

3rd Student Affairs Workshop

14th Biennial Conference on the
Biology of Marine Mammals

30 November 2001
Vancouver, BC

HOSTED BY

The Northwest Student Chapter and the SMM
Student Member-at-Large

STUDENT PROGRAM FUNDING & SUPPORT

Society for Marine Mammalogy, Vancouver Aquarium Marine Science Centre, University of British Columbia Marine Mammal Research Unit, University of Washington School of Aquatic & Fishery Sciences, Washington Cooperative Fish & Wildlife Research Unit, Little Ceasar's Pizza, and Kinkos. *We gratefully acknowledge the companies and individuals who donated raffle prizes.*

AGENDA

- I CHECK IN AND GET PIZZA 7:00 – 7:40**
- II WELCOME 7:40 – 7:45**
Amanda Bradford (Northwest Student Chapter)
- II INTRODUCTION TO SMM 7:45 – 7:50**
Leslie Cornick (SMM Student Member-at-Large)
- II KEYNOTE ADDRESSES 7:50 – 8:50**
Introductions by Josh London, Kristin Kaschner,
and Alison Keple (Northwest Student Chapter)
- 7:50 Sara Iverson**
On Being a Scientist
- 8:10 Dan Costa**
Grantsmanship in Marine Mammal Science.
Where's the Money and How to Get it.
- 8:30 Don Bowen**
The Publishing Game
- BREAK 8:50 – 9:00**
- IV SMALL GROUP DISCUSSIONS 9:00 – 10:00**
- Abundance Estimation, Distribution, and Movement**
Acoustics
Behavior
Cognition
Community Ecology
Fisheries Interactions
Foraging Interactions and Diet
Genetics
Pathology, Toxicology, and Veterinary Medicine
Physiology and Anatomy
Policy and Management
Population Dynamics and Assessment

SARA IVERSON, PHD

Dr. Sara Iverson is currently an Associate Professor in the Department of Biology, Dalhousie University in Halifax, Nova Scotia, Canada. Her research interests include physiological zoology and ecology. She is interested in how animals adapt to and exploit their environments, as answers to these kinds of questions can give us broad insight into basic physiological processes in all animals, as well as elucidation of how rigid or plastic these processes are. She is particularly interested in physiological adaptations in lipid metabolism in vertebrates, both in how it relates to understanding constraints in reproductive strategies as well as how it actually applies to understanding the foraging ecology of free-ranging populations. Important educational and professional steps in the development of Dr. Iverson's career include receiving her BS from Duke University and her PhD from the University of Maryland (in conjunction with the Smithsonian Institution); completing two Post-Doctoral fellowships (Georgetown University Medical Center, Pediatrics Division of Developmental Biology and Nutrition and the Canadian Institute of Fisheries Technology, Technical University of Nova Scotia); joining the Faculty of Science at Dalhousie University (1994); and being awarded an NSERC Women's Faculty Award (1994-2001), the NSERC E.W.R. Steacie Memorial Fellowship (1998-2000), and the Killam Prize in Science (2000). For graduate students learning the delicate balance between a career in science and life in the real world, Dr. Iverson advises you to keep questioning, stay flexible, and, above all, use your imagination to balance life and work and to keep perspective.

DAN COSTA, PHD

Dr. Dan Costa is currently a Professor of Ecology and Evolutionary Biology at the University of California, Santa Cruz. His research interests include adaptations of marine mammals and seabirds to life in the marine environment, with current research focusing on the foraging and reproductive energetics of pinnipeds and seabirds, and the energetics and physiology of natural fasting. Important educational and professional steps in the development of Dr. Costa's career include receiving a BA from the University of California, Los Angeles, receiving a PhD from the University of California, Santa Cruz, and completing a Post-Doc at Scripps Institution of Oceanography.

DON BOWEN, PHD

Dr. Don Bowen is currently with the Bedford Institute of Oceanography, in Dartmouth Nova Scotia, and is also editor of *Marine Mammal Science*. Important educational and professional steps in the development of Dr. Bowen's career include receiving a PhD in Zoology from the University of British Columbia; working for the Department of Fisheries and Oceans, Canada (since 1978); developing a research program on the population dynamics of harp and hooded seals out of the St. John's Newfoundland laboratory (1978-1984); serving as head of the Marine Fish division at the Bedford Institute of Oceanography (1984-1989); conducting research on the foraging ecology, reproductive energetics, and population dynamics of harbor and grey seals (since 1989); being an Adjunct Professor in the Biology Department at Dalhousie University in Halifax, Nova Scotia (since 1986); and serving on numerous science review panels, including the NSERC Ecology and Evolution Grant Selection Committee, several committees of the US National Academy of Sciences, and the Special Committee on Seals in the UK.

ABUNDANCE ESTIMATION, DISTRIBUTION, AND MOVEMENT

KARIN FORNEY, PHD

Dr. Karen Forney is currently with the Southwest Fisheries Science Center, National Marine Fisheries Service, in Santa Cruz, CA. Her research interests include the abundance, distribution and ecology of marine mammals; statistical techniques and sampling design in ecological research; fishery interactions with marine birds and mammals; computer applications in biological research; and ecology and behavior of birds and mammals. Her current position involves all aspects of research on population dynamics and status of marine mammal populations, with emphasis on abundance, distribution, patterns of variability, oceanographic correlates, and human-caused impacts. This work includes the design and implementation of research projects, extensive shipboard and aerial fieldwork conducting surveys of North Pacific marine mammals, quantitative analyses using advanced statistical methods, and publication of results in peer-reviewed journals and technical reports. Important educational and professional steps in Dr. Forney's career include receiving a BA in Ecology, Behavior, and Evolution and an MS in Biology; working for four years after completing her Master's degree, both in her present job and in other non-marine, conservation-biology research positions ("This was key to my decision to continue in the field of applied marine science."); and receiving her PhD in Oceanography. For graduate students pursuing a career in abundance estimation, distribution, and movement, Dr. Forney advises: 1) Be diverse in your coursework, background, and interests, and seize interesting opportunities when they are available. 2) Acquire a solid foundation in general math, statistics, probability, computer skills and programming – this will place you ahead of the pack when seeking jobs. 3) Most importantly, do what you enjoy, and you will do it well.

