#### Introduction



The province of Brindisi, territory devoted to agriculture, has undergone a profound economic change in the last 50 years: now it houses an industrial center of national importance, a port and an airport very active in the trade of goods and people. It has, however, an area of high agricultural development with groves, vineyards and arable land, in which the naturalness occupies only 2.1 % of the entire surface and appears very fragmented and with low levels of connectivity. The woodland formations and Mediterranean maquis after the agrarian reform of years '50 are represented for the most part by small and isolated flaps which represent little more than 1% of the total area. The pastures appear quite marginal insisting on only 0.5% of the total area and characterized by a high level of fragmentation. On the coast there are 5

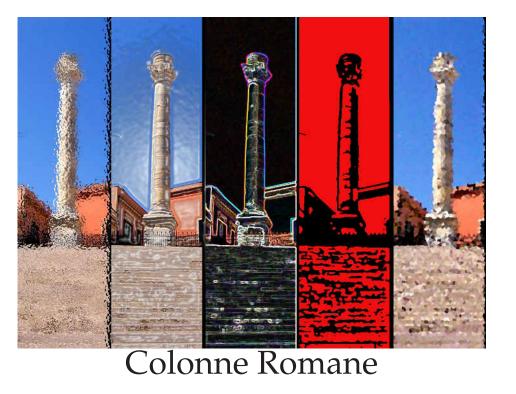
moist areas, including Torre Guaceto, all at the mouths of the various incisions erosive (channels) that develop, in agreement with the direction of greater steepness of the topographical surface, in the direction SN, perpendicularly to the coastline . The wetlands and natural formations related to the streams and channels to represent the whole 0.6% of the total area. The wetland Torre Guaceto was declared in 1981 Zone of International Importance in Ramsar Wetland Convention and the State Reserve in 1982. The reserve now has an area of about 1110 hectares. In the eastern sector of the reserve he reaches one of the major rivers of the Salento, the Canale Reale, which feeds the extensive coastal wetland. The wetland is characterized by a large reeds interrupted by some water clear with a dense network of

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Aerial view of the Brindisi countryside

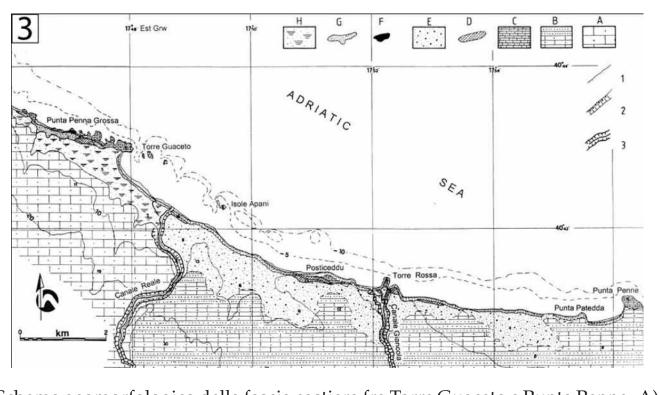
drainage channels largely filled by the reeds and some are still in communication with the sea. In addition to the natural wetland assume particular relevance the large formations of high dunes cords up to about 10 m and with a remarkable development in the hinterland. Largely they are colonized by vegetation xerophile constituted by the Mediterranean maquis with Juniperus oxycedrus, Juniperus phoenicea and Quercus ilex. In the western sector of the maquis occupying the consolidated dunes it is progressively replaced inland from a forest oaks (Quercus ilex). This wooded nucleus with the dune annexed to it currently represents the part of most naturalistic value of the reserve of Torre Guaceto. Inland is present an agrarian landscape in which they are simultaneously identified both traits typical of traditional agriculture, with extensive arable land, olive groves, old almond, both those of intensive cultivation with the presence of some specialized orchards and areas used for growing vegetables.





For two years is offered to the students of the middle school Istituto Comprensivo Sant'Elia Commenda Brindisi (with boys aged between 10 and 3 years) extracurricular activity multidisciplinary study of the land and the environment, the project " Territorio virtuale ", to enrich the learning experience in the classroom with new concepts and technologies. Subject of study are primarily the geological structure of the subsoil, the description of the geomorphology of the surface and then the structural description, the asset values, the dynamics of transformation and the criticality of the Brindisi countryside, using the tools of analysis of spatial information spread by the media in text or graphic form. The links between this information and practical experiences in the field and in the laboratory have created added value in disciplines such as Ecology and Environmental Education.

