M533 Syllabus 2017: Scientific Diving and Underwater Research

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BUMP Scientific Diving Training Program
MS533 Scientific Diving & Underwater Research Methods

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Introduction

This training will provide BU students with the credentials necessary to participate as interns or collaborators in scientific projects that involve scuba diving. It fulfills the required training for scientific divers as prescribed by the American Academy of Underwater Sciences (AAUS). It will also prepare students for entry level jobs in the environmental impact research industry and in the recreational dive industry. The course will prepare students for careers as scientific diviers for University, Government and Industry. For some background on the class, see https://www.bu.edu/today/2016/one-class-one-day-scientific-diving/

Course Description: This course is designed to introduce scuba certified students research diving and conforms to the training standards of the American Academy of Underwater Sciences (AAUS) for scientific diver certification that is accepted at most universities and at all AAUS member organizations throughout the United States. This course will provide an introduction to research methods used in the study of biology, ecology and physiology of subtidal organisms. Topics for lectures and labs include: diving physics, physiology, dive planning, first aid for diving professionals, underwater photography, population census methods and fish habitat surveys. This course fulfills the American Academy of Underwater Sciences (AAUS) scientific diver training requirements.

Students will be instructed in advanced diving, research diving techniques, enriched air nitrox, dive rescue, and oxygen administration and will be eligible to participate as a scientific diver-in-training or scientific diver after successful course completion.

This course will provide an introduction to research diving and satisfy the 100 hours of required training for scientific divers as prescribed by the American Academy of Underwater Sciences (AAUS). This training is required to participate in scientific diving activities at many universities and at all AAUS member organizations throughout the United States. BUT NOTE: you must maintain annual proficiency of 12 dives per year. Some other organizations do require all their students and employees to retake training depending on documented experience and logged dives.

Scientific diving at Boston University is administered through the Office of Research Compliance, see
http://www.bu.edu/researchsupport/compliance/scientific-diving-safety/

In order for divers to continue scientific diving at BU, divers will need to work with a Professor who supervises the research and the BU Dive Safety Officer, who supervises the diving. *Additional dive training following this course may be required depending on the depths and tasks.*

Course Prerequisites:

- Basic Open Water Scuba certification with a min. of 10 open water dives.
- Students supply their own scuba equipment (except weights and bottle).
- BU Diver's Physical Examination.
- Diver summary form
- Emergency medical Insurance specific to scuba diving (i.e. DAN).
  - BUMP pgm provides this insurance for students.
- BU Fit-Rec swim card (*AAUS swim test conducted in class)
- Permission of instructor.

Course Goals:

- To acquire an understanding of commonly applied marine research methodologies
- To acquire a deeper understanding of dive physics, physiology, decompression theory and dive planning.
- To fulfill the national training requirements for scientific diving under AAUS.

Learning Objectives:

By the end of the course you should be able to:

1. Demonstrate proficiency in diving emergency care training.
2. Demonstrate proficiency in dive rescue and accident management.
3. Understand dive physics, physiology, decompression theory and dive planning.
4. Understand AAUS scientific diving regulations and history.
5. Demonstrate proficiency in underwater data gathering techniques.
6. Be able to work cohesively in small groups to complete field based underwater research.

Required Texts; - *these will be provided to you in class at no additional cost.*

- NOAA Dive Manual; Diving for Science and Technology 4th Edition. Best Publishing (a digital version will be available in class)
- DAN First Aid for Diving Professionals. Divers Alert Network
- Nitrox Diver: Student Manual and Workbook: NAUI
- Rescue Diver: Student Manual and Workbook: NAUI

Grading:

- Nitrox written exam (online NAUI course at home) = 10%
- Rescue written exam (online NAUI course at home) = 10%
- DAN written exam (online DAN course at home) = 15%
- Dive written exam (in class) = 25%
- **Personal Dive Log** with Field diving exercises and UW observations = 40%

  Dive Log and Field Notebook

  This is a detailed notebook containing dive log information, data collected, data analysis, and general notes for the course. The idea of this notebook is to develop the habit of keeping a research notebook used by all successful research scientists.

Attendance Must attend all class sessions and field excursions/ dives.

- Students must complete 12 dives with the class in order to earn the AAUS verification of training card for scientific diving (depth 30ft).
- Depending on student experience and skill level, additional dive training may be required by the Institution's DSO.

Successful students will earn the following professional certifications

1. Divers Alert Network First-Aid for Professional Divers: First-responder certification
2. NAUI Nitrox certification
3. NAUI Rescue Diver certification
4. AAUS Scientific Diver verification of training card

DIVING EQUIPMENT REQUIREMENTS

(*) Indicates equipment supplied by each scientific diver.

- NB see item I = everyone needs a dive watch &/or dive computer.

A. **REGULATORS*.** Regulators are to be configured with a submersible pressure gauge, B.C. power inflator hose and/or dry suit inflator hose.

B **ALTERNATE AIR SOURCE*.** An alternate air source must be in use at all times in the event of an out of air emergency. (i.e.. Scubapro Air II, Sherwood Shadow, Spare Air or a safe second stage/octopus regulator is acceptable).

C. **BUOYANCY COMPENSATOR*.** B.C.'s must be capable of inflation by two separate sources, (excluding saturation diving use) and have an automatic and manually operated exhaust valve. (B.C.'s used with dry suits must not obstruct operation of the power inflator or exhaust valve).

NOTE: Your own personal diving equipment must be in working order and in good repair. Personal regulators, buoyancy compensators and power inflators must be serviced and tested at least every twelve (12) months. Any equipment in question may require as proof, a documented service record completed in the last twelve (12) months.

D. **WEIGHT BELT. *** (with one hand quick release buckle). (class will provide lead weights).

E. **WET SUIT. *** (7 or 8 mil thickness, farmer john style with hood, gloves and boots)

F. **FACE MASK, SNORKEL, FINS AND DIVERS KNIFE or cutting tool.**

H. **DEPTH GAUGE*.** (often found on regulator's diver console).

I. **DIVERS TIMER. *** (i.e.., dive watch, dive computer or pressure-activated digital timer).

J. **SIGNAL DEVICE. *** (i.e., whistle).

L. **DIVE COMPUTERS. *.** All dives using dive computers require adherence to the AAUS "Guidelines for the use of Dive Computers."

Course has the following for student use:

- Dive weights
- Scuba bottle
- DIVE LIGHTS.
- SLATES
- Underwater Compass
- REEF CHECK ID guides and slates

Special note: The Lobel Lab does have a few extra BCs and regulators to loan (these are not BUMP equipment). It is best if every student provides all their own gear. It is important to train with the gear you will use.

Some of the additional types of gear we will have to use in class include:

- Full Face Mask
- pony bottles for emergency air supply
- surface supplied scuba hose
- collecting nets for fishes and invertebrates
- "modern" double hose regulator
- "modern" double hose regulator with double botttles (also simulates weight and size of Rebreather).