PHILIP HAMMOND, PHD

Dr. Philip Hammond is currently with the Sea Mammal Research Unit at the University of St. Andrews in Scotland, UK. His research interests include foraging ecology and diet, population dynamics, the use of statistical models to estimate population parameters including abundance and survival, the estimation and mitigation of incidental mortality, the study of interactions between marine mammals and man, the conservation of small populations, and the management of renewable resources. Important educational and professional steps in the development of Dr. Hammond's career include receiving a PhD in population dynamics at the University of York, England (1975-1979); working as the head of the Tuna-Dolphin Investigation with the Inter-American Tropical Tuna Commission in California (1979-1984), the Principal Scientific Officer of the Sea Mammal Research Unit (SMRU) in Cambridge (1984-1996), the Director of SMRU (1996-2001); and currently serving as a University Reader in the School of Biology, University of St. Andrews where SMRU relocated (1996-present). For graduate students pursuing a career in abundance estimation, distribution, and movement, Dr. Hammond advises: 1) Get a good first degree. 2) Get useful practical experience. This means spending significant periods of time in which something concrete is achieved and/or some particular (useful) skill is learned. It does not mean spending a couple of weeks helping out but getting nothing specific to put on your CV. 3) Do a Masters degree. In the UK, a new kind of Master in Research (MRes) is rapidly becoming an important step towards either a job or a PhD. 4) Make sure you do a PhD for the right reasons. A PhD is training to be an independent professional researcher. 5) Learn quantitative skills. Be as IT literate as possible. Learn a powerful statistics program (e.g. S-PLUS or R). The large majority of marine mammal biologists are quantitatively weak. 6) Be proficient in a particular field of study. Marine mammals are a taxonomic group not a discipline. 7) Be flexible. ("Most people I know in marine mammal science started off doing something else.") This is less true now, but remember #6. If you are good at studying ecology or population dynamics in general, you will be good at studying the ecology or population dynamics of marine mammals. 8) Get practice in teaching. Give lectures to undergraduates as well as research seminars, popular science talks, etc. 9) If you are interested, get involved in the applied side. Much marine mammal science is funded to inform policy. Make sure you can separate the science from the rest (ethics, politics, etc). 10) Be prepared to be disappointed, frustrated, etc. Most areas of marine mammal biology are highly competitive.

NATHALIE JAQUET, PHD

Dr. Nathalie Jaquet is currently with Texas A&M University at Galveston, TX. Her research interests include sperm whale distribution, spatial organization, and movements on a range of spatial and/or temporal scales. Important educational and professional steps in the development of Dr. Jaquet's career include receiving a Bachelor degree in Natural Sciences at Lausanne University, Switzerland (1982-1986), a Master degree in Marine

Ecology at Aberdeen, Scotland, where she investigated the role of goby and O-group flatfish in the Ythan food web using enclosure experiments (1986-1988), and a PhD in Marine Ecology at Dalhousie University, Halifax, Canada, where she investigated the distribution and spatial organization of groups of female and immature sperm whales in relation to environmental factors in the South Pacific (1991-1996); being a Post-Doctoral Fellow at Otago University, Dunedin, New Zealand, where she investigated residency, dive behavior and vocalizations of male sperm whales off Kaikoura, New Zealand (1997-2001) and at Texas A&M University, Galveston, TX, where she will be investigating movements, behavior and vocalizations of large male sperm whales in the Gulf of Mexico and in the Gulf of California (2001-present). For graduate students pursuing a career in abundance estimation, distribution, and movement, Dr. Jaquet advises acquiring a thorough knowledge of statistical techniques, modeling, and GIS techniques.

JEFF LAAKE, PHD

Dr. Jeff Laake is currently with the National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service. Important educational and professional steps in the development of Dr. Laake's career include receiving a BS (1976) and PhD (1992) in Wildlife Biology from Colorado State University and an MS in Wildlife Science from Utah State University (1979); working at the Inter-American Tropical Tuna Commission on the tuna-dolphin interaction (1979-1983) and as a systems analyst at San Diego State University (1983-1987); currently working as a statistician at the National Marine Mammal Laboratory. National Marine Fisheries Service where he has focused on methods for estimating abundance and survival rates of marine mammals and marine mammal-fisheries interactions (1992-present); and developing the original version of the computer software Distance, for which he is actively involved in the development of current methods and software.

ACOUSTICS

WHITLOW AU, PHD

Dr. Whitlow Au is currently with the Hawaii Institute of Marine Biology. His research interests include all aspects of acoustics characteristics of marine mammals and the role of acoustics in the natural history of marine mammals. Regarding important educational and professional steps in his career development, Dr. Au believes that obtaining a PhD is very important, if not critical, to start your career in the right direction. He also believes that broad education is important; that you should continually strive to educate yourself as broadly as possible and make the most of any opportunities that happen along the way with old fashion hard work. He also states that career development depends on timing and good fortune; however, when an opportunity arises, you must be ready and prepared to make the most of it. For graduate students pursuing a career in acoustics, Dr. Au advises learning as much physics and math, as well as electronics/computer science, as possible. He suggests that the development of capabilities in these fields will provide a budding scientist with a tremendous advantage over the typical biologist and allow you to do things that most biologists will not be able to do. Contemplating the future of marine mammal science, Dr. Au states, "The effects of anthropogenic noise on marine mammal have a high interest for both government agencies and environmentalists. Therefore, there will be a continual effort to understand how various type of noise and artificial signals affect marine mammals. I believe that understanding the complex interrelationships in the populations of various marine mammals and how these populations are structured and how they function will continue to be of high interest. More information on the interaction of various marine mammal species with the environment they live in is also of high interest. There are many interesting and unsolved problems and issues with marine mammals that I believe the field marine mammal science will continue to expand and grow as a national priority."

SUE MOORE, PHD

Dr. Sue Moore is currently with the National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service. Her research interests include cetacean ecology and bioacoustics, polar marine ecology, and the application of acoustic tools to cetacean field research projects. Important educational and professional steps in the development of Dr. Moore's career can be described in terms of her mentors and her graduate degrees. Both Dr. Frank Awbrey, her MS graduate advisor, and Dr. Sam Ridgway, with whom she worked under contract while she obtained her MS, encouraged acoustic applications. After receiving her MS, Dr. Moore participated in 12 years of Arctic fieldwork, leading to a PhD. Having the break between degrees allowed

Dr. Moore to participate in a long-term field study of Arctic cetaceans. Then, returning to Scripps Institute of Oceanography provided her a great opportunity to refresh her academic background in marine ecology. For graduate students pursuing a career in acoustics, Dr. Moore advises pursuing a solid background in biological sciences, including natural history, as well as mathematical skills.

PETER TYACK, PHD

Dr. Peter Tyack is currently with Woods Hole Oceanographic Institution. His research interests include acoustic communication and social behavior of marine mammals. An important educational step in the development of Dr. Tyack's career was taking a year off between his junior and senior years of college to conduct fieldwork on right whales and *Tursiops* in Argentina. This experience gave him an invaluable start in fieldwork, motivated him to settle with this field, and also provided data for a senior thesis.

