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THE UNIVERSITY OF ALBERTA

Fire and Habitat Modification: An Anthropological Inquiry Into The Use of Fire by Indigenous Peoples

by

Donald Erik Reid

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Fire and Habitat Modification: An Anthropological Inquiry Into The Use of Fire by Indigenous Peoples submitted by Donald Erik Reid in partial fulfilment of the requirements for the degree of Master of Arts.

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Abstract

Hunter-gatherer peoples have utilized fire for a variety of reasons. The objective of this study was to examine their use of fire in habitat modification and resource manipulation in widely separated geographic areas. Only recently have anthropologists started to examine this facet of the hunting and gathering lifestyle. The use of the ecotone concept in anthropology was reviewed and the application of this concept to the topic of aboriginal burning was analyzed. Fieldwork for this investigation was conducted in Northwestern Alberta among the Slave Indians of the Hay Lakes Reserve, Bushe River Reserve, and Meander River Reserve. Investigations were also carried out in the Northern Territory of Australia, on Melville Island, among the Tiwi People. In Australia I studied not only the Tiwi fire technology but that of the governmental Forestry Unit as well. The field studies in Alberta and Melville Island looked at what may be termed modified systems of hunter-gatherers. The results of the work carried out here indicate that current burning practices are by and large directed by the dominant society. Their use of fire has been altered along with their traditional hunting and gathering way of life. Conservation, forestry and environmental agencies have begun to recognize the importance of prescribed burning and information pertaining to indigenous

peoples burning practices is of value to those interested in present-day parks and resource management.

Acknowledgements

I wish to thank Dr. Henry Lewis for serving as my supervisor of studies. I would also like to express my gratitude to the other members of my committee Drs. Owen B. Beattie and Arthur W. Bailey for their help during the final stages of this work.

I must also thank the Dene people of Hay Lakes, Bushe River and Meander River Reserves for their hospitality and patience with a young aspiring anthropologist. In particular I would like to express my appreciation to Chief Harry Chonkalay, his wife Elizabeth, and the band council for their assistance during my stay.

In the Northern Territory of Australia, I wish to thank the Tiwi Land Council for permission to work on Melville Island and the Northern Territory Conservation Commission for their help in working out the logistics of the fieldwork there. Peter Wright and Marian Genner at the Conservation office were very helpful. At the settlement of Snake Bay (Milikapiti) I must thank Jim and Anne Weston, and the rest of the Forestry Unit who went out of their way to make me feel at home, and for their support of my field investigations. The Tiwi must be thanked for their kind hospitality to a foreigner. Their open-heartedness and friendliness made my stay enjoyable. A special thanks to Holder Adams, for his help and patience. The Northern

Australian Research Unit helped by providing access to office and library facilities, and at times needed accomodations.

The Department of Anthropology here at the University of Alberta provided me with several Teaching and Research Assistantship positions. And before the period of budget constraints, when funds were available, they provided me with intersessional summer bursaries. I was given a small grant by the University of Alberta for my fieldwork in Northwestern Alberta. Dr. Lewis hired me as a research assistant through his Social Sciences and Humanities Research Council grant in Australia during the summer of 1983. With this aid, and personal funds, I carried out my field studies. The impetus for the work came from studies by Dr. H.T. Lewis on the subject of hunter-gatherer use of fire in Australia and North America. I am also indebted to Theresa Ferguson, a student of Dr. Lewis, who carried out research in the same region of Alberta before I did. Her thesis, and Dr. Lewis' studies proved invaluable to my research.

Thanks to Colin Chapman for computer textforming information, criticisms and to Eric Damkjar for the MacIntosh graphics. For friendship and encouragement during my stay in 'Alberia', hats off to Col, Lauren, Deb, Mr. B. (aka Sauron the Evil One), Uncle Mel and Darcy. In the end, I must express my utmost appreciation to Toyo Turner for her understanding, patience, encouragement and help during the

entire period of the investigations. Despite the assistance I have received, I alone remain responsible for any shortcomings of this work.

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I. INTRODUCTION

Chapter 1

> ...aboriginal man has had a tremendous and decisive influence on several aspects of his physical environment. Our knowledge of such effect is far from complete because anthropologists, to a large degree, have assumed that though natives adjusted to their environment, they did not change the physical world sufficiently to warrant careful investigation. It is time anthropologists revised their thinking on this matter... it is now clear that setting fire to plant cover is a universal culture pattern...it is time for ethnologists to contribute their proper share to the understanding of the interrelations between primitive man and his physical environment (Stewart 1954: 248).

Fire has been both a constructive and destructive force in the history of mankind. Fire has been utilized by man to modify his habitat for a variety of reasons. These include: forest clearing for agricultural purposes, hunting drives, maintenance of select regions for grazing animals, accessibility and ease of travel, firebreaks, firewood, and so on (other reasons will become evident in the course of this work). The use of fire by man has not only affected the course of his own evolution but also the face of this planet. The use of fire as a manipulative tool represents the focus of the following study. Hunter-gatherer groups in widely separated locations on the globe have used fire in ways quite different from the natural fire regimes, in terms of such factors as seasonality, frequency, and intensity. According to existing evidence (and the following report

will bear this out to some degree) vegetation patterns in parts of the world has been affected by hunter-gatherer use of fire. In some locations this is currently an ongoing process. Hunter-gatherers themselves clearly recognize the importance of fire:

> Fire, he is really wonderful; not a motor car, or aeroplane - fire is wonderful; that one (pointing to our campfire) I always think about. Man been find a match out of fire. Water, he no more wonderful, only this fella here, fire (Australian Aboriginal, cited in Haynes 1982).

Only recently have increasing numbers of scholars directed their attention to hunter-gatherer burning practices. For instance, studies have been carried out in such areas as the Boreal Forest of Canada, the Great Plains, California and regions of Australia (eg. Lewis 1973, 1982b, 1986; Arthur 1975; Hallam 1975, 1985; Jones 1980b). The research presented here details the nature and significance of these practices paying special attention to an aboriginal group in the Northern Territory of Australia and one in extreme Northwestern Alberta.

Chapter II consists of an outline of the primary objectives and the methods by which they were met. Problems are examined concerning the practicalities of the study are examined.

Chapter III provides the review of the burning practices in both Northwestern Alberta and Melville Island.

Here evidence is presented, particularly informant evidence, detailing these hunter-gatherers use of fire. The current situation is discussed with respect to the use of fire in habitat modification in these regions. The comments by informants are given since this is illustrative of the indigenous peoples' actual insights and perspective. I have refrained from using the names of field informants because of the sensitivity of the subject matter. Ethical guidelines of the Social Sciences and Humanities Research Council and the American Anthropological Association were followed.

Chapter IV is concerned with the problem of the use of the ecotone and edge concepts in anthropology. As will be seen, this has direct bearing on any study of fire technology. Reference is made to the two fieldwork areas where segments of the indigenous people were questioned in the hope of eliciting information describing their perception of the ecotone-edge areas. Potential future research possibilities are indicated, as well as the difficulties in examining this ecotone question in a fieldwork situation.

Chapter V provides a summary of the work, along with a statement concerning future research into the "burning question" as discussed by Horton (1982).

A. Related Studies

In the 1950's Omer C. Stewart first directed his attentions to the topic of aboriginal burning (1951, 1954, 1955a, 1955b, 1955c, 1955d). He presented considerable data and interpretations regarding fires and aborigines, and the significance of burning to various environments. And in 1963, Stewart contemplated the "Barriers to Understanding the Influence of the Use of Fire by Aborigines On Vegetation". According to Stewart (1963) the lack of scientific attention to man-made fires was the result of several factors: the unwillingness of the scientific community to accept the validity of folklore as data; lack of interest in non-European practices/ customs (ethnocentricity-the natives simply had nothing to teach the Europeans); the American Indians were part of nature like other animals, and did not have a serious effect on it; and misunderstanding of the actual influence fire has on the environment (eg. all fires are destructive). Stewart apparently had little success in his immediate endeavors of stirring interest among his colleagues on this subject, in spite of the information he put forth:

> Aborigines set fire to vegetation for a number of reasons which vary in their importance depending on other geographic conditions. In flat temperate zones with a regular dry period fires were used to drive game, to improve pasture for wild game, to improve visiblility by removing brush and trees, to facilitate travel and approach to game, and to kill insects, rodents and reptiles for protection and for food. In tropical forests fire is an indispensible adjunct to agriculture for primitive

> horticulturalists. Fire removed the forest and provided fertilizer. Often trees had to be killed by girdling before they could be burned. Even in the tropics if there is a regularly short dry period, fire can maintain grassland at the expense of trees. In some areas like the West Coast of the United States and Canada, fire aided the production of nuts, berries, wild tobacco, wild seeds and wild tubers. Finally fire was occasionally used by aborigines in warfare (Stewart 1963: 125-126).

Lewis (1982b: 4, 52) suggested that disregard for fire studies may be attributed to a disregard for studies into the effects man has on the environment. This was despite the fact that "it was, and is, a fundamental postulate of ecology that every organism both affects and is affected by, its environment" (Lewis 1982b: 4).

Other early works on the subject of fire, aborigines and habitat modification do exist. Hough (1926) mentioned the use of fire in hunting drives of aboriginal peoples. Day (1953:329) noted that:

> Many botanists seem to share the popular belief in an unbroken virgin forest and to assume that human interference with natural sucession commenced with white settlement. They appear to overlook or dismiss the possibility of significant disturbance by Indians.

Day stressed that much of the northeastern U.S. was not primeval when first seen by Whites, and that the Indians there undoubtedly had a profound effect on the landscape.

Eisely (1954: 56) recognized that "man's fire altered the ecology of the earth".

Interestingly enough, it was Budowski (1959:266) who stated that "whenever man was able to burn it can be taken for granted that he did so because there were plenty of good reasons for it".

Bartlett (1955, 1956, 1961) composed an extensive bibliography on fire with special attention to agriculture/grazing in the tropics. Sauer (1944, 1947, 1975) has discussed man's use of fire as a hunting tool and the impact of fire on vegetation patterns, particularly the plains of North America. Daubenmire (1968:210) briefly touched on the topic of aboriginal burning in his work on grassland fire ecology[1]. Komarek (1962, 1967) provided a brief review of key aspects of fire, man's use of fire and the possible effects on nature, using existing information.

More importantly Arthur (1975: 10-30) has shown that the Indians of the northern plains region knew very well the systemic interrelationship of fire, grasslands and the bison. In a similar vein, Timbrook et al. (1983) reviewed Chumash vegetation burning in Southern California while Boyd (1984) investigated Indian burning in the Willamette Valley.

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[1]Other works that may be consulted, (of interest in terms of fire ecology studies) include: Afolayan (1978); Aubreville (1947); Boughey (1963); Budowski (1956); Chrostowski (1970); Coetzee (1942); Eden 1974; Egging (1979); Hills and Randall (1968); Hope (1983); Horn 1974; Kessell 1976; Kozlowski and Ahlgren (1974); Lotan (1979); Manner and Lang (1981); Minnich (1983); Myers (1936); Rowe and Scotter (1973); Schweger (1974); Seavoy (1975); Soares (1977); Thomas, Masier and Rodiek (1979); USDA (1978); Woodard (1977); Vasievich (1977); Vogl (1979); Wright and Bailey (1982).

on the Pacific coast of the United States. Norton (1979) looked at the historical evidence of Indian fires in western Washington, and the effects of these fires on existing prairies. Russell (1983) provided an evaluation of the historical documentation used to describe Indian burning in the northeastern United States. Loscheider (1977) provided information on the use of fire, through the examination of historical documents and accounts, in interethnic and intraethnic relations. She stressed the important role of the use of fire in the cultural practices of many of these Northern Plains Indians. Fire was used to keep hunting grounds from being depleted by neighbouring groups, and it was used in conflict situations and as a means of communication. Also, the setting of fires, according to Loscheider (1977), around trading posts, increased the value of trading provisions that the Indians brought in. Loscheider (1977) emphasized that the fires were not usually set for ecological reasons (there were fewer examples in the literature examined).

Ferguson (1979) focused on the Slave (NW Alberta) controlled burning technique, utilizing ethnohistoric interviews and palynological methods (to examine vegetation trends in the region). Dobyn (1981) added an extensive collection of information/ documentation to our knowledge of native fire use in the American Southwest. Pyne (1982) presented and analyzed a vast amount of data on fire studies, through an historical narrative. Numerous

geographical regions of North America were examined in view of the use of fire by American Indians, early European settlers and foresters. Current fire management policies were reviewed.

It may well be suggested that H.T. Lewis is the most prolific of the researchers engaged in the study of aboriginal fire technology (see Lewis 1972 etc.; Lewis and Haynes 1984; McBride and Lewis 1983). His works cover data from a broad geographic spectrum: the Boreal Forest of Canada; California; Southwest Asia; and Australia (and quite recently Israel). In 1978 Lewis made a film, entitled the Fires of Spring, which documented the hunter-gatherer use of fire in northern Alberta. Lewis (1972, 1981) has studied the relationship of fire to early agriculture and plant/ animal domestication. He has contributed several papers detailing comparisons of fire technology between various indigenous peoples (Lewis 1980a, 1982a, 1983b). Not only has Lewis covered aspects of Aboriginal burning practices in Australia, but that of the cattlemen as well (1985a)[2].

Australia has served as a source of information for numerous researchers (besides Lewis) who are interested in the topic of aboriginal fires[3]. Tindale (1959) may have been one of the first scholars to draw attention to Australian

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[2]Part of the fieldwork presented in this thesis was conducted while working for Lewis in 1983, on a Social Sciences and Humanities Research Council funded project in North Australia ("Aboriginal Vs. Cattleman Uses of Fire in the Northern Savanna of Australia").

[3]For an early account of fire-making techniques see McCarthy (1945) and Hough (1926).

Aboriginal use of fire. Jones (1968, 1969, 1973, 1975, 1979, 1980a, 1980b, 1981) has written extensively on the subject. Jones (1969) apparently coined the phrase "fire-stick farming" to describe Aboriginal fire management practices. His work in Arnhemland (Jones 1980a, 1980b) is particularly noteworthy here because of its comparative value to my study on Melville Island. Jones (1980a, 1980b) described in detail the Aborigines' understanding of environmental systems (land systems concepts) and the effects of fire use.

Another important figure with respect to Aboriginal fire studies in Australia is Hallam (1975, 1981, 1985). Her major work, Fire and Hearth, provided an exhaustive look at Aboriginal/ European fire use in the southwest section of Australia[4]. Hallam's argument was that the Aboriginal management practices determined the course of European pastoral management, and over the long term the Aborigines changed the landscape. Gould (1971) reviewed the importance of fire to Aborigines, in the context of his field research among nomadic desert people of Western Australia. Blainey (1975) vividly described the widespread practice of Aboriginal burning, and its significance to the original settlement of Australia[5].

Haynes (1978a, 1978b, 1978c, 1982) provided anthropologists with a wealth of information concerning the

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[4]McBryde and Nicholson (1978) provided a review of this work.

[5]Recently Blainey served as narrator in a television series entitled "Triumph of the Nomads", in which the subject of Aboriginal fires was examined.

subject of fire and Aborigines in the Northern Territory of Australia, partly as a result of his position with Australian Parks and Wildlife Service. His work deals with what is commonly referred to as the "Top End" of the Territory. Similarly, Kimber (1976, 1983, 1984) provided data based on fieldwork experience in the Central Desert region. Merrilees (1967, 1979) considered the possibility that Aboriginal fires may have played a role in the extinction of large Australian marsupials because of the effects on plant ecosystems. Further information is provided by White and O'Connell (1982) and Flood (1983).

Nicholson (1981) reviewed the role of fire in the lives of the Australian Aborigines, using information derived from archaeology, ethnohistory, ethnography and the natural sciences. She emphasized four points regarding the study of Aboriginal fire use:

> 1) The Aborigines operated from a cultural background that European man is only recently beginning to appreciate.
> 2) Fire was a common tool that he used with control and understanding in both his domestic life and in the processes of obtaining his food from the environment in which he lived.
> 3) He not only harvested his food for today but he must take care not to destroy the food source of tomorrow.
> 4) His fire regime was evolved from centuries of experience in gaining his subsistence directly from his land.

