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Environmental Risks Monitoring of Shipwrecks in Italian Seas

By Giuseppe Masetti (Italian Navy's Hydrographic Office) and Fulvia Orsini (University of Tuscia)



Abstract

After a description of the international regulatory framework, this paper examines the European project DE.E.P.P. and provides an overview of shipwreck databases in Italy. Afterwards, it reconstructs the recent history of the supertanker VLCC Haven which represents one of the largest Mediterranean shipwrecks. The findings of this paper emphasize the need to unify all the various agencies databases into a national Territorial Information System of potentially polluting wrecks. This System would be completed by all the information available in archives and press, to allow an adequate environmental risk monitoring and classification of shipwrecks in the Italian seas.



Résumé

Après la description du cadre réglementaire international, cet article examine le Projet européen DE.E.P.P. (DEvelopment of European guidelines for Potentially Polluting shipwrecks) et fournit une vue d'ensemble des bases de données en matière d'échouement en Italie. Il reconstitue ensuite l'histoire récente du superpétrolier VLCC Haven, l'un des plus importants échouements ayant eu lieu en Méditerranée. Les conclusions de cet article soulignent la nécessité de réunir toutes les bases de données des diverses agences en un Système territorial d'informations sur les échouements potentiellement polluants. Ce système serait complété par l'ensemble des informations disponibles dans les archives et la presse afin de permettre une gestion appropriée des risques environnementaux et la classification des échouements dans les eaux italiennes.



Resumen

Tras una descripción de la estructura regulatoria internacional, este artículo estudia el proyecto europeo DE.E.P.P. (DEvelopment of European guidelines for Potentially Polluting shipwrecks) y proporciona una visión de conjunto de las bases de datos de restos de naufragios en Italia. Posteriormente, reconstruye la historia reciente del superpetrolero VLCC Haven, que representa uno de los mayores restos de naufragios del Mediterráneo. Las conclusiones de este artículo destacan la necesidad de unificar las bases de datos de todas las diferentes agencias en un Sistema de Información Territorial nacional de restos potencialmente contaminantes. Este Sistema sería completado con toda la información disponible en los archivos y en la prensa, para permitir un control adecuado de los riesgos ambientales y la clasificación de los restos de naufragios en los mares Italianos.

1. Introduction

With the word “wreck” we usually mean the remains of a craft, an aircraft or any other object of conspicuous dimension which, because of various possible causes (from accidental collisions to acts of war or terrorism), is partially or totally submerged by the sea water. The definition of “wreck” is not limited to the vessel itself, but includes equipment, personal effects, cargo and fuel. For purposes of this paper, we are looking at the relatively more modern “wrecks”¹ that may contain bunker fuel and cargo the release of which presents a real threat to the health of the marine environment.

The state of preservation of a shipwreck is mainly connected to the period lapsed from the sinking date, to the damages correlated to the sinking causes, to the construction type (i.e., welded or riveted hull), to the building materials², to the depth and the characterization of the seabed on which it lies³. A ship that sank more than 200 years ago usually has changed due to its marine environment and is likely to have stabilized from further deterioration from the elements.

Further information about shipwrecks’ state of preservation can be deduced from reports of any salvage attempt⁴ (even partial) or demolition (for example, to clear a seaport access or a water way, avoiding it becomes a danger for other ships), from the submarine current strength in the area, from the exposure to wave-motion or atmospheric agents, from the presence of marine organisms speeding up material deterioration, from recreational divers, ...

Any modern shipwreck, independently from the

type of load shipped at the moment of sinking, may be a potential source of marine pollution and certainly when it releases hazardous or toxic components in the ecosystem. The relative threat

to the marine environment depends on a number of factors including the amount of hazardous or toxic material being released and the relative state of preservation of the wreck, particularly for the containers of the hazardous material. Fuel, lubricating oil, and antifouling paint are some examples of toxic compounds that may be discharged from a shipwreck into the external environment⁵.

As there are various shipwrecks lying on the ocean seabed and, in particular, in the Mediterranean Sea, we need to define which of them could be environmental hazards in the future (Basta 2004, REMPEC 2004).

