

**Agenda: Student Affairs Workshop
World Marine Mammal Science Conference
Monaco, January 20 1998**

1. Careers in Marine mammalogy (13:30-15:00)

I. Welcome

Session Chair: Leah Gerber, Washington Cooperative Fish and Wildlife Research Unit,
University of Washington, Seattle WA 98115, USA

II. Getting ahead in Marine Mammal Science (or, Why should I have to wait tables when my heart is pure?)

Phil Clapham, Northeast Fisheries Science Center, Woods Hole MA 02543, USA

Phil has been involved with marine mammal research for 17 years, specializing in large whale biology. He became a whale biologist largely by accident in 1980, and has since been involved in a variety of fields ranging from behavioral ecology to molecular genetics and conservation management. As someone who has had extensive experience interviewing and hiring others, he has a good perspective on what it takes to succeed in this field, and will share some of these insights in the talk. The three most important lessons: get yourself known, get yourself experience, and get yourself published. All of this will take sacrifice, but it's ultimately the only way that you'll make a career working with these beasts.

III. Survey of jobs available in US and in Europe

Megan Stolen and Rachel Witcher, University of Central Florida, Dept. of Biology, Orlando FL 32816, USA

Which kind of jobs are rare/common and at which institutions are they usually available? A survey was conducted to determine areas of employment, degrees held by professionals, salary range, degrees earned and desired, and current research experience. Results will be presented.

IV. Journals: where to Publish?

Sascha Hooker, Department of Biology, Dalhousie University, Halifax, Nova Scotia, Canada, and Colin McLeod, 14 Bocclair Crescent, Bearsden, Glasgow G612AG, UK

Publishing is important to share information, gain feedback and to obtain funding. But what is the most suitable form of publication for your results? Is it a short note or an article? Which journals are best? How should you avoid having a paper rejected and how long can it take until it is published? Costs and benefits of publishing in different types of journals, readership, ease of publication, rejection policy, and charges will be summarized. Peer review, abstracting indexes, and science citation index rankings are considered important by funding agencies. Results of a survey of journals that have published marine mammal-related papers in the last 5 years will be presented. Examples of papers which could have been better placed to reach a wider and more topical readership will be discussed.

V. Sources for attaining literature and examples of available bibliographies

No matter if you are doing an essay for a course or preparing your M.Sc. or Ph.D., a solid bibliography is fundamental but often we can't get hold of it. A few sources for attaining literature and examples of available bibliographies will be provided.

- VI. Academic programs related to marine mammals
Carlos Alvarez, School of Fisheries, University of Washington, Seattle WA 98115, USA

An important step when looking for a study program is to identify potential advisors willing to accept students or suitable programs. This search may be directed by an interest in a particular taxonomic group, a field of research, a particular place or university, etc. In any case a database that has been developed which provides this information is highly valuable to assist in establishing contact with professionals. The main subject areas where possibilities are available, where they are located, the number of opportunities for different levels of study, general information about the people who responded to the survey and some of the opinions that respondents provided as advice to students searching for opportunities will be discussed.

- VII. Student Grantsmanship
David Weller, Marine Mammal Research Program, Texas A&M University at Galveston, 4700 Avenue U, Building #303, Galveston TX 77551, USA

Most of us know how difficult or impossible it is to study without a grant or even, at a later stage, to carry out projects without funding. However not many feel comfortable about writing applications. A conceptual framework for developing grants related to marine mammal research strategies and for identifying potential funding sources will be provided. Particular emphasis will be devoted to outlining a framework for research proposal development. Specific topics will include grant writing basics, idea development, qualities of the "good" proposal, and strategies for locating potential funding sources.

- VIII. Strategies for Pursuing a Career in Marine Mammal Science
Jeanette Thomas, Laboratory of Sensory Biology, Western Illinois University Regional Center, 3561 60th St., Moline IL 61265, USA

Jeanette has studied sensory abilities in marine mammals for the last 20 years, including field and laboratory studies. She emphasizes that there are two words in the career name AMARINE BIOLOGIST. Become a competent BIOLOGIST first, then apply this knowledge towards a MARINE topic. There are no shortcuts; all marine mammalogists need math, science, writing, and computer skills. It is important to remain knowledgeable about terrestrial animal science because there are many applications and theories that can be applied to marine animals. Jeanette will provide some insights into qualities and activities that promote success in the field of marine mammalogy, such as volunteering, publishing, networking, continuing education, and maintaining professional behavior. Sooner or later students must consider ways to join their interest in marine mammals with ways of making money and finding a job. Is marine mammalogy a wise career choice? What opportunities can you expect to find after finishing your degree? How can you be in the right place at the right time? Where should you look for employment? How can you create employment working with marine mammals?

