COLLEGE OF AGRICULTURAL SCIENCES

MARINE MAMMAL INSTITUTE

MMI.OREGONSTATE.EDU — 2021

From the Director

Fall greetings from Newport, Oregon! The whale that we chose to grace our annual newsletter cover this year is, to me, symbolic of the Marine Mammal Institute.

Let me explain.

In 1945, an ichthyologist found a dead whale washed up on the beach outside his office. So different was it from anything then known to science, he described it as a new species. It would be another 49 years before it was first seen alive in the wild, and that would be the only live sighting — until now.

(Director's message continues inside.)

Oregon State University

The animal above was photographed off the Oregon coast during the Beaked Whale Expedition to the Eastern Pacific Gyre (see page 15). It was subsequently identified as a female Hubbs' beaked whale (Mesoplodon carlhubbsi). *Photo by Todd Pusser.*

In this issue:

The impact of generosity
PAGE 3

Meet MMI's grad students
PAGE 4

Hangry whales?
PAGE 6

Unusual strandings
PAGE 8

Meet MMI's new faculty
PAGE 9

The power of integration
PAGE 10

New beginnings
PAGE 12

Spotlight on MMI affiliates
PAGE 14

Whale plates are making a difference
PAGE 15

This past September, I went to sea aboard our research vessel *Pacific Storm* with colleagues from MMI and NOAA to search for a cryptic species of whale. As is often the case in science (and life), unanticipated challenges came our way, and we were unable to reach our intended destination (a two-week round trip from Newport).

So, we explored the seas west of Oregon instead, and we had an extraordinary encounter with the whale pictured on our cover. It was hard work, persistence, optimism, collaboration, and world-class talent that allowed us to collect acoustic calls, photographs, video, and a pencil eraser–sized piece of skin from this animal. Once analyzed in our molecular genetics lab, the biopsy sample confirmed that this was a Hubbs' beaked whale, that very same species described almost 50 years ago and elusive since that time! (You can read more about our discovery at **beav.es/Ume**.)

Marine Mammal Institute Director, Dr. Lisa T. Ballance, on the deck of the R/V Pacific Storm. *Karl Maasdam photo.*

In my mind, the parallels between our whale encounter in Oregon waters and MMI's recent history and near future are striking.

COVID-19 continues to challenge us. Yet, the stars continue to align. This fall, we welcome two new tenure-track professors, both bringing rock-star expertise that complements our existing rock-star talent. We are now up to 8 MMI affiliates and 16 graduate students (with 8 students joining us just this fall).

Bob Pitman and Lisa Ballance take a break from visual surveys to appreciate a sunset during the Beaked Whale Expedition. See page 15 for more on GyreX. Photo by Todd Pusser.

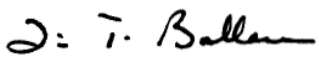
The *Pacific Storm* is sporting new equipment (including a powerful satellite internet system and a thermo-salinograph) and has had a busy year; even as the fall storms reduce our ability to go to sea, our calendar remains chock-a-block full.

We are slowly moving into — and working from! — our new offices and laboratories in the technologically advanced engineering feat and aesthetically beautiful place that is our Gladys Valley Marine Studies Building.

And we are designing new courses and integrating them into a new Marine Mammal Graduate Certificate that will touch students here at OSU, throughout the country, and worldwide.

How do we make this happen? Hard work, persistence, optimism, collaboration, and world-class talent. And one more critical piece: the support and engagement we receive from all of you. In so many ways, shapes, and forms — gifts large and small, travels with us on our annual Baja Gray Whale Expedition, purchase of a gray whale license plate, reading our newsletters, attending our talks, and visiting us in our new offices and labs — you are helping us to make a difference. Please enjoy our annual newsletter, and please take pride in these accomplishments as your own.

MMI is a powerful institute, growing in size, scope, and impact. And, like our cryptic whale encounter, a scientific discovery with impact that has resounded globally, both — Hubbs' beaked whale, and MMI — are right here in Oregon.



Lisa T. Ballance, PhD, Director

Our Donors Make It Happen

Since even before Marine Mammal Institute's formal inception in 2006, our work has been significantly supported by private contributions. This puts us in an extraordinarily valuable position, because donations allow us to leverage other resources, act on time-sensitive opportunities, and grow our institute in ways that would not otherwise be possible. We could write a book on the ways that your direct support has made a difference, and many pages would be devoted to honoring the names of all of those, past and present, who have contributed to our programs.

In this year's newsletter, we are pleased to highlight donor support of Marine Mammal Institute graduate students. Through fellowship endowment funds, the collective impact of individual donations, and ARCS sponsorships, our donors are making higher education attainable for outstanding marine science students and are changing the world for marine mammals and all of us who value the ocean.

Graduate Fellowships

For nearly four years, two family funds have supported eight graduate students as MMI Fellows. These funds are the **Dena and Larry H. Brown Endowed Graduate Fellowship** and the **Schamp Family Endowed Graduate Fellowship,** this year awarded to Kelly Lizewski and Morgan O'Rourke-Liggett.

Three more graduate student fellowships are in development. In future years, we look forward to awarding these to MMI Fellows, thanks to the **Richard S & Carol J Burton Marine Mammal Research Fund,** the **Wesley H & Marybel R Flint Butler Marine Mammal Fund,** and the **Mary Lou & Bruce Mate Marine Mammal Fellowship Fund.**

Finally, individual donations for graduate student support are growing our **MMI Fellowship Fund**, which will also soon be able to support a deserving student. Many of these contributions come from the donor–adventurers on our annual Baja Gray Whale Expedition, including recent gifts in memory of our friend, naturalist Yar Petryszyn.