We will also demonstrate the use and operations of a Rebreather diving rig, but students can not dive these units. This is the future of scientific diving and the course will familarize you with the gear

IMPORTANT

BRING TO CLASS ON DAY 1 as HARDCOPY

- **The BU AAUS Medical form signed by your MD**
- **The BU medical screening form**
- **The student diver questionnaire**
- **A photocopy of all of your diving certifications**
- **A copy of your dive logs**
- **Dated invoice** for your regulator and BC service maintenance
  - serviced in prior 12 months (i.e. between October 2016 and Sept 2017).
- **BU boating & water activities swim card** – available at Fit Rec Ctr.
  - You need to do this swim test at the FitRec pool with one of their lifeguards BEFORE our class begins. During class, we will conduct the AAUS swim test.

Be prepared to bring all your dive gear to class on DAY 2 for function review and safety checks

For those new to the BUMP Block course schedule. Every day is like a week. It all moves fast and requires everyone to keep pace.

Daily schedule on next page

Note: this course will require readings and homework to be done in evenings and over weekends; and long drives on the highway to and from dive sites.

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WEATHER can impact our field diving schedule

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Note again: this course will require readings and homework to be done in evenings and over weekends

We are targeting for a minimum of 12 training dives and a minimum of 6 hours bottom-time (if dives are short, more are required to make min BT). If time and weather permit, additional training dives will be added.

The course diving exercises may be altered based upon the experience level(s) of students in the class.

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WEATHER can impact our field diving schedule

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Consequently, classroom and dive day schedules may be swapped depending on field diving conditions. We need to be flexible in the schedule.

Note: We have a lot of different underwater drills and types of equipment to demonstrate and to try. We also may be able to schedule a few boat dives. This all depends on class progress and comfort in-water, weather, logistics etc etc. We try to do the most without ever compromising safety. We rarely can do everything but no harm in being prepared for the best.

Course schedule is tentative and can change due to BUMP program activities, BU scheduling, weather, and our own logistics and class events, etc etc.
We have a spare day held in reserve in case we miss a day or need to redo an activity, in which case the final exam is moved to last day of Block 1 (Oct 2).

September 2017	**am**	**pm**
Thursday, Sept 7	Course Intro, Admin., Basic Eqpt./Exp. suits Class dive plan	**review of AAUS** & advanced scientific diving incl Rebreathers
Friday, Sept 8	review of dive proceedures **Bring all dive gear for function test**	homework: review dive training manuals-Dive Planning & Accident Management
Monday, Sept11	Review Pool session plans **11am to 2pm**	**POOL**- gear check, basic scuba skills, AAUS swim test
Tuesday, Sept 12	DAN first aid, AED, CPR	DAN Hazardous marine life, oxygen
Wednesday, Sept 13	***DIVE 1***- bouyancy control & temperature loggers deployment	***DIVE 2-***Dive Rescue Techniques,
Thursday, Sept 14	***DIVE 3***- UW navigation, Dive Rescue Techniques, maybe field demo of Rebreather	***DIVE 4***- UW navigation, Dive Rescue Techniques, maybe field demo of Rebreather,
Friday, Sept 15	Review emergency proceedures and first aid	Intro to Deco Theory, Dive Tables & Planning, Computers-
Monday, Sept 18,	Intro to Deco Theory, Dive Tables & Planning, Computers-con't Rebreathers and Nitrox	Tables, Rebreathers, nitrox etc continued **POOL OPTION DAY 11am-1pm**
Tuesday, Sept 19	***DIVE 5-*** transects, using Nitrox, field demo of Rebreather	***DIVE 6-*** Quadrats, using Nitrox, field demo of Rebreather
Wednesday, Sept 20	***DIVE 7***-Underwater camera use, Nitrox	***DIVE 8***-cameras & Nitrox Navigation & meters recovery
Thursday, Sept 21	***DIVE 9***- -small boat Entries and Exits, lift bags, specimen collection	***DIVE 10-*** small boat Entries and Exits, lift bags
Friday, Sept 22	UW technology,advanced diving methods (eg blue water, twilight zome, HAZMAT etc	UW surveys methods, Science and underwater photography
Monday, Sept 25	Diving Physics,	Diving Physiology,
Tuesday, Sept 26 ***OVERNIGHT at Marine Biological Lab, Woods Hole***	***DIVE 11***- Woods Hole fish surveys	***DIVE 12-*** Woods Hole fish surveys
Wednesday, Sept 27	***Dive*** Woods Hole fish surveys	***Dive*** Woods Hole fish surveys
Thursday, Sept 28	*review for final exam*	
Friday, Sept 29	**final - AAUS dive exam**	
Monday, Oct 2	Cleanup gear, makeup	

The below list of skills are the key techniques that we will practise.

AAUS Skills Descriptions - *for us to practise***.**

The candidate shall demonstrate technique, control, composure and buddy contact in the skills described below acceptable to the DSO/evaluator. Skill performance should exhibit the knowledge and skills expected of the level of certification to be conferred (Scientific Diver, Dive Leader, etc).

❖ Day 1 in pool will start with the AAUS swim test.

AAUS swim test

a) Swim underwater for a distance of 25 yards/meters without surfacing.
b) Swim 400 yards/meters in less than 12 minutes.
c) Tread water for 10 minutes, or 2 minutes without the use of hands.
d) Transport a passive person of equal size a distance of 25 yards/meters in the water.

NOTE: all swim test sections *DO NOT* need to be passed at one time. Makeup sessions can be added until student can pass all exercises. However, All students will try to pass the first time.

To be demonstrated in pool or in open water (i.e. at dock) sessions:

Diving system assembly and disassembly:
Properly assemble and dissemble the dive equipment being used, without assistance; demonstrating knowledge of the equipment and configuration.

Equipment inspection:
Identify and correct equipment configuration and assembly problems with gear sets on which the diver has been trained, Conduct an inspection of own and dive buddy's equipment.

Entries and exits:
Enter and exit the water in a safe and efficient manner; technique, control/awareness of all worn/carried equipment, and buddy contact/assistance.

Proper weighting:
Determine the optimal weighting necessary for the gear configuration and conditions.

Mouthpiece clearing – snorkel and regulator:
Clear a snorkel of water by blast and displacement method. Clear a standard scuba regulator second stage of water with and without use of the regulator's purge button.

Controlled descents and ascents:
Perform a controlled descent. Arrest the descent without coming in contact with the bottom, or other fixed object. Equalize air spaces as needed to avoid injury. Conduct a controlled ascent and perform a safety stop for a specified time at a specified depth without aid of a float or fixed line.

Underwater swimming:
Maneuver underwater safely effectively with and without fins.

Underwater exercises – with and without mask:

Breathe from the scuba regulator underwater without wearing a mask. Perform simple tasks requiring the use of both hands and in various body positions, while breathing from the scuba unit with and without wearing a mask.

Buddy-system techniques:
Maintain acceptable buddy contact at all times.

Underwater and surface buoyancy control:
Achieve and maintain positive buoyancy at the surface, descend in a controlled manor. Modify and control buoyancy underwater to obtain a state of negative, neutral, or positive buoyancy. Adjust the buoyancy provided by the buoyancy compensation device both with the power inflator and manually. Control and maintain buoyancy while performing basic scuba skills.