Coffee Break (15:00-15:15)

2. Current comprehensive research programs in Europe and the U.S. (15:15-16:15)

- I. Introduction
Session Chair: Paula Moreno, Pct. Bento Moura, 2-5C, 2810 Laranjeiro, Portugal
- II. Peter Evans, Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, ENGLAND
- III.

In Europe, it has probably been the lack of funding more than anything that has hampered progress in marine mammal science. Locations of major research groups in Europe, educational establishments teaching courses relevant to aspiring marine mammalogists, and the types of jobs

available will be summarized. The possible routes to obtaining positions and types of experience and training needed will be discussed. Peter remarks that, "if you are living in Europe and aspire to be a marine mammalogist, what advice would I give? First, I would say 'Do not give up. Be persistent; it may take a lot of effort but if you really feel this is the career for you, keep at it'. Since jobs specifically in marine mammals are few and far between, and unlikely to become more common in the near future, you should build up a background that enables you to undertake jobs in related fields. A grounding in marine biology at a university is often helpful. Depending upon your particular interest, attaining skills and experience in computer science, statistics, toxicology, environmental management, or education will be important assets for your CV. With so many people competing for a limited number of jobs, personal references count for a great deal, and besides the useful experience it should provide, working voluntarily for a period (in the office/lab or in the field, or both) for a variety of groups is highly recommended. If you are good at what you do, you will be commended by others, and unpaid work will lead to paid work, and with a bit of luck onward into a career".

III. Bernd Wursig, Marine Mammal Research Program, Texas A&M University at Galveston, 4700 Avenue U, Building #303, Galveston TX 77551, USA

Bernd Wursig summarizes the following self-description and advice: "I pretend to know a bit about behavior and behavioral ecology of cetaceans, but my research interests and capabilities are really quite narrow. They involve mainly the way dolphins and whales structure their times in different habitats, and how their daily and nightly patterns may be affected by humans. While my own capabilities have become narrowly focused in the past 25 years, I have (finally; it took a long time) learned that at least for whole animal studies in nature, interdisciplinary research tends to lead to more powerful science. The combined capabilities of researchers -- cooperation among us -- leads to a better understanding of the lives of the animals than if we all act alone. We can -- and should -- "passively" coordinate data from different disciplines by citing each other. We all do this. But, we can also -- and should -- actively integrate "multidisciplinarity" into our research projects so that we draw in expertise from different disciplines for diverse data to be gathered from the same population and set of habitats. That means (for example) combining behavioral and physiological ecology, oceanography, prey studies, toxicology, genetic studies, etc., when you can. Above all, eschew overt competition. It is OK to try to be "the first" to get out an idea or a paper (remember, however, that in science, the long-term truth -- and therefore accolades -- do not necessarily go to the swift, but to the most careful, the most complete, the best). Do not, please, attempt to compete with a research group working on the same animals elsewhere or in the same area by doing the very same work -- often over and over again. Work together, and the whole will become synergistically more valuable. Be a part of this collaborative process when you can, and your frustrations will be lower and your rewards richer."

IV. Discussion with questions raised by participants

3. "Student only" session (16:15-17:00)

I. Student member-at-large: benefits for the societies and for students

The student-member-at-large is a new position for both SMM and ECS. A summary of the various roles and responsibilities, and efforts made over the past two years to increase communication among students who study marine mammals will be provided. With input from workshop participants, we hope to help establish the future role of the student-member-at-large for each society.

II. Communication: E-mail lists, Newsletters and local groups

With workshop participants, we hope to identify methods to achieve goals specified above. Some approaches to be discussed include the development of regional student chapters, task oriented

groups, use of E-mail and web pages, and newsletters. SMM and ECS student meetings will be planned for a later date during the conference.

4. Small group discussions (17:00-18:00)

I. Behavior

Kathryn Ono, University of New England, Hills Beach Road, Biddeford ME 04005, USA

Kathy received her B.A at the University of California at Santa Cruz and her Ph.D. in Zoology at the University of California at Davis. She started studying pinnipeds for her senior thesis under R. Gentry, studied lizards for her Ph.D. under J. Stamps, and did a postdoc at the National Zoo with D. Boness studying California sea lions. Kathy feels that she has been extremely lucky to have such great mentors. Currently faculty at the University of New England, her present research is on the comparative behavior of Steller sea lions in declining and stable populations. She is trying to see if behavioral differences during the breeding season might hint at the causes of decline in this species and is especially interested in prey base and environmental correlates of decline. Kathy points out that marine mammal science includes everything from public information, natural history, to laminar flow and acoustical studies in physics, as well as the development of better radiotags for use on marine mammals. It also includes policy (as long as the policy has some basis in science and biology, and is not purely politics). Her suggestion to aspiring marine mammalogists is to “work hard and be persistent.”

