THE DEVELOPMENT OF "SUSTAINABLE" SURVEILLANCE AND MONITORING ACTIVITIES CARRIED OUT BY THE ITALIAN COAST GUARD FOR THE SAFEGUARD OF THE MARINE PROTECTED AREAS

Santo Altavilla[1], Maura Pisconti[2], Federica Galeano[2], Silvia Aquaro[2], Fabio Tiralongo[2], Giuseppina Corrente[3], Emiliano Santocchini[1], Daniele Giannelli[2], Aurelio Caligiore[1]
[1]Marine Environmental Department – Italian Coast Guard – Rome (Italy)
repartoambientalemarino@mite.gov.it – phone +39 06 5722 - 5639/5634
[2] Italian Coast Guard Headquarters - phone +39 06 5908 4580 Rome (Italy)
[3] Directorate General for the Sea and Coast – Ministry of Ecological Transition

Abstract – The Mediterranean Sea represents one of the richest sites in terms of biodiversity on our planet, however, considering the nature of a semi-closed basin, it is subject to limited water exchanges with other seas, thus making it sensible to risk of pollution due to either intense ship traffic, building speculation and high number of inhabitants living along the coastal areas. The peculiar bio-geomorphological formations, which characterize the Italian peninsula, makes it a region of significant natural and environmental value, whose integrity, however, is strongly affected by the high anthropic impact that persists along the 8,000 km of coastline. The need of safeguarding this natural heritage, has led the Ministry of Ecological Transition (MiTE) to implement a strong policy of protection, regarding the national Marine Protected Areas - up to now 29, to which are to be added two submerged parks (Baia and Gaiola) and the Pelagos Sanctuary for Marine Mammals - which have gain great scientific, ecological, cultural and economic importance. Those areas are subject to environmental protection and specific regulations.
The Italian Coast Guard (ITCG), according to the current regulatory framework, is responsible of the surveillance of the Marine Protected Areas (MPAs) and also fulfils essential maritime environmental police tasks in order to protect the maritime and coastal environment. Over the years, specific environmental maritime police campaigns and complex operational activities have been planned and carried out with the aim of combining the protection of the maritime environment, the safeguard of coasts and biological resources, which are closely connected with each other, through the use of the aero-naval assets and ITCG specialized units able to discover, analyse and repress illegal phenomena that may harm the environment. This methodological approach has allowed to increase the effectiveness of deterrence and prevention of harmful behaviours.
The ITCG also carries out environmental monitoring activities through implementation of recent electrical powered vehicles and instruments which are best suitable for temperature anomalies detection of sea water, granting an observation of impacts related to climate change, especially in those protected mentioned areas. All the information acquired over time will be integrated in a database and will provide useful information to define projections on the evolution of climate change which would be essential for the decision-making process aimed to prevent harmful impacts on natural ecosystems.

Referee List (DOI 10.36253/fup_referee_list)
FUP Best Practice in Scholarly Publishing (DOI 10.36253/fup_best_practice)
Santo Altavilla, Maura Pisconti, Federica Galeano, Silvia Aquaro, Fabio Tiralongo, Giuseppina Corrente, Emiliano Santocchini, Daniele Giannelli, Aurelio Caligiore, *The development of "sustainable" surveillance and monitoring activity carried out by the italian Coast guard for the safeguard of the Marine Protected Areas,* pp. 111-121 10.36253/979-12-215-0030-1.10

Introduction

The protection of the marine and coastal environment represents one of the main institutional tasks of the Coast Guard [2], let alone one of the priority objectives to pursue, is for the wealth of the national naturalistic patrimony, both for the relevant social, economic and cultural interests involved in the enhancement and use of the relevant resources. The safeguard activity that the Coast Guard is able to guarantee through the employment of the operating members is constant and detailed, despite the remarkable extension of the coastline of our Country witch pairs to approximately 8000 km and is due to the ability to express specific skills on the national territory, as well as in international scenarios.

The Coast Guard, also considering its vocation for natural environmental, functionally depends by the Ministry of Ecological Transition and, within the powers established by the current legislative framework, carries out numerous activities to protect the marine and coastal environment not only in the MM.PP.AA. but also, in all the other sea areas under the jurisdiction of the State and subject to particular constraints of environmental protection (Ecological Protection Zones, Natura 2000 areas covered by Directive 92/43/EEC, etc.).

In those fields, the Coast Guard carries out controls of the supply chain of the traffics of the refusals, with specific reference to the marine, coastal and harbour extents, of the water releases (d.lgs 152/2006) and on the introduction of pollutants into the atmosphere by ships, including under international conventions.

