VEGETATION MAPPING FROM ERTS IMAGERY OF THE OKAVANGO DELTA

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ABSTRACT

The Okavango is Botswana's major water resource.
As yet it is essentially undeveloped and supports
large wild life populations both within the system
itself and in the adjacent semi-arid areas. De-
velopment of the delta cor its water resources and
recreational potential is inevitable and iminent.
Much basic resources data is urgently required to
facilitate sound planning.

Other workers have studied ERTS imagery of the
delta from a geological and hydrological perspective.
The present study has been specifically directed at
mapping vegetation types within the delta and
generally concerned with finding what information of
value to plant and animal ecologists could be ex-
tracted from the imagery. To date it has been found
that

(i)   It is possible to map broad vegetation
        types from the imagery. This has enabled
        preparation of a vegetation map of the
        delta which considerably refines existing
        maps.

(ii)   Imagery of the delta records the state of
        the system in a manner which will facilitate
        long-term studies of plant succession.

(iii)   Phenological events can be detected. This
        may allow inferences to be drawn about
        seasonal movements of animal populations.

(iv)   The imagery can be used to detect and map
        wild fires. This will be useful in deter-
        mining the role of fire in the ecology of
        the region.

Using the imagery it is thus possible to map existing ve-
getation and monitor both short and long-term changes.

These results have been obtained after a few months of
work using only colour composites of the delta and without
sophisticated, automated techniques of data extraction and
analysis. They demonstrate that ERTS type imagery can be

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a valuable tool to those responsible for planning and managing the exploitation of natural resources in the developing world.

INTRODUCTION

Botswana is a developing country in Southern Africa. It has an area of 570 000 km^2, much of which is sandy, featureless tree and shrub savanna. It is sparsely populated and its people are predominantly rural. The economy of the country has recently been stimulated by mineral discoveries but it is still almost entirely pastoral and agricultural with a significant fraction of the population living at a subsistance level. Several factors account for this low level of development, aridity being amongst the most important of these.

The Okavango delta is a major water resource but, although it obviously has a pivotal role in the future of Botswana, it remains essentially undeveloped. Its rich fauna and flora are largely intact and until recently were utilized primarily to meet individual subsistance requirements. The survival of the delta in a relatively pristine condition is probably attributable to its remoteness and the presence of the tsetse fly (Glossina Morsitans) host to the trypanosome organisms which cause fatal diseases in man and his domestic stock. However, this state of affairs is rapidly changing. With improved communications, tourism and hunting are increasing. The projected eradication of the tsetse fly will result in penetration of the delta for pastoral and possibly agricultural exploitation. The recent mineral discoveries in Botswana mean that development of the Delta's water resources for industrial purposes is inevitable and imminent.

At this point the ecology of the Delta is poorly understood and much environmental data is urgently required if the impending developments are to be implemented on a sound basis.

The entire Okavango Delta has been covered by ERTS imagery. The imagery has thus far been studied from the perspectives of geology (Akehurst, 1973) and hydrology (Wilson, 1973). The main aim of the present study is to map broad vegetation types in the Delta region. This objective was selected because, as pointed out by Anderson et al (1973), knowledge of the distribution and importance of vegetation types can be applied in a wide range of fields such as plant ecology, hydrology, soil science, meteorology, wild life biology and management and land use planning.

VEGETATION MAPPING

Only photographic ERTS-1 products have been available for the vegetation mapping program. A variety of products, detailed in the Table, are being used.

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TABLE : PHOTOGRAPHIC PRODUCTS USED IN OKAVANGO STUDY

	PRODUCT	SCALE	APPLICATION
1.	Black and White paper prints, MSS Bands 4, 5 & 7.	1:1 000 000	Annotation in the field
2.	Black and White paper prints, individual MSS bands	1:1 000 000	Delineating features accentuated in individual bands
3.	Color composite transparencies MSS bands 4, 5 & 7.	1:1 000 000	Differentiating color tones by transmission densitometry.
4.	Color composite paper prints, MSS bands 4, 5 & 7.	1:1 000 000	Interpretation and mapping at this scale
5.	Color composite paper prints, MSS bands 4, 5 & 7.	1:500 000	Mosaic for field work aid to interpretation.
6.	Color composite paper prints, MSS bands 4, 5 & 7.	1:250 000	Interpretation and mapping at this scale.

for identifying and delineating vegetation types the color composites have proved markedly superior to the black and white prints, the latter being used for field annotation simply because they are less expensive to produce.