Jim Heimlich-Boran, 32 Birch Road, Manchester M8 5RU, ENGLAND

Jim’s primary research interest is in Social Behavior. He has worked on killer whales and pilot whales and is interested in how the social systems of these species compare to those of other delphinids and also to the societies of large terrestrial mammals. He is interested in methods of determining cetacean abundance using platforms of opportunity. His most important experience was the opportunity to volunteer on Ken Balcomb’s study of killer whales in 1976. He had no direct interest in cetaceans at that point and was an undergraduate studying general field biology. This background in terrestrial methods has always been useful and more of it is needed in marine mammal studies. After this initial start, his main momentum has come through perseverance in situations where financial gain was not the main reward. All students know the need to balance educational training in theory and methodology with actual practice in the field. Commitment to studies in marine mammalogy primarily requires a driving interest in adding to the knowledge of the animals with financial gain and job security taking secondary importance. Students also need to be realistic in understanding that a career in marine mammalogy does not entail endless days in close contact with smiling, cuddly dolphins. There are many more days in front of a computer in a small, dark room.

Jim Darling, West Coast Whale Research, 1200-925 W. Georgia St., Vancouver BC V63-3L2, CANADA

Jim did his M.Sc work at the University of Victoria overseen by Michael Bigg and Roger Payne, and his Ph.D. at University of California Santa Cruz with Ken Norris. Jim is primarily interested in the social organization, behavior and ecology of mysticetes, particularly humpback and gray whales. Based out of Vancouver he has worked in the Pacific northwest, Hawaii, Japan and Alaska. His current studies include the investigation of the humpback song in Hawaii, the ecology of gray whales off Vancouver Island, and recently, the abundance and behavior of humpbacks in French Polynesia.

Randy Wells, Chicago Zoological Society, C/O Mote Marine Laboratory, 1600 Thompson Parkway, Sarasota FL 34236, USA

Randy Wells entered the field of marine mammal biology in 1970 as a high school volunteer, and 28 years later he finds himself studying the behavior, ecology, population biology, and health of the same community of bottlenose dolphins near Sarasota, Florida. Some have suggested that this focus is the result of a lack of initiative, but Wells prefers to think that the ability to study four generations of

recognizable resident dolphins of known sex, age, and genetic relationships provides hypothesis testing opportunities that are rarely available for cetaceans. Wells did his undergraduate work in Zoology at the University of South Florida, received a Masters in Zoology from the University of Florida, and obtained his Ph.D. in Biology under Ken Norris at the University of California, Santa Cruz. He currently holds a full-time position as a Conservation Biologist with the Chicago Zoological Society, based at Mote Marine Laboratory in Sarasota, where he also serves as Marine Mammal Program Manager. As an Adjunct Associate Professor, Wells sponsors graduate students through UCSC. Wells recommends that students interested in marine mammal science become solid scientists first before developing a marine mammal emphasis. He advises students to focus on marine mammals: 1) if they can do work that is of benefit to the animals and their populations, 2) if the animals can serve as the most appropriate subjects for research of broader scientific/theoretical interest, as long as it does not negatively impact the animals, and 3) with the expectation that the work will likely be a labor of love requiring much dedication, rather than one with substantial financial rewards.

Phil Clapham, Northeast Fisheries Science Center, Woods Hole MA 02543, USA

Although Phil has undertaken a great deal of work in basic population biology, his first love is behavioral ecology. In particular, he is interested in comparative studies that attempt to understand the behavior, social organization and mating systems of large whales from the viewpoint of evolutionary ecology. He is a big believer in multi-disciplinary approaches to the study of whales, integrating information and methods from fields as diverse as genetics, ethology and oceanography to address research issues. Phil's main advice to potential students of marine mammal behavior would be: (i) think broadly; (ii) read widely outside the marine mammal field - there is a huge volume of literature on other (easier-to-study) terrestrial taxa, and interpreting marine mammal behavior without considering this is often just reinventing the wheel; (iii) use whatever methods and techniques you need from other fields, and establish collaborations that bring in wider expertise; and, (iv) avoid the fluffy stuff. His advice on getting ahead in marine mammal science will be given in his talk on this subject earlier in the afternoon.

