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# Using acoustic methods to assess human impact on dolphins in Sardinia (Mediterranean Sea), Italy

***Course ID: ARCH 365BR***

***May 20-22 online, June 2 - 14, 2025 on site***

**Academic Credits: 4 Semester Credit Units**

**FIELD SCHOOL DIRECTOR(S)**

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**OVERVIEW**

The field school is part of long-term projects carried out by MareTerra ERC in collaboration with the University of Sassari and local stakeholders. Field school students will participate in two case studies aimed at evaluating the impact of human activities (fishing and tourism) on the local dolphin population, with the aim of identifying management and mitigation actions useful to the local and regional authorities.

**First case study: Finding the best way to measure dolphin depredation with sound technology**

The interaction between common bottlenose dolphins (*Tursiops truncatus*) and small-scale fisheries in Sardinia is a really frequent phenomenon with conservationist and economic consequences. Bottlenose dolphins interact with static nets deployed by fishers while foraging for prey, leading to instances of accidental entanglement or bycatch. Such interactions can result in injury and mortality for dolphins, as well as economic losses for fishers due to damaged gear and reduced catch quality and quantity. Understanding the dynamics of the interaction between dolphins and fishers is crucial for implementing effective conservation measures and promoting sustainable fisheries management.

**Second case study: Measuring how leisure boating noise impacts common bottlenose dolphin**s

The growing concerns regarding the impact of leisure boating on marine ecosystems are particularly pertinent for marine mammal species, given their dependence on sound and their significant spatial overlap with human activities. Marine mammals can alter their behavior in response to disturbances caused by leisure boating. Common bottlenose dolphins (*Tursiops truncatus*) utilize acoustic signals, known as signature whistles (SWs), for individual identification, communication, and social bonding. Therefore, this study aims to explore how the intensity of leisure boating influences SW characteristics and whether this influence remains consistent across different social contexts (e.g., group size and presence of calves), environmental conditions (e.g., seabed habitat type), and behavioral states within a population of bottlenose dolphins inhabiting the north-western coast of Sardinia (Mediterranean Sea, Italy). The results will determine if SW acoustic properties change in response to varying levels of leisure boating, suggesting whether SWs could serve as a reliable bioindicator for boating disturbances.

**ACADEMIC CREDIT UNITS & TRANSCRIPTS**

**Credit Units**: Attending students will be awarded 4 semester credit units through our academic partner, Connecticut College. Connecticut College is a highly ranked liberal arts institution with a deep commitment to undergraduate education. Students will receive a letter grade for attending this field school (see assessment, below). Students are encouraged to discuss the transferability of credit units with faculty and registrars at their home institution prior to attending this field school.

**Transcripts**: An official copy of transcripts will be mailed to the permanent address listed by students on their online application. One more transcript may be sent to the student's home institution at no cost. Additional transcripts may be ordered at any time through the National Student Clearinghouse.

## PREREQUISITES

The students aimed to attend the field school should have the following skills and prerequisites:

1. Students enrolled on one of the following courses may apply:

- Biology
- Environmental Science or similar
- Environmental management or similar

2. Required skills

- Minimum age of 18 years
- Good mental and physical health

- Self-confidence, flexibility, adaptability and punctuality

- Strong motivation and responsibility

- Confidence on board a motorboat

- Ability to swim properly

- Ability to work long hours in the field and the laboratory.

**COURSE OBJECTIVES**

Learning objectives:

- Increase knowledge about dolphins and the effect of human activities on their conservation.

- Gain experience in fieldwork and lab work related to marine ecology and biology and marine mammals' behaviour and acoustic.

During the activity related to the first case study, students will be engaged in field acoustic data collection using three different methods: i) high-performance Passive Acoustic Monitoring (PAM) devices (URec by NAUTA); ii) low-cost PAM devices (HydroMoth by OAD); iii) a data loggers designed to automatically monitor echolocation clicks within the relative app (FPOD by Chelonia Limited). Particularly, during commercial fishing activities, acoustic data will be simultaneously collected by means of URec, HydroMoth and F-Pod. Then, students will analyze the recordings captured by URec and HydroMoth devices by means of the visual inspection of spectrograms to identify echolocation clicks. These findings will be compared with the automatic click detection obtained by F-POD to assess its reliability. Additionally, recordings from URec and HydroMoth will be analyzed by students using acoustic indices, such as the Acoustic Complexity Index, to explore the feasibility of employing faster analysis methods to derive realistic measures of dolphin depredation.