Underwater problem solving (regulator recovery/retrieval, etc):
Recover a regulator from behind the shoulder; the ability to recognize and arrest the free flow of a second stage free flowing due to mouthpiece position or current. Recognize and correct/adapt to simple equipment problems.

Surface operation of the quick release/emergency function of the weight system:
Operate the quick release/emergency function of the weighting system employed by the diver to separate the weight from the diver; the knowledge and ability to operate the quick release/emergency function of the weighting system employed by the dive buddy to separate the weight from the dive buddy.

Removal and replacement of the weight/ballast system:
Adjust, remove, and replace the weight/ballast system worn by the diver while maintaining control of the weight/ballast system and its elements, at the surface and underwater.

Equipment care and maintenance:
Demonstrate equipment care and maintenance techniques suitable for the equipment employed.

Clear face mask:
Clear a flooded face mask. Breathe comfortably from the scuba unit underwater without the facemask in place. Replace a mask that has been removed.

> Example Drill One: Underwater, breathing from the scuba unit, with the face mask in place, the diver is to break the seal between the masks' skirt and the diver's face and flood the facemask with sufficient water to covering the diver's nose and eyes. The diver is to reseat the mask and clear the mask by exhaling through the nose. Upon completion of the drill, the mask will be sealed on the face and the mask will be clear of water to the point that no water is visible moving inside the mask. The diver must remain calm and in control during the exercise.
>
> Example Drill Two: Underwater, breathing from the scuba unit, with the facemask in place, the diver is to remove the mask and take a minimum of three breaths from the scuba unit with the mask off. The diver then replaces the mask on the face so that it seals properly and clears the mask by breathing through the nose. Upon completion of the drill, the mask will be sealed on the face and the mask will be

clear of water to the point that no water is visible moving inside the mask. The diver may not pinch the nose when their mask is off of their face, and they must remain calm and in control during the exercise.

Demonstrate air sharing:

Alternate air source:

Share an alternate air source with another diver. Alternate air sharing is defined as both divers breathing from independent second stages from a single scuba unit, or the donor placing the receiver on an independent gas supply such as a pony or bailout bottle. Perform this skill as both donor and receiver, and both with and without face masks.

As the donor, demonstrate proper reaction to a predetermined hand signal to alternate air source share. Properly position the receipient to comfortably breathe from their regulator. Initiate and control an underwater transit to a predetermined ascent point. Ascend at proper rate. Maintain proper buddy pair positioning during underwater transit and ascent. Establish positive buoyancy for recipient and self.

As the recipient, demonstrate proper delivery of a predetermined hand signal to alternate air source share. Properly position buddy pair to comfortably breathe from donor's offered alternate air source. React properly donor's hand signals. Maintain a proper ascent rate.

Example Drill One: Underwater, breathing from the scuba unit, with the face mask in place, the diver (donor) responds to an out of air signal delivered by the dive buddy (receiver) by providing the dive buddy one of the donor's second stages. After assuring both divers are breathing from the donor's scuba unit the donor communicates with the receiver with hand signals, positions the receiver for a horizontal swim (simulating returning to an exit point) and leads the receiver to a predetermined point where the donor communicates with the receiver with hand signals, positions the receiver for an alternate air source ascent, and controls the ascent of the buddy team and ascends the team at a proper ascent rate. Upon reaching the surface, the donor establishes positive buoyancy by manually inflating the receiver's BCD and inflating their own BCD. During the exercise the donor must assure the receiver remains in proper position for alternate air source sharing of the donor's gear configuration and is breathing from the donor's scuba unit. At the completion of the exercise the diver's return to their underwater starting point and repeat the exercise reversing roles.

Example Drill Two: After the divers have successfully demonstrated the ability to complete the alternate air source exercise with the mask in place, the drill is repeated without the use of the face mask. DSOs acting as the dive buddy should keep their mask in place so they can observe.

Example Drill Three: Underwater, breathing from the scuba unit, with the face mask in place, the diver (donor) responds to an out of air signal delivered by the dive buddy (receiver) by providing the dive buddy an independent gas supply carried by the donor. After assuring the receiver is breathing from the independent scuba unit the donor communicates with the receiver with hand signals to make a horizontal swim (simulating returning to an exit point) and leads the receiver to a predetermined point where the donor communicates with the receiver with hand signals to ascend, and ascends the team at a proper ascent rate. Upon reaching the

surface, the donor assures positive buoyancy of the receiver and self. During the exercise the donor must assure the receiver maintains control of the independent gas supply; continues to breathe from the unit; maintains buddy contact, and completes the ascent to the surface. At the completion of the exercise the diver's return to their underwater starting point and repeat the exercise reversing roles.

Buddy Breathing:
The diver is expected to demonstrate the ability to buddy breathe with another diver. Buddy breathing is defined as two divers breathing from a single second stage; divers alternate by each taking two breaths while their buddy exhales bubbles into the water column; the diver not breathing from the second stage must constantly be exhaling a steady stream of bubbles. The diver is to perform this skill as both donor and receiver.

As the donor, the diver is to demonstrate: reacting properly to a predetermined hand signal to buddy breathe; properly positioning the receiver to comfortably breathe from their regulator; use of the correct breathing pattern for buddy breathing; managing the regulator while allowing the receiver to breathe from the second stage and access to the purge; use of hand signals to communicate with the receiver to initiate an underwater transit to a predetermined point and to ascend; managing the receiver to assure proper positioning for underwater transit and ascent; assuring both divers exhale when not breathing from the regulator; control of the ascent of the buddy team including proper ascent rate; once at the surface the establishment of positive buoyancy for receiver and self; control and composure acceptable to the DSO or evaluator.

As the receiver, the diver is to demonstrate: proper delivery of a predetermined hand signal to buddy breathe; use of the correct breathing pattern for buddy breathing; proper positioning to comfortably breathe off of the donor's second stage; proper reaction to the hand signals given by the donor; the ability to maintain a proper ascent rate; the ability to perform as receiver both with and without a face mask; control and composure acceptable to the DSO or evaluator.

Example Drill One: Underwater, breathing from the scuba unit, with the face mask in place, the diver (donor) responds to an out of air signal delivered by the dive buddy (receiver) by providing the dive buddy breaths from the donor's primary second stage. The diver's alternate breathing from the donor's second stage by each taking two breaths while their buddy exhales bubbles into the water column; the diver not breathing from the second stage must constantly be exhaling a steady stream of bubbles. After assuring both divers are comfortable and in breathing pattern, the donor communicates with the receiver with hand signals, positions the receiver for a horizontal swim (simulating returning to an exit point) and leads the receiver to a predetermined point where the donor communicates with the receiver with hand signals, positions the receiver for buddy breathing ascent, and controls the ascent of the buddy team and ascends the team at a proper ascent rate. Upon reaching the surface, the donor establishes positive buoyancy by manually inflating the receiver's BCD and inflating their own BCD. During the exercise the donor must maintain control of the donated second stage, while not restricting the receiver's access to the regulator and/or purge button. The donor must also assure the receiver remains in proper position for buddy breathing from the donor's gear configuration and that both the receiver and the donor are exhaling when not breathing from the donor's second stage. At the completion of the exercise the diver's return to their underwater starting point and repeat the exercise reversing roles.