BEHAVIOR

ROBIN BAIRD, PHD

Dr. Robin Baird is currently with the National Marine Fisheries Service in Beaufort, NC, and Dalhousie University in Halifax, Nova Scotia. His research interests include marine mammal behavior and ecology, and his research has involved both 'pure' and applied studies on cetaceans. In the last six years, most of his work has focused on aspects of diving (sub-surface) and night-time behavior of cetaceans. Important educational steps in the development of Dr. Baird's career include being involved in a diversity of projects, focusing on different aspects of behavior and ecology of a variety of species, as an undergraduate and graduate student. He says, "This diversity in approaches, topics and study species has been quite important. As a graduate student, I was in a behavioural ecology program, working with a supervisor who had never studied marine mammals, but instead had a broad-based program studying foraging behaviour and ecology of insects, fish, birds and mammals. I was actually the only student at the university studying marine mammals for the first four years of my graduate program. In many ways, I think this was better than working with a supervisor who studied marine mammals, as it forces/encourages a broader interest in behaviour and ecology." For graduate students pursuing a career in behavior, Dr. Baird advises: 1) Attend and present your work at non-marine mammal conferences – not just taxon-oriented (like the American Society of Mammalogists) or regional meetings, but discipline-oriented meetings (Animal Behaviour Society, Society for Behavioural Ecology, etc). 2) Read question-oriented journals, not just taxon-oriented journals. 3) Focus your work as much as possible on the questions, not on the species. 4) Publish your work, and do not wait until it is 'complete' - publish notes on unusual behaviours or observations, or new techniques. 5) Aim for the best general (question-oriented) journals and do not be discouraged when your papers are rejected – learn from the reviews and re-submit to a new journal quickly. Publishing gets easier with experience, and having one or more publications by the time you finish your graduate work is going to greatly increase your chances of getting scholarships, Post-Docs, and jobs.

PETER CORKERON, PHD

Dr. Peter Corkeron is currently with the Norwegian Institute of Fisheries and Aquaculture. His research interests include applied ecology and conservation biology of marine mammals. He has worked on or overseen projects from estimating dugong abundance to determining the behavioral context of humpback dolphins' sound production, to assessing the effects of whalewatching on humpback whales' behavior, to looking at how fisheries affect bottlenose dolphins' society. His main interest is in using behavioral studies to assess human impacts on marine mammal populations. Currently, he is working on the population biology of Arctic seals. Important steps in the development of Dr. Corkeron's career include getting his PhD; setting up and running his first major research program (on humpback whales and whalewatching); moving from his PhD supervisor's lab to another university for his second Post-Doc; working as a lecturer; leaving Australia and taking a position doing something quite different from what he has done before ("As this only happened 12 months ago, I still don't know how important this will really be!"). For graduate students pursuing a career in behavior, Dr. Corkeron advises: 1) Work hard. 2) Study a question, not an animal. 3) Read widely. 4) If you are still looking for a grad school, try for the best you can. It will pay off in the long run. 5) Read the Jackson *et al.* (2001) "Historic overfishing" paper in *Science* 293: 629-638. Hopefully, the way we view our use of marine systems will undergo a paradigm shift and this is important for marine mammals. 6) Think mathematically. Study design is as important for behavioral work as it is for population

estimation. 7) Buy Hilborn and Mangel (1997) *The Ecological Detective*. 8) Learn one of the versions of the S suite of statistical programs (e.g. S-PLUS, R). Never stop learning statistical techniques. 9) Make sure there is always a 'big picture' question underpinning your work. 10) Aim for better journals than where you think you will get your work published. It improves the way you will look at your work, and with luck you might get it in! 11) Get used to having papers rejected, accepting referees' comments, making suggested changes, and resubmitting papers quickly. Referees' comments often improve a paper enormously. 12) If you want to keep working on marine mammals, expect to leave behavioral work and move into some other area of science. If you want to stay in behavior, make sure you have got another taxon to study other than a marine mammal. ("I've had a student working on macropods, and have worked on fruit bats, and terrestrial mammals really *are* easier study subjects!"). 13) Expect disappointments. There *will* be setbacks and you will wonder if it is all worthwhile. Remember, if this was easy, everyone would be doing it. 14) Be a US citizen – you have got more job opportunities that way. ☺

DAVID WELLER, PHD

Dr. David Weller is currently a Research Fellow at Texas A&M University and a Visiting Research Scientist at the Southwest Fisheries Science Center, National Marine Fisheries Service. His research interests include dolphin and whale behavioral ecology and conservation biology, and he has spent the past 17 years studying humpback whales, gray whales, sperm whales, and bottlenose dolphins worldwide. Important professional steps in the development of Dr. Weller's career include currently directing the ongoing studies of critically endangered western gray whales off Sakhalin Island, Russia; being the Co-Director of the Cetacean Behavior Laboratory at San Diego State University; and serving as an academic advisor to five graduate students conducting research on bottlenose dolphins, sperm whales, and gray whales.

COGNITION

LORI MARINO, PHD

Dr. Lori Marino is currently with the Neuroscience and Behavioral Biology Program, Emory University in Atlanta, GA. Her research interests include the processes that are associated with the evolution of large complex brains and intelligence in mammals. For the past few years, she has been conducting comparative research on cetacean and primate brains and cognition. She employs an interdisciplinary approach involving comparative neuroimaging studies of brain morphology and development, analyses of brain-behavior relations, experimental work in comparative cognition, and the study of brains from fossils. She hopes to add to our knowledge of how and possibly why both cetacean and primate brains became large and complex throughout evolution in these two groups. Important educational and professional steps in the development of Dr. Marino's career include receiving a BA from New York University (1982), an MA from Miami University (1989), and a PhD from the State University of New York at Albany (1995); working as a Research Investigator at the Laboratory of Neuroanatomy and Neuropharmacology, The Rockefeller University (1982), a Science Support Assistant in the Space Life Sciences Training Program, National Aeronautics and Space Administration of the Kennedy Space Center (1985-1986), a Research Scientist at the Laboratory of Neurophysiology, Space Biomedical Research Institute, National Aeronautics and Space Administration, Johnson Space Center (1987-1989), a Visiting Assistant Professor in the Departments of Anthropology and Biology, Emory University (1995-1998); currently serving as a Lecturer (Neuroscience and Behavioral Biology Program, Emory University), Faculty (Center for Behavioral Neuroscience, Emory University), Adjunct Assistant Professor (Department of Psychology, Emory University), Research Associate (Living Links Center for the Advanced Study of Ape and Human Evolution, Yerkes Regional Primate Research Center), and Research Associate (Department of Vertebrate Zoology, National Museum of Natural History, The Smithsonian Institution); and following her interests even when they took her on a circuitous route. For graduate students pursuing a career in cognition, Dr. Marino advises obtaining a strong science background and doing what you enjoy.

ADAM PACK, PHD

Dr. Adam Pack is currently with the Kewalo Basin Marine Mammal Laboratory, The Dolphin Institute, University of Hawaii. His research interests include animal cognition; dolphin sensory perception, cognition, and communication; and humpback whale ecology and behavior. Important educational and professional steps in the development of Dr. Pack's career include getting a background in biology, interning at the Kewalo Basin Marine Mammal Laboratory, and obtaining field research experience with whales and dolphins. For graduate students

pursuing a career in cognition, Dr. Pack advises tailoring your program to give you a broad perspective on biology, behavior, psychology, oceanography, and acoustics.