II. Conservation/management

Greg Donovan, International Whaling Commission, The Red House, Station Road, Histon, Cambridge CB4 4NP, ENGLAND

Greg will discuss the problems of being a scientist who must provide practical advice to managers/politicians. A major difficulty in working on the conservation of "popular" species such as marine mammals ("charismatic megafauna" as they have been sometimes defined) is that it is very difficult not to be sucked into areas that are outside your scientific expertise (e.g. questions of ethics and philosophy). To some extent this requires a decision as to whether conservation applies to a population or to an individual. It is important to remember that as a scientist, your views are worth no more or no less than anyone else's on such matters. The important thing to try to do is to produce the best scientific advice that you can to allow managers to make rational decisions and to admit where there is uncertainty in scientific knowledge. This should not be coloured by your own personal view of the ethics or philosophical aspects of a particular issue. It is also important to help managers put problems in a true conservation perspective, not merely one that follows public interest as perhaps defined by the media or one's own research interest. This is not always easy. The level of interest politicians or managers might wish to show in a problem may be inversely related to the financial impact on their country of taking appropriate action rather than the conservation needs of the population. It is considerably easier to be "green" about issues where other countries have to take action or make concessions, than about problems that your own country must act on, irrespective of the true conservation impact of the problems themselves. Case studies we might look at concern the management of direct exploitation and the management of "incidental" exploitation (e.g. bycatch).

Randy Reeves, 27 Chandler Lane, Hudson QC J0P 1H0, CANADA

Randy will discuss the following: "Uncompromised science is essential to conservation. It is possible, but not easy, for a scientist to maintain a rigorous "search for truth" while participating in conservation advocacy. The distinction between science and advocacy is nevertheless important to maintain. One problem that arises repeatedly, but is often ducked or avoided, is how one defines "conservation". The question of what conservation means, to an individual or a group, needs to be addressed in a forthright manner. The objectives of any conservation plan, framework, or gesture need to be made explicit and evaluated against one's definition of "conservation". Marine mammal science, regardless of how obtuse or esoteric it may seem in one context, is very often invoked in another context to support or challenge policy decisions, which are necessarily political. Some discussion ideas include: How does one evaluate research approaches that have the potential of harming individual animals but benefiting species or population conservation (e.g., capture, mark/tag, release programs)? Does, or can, captive breeding play a role in the conservation of marine mammals?"

Donald Siniff, Ecology, Evolution & Behavior Dept., 100 Ecology, University of Minnesota, 1987 Upper Buford Circle, St. Paul MN 55108 USA

Don Siniff received his B.S. in Fisheries and Wildlife and his M.S. in Statistics from Michigan State University. Following that he spent time in the Air Force as a Navigator/Electronics Countermeasures officer, followed by three years with the Alaska Department of Fish and Game as a Biometrician in the Research Division. Don remarks that this was a great position as he dealt with commercial fisheries, sport fish and game problems. After three years he was advised by his associates to get a Ph.D. and went to Minnesota, where he received his degree in Fisheries and Wildlife. Shortly after that he went to the Antarctic, started studying seals, and has continued in the marine mammal world ever since. He served as an advisor to the Marine Mammal Commission and then as Commissioner (about 1972 to 1984). He has served on recovery teams and several other advisory committees dealing with marine mammal issues. Don notes that the problem of "ignorance versus action" is always a tough one when it comes to formulating a marine mammal policy.

III. Ecology

Peter Evans, Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, ENGLAND

Peter Evans will discuss the following advice and research interests: "I suppose I am rather an "odd-ball" in the field of marine mammal science. I came into it from marine ornithology, and continue to dabble with research in widely disparate subject areas outside marine mammals - rainforest conservation biology, starling and badger population genetics, and seabird and parrot ecology for example. I wouldn't necessarily recommend this approach. It keeps me out of mischief and my brain has to stay awake to grasp a range of issues, but it means that one becomes at most a jack of all trades and most definitely a master of none. Particularly in these days of burgeoning literature, one simply cannot remain on top of more than a few fairly narrow subject areas at one time. On the other hand, it has highlighted for me the need to incorporate other disciplines into ones research, and if that takes us to subjects beyond our own ready grasp, then we should collaborate with others more expert in those fields." Peter's marine mammal research interests have followed a similar trend to those he has in other disciplines - from more theoretical biological issues (population genetics, evolutionary and behavioural ecology) to looking for practical ways in which these could be used to better understand conservation problems facing marine animals particularly whales, dolphins (and seabirds). Put more precisely, it is to gain a better understanding of how cetacean individuals and populations make use of particular habitats, and the influences of other factors such as changes in food supply from fishing, or the introduction of sounds from industrial, commercial or recreational activities. At a time when humans increasingly need to intervene to manage wild animal populations following disruptions caused by other human activities, it is important to develop a solid scientific basis behind ones management decisions. This frequently requires careful empirical observation, experimentation where possible to test alternative hypotheses, and a statistical treatment of results. Marine mammals are not the easiest creatures to study in the wild, and to achieve the above often requires ingenuity and a fair amount of resources.