Example Drill Two: After the divers have successfully demonstrated the ability to complete the buddy breathing exercise with the mask in place, the drill is repeated without the use of the face mask by the receiver. DSOs acting as the dive buddy should keep their mask in place so they can observe.

Surface dive to a depth of 10 feet without scuba:
Less scuba unit, surface dive to a minimum depth of 10 feet and return to the surface.

Demonstrate ability to alternate between snorkel and scuba while kicking:
The diver is to demonstrate: proper snorkel clearing technique; management of the scuba second stage; and the ability to alternate between breathing from their scuba unit and a snorkel while kicking at the surface without lifting their face from the water to breathe.

Example Drill: Face down at the surface, breathing from the scuba unit. The diver(s) propel themselves a predetermined distance around the pool or confined water area by kicking. During the exercise the diver(s) alternate breathing from their scuba unit and their snorkel. The diver(s) must exchange between regulator and snorkel smoothly, without lifting their face from the water to breathe, and without allowing the removed regulator to free flow. The diver(s) must alternate back and forth between regulator and snorkel at least four times during the exercise taking at least five breaths from each during each cycle.

Demonstrate understanding of underwater signs and signals:
Identify and properly respond to standard underwater diving signals.

Demonstrate simulated in-water mouth-to-mouth resuscitation:
Determine victim unresponsivness at the surface. Secure the victim in a face up position. Establish positive buoyancy for the victim and self. Issue a call for help. Properly manage the victim's airway and simulate mouth-to-mouth resuscitation breaths according to current standard.

Rescue and transport, as a diver, a passive simulated victim of an accident:
Determine whether their victim on the bottom is in need of assistance. Establish contact with the victim and transport the victim to the surface at a proper ascent rate (removal of weight is considered situationally dependent). At the surface, establish positive buoyancy for victim, then self. Communicate a distress signal. Transport the victim a predetermined distance in a predetermined time.

Demonstrate ability to remove and replace equipment while submerged:
Remove and replace all equipment worn by the diver except exposure suit.

Example Drill One: On the bottom wearing scuba unit, mask, fins, and appropriate weight, establish negative buoyancy removes and replaces in turn (order of removal/replacement can be flexible): Mask, fins, scuba unit, and weight. The regulator may or may not be removed from the diver's mouth as part of the exercise. The diver must remain calm and in control during the exercise.

Example Drill Two: On the bottom wearing scuba unit, mask, fins, and appropriate weight. The diver establishes negative buoyancy; removes and maintains control of mask, fins, scuba unit and weight (order of removal can be flexible); replaces mask,

fins, scuba unit and weight (order of replacement can be flexible). The regulator may or may not be removed from the diver's mouth as part of the exercise. The diver must remain calm and in control during the exercise.

Enter and leave open water or surf, or leave and board a diving vessel, while wearing scuba gear:
Enter and leave the water in a safe manner for the conditions and/or platform. Maintain control of equipment and acceptable buddy contact.

Kick on the surface 400 yards while wearing scuba gear, but not breathing from the scuba unit:
Kick with fins on the surface 400 yards while wearing scuba gear without breathing from the scuba unit.

Demonstrate judgment adequate for safe diving:
Demonstrate judgment adequate for safe diving.

Demonstrate, where appropriate, the ability to maneuver efficiently in the environment, at and below the surface:
Demonstrate the ability to maneuver efficiently in the environment in which the diver is expected to operate. This demonstration includes but is not limited to: maintaining control of equipment; maintaining acceptable buddy contact; adhering to dive plans and schedules; and technique, control and composure at and below the surface.

Demonstrate techniques of buddy rescue:
Assist another diver simulating a cramp.

Assist a simulated conscious diver in need of aid with ascent. Assist a simulated conscious diver in need of aid on the surface to establish positive buoyancy and return to exit.

Assist another diver simulating panic at the surface.

For a diver simulating an unresponsive victim at depth, assess and recover the victim to the surface in a safe and effective manner. Establish positive buoyancy on the surface for the victim and self. Assess the victim's condition and use established surface hand signals and/or signaling equipment. Transport the victim to a pre-determined extraction point, providing simulated in-water mouth to mouth resuscitation. Remove the victim's equipment as appropriate for extraction. Perform a safe and controlled extraction from the water.

Navigate Underwater:
Navigate underwater using natural aids to navigation. Navigate underwater using a compass a reciprocal course to a predetermined location and return. Navigate a compass course requiring the diver to calculate and execute a series of turns and return to a predetermined location.

Plan and execute a dive:
Plan and execute a dive for local conditions, or for conditions for which the diver is being certified. Brief the dive buddy on the dive plan. Lead the dive, adhering to the dive plan. Debrief the dive buddy. Assure all necessary information pertaining to the dive is properly recorded and submitted per local requirement.

Detail on diving operations, skills and underwater exercises

This section describes what we will aim to accomplish on the field training dives

Diving will begin with a pool checkout session to confirm basic skills and equipment functioning followed by two dives at the NOAA dock to practise basic AAUS skills (described following the section on Training Dives). Following this, the class will conduct a series on underwater exercises as described below.

TRAINING DIVES

As part of the research dive course we will attempt to make several training dives to familiarize you with research diving and some techniques used in the field. The data collected is only for training purposes and a diver should feel no pressure to have to complete an exercise, rather use these dives as a tool to gain more experience and understanding about what it is to perform a research dive. So remember to dive within your limits and comfort zone while always monitoring your gauges.

These dives are designed to provide the students with opportunity to develop their water skills and to become comfortable using basic dive gear and field tools.

Introductory training exercises.

The first four dives will develop student's underwater composure and will allow adjustment of their personal diving apparatus. These first dives will orient the class to the NOAA dock site where we will be conducting our training.
Our dives will concentrate on skills demonstrations as described in detail, see AAUS skills.

These dives are outlined following an idealistic goal that all dives have perfect weather and field conditions and that all divers exhibit skills competency. The specific dive objectives may be changed accordingly if we need to reschedule or students require additional practice of basic skills.

Based upon 12 dives totaling 6 hrs bottom-time, i.e. 30min per dive

DIVE 1
Training Dive: Site Survey and personal gear adjustment including personal buoyancy control
Purpose: Survey the established study site to familiarize yourself with the site (the NOAA Stellwagen facility dock).
Note Depth, temp., current and other predetermined factors.
Materials:
• slate, compass, mesh bag
Methods: To be discussed as a group

DIVE 2
Diver Rescue Techniques and practice ditch/don gear and Deployment of underwater loggers for temperature and tide.
Purpose: develop safety skills
Materials: basic dive gear
Methods: To be discussed as a group

DIVE 3
Training Dive: Underwater Mapping & Navigation
Purpose: To construct a map of the underwater site and terrain including compass bearings, three dimensions of the pipe (reef) study site. Major features such as # of marine plants, inverts, sand ripples. For the dock area map measure "piling to piling" of study site along with 5 meters away (east or west) from dock.
Materials:
• Slate, transect tape, depth gauge, compass
Methods: To be discussed as a group
Observe Rebreather diver- Phil Lobel will use a Rebreather when diving with various class members to show how system functions and how Rebreather- OC Scuba teams can interface.

