

2016-17 Annual Report – BEAMS Program

I. Narrative Description of the Status of the Discipline(s) from a National Perspective (including emerging issues and trends)

The Benthic Acoustic Mapping and Survey (BEAMS) Program completed its 10th anniversary year at the College. Housed within the Dept. of Geology and Environmental Geosciences, this program trains geology and marine biology students in the use of state-of-the-art technology and software, to study in detail the ocean's seafloor. A surge in the use of these technologies is occurring globally as mineral, fisheries and other marine resources dwindle, and climate change studies escalate. The global nature of the marine domain has in recent years prompted major advances in exploration and research on and below the seafloor, as well as within the overlying water column. Countries around the world are mapping their continental margins, while scientists explore and map the greater depths in search of understanding the unknown, to identify compelling strategies to utilize resources while preserving seafloor habitats. Marine geospatial data are in continuous demand for scientific studies of marine ecosystems, including atmosphere/ocean interactions, climate change detection, fisheries and habitat assessments, geo-hazard prediction, hydrocarbon exploitation, and identification of human health risks, to name a few.

The rapid, non-linear growth of new technology implementation has not been accompanied with a parallel growth of an informed and technologically-literate workforce. The *BEAMS Program* is designed to address the omnipresent need for qualified ocean surveyors to support the expanding academic opportunities and job market in bathymetric mapping, seafloor habitat characterization, hydrography, marine spatial planning, water column processes, marine geology and geophysics research, and remote observation of the ocean's variability through time.

CofC BEAMS student alumni have become recognized internationally for their knowledge of and experience with mapping methodologies. They are also known for their ability to analyze and interpret data collected, and are highly sought after for employment and internships during and after graduation. As a result of the program's continued growth and success, it has attracted numerous industry partners who now contribute fiscal, professional and technical resources. There is little doubt that the need for BEAMS students will continue to grow and that more students will seek the training offered at our institution.

In 2016-2017 we were able to offer four sections of the two courses that are in the realm of marine survey, for which Marine Geology (GEOL 257) is the pre-requisite course. One section of Special Topics: Introduction to Seafloor Mapping ("SeaMap")(GEOL 240) was taught each semester; one section of Special Topics: Marine Geology Research ("BEAMS Research")(GEOL 395) was taught each semester. Dr. Leslie Sautter taught all of these courses, along with the Marine Geology course. Each SeaMap class included a 2.5 day training workshop led by BEAMS alumni Josh Mode and William Edwards.

II. Program

a. *Program's Mission:*

Establish the Benthic Acoustic Mapping and Survey (BEAMS) Program as an internationally recognized undergraduate-focused academic program that offers practical experience, field training, and innovation in ocean surveying complemented by classroom education and research in state-of-the-art marine geospatial sciences software and instrumentation.

b. *Strategies and tactics in the College's strategic plan the program places as highest priorities:*

The BEAMS Program's highest priority is to offer sufficient academic knowledge and experience to meet the growing interest/needs of our students. This program includes courses in software, technology and research, combined with at-sea data collection and research experience. With the demand for our graduates in the marine geospatial survey industry and graduate programs involving seafloor studies, we hope to continuously offer a suite of courses that build off the SeaMap course. We continue to expand our academic and training offerings by inviting experts from outside CofC to teach short-courses and workshops, as well as to provide shipboard practical experiences. This program would not be the success it is today without the annual days at sea each student has been provided by the College, and, formerly by NOAA.

c. *Program goals and their relationship to the College's strategic plan:*

This program has proven to be an excellent example of the College's push to increase technology in students' academic experiences, including experiential learning out of the classroom. BEAMS students utilize the technology for active, real research, and present their work at professional meetings at regional, national and international levels.

Our goals are: 1) to further develop and expand course offerings to accommodate the growing interest and needs of students; 2) secure annual ship time to provide the critical at-sea experience which greatly advances our students' knowledge and capabilities; 3) increase the number of partners within private industry; 4) develop more paid internships for students prior to their graduation; and, 5) continue to expand student research and publish their results in internationally recognized publications.

d. *Student Learning Outcomes of the program:*

BEAMS students become active learners by first learning complex software which demands innumerable problem-solving trouble-shooting situations, then using the software to collect and analyze data, and interpret results. They use their geology and oceanography knowledge to assess and interpret seafloor morphology and habitat characteristics.