In regard of those dependencies, periodically, the Ministry of Ecological Transition stipulates with the Coast Guard, conventions for carrying out targeted activities of prevention and contrast against marine pollution and strengthening the surveillance in Marine Protected Areas and marine areas where oil platforms for the extraction of oily hydrocarbons insist.

With Ministerial Decree n. 38 of 09/02/2018, it has been approved the "Relaunch Plan of the environmental strategy" of the Coast Guard, through which has been set as objective the pursuing of consolidation and development of the functional lines in order to protect the marine and coastal ecosystem. In this context, the 3 Department "Plans and Operations" of the ITCG Headquarters, periodically prepares a program that involves all territorial Commands [3] in coordinating the activity of the aerial and naval assets and the specialized crew members for an integrated approach, which provides a synergic and coordinated use of all the specialized instruments of the Coast Guard (underwater, scientific [4], remote sensing), with the aim of covering the entire investigative spectrum and obtaining the maximum result in terms of surveillance, identification of polluting sources, coming from land or from maritime carriers, and assessment of the illegal activities that threaten the marine-coastal environment and its biodiversity.

This approach becomes even more essential in the development of certain Environmental Campaigns where the multiplicity of resources involved for the achievement of the different purposes (training, educational, media and operational [1]) requires a management capable of ensuring a coherent and coordinated use of the structures, organised on the basis of uniform national rules and procedures, governing the use of the components in the activities of support to the peripheral Maritime Offices.


Figure 1 and 2 – ITCG asset and sea water sampling operation.

Materials and Methods

In order to assure the role of the Coast Guard as an operational instrument for the implementation of the functions regarding the protection of the marine and coastal environment, on behalf of Ministry of Ecological Transition, a complex "Environmental Strategy" has been drawn up and approved, characterizing the activities of marine environmental police carried out by the ITCG staff.

As part of the Environmental Strategy, the operation "Environmental Campaign in the Mediterranean", planned and coordinated by the Plans and Operations Department of ITCG Headquarters, provided a coordinated and synergistic use of the specialist components. The main objective of the environmental campaign is summarized in a line of action that can combine the "protection of the marine environment, the defense of coasts and biological resources", closely related aspects, by the use of the aero-naval assets and the specialized supplied instruments finalized at discovering, analyse and immediately repress illicit phenomena that may affect the environment.

The ICG has deployed a Dattilo class Ships, able to carry out multipurpose operations including the command and control in complex scenarios and to use specialized teams, such as the aerial section executing environmental remote sensing activities, through airborne systems on fixed wing, such as the fixed wing ATR42MP, and the rotary wing AW139CP. Those assets are located at the Air Bases of Sarzana, Catania, Pescara and Decimomannu and can be scrambled throughout the national territory each equipped with different operational equipment:

Deadalus Scanner LLC AA 1268 EM (on ATR42MP)

The airborne multispectral scanner "Sensytec AA1268 ATM ENHANCED", is a multispectral scanning system, used for the realization of thematic maps - for example temperature maps - containing qualitative and quantitative information that properly elaborated and analyzed, can allow the identification and monitoring of pollution phenomena related to urban and industrial discharges, etc. With the acquisition of data of energy reflected and emitted from the surface flown over, wich can create up to 12 digital grayscale images, each of which, as a function in the electromagnetic range of relevance recording the behavior of the surface.

S.L.A.R. - Side Looking Airborne Radar (on ATR42MP)
SLAR is an active sensor that measures the "roughness" of the sea surface. Microwave pulse transmission (X-band) occurs on both sides of the aircraft, allowing coverage of a total area of about 40 NM. The operation of the system is based on the phenomenon of the reduction of capillary waves induced by the presence of oily substances on the surface of the sea, highlighting the area affected by the anomaly as a dark spot in contrast to the surrounding area and is able to detect even thin films of pollutants.

E.O. (Electro-optical) Turret Wescam MX-20 (on ATR42MP)
It's an electro-optical system that consists of the following sensors and provides georeferenced images and videos, such as: High-definition color camera (Daylight camera) - EOW (Electro-optical Wide); Dual channel spotter (Daylight spotter camera/SWIR camera) - EON (Electro-optical Narrow); I.R. Camera.

