COLLEGE OF AGRICULTURAL SCIENCES

MARINE MAMMAL INSTITUTE

MMI.OREGONSTATE.EDU — 2022

From the Director

I write this piece for our 2022 annual newsletter as my third-year anniversary with Oregon State University and Marine Mammal Institute approaches. When I take a giant step back and look at the past three years, I am simply astounded by how MMI has grown and flourished and by what we have accomplished.

In calendar year 2022 alone, we have hired two new tenure-track professors, grown our graduate and post-doctorate population to 22, and now total 55 strong. We are working in our offices and laboratories in person again, and for the first time in MMI's

(Director's message continues inside.)

Cover photo: Gray whales in Oregon feed in diverse ways, including this individual filtering sediment after benthic feeding, filmed by a drone.

Oregon State University

In this issue:

history, we are consolidated into a single location in the spectacular Gladys Valley Marine Studies Building. Our research vessel Pacific Storm has completed or booked 147 days at sea for 13 principal investigators, from MMI and 11 other institutions. We have published 46 scientific papers, given 65 presentations of our research at scientific conferences, served on 13 advisory boards, given 37 invited public presentations, and been featured in 45 news stories. Our work and our impact ranges from local to global. Today, Oregon State University's Marine Mammal Institute is a strong contender for the largest and most influential marine mammal focused research entity in the world.

MMI has a long history of conducting innovative research with real-world impacts. That tradition continues. In 2022, we were awarded $2M from the US Department of Energy and launched Marine Offshore Species Assessments to Inform Clean Energy (MOSAIC, beav.es/mosaic), a four-year project to collect new data on marine mammals and seabirds along the Oregon and northern California coasts. We will analyze these data, along with a wealth of historic data that MMI has already collected, using sophisticated analytical models to produce distribution maps for every species out there. MMI is extraordinarily well placed to conduct this research, because we represent a collection of marine mammal scientists with world-class expertise in visual surveys, passive acoustics, photographic identification, molecular genetics, satellite telemetry, and species distribution modeling. And, MOSAIC involves our graduate students and postdoctorates to combine their sharp minds and fresh perspectives with our collective experience and wisdom.

Above: Director Lisa T. Ballance stands in front of her office in the Gladys Valley Marine Studies Building. The plaques above the office nameplates recognize significant donors who made the building possible.

MOSAIC has real-world impacts. Offshore wind is increasingly being considered as a new source of energy off of our coasts, including here, along Oregon. The maps that our project will produce can provide unprecedented data to inform the development of this new source of energy, should the industry go forward. Offshore wind is controversial. The stakes are high. But this is right where we want to be. Right in the center of real-world issues, using our science, education, and outreach to facilitate informed decisions about how to solve problems that we are facing today and problems that we will face tomorrow.

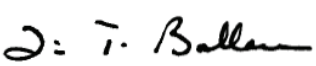
All of you reading this newsletter are united with us by three things: Passion and inspiration for marine mammals. Passion and inspiration with our Marine Mammal Institute. And passion and drive to make a difference. MMI is today what you have made us. From top to bottom, who we are and what we are able to do is a direct result of your engagement and support of all kinds, dating to the beginning of the Institute. For the first time ever, we gathered together this past September to formally celebrate our partnership and our collective accomplishments . (See page 16.) That celebration was a career high for me and for all of us in MMI.

These past three years have been the time of my life. I am so proud of what we have accomplished together. And I'm not finished! I have a vision for the next 10 years of MMI. I want to establish more endowed graduate student fellowships, because today's graduate students are tomorrow's professionals, and that is how we change the world; more endowed professorships, to ensure that when our existing professors retire, those positions will remain; an endowed scholar position, to allow a continuous influx of fresh perspectives, new ideas, and novel technologies into MMI; and centers of excellence — conceptual centers that are world-renowned in animal-borne tags, drones, molecular genetics, passive acoustics, how to use these tools, how to analyze the data they collect, how to push boundaries of technology and knowledge.

My future vision for MMI is all about people. By continuing to build support for people, I am ensuring that MMI will continue to have impacts into perpetuity. I take the trust you have placed in me with your gifts very seriously. We are today what you have helped us to be. And we still need your help. Truly, our collective whole is greater than the sum of our parts.

With profound gratitude and soaring excitement for the future,

Lisa



Backing Management with Science

Ocean Ecology Laboratory

Joshua Stewart PhD, Assistant Professor

Dear MMI Friends — I'm excited to have this opportunity to introduce myself to you. My name is Joshua Stewart; I'm MMI's newest Assistant Professor, and I lead the Ocean Ecology Laboratory.

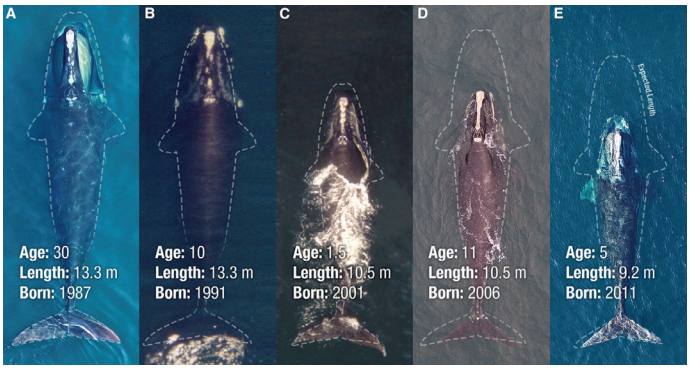
Our goal at the Ocean Ecology Lab is to use science to support the effective management of marine mammals and other threatened species. We do this in a lot of different ways. We study where animals go and why — which is most often related to what they're eating or where they're reproducing — and then we use this information to identify where and when they are most vulnerable to human impacts.

We use a wide range of tools to evaluate the health of individuals and populations and to understand how natural variation in the environment, climate change, and a growing human footprint in the oceans collide to drive population trends of vulnerable species. We then work closely with stakeholders, communities, and management agencies to support and develop science-based management and conservation strategies that will effectively protect and recover these species.

I'll give you a few examples of the work that my collaborators, team, and I have done recently that highlights the lab's approach to conservation science.

In a recent study with colleagues from Woods Hole Oceanographic Institution, New England Aquarium, and NOAA's Southwest Fisheries Science Center, we found that North Atlantic Right Whales that are entangled in fishing gear have restricted growth and can end up several meters shorter than what's considered normal. *(See photo at bottom left.)* In turn, shorter female whales produce fewer calves over their lifetimes, meaning that entanglements that don't result in a dead whale still have lasting impacts on individuals and the population. This work is helping to inform the management strategies implemented by US and Canadian federal agencies to reduce entanglements and support the recovery of this critically endangered population.

