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Book Reviews

The Lives of Seaweeds: A Natural History of Our Planet's Seaweeds and Other Algae

Julie A. Phillips
Princeton University Press, Princeton, New Jersey, 2023, 288 pages, hardback with many colour plates and diagrams. ISBN 978069122855-6.
£30

If you are someone who found algae boring as a student and were much more attracted to flowering plants, be prepared to be surprised by this book. It is written by someone who clearly knows about the traditional botanical aspects of seaweeds but who works with algae as an environmental consultant and who brings the understanding of seaweeds to a wider audience. This is so important at the present time because of renewed interest in algae ranging from their role with blue carbon to their exploitation for food and chemicals.

Seaweeds are macroscopic marine algae but they are not the only algae in the sea and, despite the book's title, it does also contain a lot of information about other algal groups such as diatoms and dinoflagellates.

The presentation of the book makes it attractive to look through. There is a wealth of good quality, large, colour plates. These include 40 species of seaweed and other types of algae. Some are shown in macroscopic and some in microscopic form. There are also well-drawn, coloured and greyscale diagrams to explain, as the title says, the lives of seaweeds. This includes internal structure, growth patterns and the great diversity of life histories where quite dissimilar forms, once regarded as separate species, are now known to be different generations in the life of a single species.

The author explains what algae and seaweeds are and how they differ from other major groups of organisms without getting embroiled in what, to some specialists, is now a complex area based on molecular evidence. The evolutionary history of algae from 3.5 billion years ago is covered with the evolution of eukaryotic and prokaryotic cells and the early dominance of Cyanobacteria which, even in this reviewer's lifetime, had been called the blue-green algae. A great diversity of algal lines has now evolved in which seaweeds are only a small part in terms of the total number of species. While this is so, the seaweeds include the largest algae, some of the largest plant-like forms, such as the giant kelps of California, and are the algae probably most frequently seen and familiar to many people.

Along with attractive colour plates to explain the range of seaweed diversity and other algal forms, the book includes simple-to-understand but technically correct aspects of the lives of algae such as growth patterns, cell-types, life histories, the different generations, reproductive processes and resistant stages, and their ecology in various habitat types. This includes mudflats, rocky seashores, subtidal kelp forests and intertidal rock pools, with particular topics such as the Sargasso Sea, bioluminescence, algal blooms and climate change.

Following this good introduction to algal diversity and the place of seaweeds in this, which runs to over 200 pages, the book then devotes more than 50 pages to Algae and Humans. The main emphasis is on seaweeds but all types of algae are considered. This part of the book looks at the use of seaweeds for food, phycocolloids, pharmaceutical products and biofuels. Seaweed aquaculture is covered. This is not a new area worldwide, but it is particularly taking off in Britain now, so it is good that this area is covered. The downside of algae is also tackled by coverage of algal blooms.

At the end of the book there are some very useful pages which include a glossary of specialist terms and a simple, valuable table which summarises the differences between the eleven major algal groups in chemical, cellular and fine-structural features.

This is a very well-produced book which can give a good scientific explanation of seaweeds and other algae to the non-specialist in a beautifully illustrated and easy-to-read format. While the book has many exquisite colour plates of various seaweeds, they are a world-wide selection, so it is not an identification book for use with shore samples in any particular area. Nevertheless, it gives you much of the background information to seaweeds that the identification guides do not cover, and it makes it easier to use these guides.

Martin Wilkinson

Fossils: The Essential Guide

Paul D. Taylor
Natural History Museum, London, 2025. 256 pages, hardback illustrated. ISBN 9780565095635.
£20

Is there life on Mars? Perhaps not the correct question to ask when reviewing a book on terrestrial fossils. As Paul Taylor discusses in his preface, perhaps the question should be "Was there life on Mars and what should we expect it to look like?" To answer this question, looking closely at the earliest life-forms on Earth may provide some direction. The book does not stop with the primitive life-forms, though, and returns from Mars to the relative safety of our own planet. It continues by introducing all the major groups that are likely to be found as fossils. From bacteria to dinosaurs, Taylor takes us on a journey through time, looking at trilobites, ammonites, snails and bivalves, plants, sea urchins and fishes, amphibians, reptiles, birds and mammals and what they left behind - he even devotes some space to his favourite invertebrates – the Bryozoa.

In his first chapter, Taylor covers all the basics of palaeontology, from how fossils form, how they get their names, what rocks they are found in, plate tectonics, environmental changes, extinctions, how old they are, as well as a little on how likely organisms and their traces are to become fossils. This introduces the reader to what is going to happen next. Without it, fossils are just dead organisms in rocks – with it, fossils become powerful entities that teach us about our planet's faunal, floral, environmental, ecological and tectonic histories.