During the activity related to the second case study, students will join boat surveys dedicated to the collection of dolphin behavioral and acoustic data. During each survey, when a dolphin sighting occurs, students will collect surface behavioral and acoustic data, the coordinates of the sighting, the presence of newborns and calves, and the presence and number of boats within 500 m of the focal group. Students will learn how to analyze the collected data in Q-GIS and the acoustic recordings in Raven Pro 1.6.5. In the latter case, the SIGnature Identification (SIGID) method (used to recognize signature whistles in the recordings) will be applied.

**LEARNING OUTCOMES**

At the end of the field school, students will be expected to have learned:

1. Basic knowledge on Mediterranean environments.
2. Basic knowledge on the ecology, behavior and acoustic of common bottlenose dolphins.
3. Basic knowledge on the impact of small-scale fisheries and tourism on dolphins and marine environment.
4. Field methods to collect data on dolphin presence, behavior and acoustic.
5. Use of PAM devices and hand-held hydrophone.
6. Techniques and software to analyze ecological and acoustic data. Specifically, the following software will be used: R Studio and Raven Pro for the acoustic analyses and Q-GIS for the ecological analysis.
7. How to read and critically evaluate a scientific article.
8. How to make and present a scientific oral communication.

## ASSESSMENT

Students will learn how to collect and analyze ecological and acoustic data and how to present it to a scientific community. Learning will be evaluated on a scale from 1 to 100 as follows:

- 15 points for the discussion on the scientific articles related to the topics of the case studies which will be discussed and explained during two online meetings prior to the start of the field school.

- 25 points for the quality of the data collected in the field.

- 25 points for the accuracy of the analysis carried out in the laboratory.

- 35 points for the final presentation on the activities carried out which will have to follow the structure of a short talk at a conference (main questions addressed; methods; results; main outcomes and take-home message).

For the final oral presentation, students will be trained on the points that make a successful scientific presentation. After the first week, students will have the opportunities to prepare the presentation and run practice every day for a couple of hours, working in autonomy in small groups.

## COURSE SCHEDULE

All IFR field schools begin with an orientation that addresses local and program protocols concerning student behavior, appropriate attire, local practices and sensibilities that may be unfamiliar, potential fauna and flora hazards, IFR harassment and discrimination policies, and the student Code of Conduct.

Please note that the schedule outlined in this syllabus can be disrupted by unforeseen circumstances, including weather, revisions by local permitting agencies, or conditions onsite. While this schedule represents the intentions of the program, adaptability is an intrinsic part of all field research, and necessary alterations to the schedule may happen at any time.

**May 20-22**

Before the start of the field school, students will be provided with scientific articles related to the topics of the case studies which will be discussed and explained during two online meetings, along with the basic methods and analysis techniques that will be used during the field school.

The online meeting will be held at the beginning of May, with the following organization:

- First meeting (2 hours with the teacher + 2 hour of individual study)

During the first meeting, the teacher will explain the main foundation of a scientific study, starting from the structure of a scientific paper. Particularly, the following points will be discussed:

i) What are the main driving questions of the paper?
ii) Why are the questions relevant?
iii) What data is needed to address the questions?
iv) What methods are used to collect the data?
v) What are the strengths and limitations of these methods as discussed in the article?
vi) What conclusions are drawn?
vii) Do the data collected and the analyzes conducted support the conclusions suggested by the authors?

Next, the teacher will present the list of required readings and online contents that will help students successfully participate in the field school.

- Second meeting (2 hours with the teacher + 2 hour of individual study)

During the second meeting, the foundation structure of a GIS project will be explained with the aim of providing basic knowledge and tools to transform data collected in the field with a GPS into geographic information useful for the study of an animal species. In particular, the aspects related to the use of GIS in marine biology will be discussed by addressing the following points:

i) The basics of GIS: what is a GIS and related common concepts and terms
ii) The geographic data: vector and raster models
iii) Setting up a GIS projects and a GPS receiver to gather data
iv) Field data: how to convert GPS data in GIS data
v) Add data to the GIS project: representation of the field monitoring activities and species distribution
vi) What kind of spatial analysis can be done with GIS data in marine biology?