F.L.I.R. (Forward Looking Infra Red) STAR SAFIRE (on AW139CP)
It's an electro-optical system that consists of four sensors and provides georeferenced images and videos such as High Definition Color Camera (H.D.E.O.); Low Brightness Color Camera (H.D.L.L.); High Definition Infrared Camera (H.D.I.R.) and short wave infrared camera (S.W.I.R.).

Figure 3 and 4 – Remote sensing systems installed on board ATR42MP aircraft and AW139CP helicopters.

For underwater operations sub operators for the prospection of the seabed and the visual Census have been employed. The section of the Coast Guard makes use of 5 Divers Units (San Benedetto del Tronto, Napoli, Messina, Cagliari, Genova), which are entrusted with some important environmental tasks, including: monitoring and control of MPAs, water sampling for detection and monitoring of marine pollution; surveillance of archaeological marine sites; and inspection of ships, platforms and submarine pipelines. During the environmental police activities and campaigns, divers have been involved in the recovery of ghost nets which are harmful for the fish stock and the ecosystem.

Figure 5 – Divers engaged in the recovery of a ghost net during the environmental campaign.

On board the Dattilo class Ships, personnel belonging to the scientific section Environmental Analysis Laboratory was also employed for the execution of sampling and analysis of water.

The Laboratory Environmental Analysis of the ITCG "CF (CP) Natale DE GRAZIA" consists of 2 Mobile Environmental Laboratories (LAM) and a traditional Laboratory (LAB) located at Fiumicino local Office. The Laboratory is run by chartered biologists and duly trained technicians able to perform both the sampling and analytical phase, using LAM and LAB instruments.

The Laboratory, thanks to its peculiar organization, can operate in dual use: ITCG employs the LAM asset to carry out sampling activities and on field analysis, and LAB asset to perform the full range of analysis by using more advanced equipment to analyse the water samples provided by the local CG Offices.

In December 2021 an important milestone was reached: the accreditation of the Laboratory Environmental Analysis "CF (CP) Natale DE GRAZIA", which is added to the quality certification ISO 9001, issued by RINA in 2013.

ACCREDIA, Single National Accreditation Body, has issued the certificate attesting the competence, independence and impartiality of the Laboratory in compliance with the requirements of the technical standard UNI EN ISO IEC 17025 strengthening even more the validity of the analytical results obtained in the laboratory and used in administrative and criminal proceedings.

Figure 6 – Environmental Analysis Laboratory.

The planning of the environmental campaign has been divided into 3 different modules, involving the regions of Campania (first experimental phase), Apulia and Sicily.

The operational activities have been executed in the Italian Marine Protected Areas already established, since notoriously they are of particular value from the naturalistic and environmental point of view. Moreover, this decision is in line with the provisions of the agreement between MITE and ITCG Headquarters, signed on 21 December 2017, namely to carry out a targeted and enhanced supervision and surveillance activity in the Italian MPAs.

At the same time, the Coast Guard contributes to monitor and observe the temperatures and quality of marine waters, using electric and/or hybrid vehicles with low environmental impact and suitable technical instrumentation.

With the stipulation of a Specific Protocol, the ITCG Headquarters has committed to the Ministry of Ecological Transition: to implement services of observation and prevention of the impacts of climate change in Marine Protected Areas through the use of electric vehicles and related charging infrastructures to perform surveillance and monitoring activities in the MPAs, as well as of equipment for promoting and communicating sustainable mobility, energy efficiency and climate-altering emissions at local and central level; to monitor the biodiversity of plant and animal species, including initiatives to survey fish stocks, in order to have a constant knowledge of the resilience of ecosystems.

Figure 7 and 8 – Multiparameter probe and *in situ* monitoring.

In order to collect data useful to monitor the temperatures and quality of marine waters and to observe the effects of climate change and the consequent harmful impacts to natural ecosystems and communities, the ITCG has purchased and distributed no. 52 multi-parameter probes for the acquisition of some parameters in A, B and C zones of the MPAs. The information obtained is reported on the IT platform named "OCEAM" developed by the ITCG Marine Environmental Department (RAM), using the specific format "Temperature monitoring and water quality in MPAs." elaborated to this aim.

Since February 2021, values of 13 chemical-physical parameters have been recorded *in situ*, contributing to provide a general picture of the quality of water in the Italian MPAs. The parameters analyzed are: Redox potential, pH, Dissolved Oxygen, Electrical conductivity, Resistivity, TDS, Salinity, Density, and Temperature.

Operational and monitoring activities results

During the environmental campaign ITCG has employed two different naval unit (U. Diciotti and L. Dattilo Ship) and several specialized assets. The operational activities, reported in the table, were performed as described below.