It is the job of every palaeontologist to reveal the history of life and its evolution through its fossil evidence. Fossils are a vital record of evolutionary change over the vastness of geological time. Our world is restless, and life on our fragile planet always has been at risk. It has survived through periods of warmer and colder climates, sea-level changes, acidification of the seas, methane degassing, environmental catastrophes as well as extraterrestrial impacts – some of these issues are currently crippling climate-sensitive societies. All these deep-time environmental changes can be inferred from the sediments and the fossils held within. This is why Taylor considers fossils key to developing contextual awareness as well as pertinent tools for introducing science to present and future generations.

One of the big issues with palaeontologists, as with many other scientists, is that it is impossible to have 100% agreement on anything. In palaeontology, understanding exactly when a fossil is a fossil, is just one niggling issue that has confounded many eminent committees. How much change must an organism have to endure through taphonomy (the decay processes involved in fossilisation) before it can be elevated to the dizzying heights of being classified as a fossil? Taylor simply places a year on the boundary – 10,000 years. Older than 10,000 years – a fossil; under 10,000 years – a sub-fossil. Is it that simple? Perhaps it should be. This is also the approximate boundary between the Pleistocene and the Holocene (which is about 11,700 years ago). This fossil/sub-fossil boundary may have to change in the future though as scientists are now able to revive nematodes from 46,000-year-old permafrost… and viruses from even further back – technically living sub-fossils. However, for the time being, this is as good a date as any.

The use of binomial latinised nomenclature for fossils is perhaps less controversial in the palaeontological literature than it seems to be becoming in the biological realm. There are few colloquial names for fossils unless they were of medicinal or decorative use. Examples include the "Dudley Locust" (a colloquial term for the trilobite *Calymene blumenbachii* from Dudley) or "bot-stones" (a term used on the Isle of Skye for belemnites that were used for medicinal purposes over 320 years ago). I agree with Taylor on this. Why artificially develop local indigenous names for fossils where none previously existed? If they did, however, they should be incorporated into the process of naming fossils wherever possible.

Personally, I would have preferred better coverage of some of the more significant discoveries of the last few decades, such as the tetrapods *Pederpes* from Dumbarton or "Ribbo" from the Scottish Borders, which have closed what had become known as "Romer's Gap" for over 70 years (the 15-million-year gap in our knowledge that covers terrestrialisation by vertebrates during the Early Carboniferous). Other fossils I would have included are the exceptionally rare and well preserved: "Bearsden Shark"; the shrimp *Tealliocaris weegie* with soft-tissue preservation; "Conan the Conodont" from Edinburgh; the proto-amniote *Westlothiana* from Bathgate; or the lovely Middle Jurassic pterosaur from Skye called *Dearc sgiathanach*. Of course, these all being Scottish, I may be accused of nationalist bias.

Although this is not a book to help with the identification of species for collectors, it is a book that elevates fossils to storytellers in order to share their own narrative. Those of us interested in listening to what fossils have to say will be delighted with this book.

It is exceptionally well illustrated with exemplary photographs and artworks supplementing and supporting the written words that tell the story of life on Earth. The reader is left astounded by the beauty and elegance of the past lives held hostage in the rocks as their story is unveiled by a professional and passionate palaeontologist.

Neil D.L. Clark

The Lives of Frogs: A Natural History

Jim Labisco & Richard Griffiths
Princeton University Press, Princeton, New Jersey, 2025. 288 pages, hardback with many colour photographs and figures. ISBN 9780691255019.
£30

Princeton University Press is well-known for its series of lavishly-illustrated WildGuides to the biodiversity of Britain and Europe. This book is not in that series, but is a similarly beautiful "introduction" to and "celebration" of the diversity and lives of frogs. The authors are Jim Labisco, a young lecturer at University College London and not-so-young Richard Griffiths, emeritus professor at the University of Kent and one of the U.K.'s most eminent herpetologists. In addition, the production team at Princeton University Press, acknowledged at the end, are responsible for much of the arrangement of the book, and such decisions as the use of American rather than British English, and the inclusion of imperial as well as metric measures.

