A SELECTED BIBLIOGRAPHY: REMOTE SENSING APPLICATIONS
FOR TROPICAL AND SUBTROPICAL VEGETATION ANALYSIS
By Lawrence R. Pettinger

NTIS NO. PB 284683/AS

July 1978
Sioux Falls, South Dakota
CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Obtaining copies of cited documents</td>
<td>4</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>4</td>
</tr>
<tr>
<td>Bibliography</td>
<td>6</td>
</tr>
<tr>
<td>Remote sensing application overviews</td>
<td>6</td>
</tr>
<tr>
<td>Vegetation (general)</td>
<td>8</td>
</tr>
<tr>
<td>Forestry</td>
<td>12</td>
</tr>
<tr>
<td>Grasslands/savannah/shrublands</td>
<td>26</td>
</tr>
<tr>
<td>Agriculture</td>
<td>29</td>
</tr>
<tr>
<td>Land use/thematic mapping</td>
<td>33</td>
</tr>
<tr>
<td>Integrated surveys/multiple resource analysis/land systems</td>
<td>37</td>
</tr>
</tbody>
</table>
A SELECTED BIBLIOGRAPHY: REMOTE SENSING APPLICATIONS

FOR TROPICAL AND SUBTROPICAL VEGETATION ANALYSIS

By Lawrence R. Pettinger, Technicolor Graphic Services, Inc. 1/

ABSTRACT

This bibliography contains 425 citations of selected technical reports, journal articles, and other publications covering the general subject of tropical and subtropical vegetation analysis. Functionally related topics that include vegetation analysis are included for completeness, and citations have been organized under the following subheadings for ease of reference: remote sensing application overviews, vegetation (general), forestry, grasslands/savannah/shrublands, agriculture, land use/thematic mapping, and integrated surveys/multiple resource analysis/land systems. The terms "tropics and subtropics" are used in the widest context to include applications related to a broad range of equatorial environments. The bibliography contains selected citations published between 1924 and 1978. Many foreign language and non U.S.-source items are included.

INTRODUCTION

In recent years, there has been a proliferation of documented applications of remote sensing techniques to many resource inventory and analysis problems. However, the majority of these applications have been demonstrated in the temperate climates of the world where remote sensing technology has been developed. Because the demand for resource information is increasing in the developing nations, resource specialists in these nations are now turning to the remote sensing literature to determine which existing techniques might be most useful to them.

1/ Prepared under U.S. Geological Survey Contract #14-08-0001-16439.
Unfortunately, the environmental conditions of many developing nations often differ significantly from those in the countries where the utility of many remote sensing techniques has been demonstrated. For example, the agricultural practices and patterns in Latin America bear little resemblance to the wheat-growing lands of the United States where crop identification techniques are being developed. Similarly, the complexity of mixed tropical forests has little parallel in the conifer forests of North America where much early research and demonstration of remote sensing applications took place. Because of differences such as these, much of the existing literature has little direct application for many persons with a great need for the technology.

The body of literature that addresses remote sensing applications in the developing nations is growing; however. The author's contact with persons from developing countries, as well as his growing exposure to this literature, have encouraged him to attempt to organize and document references that deal with remote sensing applications to vegetation studies in tropical environments.

The only other attempts at a comprehensive bibliography of this type known to the author were prepared by Lutz (1966) and Wacharakitti and Miller (1975). Lutz's work contains a critical and descriptive review of 80 references. Because remote sensing technology has very recently expanded to include Earth resources satellites and airborne imaging radar systems, two large subject areas of potential application in the tropics not extensively investigated by 1966, it seemed timely to attempt to update this work to include both the many uses of conventional aerial photography as well as these new technologies. Wacharakitti and Miller (1975) provide a good narrative overview of pertinent remote sensing literature, and a bibliography of over 250 references. However, at least one-third of their citations are of studies in non-tropical environments.

Although many of the works cited here are published in journals and other sources that are relatively unfamiliar to American scientists, they may be more accessible to resource specialists in other parts of the world than are proceedings and journals published in the United States. For this reason the author has chosen to include citations that might be considered little-known in this country, as well as those that are published in languages other than English.

