SeaBASS 2012: A Marine BioAcoustics Summer School

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LONG-TERM GOALS

The goal of the SeaBASS (Marine BioAcoustics Summer School) was to provide the opportunity for graduate students interested in pursuing careers in marine bioacoustics to develop a strong foundation of both marine animal biology and acoustics, foster technical communication across disciplines, and develop professional relationships within the field. This gave students an opportunity to learn from experts who discussed topics not often offered at universities due to the relatively small demand at any one institution.

OBJECTIVES

1. To provide fundamental concepts of underwater sound and marine animal biology and behavior to graduate students interested in pursuing careers in marine bioacoustics.
2. To create an environment for the open exchange of ideas related to careers, current hot topics and challenges facing the field of marine bioacoustics.
3. To foster professional relationships between graduate students and experts in the field.

APPROACH

SeaBASS was structured after the successful PASS (Physical Acoustics Summer Session) that has been offered in alternate years for over two decades. SeaBASS was designed to support 30 graduate students and 10 expert lecturers. A week long curriculm was created where invited lecturers within the field of marine animal bioacoustics (academic, private, and management) provided half day seminars that described fundamental aspects of underwater sound and marine animal behavior, summarized the present state of the field, identified current obstacles and challenges, and discussed important "hot topics" areas (Table 1). Each seminar included an introductory lecture followed by group discussions or group projects to gain a more in-depth understanding of the issues and technology. Structured social activities also allowed for students and presenters to interact informally to develop lasting professional mentorships for guiding the next generation of marine bioacoustics scientists.

SeaBASS was hosted by the Applied Research Laboratory at The Pennsylvania State University. The week long summer session took place June 17-22, 2012 at the Penn Stater Conference Center in State College, PA. Selection of student participants was through an open application process. The application process was online (http://www.arl.psu.edu/education_seabass.php), and preference was given to US citizens.

ONR funds contributed support for Room and Board fees for all participants, conference facility fees, and travel grants to graduate student applicants based upon need and qualifications. Twenty three travel grants were awarded to defray costs of graduate student travel. Invited lecturers provided their time at no cost. Additional sponsors of the SeaBASS program included the Applied Research Laboratory at Penn State, the National Oceanic and Atmospheric Administration (NOAA), Bureau of Ocean Energy Management (BOEM), and the Acoustical Society of America (ASA).

Table 1. SeaBASS 2012 schedule, topics, and presenters.

	Sunday June 17	**Monday June 18**	**Tuesday June 19**	**Wednesday June 20**	**Thursday June 21**	**Friday June 22**
7:00-8:00		Breakfast and Welcome by E. Liszka of ARL	Breakfast	Breakfast	Breakfast	Breakfast
8:00-12:00		**A. Frankel** *Introduction to Acoustics & Propagation*	**M. Hastings** *Hearing*	**S. Parks** *Effects of noise on marine mammal behavior*	**H. Klinck** *Passive Acoustic Monitoring - marine mammals*	**P. Nachtigall** *Echolocation*
12:00-13:00	Registration opens at 16:00	Lunch	Lunch	Lunch	Lunch	Lunch and closing remarks
13:00-17:00	Software Installation workshop (16:00- 20:00)	**S. Van Parijs** *Acoustic Behavior and Communication*	**D. Houser** *Marine Mammal Biology & Physiology*	**R. Gentry** *Hot Topic: Noise* ------ *CareerPanels*	**J. Luskovich** *Passive Acoustic Monitoring – fish & invertebrates*	**J. Warren** *Active Acoustics*
18:00-19:30	Dinner	Dinner	Dinner	Dinner	Dinner	Closing Dinner
19:30-22:00	Participant Introductions and Social	Poster Session and Social	Spikes Baseball game	Informal Career Discussions	Evening in Downtown State College	

WORK COMPLETED

SeaBASS 2012 took place at the Penn Stater Conference Center in State College, PA from 17-22 June, 2010. Thirty-one graduate student applicants were admitted to the program from 64 eligible applications. A total of 5 applications and 13 informal inquiries were declined because they did not meet the course application and eligibility requirements:

- GPA 3.0 or higher during previous 2 years of study
- Currently enrolled in a Graduate program
- Personal Statement

Applications were received from graduate students in 13 countries, and course attendees were accepted from six different countries (USA & Puerto Rico, Italy, United Kingdom, Greece, Canada, and Austria). Advertising for SeaBASS was published in the October issue of Acoustics Today 2011. Information on SeaBASS was also been distributed on the MARMAM and ASA Bioacoustics listservs. Informational flyers were distributed at Acoustical Society of America meetings, 5th International Workshop on Detection, Classification, Localization, and Density Estimation of Marine Mammals using Passive Acoustic (Mt. Hood, 2011), American Fisheries Society meeting, and other appropriate society meetings.