The book is a 288-page hardback and listed at £30. What do you get for your money? First, a lot of beautiful colour photographs of frogs. As an example, the 12-page introductory chapter is more than 50% illustrations, including three full-page photographs. Following the introduction, which summarises frog diversity and tackles the age-old question (what is the difference between frogs and toads?), nine chapters cover different aspects of frog biology: evolutionary origins; life on land and in freshwater; communication and

reproduction; development and parental care; activity; nutrition; defences against predators and disease; population fluctuations; and, finally, the frog population decline crisis and what is being done about it. At the end of each chapter, there is a set of five species accounts, with a full-page photograph and a page of text describing the species, its distribution and key features. The species are chosen to illustrate some aspect of the preceding chapter. For example, the Lesser Antillean frog *Eleutherodactylus johnstonei*, which likely originated on the Caribbean island of Montserrat and has now spread throughout the region (largely by anthropogenic means), is used to illustrate the chapter on frog movements. I have had some involvement in documenting its spread in Trinidad and Tobago. Each account includes a world map in grey, showing the frog's distribution in green (oddly missing for *E. johnstonei*). Following the topic chapters, there's a glossary defining some technical terms, a list of resources and an index.

The book has high production standards. Each photograph has a clear legend including an arrow pointing to the illustration (rather than a figure number). In addition to photographs, there are many other graphics: I particularly liked the two-page illustration of the frogs inhabiting an Amazonian floating meadow (pp. 56-7). Sources of original illustrations are given in the end acknowledgements section, but in a very concentrated format: I would personally have preferred them in the figure legends. Frog names are mostly given as capitalised common names and italicised scientific names, although scientific names are omitted from some of the graphics. I found very few typographical errors. One minor problem: the text includes frequent cross-references to pages where more information on a topic can be found; some of these are to chapter numbers, but the contents page does not number the chapters, and you need to work out for yourself that the introductory chapter is not counted as chapter one.

Who is the book aimed at? An "introduction" might seem to be for people who do not already know much about frogs, but who would like to find out, or for people who know about their local frogs, but not about any others. The book's coverage is very wide-ranging, quite detailed, pretty up-to-date and mostly uses non-technical language, so there is something here even for people who know quite a lot already. For example, the truly viviparous African frog *Nimbaphrynoides occidentalis* was new to me, as were the Brazilian frogs whose bony spines on the skull allow them to inject toxins into attackers, making them the only truly venomous frogs. I do, however, have some grumbles and reservations.

The description of North American frogs that survive extremely cold winters claims that their blood contains anti-freeze proteins. The research I have read denies this: rather, these frogs tolerate freezing by greatly increasing circulating levels of glucose which acts as a cryoprotectant, preventing damage to frozen cells.

About frogs that develop directly to froglets, without a tadpole stage in water, we read that "tadpoles complete their development within the egg capsule and hatch as fully metamorphosed froglets". There is a wide range of direct developing frogs but, at least in those I have looked at, it is misleading to think of the early stages as tadpoles, because they are so highly modified, with the tail bud developing into a hugely expanded respiratory organ.

There are some examples of what I call inappropriate "speciesist" writing, where a trait is said to have evolved in a particular species, but where it is actually characteristic of a whole group, genus or family. Examples are the occurrence of disc-shaped suckers in torrent-dwelling tadpoles (which is a feature of the multi-species genus *Amolops*, not of a single species); and the lack of a tongue in the Surinam Toad is, again, a feature of pipids in general.

It is claimed that cane toads locate tungara frogs (as prey) by detecting their calls. I would like to see the evidence for this. Michael Ryan's work showed that predatory bats locate tungara frogs by their calls, and that the frogs simplify their calls when bats are present, increasing their survival chances, but at the cost of reducing mating opportunities, because females prefer the complex calls.

I also felt that there are some odd omissions or example choices. Variable tadpole morphology in response to environmental factors (polyphenism) is exemplified by Mallorcan midwife toads, but not by David Pfennig's stunning description of the carnivore/omnivore morph system in spadefoot toads. Salt tolerance is mentioned in the American green treefrog, but the best known and most complete example of this - the crab-eating frog *Fejervarya cancrivora* - is surprisingly omitted. Similarly, there is a brief mention of one treefrog species reducing water loss by means of mucus skin secretions, but the fascinating skin-wiping behaviour - spreading a waxy secretion over the skin in phyllomedusine frogs - is absent. The farming of frogs as a source of human food is briefly mentioned, but the conditions under which these frogs live and are slaughtered is not discussed: the welfare of frogs remains a little-considered subject.

Next, a frustration. The text omits citations to sources, so how can you follow up on points of interest? The book list is a good resource (although, outrageously, the seminal book on tadpoles by McDiarmid and Altig (1999), is omitted), but only two of the books were published after 2015. You can find some of the examples in the "selected" list of research papers but, without clear citations, it is a labour, and for the general reader the book is aimed at, and who is not used to working through research papers, quite intimidating.

