Ramon Margalef (1919-2004): teacher and researcher

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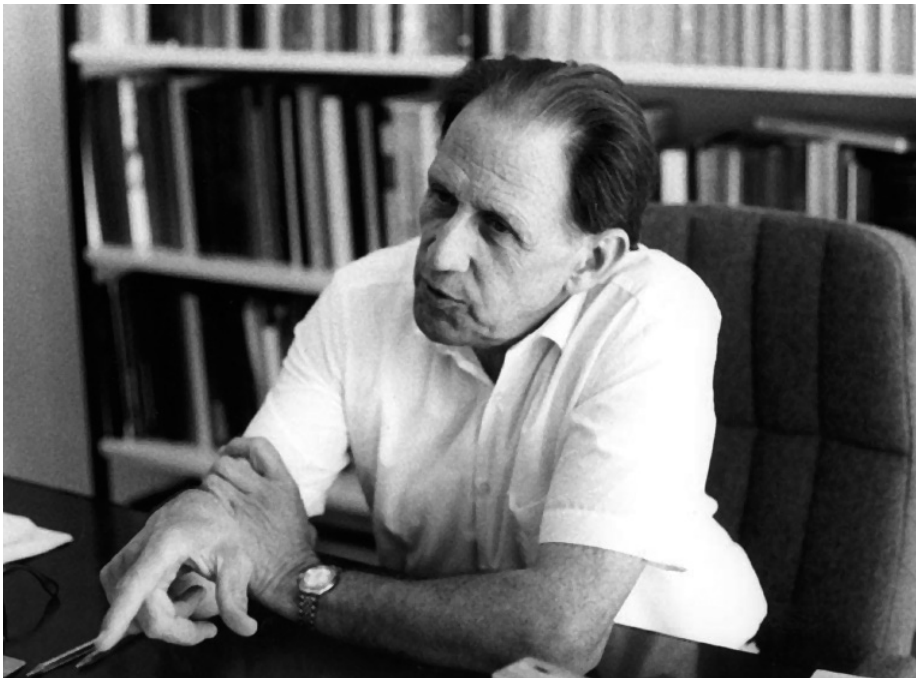

The May 23th, 2004 Professor Ramon Margalef died in Barcelona at the age of 85. While not unexpected, his death equalled his life in simplicity and dignity. The professor had refused to be subjected to a treatment that could artificially prolong his life, wholly in keeping with the tenor of his character. Already in 1979, Margalef presented some very interesting thoughts, still valid today, on r- and K- strategy behaviours amongst human populations, the generational problem and the lengthening of life span in some human populations in the article "El precio de la supervivencia. Consideraciones ecológicas sobre las poblaciones humanas" (Margalef, 1979). In it, there is a sentence which has kept its full force over time, considering the circumstances that led to his death. I remember it quite clearly as, even back then, I found it profoundly disturbing and, quoting from memory, it goes something like:" I would not like to enjoy the privileges medicine granted to Franco and Tito". It looks to me as if this sentence were what we call a living will "*avant la lettre*" and, in it as in so many respects, professor Margalef was way ahead of his time. However, I would not like to dwell on this subject which leads me to very painful recent memories, but to write about his life as a teacher and researcher at the University of Barcelona from the perspective of one of his pupils who got introduced the world of ecology by the hand of professor Margalef and lived side by side with him during part of his "golden years" of scientific research.

Margalef was not especially didactic as a teacher, at least not for those who preferred well organised lectures that allowed the taking of clear and methodical notes, with outlines to complement the

explanations in class. We need not forget that until 1974 we cannot talk of a "book on ecology that could complement his lectures". Until the publishing of *Ecología* (Margalef, 1974), we felt fortunate enough if we had a barely readable cyclostyled copy in thick paper of "Comunidades naturales" (1962), a compilation of some of the lectures he had given at a course on ecology in Puerto Rico which had been published in an unconventional way. His lectures would be a continuous improvisation and, even though there was a well-outlined thread in the syllabus, you could hardly follow it during the lecture on any given day. He followed, or better, pretended to follow some notes he had scribbled on one of those index cards we used to write down bibliographical notes. During the class, however, he would keep bringing up new topics to end up talking about the ones that were of his interest at that moment. More than once, you would write down that there were different ways of facing a specific aspect of an issue only to realise that he expanded on one of them and forgot about the rest. They could of course have been dealt with, or not, but that didn't seem to worry him at all.

