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# THE ROLE OF EXPLOSIVE ORDNANCE DISPOSAL DIVERS IN ELIMINATING THE DANGER GENERATED BY NAVAL MINES

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**ABSTRACT**

*Explosive Ordnance Disposal (EOD) divers are that category of soldiers from the Naval Forces with tasks and missions, equipment and specific training, which ensure the removal of the danger generated by explosive devices. One of the basic missions of EOD divers is the fight against sea mines, which are the most frequently used explosive devices in naval confrontations. To win the war against mines, all specialized structures must be used, depending on the specifics of the mission, no matter if we are talking about specialized ships, aviation or EOD divers.*

**KEYWORDS:** divers, EOD, mine warfare, Mine Countermeasures (MCM) ships, naval mines

## 1. Brief History of Divers

Worldwide, thousands of years ago, man's penetration under water was a continuous challenge. Even if, at that time, it was done with primitive means and for simplistic purposes, to procure food or out of pure curiosity to research the bottom of the sea, there were permanent concerns related to the diving activity of people. People quickly realized that in order to increase the time spent underwater they needed an air reserve and tried to improvise different devices, filled with air, to provide that additional reserve necessary for underwater breathing.

Although it started as a necessity to create and improve people's living conditions, with strictly economic objectives, people quickly realized, since ancient times, that underwater penetration can be used for military purposes. Thus, advantages could be obtained on the battlefield, such as: creating surprise or easily reaching the objectives located on the water or in coastal areas.

The first definite information about the use of divers in battle comes from 900 Before Christ (BC). History mentions about some divers from the ranks of the military who breathed from some leather bellows, they are represented in an Assyrian fresco swimming under water. It is the documentary attestation of the world's first "apparatus" to breathe underwater. Approximately from the same period there was another date recorded in the history of diving, namely the 5th century BC, when King Scyllos of Sion and his daughter Cyana went under the water and cut the anchors of the ships of the King of Persia, Xeres, causing them great damage and tipping the balance of final victory.

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Figure no. 1: *Attack of King Xeres' ships*
(Source: http://www.geocities.ws/scufundarero/profesionala_mond.html)

Also from this period, in 332 BC, it is recorded that Alexander the Great himself went underwater in the Mediterranean in a kind of diving bell.

In the following centuries, various inventions followed, some rudimentary, others more valuable and were improved and developed by various daredevils and enthusiasts of the world of water. In the middle of the 19th century, the naval forces of the time understood the usefulness of conquering the depths and began the execution of research activities, organized and institutionalized. Thus, in 1843, the British Royal Navy established the first school of divers in the world and the first structure specialized in the execution of military diving activities. The specialists of this school of divers invent in 1878 the diving apparatus with a closed circuit, which filtered the exhaled air and introduced it again into the respiratory circuit. This diving apparatus did not produce air bubbles in the environment, allowing the diver to move underwater totally undetectable. This event is considered by specialists to be the birthday of combat divers worldwide. In 1915, the first diving school of the US Navy was established, the development of military divers taking off worldwide. In line with the removal of the danger generated by explosive devices under water, in 1943, the "United States Navy Underwater Demolition Team" was established, the first structure of divers specialized in the execution of underwater destruction with the help of explosives.

The appearance of divers in our country is not precisely established, having no historical evidence to prove this. According to them, the first Romanian diver certified by historical documents is Emil Racoviță, who in 1891 dived for research purposes on the French coast of the Mediterranean Sea.

The end of the 19$^{th}$ century records the first diving in our country for the execution of infrastructure works or light works on the hull of ships, with the help of diving devices and equipment that were purchased from abroad. A few years later, Anghel Saligny began building large projects that had part of them underwater, requiring the use of divers for construction. This is how the need to introduce the diver specialty in our country arose, as well as the establishment of the first diver training and training unit. The regulation of the diving activity occurred on August 10, 1906 when the Consultative Committee of the Navy, through minute's no. 130 of August 10, proposed the completion of art. 6 of the Law on the Organization of the Navy, which meant the addition of military specialties, specific to the navy, electrician, military pilots and diver. Following this proposal, King Carol I approved by High Decree no. 3206 of September 5, 1906, the proposals made, this being the birth

certificate of the profession of diver in Romania. The Navy Organization Law stipulated that the training and training of divers, the knowledge necessary for this new job and the organization of exams to obtain the patent would be the responsibility of the Submarine Defense Corps. In 1911, this body drew up the first Romanian manual for the use of divers "Manualul scafandrierului".