The final chapter appropriately covers the worldwide decline in amphibian populations, reviewing causes (I feel that herpetologists have yet to factor in the likely links with the parallel declines in insect populations) and

progress towards solutions, both small-scale community-based work such as Toads on Roads campaigns, and large-scale efforts such as the Amphibian Ark, which focuses on the captive breeding of threatened species. I was surprised not to see any comment on such efforts to save Darwin's frog and the mountain chicken (both are covered under the parental care section, but with no comment on their dire state in the wild). The list of organisations at the end includes many of those involved in frog conservation, but oddly omits the charity Froglife (responsible for Toads on Roads in the U.K.) and Save the Frogs.

In conclusion, despite the reservations listed above, I thoroughly recommend this book. It truly is a celebration of frog diversity, and I endorse the message at the start that the main motivation behind conservation efforts should not be based on notions of services frogs may provide to us, but simply because they are wonderful.

REFERENCE

McDiarmid, R.W. & Altig, R. (1999). *Tadpoles: The Biology of Anuran Larvae*. University of Chicago Press, Chicago.

Roger Downie

Birds at Rest: The Behaviour and Ecology of Avian Sleep

Roger Pasquier
Princeton University Press, Princeton, New Jersey, 2025. 339 pages, hardback. ISBN 0691259968.
£30

Roger Pasquier is an eminent American ornithologist who has worked for The Audubon Society, WWF-US, Wildlife International and other natural history organisations. His previous publications include *Birds in Winter*, which was reviewed in *The Glasgow Naturalist* 27(2).

This present book includes considerations of "rest" (defined by others as wakeful immobility) as well as genuine "sleep". The very first chapter "Why do birds sleep?" is much broader than its title suggests, ranging across the whole of the animal kingdom and posing profound biological questions. At first sight, sleep appears utterly counter-productive; it makes you vulnerable to predation, and it prevents you doing other useful things, such as feeding. The argument that moving around at night might make you even more vulnerable to predation, and that other activities become less efficient in the dark, neglects the fact that both diurnal and nocturnal species "sleep" during their inactive period rather than simply "doing nothing". Sleep must be extremely important since every animal group with a nervous system appears to do it, and "lost sleep" often has to be made up later. Even though it appears essential, the benefits of sleep are difficult to pin down but may include the elimination of inactive metabolites, the repair of tissue damage, the boosting of the immune system, the consolidation of memory and the re-connection of synapses within the brain (see Anafi *et al.*, 2019). This is not to say that normal sleep patterns cannot be over-ridden; pectoral sandpipers (*Calidris melanotos*) show a huge reduction in sleep duration during the mating season, while white-crowned sparrows (*Zonotrichia leucophrys*) show a reduction during migration (see Joiner, 2016).

Like mammals, birds exhibit two forms of sleep – slow-wave sleep (SWS) and rapid eye movement (REM) sleep which is deeper. However, avian specialisms can be extraordinary. The chinstrap penguin (*Pygoscelis antarticus*) is said to have 10,000 sleep episodes a day - each of a few seconds but totalling 11 hours - and few birds show more than a few minutes' continuous sleep. Many birds also exhibit uni-hemispheric sleep where one hemisphere of the brain is asleep and the other is not; even more extraordinarily, one eye can be left open communicating with the "working" hemisphere which appears to show an activity state intermediate between SWS and full wakefulness.

The book consists of ten nugget-filled chapters whose topics include specialised roost sites, flock roosts, social behaviour, roosting times, travel to and from roost sites, and the effects of humans. Chapter 3 "Where to roost?" makes the point that roosting sites have to be actively chosen, sometimes on a daily basis - perhaps because the birds are on migration, perhaps because of diurnally changing factors such as tidal movements. Nesting sites may be chosen because of the surrounding abundance of food for the young, but successful roosting often requires greater concealment; thus, at least a third of male wood thrushes (*Hylocichla mustelina*) abandon their incubating female partners at night to hide in denser vegetation elsewhere. Conversely, it is difficult to conceive a closer linkage between feeding and roosting sites than in the insectivorous oxpeckers (*Buphagus* species), where the birds sleep on the back of the large ungulates whose irritants they consume during the day.

Communal roosting can provide further insurance against predation, but it still may not prevent up to 20% of a flock being eaten over a lengthy period of occupancy and it often needs to be allied to other deterrents. Owl pellet surveys can be instructive in highlighting this. Thus, where red-billed quelea (*Quelea quelea*) roost among reeds and grasses in West Africa, the birds make up the bulk of the skulls in regurgitated barn owl (*Tyto alba*) pellets; but if the quelea move into thorn trees which the owls dislike, the pellets only contain the skulls of small mammals. Burrows in earth and holes in trees would seem to be good roost sites, but they become death traps once snakes or other predators discover them.