Using similar approaches, our team from the Southwest Fisheries Science Center and Sealife Response, Rehabilitation and Research (SR3) was able to identify specific salmon populations that drive the body condition and health of endangered Southern Resident killer whales and identify thresholds below which killer whales become so skinny that they are at elevated risk of dying. This work was used to develop an adaptive management framework that is currently being implemented by SR3 in partnership with NOAA and the State of Washington, using data collected each summer on the body condition of Southern Residents to adjust management actions dynamically depending on how at-risk the population is that year.



The Ocean Ecology Lab is young, but we're growing quickly. Our first graduate student, Santiago Dominguez, will be joining us this winter. Santiago will study how endangered Southern Resident killer whales overlap with salmon on the outer coast of Washington and Oregon, allowing managers to prioritize salmon populations for recovery actions that will increase prey availability for killer whales.

Dylan Gomes is currently developing ecosystem models to understand the role of marine mammals and other predators in North Pacific food webs and testing how different management actions could impact their populations. Dylan will continue this project at MMI when he joins us as a postdoctoral scholar next year.

We've got more projects in the works, which I look forward to sharing with you! ***MMI***

Eavesdropping on the Ocean

Marine Mammal Bioacoustics and Ecology Laboratory

Kate Stafford PhD, Associate Professor

Can you hear climate change? If you listen underwater in the Arctic, the answer is a definitive *yes!*

Using hydrophones, which are underwater microphones, to record and archive sound, we can listen to the sounds made by different species, by ice, and by humans on ships and exploring for underwater oil and gas. In the Arctic — where sea ice can be impenetrable, temperatures are bitterly cold, and there is no light for four months of the year — usual methods of studying whales don't work well. One method that does work is eavesdropping underwater.

Sound travels far and efficiently underwater, so we can monitor a larger area by using sound than we could by looking at the surface for animals that spend most of their time under water (or ice). Sounds can be recorded year-round, regardless of overhead sea ice, lack of light, storminess, or bitter cold. And since different species make unique sounds, we can tell a bearded seal from a walrus and a bowhead whale from a beluga.

Below: A blue whale surfaces during a tagging project in northern Chilean Patagonia, photographed by Kate Stafford.

Right: A mooring with a hydrophone surfaces after a year underwater in the Beaufort Sea. Photo by Hannah Sawyer.

The Marine Mammal Bioacoustics and Ecology Lab at the MMI uses passive acoustic monitoring (PAM) to study the underwater soundscape (think acoustic landscape) around the globe. Eavesdropping underwater provides information on when and where vocally active marine animals occur, what they are doing, and the presence of anthropogenic (human-caused) threats that may impact feeding, migration, and communication behavior. Our current research is largely focused on the Arctic using both fixed instruments and novel underwater robots that can move about and record environmental and acoustic data.

The Arctic, of course, is experiencing rapid and extreme changes in sea ice extent, thickness, and seasonality due to climate change, but not everywhere is change happening equally. We are particularly interested in how Arctic ecosystems — especially at gateways between the sub-Arctic and the Arctic — are being reorganized by this change. Are sub-Arctic species such as fin, killer, and humpback whales spending more time in the Arctic and moving further north? Has the migratory timing of Arctic

species (bowhead and beluga whales, bearded seals and walrus) changed with decreases in seasonal sea ice? What about competition for prey or "acoustic space" between these summer and winter whales? How has the opening of the Northern Sea Route and the Northwest Passage affected the ambient soundscape of the Arctic, and what are the conservation concerns of increasing shipping through narrow straits? To address those pressing questions, which are aimed to help study the impacts of climate change on the biodiversity of the Arctic, we collaborate with physical oceanographers, zooplankton ecologists, and sea ice experts and use technological advances that can overcome some of the difficulties of working in remote, seasonally ice-covered environments.

Current projects in the lab include examining how climate change is impacting bowhead whale migration (led by research associate Angie Szesciorka), how subarctic species are moving further into the Arctic (humpback whale research of PhD student Sabena Siddiqui), and how bowhead whale prey is aggregated by wind direction and upwelling in the Beaufort Sea (master's student Hannah Sawyer).

We are also involved in Marine Offshore Species Assessments to Inform Clean Energy as well as projects in the Seychelles, Greenland, Chilean Patagonia, and northern Chile. ***MMI***

Right: Hannah Sawyer on the dock in Prudhoe Bay, Alaska, helping Steve Okkonen (University of Alaska Fairbanks) prepare an oceanographic mooring.

Right: Sabena Siddiqui and OSU undergraduate student Mayah Baker on the flying bridge of the Pacific Storm *during the August 2022 MOSAIC cruise.*

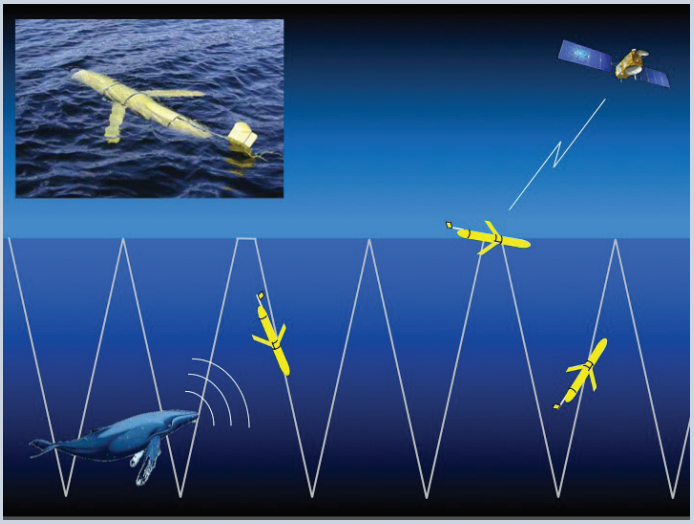
ROBOTS IN THE ARCTIC

KATE STAFFORD

Working on large ships in the Arctic — and anywhere at sea — can be a very expensive undertaking involving lots of people, time, equipment, and effort. For over a decade, oceanographers have been using underwater robots, often called *gliders*, to remotely sample many of the attributes of the ocean at a lower cost and with a much smaller carbon footprint than a large research vessel.

In the Chukchi Sea, we have been using a glider to measure temperature, salinity, oxygen, chlorophyll, and sound along zigzagging transects from just north of Bering Strait to the Native village of Utqiaġvik, Alaska. The glider collects all of these data when it is underwater and transmits them via satellite while at the surface. It uses a buoyancy pump to move up and down in the water column and has "wings" to provide lift and generate forward movement (very much like airplane wings, just without the engine).

Below: An illustrated example of how a glider surveys the ocean, courtesy of Mark Baumgartner, Woods Hole Oceanographic Institution.



During transects in the Chukchi Sea, our glider has documented changing temperatures and water masses and has heard lots of marine mammals including killer, humpback, fin, gray, and minke whales as well as walrus and bearded seals. ***MMI***

Are Migratory Destinations Changing?