DIVE 4
Sampling Technique Exercise: Search Patterns & Navigation
Purpose: This training exercise is designed to familiarize the diver with a search technique commonly used in low visibility diving.
Materials:
• 1 -10 meter transect tape
Methods:
Both divers will descend down a pelican buoy marked in the general area of a subsurface buoy. To find the exact location of the buoy, one diver will hold the end of the tape while the other reels the tape out to 5 meters. The diver at the 5 meter end will then swim in a circle to search for the buoy while the other diver holds the end of the tape in one position. The diver on the 5 meter end will swim in a full circle looking for the buoy and extend the tape to 10 meters if necessary. Upon finding the buoy the diver will give his buddy three sharp tugs to signal him to meet at the buoy. From the buoy, the divers will take a compass heading and swim straight East (90 degrees) to find buoy number two. The buoy will not be located past the dock and the divers will be responsible for conducting another search pattern to find it. Once buoy number two is found, the divers will pick up a marked zip tie or other item and swim in towards the beach.

Sampling Technique Exercises and NITROX training
For these exercises, the class will be divided into groups. Each group will collectively review their assigned exercise and present this information, along with their dive plan, to the class as a whole before making the dive the following day. Then each group will review their dive to the class. We will also be using nitrox on these dives so we will also be using testing the breathing gas with oxygen gauges prior to diving.

Observe Rebreather diver- Phil Lobel will use a Rebreather when diving with various class members to show how system functions and how Rebreather- OC Scuba teams can interface.

DIVE 5 – using NITROX
Sampling Technique Exercise: Fish Transect

Purpose: This training exercise is designed to familiarize the diver with sampling methods To determine the abundance (density) of selected species along the 10 m transect line
Materials:
• 1 underwater clipboard
• 1 underwater data sheet
• 1 10 meter transect tape
Methods:
One diver is equipped with the clipboard while the other is equipped with the transect tape. One diver will secure the free end of the transect tape along their sample area of the pipe. The 2nd diver will begin counting and recording all fish species listed below. The area sampled will be a 2m cube along the transect. As the diver moves along the pipe counting fish, the diver with the transect tape will closely follow, spooling out the transect tape for 10 m. At this point the divers will compare air gauges and if possible switch task and begin to reel in the transect tape back the starting point. Then the divers will collect the gear and swim along the dock back to shore surfacing with 500psi.
Be sure to search the habitat thoroughly however do not conduct invasive sampling (i.e. do not turn over rocks)
Some fishes typical at the NOAA Stellwagen facility dock: sea raven, flounders, rock gunnel, cunner, tautog

Observe Rebreather diver- Phil Lobel will use a Rebreather when diving with various class members to show how system functions and how Rebreather- OC Scuba teams can interface.

DIVE 6 – using NITROX
Sampling Technique Exercise: 1m Quadrats
Purpose: To determine the abundance (density) of selected sedentary indicator species along the dock.
Materials:
• 1 underwater clipboard
• 1 underwater quadrat data sheet
• 1 3-sided PVC meter square quadrats
Methods:
Each Diver will sample pre-determined points along the transect line. These sample points will be selected prior to entering the water. One diver is equipped with the clipboard and transect tape while the other with one quadrat. The divers will lay out the transect tape 5 m together along their sample section of the intake pipe, securing both end of the tapes, and return to the start of the transect tape. Position the quadrat so that one leg is on the pre-determined sampling point and place the other leg on the next greater number. Divers may cause gobies and painted greenlings to retreat into crevices, therefore approach the quadrats slowly to minimize disturbance. Count fish first within the quadrat. Once they are counted, do not count additional fish that swim into the quadrat. Be sure to search under ledges and in cracks for organisms, but do not conduct any invasive sampling (do not turn over rocks or remove organisms). Combine adults and juveniles for all species, except the algae. Record juvenile and adult algae separately. See the "Organisms sampled" section below for the definitions of adult/juvenile algae. After the first quadrat counts are completed divers should switch task and move the PVC quadrat to the sample area on the data sheet. At this point the divers will compare air gauges and if possible switch task. Then the divers will collect the gear and swim along the pipe back to shore surfacing with 500psi.
Some INVERTEBRATES typical at the site: *Metridium* anemones, several varieties of tunicates, lobsters
Snails, mussels, hermit crabs, jonah crab, rock crab, nudibranchs

Observe Rebreather diver- Prof. Lobel will use a Rebreather when diving with various class members to show how system functions and how Rebreather- OC Scuba teams can interface.

DIVEs 7 & 8 – using NITROX

Sampling Technique Exercise: Photography & videography

Purpose: To determine the species identity of species off of the dock area by photo/video documentation. Provides divers with practice in buoyancy control and photography

Materials:

• underwater still and video cameras

• 1 underwater data sheet

Methods: Divers will work in buddy teams to search for and photo/video species found in the vicinity of the NOAA dock.

Underwater video

The use of video underwater has greatly expanded the abilities of the underwater scientist to collect data. Traditionally the only means of recording events underwater was by using still photography. A compact video camera can be placed in a housing and used underwater, recording for up to 120 minutes. These cameras have high resolution and work under low light conditions. Video cameras can be mounted on ROVs and used in areas not accessible to divers. Many quantitative research techniques used with still photography can be adapted for video use including; mapping and quadrat photography, transects and surveys, measuring water flow near surfaces, time-lapse photography, and monitoring predation. Advantages to video over still photography are; longer recording time, and continuous recording. Students are introduced to using video cameras in underwater housings with hands- on familiarization of the systems followed by an underwater shooting session.

Quantitative video and photographic techniques

Underwater video and still photography provides an ideal way of collecting large amounts of data in a short period of time. In addition, a permanent record of the data is obtained and this cam be analyzed at the researchers leisure. Uses of this technique include; percent cover analysis of community structure and competition of encrusting organisms on hard substrates, direct counts of organisms in randomly placed quadrats and photographs of organisms in permanent quadrats. One of the biggest problems of this research method is that large quantities of data are obtained and this can require many hours of tedious data analysis. In this lab different methods of data analysis for determining community structure of a rock wall are compared. The data is collected using a photo and video quadrapod of the same area. Comparisons of still versus video are made as well as comparisons of different methods for analysis for percent cover. Percent cover analysis can be performed by projecting a slide or freezing a video frame and digitizing or random dot patterns. A single video frame or slide image can be grabbed with a computer and areas can be computed using the program Image

Diving Procedures Exercises

For these exercises, the class will be divided into groups. Groups will rotate in using lift bags, boats and accessories.

Dives 9 & 10

Procedures Exercises – using lift bags for salvage recovery and small rubber boat exit/entry skills.

Purpose: To practice the difficulty of diving from small boats and to practice the approved safe method for lifting objects from the seafloor.

Materials:

• small rubber boats (Zodiac & Avon rafts about 8ft)

• lift bags

Methods: Divers will work in buddy teams to practice diver water entry from a small inflatable boat and how to get back into the boat after the dive. Divers will also practice using small liftbags to practice salvage recovery of objects from the bottom.