Horton's (1982) work has stirred up controversy with regards to the importance of Aboriginal burning to Australian ecosystems (see Hallam 1985; Lewis 1984: 21; Rigsby 1982). Horton's contention, which was essentially based upon literature survey, was that the Aboriginal fire regime had little impact on the environment, rather the role has been one of maintenance of existing patterns (Horton 1982). Furthermore, Horton (1982: 247) concluded that:

> ...the ethnographic evidence is suspect and does not demonstrate the control of role, extent, seasons and fierceness of burning demanded by the firestick farming model

Lewis (1984:9), with reference to Horton (1982), claimed an opposite stance by emphasizing the differences in hunter-gatherer fires and natural fires in both Australia and North America. Hallam (1985:13) stated that:

> To a certain extent Horton's criticisms are a sort of 'shadow boxing' - demolition of ideas and concepts not actually put forward by the writers he cites; a synthetic 'Tindale-Jones-Hallam' hypothesis which neither Tindale nor Jones nor Hallam has ever advocated.

Numerous works are available on the topic of fire ecology studies in Australia. Gill, Groves and Noble (1980)

and Stanbury (1980) serve as examples[6].

Also, prehistorians have examined the Aboriginal use of fire and its environmental consequences. Of particular note is Mellars (1976) and Allen (1983). Hallam (1975: 1-8; 1985:7-13) provided details on sources of information with reference to the Australian situation[7]. Lewis (1984:7) suggested that:

> most of what is written about the origins and evolution of fire concerns the ability of prehistoric peoples to produce and use it for cooking, heating, lighting...It has been fires of the hearth and not of the field that has occasionally concerned anthropologists.

In summary, anthropologists have not paid attention to indigenous peoples's use of fire in habitat modification/manipulation until recently. As usual, it can be stated that further investigation into this topic is needed, so that indigenous ecological knowledge, and technology or instrumental knowledge (as defined by Lewis

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[6]Other studies of varying interest to the topic examined here included: Abbot & Lonergan (1983);Bell (1981); Bolton & Latz (1978); Braithwaite & Estbergs (1983); Braithwaite & Gullan (1977); Bryant (1971, 1973); Burbidge (1943); Chippendale (1958); Coaldrake (1961); Conacher (1971); Fox (1980); Fox (ed) (1974); Fox and MacKay (1981); Gardner (1957); Gilbert (1963); Gill (1977); Henderson and Wilkins (1975); Hoares et al.(1980); Lacey (1979); Ladd (1976); Lakin (1968); Luke (1971); Lunney (1978);McArthur (1968; 1972; 1973); Mott (1982); Mount (1964, 1969); Norman (1963); Raison et al. (1983); Ralph (1984); Smith (1960); Smith (1978); Stocker (1966, 1968, 1971); Stocker & Sturtz (1966); Tothill (1971); Wakefield (1970); Wallace (1966).

[7]Other works to be considered here include: Dortch and Muir (1980); Golson (1977); Hughes and Sullivan (1981); Hynes and Chase (1982); Jones (1968, 1975; 1979; 1981); Jones and Bowler (1980); Lampert and Sanders (1973).

1986: 32) will be better understood. An understanding or awareness of indigenous systems of natural resource management will prove enlightening to park managers, resource managers, forestry officials and development planners. Native peoples may be incorporated into their respective operations and plans.

II. RESEARCH METHODS AND OBJECTIVES

The primary objectives of this research included a look at the patterns of burning employed by indigenous people in maintaining the distribution and relative abundance of resources for their livelihood, and the attempt to examine aboriginal perception or conceptualization of the ecotone or edge area as an important region of resource utilization. These objectives were met through field studies which involved the Slavey Indians in Northwestern Alberta and the Tiwi of Melville Island in northern Australia (refer to the maps in Appendix 1 & 2). The following is an outline of the completed research, sources of information are detailed, and methodological difficulties are discussed.

A. Library Research

Of significant importance to the study was library research. This was carried out at a number of locations including: the University of Alberta; Australian National University, Canberra; the library of the North Australian Research Unit in Darwin (NARU); the libraries at the Australian Institute of Aboriginal Studies in both Darwin and Canberra; the facilities at the Northern Territory Conservation Offices in Darwin; and, to a lesser extent, the map collections of the Forestry Unit at Snake Bay on Melville Island. NARU is a branch of the Australian National

University. The Interlibrary loans section of the University of Alberta and the librarian at NARU were particularly helpful in obtaining resources not readily available at their own facilities. This was particularly the case with very early records of early explorer accounts. Australian works were difficult to locate in Edmonton. It was not until I reached Australia in the summer of 1983 that I was able to review them. What I was particularly interested in were the early accounts of fire uses by natives. Ferguson (1979:19) has pointed out the difficulties of archival work with respect to Northwestern Alberta. Nonetheless, she provided an excellent review of the history of controlled burning in this region of Alberta[8].

B. Ethnographic Fieldwork

I carried out research among the Dene of Northwestern Alberta from June to August, 1982. The Indians of the Upper Hay River Band were the focus of the study. Reservation locales included Hay Lakes, Bushe River and Meander River.

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[8] The bibliography at the end of this thesis lists not only the references cited directly but those used in the preparation as stipulated by the University of Alberta thesis regulations (Faculty of Graduate Studies 1983:2). To some degree it may serve as a base for those interested in carrying out future research on the topics of traditional native use of fire or even fire ecology studies in general. There is of course a definite anthropological slant to the majority of references listed, hopefully this will encourage further research. All too often, in a number of works over the past few years, I have noticed that researchers apparently ignore a number of important recent works on the subject of fire technologies or they simply did not realize that information was available. Perhaps in a small way this may remedy the situation.

Primarily, I was interested in the elderly members of the communities, since they would be able to recall the traditional ways. There were ten key informants. The approach was to conduct multiple extended interviews of an informal nature. My intention was to elicit information regarding the native use of fire and possible perceptions of ecotone and edge areas of this boreal region. A formal translator was not employed, partly due to finances and partly due to non-availability at the time. If difficulties arose members of the families often served as translators for the elderly. At no time were formal questionnaires used. The reason for this will be explained in the next section.

I spent May to August, 1983 in Australia. After some preliminary difficulties and changes of plan it was finally decided that I would conduct field investigations on Melville Island. My approach was similar to that used in Alberta. Again multiple extended interviews were conducted. Often I would visit one informant a number of times, as new information came to light. I was also concerned that I would be taking up a significant portion of time of these individuals. I thought that perhaps it might be easier for the elderly if I didn't badger them with questions over a lengthly time during one particular day. Instead it was my intention to pay visits as Ferguson (1979: 22) had done with her research. Essentially it was directed conversation. My center of operations was Snake Bay, also known as Milikapiti. Most of my informants were found in this

village, although some were located in immediate outlying areas. On Melville there were thirteen key informants. Whenever possible the interviews were conducted in English. If I ran into difficulties the family members were very willing to help out. Again I was interested in information concerning burning practices and the conceptualization of the ecotone-edge areas of resource utilization. In both Alberta and Australia field notes and tape recordings of interviews were made. Essentially the informants were asked to recall old practices from memory. However, a few of the Tiwi elders I spoke with stated that they do still engage in burning off activities from time to time[9].

I spent a considerable amount of time traveling with members of the Forestry Unit to different sections of Melville when they conducted their prescribed burning. This time proved to be quite informative since I was given the chance to observe the effects of fires, talk with the head of the Unit, and converse with the younger Tiwi who worked for the Forestry Unit. It provided an interesting comparison to my sessions with the elderly Tiwi community members.

Data collected from Alberta and Australia are compared. As indicated above the details concerning how hunter-gatherers influence their environment through the use of fire were of prime interest. Lewis (1972 to 1985b),

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[9]I suspect that there are differences between Bathurst and Melville Islands, with respect to the maintenance of traditional ways, particularly the nature of the burning off excursions. Forestry is centered on Melville. I was unable to conduct research on Bathurst because of time/permit restrictions.

Ferguson (1979) and work presented here provide an intriguing contrast to previous anthropological studies which have, at times stressed the limiting factors of environment on hunter-gatherers. In many respects the sheer nature of this and similar research puts to rest the myth of the 'noble savage' who survives through a passive relationship with the environment.

C. Discussion

A number of problems became evident when I was conducting this type of research. Firstly there were language difficulties. Often my interviews proved to be quite difficult because of problems of interpretation. In Northwestern Alberta when younger family members were used as translators, the elderly complained that the young no longer knew their own language. At times the young people could not translate certain phrases or words. This was also the case with the Tiwi but to a lesser degree. In fact most of the Tiwi elders I spoke with were quite fluent in English. It might also be mentioned that physical infirmities of the elderly sometimes made the talks more difficult. In Alberta there was the additional consideration of the long distances between reserve locations where field interviews were carried out. Often considerable time was spent travelling to a community only to find that a particular individual or individuals were not present.

To some extent the people were suspicious of the stranger in their midst. Ferguson (1979:21) commented on the reasons for this in the Indian communities of Northwesternmost Alberta. Here burning is an illegal activity if not carried out with a permit. As Ferguson (1979) indicated penalties do exist. There is some hazard reduction burning near Indian settlements on the reserves in Northern Alberta, though fire suppression is the current norm. On Melville Island it is the Forestry Unit that carries out most of the burning. There are no fines as such but Forestry wants to be kept informed of any intentions to burn. In fact, at the Tiwi Land Council meeting[10] I attended, on Bathurst Island, the Tiwi members were asked by the head of the Forestry Unit, Mr. Jim Weston, if there were regions they wished burned in addition to the aerial burning program proposed by Forestry in the land management plan for both Bathurst and Melville Islands (NTCC 1983)[11]. Members of the Council requested the addition of select regions on both Bathurst and Melville to the Aerial Controlled Burning program as presented by Forestry. These regions were "in need" of burning, according to the members, since they had not been adequately fired in the recent past and members expressed interest in hunting in these locations. Hand

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[10]It was at this meeting that I presented my proposal for research on Melville, and final permission was granted by the Council.

[11]Forestry plantations on Melville include Pinus caribaea var. hondurensis (PCH) and Cypress Pine Callitris intratropica . See NTCC (1983) for further details on the extent and location of these tree plantations.

controlled burning and aerial burning are usually carried out between the months of April and June by Forestry. The aerial burning is carried out at a time so as to not interfere with the period of the Tiwi Bush Holidays (refer to Appendix 5 for further details on the Aerial Controlled Burning program). The aerial program, according to forestry, reduces not only the risk of wildfire in the tree plantations on the island, but prevents the native vegetation from experiencing too many hot fires (NTCC 1983:33).

Ferguson (1979), with regards to the reserves she worked on, related another explanation for the suspicious attitude of the people involved. Of course there is the expected suspicion of a white stranger asking questions, but on the reserves there had been questionnaire-based censuses conducted previously which may have caused some resentment. As a result, I too wished to avoid any formal clipboard questionnare type interviews. Rather as indicated I tried an informal approach. At times concern was expressed that I was a government welfare worker of some sort trying to elicit information. Thus in certain instances it was difficult to obtain the desired detailed information. Perhaps a skilled translator may have helped the situation, but as indicated above this was not always possible. At the time that I visited the Alberta reserves most of the men who could have acted as translators were away from the reserve fighting fires.

It might be suggested that my situation was somewhat different at Snake Bay. Here once the people realized where I had come from, they became just as interested in me as I of them. At times it was difficult to keep the conversation directed when I was attempting to conduct the interviews. Certainly a friendly informal atmosphere arose from which I could conduct my studies.

At times it was difficult to obtain sufficiently detailed descriptions from informants. Perhaps in some ways this is the result of the nature of this particular study and/or a reflection of my own inexperience. In both field situations modern influences have radically affected the indigenous peoples' traditional lifestyles. The elderly are presently not actively engaged in the old burning practices. And of course interviews are not as valuable as the actual context of the activities. On several occasions at Snake Bay, as soon as the Tiwi informant heard that I was interested in fire, they started an elaborate description concerning the traditional techniques of making a fire, *jikwani*, without matches. Only when I mentioned burning off, hunting wallabies, bush fire, and so on, was my point made clear that I was interested in the way they conducted dry season bush fires. Often the elders simply do not recall certain items. At times they may assure you that a word or phrase does exist in their particular language to explain the situation you describe, although they can no longer remember it. Elderly couples would help each other recall

former ways and words. And often with the passing of these elder community members is the loss of information of ethnographic importance since the younger members of the community do not always pick up much of the traditional knowledge. I put forward questions that were relevant to the study of aboriginal fire technology. The topics of seasonality, intensity of fires and the frequency of fires were discussed.

Certainly broad statements concerning traditional burning practices and the like could be elicited. But at times it was difficult to obtain the details one needed without putting words into the informant's mouth. This was particularly the case with respect to the subject of ecotone and edge areas.

The research is of value to a number of fields including social and environmental studies. The systemic environmental knowledge of these indigenous peoples is of interest to anthropologists. This study has bearing on investigations of the origins of agriculture (see Lewis 1972, 1981). Comparisons with swidden agriculturalists or even pastoralists may prove enlightening, particularly with respect to the fire technology many of these groups around the world employ even to this day (Lewis 1985a, 1986; Dove 1985; Chrostowski and Denevan 1970). Environmental agencies expressed interest in native peoples' burning practices. In the Kakadu National Park for example, an extensive fire management program is carried out, and the Aboriginals

living there participate (Australian Parks and Wildlife Service 1980). Similar type plans are in the works for the Cobourg Peninsula region (also known as Gurig National Park) (Northern Territory Conservation Commission, in prep.). Studies of fire technology also have some bearing upon native land ownership claims, and Jones (1982) has stressed the point that Aborigines in Northern Australia actually tended and used the land they inhabited, and their use of fire is an important illustration. This is in addition to their totemic relationships to the land.

III. HUNTER-GATHERER USE OF FIRE

Early spring sees the next major movement. After trading, visiting, and, if necessary, fixing up their cabins, hunters move to their beaver hunting grounds. In most cases these are the same or close to winter trapping areas. They stay there hunting beaver, moose, and deer until the end of May, a period as important as it was fifty years ago. At this time of year, while the ground is still moist, hunters used to set fires in carefully chosen locations. These fires encouraged new undergrowth to provide browse for moose and deer, and, by warming the soil, extended the growing season of important plants. They also burned away deadfalls on many paths and trails and renewed pasture for horses. The Indians' spring burning continued in northeastern British Columbia and nearby Alberta until recently. Forest management regulations have now suppressed the practices ... (Brody 1982:193).

The country is systematically fired from about June to early August after the southeast winds have blown down the tall grasses and when there is a dew and cool weather to extinguish the fires by nightfall. Such a burning regime results in all fires being controlled, so that even in woodland the scorch line does not reach higher than a metre and most trees are not damaged. The fires "clean up" the country, are used as parts of hunting drives, stimulate the growth of fresh new grass, and help to get rid of snakes and mosquitoes ... The Aborigines practise a de facto fire management policy resulting in the maintenance of existing floral conditions...(Jones 1980b:124).

> The natives seemed to have burned the grass systematically along every watercourse, and round every waterhole, in order to have them surrounded with young grass as soon as the rain sets in. These burnings were not connected with camping places, where the fire is liable to spread from fireplaces, and would clear neighbouring ground. Long strips of lately burnt grass were frequently observed extending for many miles along the creeks. The banks of small isolated water-holes in the forest, were equally attended to, although water had not been in either for a considerable time. It is no doubt connected with a systematic management of their runs, to attract game to particular spots, in the same way that stockholders burn parts of theirs in proper seasons...The natives, however, frequently burn the high and stiff grass, particularly along shady creeks, with the intention of driving concealed game out of it; and we have seen them watching anxiously, even for lizards, when other game was wanting (Leichhardt 1847, Journal of An Overland Expedition in Australia 1844-1845).

Why do indigenous peoples set those fires anyway? This is a common question regarding the hunter-gatherer use of fire. Lewis (1983b) has pointed out the problems inherent in such an enquiry. There is no simple answer to this question. The three quotations above suggest that this is a complex issue not to be easily resolved. Lewis (1983b:2) concluded that "Asking hunter-gatherers the reason for burning is analogous to asking farmers why they plow...". This puts the issue at hand into some perspective.

