal investigator for Guam EPSCoR.

"We were able to recruit people, more researchers to work here, procure instruments to do a lot of the genetics, genomics, and then also provide funding for students," he said. "So a lot of the undergraduates that are now in the lab pursuing research experiences or research internships, they're funded through this money that's coming in."

Those students are able to do hands-on research in the water, with access to a coral reef unparalleled at any other U.S. university. Now, they also have labs to help them study what they've discovered on the reef.

"So you have the university. You have an academic program. You have the Marine Lab. Through EPSCoR funding in particular, genetics, genomics. We have been able to build and then outfit cutting-edge labs to do some of the science that much bigger universities on the mainland would do," he said. "I can look out there, and the reef is right there. So I can do studies of coral reefs in their natural environment, but then have direct access to the instrumentation, the computation. I have everything I need to do some really modern science."

Funding from nonprofit organizations also supports work at the Marine Lab. Dr. Peter Houk, Professor of marine biology, was the founding president of the Pacific Marine Resources Institute on Saipan when he joined the faculty.

Working with partners throughout Micronesia, Houk has gathered an extensive data collection on fish, corals and marine invertebrates. He and his students have built an online database with millions of fish measurements.

"We collaborate with people like National Geographic and the Waitt Foundation. We do more nonprofit collabs than most researchers here at UOG. I'd say the majority of my money comes from a nonprofit compared to federal sources. Maybe 50/50. Which I thought was good, because we don't all want to be applying to the same funding," he said.

STRATEGIC INITIATIVE IV:
To engage our stakeholders

GOAL 1: To have financial, friend, and political support from people and organizations, on island and beyond, who believe and understand the value of investing in the vision of the UOG Marine Lab. To improve, sustain, and broaden our engagement with a wide variety of stakeholders.

Combined Stakeholders:
Funders. Federal, NGOs, local government agencies, military
Community. Fishing communities, tourism, business, educators, potential students
Political. Legislative and executive branches, university hierarchy, regional governments across Micronesia

Objective 1: To increase engagement with the public, establish a science communication strategy.
- **Action 1:** Figure out best method to have a science communication strategy.
- **Action 2:** To raise visibility of the Marine Lab, subscribe to Eureka Alert.
- **Action 3:** Reach Out to Guam Visitor's Bureau and businesses.
- **Action 4:** Merchandise, promoting Marine Lab merchandise.

Objective 2: Increase presence in the community
- **Action 1:** Increase attendance and engagement at local and federally based community meetings.
- **Action 2:** Greater engagement with elected officials and university hierarchy.
- **Action 3:** Establish an annual report.

Objective 3: Greater engagement with funders
- **Action 1:** Strategize a plan with president's office for business development.

A parrotfish feeds next to a bleaching coral. *Brett Taylor photo.*

Engaging stakeholders with Marine Lab science

Since its establishment in 1970, the Marine Lab has studied problems to find solutions.

Researchers advise regulatory agencies on resource management strategies, learn how human activities on land can affect life in the ocean and look for ways to mitigate the effects of climate change.

"We just don't have time anymore to do coral reef science to learn just new things about coral reef science," said Dr. Peter Houk, Professor of marine biology. "This is the overarching thing with my research in the lab: We have to do coral reef science that can help us improve the way we manage the resources."

For more than 20 years, Houk has been cataloging observations of fish, coral and macroinvertebrates throughout the region as part of the Micronesia Coral Reef Monitoring Database Project. He launched the project before he joined the Marine Lab.

"I started a nonprofit organization that worked with governmental programs, fisheries, coral reef monitoring across Micronesia," he said. The idea was to collect data, make recommendations to resource managers, evaluate the effect of any management changes and use that information to adjust future recommendations.

He gave an example of fishermen targeting large spawning aggregations of coral trout, or groupers.

Local officials "put in some regulations, and the fishermen all had one question, when are we going to see the benefit from this regulation? You're telling me there's going to be a benefit to me, I want to know when, like, give me the number. And so we made a prediction," he said. "Between

four and six years based on growth rates, based on everything that we could possibly know. And it was really cool to see not only the increase in groupers during the annual aggregation, but we started seeing them all around the island in the marine protected areas."

Later, "we started monitoring the fishermen's catch, and we started seeing they're catching more."