But please do not reach false conclusions from my previous words: his lectures were speeches in the creative sense of the word as he was giving us a state-of-the-art account of key aspects of contemporary ecology, continually updated, as he was leading it himself together with E. Hutchinson, R. H. McArthur, the Odum brothers (Tom and Eugene) and R. Lewontin, amongst others. In his classes, he would bring up the latest books and articles from the latest issues from the most prestigious magazines and he would use them as the backbone of the lesson. I clearly remember as one time, during a lesson on marine plankton, he got sidetracked into talking about a most interesting book he was reading at the moment and about biology of leaves and he started to argue on how many times the surface of the earth could be covered if all the leaves were put one right next to the other one. A kind of biospheric foliar index which led to his reflecting on the idea of why life had not evolved towards one unique species that would cover the whole surface of the Earth, with an autotrophic top layer and an heterotrophic bottom layer, and he even predicted that its thickness would have to be no more than a few millimetres at the most, enough so that there would be a redox potential difference between layers, enough to balance production with respiration. This idea of a planet covered by just one species was the complete antithesis of the concept of biosphere but he used it to stimulate our thinking about what the biogeochemical cycles would be like within a system with no diversity, little biomass, but possibly a lot more efficient in the capture of energy from sunlight through photosynthesis. Margalef underwent cataract surgery in the days before laser surgery and with techniques that were a lot more invasive and required several days in hospital, and therefore we can imagine what it meant for him to spend those days with the eyes bandaged and with nothing else to do but to meditate on some of his favourite subjects. He asked for a cassette player to be brought to him and he recorded a story about a human expedition to a planet that fulfilled the requirements mentioned above, too long to relate now. Unfortunately, the recording is lost, even though it would nowadays be more relevant as a testimony of Margalef's personality rather than for the subject itself. What we can infer from these anecdotes is that Margalef enjoyed these kind of theoretical approaches similar to Einstein's *Gedankenexperimente* and the ones by other physicists of his time, although they were not quite the same. I am referring to experiments whose realization is frequently impracticable but which nevertheless lead to reliable results. In Margalef's case, these mental experiments were not merely theoretical, but were based on a deep and perceptive observation of nature, on simple experiments and the application of regularities he had observed in nature that were based on ecological successions. For Margalef, perfect crime didn't exist even in nature and the observation of natural phenomena allowed him to detect casual linkages that led him to discover principles that had gone unnoticed until then. That's why Margalef had always regarded himself as a naturalist. "He dignified the meaning of naturalist", wrote Joandomènec Ros (Ros, 2004) not too long ago to recall Margalef's passion for nature, and Margalef himself preferred this term to all others to describe his scientific activities. For this rea-

son, some authors have adopted Josefina Castellví's views that "talking about ecology is talking about Margalef, but talking about Margalef certainly implies a lot more than talking about ecology". With these words, "more than ecology", we mean the observation and study of nature along with deep intellectual interests.

I do not want to expand on the emerging principles of ecology that Margalef developed together with the most prestigious ecologists of his time, Hutchinson, McArthur and the Odums amongst others, or on his lifelong contributions to theoretical ecology as they have been described in detail by other authors (Bascompte and Solé, 2005; Flos, 2005; Walter, 2005). However, I would like to emphasize that, in my opinion, the most relevant article published by Margalef is "On certain unifying principles in ecology" (Margalef, 1963). Very few times more has been said with fewer words. In this paper, Margalef presented a series of emerging principles based on the ecological succession and with them he started dissecting nature. In other words, he started to study and measure all ecosystems, from the least productive seas, such as the Mediterranean, to fertile ones like the Sahara upwelling. Likewise, the Mediterranean forest, the rainforest, the small pond, the biggest lakes or dams, the coral reefs or caves, they all became the subject of his studies. Nothing escaped his ability to discern patterns and the results were spectacular. The best of his comparisons can be found in "Perspectives in ecological theory" (Margalef, 1968), where we are able to realize how powerful the tool he had created was. No wonder this book is one of the top 10 most cited works in ecology and is fully up-to-date. Just to mention a few examples that are far from exhaustive of the application of these emerging principles: Margalef deduced that the natural evolution of lakes was from eutrophic to oligotrophic aquatic systems if the influx of nutrients or organic matter was cut off (Margalef, 1968). He also explained the dynamics of a river population as an equivalent to space succession (Margalef, 1960) and the seasonal dynamics of phytoplankton as a microsuccession (Margalef, 1978). The direct consequence of this last idea led him to develop the concept of biological types of phytoplankton as an adaptation of the species to a double gradient of concentration of nutrients and of turbulent kinetic energy, with his famous mandala model (Margalef, 1980). From those research topics he developed the concept of external or exosomatic energy and its relevance in the organisation of communities. Societies or systems that use more exosomatic energy are the ones that exploit or dominate the other ones. I would suggest a "Gedankenexperimente" to you and to apply this thesis to the present geopolitical situation for the control of the non-renewable natural resources and reach your own conclusions. Margalef used to do it as well, whether to study a coral reef or to analyze any level of organisation of human populations (Margalef, 1992).