In recent literature concerning man's impact on the environment it shows that some researchers have not taken the time to ask indigenous hunter-gatherers the simple why question concerning their practice of habitat burning. All too often the investigator attributed the practice to 'pyromaniac behaviour' or 'they were just having fun'. For

example, Smith (1977: 200), with reference to Papua New Guinea, stated:

> It is clear then that a fire is and has been a potent factor in altering and degrading ecosystems in the area. However, it is probable that natural fire is absent or very rare...man continues to light fires where possible and where no authoritative restraint is perceived. Often simple pleasure in spectacular destruction is the motive.... [nonetheless] small game killed by fires may be collected, and some fires are lit for warmth...

Allison (1986: pers. comm.), a zoologist, asserted with reference to the Wau region of Papua New Guinea:

> In a number of cases fires are set for what I term "recreational burning" - juveniles are excited about the power of fire and will set fires whenever they can during the dry season. A number of adults also seem to set fires just to watch them burn[12].

Peterson (1971:89) in his thesis on Australian Aborigines concluded:

> Jones (1969:224-8) has suggested that by constantly firing the landscape the Aborigines have extended their natural habitat and increased foods associated with it. Though this appears to have been the result of long term burning, it is unlikely that the Aborigines were conscious of its effect on the total amount of food since it would take many years to induce permanent changes. Of the several reasons given for burning the country at Mirrngadja no mention was made of increased food or any long term effects. Indeed the only conscious efforts to effect food supply appear to have been magical...even the rituals were directed at maintaining the status quo rather than producing more. It is legitimate to say

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[12]The indigenous Papuans have sometimes been referred to as hunter-food gatherers-cultivators (Straatmans 1967). The PNG situation provides ample opportunity for fire studies.

that Aborigines did not produce food.

Perhaps these researchers would have benefitted from a look at Lewis (1983b), as indicated above.

A number of investigations suffer from the fact that they have not actually spoken to native informants with respect to the topic, nor have they taken the time to actually observe the indigenous peoples' use of fires in the region they described even though the opportunity existed or in some cases still exists (eg. see Horton 1982). When reading such accounts it pays to be wary of the details as they are portrayed. In a similar vein, many researchers apparently concluded that they did not think to ask informants questions regarding their fire technologies. Sometimes they themselves concluded that there was "nothing really involved about the custom"(Woodburn 1982, pers. comm.). Yet they did not pursue the topic with their informants. However anthropologists are certainly aware that every topic cannot be covered in a field situation. It is sad to note that over time a great deal of information concerning the topic of fire and habitat modification has been lost because of this oversight. Other researchers freely admitted that at the time they obviously did not know the correct questions to put to informants concerning the use of fire (Lewis 1986:8). In many places researchers may take the hunter-gatherer use of fire for granted since they have become desensitized to it because the practice is so prevalent.

Lewis (1983a, 1983b, 1984) suggested that we should view technology as knowledge, practical knowledge. It is not just the material tools of hunting and gathering societies that are important. Often, in many parts of the remote world there is an influx of new material goods or tools. This does not always change the behaviour a particular group exhibits in relation to their surrounding environment. Fire technologies of hunting and gathering groups serve as a prime example of this. Whether it is a new Bic lighter, a gasoline firebug, or a traditional firestick, hunter-gatherers such as Australian Aborigines in parts of the 'Top End' (Northern Australia, N.T.) still employ the same ecological knowledge and environmental understanding in their fire technology. The ecological systemics, according to Lewis (1983a:1) remain the same. Lewis and Haynes (1984:12) explicitly pointed out that "a fire technology is infinitely more complex and involved than just knowing how to make and use a fire drill". If the above premise is accepted, then idea of nomadic foragers having simple or primitive technologies has to be re-evaluated or even discarded.

Hunter-gatherers require an extensive detailed knowledge of their natural environment if they are to survive. They have to understand the factors of productivity and predictability as applied to resource yield (Ferguson 1979). Even though the material culture may be limited, the enviromental knowledge they possess is of necessity quite

comprehensive. Their survival depends on it.

As will be shown, fire technology is an integral part of most hunting gathering systems. Yet it must also be remembered that fire technology is often but a component of the total nomadic foraging pattern of subsistence. However the use of fire by hunter-gatherers seems to be a significant factor for influencing their surroundings. Lewis (1983a:4) recognized that there are hunter-gatherer societies that do not utilize extensive fire technologies. (eg. Arctic and Tropical Rainforest people). By and large such groups seem to be the exception rather than the norm, because of the nature of their environments.

When investigating the hunter-gatherer use of fire in habitat modification there are a number of details to be kept in mind, in order to comprehend the fire technology. These points concern seasonality of fires, intensity of fires, and the habitat location of the fires (site selection) (Lewis and Haynes 1984). If this is accomplished, then valid ethnographic comparisons may be drawn between varied hunting and gathering groups. The research presented in the study here focused upon two modified systems of indigenous burning practices in Northwestern Alberta (Canada) and Melville Island (Australia). As previously indicated, in these locations the traditional hunting and gathering ways have been radically changed and the burning practices have been altered to such an extent that it is usually only the elderly of the communities who recall

former ways. In this respect, the two societies are directly comparable. Nowadays they are heavily dependent upon the locally bought store foods. On Melville Island it is the Forestry authorities who determine when and where fire is to be used. Forestry, through both on-the-ground and aerial ignitions, carry out most of the prescribed burning. Indiscriminate use of fire, on Melville, can be worrisome for forestry officials since there are numbers of valuable tree plantations on the island. Interestingly enough, as I discovered during my fieldwork, it is sometimes Whites who are new to the community who cause some of the worst problems for the Forestry Unit by setting fires in protected areas because there were burned areas all around anyway, or they see the fires of the dry season and decide to light a few themselves, particularly around their yards. In some instances, Forestry personnel had to step in to control the blaze and prevent it from damaging property or harming trees such as the coconut palms that have been planted in sections of the village. This is not to say that some indiscriminate fires of the local aboriginal villagers do not cause problems. Also, fires set by the Unit, may get away and cause problems[13]. Considering the amount of land burnt annually, however, and the numbers of crew available to manage fires, this is inevitable. In Northern Alberta government agencies normally prohibit the use of fire,

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[13]On Melville I witnessed the damage a fire caused in a new plantation of pines. This necessitated a great deal of extra work on the part of the Forestry Unit.

except for approved hazard reduction fires near settlements. However, it is rumoured that summer 'job fires' are set to create employment.

Informants in these two areas were asked to give accounts of the old ways. As mentioned above, this should not be misinterpreted with respect to the Top End of Australia. There are hunter-gatherers who even today participate in burning the land. Regions of Arnhemland are examples (Jones 1980a, 1980b, 1982; Haynes 1978a, 1978b, 1982). Ferguson (1979:21) asserted that as early as 1942 in the Fort Vermilion area of Northern Alberta there were fines and jail sentences for unauthorized burning. There is some indication that there may have been a decrease in burning shortly after 1900 (Ferguson 1979). In 1962 the Commonwealth Forestry and Timber Bureau of Australia started a program of forestry activity on Melville Island. Plantations of Cypress pine were established, starting in the vicinity of Snake Bay (Milikapiti). Haynes (1978c) has discussed the problems with such a program for Maningrida. As early as 1941 a small government settlement for Native Affairs had been set up and in 1942 Snake Bay served as a war base.

A. Northwestern Alberta

> ...that is what they used to do a long time ago. There is one old trapper here, everytime he goes on a spring hunt, coming back he sets fires all over, where they used to get hay, have a good hay in the fall. Now nobody does that. The hay is not growing too good (N. Alta informant, 1982).

The Alberta study area is shown in the map in Appendix 1. I lived at Assumption, Hay Lakes Reserve. Informants were also contacted at Bushe River Reserve, and north at Meander River Reserve. This area comprises about twenty thousand square miles. There were few roads north of the Peace-River district before 1940, so the settlements were relatively isolated until quite recently.

Continental air masses dominate Alberta's climate. Mean temperatures for any month decline from the south to the north. North (1976:17-19) provided climatic information on this northwestern Alberta region. According to North's data for 1931-1960 the mean January temperature was minus twenty-three degrees Celsius; the mean April temperature was between minus two degrees Celsius and zero degrees Celsius; the mean July temperature was sixteen degrees Celsius; and the mean October temperatures varied between zero degrees Celsius and two degrees Celsius. North's (1976:19) figures indicated that the annual precipitation for this region was approximately forty centimeters.

Ferguson (1979:19) has shown how remote this area was, particularly from the main fur trading routes, until even the turn of this century. From the 1940's onward, intrusion increased, along with policies of fire suppression. The extension of the Mackenzie Highway, the establishment of a school at Assumption, and the drop of fur prices after WWII led to increased sedentarization, a reliance on wages, and a restricted hunting and gathering lifestyle.

Lewis (1982b:19) has dealt with the argument concerning the status of the Indians of these parts of Northern Alberta as "true hunters". Prior to World War II hunting and to a lesser extent gathering was the main subsistence strategy. Trapping of fur animals did not radically alter the dynamic relationships between hunter, plant communities, and animals. What follows is a review of Indian burning practices in this region. The information is drawn primarily from the works of Lewis (1977, 1978, 1980a, 1980b, 1983b) and Ferguson (1979), and from my own personal field interviews conducted in the summer of 1982.

The Indians knew when, where, and how to burn to achieve the results they desired. The quotation from Brody (1982) opening this chapter is indicative of the systems of knowledge involved. Another Indian elder asserted that:

> ...come out from the spring hunt. Set fires to make it good for the animals. Old timers knew what they were doing at that time (before the ranger came). Set fires when the snow was melting but there was still snow in the bush...get the new grass in the meadows...set fires for the hay...Mostly prairies in those places then...now grown up with bush...(N.Alta. informant, 1982).

Indians set fires in different locations for various reasons. Meadows, sloughs, trails, marshes, deadfalls, and berry patches were mentioned. The outcome of the burning was new growth to attract animals, removal of litter, trail maintenance, new hay growth for horses, creation of

firewood, improvement of campsites and the protection of camp areas. These are a few of the main benefits derived from the controlled use of fire.

The Indians' use of fire as portrayed in Lewis' (1978) film, Fires of Spring, emphasized the important factor of seasonality. Controlled fires were by and large set in the early spring period. This differed from the natural fire regime since lightning usually caused fires from mid-summer to fall. Spring burning provided benefits to the natives whereas the conflagrations caused by lightning later in the summer could prove harmful because of the extensive damage they might produce. Nowadays large natural fires are numerous and are caused by the fuel accumulations of litter and debris (Rowe and Scotter 1973). Informants claimed that years ago the fires were not as big nor did they cause as much damage as they do today. The halt of Indian-controlled fires is an important factor to be considered because of the consequences.

Indian elders indicated that the meadows were one of the prime areas targeted for annual burning:

> As a boy I would go out with my father to do the spring burning. Burn those meadows for the horses. We would burn that old grass. This would make it better...(N. Alta. informant, 1982).
>
> ... if there was still snow in the bush we would burn those meadows for the horses. In a short time, maybe a couple of months there would be new grass for the horses (N. Alta. informant, 1982).
>
> Do it in the spring time where there is the willows and the hay. Horses liked it - that is why they were

> doing it for. Like big prairie close to Hay Lake. When the hay gets older there is bugs inside - that is why they burned it off. Don't you see they know something. They say they are not that stupid. Burn it in the spring after the snow (N. Alta. informant, 1982).
>
> ...well where there were prairies the old people would burn them a long time ago. And now there is all that hay - all dried up in places - keeps piling up. Once that starts it just takes off. If they burn it now they have to watch... (N. Alta. informant, 1982).

The snow and moisture of adjacent forest areas prevented the fires from entering and causing extensive damage. Lewis (1982:b) noted that the subterranean parts of grasses and plants in the meadows would also have been protected because of wetness or frost. If there was sufficient old hay, the meadows would be fired usually each spring. Informants often pointed out to me the significance of these prairie fires for their horses. One elderly lady stressed that "The old people knew how to keep them horses, the Indians knew how to keep them animals". The maintenance of areas for horses was important. Lewis (1982b:28) reported that moose are also attracted to such areas and that the natives are well aware of this fact. Lewis noted that one informant suggested that the moose ate the burnt twigs and leaves to obtain the salt. Apparently a shortage of sodium exists in the diet of moose in these northern forests (Lewis 1982b:28, Jordon et al. 1973).

Certainly the firing of the meadows made travel much easier. Plus, it appears to have kept these regions open as prairies until recent times. According to informants

> why the bush is so thick is because...they stop burning...the Indians stop burning...Did you ever see them prairies. My goodness, I even remember. It was really prairie...just prairie you know (and) here and all there you see little specks of woods and if there were trees they were quite huge (Lewis 1982b:24, citing a Beaver woman, 69, High Level).

It appears that without the Indian burning the meadow areas have been invaded by the forest. And often this has happened in the lifetime of an individual as indicated by the informant evidence[14].

Early explorers recognized the significance of Indian fires in this region. Dawson (1882: 125) commented that:

> Whatever theory may be adopted and may have been advanced to account for the wide prairies of the western portion of America further to the south, the origin of the prairies of the Peace River is sufficiently obvious. There can be no doubt that they have been produced and are maintained by fires. The country is naturally a wooded one, and where fires have not run for a few years, young trees begin rapidly to spring up. The fires are, of course, ultimately attributable to human agency, and it is probable that before the country was inhabited by the Indian, it was everywhere densely forest clad.

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[14]Schweger (1974:178) provides similar informant evidence for the Fisherman Lake Area, N.W.T.

Ferguson (1979:66) observed that recurrent burning in some locales and the accompanying recolonization by grasses permitted meadows where normally trees would be expected to dominate. She mentioned a place in the vicinity of Meander River. She also discussed the role native burning played in grassland maintenance in combination with climatic fluctuations. Ferguson (1979) recognized that native burning practices have often been denigrated by depicting them as random or uncoordinated activities, consequently their importance as an ecological tool of modification has been overlooked or misinterpreted. She stated that:

> only the realization that native burning was a patterned activity which had express ecological and economic purposes can bring about a willingness to consider realistically the ways in which a powerful tool has been used in the past to modify the environment (Ferguson 1979:70).

Lewis (1982b:30) provided the following quotation by a pioneer who contrasted the differences in the cover of brush and trees near the town of Slave Lake.

> I was eleven years old (in 1912) when I came here from England with my sister, brother and mother. My father was already here pioneer farming...In those days you could see right to the lake (one mile distant) and the island out there - just a few trees on it then, and lots of deer to be hunted there, but not now...I remember being scared that first spring when the Indians set fires in all the meadows. There were smokes everywhere. That's the way they kept the country open, you know. Now, except where we actually farm, the trees and brush have taken over most of what was grassland. My father said that we'd had a terrible hard time pioneering if the country hadn't already been open (Lewis 1982b citing a White

informant, 73, Lesser Slave Lake area).

Lewis (1982b:25-26) and Ferguson (1979:70) both mentioned that the Indians sometimes burned in the fall. In the field interviews I conducted informants denied that this occurred[15]. However, Lewis and Ferguson spent a greater amount of time in the region and subsequently conducted more interviews than I was able to. Ferguson recorded information told to her from one informant:

> When we were still hunting and travelling in the fall when the plants were dried up, then we would let the fires go. We would build a campfire for tea, then just leave it and continue on our way...it had the protection of the snow (Ferguson 1979:71 citing a male Slavey informant, born 1903).

Similarly, Lewis found that:

> Sometimes we burned in the fall. It has to be at the right time because (the fire) might get away. You wait until there's snow in the bush and it's kind of wet there. The grass burns real good but it stops when it gets to the bush. Then in the spring you get a better grass (Lewis 1982b:26 citing a Slavey Indian, 79, Hay Lake area).

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[15] By the time of my study, a number of elderly community members, interviewed by Lewis and Ferguson, had passed on. The absence of a very knowledgeable woman in Meander River was felt.

