

ENEA

ENEA is the National Agency for New Technologies, Energy and Sustainable Economic Development, a public body aimed at research, technological innovation and advanced services to enterprises, public administration and citizens in the sectors of energy, environment and sustainable economic development. ENEA has highly qualified personnel, advanced laboratories, experimental facilities and excellent instruments for the realization of projects, studies, tests, assessments, analyses and training services, with particular reference to product and process innovation to contribute to the development and competitiveness of the national economic system.

Its focus sectors, organized in 4 Departments, are: energy technologies, sustainability of territorial and productive systems, nuclear fusion and nuclear safety, energy efficiency, technologies for cultural heritage, seismic protection, food safety, environment, life sciences, strategic raw materials, climate change, efficiency, technologies for cultural heritage, seismic protection, food safety, environment, life sciences, strategic raw materials, climate change. Moreover, it supports the productive system as well as public authorities in the transition towards the circular economy and the resource efficiency. ENEA has full statutory and regulatory autonomy, refers to the European Charter for Researchers, pursues gender equality, is a public research body endowed with scientific, statutory, regulatory, financial, organizational, patrimonial, accounting autonomy.

Belonging to SSPT Department, the S. Teresa Marine Environment Research Centre (La Spezia) and Portici Research Centre (Naples) are the two ENEA Centers focusing on marine studies.

S. TERESA MARINE ENVIRONMENT RESEARCH CENTRE



Focusing on research and development of methodologies and tools for the protection and sustainable management of the marine environment, including the use of bioindicators to detect environmental quality and effects of climate change. The ongoing research activity in the area began in the early 1960s and intensified starting in the 1970s. It produced a series of long-term ecological data, included in the Long Term Ecological Research Network (LTER: <https://lternet.edu>). Currently, historical data series of chemical-physical variables are available that contributed to developing a better understanding of the oceanographic circulation and anomalies in physical and biological processes in this area of the Eastern Ligurian Sea. For over 60 years, the Centre was involved in a large number of collaborations and national and international projects all addressing the marine environment (see a list of the most recent ones in Paragraph 8).

The Centre has a strategic position due to its proximity to areas recognized as UNESCO world heritage sites for their environmental and landscape value (Porto Venere Regional Natural Park and Cinque Terre Marine Protected Area and National Park). It is also located next to areas with an industrial footprint and a strong environmental impact (port of La Spezia, ENEL power station, shipbuilding, sport/commercial fishing and shellfish farming) and constitutes an important natural laboratory for the studies of direct and indirect anthropic impacts on coastal marine ecosystems.

BIOLOGICAL RESOURCES

ORGANISM COLLECTION

Given the position of the Centre, the collection of marine organisms is available from the closest coastal marine sites (Regional and National Parks) as well as from the harbour area. The most relevant habitats are *Posidonia* meadows, coralligenous, *Cladodora caespitosa* beds, and several intertidal habitats mainly dominated by calcifying ecosystems (i.e. coralline algae, bryozoans, mollusks...). Several stations and ecosystems are regularly monitored by ENEA's researchers in natural and impacted sites, contributing to an EU Network (eLTER) and local projects (e.g. Smart Bay Santa Teresa: <https://smartbaysteresa.com>).

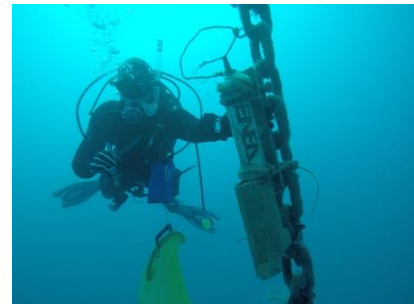
Organism collection is generally carried out, after the approval of competent organisms, in Regional and National MPAs, via scuba diving for limiting the impacts on living marine resources. The Centre has a thermostatic room and aquaria (30 to 300L) provided with heaters and aerators for living organism maintenance.

