Course Title: Cryobiology and Thermal Ecology

Modality: CFT- Transversal Training Course

Orientation:

- ☒ Ocean Observation and Global Change
- ☒ Sustainable use of Marine Resources
- ☐ Integral Management of the Sea
- ☐ Technological progress. Engineering and Business Management

Dates: 9-13 March

Timetable: 10-14.00h

Duration: 25 hours (20h in-person lectures and 5h of work at home)

Location: Aula de videoconferencia Edifico CITEXVI

Language: English and Spanish

Academic coordinators:

Name	Institution	e-mail
Estefania Paredes	Universidade de Vigo	eparedes@uvigo.es

Lecturers:

Name	Institution	e-mail
Estefania Paredes	Universidade de Vigo	eparedes@uvigo.es
Jesus Souza Troncoso	Universidade de Vigo	troncoso@uvigo.es

General description:

Temperature is one of the most important factors shaping life and ecosystems. In this course we will study how temperature affects water (in all the phases) and life under different situations from optimal ranges to extremes. Once we have discussed how temperature interacts with salinity, pH, pressure, thermodynamics, metabolism and other factors… we will approach the use of low temperatures for conservation: cryopreservation. This course will explain the basic concepts of cryobiology and the latest findings and uses regarding aquatic organisms.

Content:

The course will count with a couple of hours of lectures (topics 1-5) every day, plus a 30 minute coffee break, plus a talk (either in person or online) about related topics to the prior lectures.

1. The importance of water for life & ecosystems.

Liquid water, Ice, Changes of phase under different situations, Sea water-specifics

2. Thermal Ecology
Definition of thermal events, Margins of temperature (max/min) on earth, Temperature distribution in the ocean and how this factors shape life and ecosystems. 1 hour lecture from Jesus Troncoso about research in Polar and Tropical climates.
3. Life in extreme environments
Extreme temperatures, Extreme water contents, Extreme radiation and life limits under those circumstances. Natural cryoprotection. Thermal Ecology and Cryobiology.
4. Cryobiology
What is Cryobiology and its funding principles, Cooling and warming rates, Storage & ice stability, Benefits/uses of Cryobiology. Cryoprotecting agents: natural, chemical, synthetic.
5. Cryobiology applied to the marine environment
Specific problems & Specific solutions, What can be cryopreserved? What kind of cells cannot be preserved right now?, Cryobanks, Where if the future leading?
6. Assignment: case study

Teaching methodologies:
The 20 hours in-person lectures will be devoted to the delivery of the contents, the discussion of practical cases for the written report, and the resolution of doubts. In each of the two morning sessions there will be a 30-minute break. In addition, it is estimated that the student must devote another 5 hours to personal study (consultation of the teaching material supplied) and writing about a case study of their choice for the assignment (4 pages report whose initial ideas should be briefly presented in the last class 13/03/2020). The deadline to submit the written assignment that includes comments made during the prior presentation is the 16/03/2020, if you deliver the report after the deadline, this will only count for 60% of the total 5 hours stipulated (i.e. 3h). The report case is mandatory in order to pass the course.

Evaluation system:
The students will be graded by a pass/fail criteria based on his/her presence and participation in class and the assignment. In order to pass the course, the student must take, between in-person lectures and the assignment, a minimum of 80% of the total hours (i.e. 20h).

Brief CV of the lecturers:

Estefania Paredes: Juan de la Cierva Researcher at Universidade de Vigo at the ECOCOST lab, PhD from Universidade de Vigo 2014 in Ciencias do Mar. Expert in Cryobiology with international research experience in Cawthron Institute (NZ) and University of Tennessee (USA), Aplysia (Br), Catalina Sea Ranch (USA) between 2012 and 2019. She has participated in 7 projects with national and international funding, author of more than 20 papers published in cryobiology and amounting experience in the development of cryopreservation protocols for marine invertebrates, Microalgae, ICR-mice, Zebrafish and microorganisms. Directed 4 TFMs and 6 TFG and is currently directing two PhDs in cryobiology. She is the responsible of the Functional Preservation of Marine Biological Resources Service of ECIMAT.

Jesus Souza Troncoso: Catedratico at Universidade de Vigo, ECOCOST lab. With over 200 different publications he is a professor of Zoology at the Universidade de Vigo that has innumerable experience in benthic ecology and has directed countless students along the years. He has a very active national and international presence both teaching, mentoring and researching. Jesus has been several times sampling in Antarctica and has many publications regarding Polar ecology and biology. Recently he is involved in the study of benthic biodiversity at the ARMS project, he is the Principal Investigator for the Universidad de Vigo for both the Assemble + and the European Blue Biobank. He is also one of the authors of the "Guia de los Moluscos Marinos de Galicia" 2018.

Relevant references:

S.L. Adams, J.F. Smith, R.D. Roberts, A.R. Janke, N.G. King, H.R. Tervit, S.C. Webb, Application of sperm cryopreservation in selective breeding of the Pacific oyster, Crassostrea gigas (Thunberg). Aquaculture Research 39, 13 (2008), pp: 1434-1442.

A. Clarke, Principles of Thermal Ecology: Temperature, Energy and Life. Oxford 2017.

J.G. Day, J.J. Brand, Cryopreservation methods for maintaining microalgal cultures. In: Algal Culturing Techniques. R.A. Andersen (Ed.), Academic press, New York (2005), pp: 165-187.

W.V.Holt, Cryobiology, wildlife conservation and reality. CryoLetters 29 (2008), pp: 43-52.

N. Kronfeld-Schor, T. Dayan, Thermal Ecology, Environments, Communities, and Global Change: Energy Intake and Expenditure in Endotherms. Annu. Rev. Ecol. Evol. Syst. 2013. 44:461–80

P. Mazur, Cryobiology: the freezing of biological systems. Science 168 (1970), pp: 939-949.

P. Mazur, The role of Intracellular freezing in the death of cells cooled at supraoptimal rates. Cryobiology 14 (1977), pp: 251-272.

P. Mazur, Limits to life at low temperatures and at reduced water contents and water activities. Origins of Life 10 (1980), pp: 137-159.

E. Paredes, Exploring the evolution of marine invertebrate cryopreservation - landmarks, state of the art and future lines of research. Cryobiology 71-v2, (2015), pp: 198-209.

T. Zhang, Cryopreservation of gametes and embryos of aquatic species. In: Life in the frozen state. B.J. Fuller, N. Lane, E.E. Benson (Eds.) CRC Press (2004), pp: 415-136.