2. Legal framework

In the international field, the Law of the Sea (LOS) Convention - adopted in Montego Bay in 1982 – provides the international legal framework for uses and activities including those directed at shipwrecks⁶. Italy entered into the LOS Convention, on 1 January 1995. Moreover, the LOS Convention is now recognized as reflecting customary international law even by Countries that have not yet become parties to it.

To define rights and obligations of a Country in regard to a specific shipwreck, it is essential to identify the precise geographic location of the vessel in the marine environment. Under the LOS Convention, territorial waters may extend out to twelve nautical miles from the baseline⁷.

¹ Art.1 (4) of International Convention on the Removal of Wrecks (2007) states that a wreck is, not only a submerged ship or part of it but also “[...] any object that is lost at sea from a ship and that is stranded, sunken or adrift at sea”.

² The typical building materials of modern vessels (for example iron and steel) have several dozens years of resistance to deterioration, especially for objects of conspicuous thickness as boilers or cannons. However, when the corrosion prevails, the whole structure is doomed to collapse. Other non-ferrous metal (as brass), used only to build limited parts of a ship, have a longer period of resistance to deterioration in sea water (cf. Crochet 1991).

³ Even if wood deteriorates quickly in sea water, have been discovered wooden parts of ancient shipwrecks which just after sinking were buried underneath sandy or muddy seabed (for some examples of wooden shipwrecks findings see Lattanzi 2007, dell’Amico 2005).

⁴ Damage assessment is one of the decisive elements valued before trying a shipwreck’s rescue operation. In most cases (collision with rocks or shoals, stranding, crash with other ships, fire and explosion) the damage level is so high that the rescue attempt is not cost effective. In these cases is evaluated the feasibility of rescue a part of the wreck or only its load. This type of operation usually causes further damages to the shipwreck.

⁵ During the last ten-year period, in all the world’s waters, several releases of hydrocarbon caused by corroded shipwrecks’ tanks have been noticed (Michel 2005, SPREP 2002).

⁶ The threefold aim of the Montego Bay Convention is to update the regulations provided by previous conventions codification, to integrate the regulations which are partial or incoherent and to propose solutions for the new issues related to global technological development (Carbone 2006).

⁷ A baseline is the line from which the seaward limits of a State’s territorial sea and certain other maritime zones of jurisdiction are measured. Normally, a sea baseline follows the low-water line (lowest astronomical tide) of a coastal State. When the coastline is deeply indented, has fringing islands or is highly unstable, *straight* baselines may be used.

The contiguous zone may extend out to twenty four nautical miles from the baseline. In the territorial sea, a Country controls shipwrecks as part of its sovereign territory. Within this contiguous zone, the coastal State may continue to protect its interest in its territory and territorial sea through the prescription and enforcement of laws in specific areas: pollution, taxation, customs, and immigration. A coastal country may also regulate shipwrecks that are of historical or archaeological interest ⁸.

Italy fixed its territorial waters at twelve nautical miles ⁹, but it has not formally declared a contiguous zone ¹⁰. As such, there may be questions about the enforcement of laws in that zone against foreign flagged vessels and nationals.

Even if they have the same extension and partially similar uses, the contiguous zone must not be confused with the archaeological zone. On the basis of Article 303 of the LOS Convention, the coastal State can exercise powers of control and enforcement to its internal law about removal and commercialization of historical and archaeological goods found therein. Still in the same article of the Convention, the third and fourth paragraphs provide for the preservation of owner rights (if identifiable) and the reference at possible international dispositions about shipwreck salvage (Scovazzi 2004).

Among these, we indicate the recent approval of the UNESCO Convention on the Protection of the Underwater Cultural Heritage which outlines structured and exhaustive rules on the protection of historical and archeological goods present in all the seas. This Convention became necessary as consequence of recent technological progress; many private enterprises, in the wake of Robert Ballard - who discovered the Titanic in 1985 - are going to chase the many treasures still lying

on the bottom of the sea, to obtain economic advantages.

In Italy, discovery and salvage of shipwrecks is regulated by the Chapter I of the Title IV of the Navigation Code ¹¹. In 1998, the Ministry for the Cultural Heritage and the Ministry of Defense drafted an agreement to assign to the Italian Navy tasks of research, discovery and salvage of historical and archaeological goods on depth higher than forty meters; and, the duties of vigilance, prevention, and repression of crimes. Article 94 of the Legislative Decree of 22 January 2004 established an archaeological zone of twelve nautical miles from the outer limits of territorial waters ¹². Moreover, Law no. 61 of 8 February 2006, established ecological protection zones on which Italian Government can exercise "*its own jurisdiction on protection and preservation of marine environment, included archaeological and historical heritage*".