And, going back to the topic of Margalef as a teacher, I have to stress that all the advantages and disadvantages I mentioned before helped split his students in two groups: the ones that liked his classes and the ones that didn't, with no intended disrespect towards the latter. Margalef was passionate of natural selection and he considered it could be applied to all aspects of life and at all levels of human organisation. He was, therefore, capable of giving a pass to some students who didn't deserve it while telling them "life will fail you" or "look, I give you a pass but promise me you will never teach the subject or work in anything related to ecology". It is true that he didn't like being too hard on students during exams. He was, however, strict in his selection of the students that deserved the best marks.

Exams are always a source of stress no matter the subject or the professor, but with respect to the exams on ecology, they had the disadvantage they were also atypical as far as the questions were concerned. Many times the problem lay in the way he formulated the questions and not in the subject itself. Margalef was always on the lookout for the bright student who could become a disciple and would show some degree of originality and he would pick the best by asking questions in his particular way. Some questions were handed down from year to year by senior students to the freshmen so that they knew what to expect. The questions might be of the sort: "Why are the taxis in Barcelona black and yellow? They may seem a bit esoteric to the students that are being introduced to the subject for the

first time but it would not be an insurmountable obstacle if you knew anything about aposematic coloration. Other questions such as "effect of the Coriolis force in the curvature of the antlers of antelopes, in the growth of branches in the tree trunks, and in the distribution of the genus *Velella*" were meant to sort out outstanding students who could have otherwise remained unnoticed. No matter how hard the exams were, the percentage of passes and failures never changed, with passes to failures at about 2-to-1 ratio. However, many of the students that got a pass were aware of Margalef's opinion of them when they got back the exam together with a mark which was obviously a fail. The exams of the ones that didn't pass do not even deserve to be mentioned. Regarding the exams we had to take during our own 1970-1971 ecology course, Margalef suffered from an extra dose of originality as he decided to abolish the traditional Napoleonic exams, with the students locked up in a classroom while they were answering questions. The novelty consisted in a short meeting with all the students early in the morning in the Department library where he hand us two topics to expand upon: we had from 9 a.m. until 4 p.m. when we had to stop by his office and hand him the paper we had written on one of the two topics we had chosen. I have to admit that I had a very bad time over it and many of my classmates shared my feelings due to the difficulty of trying to write something original while having all the notes, books and other means at hand. A few days later he told us we didn't deserve this kind of exams as we had done so badly in general. To a chosen group of us, who had done well, he let us take a second non-Napoleonic term exam but we had no chance of a third for the final exam and we all went back to the traditional system. I remember that during this first exam four of my classmates handed in an essay which was the result of a joint effort, probably very well thought out as they got an A. They had, however, to share the mark democratically amongst the four of them, with the result of an obvious fail.

I have so far commented on professor Margalef's teaching career, but he pursued a career in research beyond this aspect of teaching which I would downright call frantic. In the first years of existence of the Ecology Department, Margalef combined his work between the University of Barcelona and the Fisheries Research Institute (IIP) of CSIC. He would go to IIP on Tuesdays and Thursdays and spend the rest of the week at the university. He had his own research team at each one of the centers: the marine biologists Marta Estrada in Barcelona and Miguel Alcaraz and Xavier Niell in Vigo, while at the university, the limnologists Dolors Planas and Rosa Miracle, who were at the time, early 70's) beginning their research work at the lake of Banyoles plus a group of students who would go during their free time and amongst which I counted myself. Tecla Riera was Margalef's assistant and was soon joined by Joandomènec Ros and the department became divided into two kind of doctorate students, the marine ecologists and the fresh water ecologists.