The vegetation cover of the Earth is often subdivided into arbitrary classes according to use by man—such as forest, rangeland, and agricultural land. It seemed reasonable to use one such group of categories as a basis for subdividing the body of literature being considered. With this rationale in mind, the following categories were selected:
1. Remote sensing application overviews—summary statements of international applications of remote sensing, or general papers relating to applications in the tropics

2. Vegetation (general)—papers addressing vegetation mapping as a general subject or that include more than one of the single subjects (3–7) that follow

3. Forestry

4. Grasslands/Savannah/Shrublands and related non-forest wildland vegetation cover

5. Agriculture

6. Land Use/Thematic Mapping

7. Integrated Surveys/Multiple Resource Analysis/Land Systems, including land resource analysis and classification, soil/land capability, environmental analysis, and natural resources surveys.

The reader is cautioned that this organization may result in the partitioning of the literature in a manner that does not correspond to his needs. For example, remote sensing studies of marginal forest and shrubland areas might appear under either of those headings, whereas the reader's interest may lie instead with their suitability for agricultural production. Nevertheless, it is hoped that this breakdown will provide a generally useful basis for subdividing the citations which follow.

In a similar fashion, the terms tropical and subtropical environments are taken to mean that portion of the Earth falling within or adjacent to the Tropics. Several systems of world vegetation classification are currently in use, each of which carefully names and subdivides the world's vegetation. To accept any particular system as the basis for organizing this bibliography would be to acknowledge that one system best serves the needs of the potential user of the bibliography. It is the author's belief that the broad definition given above is most satisfactory for the purposes of screening candidate bibliographic citations.

However, he also recognizes that there are common elements in the broadest vegetation categories of various world systems. Within the tropic and subtropic regions, most systems include tropical rain forest, semideciduous forest (light rain forest), tropical moist and dry deciduous forests, tropical scrub forest, and savannah/tropical grasslands. These general classes comprise the environments for which remote sensing applications are sought. The author's central concern is to exclude the main body of literature covering applications in temperate climates that is always referred to when the subject of "proven or demonstrated remote sensing techniques" is discussed. His main hope is that this effort will bring certain heretofore little-known works to the attention of interested specialists.
The earliest citation is dated 1924, and the most recent citations were published in 1978.

OBTAINING COPIES OF CITED DOCUMENTS

Publications, reports and documents cited in this bibliography may be procured from a variety of sources. Authors will often provide copies or reprints of their published materials; institutions, corporations, and university departments or libraries can often provide copies of required documents on loan or in exchange for copying costs.

Certain items in this bibliography are followed by an accession number with an "N" prefix. This number is a purchase order number for documents available from the National Technical Information Service (NTIS) of the U.S. Department of Commerce. NTIS is a centralized source for the public sale of U.S. Government-sponsored research, development, and engineering reports and other analyses prepared by Federal agencies and their contractors or grantees. Documents are available in either paper copy or microfiche format.

For current prices and ordering information, write to:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia  22161
U.S.A.

Give the NTIS accession number and other bibliographic details.

ACKNOWLEDGEMENTS

The author wishes to acknowledge the contributions of the following individuals who provided comments, suggestions, and recent references:

1. W. H. Anderson, Applications Scientist, Agriculture, and W. C. Draeger, Chief, Training and Assistance Section, USGS - EROS Data Center, Sioux Falls, South Dakota

2. R. C. Heller, Professor of Remote Sensing, College of Forestry, Wildlife and Range Sciences, University of Idaho, Moscow, Idaho

3. B. N. Koopmans, Lecturer in Geology, ITC, Enschede, The Netherlands

4. L. D. Miller, Senior Research Associate, National Research Council, Goddard Space Flight Center, Greenbelt, Maryland

5. D. Nduaguba, Remote Sensing Officer, FAO, Rome
6. G. Sicco Smit, Senior Lecturer of Forest Survey, ITC, Enschede, The Netherlands

7. D. A. Stellingwerf, Professor of Forestry, ITC, Enschede, The Netherlands

8. K. P. Tiwari, Data Processing and Photo-Interpretation Officer, Madhya Pradesh State Forest Development Corp., Ltd., Mahavir Nagar, Bhopal, India
BIBLIOGRAPHY

Remote Sensing Application Overviews


Cocca, A. A., 1976, Remote sensing of natural resources by means of space technology—a Latin American point of view, in Legal implications of remote sensing from outer space, Montreal, Canada, 1975, Proc., p. 63-68.


