

The Canadian Field-Naturalist

Book Reviews

Book Review Editor's Note: *The Canadian Field-Naturalist* is a peer-reviewed scientific journal publishing papers on ecology, behaviour, taxonomy, conservation, and other topics relevant to Canadian natural history. In line with this mandate, we review books with a Canadian connection, including those on any species (native or non-native) that inhabits Canada, as well as books covering topics of global relevance, including climate change, biodiversity, species extinction, habitat loss, evolution, and field research experiences.

Currency Codes: CAD Canadian Dollars, USD United States Dollars, EUR Euros, AUD Australian Dollars, GBP British Pounds.

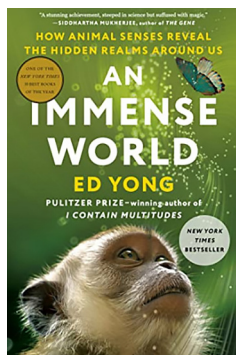
BIOLOGY

An Immense World: How Animal Senses Reveal the Hidden Realms Around Us

By Ed Yong. 2022. Random House. 464 pages, 38.00 CAD, Hardcover, 25.95 CAD, Paper, 14.99 CAD, E-book.

Ed Yong, an award-winning science journalist, begins *An Immense World* with an imaginary story about a collection of animals in a school gym. Unlike fictional classics, where animals share a common language and sensory experience, these animals—an elephant, mouse, robin, owl, bat, rattlesnake, spider, mosquito, bumble bee, and human—are only able to experience a small sliver of the immense worlds the others inhabit. Yong refers to each small sliver as an animal's Umwelt, a term that appears frequently throughout the book. Umwelt—coined by zoologist Jakob von Uexküll—is a species' unique perceptual world. In the book, Yong describes a fascinating scope of animal sensory diversity, but he does not stop there. He uses these descriptions to illustrate the importance of overcoming human sensory bias; in understanding an animal's Umwelt, we can improve conservation and recovery efforts. Yong's use of accessible language to explain his ecological insights will appeal to general readers and professional researchers.

The book explores 11 senses in as many chapters. The first of these covers senses familiar to the human Umwelt: smell, taste, and vision. Later chapters describe the less familiar sensory worlds of animals that can detect electric and magnetic fields. The



penultimate chapter discusses “uniting the senses”, which Yong describes as understanding “how animals use their senses together” (p. 322). The final chapter discusses how human activities interfere with animals' sensory perceptions. Each chapter starts with an example of how a sense is used by a particular animal and a few words from a researcher investigating it. Gradually, Yong considers the more unusual and surprising uses of that sense. He uses footnotes effectively to provide details and historical asides for those interested. Puns, wordplay, and suspenseful transitions from one chapter to the next keep the reader engaged. Yong cleverly uses the text to grab the reader's attention and emphasize his points. For example, the time required for Big Brown Bat to catch a moth is identical to the time needed to read the last seven words in Yong's paragraph describing this predatory event (p. 255). Colour photographs spotlighting the senses add to the joy of reading this book.

Overcoming human sensory bias to prevent inaccurate interpretations of an animal's Umwelt is a major theme that weaves its way throughout *An Immense World*. Yong argues for abandoning preconceived notions of the links between animal behaviours and their senses that have historically been a part of scientific speculation. Modern research by scientists who stepped outside of standard dogma and, at least partially, into an animal's Umwelt has revealed much in the animal world. We now know that bats hunt by echolocation rather than using air currents along their wings, and Blue and Fin Whales communicate over long distances with repetitive vocalizations or songs.

Magnetoreception (which allows an animal to sense the Earth's magnetic field) is the least understood and last of the senses presented in *An Immense World*. Many animals use magnetic fields for migrating and locating themselves on the Earth, but no one knows how they do it. Unlike the rapid vision and hearing processing that humans share with many animals, the completely different, relatively slower, and likely more variable inputs that occur in animals navigating by magnetoreception inhibit researchers from stepping into these Umwelten (p. 319). Yong outlines the three major hypotheses that explain the ability to sense magnetic fields: magnetite crystals that animals might form within sensory cells as north-south aligning chains could provide directional information; electromagnetic induction, which could explain the ability in animals capable of sensing electric fields, such as sharks and rays; and radical pair spin dynamics in retinal cryptochrome proteins (pp. 311–312). However, the inability to replicate experiments has been a stumbling block to resolving these hypotheses. Yong concludes the chapter by wondering just how big a role the sensory gap between researchers and subjects plays in preventing the design of definitive experiments.

The importance of overcoming sensory bias culminates in the final chapter where Yong proposes that conservation efforts could be improved by explicitly considering the Umwelten of animals under threat. Field naturalists and others interested in assessing

threat impacts on population changes or developing mitigation efforts to recover endangered species will find this chapter thought provoking. Threat assessments typically focus on the effects of human activities on non-human animal populations; but if the effects are evaluated solely using human sensory perceptions, the total threat will be poorly estimated. There are examples of this throughout the book: vultures colliding with wind turbines because their sightlines are impacted while hunting (pp. 69–70); elephant calls having greater range after sunset when the atmosphere is cold, clear, and calm, compared to the heat of midday (pp. 236–237); and electric fish sensitivity changing with salinity concentrations (p. 281). Our ability to detect other Umwelten is an asset we can use to increase the likelihood that our recovery activities enhance, rather than distort, other animals' sensory environments.

Yong's book emphasizes that animals rely on uniting multiple senses to support their life history needs. It provides a framework for integrating the knowledge its readers may have gained from more academic books or their own research on sensory perceptions. If *An Immense World* makes you curious about how humans unite their senses, you may want to read M.R. O'Connor's book *Wayfinding: the Science and Mystery of How Humans Navigate the World* (St. Martin's Press, 2019).

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