The writing of *Ecología* (Margalef, 1974), with its 951 pages, dates from that period. I suppose that, as with anything else, some people are better at writing than others but the way Margalef would write can only be described as extraordinary. His Olivetti typewriter sounded like a machine gun that only stopped when the letters hit the rubber cylinder with a different sound as when there was paper. It was time to stop, pick up the paper from the floor if it was handy or at least the carbon paper, as he used two sheets and some carbon paper to keep a copy. The writing began early in the morning, right after the ecology class, which started at 8 a.m. to allow him more time for his writing. He would seldom have a break, just enough for a coffee and he dealt quickly with any visits. He stopped writing at around 2 p.m., picked up the sheets that might have fallen to the floor, sorted them out, numbered them and piled them up at one end of the table and would call it a day just to continue two days later as if nothing had happened in between. We have to remember that on alternate days he went to IIP and he used the afternoons to attend to other matters. He kept the typed sheets inside a metallic cabinet in brown folders bound with a rubber band. On the cover of the folder he would leave handwritten notes and some of the sheets inside would also be full of them. The 951 pages could easily consist of 3000 or more sheets which made quite a considerable stack. While writing, he would include all the bibliography he remembered and then he would go over the text and insert the missing references by

hand. The draft copy was finished in one year. The final writing of the book was not a mere copy of the first one but a full rewriting that took almost as long. If we take a look at Margalef's bibliography during those years, 1971-73 (Ros, 1991), we realise that he had time to write articles on the side that can match the amount of articles published in the previous and later years. The writing of *Limnología* (Margalef, 1983), with its 1010 pages, followed a similar pattern to the one described above and I will obviously not go over it again.

Peter Wangersky, from the University of Halifax, who spent some sabbatical stays in Barcelona, used to say that Margalef could work right through a three-ring-circus show without losing track and being at his most efficient.

Margalef was a person who didn't get out of the office much but his door was always open and students and graduate students alike could visit him there any time we wanted, although we could always tell if he was eager to get on with something else or deeply involved in his thoughts. Tecla Riera was in a way a kind of transmission belt that would keep him connected to the department despite his many other information sources based on his observation skills. He knew what was going on, even though he didn't interfere much. Whenever he proposed a research topic, he felt enthusiastic about it and even anticipated the results he expected if everything turned out well. On many occasions, he would use the pages of his desk calendar to scribble and sketch data to supplement his initial exposition. When he was done, he would tear the page and somehow you would find yourself standing in the corridor, or in the office or the library staring at it, trying to figure out what it said while trying to remember what Margalef had said in relation to what while he was going on about his ideas. We all had to work in a specific taxonomic group and from there we could fit in all the ecology we were able to develop. In those days, the zoological and botanical taxonomists that worked in Margalef's department were equivalent in numbers to the ones that made up the respective departments. Quoting Xavier Ferrer, "he would send us on a single-handed voyage along the seas of research and, as a rule, he wouldn't warn you of any possible dangers" (Ferrer, 2004), always consistent with his belief in natural selection. The results would be uneven and, the same as with his students, some would just disappear discreetly without him losing any sleep over it.

As I have mentioned earlier, he had this incredible capacity for transmitting enthusiasm for the ideas that interested him. You would come out of his office holding the calendar sheets feeling you were going to start a research project that would achieve a major breakthrough in ecology. Other times, he would ask you offhand about your progress and he liked to be shown the results and would get all excited if he considered them relevant and had no qualms about mentioning these results in his papers.

Margalef founded three scientific magazines and he was a regular contributor with his papers *Publicaciones del Instituto de Biología Aplicada* (PIBA), *Investigación Pesquera* (IP) and *Oecologia aquatica*. The issues of PIBA or IP are hard to find and the articles published in them, quite often written by Margalef himself, are very rarely read. Big mistake, as you can find some gems amongst them, as not only would he present and interpret data, but he would also anticipate some of the results and conclusions and formulate hypotheses that he would develop later on. Nowadays this type of approach or projection of the results is called speculative science. "Too much speculative" is the fatal sentence that you can usually find in the letter editors send to reject a paper for publication when you spend too much time on the data assessment or on the conclusion. Margalef was not afraid to expound his ideas even though many times he himself admitted he was not able to prove them at the present stage of information available. Many of the criticisms he received from later ecologists were of the kind that he had this habit of jumping ahead while leaving many gaps to be filled, some of which have already been filled and some are still pending. The wealth of ideas we find in his writings in PIBA or IP can already be found in his earlier works, many of them geared towards the general public. In that sense I can recommend some booklets from the end of the 40's published by Seix y Barral that took up less than a hundred pages and that he wrote as a complement to a meagre salary