The SeaBASS curriculum included a general introduction to underwater sound, 8 specialized marine bioacoustics topics, and a "Hot Topics" session on the effects of sound on marine animals (Table 1). Invited speakers presented material in half-day sessions that included a traditional lecture covering fundamental topic concepts and an interactive activity consisting of analysis software demonstration and problem solving, experimental design exercises, group discussion, and a human echolocation exercise. Monday evening each student was given the opportunity to present a poster on their graduate research topic, methods, progress, or challenges. This gave students an opportunity to receive project feedback from peers and presenters. An informal career discussion took place mid-week where each invited presenter summarized their education and career path. Presenters openly shared personal experiences on issues not publically discussed in the field including family/career sacrifices, teaching vs research vs management pros/cons, value of post-doctoral experience, etc. Following the career synopses, students selected topics for additional round table discussions that consisted of family/career balance, challenges in a teaching career, pursuing post-doctoral positions, and obtaining funding. Social activities provided the opportunity for informal interactions in the evening.

Abstract books were presented to each participant at registration and included course schedule, participant directory, lecture slides for select topics, group activity information, and suggested readings. Prior to the official opening of the SeaBASS program on Monday morning, students were able to download and become acquainted with software to be used in lectures and activities throughout the week.

RESULTS

A summary of the SeaBASS 2012 program is available to the public at http://www.arl.psu.edu/education_seabass.php. The site has a summary document for download that contains topic outlines, particiapnt and presenter list, and suggested readings for background information. SeaBASS participants were given the opportunity to formally evaluate the course through

anonymous, online evaluation forms. Twenty-eight evaluation forms were returned. Table 2 summarizes the overwhelming positive response.

Table 2. Summary of online evaluation questions and responses

1. What was your favorite topic lecture and why?

- They were all good - I especially like the full day on Passive Acoustic Monitoring, because it exactly met some things that I need to do, but I also especially enjoyed Dr. Warren's and Dr. Houser's lectures
- Overview of marine mammal physiology and relative importance of sound. Clear linkage between the different species and complexity of data interpretation.
- The lecture given by Dr. Natchigall on echolocation because I am very interested in how dolphins use this ability to explore their environment.
- My favorite topic was the Fish and Marine Mammal hearing because I now have a better understanding of how fish and marine mammals hear and sense sound in the ocean.

  Passive acoustic monitoring. I'd say probably because I'm a geek that loves to see how researchers are using technology to monitor these animals.
- I liked the first lecture because it gave a really good basic overview.
- I took alot of valuable information away form Susan Parks and Sofie Van Parijs lectures on the interaction between acoustics and animal behavior. These lectures effectively connected the acoustic theory with it resulting affects on the organisms. I also enjoyed Joe Warrens lecture on Active Acoustic monitoring. It presented a field that I was unfamiliar with could be useful for my research in the future.
- I enjoyed both the introductory lecture by Adam Frankel and the PAM lecture by Holger Klinck; as they both clarified the correct usage of a number of commonly used acoustic terms that I have heard used in many different ways. I also really enjoyed Joe Luczkovich's lecture on fish acoustics as it introduced a whole new topic to me (I'm normally so focused on cetaceans!), which I found very interesting. All in all, a very mind opening experience.
- Susan Parks' noise lecture. Sofie's stood out, too. These were directly applicable to my thesis topic.
- Active Acoustics
- I thought Dorian Houser and Paul Nachtigall had very interesting topics as well as the most engaging lectures. That being said, I was most interested in learning about the topic covered by Adam Frankel.
- I felt Nachtigall's history of marine mammal study was very useful. We tend to compartmentalize as specialists in our own particular fields of study, so it's nice to go back and see how closely related our work really is. I find it quite unifying.
- Effects of noise on marine mammals because it most directly relates to my area of focus.
- Active Acoustics. It was an area of acoustics that I did not know as much about, very informative. I also enjoined Joe L's fish lecture as that was all new information, also very informative.