Certainly fall burning could prove to be hazardous. Areas that were seldom used during the winter may have been fired. Ferguson (1979:71) suggested that fall burning may have acted as a kind of safeguard if the spring time happened to be too wet for good burning. In any case, whether autumn or spring burning, the natives were well aware of factors which regulated the time of burning during the day. The extent of the buildup of litter in meadows has already been mentioned. Lewis (1982b:26-27) listed other regulatory factors such as the size of area, natural firebreaks, wind, lateness in the year, and even slope and air currents, particularly in the foothill region of the mountains.

Trail areas were usually burned each year. These often followed the course of rivers and streams. Fur bearing animals were often attracted to these fired regions and the burning enhanced the productivity of traplines along such routes. Rodents attracted to the areas served in turn to attract predators from nearby forests. For example, an Indian stated:

> In times past, people knew where to trap animals, mink, weasel, marten, lynx, lots of kinds. It makes a lot of difference for the trapper if an area was once burned...(Lewis 1982b:31 citing a Slavey, 69, Meander River).

The forest adjacent to the stream region and sloughs were usually still moist in the springtime. This prevented the

fire from spreading and causing harm.

Lewis (1982b:36) indicates that six of his informants reported the burning of deadfall forest stands. Summer lightning fires might occur in such areas. And if an open place was to be maintained in the location fires would have to be set every spring. Lewis' informants indicated that if it was opened then animals such as moose might frequent the place.

The edges of streams, and also marshes were burnt in the spring. The new growth would attract muskrats and waterbirds which were important to the Indians' livelihood. Care was taken by the natives to burn before the birds nested. Women were known to burn places where there were berries (eg. wild strawberries, wild raspberries and blueberries). The area around campsites were fired as a protective measure against wildfire destruction.

> At our cabin, my dad had a cabin - we would set fires around the cabin in the spring - when the snow is in the bush yet. In the summertime, if there was a fire around - they don't burn there. They go around (N. Alta. informant, 1982).

Trees were frequently fire killed in the spring to provide a ready source of dried wood. As Lewis (1982b) pointed out, this would often take place at the edge of meadows. The Indians would then have firewood for summer and winter. Fires around the communities would have cut down the

populations of blackflies and mosquitoes, by reducing the amount of brush and trees (Lewis 1982b). Also, Lewis (1982b:42) mentioned that there may have been religious and esthetic reasons for burning. In this thesis these aspects were not covered.

The Indians affected and altered the natural regime through the use of fire and they were well aware of the consequences and adaptive advantages of their actions. Overall, they affected the regional distribution and relative abundance of plant and animal resources so as to improve their livelihood. They were well aware of the differences of natural fires and their own burning patterns. Seasonal events were modified to suit their needs. The old Native people I spoke with were conscious of environmental-ecological problems.

> ...trapping used to be good a long time ago. But these oil companies, they have spoiled everything. They cut too many cutlines and where there is timber, the sawmills are taking all the timber... trappers used to kill lots of fur. Now not like that... (N. Alta. informant, 1982).

> ...well now you get the big fires. Forestry can't do nothing about it. What if my traplines get burnt in the big fires? What am I going to do in the next year? (N. Alta. informant, 1982).

> ...twenty years ago we lived at Hay Lakes - go a few miles and could you see the ducks and geese - so thick. Now hunters and airplanes ...build dams and the water is too high that it kills the food. And those people that put those dirty pumps in the water. Not good. Indians should get money and fight. There is few deer - jumping deer - maybe even bugs in deer (N. Alta informant, 1982).

B. Melville Island Australia

> ... you have to be careful in burning and not just burn anywhere. Like you have to watch the fires around the yams, so the tops would not get burnt off. Do that and you can't find them to dig them out...do that so they could be found later like now[16] (Tiwi informant, 1983).

The Australia study area is shown in the map in Appendix 2. After Tasmania, Melville Island is the second largest island of Australia. It is north of Darwin in the Northern Territory. Both Melville Island and nearby Bathurst Island are Aboriginal reserves, inhabitated by Tiwi (Tiwi means 'we people' or 'the people') (Pye 1980). The land area of Melville Island measures about twenty-four hundred square miles. Bathurst is considerably smaller measuring about eight hundred square miles. The major seasons are the wet, dry and the buildup (see information provided in Appendix 3 which details the Tiwi Seasons, and European Monsoonal Seasons). During the wet season extreme rainfall can make travel difficult. Fires are evident during the dry season. Little rain, if any, falls during this period. The buildup refers to the onset of the wet season when there are several

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[16] Stocker (1968:46) noted that common yam genera at the Karslake Peninsula on Melville Island include Dioscorea, Ipomoea, and Amorphophallus. And that these are often found on the fringes or within the monsoon forest.

hot humid months[17].

Before the arrival of Europeans the Tiwi consisted of nine tribal bands (each in control of a portion of Melville Island where they hunted). At times tribal ceremonies or raids would have necessitated a move out of their region (Stocker 1968). Hart and Pilling (1960:10) stated that as late as 1930 the Tiwi still thought of themselves as 'the people' and used other terms to refer to mainland Aborigines, Malay fishermen (Macassans), Japanese pearl divers, French priests and British settlers. In the past the Tiwis were reputed to be hostile towards outsiders. Klaatsch (1907:584) noted that "the natives on this island are absolutely preserved in the primitive stage, and are stated to be dangerous and treacherous". Hingston (1938) also referred to the "bad reputation of the island blacks" and their "warlike tendencies".

Pye (1980:6) concluded that the permanent entry of outsiders into Melville and Bathurst dated to 1895, however, there were earlier contacts. It was in 1824 that the British under Captain James Bremer established Ft. Dundas close to the present-day Garden Point settlement. Today that location

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[17]The Asian north-east monsoon, after changing course near the equator, being reinforced by a thermal low over Australia, causes the heavy rain of the wet. The passing of the monsoon over the warm seas surrounding Indonesia creates the large amounts of rain. Cyclones may also produce large amounts of rainfall (and cause damage, eg. Cyclone Tracy which destroyed most of Darwin in 1973). The dry season in North Australia is characterised by southerly and easterly winds, which are hot and dry, because of their passing over much of the continent before reaching the tropical north (see Australian National Parks and Wildlife Service 1980: 37-38 for additional information).

is overgrown and lies in ruin. Morris (1964) reviewed the relationships between the British and the Tiwi at the time; there were conflicts. Several causes for the abandonment of Ft. Dundas by the British in 1829 may be given. These include sickness, insects, problems with the natives, poor soil for agriculture, and isolation to name a few (Morris 1964; Bach 1958; Pye 1980). In 1828, Major Campbell at Ft. Dundas, in a letter to Colonial Secretary Macleay, reported that "at this season (May) they commence their burning off excursions" (1923c:721). This is a very early reference to Tiwi burning practices. Likely the next major influence was that of Joe Cooper who came to hunt buffaloes on the island near the turn of the century. He settled at Paru in 1905. Rev. F.X. Gsell established a mission at Bathurst (Nguiu) in 1911 (see Gsell 1956).

Goodale(1957:14) provided several details concerning the Tiwi use of fire.

> "Black Joe Mob. Him camp Anderaningo." I looked in the direction to which he pointed with his chin, but could see nothing other than white sand broken in spots with the heavy green of mangrove jungles. "There" he repeated. "See Him make big smoke". By straining my eyes...I could see a wisp of white smoke rising above the last patch of green on the furthest point of land.

Informants also pointed out to me that the presence of fire and smoke were used to indicate the locations of people. When Goodale inquired about the hunting trip she was informed that:

> No good you go bush too much grass, plenty big mob cheeky snake. By and by that mob burn the grass, then we go bush (1957:23)[18].

And when actually travelling she noted that:

> The trunks of the large bloodwood and stringbark trees were blackened for about four feet up from their base. The spiralled trunks of the screw palm, as well as their lower dried leaves, also had a charred appearance. Except for an occasional patch of grass, which the rushing fire had missed, there was not a living green plant below the four foot line (1957:23).

In describing the actual burning practices Goodale(1957:23) stated:

> Burning the country is an annual occurrence and many are the laws governing who may burn and who may subsequently hunt in nearly cleared land. Because fires are set each year, there is no accumulation of dry tinder to feed fire and allow it to rage uncontrollably. Only the grass and a few fallen logs catch and they will burn rapidly and fiercely but for a short period. Any gap in the vegetation, will stop the fire and the heavy dew falling in the evening, will also put out the flames, leaving perhaps only isolated, smouldering logs to burn through the night.

And it would appear that

> until the first shoots of new grass push their way through the charred ground, the individual hunter who set the fire has exclusive rights to the area he set alight. Of course, no one except those who belong to that country may burn without the permission of the owners. As far as possible, these

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[18]The presence/ absence of poisonous snakes represents a strong concern of the Tiwi. Judging from my own experiences it is best not to wander in high thick grass.

laws are upheld (Goodale, 1957:24).

In observing the surrounding territory while on the hunt Goodale (1957:31) noted that "This area had all been burnt by the previous parties and already little delicate shoots of grass were poking through the black ground".

Hart and Pilling (1960) and Stocker (1966,1968) commented on the large communal hunting drives using fire. Hart and Pilling (1960:34) noted that there are no large kangaroos on either Bathurst or Melville, in contrast to the mainland, but there is the wallaby. Stocker (1966:225) has suggested that the "largest and most organized fires for hunting have been observed on Melville Island". When using spears it was necessary for the Tiwi to get as close as possible to the animals to facilitate the kill.

> The topography, and the prevailing south-east winds in the dry season cause some areas of the Island to be especially favourable for driving game with fire, and these areas are traditionally used for this form of hunting. Four men are usually assigned to light and extend the fire front while as many as twenty others wait to ambush the driven game, mainly wallabies (Wallabia spp.). The aboriginals in ambush retreat from the path of the fire by moving out of the tall open forest into safe areas such as mangrove or monsoon forest. Areas burnt in hunting fires of this type may be as large as 20 square miles. (Stocker 1966:225)

Hart and Pilling (1960:41-42) stated:

> ...a senior man of the district might decide to convene a grass burning posse. To it he invited more or less whom he pleased, as long as he included other household heads of the same band and other

> senior men from outside whose ancestry gave them some claim to be invited. At the appointed time the hunters assembled, perhaps ten to fifteen men, with younger ones doing the actual hunting and the older ones supervising. The women and children acted as beaters; the grass was set fire over a big area and the kangaroos rounded up and killed while dazed by the smoke and haze. The bag of animals killed in such a concerted hunt sometimes ran higher than one kangaroo per participant, so that every man, woman, and child present was able to gorge himself on kangaroo meat for a day or two.

Stocker (1966:225) pointed out that in other regions, grassy coastal plains and some inland areas, fires were lit by the Tiwi to encircle and confuse animals to make the killing easier. He also indicated that fire was used in the hunting of the pied goose (Arseranas semipalmata). Tiwi lit fires in the grass underneath paperbark trees (Maleleuca spp.) where birds would be, causing them to fall because of the smoke. Then they would be killed. Stocker (1966) also indicated that fire was used by the Tiwi in ways similar to other Australian Aboriginals - the burning of small areas to promote green growth which would subsequently attract animals.

Ease of travel is also given as a reason for burning in the literature. Hart and Pilling (1960) indicated that at the end of the wet and the beginning of the dry season, much of the country gave poor hunting returns. The tall old grass made it difficult for the hunter to get near his prey without alerting it. After fire drives, the large burnt area attracted animals (the early green growth in such areas is commonly referred to as 'green pick'). Animals would come

here out of adjacent areas such as dense scrub or mangrove swamps, and the Tiwi would have an easier time hunting them. The removal of the tall grass made it easier to spot their prey, and avoid snake bites.

As with the Natives of Alberta, Tiwi burning was not a haphazard activity. My elderly Tiwi informants corroborated observations made by Goodale, Hart and Pilling, and Stocker in earlier studies. One informant was adamant in his description of firing procedures that:

> You had to check with an older man before burning such and such a place, and you could tell the man's importance by [the] number of wives he had...Maybe talk to a couple of people about it...then go burn the place...Certain places burnt first-around camp and favourite hunting places...(Tiwi informant, 1983).

Tiwi women recognized the need for the fires:

> Clean em up bush, then you go hunting...good bush tucker [wild bush foods] after you make bushfires...not burning everywhere... can use fire to chase animals, then club them - goanna, bandicoot, wallaby...get possums in trees, make fire, then club em (Tiwi informant, 1983).

Often Tiwi women would burn around the camps, and would be involved in "getting possums":

> ...sometimes possums get in or near these trees

> [pointing to pandanus (Pandanus spiralis?)] when we [were] trying to burn out [and] smoke them out. The dried leaves would catch and wind can carry the fire. Sometimes might burn quite a distance...the burning made it easier to get around...

Other Tiwi informants stated:

> set them early fires often, sometimes they [would] go just a little way and stop...you don't get high fire then (Tiwi informant 1983).
>
> ...when you burn a certain area the animals will go there - then you can get them (Tiwi informant 1983).
>
> ...when you burn the grass-forest edge there would be wallabies there...they would be sleeping or lying in the grass...and the smoke would make them dizzy like they are drunk...then you could spear them (Tiwi informant 1983).

A number of the elderly Tiwi confirmed that they once ate cycads (Cycas medias ?) and pandanus kernels. The significance of fire to these plants has been discussed elsewhere (see Beaton 1977; Hynes and Chase 1982; Meehan et al. (1979) and Harris (1977). According to these researchers, fire may be an important factor in plant regeneration. If an area is burned, cycads may be favored in contrast to shrub vegetation, old cycad nuts may be exposed once the leaf litter is removed by fire (Beaton 1977:169). Also, burning may synchronize/stimulate actual seed production (Beaton 1977:171). Fire may have added nutrients to the soil and encouraged reproduction. In the burnt test plots there were seven times as many seed cones as in the unburnt plots. The elderly informants were well aware of the fact that "the little peanuts" of pandanus made "good

tucker". Yet when I asked several young Tiwi (in their teens and early twenties), they did not believe that pandanus kernels were edible, or that they were even a desired food source. Jokingly they suggested that maybe the "Arnhemlanders" ate them.

One informant stated:

> set a fire if you get lost - people can find you...see the smoke from far away (Tiwi informant 1983)[19].

The Tiwi expressed concern when fires caused unwanted damage:

> ...some young fellows gone over to Goose Creek burning and cause a lot of shit...burning places where there would be geese and they cause a lot of problems...these young fellows must have been outsiders that went in there and didn't know how to burn.., (Tiwi informant 1983)[20].

With regards to the geese in this Goose Creek region, a Tiwi elder informed me that:

> ...we used to burn in there...the wild rice attracts the birds (geese)...you could burn small patches of it and the geese would be alright...the geese would dig and root around for the seeds even where it was

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[19]Nowadays this may even be a more common practice for those who get stranded with their dinghy across the bay, because of motor trouble.

[20]Weston (1983: pers.comm.), who heads the Forestry Unit, informed me that considerable damage was done to the paperbark forest in this area, and very large numbers of geese were killed at that time with the use of shotguns.

> burnt...you don't burn the wet areas where they are nesting...(Tiwi informant, 1983).

Stocker (1968:45) concluded that the greatest influence on vegetation in these islands (Bathurst and Melville) was the intensive use of fire. Karslake Peninsula, on Melville Island, was used for the driving of game (eg. wallabies) with fire. The timing was very important, the area was not to be burned until it was dry enough to provide a continuous fire. Stocker (1968:45) insisted that the Tiwi group controlling this region could have invited other nearby Tiwi to join them in the drive. Fires were lit across the base of the peninsula. The southerly winds would have carried the fire to the tip of the peninsula, where the animals could have been surrounded and killed as the fire moved through the tall open forest[21]. Severe fires, according to Stocker (1968:129), could damage or even kill the eucalypts at Karslake. These fires would have to be under very hot windy conditions, with high levels of litter accumulation. This litter buildup would occur if an area had not been burnt for a long period of time. Trees could be scarred or left with a dead side, and subsequent burns would aggravate the problem to such an extent that the tree itself may be burnt to the ground[22].

