KITCHING, R. L. 2000. Food webs and container habitats: The natural history and ecology of phytotelmata. Cambridge Univ. Press; New York. xiii + 431 p. ISBN 0-521-77316-4. Hardback. $100.

A phytotelma is a pool of water impounded by a plant. The plural is phytotelmata, pronounced phyto.**telm**.ata (in keeping with other Greek plurals ending in -ata). The word was coined in the late 1920s from the Greek words meaning plant and pool. The word phytotelm serves both as a noun (a vernacular English equivalent of phytotelma) and an adjective. The best known are the pitchers of Old World (*Nepenthes*) and New World (*Sarracenia*) pitcher plants, flower bracts of many but not all species of *Heliconia* (Heliconiaceae), leaf axils of many but not all species of bromeliads (Bromeliaceae), and treeholes (water-collecting cavities in trunks and buttresses and large branches of hardwood trees). Phytotelmata are natural containers and they have a rich fauna including specialist aquatic organisms that occur nowhere else, non-specialist aquatic opportunists, and riparian organisms (terrestrial organisms that live on the margins of aquatic habitats and may occasionally enter the water).

This is the first single-authored book on phytotelmata in general (apart from one entirely in Japanese). Roger Kitching is one of the few ecologists to have worked intensively on two phytotelm systems: treeholes and the pitchers of *Nepenthes*. Furthermore, his treehole studies were carried out in England, Australia, New Guinea, and the USA, and his *Nepenthes* studies in Sulawesi and Borneo. The disparate study sites and two major systems (colored with some experience of some other systems) allow him singular insight into how these systems function. He also collected together a substantial portion of the literature on these and other phytotelm systems and was able to weave parts of the knowledge of those other authors into this book.

The introduction gives a brief history of studies of phytotelmata, documents the locales of Kitching's own studies, and then broaches the subject that is the core of the book: the construction of food webs. He points out that manipulative experimentation is a key to how food webs work, but it cannot answer all questions. His cut-off point for inclusion of literature was mid-1997—there had to be a cut-off point. For lack of other information, he assumed not unreasonably (p. 306) that aquatic oligochaete worms "must generally reach phytotelmata in run-off and mobile debris"—thanks to Lopez et al. (1999) we know now that at least some oligochaetes and ostracods are able to disperse between bromeliad phytotelmata by phoresy on frogs and snakes.

Chapter 2 gives a brief oversight of phytotelmata formed by bromeliad axils, pitcher plants, treeholes, bamboo internodes, and plant leaf axils (including *Heliconia* flower bracts). This chapter includes tables of key works and of the plant families involved (except for those forming treeholes, because such a list could include almost all hardwood trees). Chapter 3 addresses the subject of feeding guilds within the aquatic fauna (from rotifers through arthropods to vertebrates); it does not deal with bacteria, fungi, or Protozoa, nor does it provide tables assigning taxa to guilds. Chapter 4 delineates the environments occupied by and provided by phytotelmata, physical and chemical.

Chapters 5-14, grouped into 4 sections Methods and theories, Patterns in phytotelm food webs, Processes structuring food webs, and Synthesis, are the core of the book. The study of food webs is a structured method of depiction by diagram and analysis of trophic relationships of organisms: what feeds on what, and how communities (if such occurs) are structured by predation. It covers the facets that other authors have studied under other rubrics: species richness, seasonality, invasion, succession, habitat-partitioning, competition, and population dynamics. Food webs in temperate-region phytotelmata are found to have two levels, but in the tropics may have three or even four levels. These chapters also provide hypotheses and predictions. Kitching finds evidence (p. 267) of the potentially central role of predators in all five principal classes of phytotelmata (treeholes, bromeliads, bamboo internodes, leaf axils of other plants, and pitchers). This, however, is not affirmation that predation is in all instances the central controlling factor, for in some instances in my experience the central role may be taken by rainfall, and rainfall-induced nutrient influx, and then the central role is of scramble competition.

An annex (p. 301-384) is a bestiary. Phylum by phylum, from Platyhelminthes to Chordata, it gives a brief account of each major taxon, for some at the level of phylum, for some arthropods down to the level of family. It provides a classification, down to the level of species, of some of the taxa (Annelida, Crustacea, Odonata, Culicidae, Chironomidae, Ceratopogonidae, Psychodidae, Phoridae, Syrphidae, Coleoptera, Acari, and frogs) in tables. This classification was a brave undertaking because it seems to be the first to attempt a listing for the fauna of all phytotelmata. To satisfy an arthropod systematist it would require two things that were not done: first, provision of author (describer) name(s) for every species; second, not just a listing of the species as reported from phytotelmata, but also integration of all of those species concepts with all of the subsequent taxonomic literature (not just the literature on phytotelmata) on the taxa involved. However, it gives references to the literature and thus provides much of the spadework by which a

much later compiler can complete it. It will of course not be complete for many decades because so much is yet unrecorded.

Would I buy this book? Yes, absolutely. Not just because there is none better at explaining how phytotelm communities interact (and I happen to be interested in phytotelmata). But also because phytotelmata are extraordinarily manipulable little ecosystems that lend themselves to experimentation and are helping to answer broader questions in ecology. And, I find the book to be easy to read: it has very few jargon expressions and very few typographical errors. It is illustrated by numerous black and white figures of adequate quality, and six black and white prints (one of which, in its original color, adorns the front cover) of *Nepenthes* pitcher plants.

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References Cited

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