ARCS Scholarships

The Achievement Rewards for College Scientists (ARCS) Foundation is a prestigious organization that places a high priority on the value of science to society. Among the foundation's great achievements is the ARCS Scholarship Program, which has benefitted MMI students since 2015, when Sheanna Steingass was sponsored by **Bill and Julie Reiersgaard.** Dr. Steingass is now the Marine Mammal Program Leader at the Oregon Department of Fish and Wildlife.

Through ARCS, **Sheila and Michael Goodwin** have dedicated a scholarship to MMI in perpetuity. This academic year, that scholarship has been awarded to doctoral student Sabena Siddiqui. (The Goodwins sponsored doctoral student Dawn Barlow for the past three years.) **Christine and Carl Farrington** have also provided an ARCS scholarship to MMI, and this year that scholarship has been awarded to doctoral student Clara Bird.

These awards recognize incoming and current PhD students who show potential for exceptional research contributions. ARCS awards are extraordinary not only for the funds they provide but also for the opportunities associated with membership in this national organization. ***MMI***

Graduate student Charles Nye speaks to incoming first-year students at the Louis Stokes Alliance for Minority Participation bridge program visit to HMSC in September. Charles was last year's Dena and Larry H. Brown Graduate Fellow. Photo by Itchung Cheung, HMSC Academic Programs.

Staying in Touch

MMI's first director, now Professor Emeritus Bruce Mate, and his wife (and long-time MMI associate) Mary Lou, have moved from their home in Oregon to Washington state to be closer to family.

Bruce continues to be engaged part-time with MMI and is always happy to discuss possible gifts to MMI, including property or estate planning. He can be reached on his mobile (541-272-1175) and home (360-799-9097) phones, by email (bruce.mate@oregonstate.edu), or by mail at 16125 230th St. SE, Snohomish, Washington 98296.

"We retain a very strong emotional attachment to MMI and our friends who have made MMI an international center of excellence. We know Lisa is doing a great job in MMI leadership." Bruce looks forward to visiting in person when COVID settles down.

MMI GRADUATE STUDENTS

A bright future for marine mammals and the ocean

As many of you who are reading this know firsthand, attending graduate school is no small feat. Each of MMI's students have earned their places here through hard work, perservance, and *lots* of study time. In addition, they (and we, and you) work hard to secure enough funding to support their classes and research.

On these pages, we introduce you to our talented master's and doctoral students. Starting this academic year, the number of graduate students at MMI has doubled from 8 to 16. Science is a long-term and continual process of discovery and revision. Without the ability to train the next generation of marine mammal specialists, our work could not continue. We are in awe of these young scientists and are grateful they have chosen this challenging and rewarding career path. ***MMI***

Ladd Irvine

Oregon

PhD, Wildlife Science (Daniel Palacios)

Joined MMI Fall 2018

Bridging the gap: Linking rorqual foraging ecology across multiple scales

Dawn Barlow

California

PhD, Wildlife Science (Leigh Torres)

Joined MMI Summer 2016 (MS)

Ecology and distribution of blue whales in New Zealand across spatial and temporal scales

Allison Dawn

North Carolina

MS, Wildlife Science (Leigh Torres)

Joined MMI Fall 2021

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

Rachel Kaplan

Alaska

PhD, Wildlife Science (Leigh Torres)

Joined MMI Fall 2020

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

Clara Bird

Michigan

PhD, Wildlife Science (Leigh Torres)

Joined MMI Fall 2019

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

Lisa Hildebrand

Germany

PhD, Wildlife Science (Leigh Torres)

Joined MMI Fall 2018 (MS)

Habitat use and population dynamics of PCFG gray whales

Michaela Kratofil

Michigan

MS, Wildlife Science (Daniel Palacios)

Joined MMI Fall 2021

Coordinated movement behavior of Hawaiian false killer whales

Kelly Lizewski

New Mexico

MS, Wildlife Science (Scott Baker)

Joined MMI Fall 2021

Population genomics of Gulf of Mexico sperm whales

Liam Mueller-Brennan

Illinois

MS, Wildlife Science (Daniel Palacios)

Joined MMI Fall 2021

Using telemetry and stable isotope analyses to describe humpback whale ecology

Morgan O'Rourke-Liggett

California

MS, Wildlife Science (Daniel Palacios)

Joined MMI Fall 2021

Tracking Southern Resident killer whales in GIS

Karen Lohman

MS, Wildlife Science (Scott Baker)

Joined MMI Fall 2018

Using conservation genetics/genomics to better understand the migratory connections and feeding ground use of eastern North Pacific humpback whales

Charles Nye

California

MS, Wildlife Science (Scott Baker)

Joined MMI Fall 2020

Ecological metagenomics and environmental DNA

Shanta Shamsunnahar

Bangladesh

PhD, Wildlife Science (Lisa Ballance)

Joined MMI Fall 2021

Sustainable economics of marine wildlife management in Bangladesh

Miranda Mayhall

Pennsylvania

MS, Wildlife Science (Leigh Torres)

Joined MMI Summer 2021

Acoustic behavior, abundance and distribution of Oregon coast cetaceans

Kaimyn O'Neill

MS, Wildlife Science (Scott Baker)

Joined MMI Fall 2019

Developing an epigenetic aging clock for Hector's and Māui dolphins

Sabena Siddiqui

Indiana

PhD, Wildlife Science (Kate Stafford)

Joined MMI Fall 2021

Acoustic occurrences of humpback whales in the Arctic

On the Learning Curve

Geospatial Ecology of Marine Megafauna (GEMM) Laboratory

Leigh Torres PhD, Associate Professor; Oregon Sea Grant Extension

FORECASTING BLUE WHALE HABITAT FOR CONSERVATION

After documenting a genetically distinct population of blue whales in New Zealand with year-round presence in an area of high industrial activity, the GEMM Lab has focused our research on describing, understanding, and predicting the distribution and habitat use patterns of blue whales in the region to inform conservation management efforts.

