

Remote Sensing of Vegetation: Principles, Techniques, and Applications

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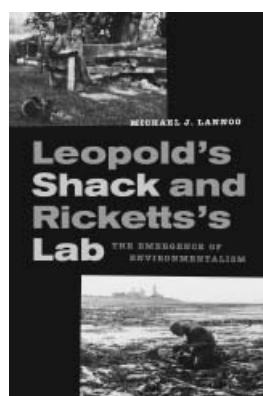
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The central idea that emerges from this interesting volume is the sense that these men led complimentary lives. Together, they express what was then an emerging, uniquely American form of environmental awareness that still defines a distinctive philosophical direction. A century earlier, a different pairing of intellects and personalities collided to define a prior movement in literature and philosophy. Ralph Waldo Emerson, the renowned poet, and Henry David Thoreau, the anarchic naturalist, followed shared insights but contrasting lifestyles that, together, embodied the Transcendentalist movement. This creation articulated an intellectual foundation on which science and nature would be united to confront the future that Thoreau predicted and that Ricketts and Leopold encountered in their twentieth-century lives. Without putting too fine a point on it, Lannoo invites us to see the subjects of his book as two lives intertwined in an effort to articulate a modern environmental ethic grounded in empiricism and committed to action—action to save nature from the unwitting march of a society utterly unaware of its destructiveness and its dependency on the natural world.



The subtitle of this book—*The Emergence of Environmentalism*—is somewhat misleading. The emergence of environmentalism is not addressed directly, nor are these men's roles in fostering it explored in any depth. Instead, we get a sense of the resonance

their work has enjoyed with those who discovered their writings long after the authors were gone. That subsequent generation, those born into the era of environmental crises, read Leopold's *Sand County Almanac* and Ricketts's *Between Pacific Tides* with wonder, impressed that the authors had such clear thoughts about such important ideas, and that they were able to write about them so artfully that these titles continue to speak today with compelling voices. Yet there are others who more fully capture the activist roots of the environmental movement; perhaps most prominent among them is Rachel Carson, who galvanized the nation around the decline of nature with the publication of *Silent Spring* in 1962. In that context, Leopold, Ricketts, and the Transcendentalists before them were rediscovered and embraced by a new generation, one that gave rise to the great environmental leaders of the late twentieth century. The emergence of the environmental movement has changed the world, but with almost seven billion humans now (three times the population of the world when Leopold and Ricketts were writing), the planet is changing even faster and, thus far, not in a manner that would give either man much cheer.

Can their words inspire the next generation as it has the past two, and will the emergence of environmentalism contribute to the adoption of the ethical stance on conservation that emerges from their fusion of natural history and philosophy? Lannoo points in this direction, saying in the book, "Leopold shows us what to do, Ricketts shows us how to do it." But he takes a different path to the book's conclusion, stepping out of the flow of environmentalism and into the field that his two subjects shared without question: natural history. By recounting their decades of detailed observations and the depth of their insights, as well as their love of being in the field and experiencing nature directly, Lannoo highlights not so much the emergence of environmentalism as a social movement, but rather the emergence

of environmental science as a rigorous intellectual pursuit, grounded in method, informed by observation, and leavened with an awareness of its relevance to society.

Lannoo writes that "the discipline of ecology, as understood by both men, could not be neatly categorized into more traditional academic fields." Through the interdisciplinary nature of their inquiry, something new and critically important was discovered and carefully communicated to the rest of us. Emerson wrote about how knowledge and nature are "still hid and expectant... as if each waited... for a destined human deliverer." Lannoo's homage to Leopold and Ricketts is a convincing claim that the two men, drawing on creativity and social conscience, were so diligent in their commitment to natural history that they uncovered a set of vital truths for those who came after.

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MAKING SENSE OF REMOTELY SENSING VEGETATION

Remote Sensing of Vegetation: Principles, Techniques, and Applications. Hamlyn G. Jones and Robin A. Vaughan. Oxford University Press, 2010. 400 pp., illus. \$55.00 (ISBN 9780199207794 paper).

