Protista

Protection of water

A fire-red lake

Lake Tovel, in the Trentino region, is known all over the world for the exceptional phenomenon of the “reddening of its waters”. During the hottest hours of some summer days, large portions of the lake surface took a deep red colour, offering an incredible sight. The spectacular colour was due to the strong concentration of a unicellular alga of the group Dinoflagellata, the Glenodinium sanguineum (also known as Woloszynskya coronata). This alga, which is just 1/50 mm long, under specific stress conditions, stores special pigments, called carotenoids, which make it look completely red. 1964 was the last year in which the reddening phenomenon appeared as clearly as usual; since then, the alga, although still living in the lake, has not reached the concentration it takes to ”inflame” the waters. Since 2001, the Provincia Autonoma di Trento has funded a research project for investigating the factors that are responsible for the missed reddening of the waters of Lake Tovel. The goal of the project is not to restore the conditions that in the past led to the flowering of the alga. The only purpose is to acquire all that information and details on the peculiarities of Lake Tovel that the local administrators need to make the best choices on the future of the lake. Lake Tovel is located in a lovely region, which attracts tourists and hikers, like many Alpine lakes, and is a precious water supply for the agriculture of the valley of the Trentino region, a reservoir of drinking water and, what’s more, an added value given by the phenomenon of the reddening of its waters.

Man paints the sea red

Under favourable conditions, Dinoflagellata can rapidly proliferate and form large clusters. Red tides are the most conspicuous proofs of the massive presence of Dinoflagellata. In 1986, an increase in the Dinoflagellata population of the type Gymnodium brevi caused a significant red tide along the coasts of the Gulf of Texas. It extended 500 km along the coasts and caused the death of over 22 million fish in 2 months. Mollusc fishing was banned along 3/4 of the coast of the Gulf of Texas, south of Galveston, which caused a loss of oysters for a total of 1,4 million US dollars. Bivalvular molluscs are filter feeders, which feed on plankton and which, although storing the toxins contained in these Dinoflagellata, are only partly affected by their harmful effects. Nevertheless, under special circumstances, the amount of toxins that can concentrate in each single mollusc can be lethal even for man. In the same year, hundreds of tursiops dolphins died along the coasts of New Jersey and Maryland, when the red tide moved eastwards from the western coast of Florida after surviving a fairly mild winter. In Italy, algal proliferation phenomena took place in 1975 in the coastal area south of the mouth of the Po. Between 1975 and 1976, the algae caused the death of plenty of benthic animals (i.e. that live in contact with the seabed) and fish. It is assumed that the human impact on the coastal areas and in particular the gradual increase in the discharge of urban, industrial, agricultural and zoo-technical waste water into the sea may have boosted the development of these toxic algae.

Micro-organisms purify water

Before being discharged into rivers and lakes, waste waters must be purified. One of the systems used for this purpose is activated-sludge purification. This process utilises the water self-purification principle, in which the micro-organisms (bacteria, protozoa and metazoa) use the organic substances contained in the water, transform them and remove them from the water. The aerobic process is the most commonly used one, i.e. oxygen is supplied to trigger the biological processes in which the organic substances are oxidised. When this reaction is over, water is purified and flakes of biological material known as “activated sludge” are produced. This activated sludge consists of organic and inorganic components and different species of micro-organisms (especially bacteria). Ciliate protozoa play a very important role in the purification process. There is competition for food in the oxidisation tanks, i.e. the place in which purification takes

place: bacteria are eaten by small predators (ciliate protozoa), which in their turn are eaten by larger organisms (carnivore protozoa or metazoa); so, bacteria need nutrients which consist of the organic matter contained in the waste water. The presence of ciliate protozoa in the activated sludge proves therefore that there are bacteria as well; if there are approximately 10 million individuals per litre, it means the purification plant works. By studying ciliate protozoa, used as bio-indicators, one can check if the plant works (low oxygen content, too many organic substances, excessive sludge extraction) and take corrective measures.

Water preservation

In the last decades is being undertaken a “biotechnological solution” which is capable of removing polluting agents from water: phytodepuration is based on the self-purification capacity of acquatic ecosystems through physical, chemical and biological processes carried out by vegetal organisms and bacteria. Plants involved are macro and microphytes which are specifically selected according to some characteristics as their capacity to adapt to the environment which needs to be decontaminated and their rapid growth with formation of biomass; in any case, the species employed for phytodepuration are water plants or hygrophilous plants which grow in moist environments. In particular, according to the type of phytodepuration system which is under construction, different types of floating, submerged and emergent microphytes are used alone or in group. Water depuration takes place thanks to the combined action of macrophytes and some associated micro-organisms: algae feed on a part of the existing pollutants and favour the development of bacteria capable of transforming harmful substances by metabolizing them. The type of installation of a phytodepuration system depends on the direction of the water flow. Surface flow systems consist of tanks or channels from 40 to 60 cm deep and recreate an ecosystem similar to ponds covered by floating hygrophilous plants. In sub-surface flow systems, instead, flowing water isn’t in contact with the atmosphere and an inert stand is inserted in the tanks where the roots of macrophytes will grow. Water flows under the inert stand to favour movement in the tank, which is 70-80 cm deep and is inclined. Phytodepuration systems are a valid alternative to wastewater treatment for small rural communities and seasonal sewers as those of camping sites, hotels and holiday villages or for the treatment of industrial wastewater, percolates coming from landfills and run-off water coming from roads and motorways. Construction costs are very variable but, anyhow, are never higher than those of conventional depuration plants whereas management costs are incredibly low as energy consumption can even be non existent.