The work gave him connections throughout the islands. Traditional island leaders, local government regulators, fishers and others have joined in the data collection.

"We now have up to 20 years of data, from how many different islands. So this is like millions of fish measurements. One of the largest databases in the world. So when projects like the Global Coral Reef Monitoring Network come to us and ask us the status of coral reefs in the tropical North Pacific, they use our data."

By working closely with island residents, Houk and his team are exposed to traditional knowledge.

"The people in Micronesia, they guide me to ask the right scientific question," he said. By visiting islands and learning about why fish runs take place at certain times, or why some fish are only harvested at certain life stages, researchers are informed by wisdom passed down through centuries of life on the reef.

"And when you get that, when you've grasped that concept, then you have a different idea on how to frame your data collection, or your analysis," he said.

The Micronesia Reef Monitoring Project also collects data on sea cucumbers. The macroinvertebrates are packed with nutrients and used in traditional Chinese medicine. Depending on the species and the market, then can sell from between $30 to $100 per kilogram when dried.

Sediment plume in the water of Pago Bay. *Olympia Terral photo.*

Erosion in the badlands of southern Guam leads to the sedimentation of coral reefs. Marine Lab scientists are concerned about how off-roading and other human activities on land affect the health of coral reefs. *Dana Williams photo.*

Dr. Alexander Kerr, Professor of marine biology, has studied sea cucumbers. His research has been used by local officials on Guam and other areas of Micronesia who create and enforce regulations on harvesting.

"Sea cucumbers are very valuable. And so they need to be managed along with other invertebrates, like giant clams," he said. Kerr has surveyed the sea cucumber population and says there are places on Guam that have been stripped of some species.

Like other researchers, he appreciates that individuals, and governments, have to make decisions about balancing short-term financial gains with long-term environmental consequences.

He has given presentations throughout Micronesia warning of businesspeople who want to deplete a resource "and move on to the next naive fishery and strip it bear amid promises of sustainability."

"But then at the same time, the mayors will say, 'Well, what can we do? You know, we need to develop a market economy.'"

For Dr. Brett Taylor, Associate Professor of fisheries ecology, community engagement involves working with managers of local agencies who are trying to base regulations on science.

"This is really the exciting stuff, the impacts of climate change to the biology of fishes. That really

has to do with food security and the potential yield of fisheries far in the future," he said.

Researchers are trying to help with climate change scenario planning, which he explained, "is trying to engage with stakeholders in the community, so fishermen, management agencies, charter fisheries, anybody who has restaurants, anybody who has anything to do with natural resources, marine natural resources. On the biological side, I can bring it to the table and say, 'Here's what our results say is what's coming in the future.'"

The research involves activities on land as well as on sea. Construction, off-roading, and fires set during hunting lead to runoff in streams and rivers, with sediment flowing onto Guam's reefs.

"I see that as a huge issue. We've always had sedimentation issues. But I think we're seeing it even worse," he said. With climate change, "a lot of predictions I've heard say we're going to get even more rainfall. And if that's the case, coupled with even more erosion on land, it's a huge, huge stressor to coral reefs."

A family in Chuuk fishes inside the reef from a traditional dugout canoe. *Simon Lorenz photo.*

STRATEGIC INITIATIVE V:
To create and maintain a great place to work

GOAL 1: Institutional support to do excellent science (for faculty, researchers and staff).

Objective 1: Make a list of employee needs and recommendations.

Action 1: Assemble a team of people to conduct interviews.

UOG's Marine Lab – a great place to work

Marine Lab faculty study the smallest building blocks of life and conditions in the largest ocean on the planet. They tell the world about new species they've discovered and advise government officials on how to regulate species that are in high demand. They investigate the fragility and resilience of marine organisms, examining the links between human activity and life on the reef. They look for ways to preserve and restore the natural environment.