Three images have so far been studied in detail for vegetation mapping. These are NASA ERTS-E-1054-07565 and 1054-07571 of September 15, 1972 and ERTS-E-1055-08023 of September 16, 1972. Image ERTS-E-1054-07565 which portrays a large portion of the delta, is reproduced as figure 1.
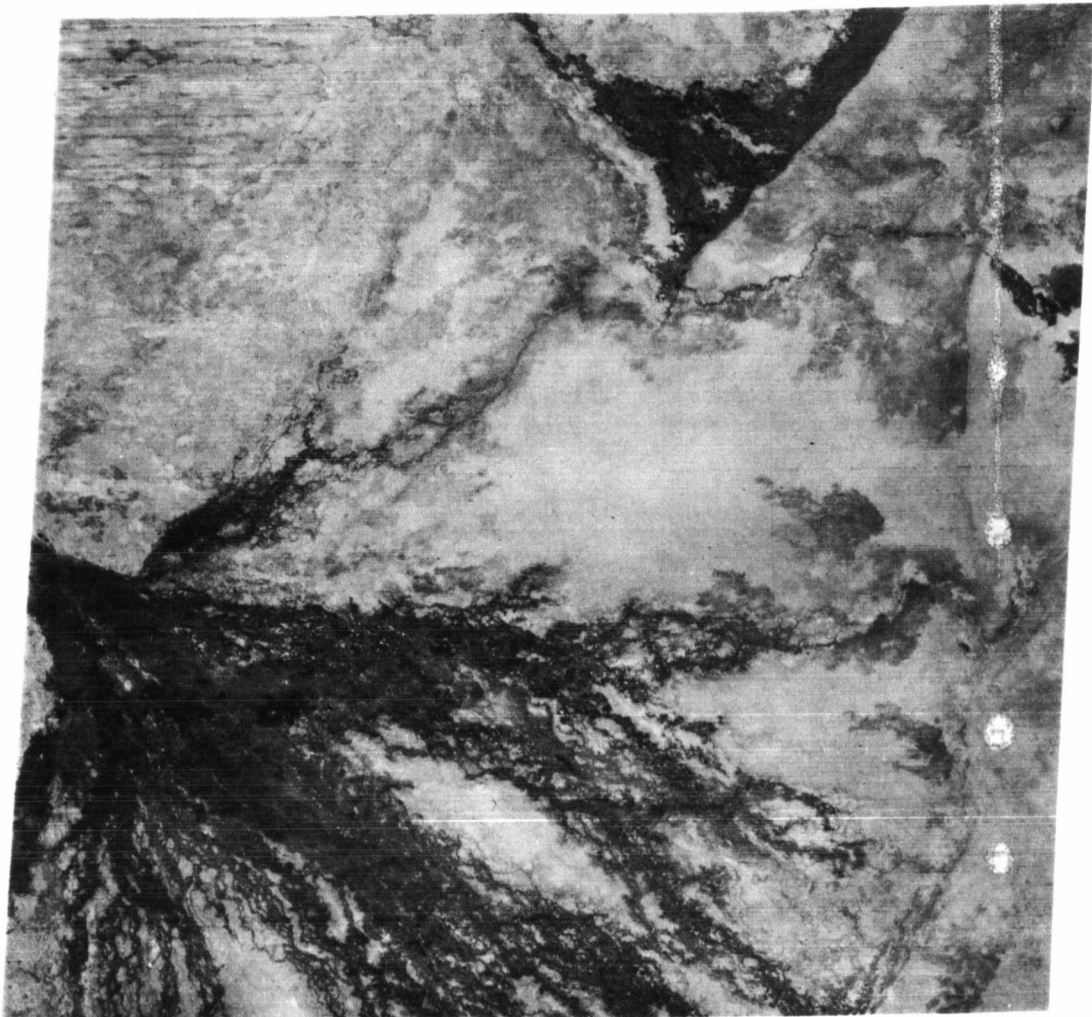
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15SEP72 C S18-51/E023-15 N S18-53/E023-21 MSS   R SUN EL48 AZ062 188-0747-G-I-N-D-2L NASA ERTS E-1054-07565-5 01

FIG. 1 : ERTS-image of the Okavango Delta.

Initial interpretation of vegetation patterns was based on
ground truth gathered by photographing vegetation on the
ground at some 86 points in the delta and the adjacent semi-
arid areas.

On the basis of this data a provisional vegetation map has
been prepared from ERTS imagery in which six habitat types
are identified, namely (i) inundated swamp (ii) dried-up
swamp (iii) closed woodland (woodland/savanna woodland),
(iv) open woodland (tree and shrub/scrub savanna), (v) mosaic
of trees, shrub/scrub and grass, (vi) grassland. The inter-
pretation and mapping has been checked by aircraft overflight
and found to be substantially correct.