Cetacean Conservation and Genomics Laboratory

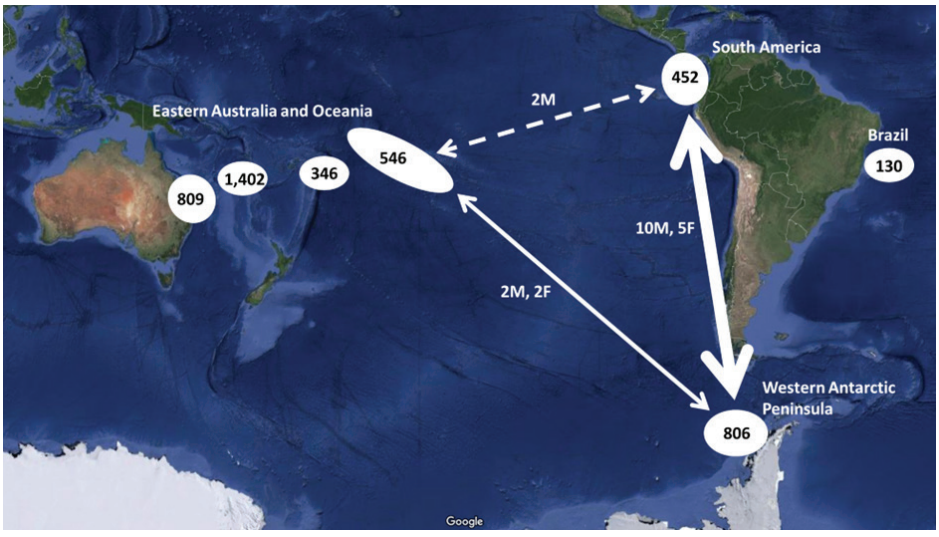
C. Scott Baker PhD, Professor, and Debbie Steel, Senior Faculty Research Assistant

Records of movement between annual wintering grounds and the migration to Antarctic feeding grounds are important for understanding the population dynamics and ecological role of humpback whales in the aftermath of commercial whaling.

For more than 30 years, we have worked with members of the South Pacific Whale Research Consortium in collecting genetic samples to describe the migratory connectivity of humpback whales on wintering grounds of the South Pacific. Through standardization of "DNA profiling," including sex, mitochondrial DNA (mtDNA) sequencing, and microsatellite genotypes sufficient for individual identification, consortium members and collaborators have contributed to a "DNA register" that now includes the DNA profiles of more than 5,000 individual whales. Recently, we have made this DNA register available to collaborators for comparisons to a growing collection of samples from humpback whales feeding near the western Antarctic Peninsula.

Humpback whales feeding near the western Antarctic Peninsula have a well-defined migratory destination along the Pacific coast of South America. This population also shows strong genetic differentiation from other populations in the Southern Hemisphere. This differentiation is evident in comparisons of the South American wintering grounds with the wintering grounds of Oceania, despite the absence of any continental barriers.

However, the extent of the isolation of the South American wintering grounds might be changing as humpback whale populations are increasing at variable rates, perhaps encouraging whales from more rapidly growing populations to explore alternate migratory destinations.



Left: A figure showing the number of individual humpback whales identified by DNA profiling on the feeding grounds of the western Antarctic Peninsula and the wintering grounds of the South Pacific and Brazil. Numbers alongside the solid lines represent the documented interchange of individuals between regions (M = male, F = female). The dashed line indicates movement between two wintering areas that was presumably made via migration to a summer feeding area in the Antarctic.

If so, it is plausible that the larger South America wintering population, now thought to be near pre-exploitation abundance, could be expanding its migratory range, encroaching on the wintering grounds of Oceania. Alternatively, whales from the eastern wintering grounds of Oceania (Samoa and French Polynesia) could be extending their summer distribution to include the highly productive waters off the western Antarctic Peninsula. Distinguishing between these scenarios is important for understanding the future of population recovery in the face of global climate change.

With funding from the International Whaling Commission, we reviewed the DNA register and added a large collection of recently available DNA profiles to improve our understanding of migratory connectivity in the eastern Pacific. We used genotype matching to document individual movement, with an emphasis on the relationship of wintering grounds in Oceania to wintering grounds along the Pacific coast of South America and to the western Antarctic Peninsula.

To our surprise, 30 years of genetic monitoring showed little evidence of a change in the migratory destinations

of humpback whales from the western Antarctic Peninsula. Most of the interchange we documented was between the Antarctic Peninsula and the known wintering grounds along the Pacific coast of South America. Otherwise, only four individuals were documented to migrate between the Antarctic Peninsula and the wintering grounds of French Polynesia and Samoa. A further two individuals were sampled in both the Oceania wintering grounds and the wintering grounds of South America. Presumably these two individuals migrated via a summer feeding area in the Antarctic, most likely around the Antarctic Peninsula. No genotype matches were found between the Antarctic Peninsula and any of the other wintering grounds in Oceania or eastern Australia and none between the Antarctic Peninsula and wintering grounds of Brazil.

Perhaps even more surprising, we found a remarkable stability in differentiation and diversity of mtDNA for the wintering grounds of South America, despite a decline from approximately 11,500 individuals to fewer than 1,000 individuals during the 20th century, followed by an estimated recovery to nearly 10,000 individuals. The expansion of the neighboring Brazilian wintering ground is even greater. This population declined from nearly 27,000 individuals in 1830 to only 450 in the mid-1950s. Although it has now recovered to nearly 25,000, it has remained largely isolated from feeding grounds of the western Antarctic Peninsula. Such stability in the maternally inherited mtDNA points to the strong influence of the mother in shaping the migratory destination of the calf, even as the calf grows to an adult.

Although our results suggest that the past structure of humpback whale populations around the Antarctic is being restored, the future remains uncertain. Even in the absence of a return to commercial whaling, these populations are threatened by the growth in krill fisheries and the potential for ecosystem collapse due to climate change. We expect that decades from now, this DNA register will still serve as a baseline for monitoring these changes and helping to inform policy for managing the Antarctic ecosystem. ***MMI***

THE GIFT OF THE DOLPHIN: A SABBATICAL LEAVE

SCOTT BAKER

Every seven years or so, university faculty are allowed leave to pursue a scholarly interest and to take a break from the obligations of teaching and administration. This year, I have been granted such a sabbatical to pursue my long-term interest in dolphins around islands of Oceania.

Previously, with the support of a Pew Marine Conservation fellowship, I was able to collect samples for describing genetic diversity and differentiation of island-associated dolphins throughout Oceania. Referred to as "A Pattern of Dolphins," this project assembled one of the largest collections to date of living dolphins from Oceania. In most of Polynesia, these dolphins are now protected from hunting by local regulation or custom.

In some communities of Melanesia, however, dolphins remain subjected to a "drive hunt," in which hundreds of dolphins are herded into shallow water and killed. The primary purpose of this drive hunt is to collect teeth for traditional use as personal adornment and as currency in payment to the family of a bride. Although the practice of drive hunting is now limited to a few villages in the Solomon Islands, the use of dolphin teeth in jewelry was once widespread and is well represented in museum collections featuring the cultures of Oceania. The purpose of my sabbatical is to better understand both the cultural history and biological significance of drive hunting and the fate of the teeth that are derived from the hunt.