Table 1 – Environmental campaign activities.

FIRST ENVIRONMENTAL CAMPAIGN			DAYS TOT. 3	
NAVAL UNIT	AERIAL MISSION	DIVING	SAMPLES	ANALYSIS
U. DICIOTTI	3 (ATR42, AW139)	5	24	200

SECOND ENVIRONMENTAL CAMPAIGN			DAYS TOT. 11	
NAVAL UNIT	AERIAL MISSION	DIVING	SAMPLES	ANALYSIS
U. DICIOTTI	2 (ATR42, AW139)	5	30	300

THIRD ENVIRONMENTAL CAMPAIGN			DAYS TOT. 10	
NAVAL UNIT	AERIAL MISSION	DIVING	SAMPLES	ANALYSIS
L. DATTILO	2 (ATR42, AW139)	5	30	300

Specifically, the use of the aircraft for TLR activities has highlighted some thermal anomalies at sea and on land, validated during the operational mission with the divers and the laboratory. During the first mission of the environmental campaign, the data received from the helicopter AW139CP allowed to detect discharges not surveyed later investigated by the Ischia local CG Office.

Figure 9 and 10 – Sampling operation on 23/10/2018 at a discharge in the marine protected area Kingdom of Neptune (island of Ischia) - thermal anomaly detected by remote sensing activity performed with FLIR.

The analyses carried out on the samples taken showed that certain parameters (COD and total phosphorus) set out in Table 3 of Annex 5 to Part Three of Legislative Decree 152/2006, the presence of which indicates the discharge of urban waste water, were exceeded.

As an example of the result obtained during the second module, the activity carried out at the MPA of Porto Cesareo is shown. In that context, the use of the aircraft for TLR activities carried out on 01.04.2019 revealed some thermal anomalies on the ground, including the following one, validated during the operational mission with the intervention of the laboratory staff. In particular the thermal anomaly n.18 of the section 2 has allowed to check on date 14.05.2019 the presence of an unauthorized discharge, sanctioned by the Porto Cesareo local CG Office pursuant art.124 co 1 of Legislative Decree 152/2006.

Figure 11 and 12 – Sampling operation on 14/05/2019 at a discharge in the MPA Porto Cesareo - thermal anomaly detected by remote sensing activity.

The analyses carried out on the sample showed that the total surfactant parameter established by Table 3 of Annex 5 to Part Three of Legislative Decree 152/2006, was exceeded; in addition, the presence of the bacterium *Escherichia coli,* which, although found with a value of colony-forming units of 300 CFU/100 ml and therefore much lower than the limit of 5 000 CFU/100 ml required by the standard, however, shows a contamination of faecal origin in a matrix that should be bacteria-free. Taken together, these data reveal the presence of urban waste water.

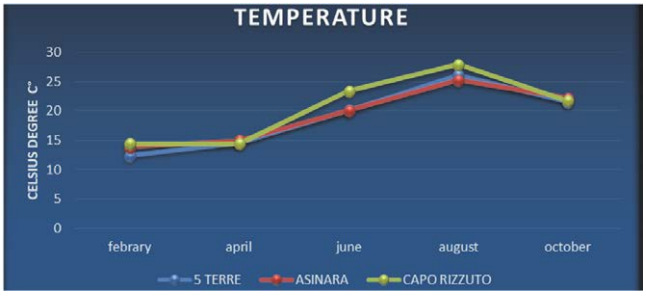
As an example of the result obtained during the third module, the activity carried out at the Isole Egadi MPA is shown. In that context, on 19.07.2019, during the inspection of the Marettimo island, the team verified the presence of an unlisted discharge at the quay of the old port.

Analysis of the sample showed that many of the parameters set out in Table 3 of Annex 5 to Part Three of Legislative Decree 152/2006 had been exceeded. In particular, the parameters ammoniacal nitrogen, sulphites, total surfactants, suspended solids, coarse materials and the bacterium *Escherichia coli* were found to be above the limits for discharge to surface waters. Taken as a whole, they indicate a discharge of urban waste water into the sea as it is.

Figure 13 – Sampling operation on 19/07/2019 in correspondence of a discharge in the MPA Isole Egadi (Marettimo island) - thermal anomaly detected by remote sensing activity.