BEAMers learn how to document their work in various visual and written formats, and present their work to a professional audience. The full BEAMS experience advances student learning and has shown to develop a student into a technology-savvy scientist.

III. Narrative Summary and Analysis of Program Accomplishments

a. *What are your strengths, and where would you like to develop?*

Our greatest strength is our students, and our ability to offer a unique undergraduate-focused academic program that offers these students highly sophisticated training and content in complex, state-of-the-art marine geospatial software. BEAMS students combine their software training with and technical experience to conduct research and showcase their results. These students are highly sought after in the marine geospatial world. “BEAMers” are known throughout the industry.

Another major strength is our growing number of academic, government, private and industry partners. Generous donations of time, personnel, software licenses, travel support, and unrestricted funds have allowed the program to be launched to a higher level. Our continued partnership with CARIS has provided the state-of-art seafloor mapping software for nearly a decade. In 2016-2017 we received the third annual gift (of a 5 year commitment) of \$30,000 from our other strongest partner, eTrac Engineering (San Rafael, California). These funds allow us to support student travel to professional meetings, as well as provide means to hire additional professional expertise to supplement our 2-faculty member “staff.”

A critical area for development is with expanding our curriculum to offer courses that 1) utilize additional critical software, 2) provide additional hands-on training in the field, and 3) expand the research opportunities for our students. These items all require additional faculty. Adjuncts, teaching Post-Docs and Visiting Professor positions would benefit the program immensely.

We also wish to develop more internship opportunities for our matriculated students, so that they gain more experience prior to graduating. We hope to add more internships by working with our growing number of partners.

A significant success occurred as a result of our students’ performance at the US Hydro meeting: Seafloor Systems donated an EchoBoat autonomous surface vehicle (ASV) to the BEAMS Program. Our recently-purchased portable sidescan sonar instrument can be towed by this remote vehicle. Harris and his grad student, Matt Hughes are working with the instrumentation over the summer, for experimentation in the fall.

Using BEAMS Foundation and Geology Department funds, we also acquired a Universal Sonar Mount (USM) which will allow us to expand our research/data collection capabilities immensely. We often have offer to borrow multibeam sonar instrumentation from some of our business partners. This USM will allow us to take advantage of the offers, and to develop day-operation survey training using some of the nearby pontoon vessels (either with SC DNR or private companies).

- *Curricular offerings unusual for the program:*

The demand continued to be great enough to offer 2 SeaMap and 2 BEAMS Research courses. Dr. Sautter taught both SeaMap and both BEAMS Research classes, as well as the Marine Geology class. Recent graduate/BEAMS alumnus, Shelby Bowden was the Teaching Assistant for the Fall 2016 SeaMap class.

Four of our students (3 who are rising Seniors) enrolled in a Marine Technology Camp offered by Northwest Michigan College. This intensive 1-week hands-on training was

extremely beneficial for the students. Our program will likely establish an official and expanded collaboration with NMC in the next and subsequent years.

Software Training Workshops:

Two CARIS HIPS software training workshops were offered, one in each semester. CofC BEAMS alumni Josh Mode and Will Edwards conducted the training to a total of 25 SeaMap students.

In February, 7 students enrolled in a 2-day HYPACK training, led by one of the HYPACK instructors.

CofC BEAMS (and MES) alumnus Samantha Bruce worked closely with two BEAMS students to train them in QPS Qimera software. These students presented their work at US Hydro meeting in Galveston in March 2017.

CofC BEAMS alumnus Sonja Tyson offered a two day training workshop for Fledermaus software. 5 students participated.

- *Instructional contributions to undergrad and graduate programs outside your department program:*

Two (2) Marine Biology students enrolled in one of the 4 BEAMS courses offered, and five (6) Computer Science seniors enrolled in one of the two SeaMap courses. We are currently working with the Computer Science department chair (Dr. Sebastian van Delden) to strengthen the link between departments. Dr. Harris is currently working with Dr. van Delden on a Fall 2017 collaborative project and international competition that both geology and computer sciences will enter.

- *Distance education:*

Due to the unfortunate timing, which fell during our spring break, we were unable to have the BEAMS students take part in the virtual at-sea experience while the NOAA Okeanos Explorer was broadcasting.

