

Chapter 2

Together We Look for Answers

Eduardo Dopico Rodríguez

The initial pages that we call the Editorial of science outreach books, similar to this one, are not usually read. Knowing that they will find interesting and veracious information inside, readers go directly to check the Index and choose the topics that provoke their interest more. The concepts of *ecojustice*, *citizen science* and *youth activism* appear throughout chapters and give formal unity to this book. Probably, after the initial curiosity has been satisfied, readers may fancy to reading the book from the beginning. At that time their inquiring gaze may stumble with the Editorial. If it is not very long it may be read; that's why editorials are justified. We would be remiss if our book did not have it. Then the reader perceives and engages in the scientific scope that surrounds the book. S/he understands in time that our aim is to analyze critically the impact of human relations with the ecosystems. The ideas contained in the book and the specific subjects treated therein can be seen much better when approaching from the Editorial. Editorials serve for this. They heat the following chapters. They provoke reflection on the discussed matters and curiosity to investigate other related issues. Let's begin.

The results of a thousand surveys are published in the *Global Risks Report 2013* presented by the *World Economic Forum* (WEF) in Davos (Switzerland). Experts in the fields of the industry, science and civil society are asked about the 50 most important global risks to the global sustainability. In order of importance, large difference of incomes between social sectors is one of the most serious problems registered. It is followed by another big global risk: the lack of adaptation to the climate change. If we travel across the planet Earth asking different peoples and cultures about the environmental problems that they consider more pressing, we would obtain results related to groups of interest. We are the protagonists of our own movie and therefore

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we report the reality from our unique and special perspective. The snow is very beautiful from the city windows but not so much if we live in a village in the mountains and are isolated. The environmental context determines the life experience. A native from the Amazon jungle has different environmental concerns than those perceived by a Tuareg in the Sahara. In the same way, the “green behavior” of a Norwegian does not have the same origin as the “green label” of some profit-seeking companies self-denominated “green”. We see this with more clarity if we consider the issues associated with water and land. Climate change poses serious challenges for land and water management. It affects negatively those native communities whose bonds with the environment are simultaneously economic and cultural. At the same time, climate change improves the business perspectives of the companies in charge of managing water resources in zones of drought, as well as those of agricultural companies that monopolize vegetable crops for biofuels.

Let's go a bit further. At present the *fracking* technology, namely, the gas extraction from Schists or Slate by means of hydraulic horizontal fracturing of the rock, is being widely criticized by the common opinion in Europe. On the other hand, in the U.S., this technique allows for collecting up to 20 % of total gas demand in the country and generates direct employment and increasing corporate profits. However, cities like New York, Buffalo, and Pittsburg are beginning to rethink this type of exploitation. To extract the gas trapped in the rock, the ground is drilled vertically (from 400 to 5,000 m) up to the Slate layer. Several kilometers are drilled horizontally (from 1 to 3 km). Explosives are used straight away for inducing small fractures in the cap of Slate. Then thousands of tons of water at very high pressure are injected in consecutive stages through these fractures, mixed with sand and chemical additives (Benzene, Xylenes, Cyanide and other chemicals, most of them carcinogenic, mutagenic and teratogenic). Pressurized water fragments the rock releasing the gas, together with water, sand and additives that rise to the surface through the well. The gas company canalizes it and then sells it to us. Gas price is always fluctuating upwards for the consumer because the *fracking* does not cheapen the costs of natural gas extraction. Evidently, research studies now report a battery of problems associated with this type of hydraulic-based methodology: pollution of the surface and underground waters; air pollution; human health affections; and seismic risks – to name a few. Despite that, some European governments encourage the use of fracking for short-term profitability. Again, everything depends on the perception, on the interests at play. Not necessarily will these interests coincide with the criteria of sustainability of the planet. To develop the comprehension of the tensions between a devastating and ecologically unsustainable culture and the needs of the ecosystems of the Earth is the central focus of the ecojustice perspective that we will see in the following chapters of this book.

No reasonable person doubts seriously about climate change or on the impact that our actions have on it. Nevertheless it seems that we are not well prepared to adapt ourselves to this changing situation. The longer we delay in doing something the more time is wasted in lessening its effects. We need to reverse the consequences of anthropic activities on the ecosystem. A long time ago Darwin indicated that the animal and plant species had evolved over millions of years from relatively simple ancestral forms. He reminds us about the need to adapt to the environment for the survival of the species. The peculiar adaptation of the *Homo sapiens* is called

culture. Culture includes all those ideas and tools that are acquired through learning, as well as the systems of knowledge, behaviors and utensils by means of which the human beings communicate with the external world: kinship systems, rites, myths, traditions and so forth. As far as we manage to understand, it seems that the order of appearance of cultural stages has been: gathering, hunting and fishing; husbandry and agriculture; industry and urbanization. Our evolutionary history of three million years is an incredible history of the adaptation to changing environments. Whoever adapts, wins. From an anthropological environmental approach we explain human adaptation to the environment through genetics and cultural transmission. That is, by the genes and the socialization process (teaching of cultural heritage from one generation to another). Thus, the combination of environmental natural resources and individual skills are key determinants of human adaptations. Adaptation is the adjustment of the population to environmental conditions. From the established ecological entity *subject – environment*, we can observe how the presence of humans and their complex relationships with the organic and inorganic components of the environment alter natural ecosystems and destroy their normal equilibrium. Everything seems to depend on human density and cultural phases. The human population grows, obviously, and deep cultural conceptions and practices weaken natural ecosystems and make them more susceptible to degradation. The socioeducative *ecojustice* perspective approaches the confluence of injustices in the social – environmental interaction, the oppression of human beings on Nature and subsequent ecological degradation. It can help us to see with clarity the cultural phase that we experience and our difficulties to adapt to climate change.