Figure no. 2: *Diver's Handbook, 1911 Edition* (Source: http://www.geocities.ws/ scufundarero/profesionala_mond.html)

The emergence and development of combat divers in our country, as a distinct type of force, began after 1965, when the Navy benefited from increased attention both from the Navy headquarter and from the state leadership. An important role was played by the naval officer Constantin Scarlat, who can be considered the founder of the school and tradition, an important personality, his name being linked to the modern stage of the history of diving at the national level as well as the appearance of combat divers in our country. Thus, in November 1967, Constantin Scarlat laid the foundations of the first sub-unit of combat divers in our country, establishing in Mangalia, Group 279 Divers, subordinate to the Navy Command through the Research Section of the General Staff of the Navy Command.

Another important event in the modern history of diving in our country took place on October 1, 1976, when the Constanta Diving Center was established, which is the continuation of the diving activity in our country.

## 2. The Importance of Naval Mines

Throughout history, a large part of military conflicts, or at least sequences thereof, have been fought in whole or in part at sea. Taking place at the beginning only between surface ships, simpler or more complex depending on the technological evolution of the times, naval battles evolved over time to become very complex, with the participation of land, air and naval forces.

A particularity of the conflicts at sea is the fact that here we find all kinds of ammunition and explosive devices that are used by the military, namely: classic infantry ammunition – projectiles, mortars – fired from the coast, rockets and bombs used by the air force, as well as ammunition used by naval forces – torpedoes, bombs and last but not least sea mines that can be launched from surface ships, submarines and aviation. It is difficult to determine which of these munitions played the most decisive role in conflicts at sea, each of which was intended for a specific type of use, but the US Naval Forces calculated the effect on the target of several categories of munitions, trying to demonstrate which of them were the most effective in naval conflicts. The results of the study are recorded in the figure below:

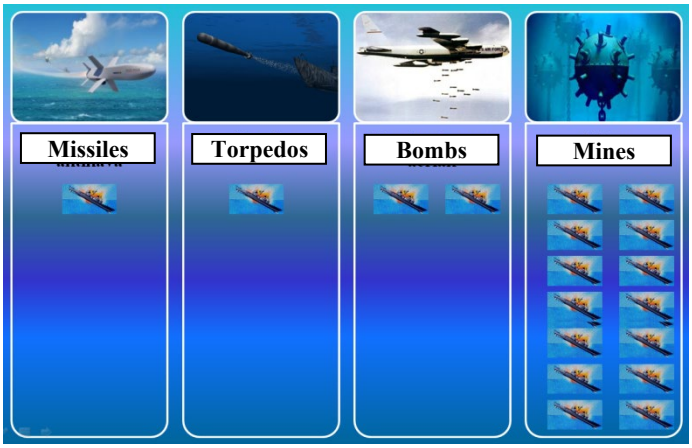

Figure no. 3: *Effects of Munitions in Naval Warfare*

We observe from this study that, if we take into account the effectiveness on the destruction of targets by the munitions used, sea mines occupy the first place, being seven times more effective than the munitions ranked second, namely aviation bombs. Also, sea mines can easily sink any type of ship or submarine due to their high explosive charge compared to other types of munitions used in naval warfare.

Another side of the particularly great danger represented by the use of sea mines is the fact that, once launched, after making contact with water, they initiate and become active for a very long period of time, unlike other munitions that they destroy themselves after being launched or fired, or if they do not have a self-destruct mechanism, they remain inactive and do not pose a real danger. On the other hand, their widespread use is also determined by the relatively low production cost of sea mines, being munitions that can be used by any state, regardless of the budget allocated for the armed forces.

An example of this is the fact that during the Second World War, a number of approximately 500,000 sea mines were planted, which sank 1.4 million tons of commercial ships. These mines planted in the Second World War are still the subject of demining operations today as they continue to endanger the safety of navigation on seas and rivers after nearly 8 decades.

Marine mines have been and will be used for the following purposes:

– prohibiting the passage or entry of surface ships and submarines;

– the disorganization of naval transport by causing the enemy losses in surface ships (combat and transport) and in submarines;

– blocking communications or some districts of the enemy;

– delaying the movement of enemy ships by sea and river;

– diverting the enemy's naval communications to the districts where their own strike forces operate;

– achieving the psychological effect on the crews of enemy ships by creating a state of high tension.

In conclusion, we can say that the sea mine is the most dangerous munitions used in naval warfare and the only one that poses problems for the safety of navigation after the end of the conflict. To remove the danger generated by them, a special chapter was needed in the doctrine of naval warfare, namely mine warfare.

## 3. Mine Warfare

The fight against mines is a complex concept that includes all the actions carried out with specialized forces, both for the discovery of enemy mining actions and the destruction of mine carriers in order to prevent mining actions and for the

destruction of launched mines, in order to remove the danger generated by their existence.