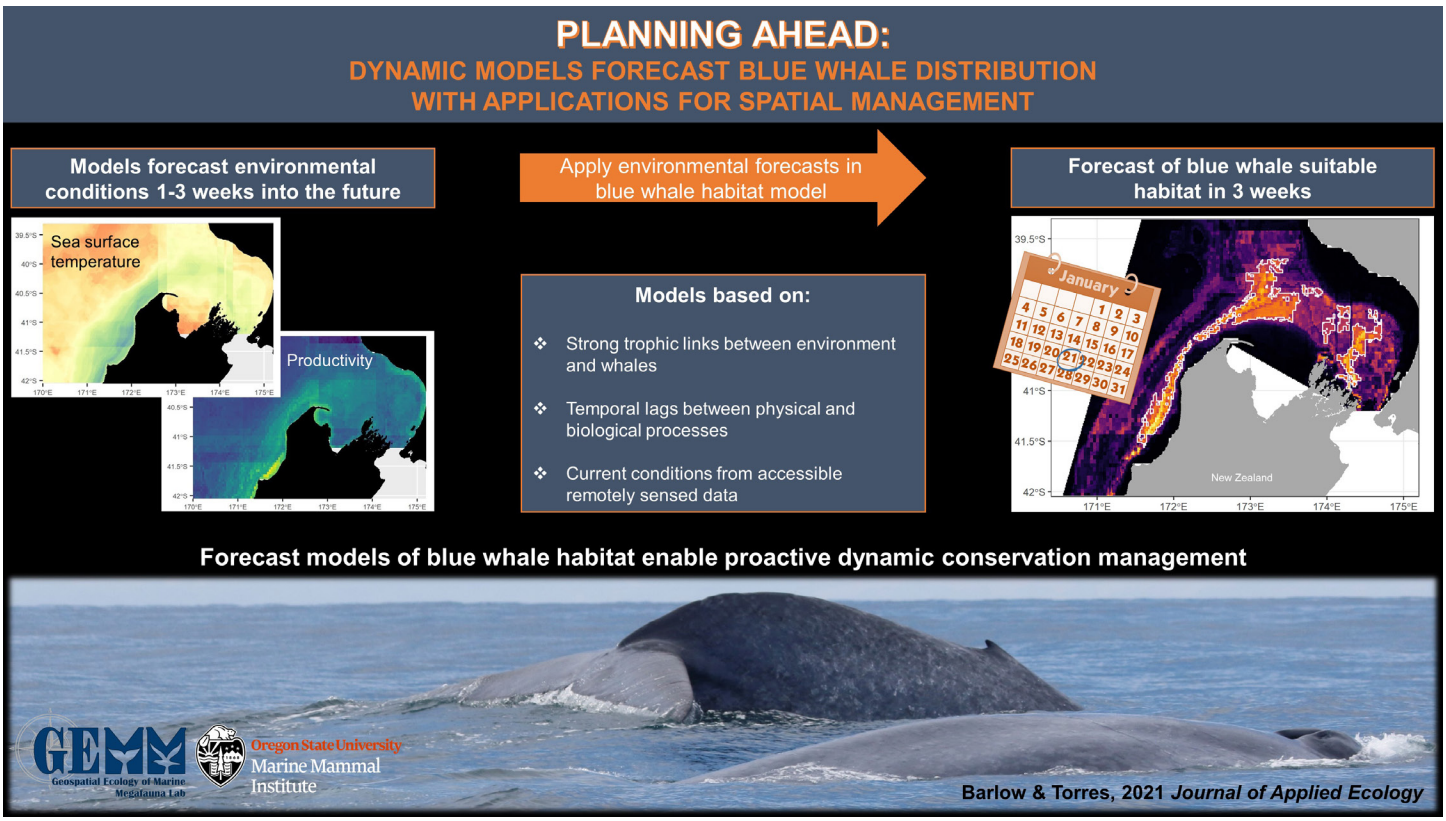
We took a stepwise approach to this objective, by first describing the links between ocean conditions, krill prey, and blue whale occurrence. Next, we evaluated the time lags between these steps: strong winds that drive upwelling conditions; the trajectory of a cold, nutrient-rich plume of water through the region; elevated productivity and prey availability; and ultimately blue whale foraging opportunities. In the last phase, we used this knowledge on trophic links (connections in the food web) and temporal lags to develop predictive models capable of forecasting blue whale distribution patterns up to three weeks into the future based on environmental conditions.

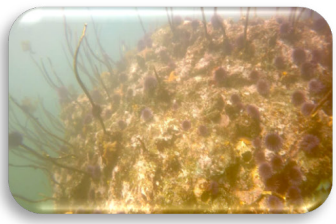
Forecasts of blue whale distribution can enable effective dynamic spatial management by minimizing overlap between blue whale habitat and industrial activities, while also minimizing regulatory burden to other ocean users. We have thus developed a desktop application for managers in New Zealand to run these models and use the forecasts to make proactive conservation management decisions.

HANGRY WHALES?

Do you ever get hangry? You know the feeling: when you are so hungry that everything annoys you or stresses you out. But when you are well fed, those same issues are manageable and easier to solve. GEMM Lab research is finding that the resilience of gray whales to disturbance may have a similar "hangry" pattern.

For six years, we have paired assessment of whale body condition from drone-based photogrammetry with quantification of the whale's stress hormone (glucocorticoids; "cortisol") level in its poop to document that skinny whales are stressed out and chubby whales are relaxed. This finding highlights the importance of accounting for a whale's body





Top to bottom: Defecation at the fluke-out dive; fecal sample collection; pride in the fecal sample; zooplankton collection; zooplankton sample; GoPro image of urchin-infested reef with dead kelp.

condition when trying to understand or predict the stress response of whales to a disturbance.

