National Council for Scientific Research

10 Years of CANA-CNRS: A Label for Marine Research in Lebanon

1. **The CANA-CNRS Research Vessel**

Ten years ago, the CANA-CNRS Research Vessel (R/V), a valuable donation of the Italian Government in 2009, opened up a vast field of research in marine studies and coastal oceanography for scientists in our country.

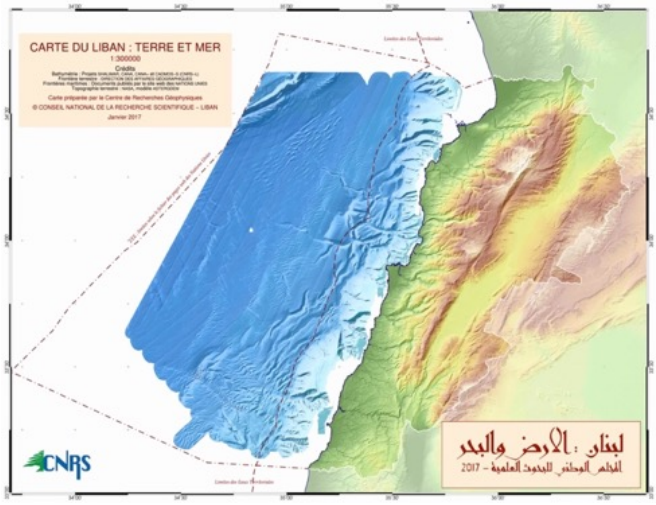
Stemming from the desire to enhance sustainable coastal development and to prioritize the study of marine eco-systems in Lebanon, and through the great efforts of CIHEAM / IAM-Bari (within the TerCom collaborative project); the first steps were initiative towards the acquisition of a fishing trawler, undergoing a complete refurbishment of the engine and hydraulics, and equipping the vessel with essential laboratories, training rooms and scientific equipment to fully transform the vessel into today's CANA-CNRS R/V

Supported by the Italian Government, the Embassy in Lebanon and Italian Agency for Development Cooperation (AICS) through the CANA and CANA Plus Cooperative Projects; and through regular work and management on the R/V in Lebanon, along with the regular introduction of technological and systematic innovation to properly equip the vessel and enhance its capabilities, CANA-CNRS R/V has developed into an 'operational facility,' well equipped with state of the art marine and oceanographic instruments and equipment - a research center in its own right – supporting and enhancing the continued work of the CNRS-L National Centre for Marine Sciences and National Centre for Geophysical Research.

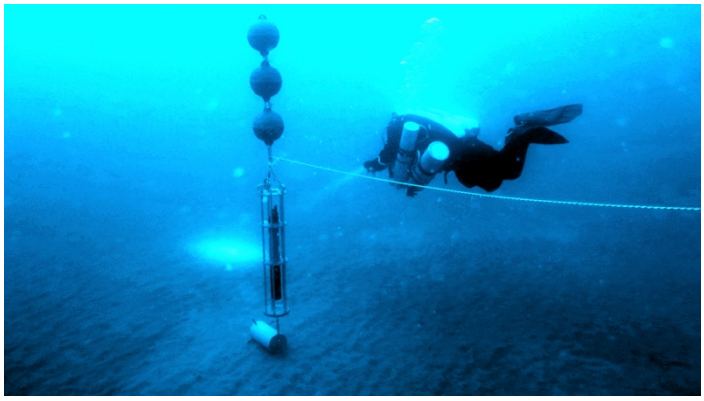
2. Research in Marine Sciences:

Physical Oceanography

Alexandre Sursock, CNRS-L Senior Consultant / CANA Tasks Manager



Previous oceanographic works were conducted in partnership with foreign researchers and their naval assets for specific periods. The CANA R/V and projects provided the first opportunity to conduct work focused mainly on the coastal zone (between -15 and -200m), continuously performed year after year to build over the last 10 years a large body of basic data.



Deployment of CTDs and Diving Expedition within the study of Underwater Fresh Water Springs in Qasmieh, Tyre (January 22,

The expertise thus acquired by the researchers, recognized by officials and the public, has in turn led to a strong demand from the authorities for works having an urgent public interest, a request to which the researchers responded with the same urgency: control of marine pollution, exploitation of fishery resources, coastal engineering works for the evacuation of wastewater or in connection with the future exploitation of offshore hydrocarbon resources, study of the sources of underwater fresh water for which Lebanon has always been known, research associated with submerged cultural heritage, assessment of tsunami-type marine hazards, hydrological work for the safety of navigation, etc.

The geomorphology of the coastal seafloor was largely unknown. The main equipment of the research boat was acquired for this first objective: its precise recognition with the means of a high-definition multi-beam device. It happened that an unexpected underwater landscape has been revealed before our eyes, such as the image of the famous Beirut canyon, the impressive continuation at sea of terrestrial faults, or the narrow incisions in the sea floor that the torrential rivers are digging as they run down from the steep slopes of Mount

Lebanon so close to the sea. Here and there, have been highlighted traces of ancient shorelines or seafloor landslides that may have triggered local tsunamis. Beyond the limit of 200m and up to -1000m, the same works resulted in an enhanced view of the already known structures along the continental slope. During these 10 years, it can be estimated that the coastal zone was covered at 80%, only the region facing the city of Tripoli having not been the object of a measurement campaign.

All these works aroused the interest of the younger generation of researchers and paved the way for new ambitions.