We must all commit ourselves to ensure an ecological sustainable future for individuals, communities and natural systems. We have to be literate in sciences and help others to understand the current ecological situation and to participate with solid criteria in decision-making processes. Those of us who are in educational contexts have even more reasons. There is a gap between what is taught in science classrooms and what students experience in the real world. The scope of the knowledge and the experience of an individual transcend the context in which learning takes place. In the classroom, we resort the deliberate use of scientific topics that students need to take part in the dialogue, discussion and ecological debate. We should also leave the classroom to see how in natural environments – still today – many human communities continue to use oral transmission as a source of teaching and learning. Outside the classroom we observe how those communities have learned their knowledge on husbandry and climatology through the direct experience inside the environmental context. Teaching transversally environmental sciences, in the curricula of all the educational levels, continues to benefit from local and traditional knowledge in educational materials. This ideal allows us also to analyze how traditional societies establish friendly relationships with the natural resources in their daily activities. Besides being instructive, it may generate new knowledge in science.

In a longitudinal study that we carried out more recently in science education, we found that too often undergraduate students face lectures that begin and end in concepts without any practical connection – repetitive, boring, and little useful lab practices disconnected from the lectures. The memory of the lab techniques that students master is as fragile as the knowledge that they acquire. If they cannot find a clear

relationship between tasks proposed to them and their potential applications in real life, something fails in our didactic practice. This undermines the educational purpose of student work in laboratories. It is possible that we have an excess of theory and too few practical works in science education at the University. Students complain about it year after year, but teachers do not seem to hear them – or there is little they can do. Surrounded with educational descriptors we try to justify the tendency to give magisterial lectures, which is easier for teachers but boring and tedious for students. The challenge is to break this static process and generate an inclusive environment of learning based on practical activities. Educators have to keep alive their intention of increasing the scientific autonomy of students and helping them to develop a deeper comprehension of how science works. Hence we need to leave the space limitation of the classroom or laboratory. Citizen science and youth activism motivate the scientific and ecological literacy, the redistribution of roles to participate in scientific knowledge production. Overcoming conceptual or dialectic tension between school and citizen science is easy. It requires pushing ahead the educational contents, putting the school in the forefront of the procedural learning, and not in the rearguard of rote learning. If we consider procedural learning as a reference, we will give more attention to learning processes than to learning contents. In this way, science teachers can teach about climate change (for example) in the same way other teachers teach about English language. Of paramount importance is learning by doing. At the same time, transversality is essential because it facilitates the connection between the school learning and the natural world, establishing a link between learning contents and the space outside the school where students and their families live and are increasing their learning about biodiversity, ecosystems and the biotic and abiotic processes that occur in their surroundings. Consider the *Ecoschool*. It is frequent at the stage of the Pre-primary School to propose all children to bring a clean yogurt container – or any other recipient – to the class and plant a bean inside. After a few days of minimal care (watering if dry!), the bean germinates and a tiny plant grows in front of the students' eyes. A so-simple-activity sensitizes children about the fragility of life and ecosystems, such as when we learn about the life cycle of butterflies by rearing small silkworms in a box.

Ecosustainability can be taught inside and outside the school. It is not necessary to separate the two spaces because both constitute a spectrum of learning-continuous. The example of actions that result from a research project that use a farm as a focus for school activities, as a learning context for science classes, will give us a clear image of this idea. Learning experiences on a farm bring us closer to *permaculture* (permanent agriculture): an agricultural activity where people adjust their needs using the resources available in nature. The ecosystem itself guides and teaches us how to produce food in a sustainable, non-pollutant way. This leads us to thinking about agricultural exploitation because we know that the agriculture or land tillage devoted to vegetable production for food involves the use of large land tracts. Specialized production always accompanies urbanization and requires intensive agriculture that reduces species diversity in an extreme way with predictable results: destruction and salinization of soil, pollution by pesticides and fertilizers, deforestation, general loss of biodiversity, and so on. Against this, permaculture evidences other routes for generating food resources based on sustainability. So does what can be gleaned from horticulture, such as the mixed culture of food plants in an orchard near the house, which is an agricultural

method widely employed in Central America, Africa and Asian Southeast. This allows the farmer to keep diverse species in the cultivated area isolated from the wild surrounding vegetation. Half way between horticulture and agriculture, there is the crop migratory technology, or agriculture in land plots that are cleared by felling or burning. This is practiced in some rainforest regions and represents the agricultural recovery of small, deforested zones that are then replanted with several types of crops.