TAXONOMIC SERVICE

The Centre is provided with a library with taxonomic books for phytoplankton and benthos as well as optical microscopic facilities for sample observations. Researchers expertise is available on some taxa: coralline algae, seagrasses, corals and bryozoans. For diatoms and bryozoans, small collections of recent and fossil specimens are also available for consultation.

ECOSYSTEM ACCESS

SCIENTIFIC DIVING AND VESSELS



The diving unit is present within the Centre and consists of: an air refilling station (compressor) and cylinders (12, 15 and 18 litres).

Coastal vessels:

“S. Teresa”, PRVF motorboat (1986), Length: 11,60 x 3.90 m, N° of engines: 2 Tot.: 147 kW, max speed: 20 knots and available for navigation within 12 nautical miles (capability: 8 people, including the crew). Average fuel consumption: 40L/ h. On board equipment: GPS, Sonar, VHF, Deck lights, 12V charge, 220V Charge, RADAR. Equipped for: Diving support, Water sampling, Sediment sampling, Oceanographic sampling. Technical equipment: Hydraulic/Electric winch.

“S. Teresa” is the master vessel, usable for different types of operations from diving to sediment sampling (coring), oceanographic activities and deep explorations (via ROV). It is managed by a Professional Diving Company, responsible for the security of the whole crew, including researchers, and it is hosted in the Harbour of La Spezia. The boat is old and engines – fully revised and

functioning- are not very powerful, so it works ideally in the area of the Gulf of La Spezia (max distance: Cinque Terre National Park). Originally designed for longer cruises, it is provided with 4 berths and a toilet, thus the boat has a covered space allowing comfortable diving operations in winter.

“Arianna”, VTR (EOLO) speedboat (1991), Length: 6 x 2,40 m N° of engines: 1 + 1 Tot.: 85 CV + 8 CV, max speed 25 knots for navigation within 6 nautical miles (capability: 5 people, including the crew). Average fuel consumption: 26 L/h. Equipped for: Diving support, Water sampling, Plankton sampling, Oceanographic sampling.

This speedboat is very simple and basic, ideal for fast operations in the Gulf of La Spezia (diving and water sampling) involving a small number of people. ENEA’s researchers and technician will be managing and driving the speedboat that will be operative from March to October. Max distance covered: Natural Regional Park of Portovenere.

SAMPLING EQUIPMENT

Sampling can be conducted *via* scuba diving and from the boats (ROV, drones, grab, dredges, core barrel), depending on needs. Both vessels are equipped for: biological, sediment and oceanographic sampling.

For underwater sampling via scuba diving: underwater photography and video equipment for non-invasive studies, mini-sorbonne and portable cores for sediment sampling. Underwater scooters are also available. Basic equipment for plankton and benthic sampling (i.e. nets, quadrats, chisel and scalpel,...) are available.

For sampling from the boats: Water Samplers Go Flo and Niskin bottles; Cores for sediment sampling of different sizes; FerryBox: 4H-JENA PocketFerryBox; Multiparametric probes: CTDS (SBE19) and sensors (i.e., portable pHmeter, O₂, temperature and salinity probes) are available for on-site measurements (daily campaigns).

EXPERIMENTAL FACILITIES



The Centre is equipped with both dry and wet laboratories as follows:

Benthic ecology- Optical and Stereo Microscopes (NIKON and Zeiss); Dinolite portable microscope; heaters; scales; fumes; muffle.

Phytoplankton – Plankton nets; Cylindric and combined chambers for phytoplankton; Optical microscopes with integrated system for image processing; thermostatic room; Hitter and autoclave; Niskin bottles; Spectrophotometer; Fluorimeter; Turbidimeter; Secchi Disk.

Hydrology – Hydrology lab is equipped with instruments for the analyses of the seawater carbonate system (titrator, spectrophotometer), Winkler (titrator) and Nutrients analyses (available in 2024) and Chlorophyll analyses.

Sedimentology – Shipeck and Van Veen grabs; water-sediment gravity corer SW-104; Reineck boxcorer; SYMPATEC Helos/kf diffraction laser analyzer; Micrometric sedigraphs 5000 ET; Sieve shaker, dry sieves in series (ASTM) with size intervals of $\frac{1}{2}$ phi and wet sieve systems; magnetic stirrers; analitic scales; AXIOPlan Zeiss petrographic and Zeiss binocular microscopes.