All contemporary natural history books must end with a chapter on human impact. This one is quite short and, while there must undoubtedly be some serious effects, the examples given here seem mostly slight. Artificial light levels wake some urban insectivorous birds up early, but they do not stay up late – suggesting they have eaten their fill long before closing time; indeed, where

that same light attracts insects, the birds may do better. Seed-eaters are not affected. Some of the more injurious effects on roosting urban birds come from our companions, the cats and rats. Artificial light may also bring breeding forwards, but often by a meagre one or two days.

This is not a mainstream ornithological topic but a fascinating one nevertheless – and unduly neglected. As you will gather from this review, it is full of fascinating examples which kindle the reader's interest. It is well-written and the examples chosen are from all round the globe. There are no photographs, but it is illustrated by a small number of charming pictures by Margaret la Farge. It is supported by nearly 30 pages of references.

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Anafi, R.C., Kayser, M.S. & Raizen, D.M. (2019). Exploring phylogeny to find the function of sleep. *Nature Neuroscience* 20, 109-116. https://doi.org/10.1038/s41583-018-0098-9

Joiner, W.J. (2016). Unravelling the evolutionary determinants of sleep. *Current Biology* 26, R1073-87. https://doi.org/10.1016/j.cub.2016.08.068

Tony Payne

Gleaners of Nature: 150 Years of the Dundee Naturalists' Society

Jim Cook, Colin McLeod & Anne Reid
Abertay Historical Society and Dundee Naturalists' Society, 2024. 157 pages, paperback. ISBN 97809000019661.
£7.50

This book has been a while in the making, since it was originally intended to celebrate the 125th anniversary of the Dundee Naturalists' Society (DNS), but the result is an intriguing history. The tale is redolent of the fortunes of so many local groupings of enthusiasts over long periods of time, with false starts, metamorphoses, ebbs, falls, great successes and even disbandments. The text is split into four main chapters of varying lengths which reflect chronological stages of this history.

The short first section "Origins" deals with the plethora of groups which arose periodically in Dundee from about 1708 until 1874 when the DNS was formed. These groups often coalesced around one or two men (there are few women at this stage); they rarely lasted long but they always gave themselves magnificent names such as the "Dundee Speculative Society" and the "Artificial and Scientific Society". In 1828, one of these groups called themselves "The Gleaners of Nature" from which this book's title is derived. Several features come through repeatedly. Expertise in natural history was classless - a widespread finding (see Allen,1976). At the time of its founding, the leader of the Gleaners was an apprentice umbrella-maker and many of these ad hoc societies formed around linen workers (some of whom found they could balance books on their looms) as well as gardeners, bootmakers or tailors. Nevertheless, members of the group often paid joining fees and annual fees far higher than other associations – and well out of proportion to their weekly wages. The definition of natural history was more akin to "natural science" than we would recognise today and would certainly include meteorology, geology, mineralogy and astronomy. Such early associations inevitably brought forth "characters", perhaps none so celebrated as the surgeon Patrick Blair who dissected an elephant that had died near Broughty Ferry; Blair later came to ruin through his support for the Old Pretender in 1715.

The second section "Heyday" narrates the flowering of the Society from its inception in 1874 to its temporary disappearance in the early 1900s. The founding fathers included an optician, a metalworker who made his own microscope, the local YMCA and a man who had a private astronomical observatory. Again, the definition of natural history is strained by the fevered pace of discovery and innovation in the Victorian Age; nobody could resist lectures and discussions on electric lamps, luminous paint, telephones and "the air quality in dwellings and schools", alongside more conventional biological topics such as the anatomy of the basking shark, snails on plants, or birds of the Tay. Public lectures gained a good audience when they were free but were poorly attended when charged for (it was the cheaper seats that were left vacant) and, in general, the Society struggled to make a profit from any attempt to gain a wider exposure in the town. Nevertheless, perhaps the most intriguing part of this section is an account of several elaborate *conversazioni* (containing short talks, musical interludes, demonstrations, exhibits, food and drink), which were held in large public buildings of the time and often attracted hundreds. The Society also thrived by virtue of its alliance with the new University College of Dundee and its programme of field-trips (though dredging at sea was more popular than the usual terrestrial activities). For reasons which are unclear, it all came to a sad and precipitate decline at the turn of the century.