Krumpe, Paul F., 1976, The world remote sensing bibliographic index—a comprehensive geographic index bibliography to remote sensing site investigations of natural and agricultural resources throughout the world: Fairfax, Va., Tensor Industries, Inc., 619 p.

METRICS, INC., 1978, International remote sensing activities: Atlanta, Ga., METRICS, INC.


Vegetation (General)


Chapman, V. J., 1947, The application of aerial photography to ecology as exemplified by the natural vegetation of Ceylon [Sri Lanka]: Indian Forester, v. 73, p. 287-314.


Dillewijn, F. J. van, 1957, Sleutel voor de interpretatie van begroeiingssvormen uit lucht foto's 1:40,000 van het Noordelijk deel van Suriname [Key for the interpretation of vegetation types on aerial photographs in northern Surinam, scale 1:40,000]: Paramaribo, Dienst's Landsbosbeheer Suriname, 45 p.


Nosseir, M. K., Batista, G. T., and Palestino, C. V. B., 1974, Mapping of natural vegetation distribution over central eastern Brazil from data obtained by ERTS-1 [Landsat], in Seminar on space applications of direct interest to developing countries, São José dos Campos, Brazil, 1974, Proc.: São José dos Campos, Brazil, Instituto de Pesquisas Espaciais, v. 2, p. 190-213.


--1969, Vegetation mapping from aerial photographs: East African Agric. and Forestry Jour., p. 80-86.


Forestry


Braithwaite, J. D., 1940, Canadian aerial photography in Burma: Indian Forest Rec., v. 96.


--1959, The application of aerial photography to stockmapping and inventories on an ecological basis in rain forest in Ceylon [Sri Lanka]: Empire Forestry Rev., v. 38, no. 2, p. 141-147.


Dommergues, Y., 1952, La prospection des peuplement forestiers tropicaux par application des méthodes statistiques: Bois Forêts Trop., v. 23.


Estrada, E. F., 1971, Clave de interpretación para el estudio de la Selva Lacandona (Estado de Chiapas) [Mexico], in Congreso nacional de fotogrametría, fotointerpretación, y geodesia, 1st, Mexico City, 1971, 10 p.


--1960, Interim rept. to the Govt. of the Sudan on forest inventory: Rome, FAO, FAO Interim Rept. No. 59/10/7837.


Francis, E. C., 1955, Interpretation of mangrove species from aerial photographs in North Borneo: Tolworth, Surbiton, United Kingdom, Directorate of Overseas Surveys.


Grijpma, P., 1959, A study of the possibility of using aerial photographs to enumerate Triplaris in the young coastal regions of Suriname: Wageningen, Holland, State Univ. of Agr., Library, Forestry Dept.

1973, Photo mensuration investigations for Tectona grandis in Allapalli (M.S., India), in Symp. on remote sensing, Freiburg, Germany, 1973, Proc.: IUFRO Subject Group S 6.05, p. 65-86.

Haller, K. E., 1968, Inventory of national tropical forests - a computer programme for the processing of data: Unasylva, v. 22, no. 89, 7 p.


--1955, Forest type mapping with the help of aerial photographs in the tropics: Tropical Woods, v. 102, p. 27-46.


--1957b, Rept. to the Govt. of Brazil on a forest inventory of the Amazon Valley—region Rio Tapajos and Rio Xingú: Rome, FAO, Rept. No. 601.

--1957c, The upper storey of tropical forests: Tropical Woods, no. 107, p. 66-84.

--1958a, Rept. to the Govt. of Brazil on a forest inventory in the Amazon Valley, part 2, regions between Rio Xingú and Rio Tocantins: Rome, FAO, Rept. No. 949.


--1960a, Dryland forest on the Tertiary and Quaternary south of the Amazon River: Rome, FAO, no. 1284, 14 p.

--1960b, Surveys particularly applicable to extensive forest areas: Caribbean Forester, v. 21, no. 3-4, p. 91-98.