Malnourished whales have higher stress levels and are therefore less likely to be resilient to added stressors like an injury, infection, or elevated ocean noise. Hence, when ocean conditions change and reduce prey availability and predictability to foraging whales, their body condition may deteriorate and experience elevated stress levels, making them more susceptible to disturbance from human activities. In fact, our research documents strong correlations between increased ocean noise, vessel traffic, and cortisol levels in gray whales. We accounted for the body condition of whales in this analysis and found that the amount of vessel traffic 24 hours before fecal sample collection was positively correlated with the whale's stress level. This time delay represents the gut transit time for the hormones to be released in the poop.

So, staying well-fed is a critical factor for whales to be resilient to disturbances. Interestingly, recent work by the GEMM Lab documented that all gray whale food is not equal, and gray whales (somehow) know this fact. We found that two of six tested zooplankton prey species of gray whales have significantly higher caloric content than the other species. Moreover, we demonstrate that gray whales preferably forage in areas with the higher-quality prey items when available, rather than in areas with more abundant but lower-quality prey. The fact that gray whales choose quality over quantity illustrates their need for fast and efficient energetic gain during the foraging season. Yet, the prey base of Oregon gray whales is rapidly changing. Using six years of data collected in Port Orford, the GEMM Lab has also documented a dramatic rise in purple sea urchins with concurrent decline in kelp and zooplankton abundance within traditional gray whale feeding habitat in reef areas.

Taken all together, this multidisciplinary work by the GEMM Lab demonstrates that environmental change is reducing the availability of critical prey resources for gray whales foraging along the Oregon coast, which can cause malnourished whales with higher stress levels. These skinny and stressed whales are more vulnerable to impacts from acute human activities, such as fisheries entanglements, vessel traffic, and elevated ocean noise.

Whales do not respond to one stressor at a time, but rather in a cumulative fashion. Therefore, we need to holistically assess multiple impacts on whale health and populations to develop effective strategies to minimize disturbance to individual whales and enhance population viability. As our oceans continue to change, the GEMM Lab hopes to support the existence of chubby, resilient whales and find ways to minimize additional disturbance to skinny, stressed whales. ***MMI***

The GEMM Lab's gray whale research in Port Orford is supported in part by the Tigger Misener Memorial Endowment Fund.

Top to bottom: Launching the drone; Piloting the drone; Drone retrieval; Surface feeding gray whale; Field team with Yaquina Lighthouse; High school intern tracking a whale using a theodolite.

New Normals

Oregon Marine Mammal Stranding Network (OMMSN)

Jim Rice, Stranding Program Manager

It has now been some 16 years since I moved to Newport from the Boston area to begin my position with the Marine Mammal Institute managing the Oregon Marine Mammal Stranding Network. Looking back over the thousands of cases I have documented during this period, I can see that there have been some remarkable changes in the numbers and types of animals prone to strandings along the Oregon coast. Indeed, what may have once been considered "unheard of" has now become a new normal.

In 2005, the year of my arrival, the number of strandings (generally defined as animals being dead, severely sick, or unable to return to the water under their own power) recorded by the stranding network was 153 total cases, limited to 11 species (5 species of pinnipeds and 6 of cetaceans). By contrast, the total case count for the year 2020 was 497, representing 15 species (6 types of pinnipeds and 9 of cetaceans). These include strandings of 27 Guadalupe fur seals *(Arctocephalus townsendi)*, a species that had not been documented in Oregon stranding records prior to 2006. The total also includes some cetaceans that had not previously been reported in Oregon stranding records: two pantropical spotted dolphins *(Stenella attenuata)* and a sei whale *(Balaenoptera borealis)*.

Left: One of two pantropical spotted dolphins that stranded at Pacific City, Oregon, on June 4, 2020.

Moreover, in recent years, we have observed strandings involving two other types of animals not typically associated with the Oregon coast: sea turtles and sea otters. Prior to 2008, no sea otters had been recorded in the stranding network database, and until 2012, we only recorded about one sea turtle stranding annually. Over the last decade, these numbers have been increasing. Sea turtle and sea otter strandings are now averaging about 5 per year each.

All of this points to the fact that we are seeing not only more strandings overall, but also more taxa of animals involved in stranding events. Some of this increase in stranding numbers undoubtedly is due to the widespread adoption of the use of smartphones during this period, which has made the reporting of stranding events by ordinary beachgoers much easier, thereby increasing our sampling effort. People who happen upon a beached animal can now immediately report it to the stranding network in real time, often providing detailed photographs and GPS-determined locations immediately.

It also seems that these changes are a reflection of increasing populations of animals and shifts in their distributions in response to broad-scale oceanographic changes such as marine heat waves. Indeed, the increases in the diversity of the species involved suggests that some of these animals are now appearing in waters in which they had been previously absent.

People sometimes ask me what it is that attracts me to the work I do. One simple answer is that it gives me a unique window in the state of the natural world and allows me to bear witness to ongoing shifts in the marine environment. ***MMI***

Above: Loggerhead sea turtle (Caretta caretta) *stranded at Lincoln City, Oregon, February 2, 2021. It was rescued by OMMSN, treated for hypothermia by the Oregon Coast Aquarium, and rehabilitated and released by SeaWorld San Diego.*

Below: Adult male northern sea otter (Enhydra lutris kenyoni) *stranding at Cape Arago, Oregon, on September 18, 2020. This animal succumbed to trauma caused by shark bite wounds.*

WELCOME NEW MMI PROFESSORS!

Mauricio Cantor

Dr. Mauricio Cantor joined the Marine Mammal Institute as an Assistant Professor this August. Growing up in southern Brazil, Mauricio was exposed to both the Atlantic Forest and the Atlantic Ocean, which triggered his interest in the ecology and behavior of terrestrial and marine mammals.