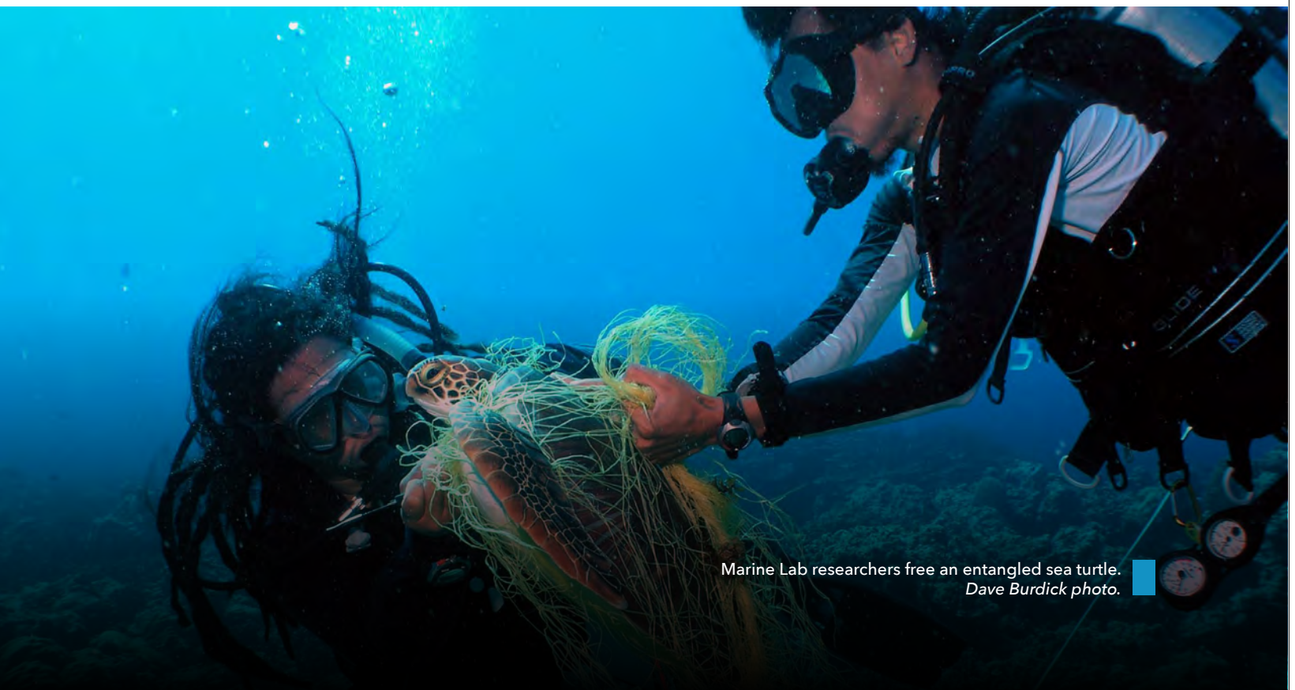
Among the strategic initiatives at the Marine Lab – creating and maintaining a great place to work.

Whether that work involves collecting samples or recording observations below the water, conducting experiments in laboratories, teaching in classrooms or analyzing data on a computer, faculty members emphasize they work as a team.

Their varied fields of expertise complement one another, so they can collaborate on projects at the university and with researchers throughout the world.

Dr. Sarah Lemer, Associate Professor of marine invertebrate genomics, said there are a number of reasons why she enjoys working at the Marine Lab.

"There's a good bunch of good people. They're very smart, and very fun and very professional, and they really care about what they're doing in their mission here. It's a great place to work because I think our director is really, really engaged and really prioritizing what needs to be prioritized, so we all feel, very supported. So that really helps."



Marine Lab researchers free an entangled sea turtle. *Dave Burdick photo.*

Staghorn corals are attached to various structures in the Piti Coral Ocean Nursery for outplanting to other areas on Guam reefs. *Luke Fernandez photo.*

"And on a scientific level, it's just ideal, because there are very few labs around the world that are just sitting a couple of meters away from the animal you study," she added. "You can just go anytime and, although it sounds like nothing, it is huge. It makes a huge difference when you don't need to budget for a trip around the world."

Guam's location saves time and money, and by alleviating the stress of travel, the scientists can focus on their work. They can make observations of the reef when temperatures or other conditions change, and newer facilities allow them to do experiments on site.

"When I was living in Boston, you had to go on a field trip, take a plane. You have three weeks to do everything you need to do, and then you try to bring your samples back alive. And so this is really good. It's a really rich reef environment. And there's still a lot to do and a lot to learn," she said.