Above: A 19th century "porpoise-tooth" headdress* (peue 'ei) *from the Marquesas Islands of French Polynesia. The necklace required many hundreds of teeth, probably from spinner dolphins* (Stenella longirostris) *or melon-headed whales* (Peponocephala electra). *Photo courtesy of Brooklyn Museum, Creative Commons-BY.

For this, I will extend the scope of my previous project to include documentation of cultural artifacts derived from the teeth of dolphins and other small cetaceans, usually in the form of jewelry. Referred to here as "The Gift of the Dolphin," my sabbatical will include visits to museums throughout Oceania, and elsewhere, to better document the species used in the jewelry and, if possible, the history and provenance of these objects of adornment. ***MMI***

Focusing on Individuals

Geospatial Ecology and Marine Megafauna Laboratory

Leigh Torres PhD, Associate Professor

The Geospatial Ecology and Marine Megafauna Laboratory (GEMM Lab) at MMI conducts engaged research that makes a difference to ocean life and our communities. Leigh Torres leads the GEMM Lab, which is a collaborative and diverse group that keeps our work fresh, connected, and impactful.

The GEMM Lab includes graduate students Clara Bird, Lisa Hildebrand, Rachel Kaplan, Allison Dawn, Imogen Lucciano, Kate Colson, and Morgan O'Rourke-Liggett and postdoctoral scholars Alejandro Fernández Ajó, Solène Derville, KC Bierlich, Dawn Barlow, and Samara Haver. We study the ecology and health of marine megafauna, engage with groups who need to make informed decisions, and integrate students of multiple ages and backgrounds into our work to teach the power and love of science.

STUDENT SCIENTISTS

For eight years, the GEMM Lab has led the integrated Theodolite Overlooking Predators and Zooplankton (TOPAZ) and Journey for Aspiring Students Pursuing Ecological Research (JASPER) projects. Each summer, a team composed of a GEMM Lab graduate student, OSU undergraduate students, and local high school students spends six weeks in beautiful Port Orford, Oregon, learning and implementing new scientific, leadership, and communication skills.

Over the eight years, the teams have used a theodolite to noninvasively track gray whale movements for 120 hours, while synoptically conducting 950 zooplankton tows and 1,130 GoPro drops to assess the prey field. This scientific work has led to three manuscripts about gray whale ecology, including the whales' choices between prey quality and prey quantity and how changes in the ecosystem affect their foraging rates.

Above: The 2022 TOPAZ/JASPER team during a kayak training session in Port Orford. Pictured from left to right are Charlie Ells, Allison Dawn, Nichola Gregory, Zoe Sax, and Luke Donaldson.

We are proud of those novel scientific outputs, but even more fulfilling is the impact we have made on the lives of 29 students who have participated in our program. All of the students have continued in STEM fields into college and beyond, and they credit the TOPAZ and JASPER projects with being a fundamental steppingstone in their journey. The following are a few quotes from previous students.

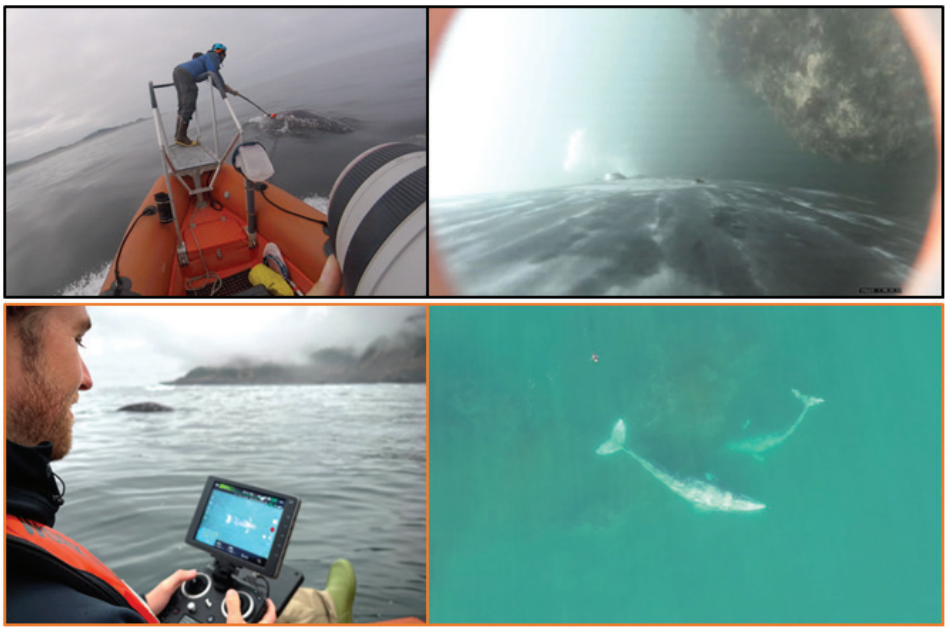
"I now understand that scientists are a much more diverse group than I thought... I now see that a scientist can be anyone from anywhere with any kind of attitude."

"My participation in the...project has most definitely had a large impact on my life. It allowed me, at 17 years old, to be a part of research affecting the ecosystem right by my home...and it helped solidify the idea that I have a future in STEM."

"The study showed me the value in using data to influence management decisions and create community engagement in marine mammal conservation. I believe it played a large role in my acceptance into graduate school."

Key GEMM Lab members on the TOPAZ and JASPER projects are Allison Dawn, Lisa Hildebrand, and Leigh Torres.

The TOPAZ/JASPER project is co-funded by the Tigger-Misener Memorial Endowment Fund and OSU Marine Mammal Institute's Oregon Gray Whale License Plate Fund Program.



Above, clockwise: Collaborator Dave Cade attaches a suction cup CATS tag to a gray whale; a recorded image of whale releasing a bubble blast while foraging near a reef; two whales feeding over and under a reef; KC Bierlich operates a drone over a gray whale to record behavior data.

DRONES, CATS, AND GRAY WHALES

It's tempting to think that all whales in one population feed the same way. This situation would make understanding their biology and ecology simple and would make potential management strategies straightforward. But is this indeed true for gray whales feeding in Oregon waters?

To find out, we use a combination of technologies to observe how gray whales behave underwater. We fly drones over whales, recording 50 hours of behavior video from 150 individuals to-date. We also attach suction cup tags, made by a company called Customized Animal Tracking Solutions (CATS), to gray whales that record video, sound, and accelerometry data. These CATS tags have stayed attached from 30 minutes to 24 hours and have provided us with 89 hours of incredible high-resolution data on the whale's underwater world.

Combined, these data show the diversity of foraging strategies these gray whales use. They do headstands, swim upside down, make bubble blasts, scull with their pectoral fins to stay stationary, plow through the sediment on their side, and jaw snap to capture food.