--1971, A progress rept. from the forest industries development project on inventory design, sampling costs, and quality assessment in the mixed dipterocarp forest of Sarawak, Malaysia, in IUFRO world congr., 15th, Gainesville, Fla.

Hollerwoger, F., 1954, Is there a correlation in the teak forests between crown diameter and the height of trees with regard to the diameter on breast height?: Jour. Sci. Research in Indonesia, v. 3, p. 3-20.


Joshi, S. C., and van Es, E., 1975, Direct volume estimations on aerial photographs of different scales in the dry deciduous forest of central India: Commonwealth Forestry Rev., v. 54, no. 3/4, p. 241-242.


--1973b, Use of recent techniques in the evaluation of forest resources: Bois et For. des Trop., v. 147, p. 35-45.


Letouzey, R., 1967, Photointerprétation en forêt dense Cameronnaise, in Meeting on the place of technical research in developing the use of tropical wood in Europe, Centre Technique Forestier Tropical, 12 p.


Merritt, V. G., and Ranatunga, M. S., 1959, Aerial photographic survey of the Sinharaja forest (Ceylon) [Sri Lanka]: The Ceylon Forester, v. 4, p. 103-156.


Myers, Brian J., 1976, Tree species identification on aerial photographs: the state of the art [applications to northern temperate, tropical, and Australian forests]: Australian Forester, v. 39, no. 3, p. 180-192.


--1974b, Large-scale aerial photography applied to forest inventories, in First Pan Am. and third nat. cong. of photogramm., photo interpretation, and geod., Mexico City, 1974.


--1962a, Aerial photographs of tropical forests: Unasylva, v. 16, no. 1, p. 3-12.


Paijmans, K., 1951, Een voorbeeld van interpretatie van luchtfoto's van oerwoud: het Malili - complex op celebes [Interpretation of aerial photographs in a virgin forest complex, Celebes, Indonesia]: Tectona, v. 41, p. 111-135 [English summary].


Philip, M. S., 1976, The role of forest inventories in the development of tropical moist forest: Commonwealth Forestry Rev., v. 55, no. 1, p. 57-64.


1973, Comparison de photographies aériennes panchromatiques et fausse couleur pour l'interprétation des mangroves des états de Oaxaca et Chiapas, Mexique [also in English and Spanish]: Photo interpretation [Paris], v. 12, no. 4, p. 28-47.

Sabhasri, Sanga, 1975, Thailand programme of the Earth Resources Technology Satellite [Landsat]: Bangkok, National Research Council, First Type I Prog. Rept. to NASA, 6 p. [N76-12443].


Sicco Smit, G., 1969, Systema de fotointerpretación recomendado para los bosques húmedos tropicales de Colombia: Bogotá, CIAF.

1970, Aplicación de las imágenes de radar en la interpretación de los bosques húmedos tropicales de la región de Tumaco, Barbacoas, Nariño, Colombia: Bogotá, CIAF.

1971, Aplicación de las imágenes de radar en la foto-interpretación de bosques húmedos tropicales: Bogotá, Centro Interamericano de Fotointerpretación, 16 p.

1972, Comparación de la interpretación de imágenes de radar y fotografías aéreas de bosques pantanosos de los Ríos Atrato-Sucio y Jiguamandó, Chocó, Colombia: Bogotá, CIAF.

1974, Practical applications of radar images to tropical rain forest mapping in Colombia: Reinbek bei Hamburg, W. Germany, Mitteilungen der Bundesforschungsanstalt für Forst- und Holzwirtschaft, Contributions to forest inventory methodology, no. 99, p. 51-64.
Singh, K. D., 1974a, On some common patterns of spatial variation in the tropical rain forest and their significance for planning of forest surveys: Reinbek bei Hamburg, West Germany, Mitteilungen der Bundesforschungsanstalt für Forst- und Holzwirtschaft, Contributions to forest inventory methodology, no. 99, p. 65-94.

Singh, R. S., 1970, Remote sensing the forest: Indian Forester, v. 96, no. 11, p. 801-810.


Soemarwoto, Otto, Ambar, Supriyo, and Khan, M. H., 1976, Luas hutan lebat di daerah aliran sungai Citarum [Dense forest areas in the Citarum river basin (Indonesia)]: Bandung, Indonesia: The Inst. of Ecology, Padjadaran Univ., Ecology and Devel., no. 4, 10 p. [English summ.].