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[21]Stocker (1968:62) indicated that the islands vegetation is related to the nearby mainland, particularly the Cobourg Peninsula, where for example E. nesopphilia is a noticeable tall open forest species as on Melville and Bathurst. And it is not known from any other area.

[22]Stocker (1968:131) indicated that old fire scars may serve as an entry point for dead wood termites.

On Melville it appears that the monsoon forest is retreating due to two factors: fires in the adjacent tall open forest; and the disturbance caused by yam digging (Stocker 1968: 134). Cyclones and successive fires would have caused sudden but infrequent retreats over large areas. It is intriguing to note that on Melville Island:

> In most places the speed of the monsoon forest retreat seems to have been slow, as the ecotones are very sharp and small isolated remnants are few. An exception seems to be Karslake Island, where monsoon forest remnants are scattered within the eucalypt forest (Stocker 1968: 134).

The jungle fowl Megapodius freycinet tumulus can be found in the monsoon forest (Stocker 1968, 1971). This bird is of particular interest since it provides evidence that the monsoon forest was once found in localities where only the tall open forests may be ascertained today[23]. On Melville the birds live in the monsoon forests. The firing of the litter in the eucalypt forests prevents them from using this region for mound building. The presence of these nests (mounds) outside the boundaries of the existing monsoon forest indicates vegetation change. Stocker (1971:30), in his study of these jungle fowl nests, put forward several reasons to account for this apparent change: cyclone damage

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[23]The nests are large mounds of litter and earth, scratched up by the fowl. Eggs are laid in the mounds, and left to hatch in the warmth of the sun and the decaying vegetation. Mounds can be as much as 25m in diameter and 3m high. The species is found along much of the coastal belt of tropical Australia, living in monsoon forests, rainforests and similar closed communities (Stocker 1971).

and subsequent burning (as already mentioned); declining annual rainfall or lengthening of the dry season; and an increase in the fire frequency because of the arrival of the Aborigines[24].

Nowadays it is the Forestry Unit (under the auspices of the Northern Territory Conservation Commission) which carries out most of the burning on Melville Island. General management objectives of the Unit include:

1) The establishment of a minimum of 200ha of Pinus caribaea var. hondurensis plantation per year.

2) Assisting the Tiwi in the development of a timber resource and the management of the resource to supply a local sawmill.

3) Continuance of activities contributing to the conservation of natural resources on Melville (with advice and assistance to the local communities) (NTCC 1983: 2-3).

Specific fire management objectives include:

1) The protection of existing plantations, experimental areas and Forestry buildings from wildfire.

2) The continuation of Aerial Controlled Burning (ACB). This is to protect the native forests of Melville from harmful dry season fires and to maintain ecological diversity through the creation of burnt/unburnt areas (see Appendix 5

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[24]Weston (1983: pers. comm.) reported that edges of the monsoon forest are often burnt by the Tiwi (inadvertedly ?), and that the reduction of the monsoon forest is taking place, but the extent of this is unknown. When I was on Melville, the Forestry science officer informed me that he had actually witnessed an Aborigine (he was unsure whether it was a Tiwi) setting a fire inside a monsoon forest region in order to catch a wallaby.

for information on ACB).

3) Conferring with the Tiwi Land Council with respect to the timing of burning operations (so as to not interfere with the Tiwi Bush Holidays).

4) Protective back burning and break establishment as soon as possible after the period of the wet season; with hand burning being carried out only when necessary since ACB is to cover much of the remainder (NTCC 1983:31-32).

It has been suggested that the Tiwi are more mobile (with their boats and motors) than they were before the arrival of the Europeans (Weston 1983: pers. comm.). Many of the young Tiwi may be going into regions where they traditionally may not have been (eg. further up some of the rivers). At these locations the fires that are set may cause high intensity blazes which can be destructive to the immediate environment. Paperbark forests are sometimes burnt, and stream banks erode as a result of the dead trees. It was noted that there may be overkill of some species in select areas (eg. the magpie goose) because of the extensive use of shotguns. Destructive fires hurt the habitat of these animals[25]. A few elderly Tiwi I spoke to expressed their knowledge and concern over the killing undertaken by younger community members. It is a matter of short term vs. long term goals. For instance, it may be very profitable to bring in one-hundred birds at a time, yet in the long term the

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[25]At one point there was illegal selling of kills at the settlement ($5.00 a bird) and officials note that this is difficult to control.

disadvantages are obvious (eg. the birds' breeding population is reduced). Weston (1983: pers. comm.) actually questioned the subsistence value of much of the hunting, seeing it more as leisure activity.

Elderly members of the Tiwi community, who I interviewed, were aware of the ongoing changes and problems in their environment, similar to the natives of Northwestern Alberta.

> ...now you can burn after Forestry burns-they burn [along] the creeks with the aeroplane. Young blokes do the burning and hunting. Before Forestry it was burnt everywhere, even along here [beach area]. Sometimes it [the fire] would get away but you try not to burn where the tucker is [yams]...Fires not big like Forestry fires [as widespread ? as intense ?] (Tiwi informant, 1983).

> ...yes before Forestry [came] we [would] burn the bush - lit em up by the road, village ...burn a place many times...but the young people now don't know how to hunt anymore...(Tiwi informant, 1983).

> Young [Tiwi] today don't know how to burn, don't bother talking to them...they don't know how to cook a wallaby - ha...young ones go hunting with their shotguns and set fires, they don't know how to do it and they don't learn...I guess this comes with civilization (Tiwi informant, 1983).

C. Discussion

Ferguson (1979:86) gave a Slavey example which can be compared to to the Tiwi situation examined above.

> Today hunting is mostly done by boat along the rivers and the moose we kill are just those we see along the banks, because it is very difficult to hunt in the bush when the underbrush is thick...Now all the people live off the store...A long time ago

> when we used to burn you could return to that spot and it was easy to hunt. If we make fire now, we might have to suffer for it so we are afraid (Ferguson (1979): citing male Slave informant born in 1892).

Nowadays, the community store has become an important center for obtaining foodstuffs in both the Tiwi and Slavey study areas[26]. This has altered their traditional means of subsistence; they simply do not depend on the traditional ways as they once did. Hunting, in the present times, can consist of river excursions. Fire suppression in Northwestern Alberta affected native traditions more so than the takeover by Forestry of fire management responsibilities on Melville. At least the Tiwi still have access to the decision-making process with the Tiwi Land Council. They can make requests to Forestry. The Tiwi can and still do engage in burning off activities, although not to the extent that they did in the past.

It is reasonable to assume that the indigenous people of Northwestern Alberta and Melville Island affected the vegetation patterns of their respective regions through the prolonged use of fire (see Ferguson 1979, Stocker 1968). The relative abundance of animals and the scale of any natural fires would have been changed. This refutes the allegation that hunter-gatherers were passive components in the scheme of nature. The resulting benefits of fire use are evident in

[26] In many parts of North Australia, Aborigines are again living off traditional foods and living in "outstations" and they continue to use fire to manipulate their environmental surroundings.

both cases. At present, fire management programs are in effect in both locations, however, it must be stated that actual burning is much more evident on Melville. Only recently have scholars directed their attentions to Northern Alberta[27]. Fire suppression is still a significant factor in Northwestern Alberta. Fire hazard reduction is a technique employed in both study areas. Ferguson (1979:119-120) demonstrated the benefits that could result if an active fire management program was put into effect in Northern Alberta. These include: the re-introduction of bison from parks to restored hay meadows; removal of deadfall; destruction of animal feces and dead grass which can be contaminated by anthrax spores harmful to bison and horses; the increase in environmental diversity favouring wildlife and benefitting tourism and native subsistence; and the creation of employment opportunities for natives of the region.

The Forestry Unit on Melville employs several Tiwi in its various operations on the island. Fire management, as indicated above, is carried out with the needs of the Tiwi Land Council in mind. Forestry assists with the "Tiwi Tours", a tourist venture, and they take care to fire-protect specific locations of interest (eg. recreational and sacred sites). As shown by the list of Forestry objectives in the previous section, the creation of

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[27]The ongoing fire ecology studies in Wood Buffalo National Park, under the direction of Dr. Ross Wein of the Fire Science Center in New Brunswick, are a prime example.

a mosaic of burnt/ unburnt areas, to promote environmental heterogeneity, was an important concern.

It would appear that the fire management program of Forestry on Melville is more specific than the varied aims of aboriginal fire management. As illustrated above, Northwestern Alberta natives and Tiwi utilized burning for numerous objectives, depending on the exisiting circumstances such as seasonality and frequency. They were interested in manipulating a wide array of plant and animal resources, in light of predictability and productivity. Essentially, a prime interest of forestry management practices was (and is) hazard reduction. On Melville this is particularly evident because of the plantation stands. It might be suggested that the aboriginal fire regime was general in nature compared with Forestry. An example of this concerns the factor of seasonality. Aboriginal fire regimes involve numerous biological variables (see the aboriginal calendars in Appendix 3 and 4). Fires are set according to environmental circumstance. However, Forestry attempted to follow a rigid set of procedures, sometimes necessitated by the bureaucracy of the organization. For example, Aerial Controlled Burning may occur on Melville despite the fact that it simply may not be the ideal time to burn those regions, because of a late wet season. The set time for handburning around select plantations may not be realistic for a given year. This is not to say that Forestry on Melville does not allow for some leeway, yet, the program is

more specific when compared to the aboriginal patterns.

Misunderstandings continue to confuse the understanding of the Aboriginal fire regime. Lewis' (1985:28) interview with a Euro-Australian cattlestation owner serves as a good example:

> You're not one of those anthropologists who's going to try and tell me that the Black Fellas knew what they were about...that they were some kind of conservationist? What a lot of bloody nonsense!

In view of the evidence presented, it is apparent that serious consideration needs to be given to the technologies of hunter-gatherers, particularly their fire technologies which are part of the traditional nomadic lifestyle. Tools do not necessarily equal technology (see Lewis 1984). Fire technology has been shown to involve more than just the methods of making fire. It necessitates a comprehension of dynamic systems of information in terms of the man-environmental relationship.

IV. ANTHROPOLOGISTS AND USE OF THE ECOTONE CONCEPT

> An ecotone is a transition between two or more diverse communities as, for example, between forest and grassland...it is a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas themselves. The ecotonal community commonly contains many of the organisms of each of the overlapping communities and, in addition, organisms which are characteristic of and often restricted to the ecotone. Often both the number of species and the population density of some of the species are greater in the ecotone than in the communities flanking it. The tendency for increased variety and density at community junctions is known as the edge effect (Odum 1971: 157)[28].

> ...If we focus on behavior as problem solving, then an examination of the insiders view, the perceived environment, is crucial to understanding the decisions and solutions. It allows us to investigate the recognition of problems, the awareness of potential solutions and the evaluation of realized benefits. A more objective appraisal of the environment, by contrast allows us to evaluate the effectiveness, long term impact, and secondary ramifications of solutions...(Jochim 1981).

Odum (1971: 158) stressed the significance of the forest edge ecotone with respect to human populations. Settlements maintained "forest edge communities"[29]. It is

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[28]Refer to Odum's (1984) Basic Ecology work for his most recent explanation. It is this 1971 work (and earlier editions), which researchers mentioned here utilize.
[29]Odum (1984:436) discussed this in light of the first settlers in Wisconsin in 1838. Odum defined the forest edge as a "ecotone between forest or grass or shrub communities". He contended that the preferred habitat of Homo sapiens was forest edge, since the species liked the shelters of trees and shrubs, but obtained its food from grassland and

suggested that "it seems likely ecotones assume greater importance where man has greatly modified natural communities"(Odum 1971). Over the years Odum's work has influenced a great many anthropologists' theoretical perspectives. Ecotone and edge effect alone serve as prime illustrations of this (eg. Hickey 1974; Noble 1974; and Peterson 1977a, 1977b, 1978a, 1978b, 1981). It is beyond the scope of this particular work to review every researcher who has utilized the ecotone concept in their studies. Rather, an attempt is made to look at key issues and points.

The focal point of this chapter is the use of the concept of ecotone in the field of anthropology[30]. Yet, ecotone as a concept may be traced to ecology. Here, a discussion of what has been termed the gradualistic point of view versus the organismic point of view is provided. Criticisms concerning the borrowing of the concept by anthropologists are given. The idea of ecotones has interested anthropologists in that humans, especially hunter-gatherers, exploit such areas. And, there is a special attraction for the study of fire technologies since hunter-gatherers create and maintain such places (Lewis 1984: pers. comm.). Evidence from my field research, and others, is presented. There are data which indicated hunter-gatherers have their own conceptualization of

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[29](cont'd) cropland.

[30]Lewis (1982: pers. comm.); Rhoades (1974, 1978) and Cooter (1974) served to arouse my interest in this particular topic. A seminar project with Colin Chapman, in ecological anthropology, entailed a preliminary look at what was to evolve into this investigaton of ecotones in anthropology.

ecotones and how they can be utilized. When such information is compared cross-culturally, benefits to anthropology and ecology may be ascertained.

Anthropologists have borrowed ideas from ecology. Rhoades (1978:608) stated that Odum's passage concerning ecotones is likely one of the most cited ecological paragraphs in spite of the fact that it is essentially a general textbook formulation. The subfield of archaeology serves as an example. In 1974 two entire symposia concentrated on the ecotonal concept ('The Ecotone Concept: Its Archaeological Implications' with the meeting of the Central States Anthropological Society and 'Adaptive Strategies in Biological and Cultural Transition Zones: Examples From a Central Arizona Ecotone' with the meeting of the Society for American Archaeology). Rhoades (1978) suggested that anthropologists, in spite of the fact that they rely heavily on general ecology, may not be in a position to adequately judge or criticize the borrowed concepts. And, ecotone may be seen as a case in point.

Here an examination is made of Australian Aboriginal and Albertan Indian uses and perceptions of edge areas, and the results are discussed. Additional comparative data are utilized. It will be apparent that ecotone and edge phenomena represent significant aspects of not only hunter-gatherer uses of fire, but the nomadic foraging pattern as a whole.

A. Literature

At the beginning of this century the idea of transitional life zones was first employed (Merriam 1890). The term ecotone was first used by Clements (1904: 153) who visualized it as a "habitat stress line". At first it was plant communities which were considered but faunal analyses soon entered the picture. Ecotones have often been interpreted as boundaries between ecosystems[31]. The shoreline between marine and terrestial ecosystem serves as an illustration. Often they are seen as separating major biomes (groups of interrelated biotic communities).

If the organismic ecological point of view is considered, then the discrete boundaries of plant communities in similar environments are recognized. Sharply defined boundaries of the communities represent an essential facet of this interpretation. Yet, as will be seen, interpretive problems arise if the ideology of the gradualistic perspective is examined. Odum (1984: 431-432) examined the debate of land plant communities as discrete units versus the idea that communities overlap in a continuum (so the recognition of discrete units is arbitrary), thus the zonal approach contrasts the gradient analysis approach. The gradualistic (sometimes referred to as individualistic or continuum) viewpoint emphasizes species rather than communities[32]. King and Graham

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[31]King and Graham (1981) provided a detailed historical review of the use of ecotones.

[32]Gleason (1926) was an early proponent. McIntosh (1967), Whittaker (1967), Whittaker and Niering (1965) and Terborgh

(1981:129) stated that available data supported the gradualistic point of view. The communities grade continuously in time and space, and are not recognizable as discrete units. But interestingly enough, they suggest that it may be useful to utilize the community concept within the context of the individualistic system, using statistical methods to discern dominant species. Afterall, the plant/animal life of a region may be very complex so that subdivisions may be a useful approach - and these segments of the gradient may be compared (thus using community as the descriptive tool). Odum (1984: 432), with respect to these two outlooks, pointed out geography sometimes dictates the utility of one perspective over the other (eg. where steep gradients or topographic discontinuities exist - ecologists might use the zonal concept; whereas the presence of uniform soils, gentle gradients may favor the presence of the use of the continuum concept).

Basically the ecotone concept is derived from the organismic ecological point of view. Rhoades (1978:610) asserted that from a gradualistic or continuum perspective, "ecotones and edge are ghost phenomena created by the typological thinking of earlier descriptive ecology". The recognition of discrete units is arbitrary, thus the zonal approach contrasts with the gradient analysis approach.

