A study proposes a new universal rule to explain the equilibrium of plant populations

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A study financed by the BBVA Foundation and conducted by scientists Carlos Duarte, Nuria Agustì and Nuria Marbà from the Mediterranean Institute for Advanced Studies (CSIC – University of the Balearic Islands) has allowed the first-time formulation of a universal rule that explains the equilibrium of plant communities, showing how plants assure the survival of their species whether their lives last a day or are prolonged over centuries.

The research project, whose results will appear in the next issue of the U.S. journal *Proceedings of the National Academy of Science*, also concludes that the life span of these organisms may be sensitive to rises in temperature. According to the authors' predictions, the mortality of plants could increase by 40% if land temperatures rise by up to 4ºC (the rate of increase projected for the 21st century by climate change prediction models).

The reasons why organisms cease functioning and die is still one of the big questions for science. Some trees live for centuries while the smallest herbs last no more than a few months. However, there is no real reason why herbs should not, in theory, live as long as trees, given that all photosynthetic organisms – plants – can live indefinitely in the absence of disturbances.

The authors of the BBVA Foundation study examined the mortality and population growth rates of 700 phototrophs, ranging from the very smallest – the cells of the marine photosynthetic cyanobacteria

Prochloroccocus (just half a micrometer across yet responsible for a considerable fraction of marine photosynthesis) – up to the largest species of trees, in search of general rules conducive to an improved understanding of plant life span regulation.

The results of the study identify phytoplankton as the shortest lived beings, with a span of around one day, while some trees reach ages of a thousand years. This was possible thanks to a methodology developed by Susana Agustí, using techniques that have permitted the first ever quantification of the cell death of phytoplankton.

The authors show that the same basic rules govern the longevity and birth rates of plants, such that the brief life span of the microscopic phytoplankton cells is offset by the vertiginous birth rates of populations, while centennial tree populations register no more than sporadic births.

Their findings provide the key to a universal regulation of the life span of photosynthetic organisms with reference to plant size and the temperatures they grow at, and suggest that the mortality rates of phototrophs evolve to match population growth rates. A further conclusion is that plant mortality is of necessity highly temperature-sensitive, such that climate change will tend to accelerate the phototroph death rates which are an essential part of the food chain. As stated, the authors estimate that plant mortality could increase by 40% in the event of an up to 4ºC increase in land temperatures (the rate foreseen for the 21st century by most climate change prediction models).

The balance between longevity and birth rates in photosynthetic organisms is what keeps their populations stable. In the event of a serious mismatch between plant mortality and birth rates, these populations would either be driven to extinction (if death rates far exceeded births) or would outgrow available resources of light, water and food with the same inevitable result (in the case of births far exceeding deaths).

Source: Fundación BBVA