DIANA REISS, PHD

Dr. Diana Reiss is currently a Senior Research Scientist at the Osborn Laboratories of Marine Science at the New York Aquarium of the Wildlife Conservation Society and an adjunct faculty at Columbia University in the Center for Environmental Research and Conservation. Her research interests include the evolution of intelligence and comparative cognition and communication. Her research focuses on the cognitive and communicative abilities of bottlenose dolphins (*Tursiops truncatus*). Using a combination of experimental and observational methods, much of her work has investigated the role of learning and the effects of social and environmental factors on vocal development of dolphins. Current research has demonstrated the ability for mirror self-recognition by bottlenose dolphins. This ability has been previously found only in great apes and humans. Research and applied work also includes developing science-based approaches to animal enrichment for zoos and aquariums. Important educational and professional steps in the development of Dr. Reiss's career include receiving her PhD after being fortunate enough to design a graduate program that was interdisciplinary, including courses in psychology, language development, bioacoustics, general systems theory, and biology (1983); founding and directing the marine mammal research program at MarineWorld Africa USA (until 1991); and serving on the faculty of San Francisco State, Yale, and Rutgers University and as a scientific advisor for several organizations, including the American Zoo and Aquarium Association's Animal Welfare Advisory Committee. For graduate students pursuing a career in cognition, Dr. Reiss advises having a strong comparative background in animal behavior, communication, and cognition.

COMMUNITY ECOLOGY

JONATHAN STERN, PHD

Dr. Jonathan Stern is currently with the Department of Biological Science, Florida State University. His research interests include the ecology of marine mammals, in particular, baleen whales. He is interested in their role in the functioning of marine ecosystems. Inherent in this interest is the determination of the appropriate spatial and temporal scales for studying the influence of environmental change on marine mammal populations. Important educational and professional steps in the development of Dr. Stern's career include having great colleagues, both in this field and in other ecological fields, and developing an understanding of what he wanted to study in the context of "science." For graduate students pursuing a career in community ecology, Dr. Stern advises, first and foremost, to become the best scientist possible. He recommends learning how to ask good questions in a way that they can be answered using sound scientific methods. He states that there is nothing magical about marine mammals; that they are part of the marine ecosystem in which they live. They influence it and are influenced by it, just like all other organisms. Contemplating the future of marine mammal science, Dr. Stern says, "I think the study of climate change on marine mammals is going to be an important field of study. Just because they are mobile does not mean that they will not be affected. Just how to study this in a predictive way will be a big challenge."

GLENN VANBLARICOM, PHD

Dr. Glenn VanBlaricom is currently with the School of Aquatic and Fishery Sciences, University of Washington, and the Washington Cooperative Fish and Wildlife Research Unit, US Geological Survey. His research interests include the trophic interactions of marine mammals and coastal ecosystems, population and conservation biology of marine mammals, interactions of marine mammals and fisheries, and the effects of oil spills on marine mammals and their ecosystems. Important educational and professional steps in the development of Dr. VanBlaricom's career included commitments to a broadly based education as an undergraduate, with foci on the fundamentals of natural sciences (see below) and the liberal arts, especially history and writing courses; to obtaining field experience as an undergraduate ("In my case I worked for a pulp/paper company during summers, taking water and benthic samples to help the company resolve pollution problems and related regulatory issues. This work did not involve marine mammals, but the experience was invaluable in preparing me for the realities and limitations of fieldwork at sea, and for dealing with supervisorial eccentricities common in our field."); to taking coursework seriously from day one of his undergraduate training ("I got into a good graduate program because I

was a serious and committed student as an undergraduate”); to attending conferences and workshops as frequently as possible in order to understand current issues in research, and to understand the culture and communication protocols of the functioning natural scientist; and to becoming comfortable as a speaker in front of an audience. For graduate students pursuing a career in community ecology, Dr. VanBlaricom advises: 1) Make certain your undergraduate education includes the fundamental building blocks of natural science: mathematics, statistics, chemistry, physics, geology, genetics, molecular biology. If you have ‘math phobia’, find a way to get over it. The field is steadily becoming more quantitative as time passes. 2) Understand the ocean. Marine mammals do not make much sense until you know about their habitats. Take oceanography courses (including chemical and physical oceanography), and take them seriously. 3) Do not fall prey to taxonomic myopia. Learn a subdiscipline of natural science, and become an expert in that subdiscipline. Example subdisciplines include population dynamics, molecular techniques for defining populations, acoustical physics or biology, community ecology, physiology, or comparative anatomy. Mastering a subdiscipline does not mean knowing everything there is to know about manatees or bottlenose dolphins or monk seals. 4) Get experience working at sea or on large animals, depending on your interests. Be prepared to volunteer (i.e. work without pay) to gain the experience. If you cannot catch on with a marine mammal project, volunteer for a project that focuses on seabirds or plankton productivity or clams. If you cannot get on a research cruise, volunteer at a farm and learn to work with horses or hogs – experience with large domestic animals can be good preparation for subsequent marine mammal research projects. 5) Practice your writing skills – constantly. There is always room for improvement. If you cannot write technical prose effectively you will fail in marine mammal science. Important corollary: Learn the skills of proposal writing as early as possible in your career, and practice your skills constantly. 6) Learn how to speak to a group about technical matters. Practice on your friends and colleagues. As in #5 above, there is always room for improvement. 7) Be flexible. Always have a ‘plan B’ ready to go. Do not be discouraged by rejection. We all have to live with it. 8) Do not fall in love with a particular marine mammal species or habitat, to the exclusion of others. Any experience with marine mammal research is good experience regardless of the specific subject, as long as the project is managed in a professional and topical manner.

JANE WATSON, PHD

Dr. Jane Watson is currently with Malaspina University College and the Marine Mammal Research Unit, University of British Columbia. Her research interests include sea otter community ecology. Important educational steps in the development of Dr. Watson’s career include being open-minded about her interests as an undergraduate and choosing a graduate advisor whose research she found interesting and who had an excellent track record in working with graduate students. For graduate students pursuing a career in community ecology, Dr. Watson advises, “I think students need to pursue what they are interested in (not what someone thinks they should be interested in) because ultimately it is one’s own passion and enthusiasm that keeps you going when the going is not easy. I also think that in an ever-changing world the value of practical skills should never be underestimated.”

FISHERIES INTERACTIONS

JIM HARVEY, PHD

Jim Harvey is currently with Moss Landing Marine Laboratories. His research interests include marine turtle, bird, and mammal ecology, specifically: foraging ecology; use of telemetry for assessing movements, dive behavior, and survival; interactions between marine mammals and fisheries; and marine mammal associations with oceanographic features and prey resources. Important educational and professional steps in the development of Dr. Harvey’s career include obtaining a strong background in biology, oceanography, and statistics; getting considerable field experience (e.g. handling and observing animals, use of small boats and other field gear); writing proposals and reports; and designing and conducting sampling and experimental studies. For graduate students pursuing a career in fisheries interactions, Dr. Harvey advises that there is a need for people to be well informed regarding a subject. That is, researchers should be well versed in the previous work conducted (i.e. well-read regarding the primary literature), understand the problem (i.e. have a working knowledge of the problem), and be free of political motivation or other biases that may influence how you conduct your research and interpret the results.