You might be saying, "Wow, that's cool, but why does it matter?" It matters because each foraging strategy has a different energetic cost to perform and therefore a different energetic gain. We are finding that different individuals use different strategies, and there appear to be patterns by age, sex, and size of the whale. So, when it comes to thinking about how changes in prey availability or habitat quality will affect gray whales, it's likely that not all individuals will be impacted in the same way. We can use this new information to inform management efforts to be more precise and effective at conserving this unique group of whales.

Key GEMM Lab players in this work are Clara Bird, KC Bierlich, Lisa Hildebrand, Kate Colson, Alejandro Fernandez Ajo, and Leigh Torres.

The CATS tags for this project were purchased through OSU Marine Mammal Institute's Oregon Gray Whale License Plate Fund Program.

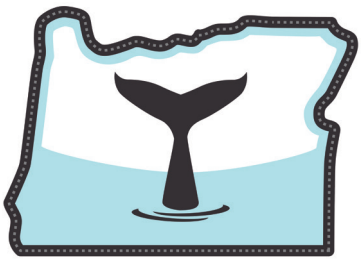
INDIVIDU-WHALE!

Like us humans, gray whales can experience life-altering events, go through periods of stress, produce offspring they must provide for, and have individual behavior patterns. Our multidisciplinary and collaborative research over the past eight years on gray whales has documented fascinating stories and events about the lives of many individuals.

To share these stories, we launched a new website called IndividuWhale that features biographies of 10 iconic Oregon gray whales, including surviving major injuries, finding mates and having calves, and feeding in specialized ways.

The website also provides information about the stressors gray whales experience in our waters, how we study these whales using drones, poop, and photographs, and there is even a game to test your gray whale photo-ID skills. IndividuWhale also has information on where, when, and how to best watch gray whales along the Oregon coast.

We recently added a citizen science component to the website where you can upload your photos of gray whales in Oregon. If we can identify the whale, we will tell you who you saw (and we get a new data point for our research). You can also "adopt" one of the profiled whales and be listed as a friend on their bio page.



IndividuWhale is a true labor of love, and we are grateful for our close collaboration with web designer Erik Urdahl. We are extremely proud to share this website, so please visit IndividuWhale.com. ***MMI***

Creating a

Kyra Bankhead

MS student, Wildlife Science
(Mauricio Cantor)

The spreading dynamics of human-induced food provisioning on Sarasota dolphins

Clara Bird

PhD candidate, Wildlife Science
(Leigh Torres)

Patterns of gray whale behavior across space, time, and the individual

Kate Colson

MS student (Kate Stafford)

Energy requirements of Pacific Coast Feeding Group gray whales in their Pacific Northwest foraging range

Allison Dawn

MS student, Wildlife Science
(Leigh Torres)

Environmental variables driving zooplankton prey aggregations during peak foraging season of PCFG gray whales

Lisa Hildebrand

PhD student, Wildlife Science
(Leigh Torres)

Foraging ecology and habitat use of Pacific Coast Feeding Group gray whales

Oregon State University
Marine Mammal Institute

Ladd Irvine

PhD candidate, Wildlife Science
(Daniel Palacios)

Bridging the gap: Linking rorqual foraging ecology across multiple scales

Rachel Kaplan

PhD student, Wildlife Science
(Leigh Torres)

Using species distribution models to understand how oceanographic factors and prey patches shape the distribution of whales in Oregon waters

Michaela Kratofil

PhD student, Wildlife Science
(Daniel Palacios)

Movement ecology of Hawaiian false killer whales

Legacy

Kelly Lizewski

MS student, Wildlife Science
(Scott Baker)

Population genomics of Gulf of Mexico sperm whales

Imogen Lucciano

MS student, Wildlife Science
(Leigh Torres)

Acoustic behavior, abundance and distribution of Oregon coast cetaceans

Stephane de Moura

PhD candidate (Mauricio Cantor)

Distribution and habitat selection by Guiana dolphins as indicators of anthropogenic impacts in the southern Brazilian coast

Liam Mueller-Brennan

MS student, Wildlife Science
(Daniel Palacios)

Using telemetry and stable isotope analyses to describe humpback whale ecology

Morgan O'Rourke-Liggett

PSM student, Fisheries and Wildlife Administration (Leigh Torres)

Standardizing gray whale survey data

Charles Nye

MSc/PhD student, Wildlife Science
(Scott Baker)

Ecological metagenomics and environmental DNA

Hannah Sawyer

MS student, Wildlife Science
(Kate Stafford)

Biophysical drivers of bowhead whales in the western Beaufort Sea

Shanta Shamsunnahar

PhD student, Wildlife Science
(Lisa Ballance)

Modelling cetacean bycatch in small-scale fisheries with human dimensions to improve bycatch management

Sabena Siddiqui

PhD student, Wildlife Science
(Kate Stafford)

Acoustic occurrences of subarctic whale species

MMI

Making Connections

Laboratory for Animal Behavioral Interaction Research in the Ocean

Mauricio Cantor PhD, Assistant Professor

When I joined the Marine Mammal Institute and the Department of Fisheries, Wildlife, and Conservation Sciences at Oregon State University in fall 2021, I began to develop a research program that integrates animal behavioral ecology and human dimensions. I named this, Laboratory for Animal Behavioral Interaction Research in the Ocean, or Labirinto. *Labirinto* is Portuguese for *labyrinth* — a network of intercommunicating paths forming a complex system that causes bewilderment and perplexity — a metaphor for the many intersections between behavior, ecology, and society.

We at the Labirinto aim to understand how animals and humans behave in the world of today, so we can better predict and prepare for how they will behave in the world of tomorrow. By combining field work with computer simulations, we investigate the intricate ways in which humans and wildlife interact with the natural world; we then investigate where these interactions overlap to propose ways to minimize the conflicting ones and maximize the harmonious ones.

We focus on the interactions between humans and marine mammals because of the learning ability and social complexity of both species, not to mention the exciting fieldwork challenges they impose.

Oregon State University
Marine Mammal Institute

BEHAVIOR, ECOLOGY, AND SOCIETY

Behavior is, essentially, everything organisms do from the moment they are born until the moment they die. Ecology is the resultant relationships among these organisms to one another and to their environment.

Everything organisms do (ourselves included) has an impact on something else — we interact. We interact with the environment, with our peers, with other species. And these interactions have consequences. By mapping these complex networks of interactions, we can not only measure their consequences for individuals, their populations, and their communities but also understand and predict the conditions under which these human–wildlife ecological interactions can flip between positive and negative.

This is perhaps best illustrated by our collaborative research on the century-old fishery involving artisanal net-casting fishers and wild bottlenose dolphins in southern Brazil.