Christina Lockyer, Department of Marine Fisheries, Danish Institute for Fisheries Research, Charlottenlund Slot, DK-2920 Charlottenlund, DENMARK

Christina's primary research interests are in cetacean natural history, population biology, ecology and energetics. She is particularly interested in life history, age determination and reproduction. She suggests to students to gain relevant work experience before graduation, to be willing to be mobile to get the ideal job, and to make contact with people in their field of interest.

Glenn VanBlaricom, Washington Cooperative Fish and Wildlife Research Unit, Biological Resources Division, U.S. Geological Survey, School of Fisheries, Box 357980, University of Washington, Seattle WA 98195, USA

Glenn received B.S degrees in Zoology and Oceanography from the University of Washington and a Ph.D in biological oceanography from the Scripps Institution of Oceanography. He did undergraduate research on the efficiency of zooplankton sampling devices before becoming interested in coastal benthic ecosystem dynamics as a graduate student. His primary research interests are the community ecology of sea otters, the population ecology of marine mammals, marine mammal - fishery interactions, and the effects of disturbances, both natural and anthropogenic, on marine wildlife and their ecosystems. Given that employment opportunities in marine mammal science are few, with no evidence of significant change in the foreseeable future, Glenn offers several points of advice to students seeking a competitive edge. First, emphasis on the fundamentals of biological and environmental science is a crucial element of preparation. Familiarity with the principles of Physics, Chemistry, Mathematics, Genetics and molecular biology, and Statistics is essential. Second, knowledge of the ocean is vitally important. Students should become educated about waves, tides, currents, patterns and causes of primary and secondary productivity, and the major taxa of flora and fauna that live in the sea. Third, students should be comfortable with computers, data management skills, and contemporary software. Fourth, students should focus on a conceptual discipline rather than a taxon or taxa of marine mammals. Experts in population assessment or physiology or paleobiology will get available jobs before experts in killer whales or dugongs. Fifth, students must have a "B" plan when developing their careers. Students whose training focuses on marine mammals will not necessarily find work in marine mammal science. Conversely, students trained in other subdisciplines may find themselves working in marine mammal science. Glenn is an example of the latter. A well-developed "B" plan may save one's career in biological science, given the extraordinary demand for positions in marine mammal science. For example, a student well-trained in bioacoustics may be able to work as productively, with as many rewards, on the biology of bats as on the biology of belugas. Sixth and finally, students must exploit the multiple avenues for cultivating contacts with professionals in the field. Those unwilling to develop contacts by volunteering, accepting poorly-paying jobs, or embracing apparently menial elements of research work are reducing the odds of entry to the field as working professionals. The same is true for those unwilling to attend conferences and present data and ideas to other students and professionals. Glenn suggests a final note - marine mammal science is not the road to material wealth. The compensation is the privilege of doing the work.

IV. Acoustics

Jeanette Thomas, Western Illinois University/RIRUC, 6502 34th Avenue, Moline IL 61265, USA

Jeanette will address the following topics during the acoustics discussion (additional information is provided above):

1. Importance of working with an electrical engineer,
2. Importance of knowing the frequency response, gain, and impedance of individual pieces of equipment and the resulting frequency response, gain, and impedance of the whole equipment system.
3. Importance of understanding your analysis system--using known frequency/amplitude/time signals to ensure that analysis is accurate and doing what you expect.
4. Using calibration tones on recordings.
5. Narrating recordings on a second channel, not with data.
6. When examining the sounds produced by a species, knowing it's hearing range and sensitivity.

7. Examining sound characteristics relative to the amount of ambient noise. Does frequency or time relationships change with ambient noise?
8. Good books-The Sonar of Dolphins, Whit Au and Marine Mammals and Noise-Richardson et al.
9. Analyzing a variety of sounds, mechanical noise, birds, fish, amphibians, terrestrial mammals, human voice, wind, rain, etc. to know how the signal looks in all 3 forms of analysis.
10. Understanding when and on what types of signals to use spectrogram, oscillogram or power spectrum analysis.