DEBRA PALKA, PHD

Dr. Debra Palka is currently with the Protected Species Branch of the National Marine Fisheries Service in Woods Hole, MA. Her research interests include estimating the abundance and by-catch of cetaceans in the Northwest Atlantic and working with several Take Reduction Teams whose goal is to develop and monitor plans to reduce by-catch of cetaceans in fisheries. For graduate students pursuing a career in fisheries interactions, Dr. Palka advises knowing that there is a need for quantitative people who are also knowledgeable about marine mammals. In fact, she knows of job openings that went unfilled, because the quantitative skills of the applicants were not strong enough. So, if you have a tendency to 'enjoy' math and computers, follow up on it. Get as much experience as possible using different statistical and modeling methods and computer programs. Good luck!

FORAGING INTERACTIONS AND DIET*IAN BOYD, PHD*

Dr. Ian Boyd is currently a Professor of Biology at the University of St. Andrews and Director of the Sea Mammal Research Unit, a university-based research unit of the Natural Environment Research Council. Important educational and professional steps in the development of Dr. Boyd's career include receiving his PhD at Cambridge University for studies of reproduction in grey seals; conducting Post-Doctoral studies of reproduction and toxicology in mammals before returning to work specifically on marine mammals for the British Antarctic Survey; and spending 14 years studying Antarctic marine mammals before moving to St. Andrews earlier this year.

CHRISTINA LOCKYER, PHD

Dr. Christina Lockyer is currently with the Danish Institute for Fisheries Research in Charlottenlund, Denmark. Her general research interests include the life history of cetaceans – age, growth, reproduction, and feeding in relation to ecology. Her current special interests include fisheries by-catches of harbor porpoise in Danish waters and ways to prevent them from happening; and investigation of feeding and growth in captive harbor porpoises at the Fjord and Belt Centre on Funen, which complements information from wild porpoises. Her long-term interests include the investigation of teeth and hard tissues in marine mammals for age determination and the possible interpretation of mineralization patterns in these structures as a cue to life history events and population structure. Important educational and professional steps in the development of Dr. Lockyer's career include receiving a BS in Biology at the University of East Anglia, UK (1968), a MS in Zoology at the University of London, UK (1972), and a PhD in Zoology at the University of East Anglia, UK (1989); being employed by the Sea Mammal Research Unit, Natural Environment Research Council, UK (1968-1996); conducting research encompassing studies of population biology, behavior, and ecosystem energetics of large whales and small cetaceans worldwide, with a total scientific publications and 'in press' record exceeding 100 papers concerning cetaceans; conducting overseas work including exchange visits to Far Seas Fisheries Research Laboratory, Shimizu, Japan (1977) and to Southwest Fisheries Science Center, La Jolla, CA and SeaWorld Research Institute, San Diego (1988-1990); conducting research in San Diego, CA on pilot whales (1991), in Sarasota, FL, on bottlenose dolphins (1992), and in Dickson, Siberia, to study beluga whales (1995); participating in the Steering Committee, commissioned by the Department of the Environment, UK to assist in determining guidelines for dolphinaria in maintaining dolphins in captivity (1985-1985); and serving on the Scientific Committee of the International Whaling Commission (since 1972), as President of the international Society for Marine Mammalogy (1989-1991), as Secretariat of the Agreement on Conservation of Small Cetaceans of the Baltic and North Seas (1992-1996), as current Chairman of the European Cetacean Society (1998-present), as a Scientific member of ICES working groups on marine mammals, and on the Advisory Committee to ASCOBANS on the Danish delegation. For graduate students pursuing a career in foraging interactions and diet, Dr. Lockyer advises: 1) Try to get as broad an education in the marine field as early as possible, i.e. do not focus just on marine mammals but also on ecology, oceanography, and marine life. Note that many researchers have come into the marine mammal field from unusual and untraditional backgrounds, e.g. engineering. 2) Get a good background in ancillary skills, e.g. computer and IT skills, boat handling, diving, travel, self-reliance, etc. 3) Try to keep fit (for fieldwork, which is often arduous). 4) Be prepared to travel worldwide for job experience. 5) Do not expect to be able to walk straight into a 'perfect' job after graduation. You may often have to work in a related field but not doing what you really want initially. 6) Try internships, but beware of organizations that use you as a doormat and do not respect your efforts! 6) Contact researchers in your field of interest for advice, possible work experience and internships,

and let them know what you can offer. 7) Finally, be prepared to do much of the legwork yourself when looking for information and references. Do not irritate busy researchers constantly with questions that could be solved yourself if a little effort was applied!

JASON SCHREER

Dr. Jason Schreer is currently with the Department of Biology, University of Waterloo in Waterloo, Ontario, Canada. His research interests include the diving ecology of seals. His current focus is on how diving behavior and physiology develop in pre-weaned pups. Species studied include harp and grey seals, which do not dive during the nursing periods and often fast for several weeks post-weaning, and harbor seals, which dive from birth. Dive behavior is monitored with archival time-depth recorders and physiology is measured in real-time with archival and hard-wired heart rate and ECG/respiration monitors and through blood (hematocrit, hemoglobin, blood volume) and muscle (myoglobin) samples. His goal is determine how these different species develop physiologically and how these differences are reflected in their diving behavior and ecology. Important educational and professional steps in the development of Dr. Schreer's career include receiving a BS in Biology at State University of New York at Stony Brook (1991), a MS in Marine Biology at the University of Alaska Fairbanks (1994), and a PhD in Biology at the University of Waterloo, with a dissertation titled "Diving behavior of air-breathing vertebrates: allometry, classification, and interspecific comparisons" (1997); working as a Post-Doctoral Fellow at the University of Waterloo, where he studied cardiac physiology of Salmonids and Centrarchids (1997-1999); and currently serving as an Assistant Professor at the University of Waterloo (1999-present). For graduate students pursuing a career in foraging interactions and diet, Dr. Schreer advises thinking very clearly about where you want to be 10 years from now. Time goes by really fast and this rate increases every day. Make sure your current path will take you where you want to be and, remember, work is not everything.

GENETICS

C. SCOTT BAKER, PHD

Dr. C. Scott Baker is currently a Senior Lecturer and Research Group Leader at the Ecology and Evolution Research Group, University of Auckland in Auckland, New Zealand. Regarding his research interests, he asks, "How can we conserve and manage the genetic resources of the oceans, where the boundaries between populations and species are poorly understood? Can the principles of conservation biology, derived principally from study of terrestrial species, be applied to the marine environment?" To answer these questions, he states we need to understand the continuities or discontinuities of genetic variation between individuals, populations, and related species. His research applies molecular genetic techniques to these issues to derive information relevant to the management and conservation of marine biological resources. To this end, Dr. Baker's research projects include determining the worldwide population structure of humpback whales, developing a molecular monitoring system for commercial whaling, studying New Zealand's pinnipeds, and examining Marine teleosts.