The water is murky. Local fishers have long figured that the dolphins, with their sonar-like echolocation apparatus, are the only ones that can track fish schools in such an opaque environment. About 140 years ago, local fishers learned to associate the presence of a busy dolphin with the presence of a busy fish school. They wait for dolphins to compact and herd the school toward the shoreline, and for the dolphins to perform specific, stereotyped moves — a sudden dive, a tail or head slap — that give away the right moment to cast their nets. Dinner is served.

Different from other places where dolphins depredate human fisheries, in southern Brazil this traditional fishery not only benefits dolphins but also benefits from dolphins.

On the terrestrial side, the interaction is clearly advantageous: fishers catch more fish when dolphins do their part than when fishers cast their nets alone. As always, there is no such thing as a free lunch. Dolphins benefit from this fishing business too — although exactly how is still unclear. The hypothesis is that dolphins go after the fish trapped in the nets and after the disoriented fish that break free from the school when nets are cast.

In all, seeing fishers and dolphins working together is a nice example of a harmonious interaction, but it also reminds us of the fragility of cooperating with others. A cooperative interaction will only persist if the number of players is stable and if the fine balance between costs and benefits is positive for them. The Laguna dolphin population has undergone a recent high mortality, especially due to pollution and entanglement in nets of other fisheries. Likewise, experienced net-casting fishers have been seeking out more profitable activities, and they have been replaced by novice fishers.

Our next quest is understanding how fragile this system is to perturbations, to propose ways to safeguard this

unusual interaction — that is ecologically important for dolphins, and culturally and economically important for people — to guarantee that all parties involved have a lot on their plate.

NETWORKING

An important lesson learned from dolphins and fishers is that collaboration is key for success. I can apply the same lesson to my new position at MMI. I am fortunate enough to have built a cooperative network with international researchers at the same time that I am welcomed by the world-class team of researchers at MMI. I bring with me a bit of the legacy of these long-term projects.

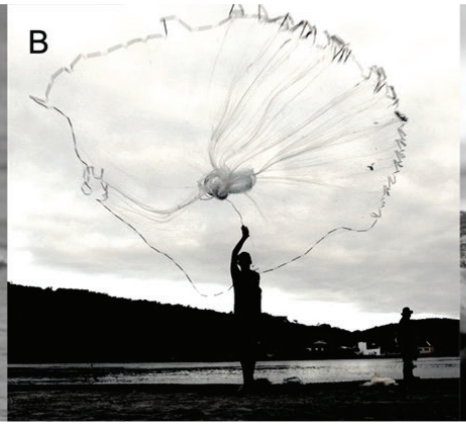
these interactions function, how they vary geographically, how they are exposed to different threats, and the causes of their current decline. This truly collaborative effort generates specific, detailed strategies for safeguarding and archiving these interspecific cultural behaviors.

BUILDING UP A TEAM

Labirinto has been growing quickly. In addition to myself, the lab includes graduate students who are advised at OSU and several others who are co-advised at international universities.

In August 2021, our first alumna, Kiera McSears, successfully defended her MSc thesis on the foraging cooperation among bottlenose dolphins at University College Cork, Ireland. In September 2022, the Labirinto welcomed Kyra Bankhead, an MSc student in Wildlife Sciences at OSU, who will investigate the diffusion dynamics of negative human-fisher interactions through social networks of bottlenose dolphins; and

Below: The traditional dolphin–fisher cooperative fishery exemplifies one way by which human–wildlife interactions can be beneficial to both parties. A) A Lahille's bottlenose dolphin (Tursiops truncatus gephyreus) *approaches the coastal waters of Laguna, southern Brazil, while herding schools of migratory mullet (Photo: F. Daura-Jorge). B) Artisanal net-casting fishers learned to interpret the dolphins' behavior as the best time to act (Photo: M. Cantor). C) The benefits for fishers include increased catches of mullet, as well as other ecological services such as leisure and cultural belonginess (Photo: M. Cantor).*



One example is a transdisciplinary international project concerned with the ecology, evolution, and conservation of the few last cases of human–wildlife cooperation worldwide. The evolutionary origins of human–wildlife cooperation — in which humans and free-living wild animals actively coordinate to achieve a mutually beneficial outcome — remain poorly understood by both the scientific community and the traditional communities that are directly involved.

The Labirinto joins this initiative that brings together ecologists, anthropologists, linguists, conservation scientists, and traditional practitioners from all continents to investigate how

Another example of collaborative efforts to understand interactions between humans and marine megafauna includes a long-term project on sperm whales. This project aims to assess the status of the different sperm whale vocal clans across the Pacific Ocean. The Labirinto has been involved with the research on the clans of whales off the Galápagos Islands, in partnership with researchers at Dalhousie University, Canada, to understand the status, distribution, behavior, and exposure of different clans to anthropogenic disturbances in offshore waters.

Stephane de Moura, a PhD candidate from Universidade Federal do Paraná, Brazil, who is concluding her thesis on the spatial dynamics of Guiana dolphins in the context of a mosaic of anthropogenic activities in Brazil. Next January, Mahmud Rahman, a MSc from Bangladesh will come aboard to study risk-taking behavior in dolphins off the Florida Keys.

The Labirinto's international connections include seven other co-advised graduate students investigating social and population dynamics of a range of marine megafauna species. It is our hope that together, we can better understand the complex web of relationships that Nature is and find a way to navigate without disrupting it. ***MMI***

Rising to the Challenge

Whale Habitat, Ecology, and Telemetry Laboratory

Daniel Palacios PhD, Endowed Associate Professor in Whale Habitats

The Whale Habitat, Ecology, and Telemetry Laboratory (WHET Lab) was established in 2020 with the three-pronged mission of developing new technology, advancing the ecology, and informing the conservation of whales.

In our second year of existence, we rose to this challenge in several significant ways. We published a paper documenting the development of our latest "smart tag" for tracking whales, we participated in a major report led by the World Wide Fund for Nature that produced the first global map of whale migratory routes (see sidebar), and we initiated two new projects that expand our approaches to studying whale ecology through the use of biomarkers.

A SMART TAG TO MONITOR WHALE BEHAVIOR BY SATELLITE

Published earlier this year in the journal *Animal Biotelemetry*, our latest study, titled "A satellite-linked tag for the long-term monitoring of diving behavior in large whales," documents the development of the "RDW tag," a new electronic device for monitoring whale behavior that we developed in partnership with manufacturer Telonics.

The new tag provides the scientific community with the ability to monitor previously unobservable whale behaviors while moving across entire geographic ranges, extending the applications of electronic devices to new areas of marine mammal physiology, behavior, ecology, and conservation.

This project is supported by the Satellite Tracking of Whales Fund.

DIVING DEEPER INTO THE DEEPWATER HORIZON OIL SPILL

This year we also started a new project to assess potential shifts in sperm whale movement, foraging, and physiology after the 2010 Deepwater Horizon oil spill.

Led by postdoctoral scholar Clarissa Teixeira, this project seeks to generate new information on the immediate and long-term behavioral and health effects of the oil spill on Gulf of Mexico sperm whales. Toward this goal, Clarissa is conducting stable isotope and hormone analyses of skin and blubber tissue samples collected during tagging expeditions to the Gulf of Mexico from 2010 to 2013.