Beyond the EEZ and continental shelf, in the area beyond national jurisdiction, Article 149 of the LOS Convention established that every historical and archeological object found must be preserved or ceded in the interests of all mankind, but taking in account the preferential right of the Country of origin or the Country of cultural, historical or archaeological origin.

In addition to these regulations, the Montego Bay Convention established duties and responsibilities about marine environmental safeguarding. Article 192, established that each Country has the obligation to protect and preserve the marine environment.

The subsequent Article 194 of the Convention specifies that the abovementioned obligations are not unconditional, but must be referred to the real technical and economical possibilities of each Country. However, each Country must commit

⁸ Art. 303 (2) of LOSC states that the removal of archaeological finds from the seabed for commercial purposes without authorizations is a violation of both national and international law and regulation.

⁹ The Law no. 327 of 14 August 1974 has modified the Paragraph II of Article 2 of the Navigation Code as follows: "*È soggetta altresì alla sovranità dello Stato la zona di mare dell'estensione di dodici miglia lungo le coste continentali ed insulari della Repubblica e lungo le linee congiungenti i punti estremi indicati nel comma precedente*".

¹⁰ However it is interesting to remember that the legislator makes reference to the contiguous zone in relation to immigration control in the Article 12, Law no. 189 of 30 July 2002 (the so-called "Legge Bossi-Fini").

¹¹ In particular, it is underlined that a shipwreck discovery in the territorial water must be reported within three days after the finding or the mooring. The rescuer must hand the wreck to the Maritime Authority or to the lawful owner and he has a claim to receive a recompense equivalent to a third of the object value.

¹² In the archaeological zone, historical goods discovered "*sono tutelati ai sensi delle Regole [...] allegate alla Convenzione UNESCO*". It is important to underline that, according to the above mentioned Convention, submarine cultural inheritance is: "*Qualsiasi traccia di vita umana avente carattere culturale, storico o archeologico che sia stata sott'acqua parzialmente o completamente, periodicamente o continuativamente, per almeno 100 anni*".

itself to balance its own policy with environmental protection. There is therefore a common responsibility for developed Countries, like Italy, to protect and preserve the environment from the threat presented by shipwrecks. This should involve employing the appropriate resources required to perform shipwreck environmental risks management.

This principle is partially included in Art. 7, 8 and 9 of International Convention on the removal of wrecks (2007) which decree the guidelines for all the authorities concerned about identification, signalling and removal of all hazardous wrecks.

3. European project D.E.E.P.P.

The necessity to protect the environment from threats caused by shipwrecks is also a priority at the European level. In 2007 the European Commission granted a project called

Development of European Guidelines for Potentially Polluting Shipwrecks (D.E.E.P.P.) in order to provide national public administrations with some guidelines and criteria to face environmental risks caused by shipwreck leaks due to corrosion.

The D.E.E.P.P. Project, devised by the *Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare* (I.C.R.A.M.) in cooperation with the homologous French institute (C.E.D.R.E.), has used the Cetaceans' Sanctuary of the Mediterranean Sea *Pelagos*¹³ as a pilot project area for a potentially dangerous shipwrecks database. In this database, shipwrecks will be classified according to their potential environmental risk; it will provide a useful instrument to set action priorities and to minimize environmental risks (Alcaro 2007). This pilot project has located and researched shipwrecks sunk in the area since the Second World War.