LANCE BARRETT-LENNARD, PHD

Dr. Barrett-Lennard is currently with the Vancouver Aquarium Marine Science Centre and the Department of Zoology, University of British Columbia. His research interests include mating patterns, population genetics, population dynamics, and culturally-transmitted behaviors of killer whales and other odontocetes. Important educational and professional steps in the development of Dr. Barrett-Lennard's career include spending eight years on the British Columbia coast working as a lighthouse keeper, whale photo-id/acoustics volunteer, biological consultant, and (eventually) marine mammal research technician after completing a BS in Biology and Math at the University of Guelph ("This period was just as useful in the development of my career as the time I spent at graduate school, because it enabled me to 1) become proficient in the navigation and the operation of boats, 2) learn marine mammal research methods, 3) become familiar with a biologically rich marine region, and 4) become reasonably knowledgeable about the natural history and environment of the species that I later focused on academically."); receiving an MS (killer whale echolocation) and a PhD (population structure and mating systems of killer whales as revealed by DNA analysis) at the University of British Columbia; and then working as a marine mammal geneticist for the Canadian Department of Fisheries and Oceans until this August, when he became senior marine mammal scientist at the Vancouver Aquarium. For graduate students pursuing a career in genetics, Dr. Lance-Barrett Lennard advises: 1) Developing expertise in a field *other* than marine mammal biology, such as

applied mathematics, statistics, computer modeling, physiology, genetics, toxicology, bioacoustics, etc. Bear in mind that there are extremely few jobs for all-purpose marine mammalogists, but many opportunities exist for experts in other fields who wish to apply their expertise to issues relating to marine mammals. 2) If you are interested in field work, being a competent and experienced mariner with basic skills in engine and electrical repair will put you further ahead than experience with a particular set of methods used in field research. 3) Finally, marine mammal research is almost always a team sport. Data come too slowly and are too hard won for researchers to get far alone. Seek out colleagues that you trust and enjoy working with and treat them like gold. They will always be your best asset.

Greg O'Corry-Crowe, PhD

Dr. Greg O'Corry-Crowe is currently with the Southwest Fisheries Science Center, National Marine Fisheries Service in La Jolla, CA. His research interests include the evolution, behavioral ecology, and management of marine mammals using modern molecular genetic techniques. His current interests lie in the study of population structure, dispersal patterns, and stock identification of beluga whales, North Pacific harbor seals, and Steller sea lions, and the social organization and mating systems of beluga whales. Important educational and professional steps in the development of Dr. O'Corry-Crowe's career include completing a BS in Zoology at University College Dublin (UCD) where he became interested in combining field-based research with lab-based molecular genetic work in the study of the behavioral ecology and population structure of large mammals (1988); completing a PhD at UCD on the behavioral ecology and social structure of Eurasian badgers (1992); beginning a short Post-Doc later that year at Dr. Andrew Dizon's lab at the Southwest Fisheries Science Center on population subdivision, dispersal patterns, and stock structure in beluga whales in Alaska; receiving a 3-year NRC postdoctoral fellowship at the same lab on the molecular genetic investigation of population subdivision, stock structure, and dispersal patterns in a number of high latitude marine mammal species, including beluga whales and North Pacific harbor seals; heading a research group at the Southwest Fisheries lab studying the molecular ecology of high latitude marine mammal species with emphasis on resolving stock questions (1997); initiating and participating in a number of field-based research projects that complement the molecular genetic studies, including several sample collection (biopsy) programs, a behavioral study of beluga whale group structure, and a number of satellite-linked telemetry studies; and currently researching stock structure and dispersal patterns in Steller sea lions and harbor seals in the North Pacific and global population structure, social organization, and mating systems in beluga whales. For graduate students pursuing a career in genetics, Dr. O'Corry-Crowe imparts, "Molecular ecology is a relatively new field and has been growing at a rapid pace over the past decade. Fortunately, there is no shortage of good research ideas or of interested students prepared to do the work. Unfortunately, there tends to be a limited supply of funding and facilities to conduct this much needed type of research. Research can be expensive. This is primarily due to the development of new, automated technologies that enable high throughput but increasingly depend on expensive, patented chemistry and equipment. This, however, doesn't have to be the case and many labs use relatively cheap techniques to produce equally reliable data. Although this type of research may ultimately be very rewarding, the actual lab work tends to be repetitive, can become tedious, and is often heart-breaking (i.e., many failures punctuated with the odd triumph, at least in the early stages). Attention to detail and an ability to trouble-shoot is important. This latter requirement requires at least a basic grasp of chemistry and biochemistry. The greatest weakness of many molecular-genetic based studies in the field of molecular ecology tends to be in areas of the research other than the lab aspect. Firstly, a substantial portion of the project's time should be spent on articulating the questions to be addressed and determining whether the molecular approach envisioned is, in fact, going to answer these questions. Secondly, a significant portion of any project should be devoted to sample collection as this ultimately sets the boundaries of the study and the power of the investigation to answer the questions you originally asked. Thirdly, a large part of any molecular ecology project should be spent on the analysis and interpretation of the molecular data. Too often, too little attention is paid to this critical aspect of any molecular-genetic based research. Data analysis tends to be overshadowed by the data collection phase in the lab, and is often reduced to entering the raw data into a canned computer program and turning the crank. The analysis of molecular genetic data requires an understanding of population genetic theory, statistics, and, increasingly, some computer savvy. Despite the current interest in the application of molecular genetic techniques to the study of marine mammals, there are few full-time jobs out there at the moment for people planning a career in this field. Funding is patchy and usually short-term. There are also only a handful of labs that currently specialize in marine mammal molecular genetic research. On the plus side, the research is potentially very interesting and rewarding. The actual molecular research methods are pretty standard and can be used in any molecular genetic lab. There is funding out there and it is possible to build a career in this field if you are serious enough about it.

PATHOLOGY, TOXICOLOGY, AND VETERINARY MEDICINE

DANIEL COWAN, MD

Dr. Daniel Cowan is currently a Professor of Pathology at the University of Texas Medical Branch in Galveston, Texas, and the State Director and Pathologist of the Texas Marine Mammal Stranding Network. His research interests include the naturally occurring diseases of marine mammals, especially dolphins, with a focus on adaptation and disease ('comparative pathology'), environmental pathology, and the dolphin as a biomonitor. Important educational and professional steps in the development of Dr. Cowan's career include receiving an MD at McGill University, Montreal; serving in the US Navy (Antarctic); conducting human pathology training at the Pathological Institute, McGill; being an NIH Special Fellow in Comparative Pathology, spent at the Penrose Research Laboratory, Philadelphia Zoological Garden; and organizing a field study of diseases found in pilot whales taken at a shore based whaling station (Newfoundland). For graduate students pursuing a career in pathology, toxicology, and veterinary medicine, Dr. Cowan says, "I don't think you can earn a living doing what I do with dolphins. You need to plan on a day job to support yourself, and work an interest in marine mammal pathology into your professional life. In essence, I created my own job in marine mammal pathology while continuing to work as a hospital pathologist/medical school faculty."

FRANCIS GULLAND, PHD

Dr. Francis Gulland is currently with the Marine Mammal Center, Sausalito, CA.