Jeanette also suggests the following URLs related to acoustics: Acoustics and You (A Career in Acoustics?) by the Acoustical Society of America (http://asa.aip.org/acou_and_you.html); International Bio-acoustics Council; (<http://www.unipv.it/~webcib/xviiibac.html>); Animal Bioacoustics by the Acoustical Society of America (<http://www.mbari.org/~dave/ASA/index.html>); and Careers in Bioacoustics by the Acoustical Society of America (<http://www.mbari.org/~dave/ASA/index.html>).

Jonathan Gordon, Wildlife Conservation Research Unit, Dept. of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, ENGLAND

For the last ten years, Jonathan's main job has been running a modest motor sailing boat, "Song of the Whale", as a research vessel for the International Fund for Animal Welfare (IFAW). For about six years prior much of his research activity had involved using small ocean-going sailing vessels as research platforms. Although most of his work is funded by IFAW, he maintains an association with the Wildlife Conservation Research Unit in the Zoology Department of the University of Oxford. Jonathan describes this work, "though by no means an acoustician, I have become increasingly interested in under water acoustics, particularly how acoustic techniques can be used in practical conservation research. I believe that the acoustic modality is a most important one both for marine mammals and for marine mammal biologists. A hydrophone should be considered an essential piece of field equipment, and provided one's research is concerned more with an animal's behavior than with the precise acoustic characteristics of particular sounds, a great deal of useful work can now be done with relatively simple and inexpensive equipment. My advise to students contemplating a career in marine mammal research is that they will probably earn more money, make better progress and have an easier life if they pursue a more popular, better supported and mainstream branch of biology. However, I always offer this gloomy counsel in the hope that the best and most determined students will not be discouraged and, aware of the likely future frustrations, will none the less pursue this fascinating field of research".

David Goodson, Chief Experimental Officer, Underwater Acoustics Group - Bioacoustics & Sonar, Electronic & Electrical Engineering Department, Loughborough University, Ashby Road, Loughborough, Leicestershire LE11 3TU, ENGLAND.

Dave is an electronic and acoustic signal processing engineer in the Underwater Acoustics Group and Loughborough University with some 21 years of research experience primarily in underwater sonar systems design and including some 12 years research involving signal processing aspects of bio-sonar systems. 'Bio' related work includes analysis and interpretation of biosonar signals and the development and testing of effective cetacean deterrent hardware for commercial fishing gear and the development of new cetacean tracking and recording techniques for use at sea. As to the choices/events that involved Dave in marine mammal research, he credits one solitary wild dolphin that approached him while swimming in the sea off Wales - so close that he could hear its sonar operating. That event triggered his professional interest as a sonar engineer. Soon after the encounter Dave met a biologist who wanted to understand the acoustics involved in dolphin communication and a 'lipid' chemist who was fascinated by the complexity of the unusual fatty tissues comprising the dolphin's acoustic 'lens'. The results analyzed from the short field study that they subsequently carried out in 1987 were eventually published in 'Aquatic Mammals'.

Dave welcomes visiting research students (self funded) wishing to be involved in bioacoustics at Loughborough for a few months 'study experience', although very limited places are available. Applicants need to be at least 'Diplomarbeit' or 'Masters' degree standard. Preferred applicants will

have some background knowledge of physics/computing as well as knowledge of biology/acoustics. Applicants wishing to register to study for a higher degree, M.Sc. or Ph.D., must also meet the University's qualification requirements. Dave plans to discuss approaches to studying underwater cetacean behavior using acoustics. Dave's best advice to students wanting to make a career in 'Marine Mammalogy' is "Don't all rush at once! There are not enough jobs for you all and you will find it very difficult to progress with all the competition without some other expertise. The alternative route is to first pursue a professional career in some (preferably financially rewarding) discipline that might have some relevance to Marine mammal studies, e.g. acoustics (but it could be anything from toxicology to psychology). Then later look for ways to offer your expertise in the context of marine mammal research (and try to be in the right place at the right time). Solutions to complex environmental problems require cross-discipline studies carried out by 'experts' from different disciplines who can communicate and work together".

V. Genetics/Evolution

Rus Hoelzel, Department of Biological Sciences, Durham University, South Road, Durham DH1 3LE, ENGLAND.

Rus received his BA in Biology in 1980 at Reed College in Portland, Oregon, USA, his M.S in Evolutionary Biology in 1984 at the University of Sussex in Brighton, England, and his Ph.D. in Genetics 1989 at the University of Cambridge in England. He first became interested in marine mammals in high school and continued that interest with an undergraduate project on killer whale acoustic behavior, and through volunteer work in the San Juan Islands on minke whale and killer whale population biology. He became involved in population genetic work during his Ph.D. studies and now focuses on the molecular ecology of marine mammals and on the evolution of gene systems in vertebrate species. He is especially interested in the mechanisms responsible for the generation of population genetic structure. Russ remarks that there is still much to learn about marine mammal population and evolutionary genetics, and some important conservation issues, but so far not all that much funding. So, for someone starting in this field, it is important that they are keen enough to persevere and creative enough to make their own opportunities when possible.