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[32](cont'd) (1971) provide more recent synthesis and examples. Here communities are seen as collections of populations with similar environmental needs, and because the ecological requirements of individual species differ, the boundaries between communities can not be ascertained.

Debate arises over the actual existence of ecotones, however, essentially ecotone is a conceptual device.

Given Odum's definition, in the opening quotation, it is evident why anthropologists have frequently adopted the concept for the study of hunter-gatherer societies. Because of the possibility of edge effect, ecotones would appear to be likely targets for human exploitation. Anthropologists have borrowed this concept from ecology, yet among ecologists considerable disagreement exists with respect to the idea of ecotones. Nonetheless, numerous anthropologists have borrowed the ecotone-edge concept for their own particular subject of study. Works include Baerreis and Bryson's (1965) investigation of Mississipian cultures; Fitting's (1966) study of the Carolinian-Canadian edge area of Michigan; Gumerman et al. (1975) Arizona Ecotone Project; Hickerson's (1965) Upper Mississippi work; Hickey's (1974) report; Noble's (1974) Tundra-Taiga ecotone study; Wattrall's (1976) thesis; and Losey's (1978) Prairie-forest thesis research. Recently J.T. Peterson carried out extensive research in the Philippines among the Agta hunter-gatherers. And the ecotonal-edge concept formed an integral component of the interpretation (see Peterson 1977a to 1981). Yet it must be remembered that like ecosystem, ecotone is a concept[33]. It has no actual existence. What we

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[33]Lewis (1982b:10-11)concluded that "ecosystems are not simply places in which we find plants, animals and man in cohabitation, and in this sense humans do not live in ecosystems as they would live in houses...It (ecosystem) is simply a conceptual device which the investigator uses to isolate and organize some, although never all, of the

have is ecotone as a concept (which can be conceivably applied to everything from a transitional zone eg: parklands) to an interface between two habitats (such as a meadow and a stand of trees) and ecotone as a place recognized and exploited by hunter-gatherers. And it is in the area between our borrowing of the concept, and a peoples' use of such, that problems arise in the literature (Lewis 1985: pers. comm.).

Baerreis and Bryson (1965: 204-205) in their work on Mississippian cultures state that :

> ... we have attempted to concentrate upon cultures whose geographic locations are near the margins of biomes, the largest definable community of interaction of plant and animal species, since this location should make them particularly sensitive to climatic fluctuations ... as the climate fluctuates, one would expect the ecotone ....to shift its locations and thus be reflected in changes in plant and animals associated with a cultural sequence in a given locality ... Archaeological work in an ecotone has an added advantage because of the operation of a mechanism designated as edge effect ... An ecotonal community often contains many of the plant and animal species of both adjoining community areas and hence is a region of increasing variety and density of plant and animal life. They would obviously be an especially favorable habitat for human occupation and one might also expect a higher population density for man and consequently a more adequate archaeological record ...

It is easy to see how these researchers have borrowed from the community point of view in ecology. Here they have recognized not only increased variety and densities of plant

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[33](cont'd) interrelationships in a small arbitrarily designated portion of the world out there".

and animal life but also a relatively higher population of prehistoric human groups as reflected by the archaeological record. On the surface it appears that they have accepted the hypothesis of the effects of ecotones before actually submitting it to testing in an actual field situation.

The Central Arizona Ecotone Project encompassed the region south of the Mogollon Rim between the Bradshaw Mountain Agua Fria drainage system and the Verde Valley in Central Arizona just north of Phoenix. The actual specific locale is at the head of the Sonoran Desert, which is to the south, and at the edge of the Colorado Plateau to the north (see Gumerman et al. 1975). In a preliminary discussion of this project Gumerman and Johnson (1971:84) asserted:

> We feel the concept of ecotone as a heuristic device provides an ideal construct for the study of factors affecting the occurrence and human habitation in a biological tension zone. The edge area may, in addition, result in and explain what are called sub-cultures or regional cultural variants. It may also explain other differences between the major environmental zone and the ecotone, such as differences in population density, settlement pattern, and the differences and diversity in subsistence patterns. It may also explain site locations in defensive situations due to warfare over the natural resources of the edge area. In other words, the use of the ecotone concept in archaeology may help anthropologists to understand the zones between culture areas, a vexing problem since the careful formulation of the culture area concept in North America ...

Interestingly enough Gumerman and Johnston (1971:85) suggested aerial remote sensing techniques as the most

practical device of delineating sub-environmental zones including ecotones. Yet one wonders if in light of the above whether or not the ecotone concept can serve as a valuable research tool. Researchers are mapping out these zones when in fact the actual existence of such zones is debatable. As long as the use of the concept as a heuristic device is recognized, then there should be little confusion with respect to actual existence of ecotones.

Another archaeologist, Hickey (1974: 96) contended, with specific reference to the Arctic and Subarctic, that:

> By pursuing the basic notion that cultures are adaptive devices, and that they may be profoundly affected within the tension zones at the margins of their territorial domains, we may yet begin to specify those 'stimuli' for interchange. Once archaeologists have begun to investigate the nature of this complex, linear and temporally variable ecotone, we may expect to begin to formulate truly rigorous statements accounting for the distribution of the cultural traits...

Hickey (1974) saw an ecotone at the northern forest edge. He discounted descriptions characterizing the edge as an "osmotic membrane" or as the "functional equivalent of the Maginot Line" (1972: 88). The edge area was depicted as drawing people in from the flanking communities. The ecotonal area was discussed in terms of "dynamic genetic activity" including a high potential for "evolutionary change" (Hickey 1974: 90). As with the previous work mentioned above, can this be a case of confusing concept and

empirical reality?

Hickerson (1965) has looked at warfare between the Chippewa and the Sioux in central Minnesota and the western part of Wisconsin. Hickerson (1965: 62) concluded that the "warfare was a function of competition over game and was waged chiefly in areas where game was most abundant". He pointed out the significance of the transitional forest park region as the most important habitat for deer. Warfare regulated and preserved a population of deer in a buffer zone where they could be eventually hunted by the Indian groups. The buffer zone corresponded to what has been termed the forest-prairie ecotone.

Fitting (1966) employed the edge concept in his Michigan Carolinian-Canadian edge study. Here again the ecological tension zone is one and the same with the prehistoric cultural tension zone. Fitting (1966:146) did not see the transition zone as being easily identifiable. In his study Fitting recognized the meeting of a high carrying capacity area with a low carrying capacity area. Where the two zones met was postulated to be an area of intermediate carrying capacity. According to Fitting (1966: 147) this was in contrast to the idea of the highly productive ecotone put forward by Odum (1965). The location of this border between deciduous and conifer forests is in Michigan. Here there is an area of a high diversity of plants and animals (deciduous) which contrasted with a relatively low diversity of food plants (conifer). However, Odum (1971) has pointed

out that increased density and productivity (of edge) is not necessarily a universal phenomenon (see the opening chapter quotation). Fitting (1966) equated ecological transition with cultural transition, as reseachers mentioned above did. In the transition zone that Fitting saw between the high and low capacity areas he recorded a decrease in site density.

In his Tundra-Taiga ecotone work Noble (1974:162) recognized,

> The role of spruce forest and associated fires has obvious ecological parameters for faunal ... and human adaptations in the north. One such cultural case is graphically represented by the Canadian Tundra-Taiga tradition dating between 1250-600 B.C. Widespread from Victoria Island to the Great Slave Lake and the upper Thelon River to northern Manitoba, this cultural tradition with its many local variants displays typical late Arctic small tools ... Clearly these people had already adapted to the forest margin by 1000 B.C. , and sometimes penetrated up to 150 miles inside the present forest border. In this case, new cultural adaptations are probably not directly caused by climatic changes per se but, rather as a response to the subsistence economics of the tundra-taiga ecotone. Edge-area adaptation appears to be the case.

Noble's (1974) work contributed to studies of the tundra-taiga ecotone in the intervening region of the central interior of the District of Mackenzie. Methodologically, as likely indicated from previous discussion, there appear to be inherent problems with the utilization of the ecotone concept. Here Noble accepted the concept and its role in explaining adaptive strategies of

prehistoric people, yet does not recognize the innate difficulty of employing such a concept[34].

Lewis (1973) has examined the use of fire by hunter-gatherers in the California region. The effects of fires on environments and the nature of the burning practices have been elaborated upon. Interestingly enough, Lewis (1973:83) stated that:

> ... as a consequence of living in a variety of zones, Indians were able to exploit the ecotones, the transitions or "edges", between forest and brush, between brush and woodland, between woodland and grass. As we know it to be a general principle of ecology, it is the ecotone area in which the density and variety of life are the greatest. Like men everywhere - the pioneer who clears the forest or the farmer who plants trees on the prairies - the Indian did not simply take the habitat as he found it. Even though the overall environment already provided two and often more natural ecotones, the Indian was able to create a variety of local ecotones within vegetational zones. At the same time, even where natural ecotones already existed, eg., between woodland-grass, and chapparal zones - aboriginal burning pushed back the upper zones of brush or trees to favor a more productive cover of mixed trees, grass and shrubs ...

Lewis (1973) suggested that the California Indians within the coastal conifers and mature chapparal "maintained edges within a more generalized cover of brush or trees to both

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[34]These concepts of ecotone and edge are important in archaeology (not only because of the possibility of increased resource availability) because any shifts in prehistoric peoples' subsistence patterns would likely first occur along ecotones - if there is environmental change caused by climatic fluctuations, according to King and Graham (1981:139).

increase and concentrate resources of plants and game". Lewis indicated that the local ecotones of the montane coniferous forests were "less distinctive in form, the natural vegetation already a mosaic of trees, brush and grasses"(1973:83). He goes on to state that"... a complex interface was maintained and regularly recreated between grasses, forbs, shrubs and trees"(Lewis 1973:83). In discussing this Indian practice of maintaining ecotones Lewis (1973: 83) emphasized the great extent of the burning practice and the subsequent impact on habitat richness. Also, King and Graham (1981:132) suggested that disturbances such as fire may increase the diversity and density of habitat (when one vegetation type sharply contrasts another).

Again it is necessary to point out that Odum (1971:157) suggested that there may be a "tendency for increased variety and density of organisms at community junctions". King and Graham (1981:132) stressed that this tendency is by no means a universal occurrence. Odum (1984: 437) contended that several organisms may not increase in density (eg. the density of trees in a forest-edge ecotone). Similarly the removal of stretches of tropical rainforest will reduce species diversity, or even cause the overall extinction of select species adapted to large areas of this particular terrain [35]. Fittings (1966) work mentioned above serves as

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[35]Thomas et al. (1979:5) stated that the "amount of edge habitat or ecotone in an area is a function of edge width, length, and configuration. Area of an ecotone is determined by width and length measurements. Less ecotone habitat

an example. Certainly an ecotone may have greater species diversity, but this does not necessarily dictate that it will be a greater diversity of food resources. King and Graham (1981:133) stated that researchers needed to keep in mind the idea that an ecotone may not be more productive than the bordering communities (in terms of the food resources exploited by aboriginal peoples).

According to Thomas et al. (1979) fire was but one of many causes of induced edges. Others included: irrigation; wood cutting activities; seeding and planting activities; the construction of reservoirs; the grazing of animals; fertilization and cultivation; and general vegetational manipulation. Causes of inherent edges may include: any geomorphic discontinuity; general topographic variables; varied soil types; actions of erosional processes; and the presence of water. These same researchers also suggested that inherent edges may change over time. That is, inherent edges may be abrupt or mosaic, and inherent edges sometimes evolve into mosaic edges over time (Thomas et al. 1979). Also it is pointed out that the pattern of induced edges may vary as in clearing activities. And here again the idea of inherent diversity of habitat and induced diversity is stressed (Thomas et al. 1979). In somes ways it may be

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[35](cont'd) results from abrupt narrow edges, in contrast to wider edge. The pattern of the arrangement of edges is labeled configuration, and this may vary from simple to mosaic. And habitat richness is related to the "contrast in vegetation structure along the edge". Where contrast is great, bordering habitats are quite different (in terms of their structure and wildlife) and the number of species in the ecotone may be increased (Thomas et al. 1979).

suggested that induced edges and inherent edges even complicate the issue of ecotone and edge further. For anthropologists have to understand the idea that there could be naturally occuring edges or ecotones (because of the natural events mentioned above), and man-made edges (because of habitat manipulation and modification as indicated above).

As shown above considerable disagreement exists within ecology as to the actual existence of ecotones. Can you quantify a concept? Essentially this is at the root of the confusion. Various anthropologists have utilized these concepts, perhaps because it offers simple ready made solutions to otherwise complex research problems (Rhoades 1978:613). This can result in a severe methodological problem if such a line of enquiry is actively pursued and continued. For example, it would be very easy to see ecotones everywhere (eg. hill-valley, shore-water, flat-slope—.).

As Rhoades (1978) with particular reference to archaeology, stated "methodologically, it would seem more reasonable to reduce the 'edge effect' principle from an unquestioned assumption to a testable hypothesis in archaeological research design". Thus it does appear that a cautionary stance with respect to the use of ecotone-edge would be advisable under these circumstances. Nonetheless

> ...we should vigorously pursue the utilization of all available resources from sister disciplines,

> especially ecology. However, just as historians and sociologists have been guilty of inappropriate application of ill-digested anthropological concepts such as tribe, band, culture, and race, we too can be accused of unthoughtful borrowing. Indeed, without careful examinations of the origins, historical development, and potential pitfalls of many concepts drived from ecology and other fields, we may find ourselves dealing less in fact and theories than in outdated fads and may ultimately demonstrate little more that we 'understood those fads even less than the originators of the fads who were by no means clear about them in the first place' (Rhoades 1978:614).

Anthropologists can test the ecotone concept, in such a manner so as to benefit hunter-gatherer studies and anthropological research in general. In this light, perhaps anthropologists should keep in mind Bennet's view that:

> ...very different kinds of generalizations are obtained from different levels of analysis...when ecological processes are viewed in the context of microsocial situations, limited in time, space, and population, the generalizations made at the higher levels may be reversed...It is not that microsocial studies are unimportant; only that their generalizing power pertains to particular circumstances, and must not be taken as having universal applicability...(1976:308).

Up until now many of the drawbacks of the use of the ecotone concept have been discussed. The other side of the coin must also be looked at. We must consider the potential use of the ecotone-edge concept in anthropological research. In doing this we must break out of the old trap of utilizing ecotone solely as a descriptive device in the manner discussed above. The concept must be viewed as a test

hypothesis. That is, it must be verified or falsified. Yet it must also be kept in mind that other lines of research should remain open.

B. Research and Field Studies

One line of research where ecotone may be utilized and tested in such a manner so as to broaden research perspectives is the subject area of 'broad spectrum economies' (Cooter 1974; Rhoades 1974). These economies involve exploitation of a wide spectrum or array of resources. Basically, such economies are seen to have developed in post-glacial times (Binford 1968). Essentially, during this time period a restructuring of subsistence and adaptive strategies occurred. Interestingly enough it seems that certain cultigens of these early economies would likely have become the major component in the later agriculturally based economies. This is of prime importance to those researchers who concern themselves with the rise of agriculture and the domestication of plants.

Lewis (1972:207), with special reference to use of fire and the domestication of plants particularly in the Assyrian steppes contended that:

> With the frequency of mutations increasing as a result of fire and with new adaptive niches opening in the Assyrian steppe, new forms could have (and probably did) become established. In fact it may be that the 'Cerelia-type' grasses...those species or subspecies which are genetically and morphologically midway between the wild and domesticated forms, derived from the oak- pistachio area and may be

> related to an earlier (20,000 B.P.) intensification and seasonal extension of man-made fires in the earliest phases of the broad spectrum revolution. Fire coupled with increased grazing (of either wild or domesticated animals), could have provided the necessary 'shock stimulus' leading to the emergence of agriculture.

And furthermore, Lewis(1972:207) citing Dimbleby pointed out that "Any human activity which concentrated the destructive powers of the goat would soon bring about a drastic change in the woodland cover".