Dr. Laurie Raymundo, the director of the Marine Lab, agrees that there are plenty of opportunities for scientists interested in working in the Indo-Pacific region.

"It's a huge, monstrously huge ocean," Raymundo said. "If you want to develop expertise, and you want to feel that your skills are going to direct management and conservation and science, this is a great place to be."

Growing up in the Philippines, Raymundo saw some of the earliest and best managed marine protected areas in the word. But she also saw reefs blasted with dynamite.

Memories of the destruction stuck with her when she went to school for her PhD.
"I thought, well, that is really what I want to do," she said. "I want to know how to combat that, or repair that sort of damage that we inflict."

Raymundo's expertise is in coral diseases, and she studied the five-year coral bleaching event on Guam from 2013-2017.

Bleaching and extreme low tides led to what she described as "death and destruction, annihilation." Corals were out of the water and exposed to sun and high temperatures for hours each day "and just got fried."

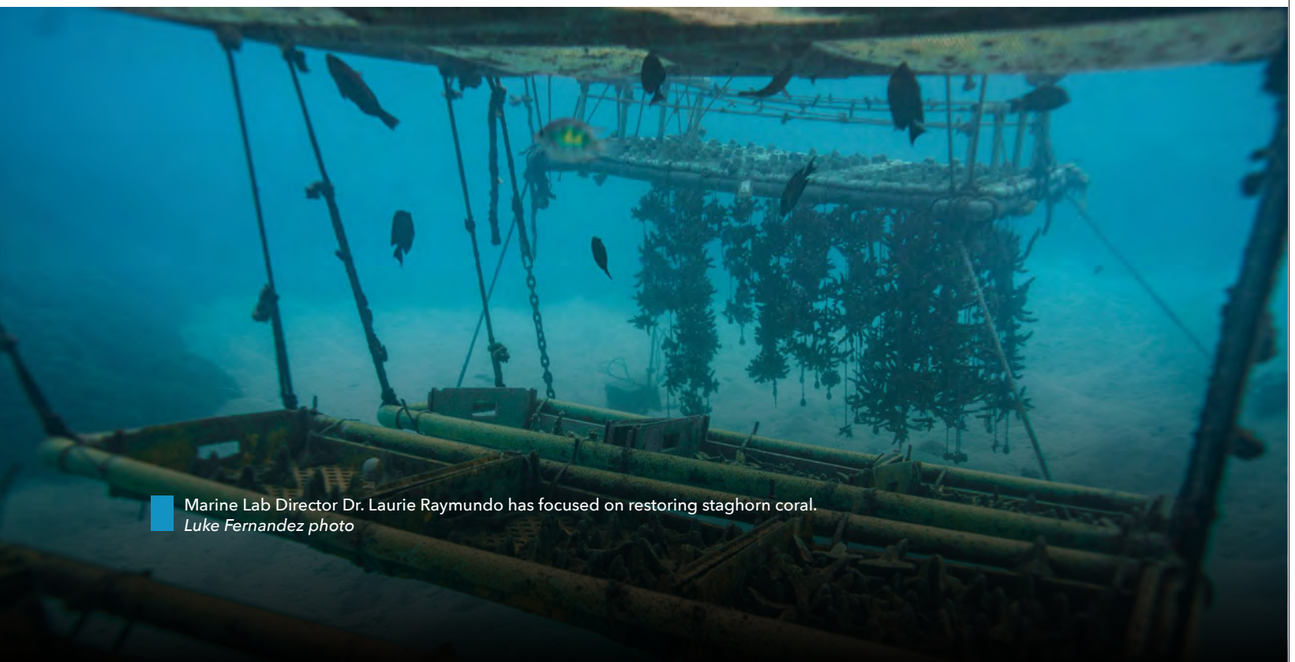
She felt like she needed to do more than document the phenomenon. She needed to fix the damage. She focused on restoring staghorn corals, the iconic fish habitats that tourists enjoy when they snorkel.

Since then, other agencies have become interested in the project, and more scientists are becoming involved in restoration. The Marine Lab's location, and Guam's diverse marine environment, gave her an advantage.

"When I started looking for work, I realized I wanted a university setting. But I wanted a university with a field station, right where you could jump into the water. That is very rare. And that is one of the biggest things I remind people of - that I have my playground in my front yard, and I have my university in my back. With the majority of universities, you have to travel for hours to get to their field station, because they're located in a place that's not right next to the water."