- *Program contributions to interdisciplinary, personalized education and high impact student experiences:*

The hallmark of the BEAMS Program is the at sea experience(s) students are provided. This academic year was the first in BEAMS' 10 year history in which we were unable to offer a dedicated at-sea research experience to our students, the result of budget constraints within the College. The demand for the course offerings (SeaMap and BEAMS Research classes) has continued, though and we are seeking sources of funds and alternative experiences for our eager-to-sail students.

As described above, 4 of our students enrolled in the Marine Technology Camp to fulfill their at-sea experience. *Several other students were able to volunteer as survey techs aboard NOAA (2) and Marine Institute of Ireland (1) research/mapping cruise.*

- *Changes in program enrollments:*

Enrollments for Marine Geology, SeaMap and BEAMS Research were 28, 25 and 13, respectively. Sautter also supervised 3 BEAMS independent study students. These numbers are approximately the same as during the previous academic year, and are the maximum that can be accommodated with the limited faculty teaching the courses!

To date, 142 students have completed the BEAMS Program's 3 courses.

- *Program workload productivity:*

In the Fall semester, Sautter taught both of the 2-credit SeaMap and 3-credit Seafloor Research classes as an overload to her normal 9-hours. In the spring semester, BEAMS Program courses accounted for 5 of Sautter's workload hours.

Both Sautter and Harris are supervising graduate students. Harris has 1 MES student, and Sautter has 1 MES student and 1 Marine Biology student.

- *Summary of student and/or graduate accomplishments:*

- 1) 1 student presented his research at the American Geophysical Union Fall Meeting in San Francisco, December 2016.
- 2) 15 students presented their research at the 2017 US Hydro Meeting in Galveston in March. Our students once again swept the 4 poster presentation awards, amounting to cash prizes totaling \$1000.
- 3) 1 rising Junior (Alexandra Dawson) was awarded an Ocean Exploration Trust Internship, and sailed for 2 weeks with Dr. Robert Ballard aboard the R/V *Nautilus* off the California coast.
- 4) 1 rising Senior (J. Ryan Hawsey) received the prestigious Woods Hole Oceanographic Institution Summer Student Fellowship.
- 5) Hawsey also received his second \$4000 scholarship from The Hydrographic Society of America.
- 6) Hawsey was also awarded a full year scholarship (for next year) by the Dept. of Defense's SMART Program. He will be working with the Naval Oceanographic Office after graduating in May 2018.
- 7) Two students (A. Dawson and W. Howard) received travel scholarships to attend the 2017 US Hydro meeting in Galveston.
- 8) 1 rising Junior was given travel support to participate on a two two-week mapping cruises in Ireland, working with the Marine Institute of Ireland.
- 9) 1 rising Senior and 1 graduate student each sailed as volunteer survey techs aboard the NOAA Ship *Pisces* (2 week cruises)
- 10) 5 of the 10 BEAMS students who graduated this year are pursuing employment in the marine survey industry.
2 have already been hired full-time: H. Meyers was hired full-time by NOAA National Response Team (a marine survey position) and G. Crenshaw was hired by eTrac.
3 recent grads are getting their at-sea experience: 2 are sailing as survey techs on the NOAA Ship *Foster* in August, and 1 will sail on the R/V *Celtic Explorer* in Ireland in September.

- b. *Curricular assessment activities undertaken, along with both actions taken in earlier years that have led to improvement and plans for improvement:*

The continued development of assessment activities proved very successful for both the SeaMap and BEAMS Research courses. A BEAMS graduate, Shelby Bowden worked as Dr. Sautter's Teaching Assistant for the Fall 2016 SeaMap course, and developed new

lectures, exercises and assessments to improve and expand the course.

- c. *Efforts made in recruitment (if applicable) to increase the presence of under-represented groups:*

The marine survey field has traditionally been severely underrepresented by women. Five (5) of this year's 13 BEAMS Research students were female, and 8 of the 25 SeaMap students were female. See Table 1 for the total program impact.

Unfortunately, ethnic and racial diversity is low in the program. BEAMS had only 1 student who was African American.

- d. *Research and professional development productivity in the program. Strengths and challenges:*

Annually, we try to have all BEAMS students attend and present at a national or international meeting. Travel funds are always our greatest challenge to attaining this goal. During 2016-2017, we were fortunate to have secured a good chunk of the costs for 15 students to attend the US Hydro meeting in Galveston. Also, 1 attended the American Geophysical Union meeting in San Francisco.

