

GEOMORPHOLOGY IN GAMES

A NEW EXTRAORDINARY PUZZLE MAGAZINE OF GAMES, CROSSWORDS, NEWS AND INFORMATION FOR YOUNG SCIENTISTS

N° 1

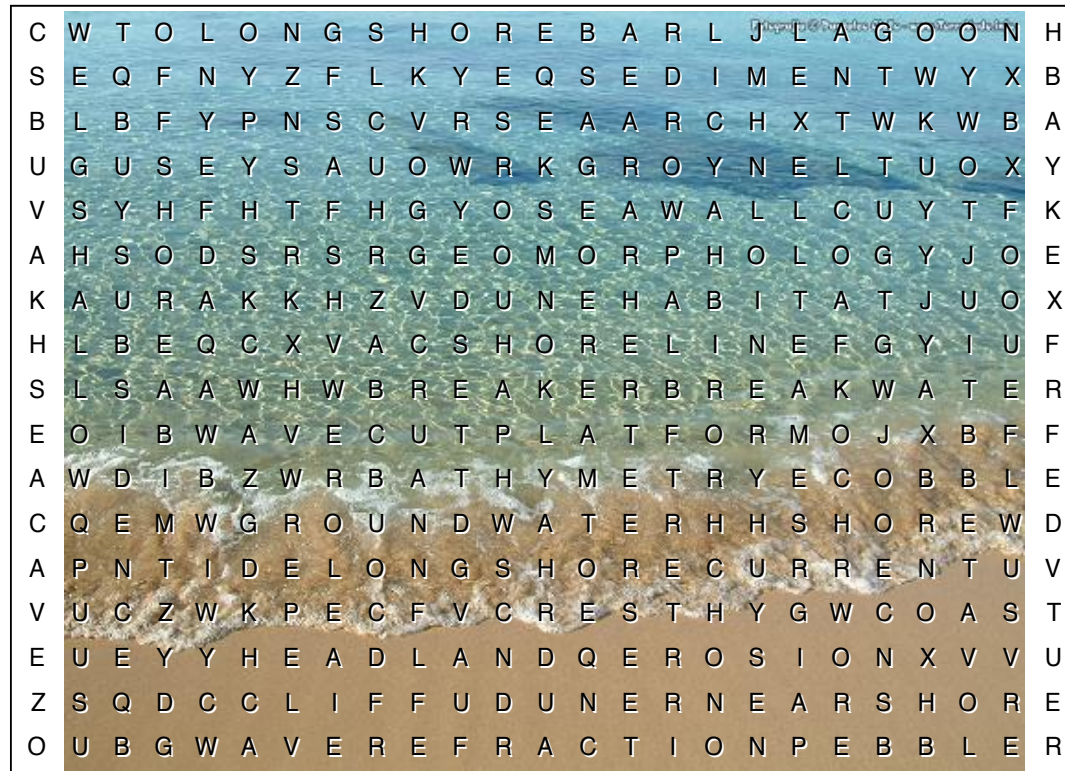
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*Liceo Scientifico A.
Oriani
Via Cesare Battisti 2
Ravenna Italy
<http://Isoriani.racine.ra.it>
Isoriani@provincia.ra.it
EDITOR-IN-CHIEF:
Gianluca Dradi
CORPORATE EDITOR:
Vincenza Ragone
EXECUTIVE VICE
PRESIDENT: Prof. F.
Marabini ISMAR CNR
MANAGING EDITOR:
Prof.ssa Elisabetta
Siboni
SCIENCE EDITOR:
Prof. Gianni Caniato
STAFF WRITERS: 1°B
Scienze Applicate
Nuovo Ordinamento*

LET'S SOLVE THE WORDSEARCH!

THE MARINE ENVIRONMENT



- | | | | | |
|-------------------|------------|--------------|-----------|-------------------|
| geomorphology | shore | shoreline | backshore | nearshore |
| coast | tide | wave | crest | sediment |
| groundwater | pebble | cobble | shallow | wave refraction |
| headland | bay | breaker | erosion | wave-cut platform |
| sea stack | sea arch | sea cave | offshore | longshore bar |
| longshore current | seawall | dyke | groyne | jetty |
| breakwater | dune | dune habitat | cliff | subsidence |
| lagoon | bathymetry | | | |

LET'S SOLVE THE CROSSWORD!