The third and fourth parts "Revival and Wartime" and "Modern Times" are to some extent recapitulations of one another and demonstrate the inevitable cyclicity over time which is a feature of most clubs and societies. "Revival" begins with the reformation of the DNS in 1911, after a hiatus of nearly ten years, to coincide with the British Association's visit to Dundee. The DNS had to take out Zeppelin-insurance during the Great War but continued to operate throughout both upheavals. However, by the 1960s, interest was beginning to wane again until the Society decided in 1972 to fend off a possible takeover by a local museum group. Luckily, this period coincided with the rise in eco-awareness by the public and media, and the increased success of DNS mirrors, on a smaller scale, the expansion of larger national groupings such as RSPB.

Many practical questions arose during this period of 150 years. Should you attempt to organise both talks (indoors at a fixed venue) and field trips (outdoors at a variety of locations) – remembering that the period runs from the horse and cart at one end, through the growth

(and subsequent demise) of both the railways and bus routes, to the current era of private transport? How much should you charge for membership? Should you produce a journal or newsletter (the earliest ones needed to be hand-written)? Should you establish "sections" within the society? Should you try to amass a collection of specimens and/or a library? How do you deal with changes of venue? Do you gain benefit from being allied to a local university or college? How do you interact with other local organisations? Some of these issues cropped up repeatedly and all are still highly relevant today.

The book ends with an appendix of short biographical notes of important persons from DNS history. There is a centre section of nearly 40 illustrations and a copious reference section to each chapter. This is a well-written and very worthwhile read.

REFERENCE

Allen, D.E. (1976). *The Naturalist in Britain: A Social History*. Allen Lane, London.

Tony Payne

The Lives of Octopuses and Their Relatives. A Natural History of Cephalopods

Danna Staaf
Princeton University Press, Princeton, New Jersey, 2023. 288 pages, hardback with many colour photographs. ISBN 9780691244303.
£30.00

This book is one of a series of "Lives of" volumes recently published by Princeton University Press covering the natural history of various ecological groups including frogs, bats, snakes, spiders, bees, lichens, butterflies, seaweeds, sharks, viruses, beetles, fungi, and moths. Like the other volumes, *The Lives of Octopuses and Their Relatives* is a hefty tome of nearly 300 pages, packed full of fascinating biological and ecological information and illustrated with numerous top quality colour photographs, many of which are full page size. The text is set at a level accessible to the general naturalist but bridging into the more scientific world of the specialist study of cephalopods.

There is a short introduction followed by a section explaining what a cephalopod is – they include many variants of octopuses, cirrate octopuses, squids, vampire squids, cuttlefish and nautiluses. Cephalopods are "lower" animals but with many advanced traits including intelligence and complex behaviour such as hunting and social signalling. They also have unusual morphologies - clawed suckers, beaks, bioluminescent photophores and amazing instantaneous mimicry. They show peculiar reproductive strategies, many being very short-lived with mass spawning events followed by mass mortalities. They include the largest known invertebrates such as the giant squid and colossal squid. They have a very long evolutionary history (with many spectacular shelled fossil species) which in some respects mirrors that of fish, although living cephalopods are far less speciose. It is not surprising that they have captured our imagination and this book explores the extant cephalopod world in considerable detail.

Following the introduction are sections on the cephalopods from seven different broad habitats: Beaches, Tide Pools, Sandflats and Mudflats; Seagrass Beds, Kelp Forests, and Rocky Reefs; Coral Reefs; Open Ocean; Midwater; Deep Sea; Antarctica and the Arctic, and finally a useful glossary and resource bibliography. The habitat sections are each prefaced by several pages describing the habitat features and the challenges they present to cephalopods. Hence readers are presented with a lot of oceanographic and marine biological knowledge which helps them fully appreciate how a diverse array of cephalopods has evolved to inhabit the entire marine realm. For each broad habitat around half a dozen cephalopod species are selected as representatives. Each of these receives a two-page spread – the first page describing the biology of the species and showing its world distribution, highlighting any peculiar features of its morphology or life history and the second page a beautiful colour photograph of a live specimen. The distribution maps are the only minor flaw I have noticed in this otherwise splendid volume. The maps all show the entire world in miniature so colour shading for those species of limited distribution is very small. There are also some inaccuracies – the Atlantic longarm octopus and the North Atlantic spoonarm octopus are both shown as occurring in the shelf seas around Britain, which is not the case (see Laptikhovsky & Ouréns, 2017). However, let us put the minor map errors to one side because there is so much about this volume that is excellent.

The cephalopods are a rather understudied group of marine organisms compared with their fishy relatives. This volume attempts to encompass the cephalopods of all the world's oceans, from shelf waters to open oceans and from the tropics to the poles. Around 50 species in total are selected to show-case the morphological and behavioural diversity of cephalopods, which currently number around 1,000 described species.