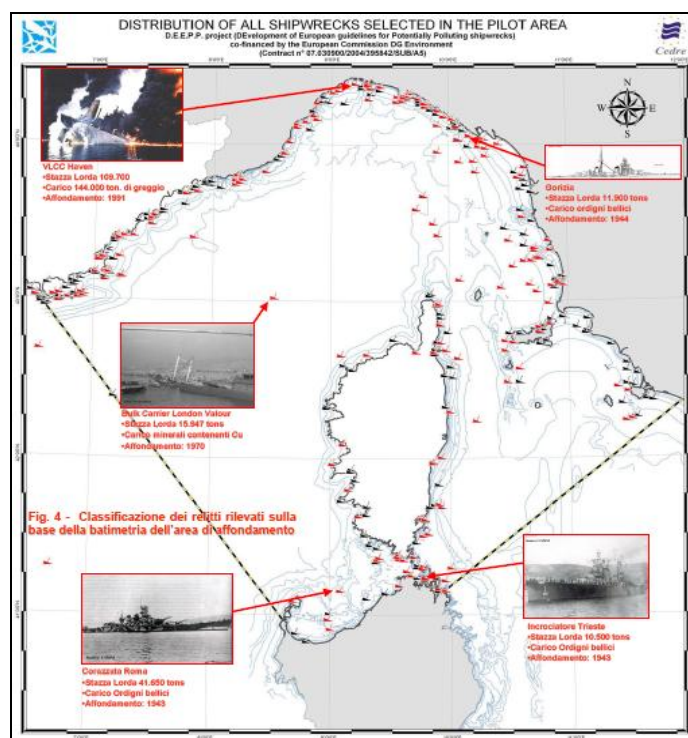


Figure 1: ICRAM Pilot Project (ICRAM, 2007)

¹³ The Cetaceans' Sanctuary of the Mediterranean Sea *Pelagos* is a marine protected area covering a sea area of about 87,000 square kilometers between the coasts of southern France, Monaco, Corse, Sardinia, Liguria and Tuscany (for more information, visit the website www.santuariodeicetacei.it).

A large part of the information required to realize the pilot project (georeferentiation, sinking details, bulk cargo and hull features, etc.) was recovered from Italian and French Hydrographic Office (I.I.M. and S.H.O.M.) archives, local harbor offices, some databases realized by scientific research institutes and bibliographical researchers¹⁴. This information, integrated with the characterization and the bathymetric trend of seabed, has been organized in a Geographic Information System (GIS).

Data collected on the basis of the environmental risk and the feasibility of a mitigation action plan, highlighted that 51% out of 436 shipwrecks analyzed lie on a seabed lower than 50 meters, and about half of all sank more than 60 years ago (during the Second World War). Just these two typologies (especially vessels of 10,000 tons or more) - according to ICRAM - are cause of concern for the future of the marine environment (Alcaro 2007).

4. An overview of the Italian situation

The presence of a shipwreck can be a navigation safety issue. Their correct position on the existing nautical charts is one of the institutional duties of the National Hydrographic Offices. Toward this end, the Italian Hydrographic Office created a database of approximately 5,000 shipwrecks

(among which about 1,000 are in national territorial waters). The Italian Hydrographic Office uses the information it contains to draw up traditional and electronic nautical cartography (I.I.M. 2007).

This database could represent a good starting point to realize a Geographic Information System of national shipwrecks. To achieve this goal it is necessary to get more and better information. Additional research and classification is needed; as documentation about shipwrecks in Italian seas is significantly variegated.

The number of shipwrecks sharply increases during some particular historical periods, for example during the two world wars. From the point of view of environmental risk, these war-related? shipwrecks are a conspicuous source of pollution and, in a few cases, even environmental disaster. Therefore, it is essential to carry out a strict positioning, classification and documentation process of national shipwrecks first.

This process has already partially started. The Superintendence of Cultural Heritage of some Italian regions (Campania, Basilicata, Calabria and Puglia) in coordination with the Ministry of Cultural Heritage has established a project of submarine archeology called ArcheoMar¹⁵.



Figure 2: Wrecks of a rails-carrying ship sunken in the Strait of Messina (Archeomar, 2004)

¹⁴ It is difficult to find data about the load or the fuel onboard the older shipwrecks. In these cases, the ICRAM researchers have made a qualitative extrapolation - based on the specifications of some shipwrecks extracted by the Lloyd's Register books - to define various classes of shipwrecks, depending on the estimated volume of their tanks.

¹⁵ See MiBAC 2006; visit also <http://www.archeomar.it/>.