Comparison of figures 2 and 3 shows that the map prepared
from ERTS imagery consitutes a considerable refinement of
existing vegetation maps of the region. On the ERTS based
map vegetation types are delineated with significantly more
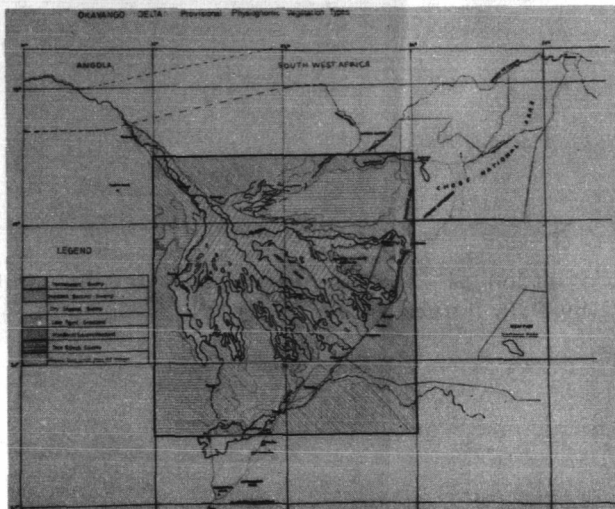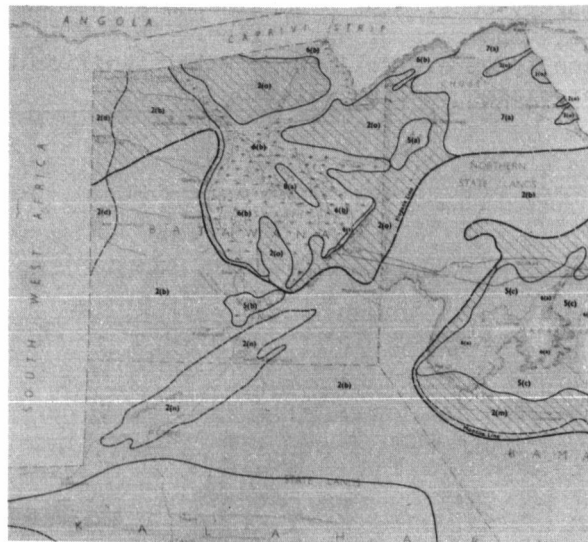detail and precision than on existing maps.

FIG. 2 : Vegetation map prepared from ERTS imagery of the
Okavango Delta.

FIG. 3 : Portion of Provisional Vegetation Map of Botswana
by P.R. Weare and A. Yalala.

It is hoped that it will be possible to further refine the
map by a comparative study of sequential imagery, to which
I have not yet had access. This hope is based on the like-
lihood that the sequential imagery will enable two important
distinctions to be made. Firstly it should be possible to
separate areas that are seasonally flooded from areas of
permanent swamp. Secondly it should be possible to distinguish
areas dominated by individual species, such as mopane (Colophos-
permum mopane), on the basis of phenological characteristics.

FUTURE AREAS OF STUDY

The application of ERTS imagery in other ways seems feasible
and needs to be investigated in further studies. For example,
of considerable importance is the fact that the imagery re-
cores the vegetation of the delta in a way that will facilitate
long-term studies of plant succession. The imagery was gathered
before any major development or exploitation of the delta and
it records important features, for instance the wetland-upland
boundary, very clearly. It is almost certain that impending
developments will induce successional changes. Comparison with
imagery of a later date will rapidly reveal any degradation or
adverse changes which may result from such developments.

The imagery also records phenological events. By observing
seasonal changes in vegetation and the distribution of surface
water it should be possible to draw inferences about the
seasonal movements of animal populations.

Finally, Wightman (1973) has shown that ERTS imagery can be
used to detect and map wildfires. This will for the first
time enable the compilation of a comprehensive record of
burning and provide a definitive insight into the role of fire
in the ecology of the region.

SUMMARY AND CONCLUSION

The present study has been in progress for five months. It
has used no sophisticated techniques of data extraction and
analysis. Using ERTS color composites existing vegetation maps
of the Okavango delta have been improved and study of sequential
imagery is expected to allow further refinement of vegetation
mapping. It will very likely be feasible to monitor both
short- and long-term changes in the vegetation of the delta
with ERTS type coverage. The ERTS system thus enables the
inventory and surveillance of a key environmental component.

This capability will clearly enhance Botswana's ability to
manage its natural resources. ERTS imagery can thus be a
valuable tool to those responsible for planning and managing
the exploitation of natural resources in the developing nations.

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