This project is supported by the OSU Marine Mammal Institute's Oregon Gray Whale License Plate Fund Program.

Below: The WHET Lab includes Michaela Kratofil, Liam Mueller-Brennan, Clarissa Teixeira, Tomas Follett, Ladd Irvine, and Daniel Palacios.

BALEEN WHALE FORAGING ECOLOGY IN THE CALIFORNIA CURRENT ECOSYSTEM

Finally, in 2022 we initiated a new project to conduct stable isotope analysis of blue, fin, and humpback whale skin tissue samples collected between 2004 and 2019 in the California Current Ecosystem. These samples contain information about whale movement and diet coded into the isotopic composition of the skin, which we are combining with satellite tagging data of the same individuals to refine our understanding of habitat and resource use of these three species.

As part of the project, master's student Liam Mueller-Brennan has been focusing on the humpback whale data for his thesis. Humpback whales inhabiting the North Pacific Ocean are the focus of current efforts to identify distinct population units for improved management, and Liam's work will contribute to this goal by generating new ecological insight into their population structure.

This project is supported by the OSU Marine Mammal Institute's Oregon Gray Whale License Plate Fund Program

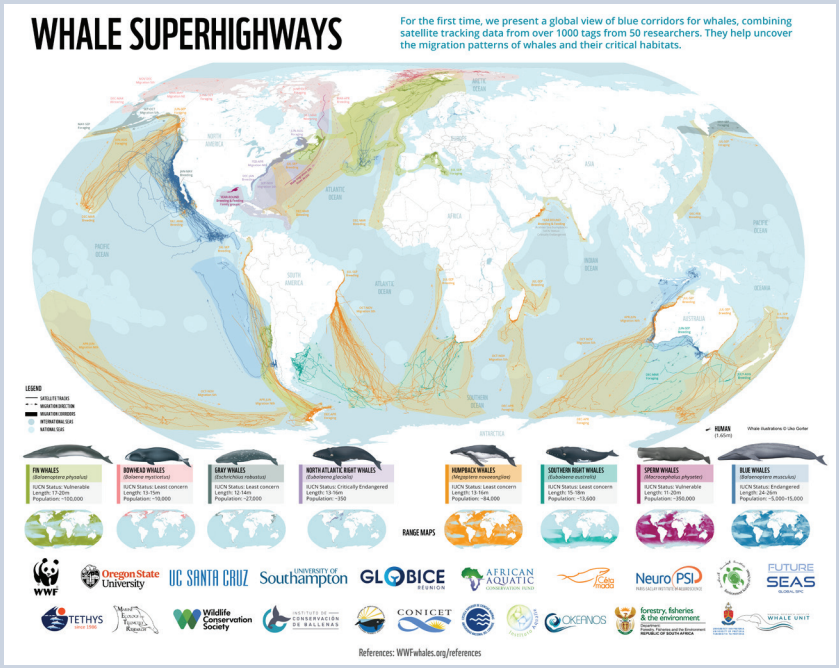
While these projects have been incredibly interesting and fun to work on, they would not have been possible without the support we have received from donors to MMI — we are deeply thankful!

We continue to work very hard on these and other initiatives, and we look forward to reporting on them next year. ***MMI***

PROTECTING BLUE CORRIDORS, A WWF INITIATIVE

DANIEL PALACIOS

In February 2022, a new report was published by World Wide Fund For Nature (WWF) in collaboration with academic partners, who joined forces to produce the first global map of whale migratory routes, their critical habitats, and the mounting threats they face. The report, titled "Protecting Blue Corridors: Challenges and Solutions for Migratory Whales Navigating National and International Seas," highlights how the cumulative impacts from industrial fishing, ship strikes, pollution, habitat loss, and climate change are creating hazardous and sometimes fatal conditions for whales in their critical ocean habitats along their migration superhighways, or "blue corridors."



Above: Global map depicting migratory routes for eight whale species, as they appeared in WWF's "Protecting Blue Corridors" report. Blue corridors are the critical ocean habitats where whales feed, mate, give birth, nurse young, socialize, or migrate. The report is available online at https://beav.es/5US.

The report is the product of a collaboration among more than 20 academic organizations who combined data from over 1,000 satellite tags; the WHET Lab alone contributed data from more than 360 tags. For each major ocean basin, the report identified areas of high cumulative impacts from fishing, ship strikes, pollution, habitat loss, and climate change.

The results of this effort will help inform improved policy processes and conservation measures, both in national waters as well as in the high seas. As the threats to whales evolve, our conservation approach must evolve too.

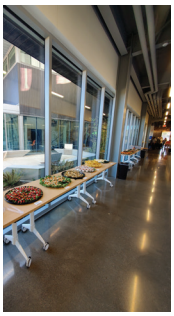
WWF's Protecting Blue Corridors initiative also calls for a new conservation approach that involves science, civil society, industry, states, and intergovernmental bodies at all levels from local to regional to international. Through this enhanced cooperation approach, we all can play a role in safeguarding whales and their migrations, mitigating threats, and co-designing solutions. ***MMI***

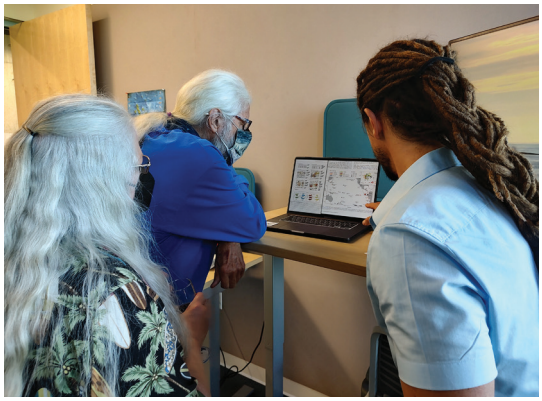
Friends Gather to Celebrate

Marine Mammal Institute Donor Appreciation Open House

On September 24, 2022, the Marine Mammal Institute held our first Donor Appreciation Open House. We started in the morning with a tour of our research vessel *Pacific Storm*, docked at the Newport Bayfront, then in the late afternoon we gathered in the new Gladys Valley Marine Studies Building at the Hatfield Marine Science Center for refreshments, a presentation, and exploration of MMI labs.

More than 200 donors, guests, community partners, and MMI and OSU faculty, staff, and students gathered to celebrate our accomplishments together. This was a career highlight for our faculty and absolutely inspiring for our students. It was fantastic to meet so many of you, share our stories, and hear yours. On behalf of MMI, *thank you* for all that you have helped to make possible.