to help support his family of six. That's why, with a mischievous smile, he used to call these papers "nutritional ecology". The topics, of course, were varied but all juicy nevertheless: *La vida en el mar, Los insectos sociales*, *Las plantas carnivoras* are some of the titles I have been lucky enough to read many years after they were written. One of my favourites has always been the latter as in it he predicted the new food adaptation of carnivorous plants, an example of allotrophy. According to Margalef, this adaptation came about because they had no other chances of obtaining nutrients through more orthodox means. A few years later we had the chance to prove his theory right at the old department in University old building with a specimen of *Sarracenia* he had brought from Canada and which we had kept for a long time in a crystallizer, watering it with distilled water and with regular visits to the genetics department to get a pot full of *Drosophyla* to feed to it.

From the many activities going on at the department, the so-called magic soirees on Thursday afternoon were of special interest. We euphemistically called that to the seminars held by Margalef. They were open activities and they were not based on a previously announced topic; we would just attend and if it was time and nobody came up with a topic, Margalef would stand up and start talking about something that could lead to a discussion, without necessarily having to reach any conclusions. Many of the graduate students at IIP used to take part in those seminars and also many physicists, Jorge Wagensberg amongst others, and many of the physicists involved in the group of complex systems. Jordi Flos was the one that started calling these seminars magic soirees not because of the topics being discussed but for the way the ideas would flow, just like rabbits coming out of a magician's hat. Flos gives a short but interesting account of those seminars in his book *Ecología, entre la magia y el tópico* (Flos, 1984).

Ramon Margalef kept up his activities until his illness prevented him from leaving his house, and that was for a very short time. He kept coming to his office at the department, mostly as an incentive to walk around the libraries of the faculties of Biology, Geology and Physics and Chemistry. He remembered what day the issues from *Science*, *Nature* or many other magazines were expected and there he was, ready to be the first one to read them. His personal evolution during his last years was clearly the one of a K strategist, with a mental lucidity and incredible observation skills which he now used on himself. He didn't mind talking about his illness and how his life had been altered because of it. He used to say he found interesting the way we lose memory, "just like the hard disk of a computer; clusters get deleted without having any links with one another".

He used to come and see us and he liked to stop by for a chat and tell us about his ideas and projects he thought interesting and could no longer embark on. He was concerned about the big man-made changes to the landscape, and he used to call them "the inversion in the landscape topology". At the same time, he was interested in the number of cells of many species from a same taxonomic group that, according to him, was discontinuous at the species level. He used to compare those discontinuities to shoe size, "sort of a quantic cytometry", and was as always worried about nutrients, with a special emphasis on phosphorus. During the opening speech of the Second Iberian Congress of Limnology in Valencia (June 2000), he insisted on his concerns over the pending issues and the relevance of their study in the future. He wrote these words in a short but delightful article, "Cabos sueltos" (2001), published one of the previous volumes of *Limnetica*, and it can be considered as a sort of future projection of his ideas.

He used to enjoy our visits to him at his home. Delivering his mail was always a good excuse; just that many times there were several of us just for a few letters. Even though his memory was failing him, you could immediately tell if the subject caught his attention as he would awaken, his eyes would sparkle and would start up a typical Margalefian discussion. He admitted that our visits helped him while away the "black hours", as he called the hours he spent by himself or in the company of his dear wife Maria. He died as he would have liked, on a Sunday, surrounded by his whole family and able to say his last goodbye to them.

It was then when many of us found out he had been a religious person and were finally able to understand some moments in his life when he had shown extreme fortitude. Pere Ynajara, parish priest from Sta. Eugenia del Congost and a good friend for many years, presided over the funeral service and during the homily he spoke about many aspects of his personality amongst which I would like to single out the sense of irony Margalef would display on many occasions. "He was worried about what would happen to his nutrients", the priest told us. Which is logical as, being a religious person, he couldn't have had many doubts regarding more spiritual matters. I can assure you I have no doubts he said it, nutrients being an issue that interested him and one that, once again, he applied on himself. Well then, I can only say that I truly hope his nutrients soon get to an oligotrophic ecosystem, such as the Mediterranean Sea, the waters around Mallorca or the Gulf of Lyons or along the coast of Castellón, the places he studied, described and became the basis of many of his scientific hypotheses. In those waters of great diversity and biodiversity, with low P/B values, with an internalization of the nutrient cycle, great pigment diversity and big sized K- strategist species, there is where I hope he can continue to enjoy the wonderful world he helped us understand.

May he rest in peace.

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