THE MARINE ENVIRONMENT



Across

1. It is an isolated rock tower, produced by erosion, and left on a wave-cut platform.
3. It is a wall or jetty built out from a riverbank or seashore to control erosion.
4. It is a rhythmic movement carrying energy through matter or space, in this case, ocean water, generated mainly by wind blowing over the water surface.
5. It is the area of shore lying between the average high-tide mark and the vegetation, affected by waves only during severe storms.
8. It is a body of water cut off from the open sea by coral reefs or sand bars.
10. It is the highest point of a wave.
11. It is the region of land extending from the backshore to the beginning of the offshore zone.
13. It is a wide semicircular indentation of a shoreline, especially between two headlands or peninsulas.
14. It is the area of land between the lowest water level at low tide and the highest area of land affected by storm waves.
17. It having little depth.
19. It is an embankment constructed to prevent flooding, keep out the sea.
20. It is a clast of rock larger than granules and smaller than cobbles.
22. It is a hill of sand built either by wind or water flow in coastal areas important in protecting the land against potential ravages by storm waves from the sea.
24. It is a naturally occurring material broken down by processes of weathering and erosion, and subsequently transported by the action of wind, water, or ice, and/or by the force of gravity acting on the particle itself.
25. It is a large wave with a white crest on the open sea or one that breaks into foam on the shore.
26. From, away from, or at some distance from the shore.
27. It is the measurement of the depth of bodies of water.

Down

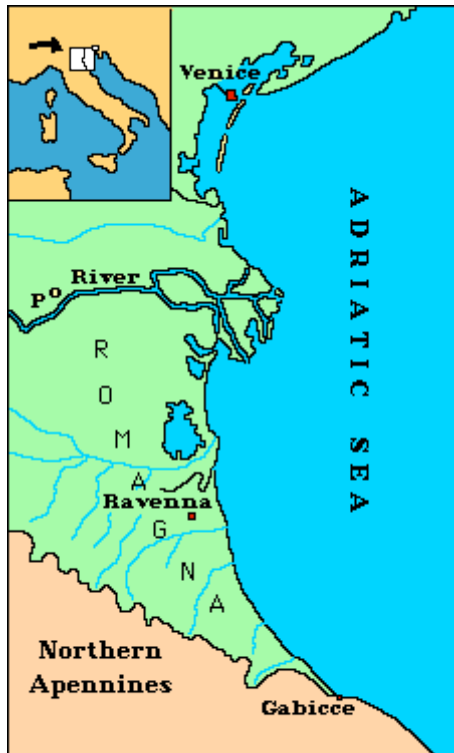
1. It is a natural opening eroded out of a cliff face by marine processes.
2. It is the line or zone where the land meets the sea or some other large expanse of water.
3. It is the branch of geology that is concerned with the structure, origin, and development of the topographical features of the earth's surface.
6. It is the periodic rise and fall of sea level caused by the combined effects of the gravitational forces exerted by the Moon and the Sun and the rotation of the Earth.
7. It is the place where the ocean meets the land, being shaped by the action of waves, tides, and currents.
9. It is water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations.
10. It is a clast of rock larger than pebbles and smaller than boulders.
12. It is a tubelike passage blasted into the headlands at sea level by the constant assault of the breakers.
15. It is the motion of the Earth's surface as it shifts downward relative to the sea level.
16. It is a structure built from a shore out into the water to direct currents or protect a harbour.
18. It is a point of land, usually high and often with a sheer drop, that extends out into water: it is also called promontory.
21. It is the removal and transport of weathered materials from one location to another by agents such as water, wind, glaciers and gravity.
23. It is a steep high rock face, especially one that runs along the seashore and has the strata exposed.

DO YOU KNOW THAT...

