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Researches on marine biology in the Straits of Messina: past and present

The Straits of Messina are a very turbulent tract of sea, long about 33 Km, dividing Sicily from the Italian peninsula. In mythology they have been known since ancient times as the dwelling place of monsters because of the strong currents which make it extremely difficult to cross.

From a geomorphological point of view, the Straits of Messina cut through the Calabro-Sicilian Arc and link the Basins of the Tyrrhenian and Ionian Seas. This event probably took place during early Pliocene times. Since then tectonic activity has directly controlled the dynamics and morphology of the Straits. At the present time, the Straits have a funnel-shape with the wide part (ca. 17 Km) facing south and the narrow part (ca. 3 Km.) toward the northern entrance. Its depth from south to north diminishes rapidly from 2000 m opposite Capo d'Armi (Ionian Sea) to about 80 m on the sill rising between Punta Pezzo (Calabria) and Ganzirri (Sicily).

The peculiar geomorphological conformation, the opposite tidal phases of the two neighbouring seas and the different physical and chemical features of their waters are the cause of this well known strong turbulence in the Straits of Messina, aggravated by the abrupt change in bottom topography in the vicinity of Messina..

The current flowing from south to north is locally called "Rema montante" and that running from north to south, "Rema Scendente". Although the tidal amplitudes are relatively small (27 - 10 cm), current speed reaches 2-3 m/s due to the morphology of the Tyrrhenian and Ionian Basins in the vicinity of Messina. Near the coasts the currents originate secondary currents, locally called "refoli" and "controrefoli", vortices and the so-called "sorgimenti d'acqua", like oil spots, closely connected to the vortex forming. During "Rema Montante" upwelling and mixing of the fertile Levantine Intermediate Water (LIW) with surface waters occurs. Therefore different water masses dynamically coexist in the area of the Straits, with steep energy gradients at their boundaries, causing a high variability of hydrographic features even on a small spatial and temporal scale.

The hydrographic, physical-chemical and biological features of the Straits have a remarkable effect on the abundance and structure of planktonic, benthic and nektonic communities, making this ecosystem unique in the Mediterranean Sea with regard to the biodiversity and the biocenoses. Many species, known as rare in the Mediterranean, reach significant concentrations of individuals in the Straits of Messina, defined as a zone of "accumulation" that produces a subsequent "insemination" of the neighbouring Tyrrhenian and Ionian seas. In fact, it is common to find deep species at the surface and vice versa, or open-sea species along the coast. Moreover, the water upwelling gives one the possibility to easily watch abyssal organisms still alive which, under

favourable conditions of time and wind, are dragged by the streams flowing from the bottom to the surface and sometimes even stranded on the shore.

The abundance and variety of the living organisms that can be easily collected for research have always attracted scientists from all the world, thus playing an important role in biological progress. The first scientific observations date back, maybe, to the 4th century B.C. (Aristotele, 384-322 B.C.), but documentary studies are only found at the end of sixteenth century, when the University of Messina was established and became the centre of both humanistic and scientific activities, drawing famous biologists to Messina. Naturally, biological research in Messina was above all directed towards marine organisms, caught in the Straits. In this meeting it will be possible to briefly remember only some among the most famous.

The Benedictine Abbot Francesco Maurolico (1494-1575) was one of the earlier naturalists from Messina. He described the fishes from the seas around Messina in the “Tractatus per Epistolam Francisci Maurolici messanensis ad Petrum Gillium de piscibus siculis”, written in 1543, making a punctual list of the more common fishes, furnishing their Latin and popular use of names and describing their morphological characteristics and the usual means of catching them too.

Then, Marcello Malpighi, (1628-1694), who was at the University of Messina from November 1662 to May 1666, carried out studies not only on anatomy and botany, but also on the optical nerve of the *Xiphias gladius* Linneo (the sword-fish). Malpighi's interest in the sea of Messina is also confirmed by his sketches which give topographical information of historical importance.

Anastasio Cocco, born in Messina (1799-1854), a doctor of medicine and teacher of Pharmacology at the University, described new species, among which the well-known *Argyropelecus hemigymnus*. Cocco's papers were known far and wide by national and international scientific societies. He continued his research as evidenced by his letters and communications to the most famous zoologists of old remains.