QGIS download page: https://www.qgis.org/download/ (download the long term version)

QGIS does not require or specify any particular system requirements, however, to avoid your GIS software stalling and crashing and processes are elaborated at a proper speed, here we provide them:

| **System Requirements** | **Minimum** | **Recommended** |
|---|---|---|
| Processor - CPU | Core i3 2.7 Ghz | Core i7 3.5 Ghz |
| Memory RAM | 2 Gb | 8 Gb or More |
| Hard Disk Storage | 1 Gb | 1 Tb for professional users |
| Graphic Card | 1 Gb RAM | 2 Gb RAM (NVIDIA GeForce) |

To check the hardware for Windows users:

1. Click on the Windows Start button
2. Click on Settings (the gear icon)
3. In the Settings menu, click on System
4. Scroll down and click on About
5. On this screen, you should see specs for your processor, Memory (RAM), and other system info, including Windows version system info, including Windows version.

To check the hardware for MacBook users:

1. Click the Apple icon and choose About This Mac.
2. The Overview tab will provide the operating system version, processor, and memory information

**June 2-14**

During the first day of the field school, basic knowledge on the topics of the field school, sampling protocols and sound analysis techniques will be deeply explained by means of lectures and exercises.

From the second to the tenth day, in the morning students will be involved in data collection, while the afternoons of each day will be dedicated to the analysis of the acoustic recordings and ecological data collected, under the supervision of the tutors assigned to the students.

During the evening hours of two days a week, each student will be asked to present to the class the objectives, methods and results of two studies chosen from those assigned as compulsory readings.

At the end, in the last two days of the field school, students will be asked to produce an oral presentation of the activities carried out which will have to follow the structure of a short talk at a conference: main questions addressed; methods; results; main outcomes and take-home message.

## REQUIRED READINGS

PDF files of all mandatory readings will be provided to enrolled students. Program participants are expected to be prepared to engage in discussions led by facilitators, all of whom will be looking for compelling evidence that students have read and thought about the assigned readings prior to the scheduled day on which they are first discussed.


- La Manna, G. et al. Whistle variation in Mediterranean common bottlenose dolphin: The role of geographical, anthropogenic, social, and behavioral factors. Ecol. Evol. 00, 1–7 (2020).
- La Manna, G., Manghi, M., Pavan, G., Lo Mascolo, F. & Sar., G. Behavioural strategy of common bottlenose dolphins (Tursiops truncatus) in response to different kinds of boats in the waters of Lampedusa Island (Italy). Aquat. Conserv. 23, 745–757 (2013).
- La Manna, G., Rako-Gospić, N., Manghi, M. & Ceccherelli, G. Influence of environmental, social and behavioural variables on the whistling of the common bottlenose dolphin (Tursiops truncatus). Behav. Ecol. Sociobiol. 73, 12 (2019).
- Janik, V. M. & Sayigh, L. S. Communication in bottlenose dolphins: 50 years of signature whistle research. J. Comp. Physiol. https:// doi. org/ 10. 1007/ s00359- 013- 0817-7 (2013).
- La Manna, G., Arrostuto, N., Moro Merella, M., et al. Towards a sustainable fisher-dolphin coexistence: Understanding depredation, assessing economic damage and evaluating management options. Journal of Environmental Management, 351 (2024).
- La Manna, G., Arrostuto, N., Campisi, S.S., Manghi, M., Fois, N., Ceccherelli, G. Acoustic detection of bottlenose dolphin depredation on nets and implications for conservation. Aquat. Conserv. Mar. Freshw. Ecosyst. 2022, 1–12.
- Romeu B, Cantor M, Bezamat C, Simões-Lopes PC, Daura-Jorge FG, Ebensperger L. Bottlenose dolphins that forage with artisanal fishermen whistle differently. Ethology. 2017;123(12):906-915.
- Valle-Pereira JVS, Cantor M, Machado AMS, Farine DR, Daura-Jorge FG. The role of behavioural variation in the success of artisanal fishers who interact with dolphins. ICES journal of marine science. 2022;79(4):1150-1158. doi:10.1093/icesjms/fsac038