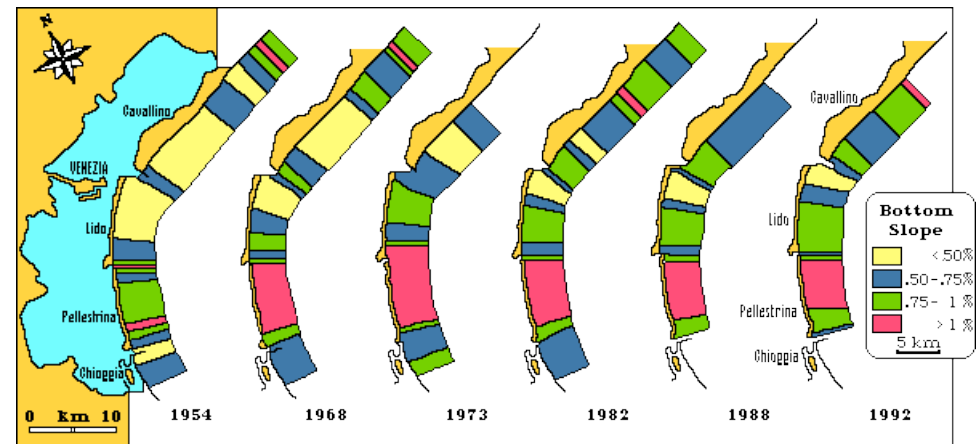
Since the beginning of the last century, everywhere in the world, the coastal areas have been affected by a widespread regression, which reached the critical stage after 1950. This situation is in contrast with the general trend of accretion that has affected the coastal zone in the past century.

The 8000 km of Italian coast show a large variety of shoreline. Today about 45% of the Italian coast is threatened by a progressive and general degradation, which is mainly manifested as beach erosion. This phenomenon seemed to worsen in the '50s after a long period of general beach stability.

If you consider the intense intervention of man on coasts for touristic purposes, by demolishing the dunes to create beach areas, summer residential and marine areas, the diminished fluvial sediment load to the sea by haphazard removal of riverbed material, the increased subsidence caused by groundwater, gas and oil extractions in areas too close to the sea, you obtain a picture which easily explains the rapid instability of this coastal environment. The situation is present not only along the Italian coast but, in a greater or lesser degree, includes the coastlines of many other countries.



Position map of Venice lagoon, Po river delta and Romagna coast

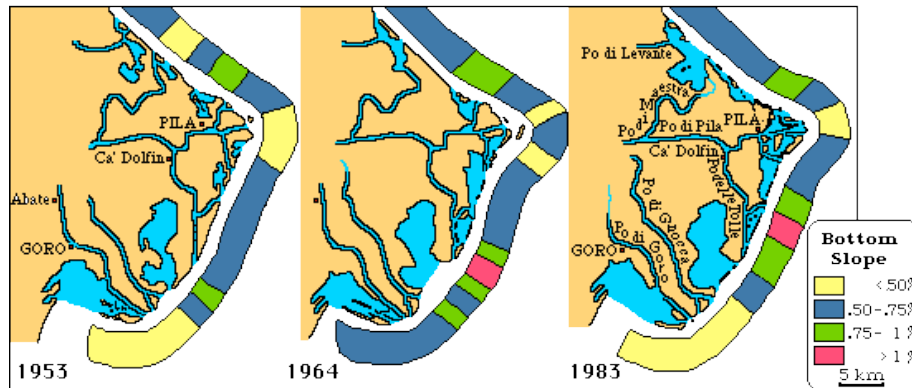


The variations of the bottom slope in front of the Venice lagoon from the shoreline to the 5 m depth

This increased economic development, without worrying about what would be the future impact on the environment, tends to worsen the current precarious situation even more.

From the end of the fifties, up to the present day, the coastal area was used as an inexhaustible and indestructible property on which it would be possible to burden an infinite number of works without this feeling the least bit. An improper exploitation, by 'robbery', was used in this fragile region, without taking into account the consequences, instead of managing it as a precious commodity which must last in time to permit better economic management.

The upper Adriatic coast of Italy, from the Venice Lagoon to Gabicce promontory is a good example of the above mentioned state of environment destabilisation.



The Po river delta from 1953 to 1983 with the variations of the bottom slope from the shoreline to the 5 m isobath (Carbognin et Marabini, 1989)

Going from North to the South, you first meet the thin Venetian littoral, with the lagoon at its back; the Po River delta follows, continuously developing into the sea. From here to Gabicce promontory a continuous shallow littoral, with the Po Plain at its back, extends.