Mauricio earned an master's degree in ecology studying the social lives and population dynamics of Guiana dolphins. He then pursued a PhD in biology by splitting his time between sailing off the Galápagos searching for sperm whales and spending time in the lab trying to make sense of their social lives through computer simulations. Upon returning to Brazil, Mauricio led a project on a unique cooperation between artisanal fishers and bottlenose dolphins. This project has turned into a series of postdoctoral appointments in Brazil, Germany, and Switzerland and opportunities to teach and supervise students.

Mauricio has arrived at the MMI inspired to develop a research program that combines his passion for behavioral ecology and ecological interactions. An initial research goal will be to investigate how behavioral specializations emerge among individual animals and shape the structure of their social systems and how those social systems scale up to influence ecological interactions between species, including those between humans and marine megafauna.

Kate Stafford

Dr. Kate Stafford will join MMI as an Associate Professor this December. Her research focuses on using passive acoustic monitoring to examine migratory movements, geographic variation, and physical drivers of marine mammals, particularly large whales.

Kate has worked all over the world from the tropics to the poles and has been fortunate enough to have seen (and recorded) blue whales in every ocean in which they occur. Kate's current research focuses on the acoustic behavior of bowhead whales and the changing acoustic environment of the Arctic. She studies how changes — from sea ice declines to increasing industrial human use — may be influencing subarctic and Arctic marine mammals.

Before joining the MMI, Kate was a Senior Principal Oceanographer at the Applied Physics Lab and an affiliate Associate Professor in the School of Oceanography at the University of Washington in Seattle (where she did *not* become a Husky fan — Go Beavs!). She has degrees in biology and French literature from the University of California at Santa Cruz and degrees in wildlife science (MS) and oceanography (PhD) from Oregon State University. Prior to graduate school, Kate lived in Paris for a year as a Fulbright scholar studying medieval french literature.

Kate's research has been featured in, among others, *Wild Blue: A Natural History of the World's Largest Animal* by Dan Bortolotti, the *New York Times* Scientist at Work blog, *The Planet* magazine, TED, and in *Highlights* magazine. Kate is looking forward to returning to Oregon and collaborating with the researchers and students at the MMI. ***MMI***

These faculty hires were made possible by the Jungers Faculty Development & Research Fund and the Marine Mammal Research Program Fund.

Profiling Sperm Whales

Cetacean Conservation and Genomics Laboratory (CCGL)

Scott Baker PhD, Professor; Kelly Lizewski; and Debbie Steel MS

A growing number of large-scale, long-term studies of whales and other marine megafauna (such as sharks and turtles) have collected records linked through individual identification photographs to genetic samples and telemetry tracks. DNA profiles and photo-identification records are increasingly used for defining populations for management purposes and for estimating abundance and trends using capture-recapture models.

The skin and blubber biopsy samples collected for genetic analyses are also used for a growing number of ecological markers (for example, stable isotopes and fatty acids) and environmental contaminants (like persistent organic pollutants and heavy metals). Together, these datasets provide the potential for long-term monitoring of cetacean populations, especially those exposed to human disturbance.

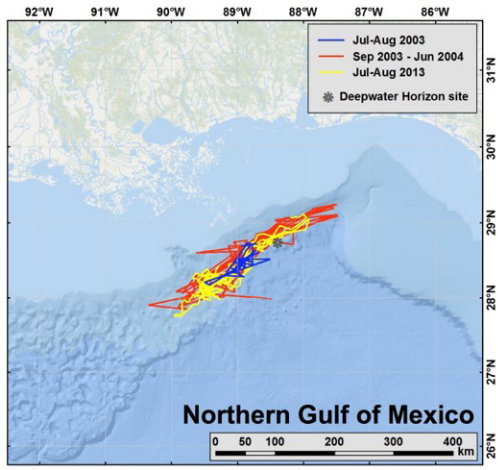
Sperm whales in the Gulf of Mexico have been the subject of several such studies over the last two decades, including collections of both fluke photographs for individual identification and biopsy samples for genetic analyses. It is a population of concern given its genetic isolation and exposure to industrial development and disasters, including the *Deepwater Horizon*, considered to be the largest marine oil spill in history.

Above: Sperm whales in the Gulf of Mexico are at risk of impact from increasing industrial development. Photo by Craig Hayslip.

The Whale Habitat Ecology and Telemetry Laboratory (WHET Lab) has been an active contributor to these studies, collecting both fluke photographs and biopsy samples, while focusing on satellite tagging and tracking of individual whales.

With this as a starting point, we in the Cetacean Conservation and Genomic Laboratory have identified and contacted other dataholders from past studies and secured their agreement to coordinate and integrate data using the open-source software platform, *Flukebook* (**wildme.org**).

		Year	Sex	mt DNA	Microsatellites						
					EV1	EV5	EV94	SW13	SW19	FCB1	GATA417
1	SWSS1081406	2001	F	X	123 133	155 159	202 202	160 160	124 132	121 125	182 182
	OSU11GMX05	2011	F	X	123 133	155 159	202 202	160 160	124 132	121 125	182 182
2	SWSS2082304	2002	F	X	123 123	155 155	206 220	162 166	97 128	121 131	170 182
	OSU11GMX06	2011	F	X	123 123	155 155	206 220	162 166	97 128	121 131	170 182
3	SWSS1081801	2001	F	Y	123 123	159 167	212 226	162 164	122 128	121 129	182 186
	SWSS3070501	2003	F	NA	123 123	159 167	212 226	162 164	122 128	121 129	182 186
	OSU13GMX01	2013	F	Y	123 123	NA NA	212 226	162 164	122 128	121 129	182 186
4	SWSS2070702	2002	F	X	123 123	155 155	202 204	162 170	97 166	121 121	170 182
	OSU11GMX14	2011	F	X	123 123	155 155	NA NA	162 170	97 97	121 121	170 182



DNA profiles, photo-identification and satellite telemetry tracks of the female, SWSS3070501, tagged in 2003 (361 days total) and again in 2013 (42 days total)

We are now working with the software developers to enhance current functionality for both automated matching of fluke photographs and processing of genomic markers for individual identification and population analyses. Last year, we facilitated a virtual workshop among primary data holders to discuss the need for archiving and integrated software solutions to the long-term study of this population. This project is intended as a demonstration of developing standards for other long-term studies of cetacean populations relevant to the Bureau of Ocean Energy Management (BOEM).