(IE divers should NOT use BCs for buoyancy when lift heavy gear from the bottom to the surface)

Specimen Collecting Procedures Exercises

For these exercises, the class will be divided into groups. We will have a variety of tools used to capture fishes and invertebrates in the field. Groups will rotate in using nets, spears and other gear.

Dive 11

Procedures Exercises – collecting marine specimens

Purpose: students will learn how to capture marine animals by net and spear

Materials:

• a variety of spears and nets used by ichthyologists

• specimen bags and keeps

- Target floats with anchors

Methods: Divers will work in buddy teams to try using hand nets to collect critters and place into keeps. Divers will practice spearing using a variety of pole spears. Targets will be floats held in place by weights and suspended about 1 m above the bottom. NO live animals will be speared.

Dive 12

Procedures Exercises – Underwater Metal Detecting

Purpose: students will learn how to use an underwater metal detector to search for buried treasure and other debris.

Materials:

• Underwater Metal Detectors (2 units available).

• slate to record position data

- Compass to map search track.

Methods: Divers will work in buddy teams to map a search area while using an underwater metal detector to find buried metal stuff. Students will carefully excavate detected objects, and if small, will bring such to the surface. Location of the search divers swim track and location of objects found will be mapped.

*****

WEATHER can impact our field diving schedule

*****

Note: this course will require readings and homework to be done in evenings and over weekends

We are targeting for a minimum of 12 training dives (6hrs BT) but if time and weather permit, additional training dives will be added.

The course diving exercises may be altered based upon the experience level(s) of students in the class.

*****

WEATHER can impact our field diving schedule

*****

Consequently, classroom and dive day schedules may be swapped depending on field diving conditions. We need to be flexible in the schedule.

MS533 Course DIVE PLAN, Sepember, 2017

BU DIVE PLAN, Sepember, 2017

Project location: NOAA Stillwagen facility, Scituate MA
Diving is being conducted under the MOU aggrement between NOAA and BU for scientific diving.

Field Dates: September, 2017: BUMP Block 1, scientific diving course.

Divers Qualifications:

Prof. Phil Lobel	BU Professor: Dive Supervisor.
Katey Lesneski	BU Teaching Fellow and Lead Diver

Emergency Contacts

- refer to separate list for class contacts, appended (to be updated after class day)

Recompression Chamber/Hospital/Transportation:

Transportation by emergency response to 911 phone call.
(see additional chambers in MA on attached pages)

Primary Operational Hyperbaric Chamber

Name:	Massachusetts Eye and Ear Infirmary,Norman Knight Hyperbaric Medicine Center
Address:	243 Charles Street Boston, MA 02114
Point of Contact:	Director Daniel G. Deschler, M.D., F.A.C.S
Telephone Number:	(617) 573-4411

Secondary Operational Hyperbaric Chamber

Name:	South Shore Center for Wound Care and Hyperbaric Medicine
Address:	90 Libbey Industrial Parkway, Suite 100 Weymouth, MA 02189-3130
Point of Contact:	Gary Gibbons, MD Medical Director
Telephone Number:	(781) 624-4950

DIVERS ALERT NETWORK
USA 919-684-4326

Boston University Project numbers
BUMP MS533 Scientific Diving course

Approximate Number of Proposed Dives:
Approximately 12 person over the course of 4 weeks. We will typically make one to four dives per day per person. Total 6 hours BT is required.

Location of Proposed Dives:

1. NOAA Stillwage dock facility, Scituate Harbor, MA
2. Offshore of Scituate harbor, diving from RV SEACAT, water depth max 45ft
3. WHOI dock, Woods Hole
4. MBL Beach, Woods Hole
5. Gloucester, MA beach dives

Estimated depth(s) and bottom time(s) anticipated:
All dives are planned to be less than 60 ft. for variable times. Dive computers will be used. Most training dives will be at the NOAA Scituate dock with maximum water depth of 25ft. The water depth at the offshore of Sciuate harbor diove site is less than 45ft. The WHOI dock is the deepest dive site at 60 ft depth.

Decompression status and repetitive dive plans:
All dives are planned for no decompression. All divers will be using dive computers.

Notify chamber if decompression diving is anticipated:
Not anticipated; but details contact for all chamber in area is attached

Proposed work, equipment, and boats to be employed:
For teaching the BUMP scientific diving course in Sept 2017.

Any hazardous conditions anticipated:
All diving will adhere to the Boston University Diving Safety Manual.
Emergency oxygen and first aid kits for first aid will be available.
Potential hazards include stings by marine life (first aid kit will be onsite).

Fishing Line hazard potential – since we are diving in a harbor at a dock, the potential exist for fishing line to be present. This is a risk of entanglement for the diver, therefore each diver will be equiped with a knife or a BUMP issued 'DAN Trilobite' cutting tool.

Dive Plan

Divers will be conducting training as detailed in the MS533 course syllabus.
Activities include gear manipulation, rescue techniques training and conducting underwater surveys, both visual and photographic.

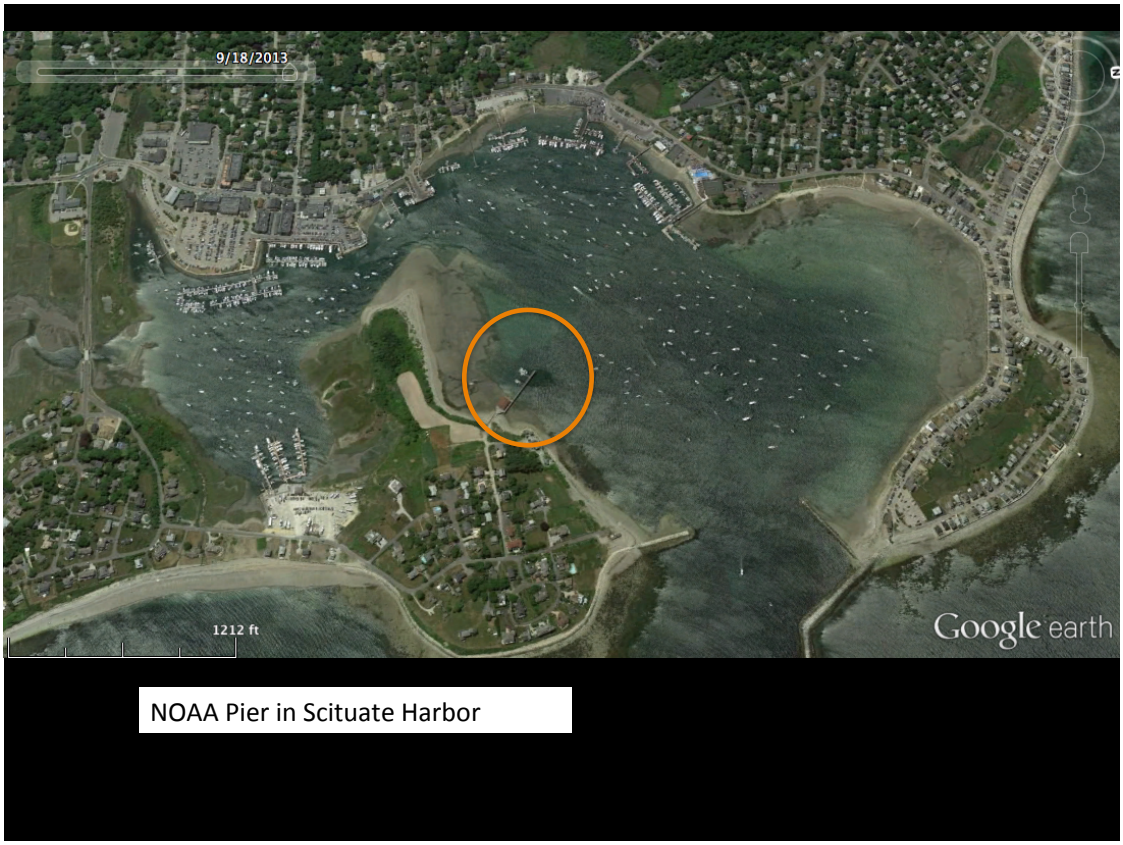
Dive Sites description:

Scituate Harbor

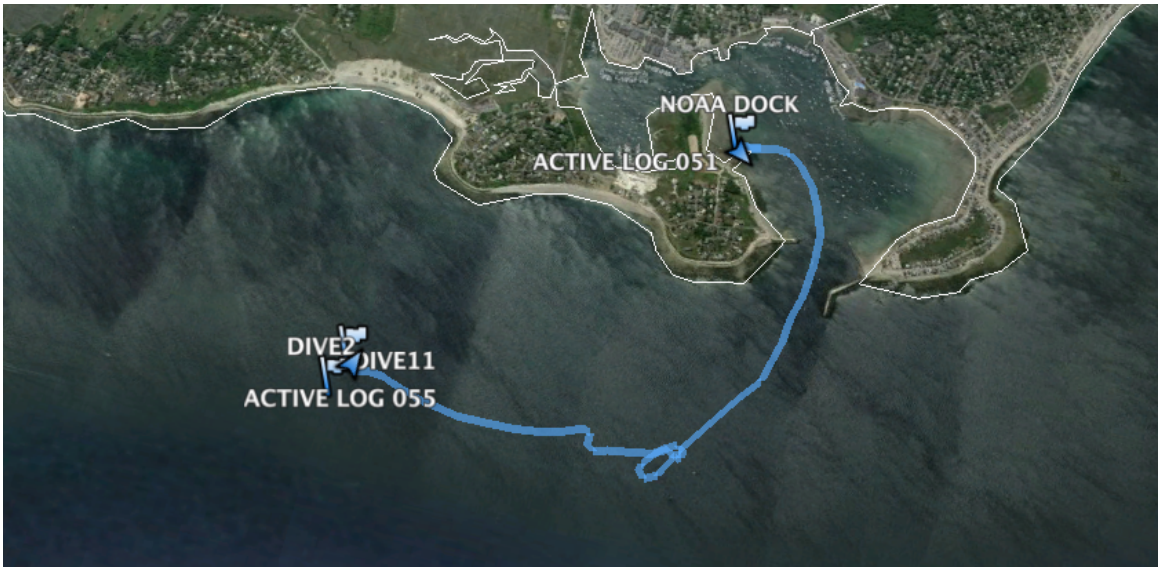
Dive site location details on web at http://stellwagen.noaa.gov/about/office.html
175 Edward Foster Road Scituate, MA 02066 Phone: 781-545-8026

Diving will be from the dock and from the R/V SEACAT at a location just outide of the harbor.

Scituate Harbor is the class primary dive location. Additional dive locations are also included below, which may be used if time and weather permit



The NOAA dock dive location: diver activities are closely coordinated with NOAA ship operations so that divers are not in the water when the ship is active.



Offshore dive site, one mile from the NOAA dock, water depth ~ 40ft.
Diving from the R|V SEACAT.

OTHER DIVE LOCATIONS – *exact time and dates weather dependent*

Woods Hole
The WHOI dock and the MBL 'Garbage' beach are areas used frequently for AAUS training and proficiency dives. Entry is a shallow beach with sea grass. The slope is gradual, dropping to about 20m at it's deepest point. At approximately 3 m, the slope becomes a mixture of sand and rocks. Currents are typically low in this region except on spring tides. Primary hazards are boats and fisherman, described above. In addition, this region can experience very low visibility (<10ft). As such, review of lost buddy procedures will be reviewed prior to every dive.

Marine life hazards are typically low, although there are skates and rays that should be avoided as some have stingers or are electric. Large sharks are extremely rare, but can occur in local waters. Similarly, Portuguese Man-o-war can drift into local waters. No diving will be conducted during such times.

Prior to the commencement of any diving activities, Dr. Lobel will assess the conditions of the dive site and provide a briefing about the conditions prior to diving, and will review safety and lost-buddy procedures. Based on the prevailing conditions, diving will only occur if conditions are deemed safe. All divers will have the right not to dive if the pre-dive briefing indicates conditions in which they are uncomfortable diving.

Gloucester, MA

There are several good beach dives in the Gloucester area.
These are two we usually go to.

Pebble Beach in Gloucester, MA

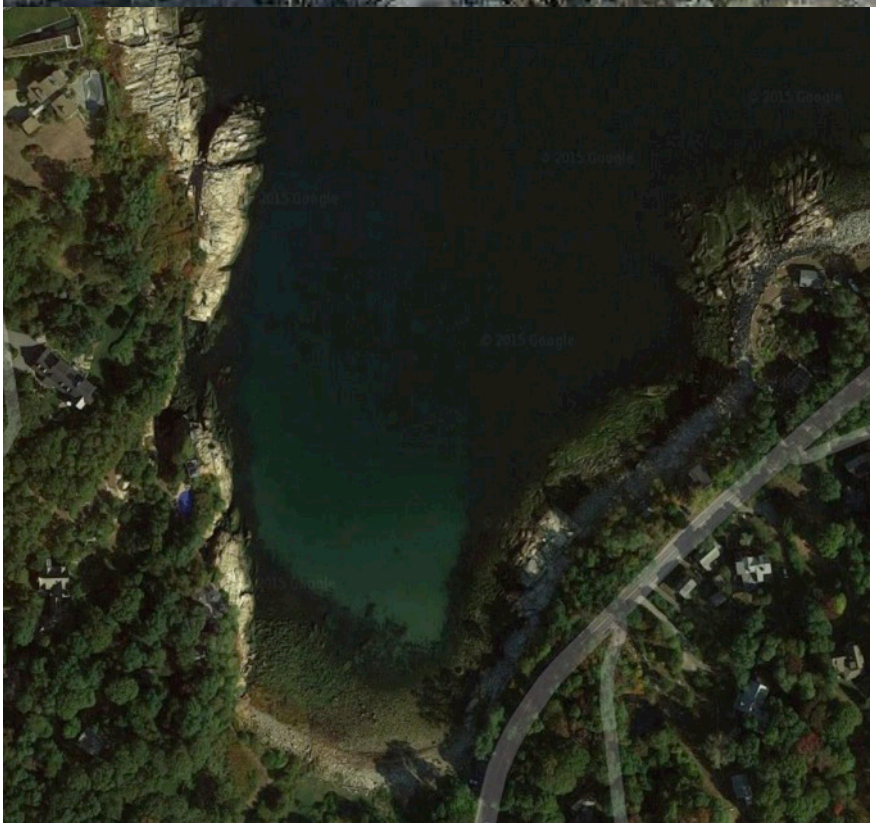
The dive will be conducted at Pebble Beach in Gloucester, MA. The proposed site is a coastal shallow sandy beach with an average depth of 12ft. Visibility at this site is variable, and can range from 5-18 ft.