Researchers from other places frequently come to Guam to do field studies, and faculty members at the Marine Lab have working relationships with scientists around the world.

Raymundo described the Pacific as "a vast place with tiny, tiny, tiny little island groups and some coastline. And the per capita density of scientists is very low. So there's a place for you to develop your expertise without a cutthroat competitive atmosphere. That makes it friendly and collaborative. You may be collaborating with people tens of thousands of miles away, but you've got those connections going."



Marine Lab Director Dr. Laurie Raymundo has focused on restoring staghorn coral.
Luke Fernandez photo

Marine Lab faculty

Dr. Bastian Bentlage is an Associate Professor of Bioinformatics and the co-principal investigator for research for the Guam EPSCoR program. His background is in evolutionary biology, and most of his work focuses on jellyfish, hydroids, corals and their relatives. He has a PhD in ecology and evolutionary biology from the University of Kansas, and a Master's degree in zoology, ecology, and hydrobiology from University of Hannover in Germany.

Dr. David Combosch is an Associate Professor of Population Genetics and concurrently, the ML Division and M.S. Biology Program Chair. His research addresses fundamental questions about the evolution of marine invertebrates. He has a PhD in ecology from Northeastern University in Massachusetts and a Master's degree in environmental sciences from University of Duisburg-Essen in Germany.

Dr. Terry J. Donaldson, former Marine lab student, is a Professor of Ichthyology and the principal investigator and project director of Guam EPSCoR. His research focuses on behavior, ecology, biogeography, historical ecology, evolution, systematics, conservation biology, and fisheries biology of marine and insular freshwater fishes. He has a PhD in systematics and evolutionary biology – ichthyology from Louisiana State University and a Master's degree in biology from University of Guam.

Dr. Atsushi Fujimura, is an Associate Professor of Oceanography. He studies coastal oceanography, ocean surface waves, computational fluid dynamics, remote sensing, air-sea interaction, ship hydrodynamics, biophysical interactions, coral biology, plankton ecology and coral reef ecology. He has a PhD in applied marine physics from University of Miami and a Master's degree in marine biology from Nova Southeastern University in Florida.

Dr. Peter Houk, former Marine Lab student, is a Professor of Marine Biology. He operates the Micronesia Reef Monitoring project and studies coral reef ecology, conservation biology, fisheries, food webs, population ecology and resource management. He has a PhD in marine biology from Florida Institute of Technology and a Master's degree in biology from University of Guam.

Dr. Alexander M. Kerr, former Marine Lab student, is a Professor of Marine Biology. His interests include evolution and systematics of invertebrates. He has a PhD in evolutionary biology and a Master's degree in biology from Yale University, and a Master's degree in biology from University of Guam.

Dr. Sarah Lemer is an Associate Professor of Marine Invertebrate Genomics. She studies evolutionary biology, genomics of marine invertebrates, adaptation of coral reef species in changing environments and using genetic tools to estimate population responses to changing environments. She has a PhD in genetics, biodiversity and evolution from Sorbonne University in France and a Master's degree in oceanography, marine biology and ecology from University of Aix-Marseille II in France.

Dr. Laurie J. Raymundo is the Director of the Marine Lab and a Professor of Marine Ecology. She studies coral health and disease, and currently runs Guam's coral restoration program. She has a PhD in coral ecology from Cornell University in New York and a Master's degree in water resource management from State University of New York College of Environmental Science and Forestry.

Dr. Tom Schils is a Professor of Marine Biology/Phycology. He studies cryptic diversity of marine macroalgae in Micronesia, invasive species risk assessments, monitoring of benthic reef communities in Guam and oceanographic parameters, and microbial (endolithic algal) communities as part of the coral holobiont. He has a PhD and a Master's degree from Ghent University in Belgium.

Dr. Brett Taylor, former Marine Lab student, is an Associate Professor of Fisheries Ecology. He studies tropical fish biology, fisheries ecology, biochronologies and climate change. He has a PhD in marine biology from James Cook University in Australia and a Master's degree in biology from the University of Guam.