Prototyping

3-D printer FDM (fused deposition modelling), for PLA and ABS proto-types.

Aquaria – Temperature and CO₂ (Li-cor 820) regulated semi re-circulatory system (max capability: 1400 L); macroalgae culturing room (<https://medclimlizers.wordpress.com>); 10-300L aquaria; Heaters/Coolers for temperature regulation.

Habitat Mapping - 3 workstations with Windows operating system with proprietary satellite image processing software such as ENVI 5.7 with IDL (NV5©) and eCognition 10.3 (Trimble©) and latest version of open-source software such as: ESA-SNAP; QGis; Orfeo Tool-Box; SAGA.

Environmental radioactivity – gamma and alpha detectors for radioactivity determination; *in situ* seawater sampling systems (Rosette) for sampling large volumes (30 l Go-Flo bottles) along the water column.

ENVIRONMENTAL DATA

Oceanographic observations were carried out by ENEA since 1961. Data were collected during oceanographic campaigns carried out in the Gulf of La Spezia, using profiling and multi-parametric probes, providing non-continuous series of hydrological data (Ammonia/ammonium, Chlorophyll, Fluorescence, Nitrates, Nitrites, Inorganic Phosphate, Silicate, Nitrogen and Total Phosphorus (unfiltered), Oxygen, pH, Salinity, Water Temperature, Turbidity, Current (speed and direction)).

Since 2009, these parameters have been seasonally acquired and, under the Projects RITMARE and RIMA, a new wider monitoring scheme was added in order to study the outflow of the Magra river. Today, long-term data series from previous campaigns and projects are available for the area and present observatories, for meteo and marine environmental data, are continuously monitoring the Gulf of La Spezia. All data also contributes to the eLTER ecological network.

SMART BAY S. TERESA OBSERVATORY

Started in 2021, Smart Bay Santa Teresa is a cooperation platform involving three main research institutes cohabiting in the ENEA S. Teresa Research Centre: ENEA, CNR and INGV.

The three institutes developed an observatory (*in situ* high resolution data acquisition) based on 6 stations, 2 in the Marine Regional Park of Portovenere, and 4 in the Gulf of La Spezia, in the harbour area. High resolution data (temperature, dissolved oxygen, conductivity, pH, pCO₂, turbidity, chlorophyll, current) are acquired by high quality multi proxy probes and transmitted via an IoUT system, stored in an ENEA server and visualized in a dedicated platform set for different type of users. The stations are included in EU research infrastructures and networks (IR Jerico and eLter- Site of the Eastern Ligurian Sea). Acquired data are validated via analytical approaches (i.e. on carbonate system, pH, oxygen, chlorophyll) and data quality check and control is guaranteed on all data output.

METEROLOGICAL STATION

Since August 2003, an automatic Meteorological Station ([http://192.107.66.195/Meteo_Station/\[ENG\]_Index.htm](http://192.107.66.195/Meteo_Station/[ENG]_Index.htm)) acquires the main meteorological parameters at the ENEA S. Teresa Research Centre (44° 5' 1" North; 9° 52' 55" East, 45 m above sea level). The station is equipped with the following sensors: wind speed Didcot DWR-201G, wind direction Didcot DWD-103, air temperature Rotronic MP101A, air humidity Rotronic MP101A, barometric pressure Vaisala PTB101B, global solar radiation Lastem C110R, precipitation Lastem C100A.

LONG TERM DATA SERIES

Continuous time series of water temperature are available at 9 fixed locations from 2007 to present (with some missing data): Tino (Lat. 44.032 Long. 9.848), Mooring Tino (Lat. 44.017 Long. 9.817), Mooring Tinetto (Lat. 44.024 Long. 9.850), Baia Blu (Lat. 44.083 Long. 9.884), Castello (Lat. 44.072 Long. 9.907), Tinetto (Lat. 44.024 Long. 9.850), Saladero (Lat. 44.052 Long. 9.854), Olivo (Lat. 44.057 Long. 9.846), Mooring *S. Pietro* (Lat. 44.047 Long. 9.832). Measurements of salinity (conductivity) are available for the station Tinetto and for the Mooring Tino. Measurements of current speed and direction are available for the Mooring of Tino and Tinetto.