In addition, in the course of the operations planned for the second and third modules of the environmental campaign, the crew on board and the personnel of the specialized assets have identified and collected both on the surface and on the bottom marine litter, of various types and of different origin, such as polystyrene containers, plastic bottles and small artisanal fishing gear as well as fishing nets. The plastic material has been identified in greater quantities in Marine Protected Area of Torre Guaceto (Brindisi - Apulia) and in smaller quantities in Sicilian MPAs. The presence and accumulation of this waste in the Torre Guaceto Marine Protected Area is presumably related to the presence of local currents and wave motion rather than to the actual improper tourist/ recreational activity in the protected area.

As regards the monitoring activity, by comparing the results obtained in 2021 with literature data available from open sources, it was found that none of the parameters examined showed outliers in relation to the average values found over time in the same areas. In particular, as reported below on the graph of the MPAs Cinque Terre, Isola dell'Asinara and Capo Rizzuto, the temperature range varies between 12 and 28 ºC during the various months of reference.



Graphic 1 – MPA Cinque Terre, MPA Isola dell'Asinara, MPA Capo Rizzuto – temperature values in °C - as can be seen from the graph the values fluctuate between 12 and 28 ºC in relation to the reference period and to the MPA.

Discussion

The activity carried out in MPAs of the Regions Campania (Regno di Nettuno and Santa Maria di Castellabate), Apulia (Porto Cesareo, Torre Guaceto and Isole Tremiti) and Sicily (Isole Egadi, Isola di Ustica, Capo Gallo and Isola delle Femmine) has been aimed to realize an efficient investigative tool that operates in a synergistic, coordinated and complementary way, in order to achieve the full spectrum of surveys in the field of environmental investigations. This approach is actually appreciated at regional level by the local Public Prosecutor's Office. On several occasions they have indeed invoked and invoke the intervention of the Coast Guard personnel and its specialized assets for the execution of specific environmental activities, trusting in their competence and expertise.

With regard to the monitoring of the parameters, it is reported that, to date, no abnormal values have been found for any of the recorded parameters, but to advance more precise considerations about possible changes in time, expects the availability of multi-annual data and time series, which will also be provided to ISPRA for further additional enhancement.

Conclusion

In conclusion, among the various strengths of the environmental campaign, it's worthy to highlight its innovative character; For the first time, in fact, the Plans and Operations Department has organized an operation so articulated, capable of implementing the core principle of the integrated approach to environmental protection; the multidisciplinary nature of the mission has made it possible to carry out a monitoring activity covering different areas among the ITCG institutional tasks, including fisheries supervision, environmental protection, investigation of any illegal activity in violation of the regulations of the MPAs. The prolonged stay in the area of the Coast Guard structure is a means of control for repressive purposes as well as an efficient preventive device for deterrence purposes. In addition, it is worth highlighting the readiness of the ITCG personnel to engage in activities other than purely institutional ones, such as the measurement of chemical-physical parameters for monitoring the quality of the marine environment. The synergic and multidisciplinary effort carried out by the ITCG has ensured significant results for the environmental protection, that has always been one of the most importance services provided by the ITCG for the well-being of the community. This integrated activity becomes even more important and impactful taking into consideration the current awakening of environmental consciousness and awareness in citizens and Institutions.

References

[1] Altavilla S., Caligiore A., Ceccarelli J., Corrente. G., Galeano F., Pappacena G., Pisconti M., Petrillo A., Rottino F., Puri P., Scatigna G., Simione F., Sinesi T., Spaccavento G., Ubaldi C. (2020) - *Environmental training of the italian coast guard between tradition and innovation,* in Eighth International Symposium "Monitoring of Mediterranean Coastal Areas. Problems and Measurement Techniques", pp. 155-163

[2] Daniela Berto (ISPRA, BIO-ACAM), Nicoletta Calace (ISPRA, COS-ODC), Maura Pisconti (Guardia Costiera), Silvia Aquaro (Guardia Costiera), Federica Galeano (Guardia Costiera) et alii (2021) - *Analisi degli impatti ambientali del lockdown 2020 alle foci dei fiumi Po, Brenta-Adige, Metauro e Tevere*. Rapporto ISPRA 347/2021

[3] Rovito C. (2016) - *La campagna di tutela ambientale della Guardia Costiera a tutela e difesa dell'ambiente marino e costiero*" in magazine on line "Diritto all'Ambiente" www.dirittoambiente.net

[4] Rovito C., Pisconti M. (2016) - *Le Capitanerie di porto Guardia Costiera ed i L.A.M. –Laboratori Ambientali Mobili al servizio della tutela dell'ambiente marino*, in magazine on line "Diritto all'Ambiente" www.dirittoambiente.net