Biodiversity and Hydrology:

Milad Fakhri, Director of the CNRS-L National Centre for Marine Sciences / CANA Vessel and Task Manager
Gaby Khalaf, CNRS-L Senior Consultant / CANA Tasks Manager

The CANA Research Vessel offered the opportunity to investigate the maritime domain of Lebanon, with new capacities and equipment reaching new depths of 1000 m. This gave researchers the chance to evaluate the variation of different physico-chemical parameters of the water column; with variations linked to the continental outputs and to seasonal variability. In parallel, it was possible to further enhance the monthly monitoring of the spread of pollutants along the Lebanese coast - mainly those of domestic and industrial origins.

It was also possible to treat in details the subjects of biodiversity from small living organisms from plankton till megafauna represented by sharks and Cetaceans: by using visual observations, deploying Remotely Operated Vehicles (ROVs) and diving activities. Studies included areas of distribution and abundance as well as determinations of dominant species and their behavior.

In parallel, and through the mutual cooperation with the ministry of Agriculture, studies concerning the fishery sector, considered till only recently scarce with data, were executed:

assessing different biological parameters of species with high socio-economical value, applying new fishing methodology for catch improvement, assessing the fish-stock in Lebanese territorial waters (including alien species), investigating fragile habitats and studying endangered indigenous species.

3. **Visibility, Dissemination & Capacity Building:**
   CANA regularly welcomes onboard visiting delegations, stakeholders, and students as part of its tasks for ensuring wide-base visibility of the activities and capabilities of the vessel.

   A CANA Documentary and 3 Book Publications have been produced by the CNRS-L:

   CANA Documentary: The 20-minute documentary titled: ***Li Bahr Lubnan / For the Lebanese Sea***, is a unique visual opportunity to delve into the daily scientific work of the vessel, while also framing the achievements of the project within the broader context of collaborations and partnerships. (A short extract of the film is available at: https://www.facebook.com/CNRSLebanon/videos/184956039114248/)

   CANA Publications:
   - CANA-CNRS A Scientific Vessel for Lebanon***: Unveiling our National Marine Natural Resources and Coastal Patrimony (2009-2015)***
   - CANA-CNRS A Scientific Vessel for Lebanon**: *Main Scientific Achievements towards Strengthening the Sustainable Development of the Marine Environment. (2013-2014)***
   - CANA-CNRS A Scientific Vessel for Lebanon: ***Strengthening Cooperation Between Italy and Lebanon Towards the Sustainable Development of the Marine Environment (2012)***

   Capacity Building and Journal Publications:
   - 16 PhD students have prepared their thesis in areas directly related to the tasks of the Vessel.
   - Around 20 publications in peer reviewed journals.

5- The Way Forward:

CANA-CNRS enable us to join in an operational way international, regional and European programs on the Mediterranean and to consider partnerships on advanced topics. Few countries of the Levant have this possibility at present. It also continually opens new horizons for research, ***building on rich data availability from the past 10 years of CANA research in Lebanon***, and leading to the development of many 'hot' and emerging marine topics linked to the socio-economic development of the Lebanese coastal communities, including:

Pollution Studies Extended to include Microplastics as an Emergent Pollution: The quantity of micro-debris in the Mediterranean Sea is evaluated to 800,000 particles/km^2. Due to their different densities (0.9 to 1.39 g/cm^2) and composition (polystyrene, polypropylene…) they are either found at the water surface layer or sunk at the bottom. Therefore, both pelagic and benthic organisms may be affected by these plastic pieces, that can enter the food web of aquatic environment via direct and indirect pathways including inhalation, entanglement, ingestion… Because of their ubiquitous presence and small size and properties they are likely to threaten the health of various organisms.

Recent studies conducted confirm the presence of these particles in non-negligible quantities in the stomach contents of fish and crustacean. Regarding their toxicity and negative effect on the marine environment; an investigation on the presence, dispersion and effect of microplastics on biodiversity must be conducted towards the proposition of remediation measures.

Environmental Risk Assessment for upcoming Petroleum Explorations in Lebanon:
Petroleum explorations foreseen in the Lebanese marine waters is at every stage (drilling, tubing, pumping and transport) a source of potential physical, chemical and biological pollution and can generate the destruction of pelagic and benthic habitats and modify water quality of the sea of Lebanon.

It is imperative to conduct studies that establish 'state zero' – prior to any development – in parallel to studies that predict the *possible* damage to the different biotic and abiotic parameters of the sea waters being carried to the coastal area by approaching water currents. In the face of possible risks, it is

indispensable to preserve the habitat, biodiversity and existing and proposed protected marine areas for the conservation of our national patrimony.

Climate Change Consequences in Lebanese Marine and Coastal Ecosystems:

Preliminary results from time-series stations show clearly that the Lebanese seawater's biogeochemistry is changing and a sign of ocean acidification is being detected. Moreover, a rise of air and sea temperatures is also detected in our time-series monitoring. These results arise concerns on the response of marine and coastal ecosystems, already influenced by various anthropogenic pressures, towards the warming, sea level rise, deoxygenation, and the observed acidification.

Climate change consequences would have milder effects on the Lebanese marine and coastal ecosystems, and thus on the Lebanese community, if they are well studied and surveyed. National monitoring programs should be expanded to better understand the tendencies of marine and coastal biodiversity, and environmental parameters in the context of climate change.