The first phase of this project allowed for the creation of 628 file records containing data collected from different archives and libraries. Less than 9% of the sites had verifiable geographical coordinates; 50% had indications of the area; 41% were approximately indicated. Additional information has resulted from this analysis: in some parts of the coast there is a high concentration of submerged archaeological areas. These areas are located on known commerce routes, highly populated zones or theatres of war. The census phase was followed by survey and investigation of 287 sites (located between the coastline and the 400 meters bathymetry) and have now been precisely georeferenced and documented with videos and photos.

This first project, carried out from 2004 to 2007, will be followed by a similar project in two other Italian regions: Latium and Tuscany.

An analogous project has also been developed by the Sea Superintendence of Sicily. It has elaborated a Territorial Information System based on a database of marine cultural goods and is being done in cooperation with the Italian Hydrographic Office ¹⁶.

5. The Haven shipwreck

The wreck of the supertanker VLCC *Haven*, 344 meters length, is one of the largest shipwrecks in

the Mediterranean. The main body lies on a muddy seabed, off the coast of Arenzano, at about 75 meters of depth, whilst a part of the bow with the bulb is at more than 500 meters of depth. The sinking, dating back to 14 April 1991, was due to a fire caused by a violent explosion abreast of the forward tank ¹⁷.

After the sinking, the combusted and semi-combusted residues were removed from the seashore and the seabed as far as the 10-meters isobath, and have been pumped from the shipwreck tanks and premises. The residues present on seabed beyond 10 meters have been left to environmental auto-decomposition process. Still today, small amounts of hydrocarbons continue to leak from the main body of the vessel and there are various tar remnants can be found in a vast area around the shipwreck.

In 1998, at the end of a dispute lasting about eight years, the Italian Prime Minister solved, with an out-of-court settlement (a direct mediation between Italian Government, the IOPCF ¹⁸, the ship-owner and the ship assurance company), the dispute concerning the sinking related damages compensation ¹⁹. Part of the damage compensation has been employed to perform both decontamination operations on the shipwreck and interventions of environmental restoration of the sea and coast area which were most damaged by the accident's harmful effects.



Figure 3: Picture of a part of the Haven shipwreck (Subnormali Team, 2007)

¹⁶ For further information, visit the web-page <http://www.regione.sicilia.it/beniculturali/archeologiasottomarina/>.

¹⁷ For further information about the supertanker VLCC Haven, visit the website www.haven.it.

¹⁸ The International Fund for Compensation for Oil Pollution Damage (IOPCF), with headquarters in London, is an international organization founded by the Brussels Convention of 18 December 1971. Italy has adhered to the fund on 27 February 1979 (with the Law no. 185 of 6 April 1977).

¹⁹ The settlement finished with the obligation to pay to the Italian Government 117,600,000,000 Italian Lire (about 60,735,000 Euro), including legal expenses for surveys carried out during the penal proceeding.

Underwater explorations of the shipwreck's main body were carried out to locate oil remaining on the vessel. No oil was found in the tanks or the engine room, but about one hundred tons of hydrocarbons were found in the forecastle ceiling which came from the lower structures of the vessel. A risk analysis was carried out on the basis of two possible scenarios: scenario A concerned a continuous and constant hydrocarbons spillage for a period of 70 years; scenario B concerned a catastrophic release caused by a sudden structural failure of the shipwreck.

The results of the two-scenario simulation found that a continuous and constant spillage of hydrocarbons is not a danger for human health or for the environment; whereas the B scenario could produce remarkable pollution along the coast from Arenzano to Capo Noli. Moreover, considering that the risk level is acceptable if the released hydrocarbons amount is less than 2 tons, this amount was used as minimum goal for the decontamination operation.

The Regional Agency for the Ligurian Environmental Protection (A.R.P.A.L.) was in charge of environmental control and monitoring during decontamination operations. The shipwreck decontamination operations ended on 12 June 2008.

After few years, through periodic reconnaissance of the shipwreck it was possible to recreate the *Haven* metamorphosis process: from a significant source of pollution to an oasis of submarine life²⁰. The shipwreck represents a benchmark study area for marine biology and environmental risks monitoring related to modern vessel sinking.

From the environmental point of view, the decontamination operation of the *Haven* represents an important pilot experience at international level because of both the location of the hydrocarbon tanks to decontaminate and the shipwreck position, lying on shallow seabed at few nautical miles from a tourist coastal zone.