The preliminary results of this synthesis have been promising. As part of her PhD at OSU, Alana Alexander, now at the University of Otago, used a standard DNA profile developed by Dan Engelhaupt for samples collected during the Sperm Whale Seismic Study (SWSS) from 2000 to 2005. These profiles included sequences of mitochondrial DNA (mtDNA haplotypes) for identification of maternal lineages, microsatellite genotypes for individual identification, and a molecular marker for sex. Alana was first able to compare the frequencies of mtDNA haplotypes from the SWSS project and the OSU WHET Lab to her worldwide survey, confirming the isolation and very low diversity of the sperm whales in the Gulf of Mexico. Such low diversity is characteristic of sperm whales in other inland seas, such as the Mediterranean.

We were then able to compare the DNA profiles from SWSS with those from biopsy samples collected by the WHET Lab from 2011 to 2013. From an initial comparison, four matching DNA profiles were found between SWSS and the OSU project. One female was first sampled during SWSS in 2001 and tracked by satellite telemetry in 2003 and again in 2013. A review of associated records showed that she was also photo-identified in 2003 and 2013, but the 2001 encounter was only identified from the DNA profile.

With this initial success at integrating DNA profiles, photo-identification, and satellite telemetry, we feel that we are just scratching the surface of the information available for this population.

With funding from BOEM, through the Cooperative Ecosystem Studies Units, we will work with our collaborators over the next year to preserve these invaluable records and to make them accessible for long-term monitoring of this vulnerable population. ***MMI***

AN UNCERTAIN FUTURE FOR NEW ZEALAND'S MĀUI DOLPHINS

Debbie Steel and Scott Baker

The New Zealand endemic Māui dolphin is thought to be the rarest dolphin in the world. In an ongoing effort to improve estimates of trends in this critically endangered subspecies, the CCGL has been working with the New Zealand Department of Conservation and Dr. Rochelle Constantine at the University of Auckland to estimate abundance using DNA profiling for individual identification (see 2020 newsletter).

Earlier this year, a team of rangers and researchers collected 34 small biopsy samples during boat-based surveys off the west coast of New Zealand's North Island. This field effort completes the second year of the most recent two-year survey, following up from previously conducted surveys. DNA profiling of the 34 biopsy samples identified 24 individuals, 13 of which had also been sampled during the 2020 survey.

Using this recapture information, we estimate that only 54 individuals over one year of age were alive at some point during the two survey years. This is lower than the estimate of 63 individuals from the previous survey in 2015–16 but about the same as the estimate of 55 individuals from the 2010–11 survey. We had hoped the ongoing surveys would provide evidence for a trend of recovery. Instead, the low and variable numbers suggest Māui dolphins face an increasingly uncertain future.

Photo of a Māui dolphin courtesy of New Zealand Department of Conservation and the University of Auckland.

We thank Steve and Lisa Robertson and the Harbers Family Foundation for generous support of Māui dolphin research.

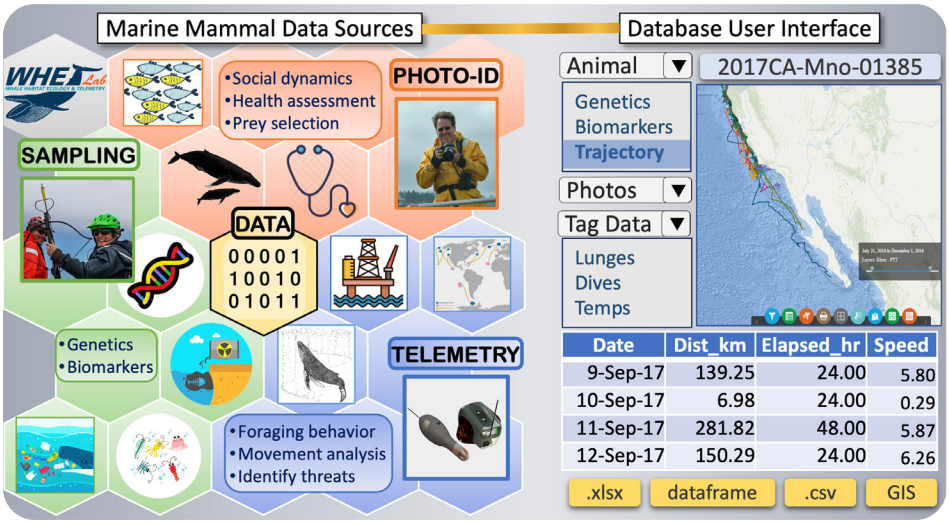
A Year of New Beginnings

Whale Habitat, Ecology, & Telemetry (WHET) Laboratory

Daniel Palacios PhD, Endowed Associate Professor in Whale Habitats

Although I have been with MMI since 2013 as a research professor, in 2020 I took on a new role as a tenure-track professor. With my new role, I established a new laboratory, the Whale Habitat, Ecology, & Telemetry (WHET) Lab, as the successor to the Whale Telemetry Group (WTG), the original lab founded by our previous director, Dr. Bruce Mate.