The only factor common to such a morphologically diverse coast is erosion. To make up for the increasing erosive processes, many kinds of defence works have been put into operation. The sea walls or 'Murazzi' associated with groynes to protect the Venice Lagoon; dykes to defend the lowland behind the shoreline and longard tubes in the Po River Delta; breakwaters from the Po Delta to Gabicce promontory lie

here and there along coastal stretches mainly protected by groynes, or star-shaped concrete elements established on piles or by underwater barriers, constructed of synthetic sacks filled with sand and laid down in a cell-like system where cell is artificially replenished with sand.

All these protective works, constructed at different times and impelled by necessity, involve the coast without guaranteeing its future stability. Moreover, since they were built in the course of erosive process, their cost was enormous.

If you consider the evolutionary trend of the whole coastal area from Venice to Gabicce promontory, it is possible to show some significant parameters derived from the numerous preceding studies.

Along the Venetian littoral, both an apparent stability of the shoreline and anomalous accretions near the jetties have been occurring. The former situation is due to the 'Murazzi' that, from ancient times, have protected the beach stopping any shoreline change, but did not prevent the sea bottom slope from increasing. An increase in bottom slope is also noted in the Po Delta area from the 1960s on, in connection with the diminished fluvial sediment yield to the sea, which allowed the submersion of the more external sandy barriers of the deltaic system.

The same situation of a continue increase of the bottom slope between the shoreline up to the 5 m isobath is also noted along the coastal area between the Po river delta and Gabicce promontory from the '60 up to the present time.

From the comparison among the diagrams plotted utilising the adopted parameters you can see that erosion gradually developed in time through a continual increase in the nearshore bottom slope, which in turn led to a shoreline regression, often achieving irreversible situations.

It is quite evident, from the studies made, the possibility of a preventive action to avoid erosive phenomena, which, today, are very dangerous and very difficult to solve. Not only in Italy, but also in many countries coastal protective structures are built only after the setting in motion of the erosive process, and in many cases when it is irreversible.

A tardy intervention is, of course, more expensive and more difficult.

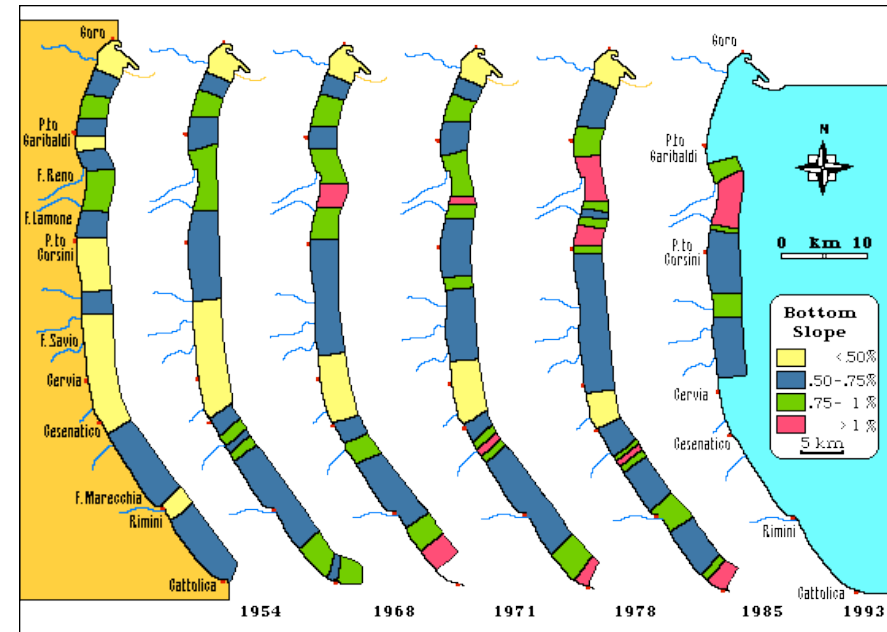
The comparison among changes of bathymetry and consequently shoreline regression shows that it would have been possible to predict the present situation and a correct protective action, made years ago, could have had better chances of maintaining the environmental equilibrium.

It is incomprehensible why this obvious principle is never used in the coastal environment defence.