The Beaches, Tide Pools, Sandflats and Mudflats section briefly describes tides and their impacts; intertidal habitats; life in air and water; burying and burrowing behaviour; and the use of glue and suckers by cephalopods. Species highlighted include the tool-using coconut octopus which uses coconut halves to hide in – poking out two legs to walk along the seabed. The sand octopus is the only species to make a true burrow in sediment, meanwhile the wunderpus octopus, whose scientific name is *Wunderpus photogenicus*, has a striking (but fixed) banded colouration pattern resembling a poisonous sea krait snake or lion fish, a perfect example of Batesian mimicry. Surprisingly the world-famous mimic octopus, with its more dynamic mimicry of flounder, sea snakes etc. only gets a passing mention here. The southern bobtail squid has a light organ on its underside, powered by symbiotic bacteria, which provides countershading (against moonlight) at night and the southern bottletail squid produces copious

slime to deter predators in the same manner as the famous hagfish.

The Seagrass, Kelp Forest, and Rocky Reef section describes: the origin of algae and algae ecosystems; the challenges of living in estuaries – only a very few cephalopods manage to cope with brackish waters; cephalopod gatherings to mate and spawn; and their targeting by human fisheries. Species highlighted include the southern pygmy squid, one of the smallest cephalopods, which glues itself to seagrass fronds – the females are 3 cm long and the males only 1.5 cm. Here too is the Pacific red octopus – 10 cm long but with a painful venomous bite and the Maori octopus nearly 1m long. The common Sydney octopus forms multi-generational congregations, now nicknamed "Octopolis", where much social squabbling occurs and there is mention of a recently described small Brazilian octopus whose typical hidey-hole is discarded beer cans!

The Coral Reef section describes the anatomy of corals; coral reproduction; algal partners of coral and coral bleaching. Coral reefs are discussed as evolutionary hotbeds including the famous Coral Triangle in the Indo-Pacific. Coral reefs are home, among others, to the night octopus – a nocturnal hunter of other octopuses; the poison ocellate octopus which drills mollusc shells to insert deadly venom; and the bellybutton nautilus, a prehistoric relic with a spiral shell and suckerless tentacles, which migrates daily from deep water to feed nearer the surface at night.

The Open Ocean plankton communities are exploited by pelagic cephalopods including both larval and adult stages. Some, like Humboldt squid, are large active hunters, other cephalopods lead a more sedate "jellyfish life-style" plucking zooplankton from the water column. Many midwater cephalopods undergo diel migration - coming to the surface at night to feed or hunt or spawn. They are heavily targeting by human fisheries. Post spawning cephalopods die and float and are a major food source for seabirds. Many cephalopods change depths as they grow – ontogenetic migration. The Open Ocean and Midwater habitats host a huge variety of octopus and squid including knobbed argonauts which produce an exterior protective shell; and the football octopus which has a swim-bladder, the female is up to 80 cm long, but the male is only about a tenth her size and with a large detachable reproductive arm. Here too we find purple-back flying squid, 2 m long, which can leap like a flying fish and large glass squid up to 2.7 m, both species with light producing photophores. The famous giant squid, with a total length of 13 m also lives here, hunted by sperm whales. It was first filmed alive in 2006. Just a little shorter, but heavier, is the colossal squid, without arm suckers but with strong swivel hooks. Most of the squid species feed on fish or crustaceans but the vampire squid survives on particulates from "marine snow".

Finally, the Deep Sea and the Antarctic/Arctic regions are described including global circulatory systems and the growth and impacts of ice-caps. A short history of both deep-sea and polar explorations is provided along with the discovery of undersea volcanoes and the spectacular deep-sea vent communities. The importance of sinking food such as "marine snow" and whale falls is discussed as well as visual communication in the dark via photophores. Deep and cold waters present many challenges and there is some interesting speculation on a polar evolutionary origin of cephalopods. Among the inhabitants are the Dumbo octopus with its webbed tentacles and flapping "ear" fins, which is the deepest known species from 7 km depth. In the dark zone there is the blind cirrate octopus with vestigial lens-less eyes covered in skin. It has umbrella arms and is possibly a plankton feeder. The deep-sea vent octopus crawls around the hot vents catching crabs and shrimps. It has eyes but they do not respond to light. The female seven-arm octopus is 4 m long but the males are only 20 cm long. Strangely, a broken arm of this poorly known deep-sea species washed up on Scottish shores in 2025! The Antarctic glass squid feeds on krill but is itself food for albatrosses and elephant seals. The Arctic octopus, the first cirrate octopus to be described, feeds mostly on worms. It lays hard-shelled eggs which take 32 months to hatch. The North Atlantic spoonarm octopus lives at depths over 400 m. The have an unusually long lifespan of 3-6 years and have been successfully bred in a laboratory, brooding their eggs for over a year.