The WHET Lab's scientific mission is three-pronged: a) maintaining leadership in tag technology development and applications; b) addressing important but unanswered scientific questions in whale ecology; and c) ensuring that the new information generated reaches natural resource managers toward enhancing whale conservation. We also have the educational mission to train the future generations of wildlife professionals through the recruitment and mentoring of graduate and undergraduate students. Below, I provide the highlights of some of our main activities in the last fiscal year (July 2020–June 2021).



The concept behind the WHET Lab's bespoke database approach. In addition to the telemetry data we obtain from our tags, we also collect valuable information like photographic records and tissue samples for a suite of studies (left). These disparate data sources are integrated under a flexible database back end that allows us to make new discoveries from the combined information through a user-friendly interface (right).

ADVANCING TAG TECHNOLOGY

Building on Dr. Mate's leadership and pioneering tradition in the field of whale telemetry, we are very excited about our newest tag for monitoring the movements and dive behavior of whales via satellite. Developed in collaboration with manufacturer Telonics, Inc., we refer to the new device as the "RDW tag." Within the WHET Lab, the effort was led by Faculty Research Assistant Ladd Irvine.

The RDW tag contains sensors including a saltwater conductivity switch, a tri-axial accelerometer, and a pressure transducer. The new tag also features onboard data processing and algorithms for detecting behavioral events or activities of interest for transmission via the Argos satellite system without requiring recovery.

The tag's ability to record behavioral activities over a period of multiple months is a truly ground-breaking advance in the way we study whales and will provide a huge boost to many aspects of whale research and conservation. While our previous tags allowed us to track the location of whales for over a year, the RDW tag lets us see what whales do underwater as well, documenting feeding and other dive behavior, greatly enhancing the ecological implications of our data.

ENSURING DATA PERSISTENCE THROUGH ROBUST DATABASE DEVELOPMENT

In 1986, Dr. Mate successfully deployed the first satellite tag on a whale. Since that time, the WTG and subsequently the WHET Lab have tagged over 900 whales, and we now hold a substantial amount of whale tracking datasets from across the globe. This volume of data necessitates an infrastructure to ensure ready accessibility, quality, and persistence in the form of a dynamic database that meets the standards of the hyperconnected and data-driven world we live in.

Our database is being designed around six requirements: 1) automate acquisition and quality control of telemetry data; 2) incorporate diverse biological and environmental datasets; 3) provide tools to explore, visualize, and extract data; 4) maintain an inventory of tag units, as well as of specifications associated with tag design, construction, and programming; 5) provide robust and secure storage and archiving; and 6) meet current data and metadata standards. Users can easily browse, sort, filter, and export data to convenient formats, as well as visualize whale tracks on a map, as illustrated in the schematic on the opposite page.

The database's innovative architecture gives us the ability to relate an animal to any data source and measurement in it, from which we can make new discoveries from the combined information that may not have been initially evident. Faculty Research Assistant Tomas Follett has been the mastermind behind this development.

GROWING THE LAB

As part of our educational mission, adding to our existing PhD student, Ladd Irvine, this past year I recruited three new MS students: Liam Mueller-Brennan, Michaela Kratofil, and Morgan O'Rourke-Liggett. I invite you to meet the current students in the WHET Lab in the graduate student section of this newsletter. I am looking forward to reporting on their research projects next year.

We have also been developing ideas for projects suitable for undergraduate students interested in having a research experience. This not only helps advance our lab's scientific objectives, but it also fulfills a critical educational mission by fostering undergraduate student retention in STEM fields. In fall 2020, we had our first intern, Aimee Aguilar, an undergraduate student in OSU's Fisheries, Wildlife, and Conservation Sciences Department, who successfully completed her project documenting photographic resightings of blue whales observed during our field expeditions off the California coast. Aimee worked alongside Faculty Research Assistant Craig Hayslip and Affiliate Dr. Renee Albertson as her direct mentors. ***MMI***

Finding 52: A Glimpse into the Habits of the Loneliest Whale

July saw the acclaimed release of the documentary *The Loneliest Whale: The Search for 52*, a cinematic quest to find a mysterious animal living in the North Pacific Ocean, whose unique calls at the frequency of 52 Hz many believe remain unanswered by other whales, making it the loneliest whale in the world. While the filmmakers attempted to locate "52" at sea, members of the WHET Lab (Faculty Research Assistants Barb Lagerquist and Craig Hayslip) and Cetacean Conservation and Genomics Lab (Scott Baker and Debbie Steel), along with external collaborators, had a quest of their own: to determine the identity of a whale we tagged in 2015 off San Miguel Island in southern California that had characteristics intermediate between and a blue and a fin whale. During a 28-day tracking period, this whale traveled north to Big Sur, in central California and visited offshore features like Davidson Seamount and Santa Lucia Bank before returning to the tagging location west of San Miguel Island.

Genetic tests on a small skin sample collected during tagging allowed us to determine that this animal was a male, and further, that it was a hybrid between a blue whale mother and a fin whale father. Photographs collected at the time of tagging allowed us to match this animal to at least 20 sightings going back to 2004 at several locations in the Gulf of California, Mexico, as well as throughout southern California, where it has come to be known affectionately as "Flue" by whalewatchers. Although we did not record the acoustic repertoire of this animal, we surmised that a blue–fin whale hybrid likely calls at an intermediate frequency between the two parent species, making an animal like Flue the most likely candidate for the 52-Hz whale. But Flue wasn't all alone — in most sightings, he was in the company of other blue and fin whales. So, if 52 is Flue, he is not the loneliest whale in the world after all!

What does a blue/fin hybrid whale look like? The photographs above, by Craig Hayslip, provide glimpses of Flue's external morphology and coloration pattern.

SPOTLIGHT ON MMI AFFILIATES

Renee Albertson

Senior Instructor Dr. Renee Albertson can often be found immersed in teaching field courses to OSU students at Hatfield Marine Science Center. In addition to providing critical research skills to future marine scientists, Renee's classes also provide teaching opportunities for MMI graduate students.