Strengths

- Diverse faculty and student community
- Location: access to study systems, access to the university, embedded in Micronesia
- Diverse expertise
- Rich history: taxonomic framework, local knowledge, strong ecological background
- Collegial relationships
- Strong mentorships
- Beautiful facilities
- Collaborative networks
- Grantsmanship
- Good students
- Momentum
- Biological collections
- New equipment and research capacity
- A fun place to work
- Highly collaborative
- Capacity to leverage existing funding

Weaknesses

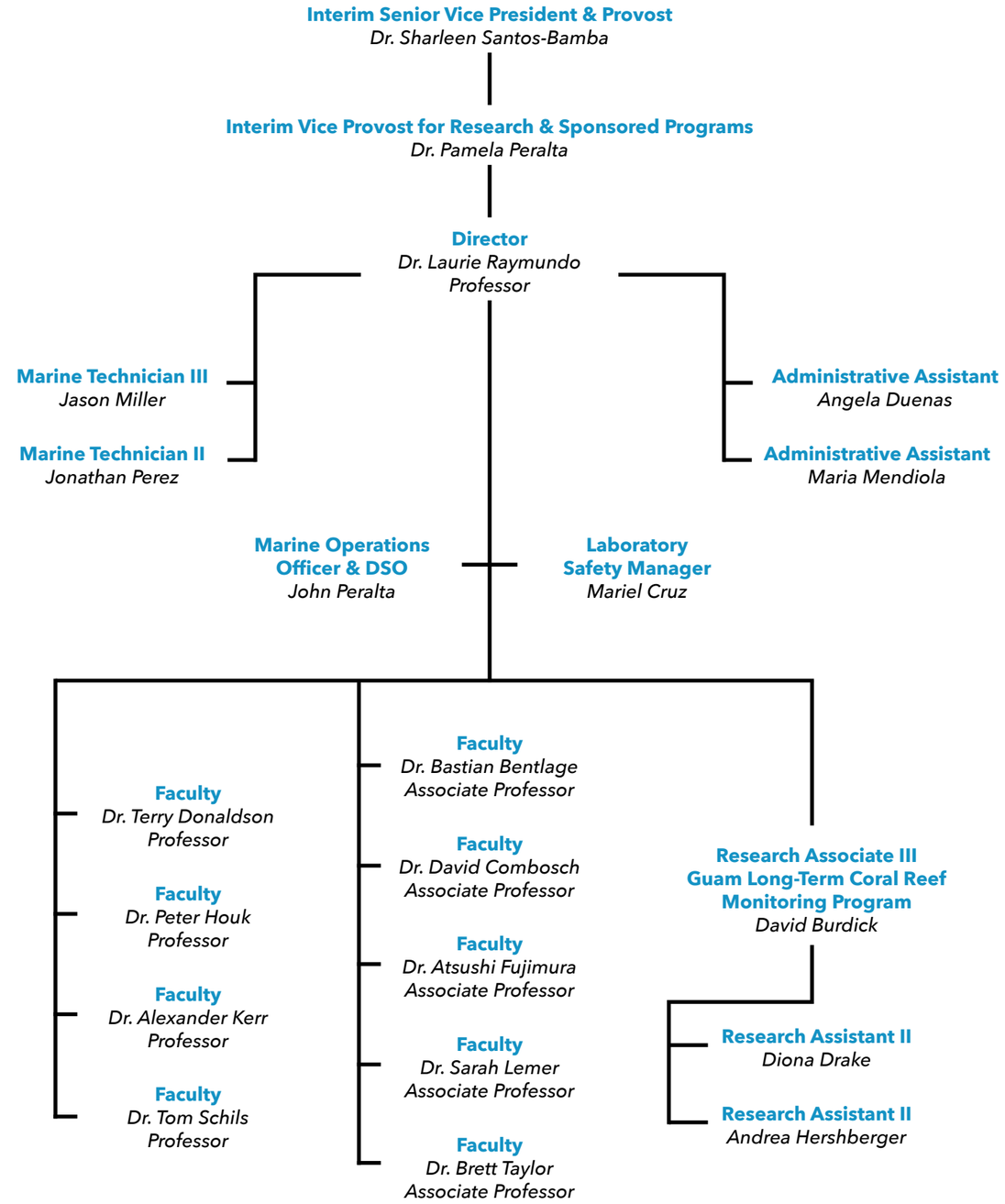
- Lack of space / crumbling infrastructure
- Isolation
- Appearance of (marine lab) property
- Economy / cost (maintenance, supply chain)
- Library resources
- Investment by (interest from) local students
- Recruitment of local students
- Lack of diversity funding sources
- Strengthen relationship with rest of campus
- Lack of PhD program
- Lack of teaching assistantships
- Lack of technical support / equipment maintenance