PETER ROSS, PHD

Dr. Peter Ross is currently a Research Scientist at Fisheries and Oceans Canada (Institute of Ocean Sciences). His research interests include using marine mammals as sentinels of marine ecosystem health; characterizing the levels and patterns of Persistent Organic Pollutants (POPs); assessing the health effects of POPs on marine mammals; harbor seals and killer whales; characterizing contaminant transport and fate in marine mammal food chains; and endocrine disruption and immunotoxicity. Important educational and professional steps in the development of Dr. Ross's career include carrying out three degree programs at different universities, including a PhD overseas; getting experience with different laboratories, researchers, and projects; combining field work with solid laboratory-based research; having a solid focus but strong multidisciplinary approach; and understanding ecosystem function and interactions. For graduate students pursuing a career in pathology, toxicology, and veterinary medicine, Dr. Ross advises: 1) Let your curiosity drive you through science. 2) Seek a greater 'truth' through science limitations to understand systems. 3) Work openly with like minds and try not to be enveloped behind a curtain of mistrust. 4) Do not become defensive when confronted on your findings, thoughts or data. 5) Let the scientific process improve our view of the world, and recognize your role, however small, in this. 6) Publish. Publish. Publish.

PHYSIOLOGY AND ANATOMY

JENNIFER BURNS, PHD

Dr. Jennifer Burns is currently with the Department of Biological Sciences, University of Alaska Anchorage. Important educational and professional steps in the development of Dr. Burns's career include spending summers at Marine Science Field Stations during undergraduate years; receiving her Masters at the University of Washington and working at the National Marine Mammal Lab (1990-1993); receiving her PhD at the University of Alaska Fairbanks (1993-1997); getting much research experience not related to her thesis work with agencies and faculty at other institutions; doing a Post-Doc at the University of California Santa Cruz and Moss Landing Marine Laboratories (1997-2000); and working with University of Tromso Norway and Alaska Department of Fish and Game. For graduate students pursuing a career in physiology and anatomy, Dr. Burns advises: 1) Realize that the ultimate responsibility for your thesis (and career) rests with you. If the project is not going the direction you want it to, try and figure out why and make the changes yourself. 2) When asking for help/advice, have specific questions and really listen to the answers. 3) Get involved in many different projects and help other students when possible. 4) Take more math and statistical classes than you think you need. 5) Make lots of contacts with scientists outside your field. 6) Read a wide range of primary literature. Often the newest developments in your

field will first be tested in other systems (medical, human, terrestrial wildlife, oceanography, etc.). 7) Practice writing skills. 8) Become computer literate (more than just MS Windows and Office). 9) Physiology is moving towards more molecular and technical methods. If you get a chance, take classes in molecular biology/techniques. 10) If interested, learn some engineering/electrical problem solving skills.

MICHAEL CASTELLINI, PHD

Dr. Michael Castellini is currently with the School of Fisheries and Ocean Sciences, University of Alaska Fairbanks. His primary research interests include marine mammal physiology and biochemistry related to diving, fasting, and nutrition. Important educational and professional steps in the development of Dr. Castellini's career include receiving a PhD at Scripps Institution of Oceanography (1981), receiving Post-Doctoral fellowships for four years at the University of British Columbia, and serving as a research faculty member for several years at UC Santa Cruz. For graduate students pursuing a career in physiology and anatomy, Dr. Castellini cautions that all of the labs being run around the country in the field of marine mammal physiology, etc. are being run by people who came into the field from the areas of medicine, comparative physiology, psychology, etc. He says, "Most of us did not get into this field because we always wanted to work with marine mammals. Most of us have broad interests in biology and physiology and work with marine mammals because they represent extreme examples of mammalian adaptations to environmental problems." Thus, his advice to all new or prospective graduate students is to make sure you have a solid program in your field of interest (e.g. population biology, behavior, etc.), and then apply it to marine mammals. That is, 'marine mammal biology' by itself is not a field of study.

POLICY AND MANAGEMENT

PHILLIP CLAPHAM, PHD

Dr. Phillip Clapham is currently with the Dallas Cowboys Cheerleaders...oh no, sorry...the Northeast Fisheries Science Center in Woods Hole, Massachusetts. He is also associated with the Smithsonian Institution in Washington DC. Oh, and he is a member of the IWC Scientific Committee ("to which they drag me every year, kicking and screaming every step of the way"). His research focuses on large whales of various species, notably humpback and right whales. His primary research interest is in conservation, and therefore in various aspects of population biology as they relate to the management of endangered mysticete populations. He has been involved in work on both North Atlantic and North Pacific right whales (both critically endangered), as well as with North Atlantic humpback whales and various other large whale populations worldwide. Before he became "a worthless government bureaucrat," he was heavily involved in behavioral ecology, with an emphasis on social organization and mating systems. Regarding important educational and professional steps in the development of his career, Dr. Clapham says, "I did everything backwards (no comments from my colleagues, thank you)." He started out with "inappropriate qualifications" working as a volunteer in a small non-profit organization, obtained experience with research, and then went back to school for a doctorate. He then completed Post-Docs in genetics and conservation management, leading to his current position running large whale research at the Northeast Fisheries Science Center. Of this process, Dr. Clapham notes, "Contacts were extremely important - I wouldn't be here today if it had not been for the openness and generosity of certain key individuals in this field." For graduate students pursuing a career in policy and management, Dr. Clapham advises: 1) Read as much as you can (primary literature, not popular stuff). 2) Volunteer or do whatever it takes to get experience with a real research program. Experience is an invaluable currency in this field. 3) Make contacts shamelessly. They lead to other contacts and experience. 4) Publish at every opportunity, even trivial stuff. Nothing does more for your future career than a proven ability to publish papers and write well scientifically.

DOUGLAS DEMASTER, PHD

Dr. Douglas DeMaster is currently with the National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service. His research interests include population dynamics, conservation biology, and management. Important educational and professional steps in the development of Dr. DeMaster's career include doing a PhD with Dr. Don Siniff at the University of Minnesota, where he was introduced to population studies on Weddell seals and encouraged to get a strong background in statistics, quantitative ecology, and modeling (1973); conducting cooperative studies with Dr. Don Siniff and Dr. Ian Stirling, comparing dynamics of Arctic and Antarctic ice seals (1975) and with Dr. Ian Stirling on polar bear ecology in the Canadian Arctic

(1975); being hired by Dr. Robert Brownell to run the polar bear research program in Alaska for the Fish and Wildlife Service (1978); serving on recovery teams for southern sea otters and Hawaiian monk seals; being hired by Dr. Tim Smith to work on ETP dolphin conservation and management for the National Marine Fisheries Service (1980); and becoming affiliated with Scripps Institution of Oceanography (1984) and University of Washington (1993) as an Associate Professor, where he is allowed to serve on graduate student committees. For graduate students pursuing a career in policy and management, Dr. DeMaster advises: 1) Pick a discipline, not a species, that you are totally committed to. 2) Work with someone who is a recognized expert in the field (it also helps if they have a reputation for being kind to their graduate students). 3) Listen to your advisor. There is some chance that he/she is right. 4) Read the literature (pick a set of publications and read them as they come out). Start your own reference collection. Take notes on really important papers. Participate in journal clubs, as possible. 5) Learn to write well. 6) Learn to enjoy speaking in public and learn to speak well. 7) Be a team player. Share your data and be generous with your opportunities. 8) Be willing to start at the bottom of the ladder with no pay, if necessary. Get your foot in the door and keep it there. 9) Publish at least one article a year in a peer-reviewed journal, if at all possible as soon as possible. 10) Work harder than most of the people you know and some of the people you admire.