Within the project, the students have created the drawings that express the personal perception of the landscape: they are in a Web site they created http://territoriovirtuale.altervista.org/portale



3) sabbie e arenarie giallastre; C) calcareniti di spiaggia irreniane: E) sabbie rosse lagunari tirreniane; F) eolianiti 1) sabbie di spiaggia; 2) falesie; 3) incisioni fluviali.

The tract that extends from Punta Penna Grossa to Torre Guaceto is characterized by a large sandy beach, surrounded by towering dunes and fossil wetlands behind the dunes covered by a thick Mediterranean maquis, with numerous examples of arboreal holm-oak and juniper. After passing several rocky bays in a crescent shape, you reach the grassy plateau of Guaceto Tower, topped by a fortified building, located on a small promontory that closes the bay protected by three islets. Here, the sandy and linear coast is bordered by very evident active and fossils dune cordons, the backs of which extend fragments of marshy areas. In particular, the first cordon of dunes is the backbone of the coastal relief, and was formed during the Holocene average.  $C^{14}$  analysis of *Helix sp.* indicates a cordon age of about 6000 years ago. In a subsequent step, a different sedimentary episode has determined the accumulation of a second accumulation on the previous dune.  $C^{14}$  analysis of samples of *Helix sp.* indicates an age of about 2500 years ago for the second cordon of dunes. The coastal area of Torre Guaceto is characterized by the presence of a low rocky coast that, where possible, is home to pocket beaches. The overlap of the dune cord Holocene on the Tyrrhenian, obstructing the flow of shallow coastal aquifer waters, in relation to sea comeback, has allowed the construction of a wetland behind the eponymous tower. The surface of the pond is just above the sea level. The three islands are the edges of the Tyrrhenian dune that you continue in several adjacent locations (as of Apani medio- oloceniche; G) eolianiti greco-romane; H) depositi retrodunari e lagune; rocks) and that somehow allows you to identify the position of the sea level and the shoreline of about 125000 years ago.

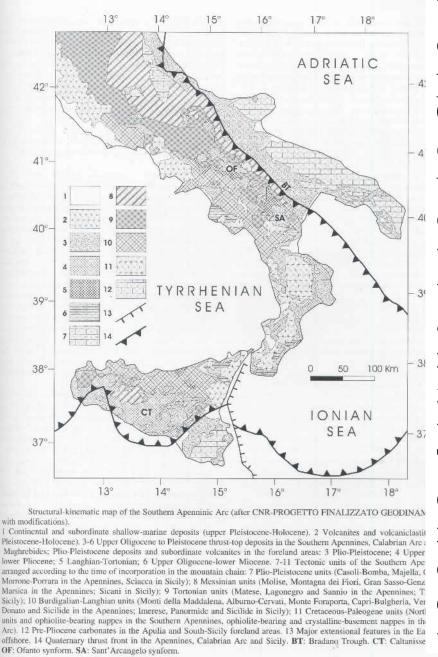


The islets have been detached from the mainland as a result of sea transgression over the past 6/7 thousand years when his station began the profound erosion of retrodunal uncemented deposits. At this stage the islets of Torre Guaceto represented the morphological high that dominated an extensive paralitorale basin that stretched to NO for a few hundred meters. This place is known for the ancient presence of a safe harbor and the wide availability of fresh water, both spring that brought by the Reale and Apani channels: these elements have led to a stable human presence at least since the second millennium BC the late Middle Ages.

# Building awareness of their origins from the knowledge of the territory

### Geological outlines

The province of Brindisi is situated in the Apulian foreland, formed during the Apennine orogeny and consists of a succession of powerful carbonate platform rocks. The pressures related to the different tectonic phases have only marginally affected the foreland, generating essentially disjunctive structures such as fractures, normal faults and mild broad-folds. In particular the territory of Brindisi is on the border between two blocks of Apulian foreland, Murge and Salento, characterized by some differences in the geological-structural aspect.