6. Findings

Every shipwreck containing hazardous cargo or bunker fuel will eventually collapse and release the remaining buoyant substances trapped inside. This collapse can happen in various ways, from limited and progressive structural failures to a sudden break down or a cascading process which ends with the destruction of the entire structure.

Even if technical literature and experience do not give accurate indications on the abovementioned process' time-frame, the current interest of the international maritime community about shipwreck decontamination comes from recent hydrocarbon releases from vessels sunk during World War II. We can estimate that shipwrecks of vessels built in the last century will probably have structural collapses in a time lapse ranging from forty to one hundred years (Monfils 2005, Petersen 2007).

Moreover, besides the complete structural collapse, hydrocarbon spills from little leaks (from rivets, failed pipes, valves, ..) and cracks (present on the tank walls and worsened by the corrosion process) are possible.

The safety settings related to environmental risks must provide the clearance of hydrocarbons of any form which are present into the shipwrecks. Even if light hydrocarbons can be removed with relative easiness, the direct pumping of may be difficult because of slow flow and backpressure. These are effects caused by the long pipes which bring heavy oils to the surface. So it is important to choose the correct tools to operate efficiently.

At the same time, during the planning stage, it is possible to evaluate what will be the amount of hydrocarbons which remains trapped inside the shipwreck.

On the basis of these observations, it is clear that the need to collect all the elements available to evaluate environmental risks related to shipwrecks is urgent.

²⁰ The fire, lasted over three days, had the important function to create a natural environment setting in the shipwreck main body. The high temperature reached (above 900° C) removed from the steel all the protective substances (as paint, plastics, plating, etc.) facilitating in this way the settlement of benthic forms after few months since the sinking. For example, at the end of 1991 was detected a growing colony of lamellibranches (oysters and anomias).

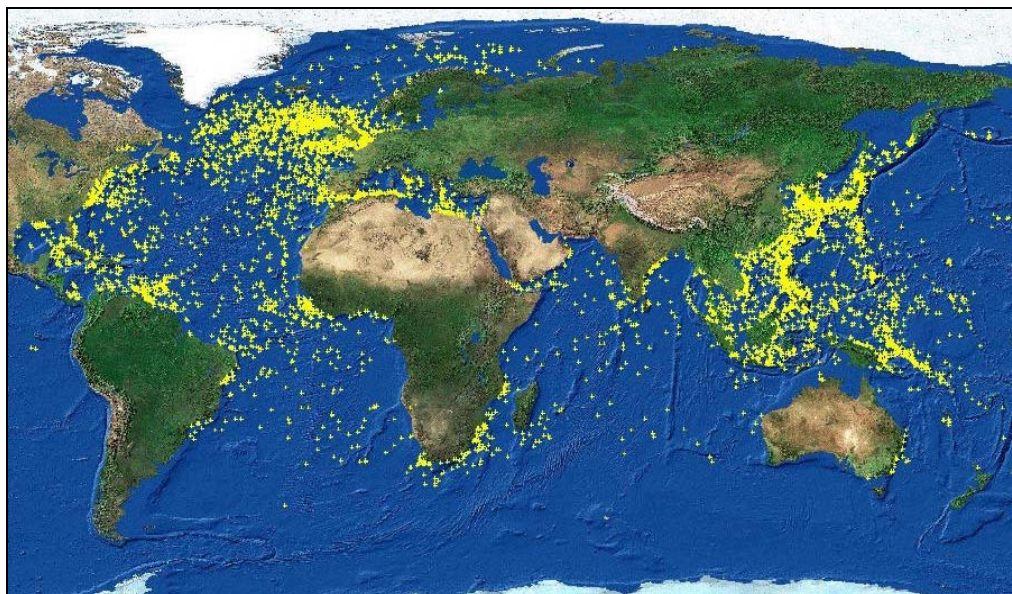


Figure 4: Database of modern shipwrecks collected by Sea Australia (R. Monfils, 2004)

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Biographies

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Fulvia Orsini (University of Tuscia) was born in Naples (Italy) in 1984 and graduated in law at University "Federico II" of Naples in 2008. In the same year she begins to attend the "School of specialization of the forensic practices" at University of Tor Vergata and she gets the honorary fellowship in International Law at the University of Tuscia.

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