- I really enjoyed all the lectures but if I have to choose one I would say that the Passive acoustic Monitoring has been my favorite because it was presented very clearly and would give us a lot of practical information relative to the experimental set up that will be very useful for my research
- Dorian's lecture because he was one of the better lecturers; he brought up some things I didn't know and presented them really clearly. It was also one of the most useful parts for my research.
- Susan Parks - very relevant to my research and interests.
- The lecture by Adam Frankel on sound and sound propagation was probably the most useful for me, since I haven't had many opportunities to learn those fundamental concepts that are so important to every application of bioacoustics.
- Susan Park's discussion of the impacts of acoustics on behavior because it is what I study and is the most applicable topic
- What an incredibly difficult choice! I got something out of every lecture. Since there was so much good and varied information in all the lectures, I would have to give it to Paul for his storytelling.
- Paul Nachtigall's lecture on echolocation was my favorite because I like to know about the giants whose shoulders we are all standing on, and because the activity was a lot of fun.
- That's hard to say. I really liked Holgers presentation because it seemed pertinent to my area of research, however, the biologically focused presentations also taught me a lot as well. It was a good balance to me.
- Holger Kinck's - PAM. Because it was very relevant to me, and was practical.
- I had a few favorites. The first lecture about sound propagation was an excellent introduction and also had a good level of depth. Although I wished we touched a bit deeper on some of the topics. I also enjoyed Susan's talk because it helped me think about many important things on my research topic.

2. What was your favorite hands on or group activity (or activities)? Why?

- Working hands on with the software that I need to use for my future research.
- The passive acoustic monitoring on Thursday afternoon was GREAT. and, we have all the instructions printed out so we can keep working on it at home. It would have been nice to know in advance that MatLab would be helpful! Because the logistics were difficult. But the idea was great.
- Recording and analysis of sound using off the shelf software products.
- All of the computer programs stuff. I have had very limited exposure to this and it was most helpful to have experts on hand to help with any issues I may of been having.
- I liked the echolocation activity. It was a good illustration without needing previous knowledge of a software program.
- I have to say the career paths panel discussion. It helped a lot to see that an uncertain path is not necessarily a bad thing and learning from the experience of others will help a lot.

- The echolocation demo by Dr. Nachtigall. It helped me conceptualize echolocation like I never had before and made me think about it from a totally new perspective.
- I enjoyed Joe Warrens activity on active acoustics. It was smoothly delivered and effectively demonstrated how active acoustics can be utilized to address questions in marine ecology.
- I enjoyed the majority of activities as it was helpful to learn how to use new software. I particularly enjoyed Sofie Van Parijs' conservation through acoustics activity - seeing the wider application of the method was thought provoking and exciting.
- The propagation modeling software, and Osprey (learned new aspects even after having used it awhile! very exciting!)
- Echolocation exercise. It was funny and interesting.
- I enjoyed the activities using Raven and Ishmael because I felt like I was learning something that I could really apply. It would have been nice to also practice using some common types of acoustic equipment (e.g. sound level meters).
- I needed experience with computer modeling and programming. I know it can be a bit tedious for those with a great deal of experience, but it was actually the most useful thing we did in my opinion.
- I really enjoyed the echolocation activity because it gave us a chance to get a feel for what the marine species go through. I also really enjoyed Susan's activity (masking conversations) because again it was sort of simulating something marine species encounter.
- The echolocation activity was fun, but the raven and ishmael tutorials were the most useful as I learned some new aspects of those programs I was unfamiliar with.
- I really enjoyed the echolocation and noise activity which I found very entertaining and they both made us get into the place of the animals and become a bit more conscious of their perception of the environment. Also, the rest of the activities were very useful because I got some experience on how to use tools (Ismael, MMPE, Raven) that I need for my data analysis
- I liked the echolocating activity because I didn't know that we'd be able to do that.
- I liked Holger's lesson on Ishmael - it was described in a way easy to follow and useful to understand to use again.
- I enjoyed the activities associated with Susan Parks' and Holger Klinck's lectures, since they are relevant to my interests and provided good practice with sound analysis software. And Paul Nachtigall's echolocation activity was just fun!
- Joe Warren's calculation of the density of krill patches because it involved calculations that were difficult but with discussion could be solved.
- The introduction to Raven would have to be my favorite, because I can see that it will be quite useful once I learn more about it.
- It was useful to see MatLab in action in multiple activities.

