MACRODESCRIPTORS: LOOKING AT SIMPLICITY TO UNDERSTAND COMPLEXITY

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Abstract

Macrodescriptors inform in a simple way about the state of complex systems, and can help in detecting biological responses to global change. Possible macrodescriptors are: gelatinous plankton blooms, mass mortalities, red tides, arrival of alien species, disappearance or retreat of common species (such as gorgonian corals), changes in seasonal phenomena, increase in population size of species that alter habitat features (e.g. sea urchins leading to sea urchin barrens), accumulation of shells or *Posidonia* leaves on beaches, state of the populations of habitat forming species. These, and many other descriptors can be evaluated with no special instruments to obtain easy-to-take and informative data on the state of changing environments.

Keywords : Biodiversity, Bio-indicators, Global Change, Monitoring.

In a period of fast change, it is important to understand if and how the biological components of ecosystems are answering to changes in chemico-physical features of the environment. The evaluation of biodiversity at species level is extremely important, but it inevitably requires specialized expertise and long research programmes. Some macro-expressions of biodiversity, however, can become macrodescriptors that sum-up the state of ecological systems. These descriptors are evident, but they are often neglected by scientific literature, or are treated in isolation, whereas proper organization of their perception gives the opportunity to reconstruct the history of particular systems, leading to better understanding of current situations. The history of the Adriatic Sea, for example, is marked by a series of macrodescriptors that might be linked with each other (Fig. 1) [1].

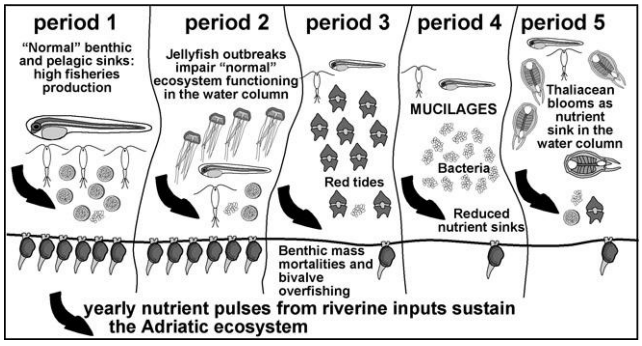

Fig. 1. The macrodescriptors of Adriatic Sea history. The blooms of the medusa *Pelagia noctiluca* are identified as the trigger of a series of events that changed the ecological setting of the whole basin.

A "healthy" period characterized by high yields in fisheries was followed by a series of events that, when seen as connected parts of a history, can acquire greater significance than when considered one by one. These events, here considered as macrodescriptors, were: 1 - massive blooms of the medusa *Pelagia noctiluca*, probably exerting high predation pressures on planktonic and nektonic populations; 2 - dinoflagellate red tides, representing the biological response to the traditionally high nutrient availability of the Adriatic when a well structured carbon sink is absent (due to *Pelagia* predation); 3 - benthic mass mortalities, often caused as a side effect of toxic algal blooms; 4 - increased fisheries pressure, caused by a decrease in the natural populations, leading to the disappearance of common species (e.g. the clam *Tapes decussatus*); 5 - deliberate introduction of alien species (e.g. the clam *Ruditapes philippinarum*) to re-build over-exploited natural populations; 6 - pelagic or benthic mucilages, probably linked to huge carbon availability for bacteria; 7 - blooms of gelatinous filter feeders, quickly exploiting microscopic primary producers. These events "describe" the history of the Adriatic and most were and are recorded even in the local press whenever they occur. Each of them has been studied in isolation, as if not part of a "history". At present, the Adriatic goes through a mixture of multiple states that can be classified within the macrodescriptors listed above.

A similar situation, with different actors, has been described for the Black Sea [2], with a pristine period in the Sixties-Seventies, in which gelatinous plankton was dominated by *Rhizostoma pulmo*, a second period, in the Seventies-Eighties, in which *Aurelia aurita*, became prevalent, a third period in the Eighties-Nineties when *Mnemopsis leydi* arrived and monopolized the system, with catastrophic impact, and a fourth period, from the late Nineties to present, in which the arrival of *Beroe ovata* buffered the impact of *Mnemiopsis*.

These changes in the biotic components of the ecosystems might be generated by shifts in the outcome of biotic interactions. In other cases, the biota responds in a dramatic way to even very brief changes in physical conditions, as happened with the mass mortality of gorgonian corals observed in 1999 across the Ligurian Sea due to a sudden deepening of the summer thermocline [3]. This event showed that some evident and long-lived organisms, such as gorgonians, cannot bear high temperatures, even for very short periods. The upper depth in their distribution thus might be a sharp tool to measure changes of the summer thermocline, especially in a period of global warming. Desertification is matter of great concern in terrestrial habitats, but is less perceived as a problem in marine systems. Desertification of marine habitats can be produced by human activities, such as date mussel fisheries, or by the abnormal growth of sea urchins that, with their grazing, lead to the so called sea-urchin barrens. Both types of desertification often coexist [4]. The perception of desertification is immediate, and its mapping through a network of observatories would be highly informative of the state of marine systems.

Other possible macrodescriptors include the presence of alien species, changes in the distribution, population size and activity of evident native species such as marine mammals and fish, and the accumulation of *Posidonia* leaves and shells on beaches. The organization of a network of observers that immediately detects evident change, recording its origin and distribution, could provide a monitoring of the state of marine systems. Since macrodescriptors are reported even in the press, data mining in journals and magazines, as a complement to scientific literature, might lead to historical reconstructions that will be of great help in understanding the present state of marine ecosystems and will also provide some hints to depict future scenarios.

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