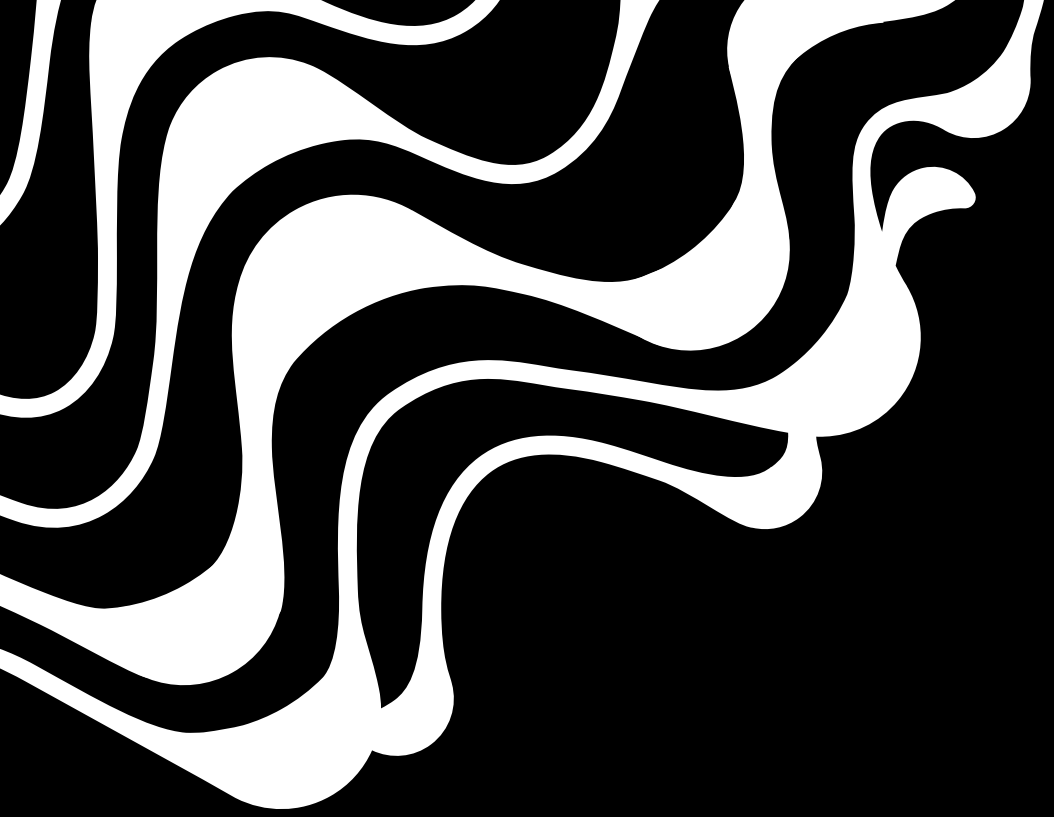
Opportunities

- Leverage grantsmanship
- Partnerships with other institutions
- Location
- Private donors
- Global expert in Micronesia
- Growing research capacity and potential for expansion
- Expanding collaborative networks
- More opportunity for interdisciplinary science
- Sea Grant: opens outreach and research opportunities
- Interesting ecological activity relevant to the rest of the world
- Capacity to influence climate change resilience
- Opportunity to partner with another university for a PhD program
- Satellite for offering a PhD program
- New technology, building a world-class collection
- Direct conservation impact
- Opportunity to diversify student population
- Strengthening connections with other lab stations
- Access to government leaders
- Military buildup

Threats

- Over-commitment; too few experts in the region
- Lack of local funding
- Drying up of federal funds / unstable funding for environmental
- Regional political stability
- Typhoon / weather / climate change
- Equipment failures, maintenance, electrical instability
- Military buildup
- Permitting / changing laws
- Loss of tuition scholarships





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