Above all the papers about the “stranding phenomenon” brought many naturalists to Messina. Among them, we can remember Ruppel, Milne-Edwards, Müller, Claus, Kolliker, Foll, Gegenbaur, Haeckel, Metschnikoff, Hertwig, Dhorn and Khron, who defined the Straits of Messina as “the zoologists' paradise”.

In this crowded swarm of scientists, who used the specimens from the Straits for their study, it is particularly interesting to remember Metchnikoff (1845-1916). While carrying out experiments on the Poriphera *Sycandra raphanus* and its larval development in the aquarium located in the "Ringo" village, he observed the cell ameboid role of the mesoderm. To confirm this phenomenon he introduced some rose thorns under the epidermis of *Bipinnaria* (Asteroidea larva) and saw a large number of amebocytes surrounding the foreign bodies and englobing them. From this

observation he enunciated the hypothesis that the particular richness of leukocytes in the inflamed tissue played a defensive role by means of phagocytosis mechanism. This was surely a very important discovery for the development of human pathology and it took place in Messina.

Luigi Facciola studied many genera and species of fishes and his 25 new Leptocephalidae, were collected from the Straits. In 1883, ten years after Grassi and Calandruccio, he found fishes with body-shapes which showed the transition between Leptocefalidae (*Leptocephalus kollicheri*) and Murenoidae (*Conger mistax*).

Since then, the scientific and cultural tradition of the marine biology of the Straits has been kept alive by many experts who have succeeded one another at both the University and the Experimental Thalassographic Institute of Messina (now IAMC of the CRN), founded the latter, such as the Station of Marine Biology in Ganzirri on the Straits' seaside, at the beginning of the last century. Among the most famous marine biologists, we must recall Mazzarelli, Sanzo, Scordia, Dulzetto, Bolognari and Genovese.

Mazzarelli is to be mentioned for the first real systematic observations on stranding. He provided information about the periods of stranding and compiled a list of organisms stranded during a period of two years, including the sites, the frequency and the abundance of the different species. Sanzo's (1874-1940) observations confirmed the role of the Straits' hydrodynamics in concentrating and selecting planktonic and abyssal species. His hypothesis will be strengthened in the following years both about plankton and abyssal fauna.

Scordia and Dulzetto studied above all the ichthyofauna of the Straits and of the brackish lake of Faro and Ganzirri with particular regard to the biology, development and comparative anatomy of the current species.

After the second world war, a new and strong impulse towards marine biology came with Bolognari (1917-1981) and Genovese (1927-1982), who were surrounded by many young researchers and students, full of enthusiasm and passion for this field of study. Numerous experts from all parts of Italy and the world were drawn again to Messina, to investigate several fields of the marine biology in the Straits of Messina, and in the neighbouring seas.

Just as an example, the observations on the benthonic populations, carried by underwater innovative equipment (certainly more suitable for an environment with such a high hydrodynamics), enabled us to have a much better knowledge of the spatial and vertical distribution of the vegetable and animal species, some of which rare or nonexistent in the Mediterranean, such as the great laminaria *Laminaria ochroleuca* or the only Mediterranean Stylasterina, *Errina aspera*. Then, in 1980, under the supervision of Genovese, the oceanographic campaigns for collecting samples down to 800 m of depth allowed us to obtain more knowledge on the zooplanktonic and

micronektonic fauna and to note that, due to the Straits' turbulence, many organisms are found at a depth which is certainly higher than in any other area of the Mediterranean Sea. At the same time, a series of dives undertaken with the use of the deep-diving vehicle "F.A. Forel" constructed by J. Piccard, permitted us to observe the behaviour and the bioluminescence phenomena of the mesopelagic fishes in their natural habitat and the formulation of a more precise hypothesis concerning the preferential stranding of some species. Without doubt and it is not only my opinion, Sebastiano Genovese was also the first in Italy to open new research horizons in the field of marine and brackish lake microbiology (such as biogeochemical cycles, sulfur bacteria, nitrification, self-depuration of seawater, microbial pollution and hydrocarbon-degrading bacteria). Thorough ecological interdisciplinary investigations in this area were developed in 1991 (Straits of Messina) and in 1994 and 1995 (low Tyrrhenian Sea) carrying out oceanographic cruises with the participation of experts from all the world.

Today, the peculiar features of the ecosystem of the Straits of Messina continue to interest the scientific community from all over the world.

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