Both Rhoades (1974:28) and Cooter (1974) have put forward the suggestion that ecotonal areas were favored by practioners of the the broad spectrum economies. However, Harris (1969,1972) may well be one of the earliest recognized proponents of this idea. In any case the researchers suggested that such areas would have been chosen because of the assured diversity of plants and animals and the relative ease of accessibility. Rhoades (1974:28) asserted that:

> The more particularly favored ecotones would have been upland - lowland margins in mountainous settings or between major biomes where the juxtapositon of ecosystems provided, within a relatively geographically confined area, readily obtainable food and a balanced diet which in turn promoted a tendency toward sedentary settlement.

Harris (1969) also considered that ecotones may have been vitally important in the emergence of incipient cultivators and subsequently the emergence of agriculture. In

particular, the areas disturbed by man's activities are stressed in this scenario.

From this a scheme can be elucidated whereby the ecotonal-edge concept, as a generalization, may be tested. However, the cautionary note indicated previously must be kept in mind. That is, they should not accept the ecotone concept at face-value. The concept needs to be viewed as a hypothesis which can be tested through the application of an appropriate research design. As a matter of fact Rhoades (1974:32) concluded that "... it is necessary to build on available ecological and anthropological knowledge of such regions by recourse to a number of ecological principles which have predictive utility that go beyond the ecotone concept itself".

Cooter (1974) considered not only the edge effect and its apparent advantages to peoples exploiting ecotonal regions. Cooter's selective advantages of ecotone regions included: a higher level of productivity than adjacent ecosystems; high species diversity; lower level of maturity (which may encourage cereals that might not normally survive in suitable quantities for exploitation in mature ecosystem); the interspersion of the regions (making ecotonal regions very attractive to the system of broad spectrum economies); and finally the range of habitats in the region which may prove useful to their survival and propagation. Essentially Cooter saw a mosaic of microenvironments within select ecotonal regions and that

this would prove to be very beneficial to people who need to exploit a wide variety of resources. If these places, the locations of the varied resources, were close together then they obviously could be exploited with a greater ease, particularly if a number of the food plants reach production stages at the same time.

Cooter (1974:45) believed that:

> Ecotones offer many inducements to societies practicing broad spectrum economies, but perhaps their greatest inducement is that such regions could be resistant to ecological degradation. Quite possibly a number of types of ecosystems could offer initial adavantages comparable to those of ecotones, but such ecosystems are probably more susceptible to positive feedback processes that could affect their level of productivity in the amount of sociocultural inputs necessary to maintain them at a desired level of productivity.

Oddly enough, Cooter (1974:45) concluded that "Human subsistence activities almost invariably lower the maturity and stability of natural ecosystems - perhaps the only exceptions being simple hunter-gatherers systems or swidden systems based on vegeculture as practised in tropical rainforest environments - and almost invariably this tendency makes necessary increased labor inputs...". Cooter did not stress hunter-gatherers' extensive use of fire[36] in many parts of the world to influence the diversity and

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[36]Lewis (pers.comm.) points out that in terms of succession, fires lower the maturity and stability of natural ecosytems, but it is the overall pattern of the fire mosaic that makes for diversity and abundance.

numbers of plants and animals which may be exploited (see Lewis 1981, 1982a, 1982b; Jones 1969, 1975, 1980a, 1980b)[37]. Nonetheless the above brief discussion of broad spectrum economies represented only one potential area where the ecotone concept may be utilized and subsequently tested as to its viability. Other possibilities do exist.

Peterson has carried out extensive research among the Agta hunter-gatherers and Palanan peasants in Northern Luzon in the Philippine Islands (see Peterson 1977 to 1981). From data on game habits, environment and hunting success, Peterson (1981:1) found that as the Palanan farmers expand their fields, the extent of the forest/ field ecotone is increased. This in turn affects the distribution of game animals that the Agta hunt. As a result the Agta can be found on the peripheries of the Palanan peasant settlement, and in this manner the hunting gathering lifestyle of the Agta is perpetuated. Agta hunt and trade in close proximity to the farmers of the Palanan area. There is an interrelationship between these two peoples, through trade they feed each other, both are dependent on the game and the expanded crop areas for food. The Agta keep the game in check, which lessens damage to farmer's fields. The consideration of ecotones or margin areas was an integral part of her work. Two of her primary objectives have been

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[37]One may also wonder what Cooter precisely meant when he referred to "simple hunter- gatherer systems". Actually things may not be as 'simple' as they appear at first glance. This point concerning hunter-gatherers will be elaborated upon later in this work.

the delineation and description of the forest-field ecotone in Palanan, and locating and describing sites where the Agta hunters focus their efforts, and their subsequent relation to the ecotones. Peterson has indicated that the Agta are well aware of the ecotone, but initially she was not concerned with their conceptualization or perception of this forest-field area. Peterson does show that the Agta are aware of the consequences of extensive, continually spreading agriculture to their livelihood. That is, the Agta realize that at some future point the agriculture may spread so far as to actually harm their way of life. But at the present time, as Peterson indicated, the relationship between the Agta and the Palanan peasants is beneficial to both parties concerned. Peterson noted that the Agta identify ecotones (edges) as *digdig*[38] and that most recognize their significance to the behaviour of game (1981:8).

Nevertheless, emphasis in her work was placed upon quantification of resources found in the ecotone. Her work may help to solve the ecological debate surrounding the ecotone concept, of particular interest is the understanding of the Agta perception of ecotones. Basically what Peterson was studying was induced edge through the agricultural

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[38]The Agta, according to Peterson (1981) recognize five important environmental types particularly relevant to hunting and game: *dinum* (water, referring to any body of water); *baybay* (land beside water, whether a beach or a river bank); *sikau* (any cleared area - a crop field, road trail or grassland); *katalonan* (dipterocarp/luan forest); and *pagabat* (or *bahikatkat* a dialect difference, for fruit forest).

activities of the Palanans (although it was also reported that at times the Agta engaged in swidden farming to a small extent). Because of this it was difficult to extrapolate from her results to the subject of inherent edges which supposedly result from different causes. This was not the primary objective in her work in any case. Peterson pointed out that a fully detailed interdisciplinary program may clarify the matter of ecotones and human relationships even further (1981:20). The study of Peterson served to point out the intricate ties between hunter gatherer populations and a sedentary agricultural population particularly in terms of exchange. Here the ecotonal concept was used as a focus for her investigations. And yet, she too has accepted the general ecological textbook formulation. It may be suggested that the contribution of anthropologists to the ecotone debate will not be in areas of <u>quantifications</u> or <u>biological descriptions</u>. The anthropological contribution may well be in understanding indigenous peoples' perception or conceptualization and uses of areas that we, and they, designate as ecotones or edges. Understanding ecotones may be a cognitive problem. Humans, in particular hunter-gatherers seem to utilize areas or regions such as these.

Satterthwait (1980:149) in his study of Australian Aboriginal materials stated that "localized increases in subsistant complexity might be expected to occur among

foragers in a position to exploit ecotone communities"[39]. Satterthwait asserted that Australian Aborigines, most notably in the area of Northeastern Arnhem Land, recognized 'land types' or 'associations' comparable in many ways to the typologies created by ecologists[40]. Furthermore it appears that they knew very well what food supply each 'association' of animal or plant will yield (Satterthwait 1980: 98-99). This is essentially the land systems concept of the Aborigines to which Jones(1980a, 1980b, 1982) has referred. These systems are integrally connected to the rhythm of the seasons (Jones 1982). Satterthwait mentioned aquatic environments which could be said to fall within the ecotone concept. Again with regards to these aquatic environments Satterthwait recognized the effects they may have on the subsistant complexity. In one instance he used the example of shellfish. Satterthwait saw these animals as being analogous to plants in some respects. In areas where there are pounding waves and periodic dessication these burrowing organisms may be found. Here, at these places, the people would only possess simple subsistant technologies because of the ease of harvest of these organisms. Estuaries and upwellings are also seen as ecotonal type regions, whereby subsistant technologies may be influenced because of the nature of the resources found here and because of the kind of subsistant technology needed to exploit them.

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[39]The use of the term 'subsistant' appears to be a construct of Satterthwait.

[40]Or the land system units used by the NTCC (n.d.).

Satterthwait (1980:151) asserted that "Some of the world's most important fisheries are located in estuaries and areas of upwelling and the conditions that prevail in these habitats would tend to favor comparatively complex subsistant technologies". Besides these Satterthwait(1980) also recognized the effects of man-made ecotones through the burning of vegetation. Here again ecotones represent potentially significant topics of study.

Satterthwait's suggestions pointed to two possible contributions. On the one hand his work of course falls into the realm of material culture studies. However, on the other hand, he referred to the knowledge of the land which the aborigines possess. An interesting hypothesis becomes evident. Can material subsistant technologies be evaluated to some degree in terms of regions i.e. the degree of subsistant technological complexity required to exploit a particular locale? Is there a corallary between ecotonal areas and certain degrees of subsistant complexity? Satterthwait appears to have pointed in that direction. Yet it appears difficult to clearly evaluate 'subsistant complexity' or 'subsistant simplicity' or groups because of the number of variables that have to be accounted for. Groups exploiting a series of microenvironments may possess a highly variable subsistant technology making it difficult to associate degrees of subsistant complexity or simplicity with particular environs or for that matter specific ecotonal regions. Not only this, but the various facets of

ecotonal regions themselves needs to be kept in mind. As Cooter (1974) has shown there may be a number of facets besides the edge effect which are inducements to human exploiters. Cooter's interpretation of the inducements of ecotones to human populations practising broad spectrum economies was mentioned above. In some ways Satterthwait's rather loose application of the ecotone concept itself caused a problem. Again the problem of the method of investigation came to the foreground. This was particularly so if we looked at technology as knowledge (Lewis 1983a). For instance Aboriginal fire technology may be remarkably complex but this will not be reflected in Satterthwait's findings of "subsistant complexity".

As indicated, a solution to the problem of using the ecotone concept in research, may lie in the anthropological study of peoples' perception or conceptualization of ecotonal environments which they exploit. If hunter-gatherers recognize and utilize these areas, the potentials of future study is great. Hunter-gatherers often do possess an extensive knowledge of the environmental system which they manage and utilize[41]. The studies of Peterson, Satterthwait, Lewis, Jones and preliminary

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[41]Jones (1980b:112-125)described how the Gidjingali hunter-gatherers, living near the mouth of the Blyth River in Arnhem Land, exploited land and water resources and defined their surrounding environment in terms of land systems (which are a combination of vegetation, soils and resources obtained from them). The major recognizable Gidjingali land systems include: *Malpi* (open woodland); *Kapal* (black-soil plains); freshwater swamps and lagoons; *Djaranga* (old inland dunes); *Man-nga* (monsoon jungle thickets); and *Madua* (open beach) or *badpa wana* (open sea).

investigations by this author point to a viable use or test for the ecotonal concept in modern anthropology. Of particular interest is the hunter-gatherer perception or conceptualization of ecotonal edge areas of resource utilization. Although the study of hunter-gatherers is stressed here, this does not preclude investigations of other types of societies. For example, swidden agriculturalists such as the Campa Indians of the Gran Pajonal of Eastern Peru; or Highland groups of New Guinea offer logical possibilities (Scott 1977, 1978; Golson 1977). The Wopkaimin of the Upper Fly River region of New Guinea are well aware of biotope gradients and the significance of them to their subsistence (Hyndman 1982). These people often utilize 'man-made ecotones' to varying degrees. It has been suggested that the Wopkaimin at times created swidden plots in the hope of attracting game which could then be hunted (Hyndman 1982:247). Furthermore, evidence indicated that these people were well aware of the environmental consequences of their actions, just as, Indians of the Boreal Forest were aware of the effects of controlled burning in their environment. Such is also the case with the Australian aboriginals of the Northern Territory. Peterson's Agta were aware of the effects of the expansion of the forest field ecotone on game behavior and hunting possibilities. Why has there been few of these studies in anthropology which could carry this to its logical extent? Perhaps Lewis (1982a:46-47) has discovered the explanation

for this oversight through his investigation of patterns of Indian burning. It follows that:

> Besides the fact that anthropologists have given virtually no thought to indigenous customs of burning, there is the tendency among us to view such behaviors as simply based upon tradition. We tend to see them as activities carried on because of some cultural, social, economic, techno-environmental, or other imperative, which directs or even determines what people must do. This view implies that hunters are essentially unaware of the broad ecological relationships by which we characterize a natural environment. This is coupled with our image of foragers as passive respondents in environmental dynamics.

As Peterson (1981) has indicated the Agta hunter-gatherers used the term *digdig* to identify edges. They also used the term *bukid* to distinguish steep slopes from flatter land. Thomas et al. (1979) have stated that topography may be a factor distinguishing inherent edge. Jones (1982) has suggested that Australian Aboriginal hunter-gatherers in Arnhem Land are well aware of the concept of edge and they recognize *boc-la-cal-jil-pa* as being the "forehead of the land" or "its forehead". Indians in Northern Alberta and Aborigines in the Northern Territory of Australia recognized areas (some areas) that are roughly parallel conceptions to what we term ecotones, in some instances they also have names for these regions. In Northern Alberta, Indians such as the Slavey, Beaver and Cree were aware of the significance of areas such as sloughs

and other regions that they at one time managed through the use of fire. Sloughs, for instance, were often burned yearly and this favored fresh new plant growth which would attract a variety of animals which could be eventually exploited for furs or meat. Furthermore as Ferguson (1979) indicated, the Slavey people had a name for the burned places in the forest. This was *go'leyde'*. This was where the 'little branches came out'. These would be good places to hunt in later on. There was also *'klo degogedaleyde'*. This was a good location for hay for the horses (Ferguson 1979:62). These people recognized the significance of edge type regions[42].

If Thomas et al. (1979) conclusions are used, it could be suggested that these Albertan hunter-gatherers not only exploited the edge areas but quite literally induced them, by their use of fire. Meadows were maintained by firing, since it was apparent to the Indians that forests would invade in the absence of regular fires. And the early growth in the burnt meadows maintained browse and grazing locations for animals. Firing these areas, as shown in the previous chapter, facilitated hunting, since animals would come to these areas soon after the fire, and because a distinct line between the grass and advancing forest was created making game easier to spot.

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[42]Informants pointed out to me that there were several Slavey names for places by the river, or certain places on land, but it was hard to translate using young family members, because they had forgotten the language.

An informant of Lewis (1982b: 29) stated that:

> They used to burn places where they think it was very useful. Like for instance, the places where the horses used to winter in order to have plenty of good feed for them on grass; and there where there's lakes, around lakes, where there's muskrats, so they could always have real fresh roots. (Muskrats) live on grass roots mostly - to keep them nice and fresh. If they don't burn the roots will spoil and rot you know, and then they'll die off every so many years. Places where there's moose, and where the moose usually like to roam around. They burn the brushes there so that they'll have good green leaves and things to live on in summer. And, places where the Indians live close to...they'll be brushes like you see around, poplars growing in one place, eh. That's where they used to burn (Lewis citing a Beaver Woman 69, High Level area).

Informants were aware of the advantages in hunting and trapping in beaver dam areas.

> Beaver dams...best places to hunt...even lynx. Lynx like that. They like beaver houses. Lynx like to hunt beaver quite a bit I think. That is where if you want to set a trap or something you set it right on top of the beaver house, You will catch them just about everytime. Never miss...Other animals around beaver dams like minks, and otter...(N. Alta. informant 1982).

These beaver dams could be viewed as areas of disturbance, and in fact interpreted as areas of induced edge. Apparently the Indians of Northwestern Alberta exploited these locations, and most certainly recognized their significance as a source of resources.

As indicated previously, these hunter-gatherers were not merely imitating the natural fire regime, natural fires are unpredictable and may cause widespread destruction whereas man-made fires resulted in numerous benefits[43]. The Indians burned select areas to increase the abundance/ distribution of resources which were most valuable to them, and this, as Ferguson (1979: 112) concluded, maintained a high ratio of edge within forested areas. Informant evidence presented corroborated Lewis' (1983b: 9-10) point that "I have never had an informant answer the question of why fires were set by detailing the importance of mosaics, resource diversity, environmental stability, predictablility in the maintenance of ecotones, elements of these ideas where presented and, when questioned further, discussed knowledgeably".