--1966, Practical applications of aerial photographs in forestry, tropical salt and fresh water swamp forests: ITC Pubs. B36, B37, and B38.


Swellengrebel, E. J. G., 1959, On the value of large scale aerial photographs in British Guiana forestry: Empire Forestry Rev., v. 38, no. 1, p. 54-64.


--1965, Reconnaissance of tropical forests with aerial photographs: Commonwealth Forestry Rev., v. 44(2), no. 122, p. 142-150.


--1972, A guide for obtaining aerial photographs and their costs [in India]: Indian Forester, v. 98, no. 9, p. 543-551.


Grasslands/Savannah/Shrublands


Agriculture


Nduguba, D. C., 1974, The application of remote sensing techniques in agriculture: Rome, FAO, AGOA (Misc.) 74/1.


Land Use/Thematic Mapping


Beard, J. S., 1941, Land utilization survey of Trinidad: - The Caribbean Forester, v. 2, no. 4.


García de León, Porfirio, 1972, Mexican thematic map products: Photogramm. Eng., v. no. 12, p. 1203-1208.


Sicco Smit, G., 1976, Experience with the use of SLAR in forest and land-use classification in the tropics, in Interregional training seminar on remote sensing applications, Lenggries, West Germany, 1976, Proc.: UN-FAO and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt E.V., p. 149-155.

Sridas, S., 1966, Interpretation and mapping of rural land use from air photographs in Ceylon [Sri Lanka]: Photogrammetria, v. 21, no. 3, p. 77-82.

Steiner, Deiter, 1967, Index to the use of aerial photographs for rural land use studies: Bad Godesberg, W. Germany, Selbstverlag der Bundesanstalt für Landeskunde und Raumforschung, 232 p.


Taiwan Prov. Agric. and Forestry Aerial Survey Team, 1961, Land use and forest resources aerial survey instructions, Manual No. 5, 175 p.


Tomar, M. S., 1969, Identification of land use and forest cover types on aerial photographs: Indian Forester, v. 95, no. 2, p. 85-89.


Integrated Surveys/Multiple Resource Analysis/Land Systems

Adrien, Pierre Marie, and Baumgardner, Marion F., 1977, Landsat, computers, and development projects [Sudan example]: Science, v. 198, no. 4316, p. 466-470.


Darmoyuwono, Kardono, and Hadisumarno, Surastopop, 1976, Experiences with Landsat data for resources inventory in Sumatra, in Interregional training seminar on remote sensing applications, Lenggries, West Germany, 1976, Proc.: UN-FAO and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt E.V.


Hildebrant, G., 1976, Mapping, inventory and monitoring of forest and rangeland in the tropics, requirements and objectives, in Interregional training seminar on remote sensing applications, Lenggries, West Germany, 1976, Proc.: UN-FAO and Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt E.V., p. 131-137.


40


MacPhail, Donald D., 1971, Photomorphic mapping in Chile: Photogramm. Eng., v. 37, no. 11, p. 1139-1148.


Martin-Kaye, p., 1972, Application of SLAR in Earth resource surveys, in Bristol symp. on remote sensors, Univ. of Bristol, United Kingdom.


Moreno, N. V., 1973, Forestry, geology, and hydrological investigations from ERTS-1 [Landsat-1] imagery in two areas of Ecuador, South America: Quito, Ecuador, Junta Nacional de Planificación, 41 p. [N76-10371].

Newsweek, 1973, Brazil: geography lesson: Newsweek, v. 82, no. 12, p. 44.


Romero, Adolfo C., 1976, Development of techniques to simplify the process of investigation and estimate of natural resources in remote and relatively unexplored areas, Venezuela: Caracas, Dirección de Cartografía Nacional, Final Rept., NASA, 153 p. [N76-30621].


U.N. Special Fund, 1964, Reconocimiento edafológico de los Llanos Orientales, Colombia: Informe FAO/SF, 11/COL, 4 v.

Vaidyanadhan, V., 1973, Index to a set of seventy aerial stereopairs illustrating physiographic features from India: Waltair, India, Geol. Dept., Andhra Univ.