Per Palsbol, Department of Ecology & Evolutionary Biology, University of California, Irvine, 321 Steinhauss Hall, Irvine CA 92717-2525 USA.

Per's primary research interest is in molecular ecology and population genetics of cetacean populations. He did his M.Sc. in Molecular Population Genetics (Minke whales), his Ph.D. in Evolutionary Genetics (Baleen and toothed whales), and has held Postdoctoral fellowships at the University of Copenhagen (Molecular analyses) and at University of California, Irvine (Data analysis and theoretical population genetic at Dick Hudson's lab). He suggests to students to make sure what aspects of the work that you like and focus on those. It's going to take a lot of work to actually make a career in this field (irrespective of whether it is behavior, genetics, field work, etc.) and the only way to be able to invest the effort that it takes is if you like it too. It is a very rewarding field, however, because of a nice mix of field and deskwork. In his experience many students have an erroneous perception of what kind of work molecular genetic work entails, and hence often become disappointed and eventually drop out. Many people think it is 'fast & easy' work, where the truth more likely is many long, lonely and frustrating hours in the lab. In addition, as matters are evolving today, the 'new' generation will have to conduct far more extensive studies (analyze more samples and more DNA) to publish their work. Finally, cetacean genetics are governed by a lot of territoriality which may cause 'newcomers' to become thrown off if the wrong approach is taken, so a little insight into that unpleasant aspect will be provided.

VI. Population Dynamics

Douglas DeMaster, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 7600 Sand Point Way, Seattle WA 98115, USA

Doug's background is in population dynamics and quantitative ecology. He has worked as an applied research biologist since getting his Ph.D. in 1978. Since then he has worked with providing managers with the current information they need for setting quotas or incidental catch limits. He is currently in charge of the Cetacean Assessment and Ecology Program at the National Marine Mammal Laboratory. He suggests that "there are a number of sources of information that you should be familiar with (e.g., article by DeMaster and Klinger on getting into graduate school published in recent Marine Mammal Newsletter) that will help with your search for graduate training or a permanent job. At this point, the job opportunities working on marine mammals are relatively few in number. Therefore, graduate school is an excellent way to establish yourself in the community and make the necessary contacts to find a job with a Master's degree or Ph.D. In any event, my experience has been that potential employers don't want to hear that you 'want to work on marine mammals'; rather they want to hear what discipline you are interested in basing your career on, and the extent to which you are willing to take entry level jobs to demonstrate your abilities." He plans to discuss 1) the importance of experimental design, 2) why should one learn to program, and 3) what is the difference between collecting data and doing research?

Anne York, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, 7600 Sand Point Way, Seattle WA 98115 USA,

Anne received her BS in Mathematics at the University of New Mexico, her MS in Mathematics at the University of Iowa, and her MS in Biomathematics at the University of Washington. Anne's experiences are diverse: she has taught mathematics as a Peace Corps volunteer in Colombia, taught high school in New Mexico, and taught at a small college in Maryland. Anne became interested in biology and applications of mathematics to biology while teaching in Maryland and came to Washington to study statistics and biomathematics. Her current research interests are in population biology, modeling, and statistics. Anne's advice to students is to "Have fun. If you don't like what you're doing, don't make a career out of it. Learn to work effectively in a group-- most major projects on marine mammals involve a lot of people and to be successful, you must know how to deal with many different types of people from various disciplines. If you don't like statistics and population biology, at least learn enough to be able to understand the statistician that you hire".

VII. Physiology/Anatomy

John Reynolds, Marine Sciences & Biology Departments, Eckerd College, 4200 54th Ave S., St. Petersburg FL 33711, USA

John Reynolds received a BA in Biology from Western Maryland College, and his MS and Ph.D. from University of Miami's Rosenstil School of Marine and Atmospheric Science. His research has involved gross and microscopic anatomy, behavioral ecology, population biology, and immunology of manatees and bottlenose dolphins. In addition to his research, he has served as Chairman of the U.S. Marine Mammal Commission since 1991; this position has caused him to become involved with policy. John is currently a Professor of Marine Science and Biology at Eckerd College a Visiting Professor at the Duke University Marine Laboratory, an Adjunct Professor at University of South Florida, and the Chairman of the Marine Mammal Commission. He supervises about a half dozen undergraduate students in research each year. He encourages students to prepare themselves by becoming first-rate biologists (or molecular biologists, or biochemists). Once students acquire the fundamental skills and knowledge associated with their discipline, they are well prepared to address research questions involving marine mammals.