GREG DONOVAN, PHD

Dr. Greg Donovan is currently the Head of Science at the International Whaling Commission and the Editor of the *Journal of Cetacean Research and Management*. His research interests include population dynamics, abundance estimation, management procedures, and incidental captures. Important educational and professional steps in the development of Dr. Donovan's career include choosing a strong Zoology Department for his initial degree, deciding to leave 'theoretical' research into ultrasound in infant rodents and move to a 'practical' institution working on management (of cetaceans), working towards reconciling the need for academic rigor and the need to provide timely and practical advice to managers, and working for improvement in the standard of publications of a management body ultimately leading to the establishment of the *Journal of Cetacean Research and Management*. For graduate students pursuing a career in policy and management, Dr. Donovan prefaces, "Cetacean populations face an enormous number of problems around the world, many of which have human 'origin,' i.e. can potentially be addressed by management actions. Management science is generally at the level of 'management stock' not the individual animal. Students who wish to become involved in management science need to bear in mind the following 'key' points." He advises: 1) Be quantitative. Authorities will normally only act if there is strong quantitative evidence that action should be taken. Modeling provides a valuable management tool with less severe implications than getting it wrong in the real world. 2) Be objective. The scientists' role should be to provide the best scientific advice irrespective of whether they like the implications of that advice or not. Do not fall into the temptation of abusing your position of scientific advisor (for which you have the necessary qualifications) to act as a 'moral' judge (for which your views are worth no more than anyone else's). 3) Be honest. Scientists must be prepared to admit to their uncertainty where it exists. Advice provided should take this uncertainty explicitly into account. 4) Do not be (pre-) judgemental. Assigning 'evil' motives to certain categories of people (fishermen, whalers, etc.) is unhelpful and usually counter-productive. Both quantification of a problem and solutions to a problem require trust and cooperation between the scientist and the 'receiver' of management advice. 5) Do not be arrogant. Part 1. Be prepared to listen with respect to those with experience of a management problem irrespective of their academic qualifications. This applies equally to their view of whether something is a problem and what a potential solution might be. History is littered with examples of scientists getting things wrong. 6) Do not be arrogant. Part 2. Draconian solutions should be a last resort. Management advice usually has implications for people's livelihoods and this should be taken into account for several reasons, including the likelihood that it may be ignored with even more serious implications for the animals we are trying to help. 7) Be firm. If you have followed #1-6 above, stand by the evidence you have accumulated and the advice you believe it warrants irrespective of whether it makes you unpopular with politicians, industry, conservation groups or special interest groups – or indeed all of them!

POPULATION DYNAMICS AND ASSESSMENT

LEAH GERBER, PHD

Dr. Leah Gerber is currently with the National Center for Ecological Analysis and Synthesis, UCSB (until December 15) and the Department of Biology, Arizona State University. Her research interests share the common theme of applied population ecology. She develops quantitative approaches to decompose sources of uncertainty and connects that uncertainty to decision-making in marine conservation biology. In general, her research focuses on questions that relate to 1) endangered species recovery, 2) marine reserve design, and 3) disease and conservation. First, she works on developing approaches to improve the process of recovery under the ESA. Her dissertation research focused on developing population viability models that would serve in Endangered Species Act listing and delisting decisions for marine mammals. More recently, she conducted a meta-analysis of the use of biological information in almost 200 recovery plans with the goal of improving the use of science in the planning process. Second, she is interested in marine reserves as mechanisms for conserving marine populations. She is looking at how life history traits, level of depletion, density dependent mechanisms, dispersal mode, recruitment variability, and time since the establishment of a reserve influence our ability to detect population-level responses to reserve establishment. She is also working on a project on designing reserves for multiple species based on the distribution of top predators such as marine mammals. Third, she has recently become interested in the intersection between epidemiology and conservation theory. She is using matrix population models to test the hypothesis that disease contributed to the recent decline of Southern sea otters. More generally, she is developing practical approaches to integrate data on disease into standard extinction risk models. Important educational and professional steps in the development of Dr. Gerber's career include receiving a Master's degree in Marine Affairs and then building on her initial training in policy aspects of marine conservation. The skills that she developed during her dissertation research have proven to be relevant and useful approaches to a number of other questions in marine conservation biology. Most recently, she has benefited from the emphasis on 'analysis and synthesis' during her Post-Doctoral appointment at NCEAS. Exposure to a broad range of scientists and new ideas led her to broaden her research interests and apply her marine mammal background to interdisciplinary environmental problem solving. For graduate students pursuing a career in population dynamics and assessment, Dr. Gerber advises: 1) It is important to build your 'tool box', not only with field experience, but also with skills in modeling and statistics. 2) Research focused on conservation and management is more likely to be funded given the limited resources in marine mammal science. 3) Marine mammals per se should not be a research focus, rather a study system to address questions in ecology, behavior, medicine and conservation. There are not a lot of PhD-level jobs in marine mammal science, but the market is really good in ecology and conservation biology. Adopting a broad approach to your research, in which you focus on questions rather than particular organisms, is likely to fare better in the job market. 4) Try to think of your dissertation as a collection of related research projects, rather than a single tome. Submit your chapters for publication as they are completed, and when it comes time to finish your dissertation you will have already written (and hopefully published) some of the chapters. The worst mistake you can make as a graduate student is to wait until all of your research is done to write your dissertation.

PAUL WADE, PHD

Dr. Paul Wade is currently with the National Marine Mammal Laboratory, Alaska Fisheries Science Center, National Marine Fisheries Service and is an Affiliate Assistant Professor with the School of Aquatic and Fishery Sciences, University of Washington. His research interests include the population dynamics of mammals and birds, particularly cetaceans; conservation, management, and assessment of marine mammal populations; abundance estimation using line-transect surveys, and abundance and survival estimation using mark-recapture methods; and statistics and quantitative methods in ecology. Important educational steps in the development of Dr. Wade's career include receiving a BA in Environmental Studies at Colby College, a MS in Biology at Montana State University, and a PhD in Oceanography at Scripps Institution of Oceanography. Important professional steps include serving in the IWC Scientific Committee, the IUCN Cetacean Specialist Group, Spectacled and Steller's eider Recovery teams, the southern resident killer whale Biological Review Team, and the NCEAS working group on extinction risk. For graduate students pursuing a career in population dynamics and assessment, Dr. Wade states that the study of populations has become increasingly quantitative in recent years. He advises: 1) Take an upper undergraduate level (or higher) sequence in probability and mathematical statistics. 2) Learn how to use one main programming language.