the difficulties in communicating all this to a public that, by and large, lacks an understanding of science processes, theory building and modelling. The final part of their chapter calls for a better attempt to convey the 'struggle of ideas' within the science as it is this that embodies the essence of what ecology is, which is needed, they argue, as a counterpoint to the usual 'catalogs of … facts and principles'. And, I would add, which is needed to challenge the simplistic truths that are transferred, metaphorically, in strictures about how we all might live.

In the end, I was left wondering whether *Environmental Education and Advocacy* might more usefully have been a book about ecology and science (not environmental) education. I say this principally because, in schools and universities at least, the greatest scope for dealing with these issues is through science education as this is more firmly rooted and better valued by society than is environmental education, and much better staffed and resourced. Perhaps if modern science educators were to discover modern ecology, we all might end up better educated, and prepared.

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Icy life in space and time

Life in Ancient Ice edited by John D. Castello and Scott O. Rogers. Princeton University Press, 2005. US$69.50/£45.00 hbk (307 pages) ISBN 0691074755

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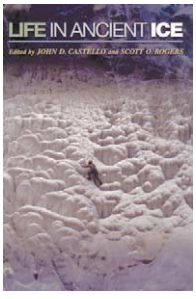

Occasionally, one opens a book and, while reading the first pages, feels like one is opening a door into a new world. In the case of *Life in Ancient Ice*, this world is not new, but is extremely ancient, and largely unknown to us. What John D. Castello and Scott O. Rogers have compiled is the first comprehensive insight into what is deposited, dormant, or thriving in ancient ice or permafrost on Earth.

Life in Ancient Ice brings together national and international scientific efforts, notably from Russia and the USA, and over 20 chapters, summarizes the comprehensive state-of-the-art of life-in-ice research. It also demonstrates the potential and future global outreach of the field. Several chapters combine sub-themes, which all follow one fundamental question that appears throughout the book: is there evidence of life in ancient glacial ice and permafrost?

When looking deep into ice, we are dealing with unfamiliar life forms, from fungi, protists, and viruses, to bacteria, archaea, pollen and other particles of biotic origin. This life is tiny and floats around the Earth by means of global winds before becoming preserved in, or indeed released from, ice over time. Accumulated in ice cores, this life could serve as a global climate archive that reflects local and global climate scenarios [1], which are often difficult to distinguish. But the question of life in ice points far beyond climatic conditions: can these life forms survive a cryostatic stage, which might last thousands to hundred thousands of years? What is the timescale that we are looking at and what are the consequences for reintroduced ancient genes following release into contemporary gene pools? Answers are currently lacking, but the possible release of preserved pathogenic organisms and viruses demands detailed examination. What sounds like science fiction is indeed the world in which we are living. For example, viruses have been isolated from Greenland ice that is up to 140 000 years in age, and some of the ancient bacteria, fungi, and archaea found thus far have been shown to be metabolically active *in situ*; it is even suggested that DNA repair mechanisms in some microbes could be working effectively under cryostatic conditions, given that some damage to chromosomes over such long spans of time would be expected.

Since the discovery of sub-glacial lakes in Antarctica, of which Lake Vostok is the most well known, astrobiologists have recognized ice caps on Earth as being the best *in situ* laboratories for testing theories of life in our solar system and beyond. It might be that life in ancient ice on Earth could provide support for hypotheses of similar life forms in ice-covered bodies on our moon, Mars, and on Europa, one of the moons of Jupiter.

The book concludes with information about technical innovations for sample design, and the long expected discussion of the problem of contaminating an environment that has been isolated for millions of years from the rest of the biosphere, in particular the ancient water bodies within the Antarctic ice cap. Such information is vital if we are to continue analyzing life in ancient ice, without contaminating it with life from more recent times.

The beauty of this book is not only its scientific stimulus, but also its significance as a scientific milestone.