Folly Cove in Gloucester, Massachusetts

The dive will be conducted at Folly Cove in Gloucester, Massachusetts. The proposed site is a sheltered, saltwater cove with a mostly sandy bottom and surrounded by sloping rock walls. The left rock wall extends to a maximum depth of 75 ft, while the right rock wall can read 50 ft. Visibility at this site is variable, and can range from 5-20 ft.

see photos next page


ShareDiving.com



Emergency Plans:

For suspected DCS or other dive-related injuries possibly requiring recompression, we will call 911 and DAN USA or (1-). DAN will provide guidance as to the treatment of the diving injury as well as assist in arranging necessary dive specific medical. For all other injuries that require emergency medical, we will call 911.

Oxygen kits and first-aid kits will be on site and on the boat.

DAN USA: 1-919-684-8111

See additional information on Boston Area Hyperbaric chambers, attached

DIVING EMERGENCY MANAGEMENT PROCEDURES

Introduction

A diving accident victim could be any person who has been breathing air underwater regardless of depth. It is essential that emergency procedures are pre-planned and that medical treatment is initiated as soon as possible. It is the responsibility of each Boston University Principle Investigator to develop procedures for diving emergencies including evacuation and medical treatment for each dive location.

General Procedures

Depending on and according to the nature of the diving accident:

1. Make appropriate contact with victim or rescue as required.
2. Establish (A)irway, (B)reathing, (C)irculation as required.
3. Stabilize the victim
3. Administer 100% oxygen,
   if appropriate (in cases of Decompression Illness, or Near Drowning).
4. Call local Emergency Medical System (EMS) for transport to nearest medical treatment facility.

Explain the circumstances of the dive incident to the evacuation teams, medics and physicians.

Do not assume that they understand why 100% oxygen may be required for the diving accident victim or that recompression treatment may be necessary.

5. Call appropriate Diving Accident Coordinator for contact with diving physician and decompression chamber. etc.
6. Notify DSO or designee according to the Emergency Action Plan of the Boston University.
7. Complete and submit Incident Report Form of the BU Dive Safety Manual to the BU DSO (Section 2.70 Required Incident Reporting).

MS533 Course Boat Float Plan

Trip Details

Departure Date: Sept 2016 Time: 1000 Return Date: Sept 2016 Time: 1630

daily on select dates during BLOCK 1 BUMP semester, weather dependent

Departing From: NOAA Scituate facility dock Returning to: same

Going to: offshore site outside of harbor VIA: Scituate harbor

Return VIA: Scituate harbor **Latest Time of Return**: 1630

Other travel notes: We will have communications with NOAA and the Scituate Harbor Master as well as the USCG, see cruise plan map below

Weather Considerations Source: Weather Channel

OTHER PEOPLE ON BOARD

NAME	Phone #
Prof Phillip Lobel	508 274 9783
Plus members of MS533 See dive plan for list and details	

Name of vessel: R/V SEACAT

Operator Name: Prof Phillip Lobel Telephone #: 508 274 9783

Local address: Bio Dept, BU

BU Principle Investigator: Prof Phillip Lobel On Board? max 8 people with dive gear

Description of Vessel

Type: twin hull power cat Color: white

Color of Trim: white Registration # MS

Length: 21-feet Sails: N/A Make: American Fiberglass

Engines: twin 90-hp outboard

"Seacat" has been the Lobel Lab Boat since 1993.

Survival and Safety Equipment

PFD's: min 8 Paddles: 2 Bell/whistle/horn: whistle and horn

Working Radio: 2 Monitoring Channel: 16 Cell phone: 508-274 9783

Day Signals: yes, + flares Night Signals: red/green/white lights + flares

Exposure Protection: none

Anchor: yes Amount of line: > 100-feet Sea Anchor: no

Fire Extinguisher: yes Bailing Device: yes Tool kit: yes

Compass and Charts: yes

Notification

Shore Contact: Dave Slocum, NOAA Phone: 978 500 0761 cell or Office: 781-545-8026

alternative contact Matt Lawrence, NOAA Office: 781-545-8026 x213

Mobile: 617-827-4368

If no contact is made with Shore Contact by: 1400hrs (time)

Call the Coast Guard (Boston) at (617) 223-3333 or

Police Department at 911

Planed Activity: class scuba training, see dive plan for details

see next page for cruise plan map

Offshore dive site, one mile from the NOAA dock, water depth ~ 40ft.
Diving from the R|V SEACAT.

total travel from dock to dive site approximately 1 nm

COURSE INSTRUCTORS

Professor

Phillip Lobel, PhD, phone 508 274 9783

Professor of Biology, Boston University

- Lifetime member of the American Society of Ichthyologists and Herpetologists
- **2012 NOGI Science Awardee** and Lifetime Fellow of the Academy of Underwater Arts and Sciences
- former BU Dive Safety Officer 2003 - 2016
- Current Diving and Emergency Response INSTRUCTOR Certifications

National Association of Underwater Instructors (NAUI)

- Scuba and Nitrox Instructor - # 41363

American Academy of Underwater Sciences (AAUS)

- Scientific Diving Instructor - # 18739

Divers Alert Network (DAN) Instructor - # 293390

Instructor for all of the following

- CPR: Health Care Provider
- Diving Emergency Management Provider
- Diving First Aid for Professional Divers
- Emergency Oxygen for Scuba Diving Injuries
- First Aid for Hazardous Marine Life Injuries
- Neurological Assessment

Scuba Diving International (SDI-TDI) Instructor - # 18887

- Open water Scuba diver Instructor
- Computer Nitrox Instructor
- CPROX1st AED Instructor
- CPROX Instructor
- CPR1st Instructor

Teaching Fellow

Ms. Kathryn Lesneski, phone 978-729-0116

PhD Candidate, Biology Dept. BU

Assistant Dive Instructor.

Ms. Kathryn Lesneski has been diving since 2007 and became a PADI Divemaster (DM) in August 2013, an AAUS Dive Leader in 2015, and a NAUI Assistant Instructor in 2016. She has logged over 270 dives and nearly underwater without incident. She has interned or worked as a DM at 3 scuba shops, in New England and Florida. About 50 surveying dives were conducted in Trinidad and Tobago with Coral Caye Conservation in 2008, another 30 for recreation and surveys in Turks and Caicos in 2011, 30 for research near Tavernier, Florida, and 40 for research at Calabash Caye, Belize. The majority of the remaining dives were recreational and training dives in the cold waters of New England and California and warmer waters of the Florida Keys