If for the phase of preventing the launching of mines, namely the execution of actions during the organization and planning of mining actions or even during their development, forces and means used in classic naval confrontations can be used, for the phase that begins with the launching of mines into the water they must be used the forces specialized in the fight against them. They are specially equipped and prepared for the discovery, neutralization and destruction of mines and are divided into two major components: swiping and mine hunting.

Appeared as a necessity for the creation of safe navigational lines immediately after the end of the Second World War, swiping is a set of actions to search, discover and remove the danger of mines using specialized towed systems (mechanical, acoustic, magnetic, hydrodynamic, combined, etc.). Much later, due to the increase in complexity in the construction of mines, military specialists concerned with the fight against these weapons developed a new concept called “mine hunting”. The implementation of this concept led to the creation of specialized ships, with special possibilities compared to those of swiped and which are known under the generic name of mine hunters. They are built and equipped for the search, discovery and destruction of mines, ensuring greater effectiveness in the fight against non-contact mines, very difficult to discover and neutralize with the means specific to swipe.

The use of specialized ships in the fight against mines presents a number of advantages, such as:

– can execute combat missions up to the sea level 5-6;

– ensures high navigation accuracy;

– have special resistance to mine explosions by adopting special constructive solutions for live work (some ships withstand an overload of 250 g/mm$^2$, for 5 seconds, which occurs when a 1000 kg Trinitrotoluene, mine explodes, produced 150 m across or at 30 m below the keel);

– the parameters of some physical fields of the ships are at a very low level through: the use of non-magnetic materials for construction, the reduction of the acoustic field of the installations and propellers through the use of shock absorbers, the use of special installations to reduce the pressure produced by the ship's hull;

– they have a sufficiently large range of action and autonomy to cover very large areas;

– very high productivity.

Among the main disadvantages, we mention:

– MCM ships cannot perform mission in small spaces (inside ports, on access passes, on rivers or canals, etc.);

– MCM ships cannot execute mission in places with low depths (below 10m);

– greatly influenced by certain hydro meteorological or environmental conditions (sea state, air temperature, water salinity, water depth, wave propagation conditions, visibility, nature of the bottom, etc.);

– are prohibited in places where underwater explosion is not allowed (in harbors, ports, near platforms, pipelines or cables);

– classic operations against mines cannot guarantee a percentage of 100% cleaning of a water area, but through these actions, only a certain probability of cleaning the water area can be considered, which differs from one means used to another.

At the moment when at least one of these factors decisively influences the optimal parameters of the classical forces and means of combating mines, the question arises of using another force capable of acting for the search, discovery, identification and destruction of mines.

## 4. Participation of EOD Divers in Mine Action

If conventional forces and means cannot be used for one of the reasons listed above, then the only capability that can successfully resolve the threat posed by the existence of sea mines is the EOD diver.

The main advantages of using EOD divers in the fight against mines or improvised explosive devices are:

– they can act regardless of the depth of the water;

– they are the only mine-fighting force that can execute underwater mine neutralization actions;

– the use of diving equipment with closed/semi-closed circuit and a magnetic allow safe movement in the vicinity of the mine to carry out their identification, neutralization and destruction;

– are the only force that can generate a 100% probability of cleaning a water body;

– can perform actions to move a mine from the place of discovery to another destruction area if the explosion is not allowed;

– it is the only force specialized in the execution of demining actions of submerged critical infrastructure (ships, bridges, locks, docks, oil platforms, etc.).

The phases of a mine action mission using EOD divers, in chronological order of execution, are:

– Searching, finding and marking – is the most resource and time consuming part of the EOD divers' mission. It depends a lot on the accuracy of the information received, the accuracy of the landmark positioning tools, the underwater conditions. Optimal execution procedures: search on marked passes, surface towed search, underwater propulsion search and instrumental search, with underwater detection means or with surface detection means (towed or self-contained);

– Identification – represents the operation of distinguishing the shape, dimensions, particularities of the device and comparing them with the existing database at the unit level. The identification is called positive if the discovered device was found in EOD specialist publications, determining its type and category accurately. The identification of an explosive device is extremely important for the subsequent safe execution of neutralization and destruction actions. This is highly dependent on the EOD diver's experience, underwater visibility and available database;

– Neutralization – interruption of the ignition chain of the firing mechanisms and is carried out when the explosion of the mine is not allowed in the place where it was discovered, and for its destruction it is necessary to move it to another area or when the discovered Mine/device must be recovered at area for study or research;

– Destruction – the total removal of the danger generated by it. This is usually done by mounting an explosive charge and detonating it from the safe zone.