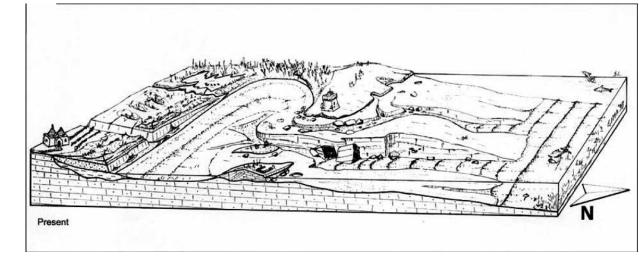
The Murgia area consists of an extended raised block, bordered both on the Ionian coast to the Adriatic by extensional structures with staircase blocks. More com-<sup>4</sup> plex is the structural setting of the Salento, characterized by a series of Horst and Graben variously extended, generally oriented in the direction NW-SE. The plain of Brindisi coincides with a wide structural depression open to the Adriatic coast, which affects the foreland carbonate rocks, in which you have deposited sediments of the filling cycle of Bradano trough and terraced marine deposits that make up the shallow aquifer. Above the Mesozoic carbonate substrate, there is an outcrop of the terms calcarenitic and clay of sedimentary cycle of Bradano trough of Pliocene age, on which rest the most recent terraced bioclastic deposits of shoreline environment and Holocene and current continental deposits. The terraced deposits form an essentially sandy shallow aquifer, somewhere supported at the base by the terms of argillaceous sedimentary cycle infrapleistocenico (Clays subappennine). This aquifer was already used by the empire of Rome for the water supply of the city of Brindisi, at the time the most important Adriatic port. The use of such a flap is never stopped but in time became exclusively agricultural. In the course of this century, prior to the recent development of water supply networks that also use extra-regional resources, the use of surface water has grown by wells that, given the modest potential and depth to the surface aquifer, were made to dig and large

diameter. Below the surface of the aquifer, generally supported from below by the clay soils of Pliocene-Pleistocene age, it takes place, in the Mesozoic limestones of the Apulian Platform, a powerful and extensive carbonate aquifer, home of the prized deep aquifer, the main regional water resource. The morphological structure of the Brindisi area, generally flat, reflect the tabular structure of the Plio-Pleistocene deposits and Mesozoic outcrops. The morphological element that characterizes the area is the presence of a series of terraced surfaces sloping toward the Adriatic Sea and bordered by modest and discontinuous slope falls on ancient shorelines.

The hydrographic network is well developed locally and generally characterized by numerous shallow drainage lines. In the vicinity of the coastline, particularly to the south of Brindisi, there are wetlands at the mouth of streams and / or emergence of groundwater. The original geomorphological structure was largely intensely modified by human activities; particularly important was the cultivation of the soil made by the farmers, which modified locally even the natural outflow lines of surface water. The Brindisi coast represents the end of a plain engraved by shallow furrows torrential and bounded by weak undulating hills that slope towards the sea. The coast is low and characterized by a trend little uneven and rather linear; there are both sandy stretches, often accompanied by the presence of dune cordons, marshes and dune lakes, both traits in soft rock, with the presence of a cliff sections (also anthropogenic)



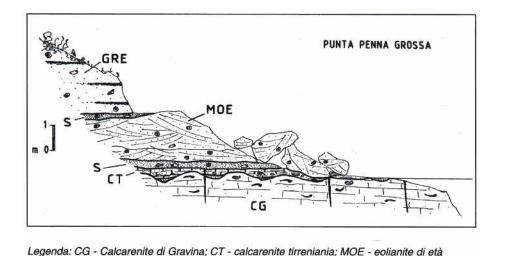
#### Torre Guaceto



Block diagram of the coastal landscape evolution; well evident is the dee valley shaped in the calcarenite.

In this area, and especially in the tidal range in front of the headland of the Tower, are evident the archaeological structures related to the Bronze Age: there are also some pole holes, excavated by various shapes and sizes, at least partially excavated in the Tyrrhenian dunes of calcarenite and sometimes lacking in their filling, unequivocally marking the space created by the artificial world of the second millennium BC. The site is located on Apani islands (also called Cliffs of Apani), moderately sized islets about 500 m from the resort's coast Apani, north of the city of Brindisi, part of the Marine Protected Area of the State Natural Reserve Torre Guaceto. The islands are formed from strips of old Tyrrhenian dunes that allow you to identify the position of the sea level about 125000 years ago. The study of geoarchaeological markers allowed to place the sea level at that time 3-4 meters lower than at present; thus it can be assumed a scenario where the north coast of Torre Guaceto should be less jagged promontory of the bay and present harbour in South represented a wide rich coastal plain ponds fed by channels corresponding the current Canale Reale and Apani, while current islets were united to the mainland. The presence of a deep blade situated between the promontory of Torre Guaceto and neighboring islets, allowed the boats to access a safe harbor to the south side of the cape; today this blade is completely submerged. The State Nature Reserve of Torre Guaceto is an area of great natural and scenic value and, at the same time, for the archaeological discovery of a Neolithic village. The site is characterized by the presence of Mediterranean maquis and marsh vegetation.





medio-olocenica; GRE - sabbie eoliche di età greco-romana; S - suol

The high dunes, overlooking the sea, are dotted in summer by sea lilies, topped by junipers. The site is an important wintering and resting area during migration for major contingents of different species of birds associated with aquatic environments. Freshwater springs feeding reeds that extend up to Apani. The immediated hinterland is planted with olive trees and punctuated by kilometers of stone walls. The marine protected area that stretches for 2207 hectares to a depth of 50 meters is characterized by the presence of a wide meadows of oceanic Posidonia and valuable endemism of Puglia precoralligene.