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Life in Ancient Ice is written for the specialist as well as for non-specialists with an interest in the natural sciences. Each chapter follows a broad scientific theme, carrying the reader from a global and evolutionary perspective down to the level of, for example, microbes or fungi in their current deep-frozen and inhospitable shelter.

On reaching the end of *Life in Ancient Ice*, one might ask whether there is any life in Space? The answer is as yet unknown, but ancient ice might hold one possible answer to this challenging question.

Reference

1 Alley, R.B. (2000) *The Two Mile Time Machine: Ice Cores, Abrupt Climate Change, and our Future*, Princeton University Press

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Lessons learned from guppies

Evolutionary Ecology: the Trinidadian guppy by Anne Magurran. Oxford University Press, 2005. £60.00/£27.50 hbk/pbk (224 pages) ISBN 0 19 852785 3/0 19 852786 1

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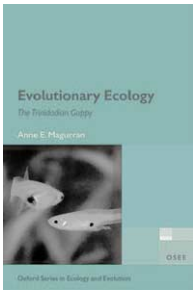

The 'birth' of guppies *Poecilia reticulata* as a paradigm of evolutionary biology was in the Arima Valley of Trinidad, where Caryl Haskins first described the simple gradient of fish communities found in the ascent up the drainages of the Northern Range Mountains and its consequence for guppies. At lower elevations, guppies lead a fugitive existence to avoid the constant threat of predation. Above waterfalls that exclude predators but not guppies, the guppies have a greatly reduced risk of being eaten and thus occupy the whole river. This contrast in mortality risk provides a basis for applying and testing evolutionary theory on natural populations. The presence of many drainages, each of which repeats the contrast between high and low predation, provides independent replicates for evaluating these predictions. It is this natural setting, combined with the facility of breeding guppies, their short generation time, their exuberant and frequent social interactions, and the remarkable color polymorphism of the males, that makes them ideal for research.

Evolutionary Ecology: the Trinidadian Guppy compliments Anne Houde's monograph on sexual selection in guppies [1] and expands on ecology, predator evasion, components of reproductive success, life-history evolution and speciation. Its greatest strengths are those parts that are derived from Magurran's research program, which includes ecology, behavioral ecology, sperm competition and the evolution of reproductive isolation. Each chapter is a graphically illustrated synopsis of research, accompanied by a summary of pertinent theory and often references to relevant research on other organisms.

One weakness is that Magurran is too polite. There is substantial variation in the quality of the published research. For example, Kelly *et al.* [2] report the important result that many antipredator behaviors can be enhanced through association with experienced fish. A consequence of the potential for such cultural transmission for other research is that it argues that, if the goal is to characterize a genetic basis to behavioral differences among guppies from populations that differ in mortality risk, then the subjects must be the product of a rearing program that prevents such transmission. The sources of guppies for experiments range from wild-caught adults to individuals collected from continuous lab culture to individuals who were reared in isolation from birth. Such differences have an impact on an investigator's ability to define behavioral differences among populations as the product of natural selection. A second source of variation is replication. Some studies represent high- versus low-predation environments with a single population of each; others exploit the abundance of available replicates. Such diversity in quality demands a critical review to help discriminate between strong and weak results. Magurran is certainly capable of doing so, but did not, save for a brief commentary at the end of the last chapter. As a consequence, the book serves well as an introduction to what we know about guppies, but should not serve as a substitute for reading the primary literature.

Although theory and empiricism are always represented in this book, they are often blended in a way that obscures how theory motivates research, as exemplified in the chapter on the evolution of reproductive isolation. Guppies display remarkable local adaptation, but reproductive isolation is not simply a sequelae of such adaptation. Addressing whether local adaptation can cause reproductive isolation should begin with a specific model, such as ecological speciation [3]. This model predicts that, if local adaptation causes changes in the phenotype that have a direct impact on mate choice or the fitness of hybrid offspring, it will also contribute to the evolution of reproductive isolation among populations. Local adaptation does not appear to influence mate preference in guppies. We are only beginning to learn about other

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