Based on past experience, it is recommended to establish a continuous and systematic survey of those environmental parameters capable of showing evolutionary variation in coastal areas. Management in this way will avoid being taken by surprise when erosive processes develop.

On the basis of the data resulted by the survey, it was possible to prepare thematic maps of the territory showing the different steps of the environmental dangerous situation.

Considering the possible hazard like a threatening event, or the probability of occurrence of a potentially damaging phenomenon, within a given time period and area, we must consider two phases before the environmental disaster: vulnerability and risk. The vulnerability is the degree to which a system is susceptible to, and unable to cope with injury, damage or harm, corresponding, with increasing gravity, to the bottom slope intervals 0,50-0,75% and 0,75-1% in the Adriatic coastal zone.



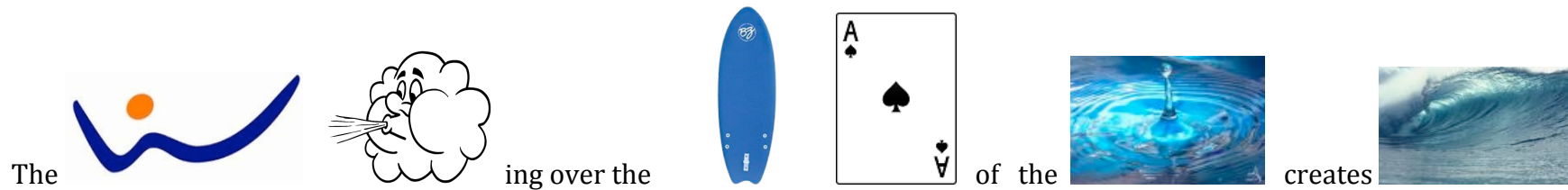
The variations of the bottom slope from the Po delta to the Gabicce Promontory

The risk consists in expected losses (of lives, people injured, property damaged and economic activity disrupted) due to particular hazard for a given area and reference period and corresponds to the bottom slope interval $>1\%$ in the Adriatic coastal zone.

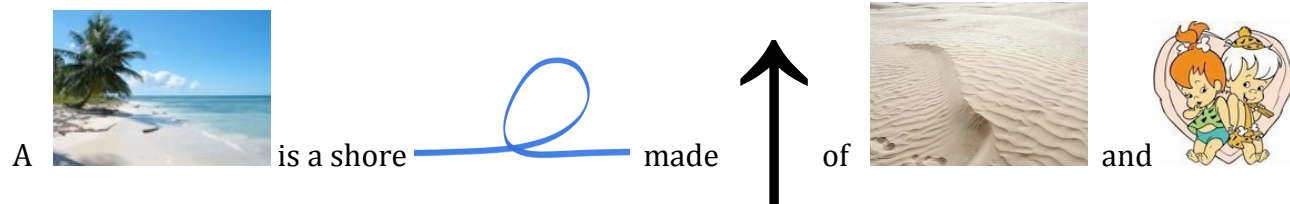
It should be remembered that for a basic survey for possible future interventions, it would be sufficient to measure very simple parameters as those previously described which should serve not to quantify the interventions, but to indicate when the situation is developing into dangerous levels for the equilibrium of a coastal environment. The cost of such a service is relatively low, but it would guarantee greater possibilities of success in protecting our coasts in the future.

LET'S SOLVE THE REBUS!

(3,4,7,4,3,7,2,3,5,7,5)



(1,5,2,1,9,4,2,2,4,3,7)



(5,3,10,2,3,13,10,2,3,4,3,3,3)



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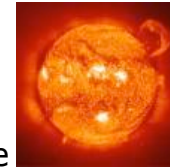
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(3,4,4,2,3,8,4,5,5,5,8)

The surf Z



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Alla scoperta delle coste ravennati

L'Italia è una penisola e presenta un perimetro costiero assai ampio, in quanto il nostro Paese confina con la piana continentale europea solamente attraverso l'arco alpino.

In Italia sono presenti principalmente due tipi di coste: quella bassa di origine alluvionale e quella alta di origine tettonica.

L'ambiente costiero è dato dall'incontro tra le tre fasi: l'atmosfera, l'acqua del mare e la terraferma.

