Fisheries yield. NETWRK calculates fish yield per unit of primary production using the analysis of the input and of phytoplankton provided by input-output analysis. Ecopath calculates the primary production required for direct and indirect utilisation by fisheries and any other group that utilises primary production as food. Thus, NETWRK and Ecopath can both be used to calculate the amount of phytoplankton production reaching fish consumers, directly and indirectly.

Global system indices. It was found that the values for global system indices such as development capacity, ascendency, overheads and redundancy, do not differ much from each other using NETWRK and Ecopath, respectively.

In conclusion, it would appear that the differences between the two analytical approaches to assess ecosystem function are of less importance than the great amount of similarity between them.

Comparison of the results introduces two interesting points. First, despite the fundamental differences in some methodologies or routines and eventual results derived from the same data set, most of the global indices fall within the same order of magnitude. Second, it is clear that our understanding of how ecosystems work is not complete. The inherent variability of biological systems, their capacity for self-organisation, and their hierarchical nature defy simple analysis and approaches.

Trophic structure of the Maspalomas Lagoon (Gran Canaria, Canary Islands) before collapse and after a new settlement process

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The Maspalomas Lagoon is located at the southern end of Gran Canaria, Canary Islands, and has a present area of 45,000 m^2. This coastal system is subjected to highly seasonal fluctuations of physicochemical parameters (temperature, salinity, pH and dissolved oxygen) and to variations in volume of water and turbidity.

A model of the trophic structure of the Maspalomas Lagoon was developed for the period May 1993 to May 1994 when conditions were optimal for the development of macrophytes. There was a continuous supply of organic matter from outside the ecosystem from visitors feeding the fish. In May 1995, the system collapsed due to eutrophication, and temporary anoxia caused most of the fish populations to die, except for guppies (*Poecilia reticulata*). After this incident, a new process of natural recolonisation occurred. In February 1996, the lagoon opened again to the sea. A new study was started after this new settlement process. This study found that the dominant populations of animals and plants were very similar to those during the previous period. Legislative action prevented visitors from feeding the fish during the second period.

Fluxes were estimated using the Ecopath II steady-state ecosystem model. Some input data were measured *in situ*: biomass of each component, primary production, and growth rates and diet composition of fish species. Data on production and diet of invertebrates were taken from the literature.

Living components of the modelled ecosystem were arranged in nine groups: three for primary producers—a seagrass (*Ruppia maritima*) and two algae (*Lamprothamnium succintum* and *Cladophora* spp.); two for primary consumers—amphipods and insects; and four for fish—mullets (*Liza aurata*, *Chelon labrosus* and *Mugil cephalus*), white seabream (*Diplodus sargus*), spotted seabass (*Dicentrarchus punctatus*) and the guppy (*Poecilia reticulata*).

Fish occupied the highest trophic levels, as in most aquatic ecosystems. Among them, the group of mullets had the biggest biomass and highest consumption rate in both study periods. They preyed on the lower trophic levels, consuming mostly detritus. The lagoon was unexploited in terms of fishing; its trophic web was based on detritus and the top predator was the insectivorous guppy.

The most important inflows were consumption of detritus by the mullets and, secondarily, by the group of insects. Total system throughput reached 43,315 g $m^{-2}.year^{-1}$ during the first period and 90,592 g $m^{-2}.year^{-1}$ during the second period.

Objective functions of the ecosystem, such as net ecosystem production, primary production/total respiration rate, and primary production/total biomass ratio, indicated that the ecosystem was immature and developing during both periods. During the first period, the surfeit of food given by tourists caused an excess in fish biomass compared to primary productivity. During the second period when food availability was restricted to natural resources, the trophic pyramid changed. Trophic levels of two fish groups, *Dicentrarchus punctatus* and *Diplodus sargus*, increased because their feeding activity became mostly carnivorous.

A low level of organisation of the ecosystem both before collapse and after new colonisation suggests that this system is continuously in an early stage of development without any possibility of reaching maturity and stability. We conclude that the ecosystem carrying capacity was altered by food addition, which caused an increase in biomass of groups at upper trophic levels and in the biological demand for oxygen, accelerating the system collapse.

Simulating anchovy-sardine regime shifts in the southern Benguela ecosystem

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In the southern Benguela ecosystem, there has been alternation between anchovy-dominated and sardine-dominated ecosystem states. This situation is similar to that found in most upwelling regions where anchovy and sardine co-exist. The changes in ecosystem state have been termed regime fluctuations and are frequently referred to as regime shifts. The factors most likely to account for changes in states of upwelling ecosystems are changes in fishing pressure and environmental changes. This study explores aspects of both factors in the southern Benguela ecosystem.

In general, upwelling ecosystems are characterised by a large number of species at low and high trophic levels but few species at intermediate trophic levels, and these are mainly small pelagic fish. Such ecosystems are called “wasp-waist”, in which the small pelagic fish control the ecosystem structure both up and down the food web from the “waist”.

This study explores the possible causes of ecosystem changes in the southern Benguela ecosystem, using Ecopath with Ecosim models to test hypotheses about causes of change from a 1980s ecosystem, when anchovies were abundant and sardines scarce, to a 1990s ecosystem when sardines were increasing and anchovies decreasing in abundance. Two hypotheses are tested: i) that fishing caused changes in ecosystem structure between the 1980s and the 1990s, and ii) that large-scale changes in the environment (a regime shift) caused the observed changes in small pelagic fish.

First, using the model of the 1980s, four scenarios were considered in which different combinations of fishing mortality rates of sardine, anchovy and horse mackerel were used to mimic the situation in the 1990s model. When fishing mortality rates of the three species were altered over a 10-year simulation