- The cross correlation activity. It was really interesting to me because it showed me some other methods by which to perform my own analyses.
- The detection programs (Ishmael, Raven), because I am using detection programs for my thesis, and it was good to see what is out there.

3. Are there additional topics that you think should be covered in future SeaBass courses?

- Can't think of anything at the moment
- Yes, more hands-on how to do acoustic analysis in different programs.
- Provide more "real-life" examples of issues and data interpretation, including working with limited data in a time-sensitive environment. How are these data best communicated outside an academic environment?
- More information on hearing in marine mammals.
- There should be a short session, perhaps after Roger Gentry's, that briefly presents the National Environmental Policy Act, Marine Mammal Protection Act, and Endangered Species Act. I believe that it is important for the students to understand the regulatory framework and how it is tied to a significant portion of research funding for marine organisms.
- No, I think it is a good balance of topics for a week course.
- Playback experiments
- A lecture on the use of passive acoustic monitoring of coral reef environments and its application for marine protected area development would be a nice addition.
- Potentially a terrestrial bioacoustics lecture (expertise sharing and to make contacts outside of the marine realm!). Combining disciplines is sometimes difficult when you (like me) work in the Ocean Sciences department and the Biological Sciences department is on a different campus!!
- Someone from the Southall et al paper (like Ann Bowles) to discuss the management advice to industry for noise regulations.
- More on masking, and the other impacts of noise exposure. I also think there should be more of a focus on the fundamentals/physics of sound and acoustics. Biology courses are offered in many places, but I think it is more difficult to find a good intro acoustics course.
- Calibrating a hydrophone is a good excercise. I know it was done before, but I'd like to see it brought back.
- I think it would be useful to provide background on some of the regulatory aspects and how the science that is being conducted is incorporated into those processes. This could possibly work very well during the Hot Topic time slot since that one did not take the full 4 hours and would also tie in very nicely.
- There was no discussion about PAMGUARD. Having a session going thru the utlity of the various acoustic and acoustic related programs would be helpful. Holgers section on developing auto detectors was useful but I think even more could be done with that as well.

- I find ethics and acoustic research an interesting topic, and i would like to see what concerns scientists have. Also Conservation, Policy, LEgislation is a subject that I would like to hear more about in relation to the acoustic research.
- I think a policy lesson would be good - needs of regulators, laws related to bioacoustics, etc.
- I think more time could be spent covering the topics of the first lecture (sound and sound propagation) in a bit more depth. Of all the topics covered, I think this one was the most broadly relevant to all participants.
- I think more practical field aspects like calibration and learning the equipment would be helpful.
- A discussion about regulations and permitting as it applies to the ESA, MMPA and local regulations. Over pizza I was talking with Laura about permitting. Holger and Joe joined in discussing issues that they were confused about.
- I think we should discuss the current advances in ship quieting technology.
- Some of the participants mentioned they would like more fundamentals of acoustics. Of course, I wouldn't need any more of that, but most of the other students said they would have liked it.

4. Please rate the following aspects of the program on a scale of 1-5 where 1 is extremely poor and 5 is excellent.

5. Please rate the following aspects of the program on a scale of 1-5, where 1 is extremely poor and 5 is excellent. Create Chart Download