Si può perciò affermare che l'ambiente costiero si trova perennemente in un equilibrio dinamico, ovvero è un ambiente sempre in trasformazione, in cui ogni carattere estraneo può cambiare radicalmente la biosfera locale e la composizione strutturale degli ambienti limitrofi alla costa.

Il litorale dell'Adriatico settentrionale risente solo in parte del clima mediterraneo ed è caratterizzato da inverni miti, primavere ed autunni in genere piovosi ed estati afose. I tassi di umidità sono in media elevati a causa dei flussi d'aria umidi provenienti dal mare.



Tale tratto di costa è soggetto al fenomeno della subsidenza, l'abbassamento del terreno dovuto principalmente all'estrazione del gas metano.

A nord la costa adriatica è caratterizzata dalla laguna veneta che si presenta come un bacino naturale d'acqua salmastra e fondali bassi chiusa da un cordone di terra.

Nel secolo scorso i veneziani hanno effettuato deviazioni di fiumi per mantenere un equilibrio tra le acque di quest'ultimi e quelle provenienti dal mare. Oggi le acque marine tendono ad invadere la

laguna mettendo a rischio la stessa Venezia e pur con la costruzione di costosi "Murazzi" i problemi permangono.

La riviera romagnola, famosa in tutto il mondo per le sue pinete di origine romano-medievale, le dune, le spiagge di sabbia fine e la composizione territoriale articolata attraverso fondali bassi e paludi di acqua salmastra nell'entroterra, negli ultimi sessant'anni ha subito radicali cambiamenti a causa della massificazione indotte dal turismo estivo e dalla speculazione edilizia di agenzie immobiliari e aziende multinazionali.

I principali fenomeni che hanno apportato una sostanziale modifica della costa adriatica sono:

- L'erosione delle spiagge
- La speculazione balneare e residenziale
- L'inquinamento delle acque

Questi fenomeni sono la conseguenza di un continuo sfruttamento iniziato sessant'anni fa il cui arresto è impossibile a causa dell'economia che ruota intorno a questi unici paesaggi costieri, che andrebbero preservati.



Il continuo ed ormai irreversibile effetto erosivo delle coste è provocato dalla sempre minor portata a mare del materiale argilloso e sabbioso da parte dei fiumi, principalmente il Po.

Negli scorsi decenni per sfruttare al meglio l'andamento non impetuoso del letto dei fiumi sono state costruite dighe artificiali con l'intento di incrementare la produzione di energia idroelettrica attraverso turbine a getto perpetuo d'acqua.

Ne è così conseguito un evidente degrado della costa a causa dello scarso materiale portato a valle dal Po, inevitabile conseguenza dei sempre più numerosi sbarramenti nel fiume principale e nei rami del delta.

Per far fronte a questo problema vengono effettuati apporti di sabbia fluviale e vengono costruite scogliere artificiali.

In tutto il litorale romagnolo sono stati costruiti sulla spiaggia, a ridosso della pineta (ove ancora esiste), stabilimenti balneari a scopo turistico e attrattivo in cui è possibile praticare sport estivi, rilassarsi sotto l'ombrellone e usufruire di bar e ristoranti a ridosso del mare.

Sono stati edificati palazzi nella zona limitrofa alla spiaggia, non rispettando un ecosistema costantemente in bilico, che ormai di naturale ha ben poco.

Esempi di costruzioni mal eseguite o mal progettate sono il porto di Casal Borsetti o quello di Marina di Ravenna, chiamato Marinara, in cui sono stati costruiti alloggi e negozi in una zona con un paesaggio non troppo particolare e maggiormente inquinato.

Lo sviluppo di costruzioni a scopo residenziale a poche centinaia di metri dal mare e di stabilimenti balneari direttamente sulla spiaggia, ha provocato la distruzione di migliaia di ettari di pineta e di interi chilometri di dune sabbiose.

Quest'ultime, create e rese stabili da una particolare vegetazione con radici lunghe anche sette metri, costituivano da millenni un ambiente costiero caratteristico e fungevano da barriere per il vento ed il moto ondoso.

L'intervento dell'uomo ha provocato il loro smantellamento anche a causa dei mezzi meccanici utilizzati per la pulizia della costa, l'eccessiva concentrazione di stabilimenti balneari e strutture turistiche.