Terrie Williams, Department of Biology, EMS Building, University of California, Santa Cruz, Santa Cruz CA 95604, USA

Terry graduated from Rutgers University in 1981 with a Ph.D. in Physiology, and did a post-doc with Gerry Kooyman at Scripps Institution of Oceanography. Subsequently, she has worked at the San Diego Zoo, as a Program Manager for the Office of Naval Research Marine Mammal Program, Director of the Valdez Sea Otter Rescue Center during the spill, and in Hawaii on the diving and

swimming energetics of Dolphins. Currently, Terrie is a Professor of Biology at UCSC. Her advice for students is to remain flexible in their day to day work, but determined in their ultimate goals; "There are a wide variety of jobs (I've worked with industry, academia, the government and for private foundations). It has been rewarding but the sacrifice was stability. In the end I was able to do exactly what I set out to do research on an exciting group of large mammals".

VIII. Medicine/Disease/toxicology

Antonio Raga, Department of Animal Biology, Faculty of Biological Sciences, University of Valencia, Dr. Moliner 50, E-46100 Burjasot, Valencia, SPAIN

Toni's main research interest is the parasitology of marine mammals. He received his MS and Ph.D. from the University of Valencia, Spain, and has held postdoctoral fellowships at the Natural History Museum of Paris and the California State University at Long Beach. He is currently a Professor of Animal Biology at the University of Valencia, and a member of the European Cetacean Society Board and several scientific institutions. Toni is especially interested in the development of educational programs on marine mammals. He was the head of, and organized the "Second European Seminar on Marine Mammals: Biology and Conservation" under the auspices of the Menendez Pelayo International University. He has supervised 4 Ph.D. and 12 MS students. He encourages his students to acquire a solid basic education, including statistic and molecular techniques, to know how to choose the research team where they wish to be educated and to develop their ability to obtain funding for their projects.

Ursula Siebert, Forschungs-und Technologiezentrum Westküste, University of Kiel, Werftstr. 6, D-25761 Büsum, GERMANY

IX. Survey Techniques/Statistics

Phil Hammond: Sea Mammal Research Unit, Gatty Marine Lab, University of St. Andrews, Fife KY16 8LB, ENGLAND

Phil has been working on the problems of estimating marine mammal population parameters since 1979. He worked at the Inter-American Tropical Tuna Commission in California before moving to the Sea Mammal Research Unit in the UK. SMRU has recently become part of the University of St. Andrews and he now combines research with teaching, including a first year Quantitative Methods in Biology course. He says: 'I did my PhD on insect population dynamics, and then applied for about 20 jobs: 3 marine mammal and/or fishery-related and 17 others. Result - interviews for the three marine jobs, none for the others. This was a few years ago but the message is the same today: the marine biological sciences need people with a sound quantitative (mathematical and statistical) background. Biology is still viewed as the least quantitative of the natural sciences. Whilst there are plenty of areas where the theoretical background is not particularly quantitative, collection and analysis of data is a quantitative business. You don't have to be a mathematician or a statistician to be a biologist but it is increasingly difficult to be a competent marine biologist without a quantitative background. But it is important to remember that methods of collecting data (surveys, photo-id) are a means to an end, not an end in themselves'.

Jay Barlow: Southwest Fisheries Science Center, National Marine Fisheries Service, PO Box 271, La Jolla CA 92038, USA

Jay conducts research on marine mammal abundance estimation, population dynamics, and management. His work typically involves 1-2 months of fieldwork each year and 10-11 months of office work (data analysis, modeling, and writing papers). Most of his work takes place in California, but various research projects have also taken him to Mexico, Colombia, and New Zealand. He started working on marine mammals AFTER completing a PhD in biological oceanography at Scripps Institution. Many of the skills needed to work on marine mammals can be learned (often faster and more effectively) while working on terrestrial mammals or birds. The only "growth area" that he

foresees for jobs in marine mammal science are for those trained in quantitative aspects of abundance estimation and population dynamics.

Tim Gerrodette: National Oceanic & Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, PO Box 271, La Jolla CA 92038, USA

Tim became interested in marine mammal population dynamics as a graduate student at Scripps Institution of Oceanography while studying coral dynamics. His current research interests also include population estimation and decision theory. His advice to aspiring marine mammalogists is to “get the most quantitative background you possibly can”.