	Poor	Below Average	Average	Good	Excellent	N/A	Rating Average	Response Count
Application process	0.0% (0)	0.0% (0)	0.0% (0)	11.5% (3)	**73.1% (19)**	15.4% (4)	4.86	26
Number of participants	0.0% (0)	0.0% (0)	0.0% (0)	19.2% (5)	**76.9% (20)**	3.8% (1)	4.80	26
Length of program	0.0% (0)	0.0% (0)	3.8% (1)	30.8% (8)	**61.5% (16)**	3.8% (1)	4.60	26
Length of sessions	0.0% (0)	0.0% (0)	11.5% (3)	**42.3% (11)**	**42.3% (11)**	3.8% (1)	4.32	26
Topics covered	0.0% (0)	0.0% (0)	0.0% (0)	30.8% (8)	**65.4% (17)**	3.8% (1)	4.68	26
Activities	0.0% (0)	3.8% (1)	3.8% (1)	38.5% (10)	**50.0% (13)**	3.8% (1)	4.40	26
						Other (please specify) Show Responses		4

Other comments: More hands on would be great. We had REALLY amazing discussions when set to solve problems together at our tables, and I think there could be more of that. We all enjoyed working together to solve problems.

In particular, I was pleased that active acoustics was covered (and excellently so) as it was a topic often ignored by internal university courses. I also really enjoyed the social activities; they were great for networking. I particularly enjoyed the baseball (completely new experience!!) and the hike. The poster session was also interesting as I enjoyed learning more about my peers' current research.

5. Program facilities: Please rate the following aspects of the conference center on a scale of 1 to 5, where 1 is extremely poor and 5 is excellent:

6. Program facilities: Please rate the following aspects of the conference center on a scale of 1 to 5, where 1 is extremely poor and 5 is excellent. Create Chart Download

	Extremely poor	Below average	Average	Good	Excellent	Rating Average	Response Count
Meeting Rooms	0.0% (0)	0.0% (0)	15.4% (4)	26.9% (7)	**57.7% (15)**	4.42	26
Hotel Rooms	0.0% (0)	0.0% (0)	4.2% (1)	12.5% (3)	**83.3% (20)**	4.79	24
Meals	0.0% (0)	0.0% (0)	0.0% (0)	3.8% (1)	**96.2% (25)**	4.96	26
Break Room	0.0% (0)	0.0% (0)	7.7% (2)	15.4% (4)	**76.9% (20)**	4.69	26
Arrival/Departure	0.0% (0)	4.3% (1)	4.3% (1)	17.4% (4)	**73.9% (17)**	4.61	23
					Other (please specify) Hide Responses		10

6. What is the most valuable thing that you will take from SeaBass?

- The contacts I made.
- The contacts made and discussions of mutual interest including sharing across disciplines.
- Meeting other students that are in the acoustic field and learning about their research.
- The knowledge that I gained from the instructors.
- A network of contacts and knowing where the field is headed.
- I really enjoyed the career break out session. It was really the most relevant career talk that I have experienced.
- An introduction to bioacoustics that has given me a broad overview of the techniques used to collect acoustic data and the issues with experimental design. SeaBASS has also allowed me to interact with peers in the field of marine science and bioacoustics that will be valuable colleagues in the future.
- Feeling so reinvigorated about science again after meeting and talking with so many enthusiastic, intelligent and interesting people (speakers and participants). I also highly value the social activities and communal eating, as I think I learnt as much from conversations outside of lectures - dinner time debates and hot tub (!!) conversations.

- The networking. And the great explanation of different dB units by Adam. An introductory talk like his needs to happen every year: it truly set the precedent and created a strong foundation for the rest of the week.
- Meeting people working in the field
- I think the contacts I made (both with other students and with the presenters) and the discussions we had over the course of the week, will prove very valuable. The notes I took, as well as the PDFs of all the lectures, will also be a very useful resource!
- The contacts I made, and the exposure to computer programs. It is always good to get your name out there. The field is growing, but it is still small enough for us to know each other well, and collaborate in the future. This set a good foundation.
- The networking connections that were made.
- Meeting other researchers, updating and learning new tools in software and learning about fish and active acoustics. (so there's several valuable things I'm taking away!)
- The contacts with the people that work on this field, both student and lecturers and the knowledge/experience acquired
- The people I met.
- Better understanding of bioacoustics, and a new group of friends.
- The most valuable part of the course, to me, was the opportunity to build a community with an amazing group of students from around the world, with diverse interests in bioacoustics. I also found the presenter's stories inspiring, and left with a greater sense of purpose for my graduate studies and career.
- The network of fellow marine acousticians
- I came into SeaBASS from the biology side, knowing that acoustics is an important aspect of marine mammal research. SeaBASS introduced me to a wide range of bioacoustic topics and tools, showing me what I need to concentrate on learning from here on out.
- Personal connections.
- Broader knowledge of marine mammals and their biology
- New friends and professional connections. Networking. Exposure to a variety of research in the very specific and specialized field of of marine bioacoustics.
- The knowledge acquired about different topics in marine bioacoustics, and particularly those that interest me the most. Also, meeting all the amazing people in the field that I hope to collaborate with at some point in my career.
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7. Any additional comments?