Infine un problema che riceve sempre maggiori riscontri scientifici è l'inquinamento delle acque marine.

Infatti negli ultimi decenni, a causa dell'aumento delle industrie nelle zone vicino alla costa (Enel, Marcegaglia, ANIC,...) sono nettamente aumentati i composti chimici presenti nell'acqua e ciò provoca il proliferare di alghe dannose e la morte di pesci, modificando così l'intero ecosistema marino del nord Adriatico.

Per risolvere questa situazione non è necessario cessare di usufruire delle spiagge, ma sfruttarle in modo consapevole e controllato, nel rispetto dell'ambiente.

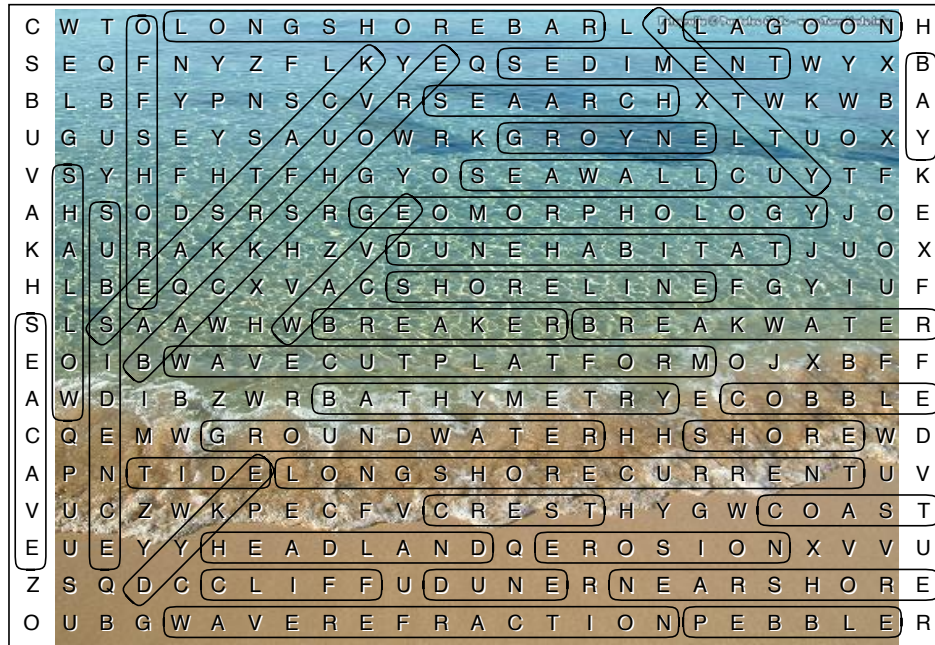
Più tardivi saranno gli interventi, più costoso e meno efficace sarà provvedere.



KEY

WORDSEARCH:

THE MARINE ENVIRONMENT



CROSSWORD:

THE MARINE ENVIRONMENT



REBUS:

1. THE WIND BLOWING OVER THE SURFACE OF THE WATER CREATES WAVES.
2. BEACH IS A SHORELINE MADE UP OF SAND AND PEBBLES.
3. TIDES ARE INFLUENCED BY GRAVITATIONAL ATTRACTION OF THE MOON AND THE SUN.
4. THE SURF ZONE IS THE OFFSHORE BELT ALONG WHICH WAVES COLLAPSE.

FONTI

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CREDITS

CLASSE 1B Scienze Applicate LS A. Oriani Ravenna:

Biagioni Martina, Casadei Carlo Alberto, Coa Luca, Colaci Davide, De Pace Gabriel, Diolordi Francesca, Donati Giacomo, Esposito Vincenzo, Franco Stefano, Galeotti Matteo, Guza Sindi, Jusufi Seval, Lucarini Mattia, Mazzotti Federico, Meldolesi Gaia, Okonkwo Naomi, Paguri Matteo, Peviani Giorgia, Porcellotti Matteo, Porta Samuele, Rossi Alessandro, Scampa Kei, Soprani Laura, Telloi Luca, Testi Caterina, Turso Federica, Valentini Francesca.

Prof. Gianni Caniato docente referente (scienze)

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