This summer, Renee led Biology of Marine Mammals for undergraduates. PhD student Lisa Hildebrand worked with the class in the field, teaching the students how to track gray whales using the theodolite (top right).

This fall, PhD student Clara Bird was a guest instructor for Renee's Methods in Physiology and Behavior of Marine Megafauna class. Clara presented a lecture on photogrammetry and taught a workshop on how to measure and analyze photographs taken by the drone. Using aerial photos, Clara taught the students how to analyze the body condition of whales. As a certified drone pilot, Clara demonstrated a drone flight and had the drone take a class photo (bottom right).

Also in this class, MS student Charles Nye presented a workshop on using eDNA to determine prey abundance for North Atlantic right whales in Cape Cod, MA.

After nearly 4 years since he moved from HMSC to Cornell University, bioacoustician Dr. Holger Klinck returned to Newport to participate in the inaugural cruise of the Holistic Assessment of Living Marine Resources off Oregon (HALO) project. This project is partially funded by *Coastal Playground* whale license plate sales and renewals.

Holger Klinck

The mission of HALO, a collaboration between OSU and Cornell, is to understand how changes in ocean conditions driven by global climate change influence living marine resources in Oregon waters.

Holger and his PhD student Marissa Garcia deployed three passive acoustic recorders from the R/V *Pacific Storm* to continuously monitor the underwater soundscape at the deployment locations for cetacean vocalizations. The data will provide insights into spatiotemporal occurrence patterns of whales and dolphins in the study area. The recording units, also called Rockhoppers, will be serviced every six months. Holger and Marissa will return to Newport in April for the next phase of this exciting project. This is the first time offshore Oregon waters are being monitored continuously during the winter months, and we can't wait to find out what the Rockhoppers record. Visit **halo.oregonstate.edu**. *MMI*

Whale Plates Make It Happen

A little action, multiplied by thousands, makes a huge collective impact. The Oregon Department of Motor Vehicles has been offering the *Coastal Playground* gray whale license plate to Oregon drivers since Feburary 2019. Since then, more than 19,000 people have taken that little action of purchasing or renewing the whale plate, resulting in nearly $600,000 supporting marine mammal research, education, and outreach at the MMI. We are so grateful for this level of support from our home state, and we want to show off some of the projects that license plate funds have made possible. For more about the whale license plate and its impact, visit **whaleplate.com**.

Scouting Mission to Kodiak

In August, GEMM Lab postdoctoral scholars traveled to Kodiak, Alaska, to do a preliminary assessment on the presence of gray whales off the island to judge the feasibility of further research.

During their visit, KC Bierlich and Alejandro Fernández Ajó were guided by a Sun'aq Tribe biologist and a local fisher, who provided critical information about whales in the area. The postdocs collected fecal samples for hormonal analyses, drone images for body condition and behavioral assessments, prey samples, and photo-ID images. The scouting mission identified several knowledge gaps about gray whale ecology, physiology, and population connectivity that can be feasibly addressed through expansion of GEMM Lab research efforts to the Alaskan region. The trip facilitated important networking with locals to establish potential collaborations for future work. For a firsthand account of the mission, visit **beav.es/Um3**.

GyreX

In September, a team of scientists and crew from MMI and NOAA, led by Director Lisa T. Ballance, set sail to uncover one of the long-standing mysteries of marine mammal science: to find and identify beaked whales that have never been seen alive in the wild. As we followed the journey of the Beaked Whale Expedition to the Eastern Pacific Gyre (GyreX) at **beav.es/gyrex,** we learned about these unusual whales and the expertise it takes to find them. ***MMI***

On the R/V **Pacific Storm,** *the GyreX team is ready to launch. The Beaked Whale Expedition to the Eastern Pacific Gyre is a discovery mission supported by license plate funds. Photo by Minda Stiles.*

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Marine Mammal Institute

Mega Bite

Robert Pitman

Among cetaceans, the toothed species — especially the dolphins — are generally considered to be the smartest ones in the room. By comparison, the baleen whales seem almost dull and plodding, like cows in the field. But even cows need survival skills.

During April 2005, the expedition vessel M/V National Geographic Endeavour *was sailing from Panama to Aruba in the southwestern Caribbean. The naturalists on board had barely seen a seabird all day, when a feeding flock appeared in the distance.*

As the ship approached to investigate, the birds excitedly swirled around a school of leaping tunas feeding at the surface. The tuna had corralled a school of small baitfish and were rocketing in from the periphery to pick off individual from the edges of their protective ball.

The birds were busy picking off a few for themselves when suddenly a billboard went up in the middle of the melee: jutting straight up out of the water was the rostrum (upper jaw) of a Bryde's whale, a species of baleen whale found mainly in the tropics. Fully exposed were the whale's baleen plates, which hang down from the whale's upper jaw and are used for filtering small prey when the whale gulps in huge mouthfuls of seawater. The whale's lower jaw projected out at a 90-degree angle, just under the surface of the water, and its body hung vertically in the water below its wide open mouth.

A Bryde's whale feeds at the surface, revealing the baleen plates that filter its small prey. Photo by M. Greenfelder.

As the tuna pressed their attack, the baitfish packed in around the whale, looking for a place to hide. Many found refuge by jumping into the pool formed by the whale's mouth — out of the fire and into the frying pan. After hanging motionless in the water for about 20 seconds, the whale slowly rolled forward as it lifted its lower jaw above the water, brought down its upper jaw, and closed its mouth. As it did so, it left just enough of an opening to use its tongue to force the water out of the sides of its mouth through the baleen plates, leaving only a mouthful of fresh fish behind. A pretty savvy fishing technique — for a cow! **MMI**