Just a flavour of the enormous variety of lifestyles, and astounding adaptions of the cephalopods has been indicated in this review. You really must read this volume to fully appreciate the wondrous morphological and behavioural plasticity of cephalopods. Although I am already a "well-informed" marine biologist I found this volume absolutely fascinating, crammed full of facts and insights into an alternative "zootropolis of alien creatures" from our shallow coastal seas to the barely explored parts of our oceans. These, often bizarre, organisms are of great interest to evolutionary biologists and deserve to be much better known by natural historians.

REFERENCE

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On the Trail of Sloths

Desmond Philip Gilmore, Carlos Peres da Costa and Denia Fittipaldi Duerte.
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Sloths may appear harmless, and even cuddly, but they often receive a bad press. Oliver Goldsmith, writing in 1825, was unkind to them "One of the meanest and ill-famed of creatures that chews the cud" while a 20th century evaluation was that "they have no right to be living on earth, but they would be fitting inhabitants of

Mars where the year is over 1,000 days long". Their very name is one of the deadly sins. Nevertheless, they represent a considerable proportion of the mammalian biomass of south and central American forests on both sides of the Andes, and they are remarkable in their adaptations to their chosen lifestyle.

This book by the late Des Gilmore from Physiology at the University of Glasgow and his colleagues at the University of Pernambuco, Recife, Brazil covers every angle of sloth biology. Taxonomically, sloths are lumped in with other new world curiosities – the armadillos and anteaters – and this Superorder was, until recently, termed the Edentata. This is misleading as only the anteaters lack teeth completely while the rest have premolars and molars; in sloths, there are no milk teeth and the adult teeth (which lack enamel) grow throughout life, being kept in check by grinding. The Superorder is now known as the Xenarthra (meaning "strange joints") which refers to the unusual articulation of the vertebrae. In fact, so much of sloth structure is strange, with one peculiarity being the number of cervical (neck) vertebrae. Every one of the 6,500-7,000 mammals alive today has seven cervical vertebrae except for manatees and sloths. However, the two-toed sloths have gone in for a reduction, while the three-toed species have elected for an increase. While the ability of sloths to rotate their heads while hanging upside down is remarkable, it appears to be the shape of the vertebrae, rather than their number, that matters. The reproductive system is primitive; males have internal testes, while females have no clear separation between the vagina and uterus. The main vein of the trunk (the vena cava) is paired in sloths, a perpetuation of the embryonic condition which is lost in other mammals.

Historically, sloths were found throughout north and south America (and even the Caribbean islands) and included both terrestrial and arboreal species. Some ground sloths weighed up to four tons and this group became extinct only within semi-historical times (10,000 years ago), even continuing to feature in some tribal oral traditions. The two living groups - the two-toed and three-toed sloths - diverged from one another 30-40 million years ago and are only distantly related. A dramatic case of convergent evolution?

This book explicitly builds on earlier major reviews and contains two dozen chapters. Some deal with specific body systems; the skeleton; the muscles; gut and feeding; lungs and respiration; liver, spleen and kidneys; heart and blood pressure; brain, spinal cord, special senses. Others deal with evolution; distribution and ecology; activity patterns; breeding; cytogenetics; thermoregulation. Finally, there are chapters on sloth diseases, parasites and commensals, and the problems of keeping sloths in captivity.

Probably the best-known attribute of sloths (they are very slow) explains many of their idiosyncrasies. Food usually takes a week to pass along the alimentary system and can take much longer on occasion. As the sloth normally descends to ground level to defaecate and urinate, it does so only every few days; this means that the stomach and bladder together can periodically constitute up to a third of body weight. Moreover, as the leaves which make up its diet are so poor a source of nutrition (fibre, but hardly any protein), a sloth could theoretically starve to death with a full stomach. The resting metabolic rate is so low that a sloth can cease to breathe for 20 minutes and still be revived.

The book forms a handy, compact review of sloths and their world. The writing is of a distinctly scientific tone, but clear and understandable, and editorial assistance (by Dr. John Shaw Dunn) is highlighted in the acknowledgements. There are few illustrations, which is a pity and may perhaps be due to the untimely death of the lead author. For compensation, the bibliography runs to an astonishing 40 pages.

Tony Payne