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#### Classroom work



pupils of Istituto Comprensivo a spring due to the deep underground Sant'Elia Commenda Brindisi, classes circulation in the Mesozoic limestone 2A-3B, have followed a regular course substrate. It is water coming from of studies which includes topics the neighboring heights present inrelated to natural environments land ending their journey near the inand ecosystems. topics was organized a two day ing back to the lower relative density trip in the nature reserve of Torre They originate in this way a pond that Guaceto where students observed widens at the back wetland coasta the geological structure of the coast wind dunes. Pupils have taken within getting an explanation on a result the area some water samples from the from the presence of the three islands source by measuring the temperature. of the sea level during the Holocene. The Mediterranean maguis grows due On the second day was observed to the presence of fine sediment de-Mediterranean vegetation which is posited by the waters in the area belocated in the back of coastal dunes.





To explore these terface with the marine waters, gohind the dunes.



During the school year 2016/2017 In the vicinity of Torre Guaceto gushes During the visit it was observed ecological succession (climax) in relation to the characteristics of the substrate (fine sand, coarse sand, clavs etc.). Great attention has been paid to the recognition of species of Agropireto Ammofileto Crucianelleto, and the gaps behind the dunes and coastal forest. On this occasion we made use of the collaboration of the staft of the reserve of Torre Guaceto. addition to protection of the dunes formed in greek-Roman times, some species ammofile that encourage the henomenon of accumulation of aeolian sands of the newly formed dunes were restored by the management of the reserve.

> Chemical analysis carried out at school are an excellent opportunity to teach students the basics of Physics and Chemistry and illustrate the environmental conditions (parameters and limiting factors) that affect coastal ecosystems. n the laboratory, we have a CBL2 of the Texas Instruments interface with which it is possible to monitor the temperature, pH and salinity (conductiv ity in Siemens) of the water withdrawn. The measurements obtained hav allowed us to prove the existence of a circulation of deep fresh water near the coast mixes with the warmer salt water.







Later, the students visited the Rehabi itation Center for Sea Turtle (Centro Recupero per le Tartarughe Marine) located in Punta Penna Grossa, named after Luigi Cantoro, historical Brindisi WWF activist who has dedicated his life to the defense of Torre Guaceto. The center's main objective is the protection and conservation of sea turtles, through the rescue, care and rehabilitation of specimens found in difficulty. Its activities include research, conser vation, information and public awareness on the protection of marine and especially turtles



mer, enrich the landscape of colors and scents, thanks to the wonderful blooms and the intense and characteristic aroma given off during the hottest hours from the leaves, while flowers are almost devoid of perfume.



With this gr-code it is possible connect with Youtube to see a movie about 28 minutes in which he describes the visit to the reserve of Torre Guaceto (https://youtu.be/HEbIk1-r92Y)



The University of Lecce Unisalento annually organizes Ecology Olympiad for young, first national online Ecology game aimed at children. To participate you have to form one or more teams competing in three stages: the final stage will take place in May. The themes of the tenth edition will be ecosystems and their evolution, management and consevazione of natural areas. In recent months the boys have participated in the training for response to multiple choice questions on these topics. In this way we complete the field of study and we make good the commitment to schooling.

#### References

This poster represents the ideas that guide us in our work as educators. We are aware that Science, and Geology in particular, can help the growth of the people despite the difficulties that you encounter every day.

The maps and diagrams of this poster are from:

- Guide Geologiche Regionali " Puglia and Monte Vulture " BE-MA Editrice

- "Geology of Italy" Special volume of the Italian Geological Society for the I.G.C. 32 Florence 2004

Scarano T. et alii "L'archeologia del paesaggio costiero e la ricostruzione delle trasformazioni ambientali: gli insediamenti di Torre Santa Sabina e Torre Guaceto (Carovigno, Br)".

We thank the management of the reserve and driving Andrea Motolese. Thanks for participating in the working class the teachers of the Istituto Comprensivo Sant'Elia Commenda Brindisi Antonio Tundo and Serena Cuomo.





Ecologica Cup Universitá del Salento Lecce

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Riserva Marina Statale di Torre Guaceto Carovigno Brindisi

This poster was made by LATEX

Acquired on 15 March 2017, this subset from the first image from Sentinel-2B features the southern Italian port city of Brindisi appropriately the same word for the 'toast' ritual in Italian.

Poster presented at EGU2017, 24 April 2017, Vienna EGU2017-17501 X4.470