However, it is support for ship time that is most lacking and by far our greatest challenge in terms of research. We are working closely with the Development officer for the School of Sciences and Mathematics to identify potential donors. In the last year we have revamped and re-launched the BEAMS Program website:

<http://oceanica.cofc.edu/beamsprogram>, which has increased our visibility. We also have an extremely active Facebook groups with ~250 members.

- e. *Program service and outreach contributions. Strengths and challenges:*

Four BEAMS students conducted a demo at the Lady Cougar STEM Festival this year, and two BEAMS students presented at the STEM Fest, held at Brittlebank Park. Also, 2 students presented at a local middle school. We do not see any particular challenges in this arena, only the strengths of our amazing BEAMers!

- f. *Professional development opportunities for faculty?*

Sautter attended the US Hydro meeting with 16 BEAMS students (March 2017).

Harris presented BEAMS-related research at the Southeastern GSA annual meeting.

Sautter visited the Marine Institute of Ireland (March 2017) to continue the collaboration, during her spring break.

Harris is conducting BEAMS-related research in Greece this summer, and hope to establish a cooperative agreement with his colleagues there.

- g. *What success have you had in meeting program, departmental, school or College goals? What obstacles prevent you from reaching specific program, departmental, school or College goals? In what way can Academic Affairs support your efforts?*

Renewed support for annual ship time is the primary way in which our program can maintain the level of excellence and to offer our students a unique undergraduate program experience.

As stated earlier, our greatest challenge is in accommodating the students in the area of research. We have too few faculty who can supervise research. Support for graduate students, Post-Docs, or visiting faculty would enhance the program immeasurably.

- h. *What curricular development or other major changes in the program(s) are planned for the next three years? Briefly, what resources are required to implement these?*

Below is a list of the courses we hope to offer in the next three years:

Introduction to Seafloor Mapping (“SeaMap”) – 2 credits:

This course will be proposed as a New Course (GEOL 2xx) in Fall 2017

It will be offered as an Express II class to 12 students in Fall and Spring semesters

It may be offered as a Summer I or II class in 2018

Marine Geospatial Research (“BEAMS Research”) – 3 credits

This course will be proposed as a New Course (GEOL 3xx) in Fall 2017

It will be offered to 8 students in Fall and Spring semesters each year.

Advanced Seafloor Mapping – 2 credits

Sautter will be adding this special topics course (GEOL 395) to the curriculum in

Fall 2017, in order to accommodate the research interests of the 6-8 students who are still matriculated and have completed the BEAMS courses offered.

Field Methods – 3 credits

Dr. Harris will be teaching this course in Fall 2017. Although the course is not solely marine-oriented, there will be some marine survey work conducted.

We also plan to continue offering additional workshops and specialized classes that would be offered by experts in the field, as we have found significant interest by our partners to teach and work with our advanced BEAMS students. These courses might include:

Software training – 1 credit (Fledermaus, Hypack Navipack, EIVA)

Field training – 2 credits (research and technical training on board small vessels)

Focused Topics – 1 credit (Water Column Analysis, Autonomous Underwater Vehicles, Backscatter Analysis)

Table 1. Summary of BEAMS Program statistics June 2007 to June 2017.

#	%	As of June 30, 2017:
<u>142</u>		Total # of CofC BEAMers (those who have completed/presented research)
65	45.8	# of female BEAMers
113		# research presentations outside of CofC (at professional meetings) (some were co-authored)
57	40.1	# who have gotten internships before or after graduation
9		# who received scholarships during academic years
63	44.4	# who have participated as volunteer survey techs
94		# of cruises that have included 1 or more BEAMS volunteers
<u>124</u>		# BEAMers who have already graduated
		<u>Of the GRADUATED BEAMers...</u>
68	54.8	# successfully entered the workforce
32	25.8	# Females in the workforce
	47.1	% of workforce that's female
18	14.5	# who have gone on to grad school
28	22.6	# of students who have had contractual/part time jobs
57	46.0	# of students who have had full time positions
16	12.9	# of students who have had NOAA full time positions
41	33.1	# of students who have had non-NOAA full time positions