An ever-expanding constellation of Earth-observing sensors provides us with a virtual tsunami of data, much of it now freely available. But channeling this digital torrent into useful information about the vegetated land surfaces requires a skillful blending of radiation physics, image processing,

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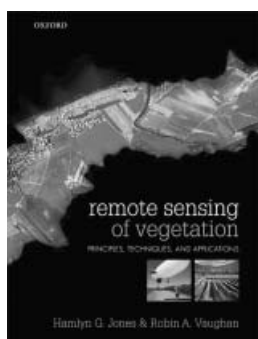
ecophysiology, and landscape ecology. This can be a complicated endeavor for the uninitiated. Most textbooks on remote sensing aim to survey the technology and applications broadly. Moreover, the recent rapid growth of online and open-access journals has increased the heterogeneity of an increasingly global remote-sensing literature.

Remote Sensing of Vegetation: Principles, Techniques, and Applications is a very welcome contribution as an introductory textbook for advanced undergraduates, graduate students, and autodidacts. The authors—Hamlyn Jones, honorary fellow of the College of Life Sciences, and Robin Vaughan, honorary fellow of the Centre for Remote Sensing and Environmental Monitoring, both at the University of Dundee, Scotland—have aimed “to provide a rigorous, yet fairly simple, grounding in the relevant basic physics and plant physiology to allow the reader to choose from and critically assess the plethora of new techniques that are becoming available” for the remote sensing of vegetation. The authors draw on their deep experience to pull together a text that presents sufficient mathematical detail without overwhelming the narrative flow with equations.

The book contains 11 chapters, and the argument is divided into four themes beyond the introductory chapter: the salient characteristics of illuminating radiation and the targets of interest (chapters 2–4); the general mechanics of data acquisition, processing, analysis, and modeling (chapters 5–8 and 10); the specific linkages among observed radiation, energy balance, and mass fluxes (chapter 9); and examples of applied remote sensing (chapter 11). The authors provide, at the end of the book, solutions for the illustrative exercises that conclude most chapters. Several pages of material are provided to decode the many symbols and acronyms used in remote sensing. Three appendices provide relevant units and conversions, a chronology of Earth observation, and a

selective listing of current sensors that provide data for monitoring vegetation. Links to the Web sites mentioned in each chapter can also be found on the publisher's Web site.

I applaud the authors for addressing the thermal and microwave regions alongside the more familiar wavelength region of the visible to short-wave infrared. Many textbooks segment the topic of remote sensing by the instrumentality of the observing process, rather than through the perspective of the object of interest. By taking the latter approach, Jones and Vaughan revisit several times how active and passive microwave and thermal observations can shed light on various aspects of leaf, canopy, and land-surface dynamics.



Vegetation indices can be one of the more bewildering aspects of contemporary remote sensing. (One table in the book lists 28 different indices—merely a representative cross-section of the literature!) Jones and Vaughan provide an illuminating discourse on what spectral vegetation indices seek to do and how they relate to leaf and canopy properties such as chlorophyll content, leaf-area index, fraction of absorbed photosynthetically active radiation, and fractional cover.

A substantial section covers multiangular spectral data (obtained either remotely or “in field”), how they relate to models of canopy reflectance, and methods of model inversion. Jones and Vaughan provide a gentle but acutely informative introduction to bidirectional reflectance distribution functions (BRDFs). This treatment is particularly welcome, because recent

standard data products benefit from multiangular observations (e.g., the albedo and nadir BRDF adjusted reflectance products from NASA's workhorse instrument, MODIS).

In the chapter on sampling and scaling, I was surprised to find no discussion of intensive versus extensive variables and the challenges that intensive variables (quite common in remote sensing) pose for reconciling scales of observation. Moreover, given the need to link remotely sensed data with data collected at or near ground level, I was disappointed to see only a scant paragraph devoted to the difficult process of validation.

Remote Sensing of Vegetation concludes with surveys of five “integrated applications” that demonstrate how to implement, in a broad sense, the various modalities of remote sensing to address pertinent questions concerning the detection and diagnosis of plant stress; precision agriculture and crop management; ecosystem management; forestry; and, finally, wildfires and biomass burning. This section is in many ways the riskiest, because it must move beyond the abstract principles of the earlier chapters to particular alternative solutions to concrete problems. Because the authors had to choose which solutions to emphasize amid an active literature, some readers may find some of their choices less than satisfying. Yet, on the whole, the effort succeeds. Jones and Vaughan provide an excellent introduction to a growing transdisciplinary field of inquiry and practice—one that should find its way into many a syllabus.

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