Oregon State University
Marine Mammal Institute
Donor Appreciation
Open House
Private Event


BLUE HEART
BEAUTY AND CHANGE ALONG AMERICA'S WESTERN SHORELINE
EXHIBIT


The Whale Habitat, Ecology & Telemetry Lab
WHALE SUPERHIGHWAYS

Make a Difference Now and Forever

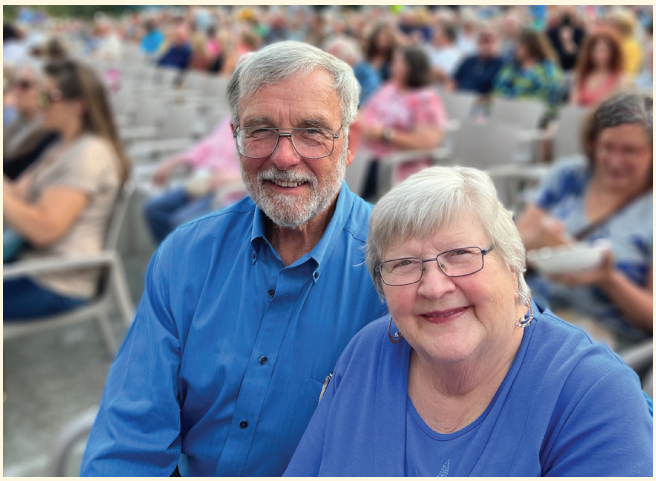
Bruce Mate PhD, Professor Emeritus

Thank you for supporting the Marine Mammal Institute! I am personally grateful to so many of you who, during the last 40 years, have helped MMI through your gifts. The past three years have been a time of transition, and in this context, I am thrilled with our super well-qualified MMI Director, Lisa Ballance. Under her leadership, MMI has flourished, and the Institute's future is bright. Lisa has a 10-year vison for MMI, and I like it! That vision includes creating additional graduate student fellowships, endowed faculty positions, an endowed scholar position, and MMI centers of excellence. I continue to work with her to turn this vision into reality.

Let me tell you a personal story.

Like many of you, my wife, Mary Lou, and I have some ability to give now, but most of our resources are tied up in our home, retirement funds, and savings for unexpected family expenses. Most of our wealth will be what remains when we pass and will be distributed by our estate plan to family, MMI, and a few other charities. Of course, MMI is our principle "charity." Recently, Mary Lou and I found a wonderful way that we can afford to make significant donations, and in doing so, obtain tax advantages while experiencing the fulfillment and pride of being part of making a difference for MMI students, faculty, and programs! Sound interesting?

Many of you, like us, are already retired and live on pensions, IRA annuities, and other retirement vehicles. If you have an IRA and are over 70½ years of age, you generally take an annual Required Minimum Distribution. It is easy to make a direct transfer of these funds (and more — up to $100,000 per year) to the OSU Foundation, a 501(c)(3) organization, to benefit MMI. These direct transfers are a way to make tax-free donations with your pre-tax dollars in your lifetime, allowing you to see the great things you fund come to pass! And when you name OSU Foundation to benefit the Marine Mammal Institute, 100% of it goes to support MMI!



Above: Marine Mammal Institute founder Bruce Mate and Mary Lou Mate celebrate their 55th wedding anniversary at an outdoor concert.

When Mary Lou and I learned of these tools, we immediately decided that we would create an endowed graduate student fellowship now, providing full support for an MMI graduate student every year, forever! We had originally planned this and other things as estate gifts. Now, instead of waiting, we will be a part of these students' graduate careers, development, and successes in the immediate future (as well as in perpetuity)!

When we described our plan to an attorney friend recently, her reaction was, "Sign me up!" Within six weeks, her named endowed graduate student fellowship had been established. It is that simple. This process also works for endowing faculty positions and the MMI director's discretionary fund. There are also matching opportunities to reduce the overall cost of endowed graduate fellowships and faculty positions. And finally, there are tips on how to maximize the benefits of gifting stocks.

MMI exists *only* because of impassioned donors. Most of us, as donors, can make these important and exciting goals in education, marine conservation, and management happen — now. If you would like to explore these and other giving possibilities, please give me a call at (541) 272-1175, or send me an email at bruce.mate@oregonstate.edu. ***MMI***

License Plate Funds to the Rescue

Oregon Marine Mammal Stranding Network

Jim Rice, Stranding Program Manager

Thanks to the generosity of Oregonians who have purchased license plates bearing the beautiful depiction of a gray whale mother and calf, the Oregon Marine Mammal Stranding Network (OMMSN) got a big boost of support this past summer. For the first time ever, I was fortunate to have a dedicated assistant to help me with the daily operation of our marine mammal stranding response unit.

The OMMSN provides a first line of detection for ocean health concerns, through the continuous surveillance of emerging, infectious, and zoonotic diseases in marine mammals in areas frequented by the general public. We track human causes of marine mammal morbidity and mortality, such as fishery takes, ship strikes, shootings, and entanglement in marine debris. Our efforts also offer a humanitarian response to animals in distress, and by mitigating interactions between marine mammals and humans, help to minimize risks to public health and safety.

Since October 2005, I have managed the daily operation of OMMSN virtually single-handedly. This work entails monitoring a statewide stranding hotline seven days per week (over 1,000 calls annually), and responding to all manner of stranding-related issues as they occur. During the summer months, this typically involves answering a near-steady stream of calls, often from desperate tourists alarmed by the appearance of a live mammal on the beach, such as a newborn harbor seal pup or an elephant seal enduring its annual "catastrophic molting" process. Such calls typically lead us to dispatch volunteers to help keep these resting animals from being negatively impacted by curious people (and their dogs).

Above: Charles Nye samples the remains of a gray whale at Cape Arago.

The work also involves venturing out to far-flung locales along the coast to investigate the causes of mortalities and sometimes even to provide euthanasia to severely sick or injured animals.

The temporary employment of a part-time graduate assistant during the busiest time of the year allowed me to manage a high volume of stranding events more effectively, while affording an opportunity to tend to some long-overdue projects in the necropsy lab. I'm confident that it also provided an enriching learning experience for a highly motivated and engaged graduate student.

Charles Nye, a PhD student in MMI's Cetacean Conservation and Genomics Laboratory, served as my Graduate Research Assistant between mid-June and mid-September. Charles helped me enormously in many facets of my day-to-day routine, by receiving, logging, and investigating hundreds of reports of marine mammals ashore and engaging in numerous beach responses, including the examination of a dead gray whale at Cape Arago and the rescue and transport of an entangled Guadalupe fur seal *(Arctocephalus townsendi)* at Gleneden Beach.

Charles eagerly assisted me with numerous necropsies (and took the initiative to conduct several necropsies on his own while I was away on leave) and helped me manage our vast inventory of archived frozen tissues. Using his skills in the genetics lab, Charles sought to determine the ecotype of a dead floating killer whale, among other things.

The support that Charles provided this summer was a welcome enhancement to OMMSN, and it was made possible by the Marine Mammal Institute's Oregon Gray Whale License Plate Fund Program. I look forward to drawing upon further such opportunities for student involvement in months and years to come. ***MMI***

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