From the perspective of practitioners, citizen science can be found in the analysis of narrative descriptions from people who have solid links with natural environments. A matter of pedagogic discussion arises when we evaluate if living in an “ecological” environment (what bucolically can be called *the field*) is enough to guarantee basic levels of learning about the natural world. Evidently, people learn and acquire habits depending on their experiences and interactions inside a specific community or context. If we examine the history of citizen science through the oral history we can observe how still today many human communities keep using oral transmission as a source of education. This may explain how peasants have learned their knowledge on agriculture and livestock breeding or how they manage to maintain a friendly and sustainable relationship with the environment with the ecological environment on which they depend. The agro-husbandry traditional practices orally transmitted from generation to generation have a high ecological value. This Eco-educational learning is natural and contextual learning. It takes place in a context in which people experience their reality, develop their activity through practical didactic examples observed directly in real spaces of the natural environment. The consequent axiom will be an Ecoeducative paradigm. This way, *Ecoeducation* means: an action, expressed in the activity developed in the context of work; and an effect, caused by the use of traditional education methods (oral transmission) for a set of practical knowledges necessary for living. The learning contents (what is taught and learned) are related to what is necessary for life. Let’s not forget that the scope of knowledge and experience of an individual is the context in which the learning takes place, and may transcend such context. This form of learning, where everyday tasks are engaged in the exploitation and the sustainable maintenance of environmental resources, constitutes a synthesis of ecological and educational knowledge. It is an important issue for scientific education.

In the ecojustice and citizen science practices, the youth activism takes an important place. We have many points of reference to focus on. Let’s go to a river of the Atlantic Arc. Environmental and biodiversity knowledge can be acquired to clean a river. Two Angler’s Associations *The Banzao* of Tineo, and *Narcea Sources* of Cangas, both in Asturias – North Spain (43°28’0”N; 6°7’0”W), organize Cleaning Days in the Narcea river margins, focused on urban perimeters where the river tends to suffer attacks from urban nuclei and play the unpleasant role of garbage collector. This action is part of a social awareness campaign about river conservation called, “Rivers for All, Thinking Ahead”. Developed by the *National Union of Conservationist Anglers*, its aim is to mobilize the entire population on the idea that rivers are not sewers. This project is based on the work of volunteers who carry out the activity during the weekends before and after March 14, *International Day of Action for Rivers* and March 22 *World Water Day*. It makes visible the need to maintain a respectful relationship with the river ecosystem and aquatic life. The fluvial team squads remove residues from the river and river banks. In their last action in 2012 the volunteers

extracted almost 20 t of garbage from approximately ten river kilometers. The most important thing of these actions is not the quantity of garbage removed, that of course is also important, but the public denunciation of the situation of rivers used as sewers. The youth activism also provides the opportunity for analyzing the quality of water, making an inventory of macro invertebrates and vegetation of river banks, and calculating the human footprint on water. Cleaning the rivers and activating the consciences to preserve water quality, fauna and flora, encourages maintaining a friendly relationship with the ecosystem. When we use the concept of sustainability from the ecojustice perspective, we are encouraging youth to experience a fair relationship with others and with the Earth's ecosystems. We are proposing behaviors of ecological value and empirical strategies to preserve and maintain the biodiversity.



Another problem is the expansion of alien species introduced by humans that combined with the reduction of the number of autochthonous species is an environmental problem of enormous magnitude in the Biosphere. It threatens biodiversity worldwide. Taking everything into account, is it possible to regulate the recovery of the biodiversity? Can we encourage specific legislative initiatives to sanction the use of invasive species and to stimulate the recovery of biodiversity? How? An example can be *Corvera*, an Asturian little county of 46 km² and 16,500 neighbors. Its inhabitants want to eradicate invasive plants from its territory and forbid the implantation of non-native vegetable cover. Banning alien species helps local biodiversity to recover. This initiative stems from the deterioration of the ecosystem of the coastal forests. Years ago a massive eucalyptus forest was planted in the zone. This is an Australian native species of rapid growth and high performance for the timber industry and trees are called *ocalitos* in the local language. *Corvera* inhabitants also eradicate leguminous plants such as *mimosa* (*Acacia dealbata*), rhizomatous grasses such as *plumeros* (*Cortaderia selloana*), climbing plants such as *uña de gato* (*Uncaria tomentosa*), shrubs as *flor de lila* (*Syringa vulgaris*) and cannabaceae as *flor de hombres* (*Humulus lupulus*). Local authorities have also banned the use of transgenic varieties and try to extend the areas of protected habitats within the county. The owners of eucalyptus plantations have agreed to cut down the trees and sell the timber. Later, if they want, they can plant a new forest crop, but only with autochthonous species.

The world where we live faces increasingly complex problems: climate change, loss biodiversity, and environmental injustice. Together we can look for answers. In this exciting book you will read some of them. Others are on the way and will become visible soon. Some of the most important actions will be proposed **by you** after reading this book. We cannot stop to contemplate what happens. Hence, this Editorial is stopped here. It's the acting time. The planet Earth is yours.

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