Areas of the open sea near the coasts are usually areas where specialized vessels cannot intervene, due to the limitations they have. These waters with shallow waters (very shallow water) present following particularities that make it impossible to use other capabilities for demining:

– the water depth, generally between 0-10 m, is dangerous for navigation and the maneuvering of ships specialized in the fight against mines;

– if the shallow waters have an irregular bottom with rocks, rocks or natural obstacles, it is almost impossible to detect mines by technical means;

– the tide, currents and waves have a stronger action than in other waters where their influence is not so great;

– the proximity of these waters to coastal areas and the possible dangers that may arise, especially when we are in enemy or hostile territory.

Even if these waters are not frequently used for navigation, the presence of mines in these areas is justified by the fact that the anti-landing protection of

coastal areas is done here or there may simply be mines detached from dams and brought to coastal areas by currents or waves.

The shallow water depth in these areas, the great disadvantage of specialized anti-mine vessels, is a great advantage of using EOD divers, as it allows them to stay underwater for a long time without performing decompression when returning to the surface. Another great advantage of using divers near enemy coasts is the fact that they can operate in secret, undetected by the enemy's visual or technical means. The use of closed/semi-closed circuit and non-magnetic diving equipment allows EOD divers to remain undetected and perform specific missions in enemy territory as well.

The landing operation on the coast is carried out for the purpose of transporting the landing troops from the sea or river to land, in coastal areas, for their transition to the offensive. The main danger is the existence of anti-landing marine mines planted in these areas or the existing genetic facilities or natural underwater obstacles.

For the success of the landing operation, it is necessary to create safe corridors for the landing ships carrying the landing troops. These safe landing corridors start at the landing formation area and end at the shoreline. They are created through the combined action of mine countermeasures vessels and EOD divers.

Even if the water depth is usually shallow and these areas can be called shallow waters, the action of EOD divers in support of the landing operation presents some particularities:

– it takes place in a very short time, approximately 2-4 hours, immediately before disembarking;

– they usually act in enemy territory, so the divers' actions must be carried out in secret.

Due to the short time to execute safe landing lanes, the mission of EOD divers is to search and find lanes free of mines or artificial or natural obstacles and not to clear a pre-established lane. For disembarkation, a few beach areas are chosen that make disembarkation possible, and following the execution of their research with ships or specialized means and with EOD divers, it is determined which will be the disembarkation area.

Port waters, access passes in ports as well as ship anchorages are the maritime and river areas most mined in naval conflicts. In these areas, mine damage is mainly due to the concentration of a large number of ships in a relatively small area. The particularities of these water areas are:

– the relatively small dimensions that make it impossible to maneuver ships specialized in the fight against mines;

– the irregular shapes of the port waters;

– variable depths;

– the existence of many metallic objects with approximate shapes of sea mines that make detection with technical means difficult;

– the destruction of mines is not allowed in these areas, the discovered mines having to be transported to districts specially intended for destruction;

– the berths and the waters in their immediate vicinity cannot be surveyed by other means.

All these disadvantages of using specialized vessels make EOD divers the only mine fighting capability in and around ports.

## 5. Conclusions

From the analysis of the use of sea mines in naval confrontations and from their technological development trends, it emerges that combat actions against mines and explosive devices must be carried out together, with all available capabilities: dredgers with mechanical and electromagnetic dredges, mine hunting with high-performance sonars and remote-controlled vehicles and last but not least with EOD divers, both in the crews of specialized ships and as independent structures.

The conditions and decisive factors for achieving success in mine action are:

– the use of naval groups that include all types of MCM forces. In this way we can eliminate all the limitations that each kind of force has;

– the designation of a single staff/person to have the command of all forces intended for mine actions, as well as the creation of a centralized system of their command and control;

– continuous technological modernization of the forces and means participating in actions to eliminate the mine danger;

– continuous updating of the procedures against mines;

– execution of joint trainings and exercises with the participating forces to increase the degree of interoperability;

– continuous updating of databases and specialized EOD publications as well as ensuring the possibility of studying them at the place of execution of demining actions.

Whether we are talking about the protection against underwater diversion of critical infrastructure, mine recovery actions for research or their transport to other waters for destruction, search actions in shallow water areas or ports, or diving in waters without visibility or with heavy vegetation, EOD divers will not be able to be replaced by another capability to remove the danger posed by sea mines.

Even if, worldwide, in sea mine action, there is a tendency to replace the human factor with autonomous or remotely controlled means, EOD divers will always represent an important capability, without which mine warfare will not be possible won.

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