- The week was totally awesome and I wish I could come back!!! How about a SeaBASS II for alumni?

- Overall, a great program with a little room for improvement. Thanks to all who worked to make this program a reality.
- All of the instructors were fantastic and I learned so much from this experience.
- The course was well done, and I learned a lot in a very short time. However, I promoted the opportunity for BOEM employees to interact with the graduate students, as a reason for BOEM to sponsor SeaBASS. Unfortunately, the logistics of not staying at the Penn Stater limited that interaction. You should coordinate with the Penn Stater (or other conference hotel) to hold a block of rooms at the conference rate for the SeaBASS sponsors. When you negotiate with them, you can ask them to hold some rooms for a specified time (up to two weeks before the workshop). The sponsors would be responsible for booking these rooms and if they don't do it prior to the room release deadline, they could either pay the higher rate or find someplace else to stay.
- I had a great experience and walked away with a few more friends, a bit more knowledge, and several more pounds. THANK YOU!
- Thank you for organizing this course. It was an amazing opportunity to gain experience with underwater bioacoustics.
- Thank you to Jen and Susan for organising this amazing week, I can't imagine how many hours of effort it required; nor can I begin to show how valuable of an experience it was for me. Thank you to the lecturers for giving up their time - it was honestly appreciated by us all. I hope one day to be able to donate my time to teach on such a course (fingers crossed!).
- Thank you so much for putting this on. It will be many years before another conference stack up to this one!
- This was a great course! It is still new and some improvements could be made, but overall I'm really glad I participated in this course and think it was very valuable.
- Outstanding job organizing the event. Everyone involved is to be commended. Getting a group of scientists together, especially young, budding, easily distracted scientists can be as difficult as herding drunk cats. I think it went off about as well as it could have.
- THANK YOU !!!!!!!!!! The class was excellent and your efforts are greatly appreciated.
- Thank you! it will be unforgettable
- This was a lot of fun and really useful. Thanks!
- I think this was an excellent course and very worthwhile. I would love a SeaBass part 2!
- Great job, SeaBASS was a really well-organized and effective course. I didn't know it would be so much fun, too!
- With only enthusiastic and intelligent students, as well as incredibly knowledgeable presenters, I can honestly say that I learned more in one week than I did in either of my first two quarters of graduate school.
- Thank you one thousand times over for this opportunity.
- Great Summer School!

- SeaBass is an extremely valuable program. It does a great service to grad students in bioacoustics.
- Please, keep this program going. It is excellent!!

IMPACT/APPLICATIONS

The SeaBASS program allowed for extended interaction and discussion by students with each other and with leaders in the field of marine bioacoustics to define current and future research priorities and directions in the field. Evidence of the connections and collaborations made during SeaBASS 2012 is demonstrated by a SeaBASS student initiated, online networks on Facebook (30 members) (https://www.facebook.com/groups/192730237521891/). This is in addition to the SeaBASS 2010 networks on Facebook (http://www.facebook.com/#!/group.php?gid=133952333289137&v=wall&ref=ts) and LinkedIn (http://www.linkedin.com/groups?mostPopular=&gid=3186754). Subscribers have been using the online resources to exchange research ideas, seek feedback, solicit Matlab help, exchange information on upcoming conferences, and explore research funding opportunities.

TRANSITIONS

SeaBASS provided training for graduate students in the growing field of marine animal bioacoustics. Expertise in this area will contribute to the Navy's need to understand how sound may potentially impact marine animals, how marine animals use sound, and how to effectively monitor for presence of marine animals.

RELATED PROJECTS

Not applicable at this time.