SOOP

Over the last 20 years, the ENEA S. Teresa Research Centre has accumulated a relatively large dataset of XBT observations in the Mediterranean Sea and, in particular, along the ship route joining the Italian harbours of Genoa and Palermo, under the Ship of Opportunity Program (SOOP). The focus of the activity, part of the Mediterranean Oceanographic Network for the Global Ocean Observing System (MONGOOS), is on operational oceanography, and one of its objectives is the monitoring of the upper-ocean temperature.

LOGISTIC FACILITIES FOR HOSTS:

- A small museum with equipment and historical documentation drawn up and used by the ENEA researchers since 1958;
- Work-stations available for guests (short and long stay), provided with Wi-Fi or doors *via* cable internet connection and phone;
- A multimedia conference room, which can host up to 60 people, is available for conferences, meetings and training courses. Audio-visual facilities are tech-assisted and include video- and sound systems and video-conferencing facilities;
- A common room for meals (80 seats) provided with fridges and microwaves
- A private parking area is available for researchers and guests.

PORTICI RESEARCH CENTER



Since 1999 this research center hosts a large aquaria facility endowed with tanks of different capacities (from 300 liters to 60 liters), in addition a new system of aquaria equipped with probes and controlled lighting is in the process of being acquired. The proximity to the sea facilitates the maintenance and management of the seawater system and of the marine organisms. The facility is fully equipped to ensure the environmental conditions needed for the fauna farming/housing such as temperature and illumination, and to control different water quality needed for the fauna farming/housing such as temperature and illumination, and to control different water quality parameters. This facility was used in different projects for mollusk, fish and echinoderms housing and for the study of their well-being parameters and early stress signals (CARISMA, Virge, B Blue, RIT mare, etc.). In the same place, microalgae cultivation facilities are present. Currently the aquaria room hosts a series of equipped microcosms for experimenting the potential adverse environmental conditions for organisms health in nature and for their breeding.

BIOLOGICAL RESOURCES

CULTURE COLLECTION

The Ecotoxicology Laboratory contains all the necessary equipment to test the effects of pure chemical substances, mixtures of substances, or contaminated environmental matrices (soil, water,

sediments) on test organisms using standardized procedures (ISO). Test organisms recommended by EU guidelines for ecotoxicological and trophic testing are cultivated. In particular different species of microalgae (*Dunaliella tertiolecta*, *Tetraselmis suecica*, *Phaeodactylum tricorutum*) and crustacean (*Daphnia magna*, *Artemia salina*) are bred in laboratory.

EXPERIMENTAL FACILITIES



Aquaria and tanks are also available for manipulative experiments on marine invertebrates. Climate controlled room with experimental seawater tanks for maintenance and experiments on marine organisms.

The laboratory is equipped with instruments to test the acute and chronic effects of substances and environmental matrices at different times from contamination.

The instrumental equipment includes:

Biological safety cabinet; Autoclaves; Water filtration apparatus for seawater; pH meter; Precision scales; Stereomicroscope Zeiss; Inverted microscope; Optical microscope (Zeiss Axioskop 50) equipped with a camera (Axiocam) connected to a PC, including image processing software; Horizontal shaking apparatus for the preparation of elutriates; Refrigerated centrifuge equipped also with a fixed angle rotor; Benchtop centrifuge for small volumes; Incubation chamber for the growth of test organisms, including adjustable light; Thermostatic chamber for breeding microalgal cultures and bioindicator organisms for toxicity testing; Biolight toxy to measure the inhibition of bioluminescence of *Allivibrio fischeri*; Spectrophotometer (Spectramax), for reading multi-well plates to perform biomarker test;