In many parts of North Australia, traditional Aboriginal lifestyles may be witnessed. Burning of the landscape is but one example. A range of animal and plant species are maintained through select habitat fires.

As indicated by informant statements, the Tiwi were (and remain) aware of the effects of fires on various habitats. Good "tucker" would be available in regions shortly after the period of burning. Again these hunter-gatherers, similar to the Northern Albertan Natives,

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[43]This is not to say that hunter-gatherers couldn't benefit from natural fires to some extent. For example lightly fired areas were recognized as being very good for types of berries, and berries attracted bears. Thus such burnt areas served as ideal bear hunting grounds.

were inducing edge areas through their use of fire. They affected the distribution and abundance of animals. For example, wallabies, traditionally a primary food source, were attracted to the green pick resulting from the firing of the land. Sometimes fires at the forest/grass edge would be set to facilitate the capture of wallabies (which were often found to lie there). This edge region, according to informants, was a prime location to search out these animals[44]. Often the Tiwi used large fire drives to capture animals, after these drives the burnt areas may have served to attract nearby remaining animals.

A few early explorers in Australia recognized the interrelationships of fauna, vegetation and the Aborigines.

> Fire, grass, kangaroos, and human habitats seem all dependent on each other for existence in Australia; for any one of these to be wanting, the others could no longer continue. Fire is necessary to burn the grass, and form those open forests, in which we find the large forest-kangaroo; the native applies that fire to the grass at certain seasons, in order that a young green crop may subsequently spring up, and so attract and enable him to kill or take the kangaroo with nets. In summer, the burning of the long grass discloses vermin, birds' nests etc on which the females and children, who chiefly burn the grass feed. But for this simple process, the Australian woods had probably contained as thick a jungle as those of New Zealand or

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[44]One of my informants suggested that this place may be called *timbra-ella* or perhaps *tippi-yunni* (I am spelling these terms in english, as I heard them. Osbourne (1974) records hill as *tipinuni*. *Tempira (or wuraya)* is given as 'dense' or 'of jungle'. Osbourne utilizes symbols in his terms that are unavailable here. During the periods of fieldwork for this thesis, it became evident that information pertaining to the "insider's view" would be difficult to obtain, if at all, considering the project time frame, and the reasons have been discussed in Chapter 2.

America...(Mitchell, 1848, Journal of an Expedition into the Interior of Australia, In Search of a Pacific Route From Sydney to the Gulf of Carpentaria)

It is widely accepted that the green pick regions were favored by macropods in Northern Australia. As shown above, the Aborigines utilized fire to create (and maintain) such places, and in turn they benefitted by the taking of the animals[45]. Several researchers have commented on the phenomenon of green pick (eg. Lewis 1985a, 1985b; Haynes 1978b; Jones 1969, 1975, 1980b; and Stocker 1966, 1968). The dynamics of actual Aboriginal fire regimes have been described in detail by Jones (1980b), Haynes (1982), Lewis (1985b) and Lewis and Haynes (1984).

Hallam (1985:13) and Lewis (1985a:22) emphasized the mosaic of resources resulting from Aboriginal burning practices. The selective firing of habitats, at different times (sometimes repeatedly over intervals of time) creates a broad spectrum of resources, both plant and animal, which these hunter-gatherers rely on. Heavily vegetated areas may be opened up giving the Aborigines access to viable resource alternatives. These Aboriginal burning patterns are interrelated with seasonal/ biological events (as shown in the Aboriginal calendars in the Appendix). The manner in which specific areas are burnt depends on factors of recognizable resource value; the characteristics of the land

[45]Haynes (1978b: 15-16) pointed out that this green pick, as it develops, was "likely to be less than 5% of the burnt biomass but the nitrogen and phosphorous content therein is four to five times higher".

system (using Jones' interpretation as presented above); and general accessibility (see Lewis and Haynes 1984). For instance, Aboriginal fires early in the dry season may result in "an uneven and patchy" vegetative pattern, in contrast to the late dry season fires where a more "even" burn is produced.

It is this mosaic of burnt/unburnt habitat that serves as a protective measure, against very large intense fires. Lewis and Haynes (1984:7) suggested that the unburnt places may serve as refuge areas during the day for animals hunted by the Aborigines. After a fire (and before green pick starts), the burnt area may attract animals which dig for roots. Tiwi informants provided similar evidence. As discussed above, Thomas et al. (1979) and Odum (1984) indicated that increasing edge may increase diversity, under conditions whereby habitat blocks are fairly large, and total edge in the region is also fairly large[46]. In this sense, Aborigines are inducing edge (and are aware of its' significance) with their fires in different habitats (an explanation of firing procedures is provided in the Seasonal Calendar for Kakadu in the Appendix). Flannery (1971) observed that primitive people may depend on plant and animals whose ranges cross into numerous habitat types. The Aborigines, for instance the Tiwi, have exploited animals such as the wallaby (M. agilis), and these creatures range

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[46]See Odum's (1984:437, 107) review of this diversity-area trend and Thomas et al.(1979: 5-7) examination of area size and diversity.

over different habitats (and utilize both burnt/ and unburnt locations).

Lewis and Haynes (1984:3) have concluded that "behind the reasons for why fires are set, Aborigines have a theory of what is involved". The Aboriginals comprehend the numerous factors, benefits and detriments of fire use in habitat modification, and they strive to maintain control of the events in an ordered manner. Their understanding of the "overall environmental mosaic of managed habitats" can serve as a subject for future study, particularly with reference to the ecotone phenomenon touched on here.

C. Discussion

Lewis (1982a) has provided a cross-cultural study of indigenous peoples' burning patterns, based on the available data from North America and Australia. Seasonality, frequency and intensity of fires are seen as significant factors in both regions. Spring burning was carried out by the Indians of the Boreal Forest. Plains Indians burning patterns were linked to the hunting of bison (see Arthur 1975). Spring parkland burning and fall burning of northern short grass prairies, influenced plant growth, and affected the movements of bison. In California and Oregon, Lewis (1982a: 55) emphasized three environmental zones: grasslands (including the foothill woodland belt); chapparal; and the coniferous forests where Indians used fire as a management tool to affect the seasonal patterns. The California

grassland fires, in contrast to fires of the Boreal Forest and Plains, occurred in summer and subsequently green grass grew following autumn rains. Although Lewis (1982a: 56) mentioned the lack of historical accounts detailing chapparal burning, he concluded that open grassland regions were managed in this zone, and the fires were set in the fall. The studies of Boyd (1984) and Timbrook et al. (1983) supported his interpretation.

The new growth attracted deer which were hunted by the Natives. Because of the fall burning pattern, grasslands and brush stands were present. Spring fires in the chapparal regions cleared places for tobacco, but did not encourage much new growth according to Lewis (1982a: 57). Yet, if this was the case, I suspect that numbers of animals were likely attracted to these plots, in a similar way as the Wopkaimin of New Guinea used swidden plots to attract game.

The third zone, coniferous forests, was burnt at different times depending on the geographic location. Fall burning of litter and young trees took place in the Sierra Nevada region, as the Indians moved down the slopes as their seasonal subsistence patterns dictated. Lewis (1982a) believed that the Indians recognized the advantages of a more heterogeneous environment, and burnt the region every eight to twelve years (which is different from the natural cycle of fires - twenty-five to fifty years). This was similar to the mosaics created by Indians of northern Alberta and Australian Aborigines which serve to promote

diversity of environments. Apparently Indian fires in the redwood forests of California were relatively restricted, and produced little impact. Yet interrconnecting trails and meadows were often burnt, and this is remarkably close to patterns observed in North Australia and Northern Alberta that have been examined in the previous chapter.

Indigenous peoples in California-Oregon, Australia and the Boreal Forest were aware of the interrelationhips between fire, plants and animals, and seasonality. Fire was employed as a management tool, and in most respects was the major force in modifiying the landscape over both the short and long term, and these peoples apparently recognized the significance of induced and inherent edge areas (Thomas et al. 1979). These groups recognized the usefulness of the new growth resulting from fires. North Australia may be considered as an important source of this information, because of the fact that hunter-gatherers still engage in these activities, in contrast to the other regions. Certainly there are differences in times and frequencies of aboriginal fires in the different geographic locations. What is interesting is the overall pyrotechnic knowledge of these peoples and the possibilities of future research into this subject. More data is needed before the aboriginal perception of ecotone/edge places can be fully appreciated.

This chapter has reviewed problems involved with the concept of ecotone, firstly, in the field of ecology, and, secondly, in the field of anthropology. As previously stated

a strict dichotomy exists regarding the nature of ecotones. The organismic or community point of view clearly identified with the empirical reality of ecotones, whereas the gradualistic point of view does not recognize the existence of ecotones or the usefulness of the concept. Gradualists delegate it as an example of early, highly descriptive ecological work. Anthropologists who have borrowed the concept from ecology without examining the organismic/gradualist debate have created problems for themselves. Anthropology needs to be cautious in borrowing terms and concepts from other disciplines and the ecotone concept serves as an illustration. As concerned social scientists anthropologists should be in a position to recognize and evaluate any problem such as the one discussed above. This may prevent the adoption and implementation of an idea borrowed from another discipline, as ecotone was taken from the field of ecology.

However, the concept of ecotone has potential for anthropological research. As discussed, ecotone should be viewed as generalization or hypothesis in need of testing. Potential subject areas where ecotonal subject studies may be implemented have been looked at. These include the study of broad spectrum economies (see Cooter 1974); the study of induced and inherent edge areas which may be viewed as ecotones as Thomas et al. (1979) indicated; subsistant technological diversity (according to Satterthwait 1980); hunter-gatherer and agriculturalist exchange relations in a

possible ecotonal region (see Peterson 1977-81); and finally the perception or conceptualization of ecotone areas by human populations since they appear to exploit these regions in many instances. The latter suggestion in particular appears to fall into Jochim's category of the "perceived environment" which was indicated at the beginning in the opening quotation. Through this type of investigation of the perception or conceptualization of ecotonal areas anthropologists should be able to evaluate the heuristic value of the ecotone concept.

Since a number of hunter-gatherers recognize what we identify as ecotonal areas, it is important that anthropologists examine edges and edge effect. Furthermore the relative importance of these same areas to resource utilization and manipulation can be ascertained. The ethnographic fieldwork carried out here has skimmed the surface of what is available with respect to native groups. Surely more comparative materials are waiting to be discovered in field situations, not only hunting and gathering groups but swidden agriculturalists as well (eg. Dove 1985).

It is imperative that the researcher be aware of the ecological situation which the informants occupy. Ideally, a research design would necessitate a grasp of knowledge from several independent disciplines. A multidisciplinary research approach would prove fruitful. If the investigator is to put relevant questions to the indigenous informants

concerning ecotones/environment, he must comprehend the interrelationships of such factors as plant/animals, soil, and climate in the region.

Participant observation research methodology would prove useful. Once an understanding of the "insiders' view" or the "perceived environment" is achieved the fine distinctions governing the topic of ecotones may be approached. Data presented here indicated that indigenous people recognize and utilize such areas. Native exploitation technology (knowledge) and its' relationship to the surrounding environment must be considered. How do subsistence techniques vary from region to region, and how do the indigenous inhabitants account for any variability? For instance, with respect to ecotones, do the people rely on resources from areas of disturbance (eg. fire)? And how important to the indigenous people is the maintenance of disturbed regions for their livelihood? It would prove beneficial to ascertain whether the informants recognize/perceive ecotones in a similar manner as presented in the scientific literature. The land system recognized by the Gidjingala is more complicated than land type descriptions utilized by parks and wildlife people, because of its integrative nature (see Jones 1980a, 1980b). Hunter-gatherer fire regimes are more involved than those of pastoralists, or Forestry (Lewis 1986). Can the realization that these indigenous peoples perceive such areas be tested, by observing foraging patterns?

This research can benefit anthropology. Comparative information on indigenous peoples' environmental modification and manipulation technology needs to be collected, and this would facilitate additional cross-cultural correlations (see Lewis' 1982a comparisons). At this period time, traditional information is lost with the passing of the elderly, as this study shows. The points mentioned here may help in the retrieval of such data by future researchers.

V. CONCLUSIONS

The primary objectives of this research involved the examination of indigenous peoples' fire technology and perception of ecotone edge areas as potential resource locations. These objectives were met by literature study, and field investigations in Northern Alberta and Northern Australia. Evidence presented here added further support to the argument and growing recognition that hunter-gatherers modified and manipulated their environments. Also, based on information collected in the field and literature sources, it was apparent that a number of hunter-gatherer societies distinguished environmental locations that approximate the conceptions we have in the ideas of ecotone or edge. Indigenous names for these places have been given in some instances (eg. *dig dig, go'leyde'* as in the previous chapter). It is known that hunter-gatherers forage for a variety of resources in or along areas that may be called ecotones. And, not only are these areas exploited, in many cases indigenous peoples used fire to create and maintain the places and conditions involved. The procedures which would benefit future study into this aspect of the hunter-gatherer existence have been outlined.

The Tiwi and the Indians of Northern Alberta affected vegetation patterns through time with their use of fire. Intensity of natural occurring fires was reduced. Mosaic

areas of burnt and unburnt areas were created, from which they benefited. Distribution and abundance of animals and plants were manipulated to their advantage, in a controlled manner. These hunter-gatherers were by no means passively adapted to their surrounding environment. Their use of fire represented a directed effort to affect the environment. It was not haphazard activity. As discussed, the technology of fire represented an intricate web of knowledge, and reference to "simple" hunter-gatherers is inappropriate. The comparison of aboriginal burning patterns from North America and Australia entailed a number of considerations as described by Lewis (1984): size and intensity of the man-made fires; conscious site selection; seasonality of the fires; and the frequency with which specific locations are burned.

In light of the above, the controversy surrounding Horton's (1982) article may be appreciated. A key assumption to Horton's (1982) argument was the belief that Australian Aborigines (and other hunter/gatherer groups, particularly in North America) had little, if any, effect on the environment (since they replicated the natural fire regimes); hunter-gatherers were observers and used detailed knowledge to extract energy - yet the system remained stable since they detected and harvested surplus. Horton (1982:247) stated that existing ethnographic information does not support the "fire stick farming model" (which was essentially a construct of Horton's as discussed in chapter

one). Pollen data, as interpreted by Horton (1982:241), did not support the idea that Australian Aborigines induced major vegetational changes. Further, Horton (1982:237) stated that fire management practices would have had adverse effects on small mammal populations.

The evidence provided here, and data of others (eg. Hallam 1985; Burbidge 1985; Lewis 1977 to 1986; Jones 1980b; Kimber 1983), suggested that Horton's arguments were unfounded. Hallam (1985) suggested that Horton's perception of fires may have been influenced by the onetime prevailing viewpoint whereby fires were seen as potentially harmful and destructive forces. This perspective has been considered by Stewart (1963) in his early work, and has been discussed in this thesis . Horton (1982) did not take into account the complexity of the Aboriginal fire regime, with the interplay of local factors affecting the use of fire in specific habitat locations. Quite simply, it would appear that Horton was unaware of the detailed evidence available, not only from Australia but from other areas of the world as well.

Hallam (1985) has criticised Horton's (1982) statements in depth. She has pointed out how Horton's interpretation of the pollen record was misleading (Hallam 1985:13). The firing of varied ecological zones, and the subsequent reactions, over time affects the pollen record, but not in the simplistic manner as Horton (1982:241) has indicated. Both Hallam (1985:14) and Burbidge (1985) have shown the benefits of Aboriginal fire practices to varied species of

small animals. Mosaic burning offered both food and shelter to such animals, and this would have benefited the hunter-gatherers. Horton (1982) has ignored ethnohistorical and ethnographic data which details the frequency, seasonality, intensity, and effects of hunter-gatherer fires as presented here.

In conclusion it can be stated that an understanding of Indigenous peoples' burning practices will benefit environmental agencies, government, forestry and the aboriginal peoples themselves. Evidence presented here points to the advantages of a fire management program in Northwestern Alberta, in which Natives are actively involved. Fire hazard reduction is but one aspect. The traditional subsistence base could be improved, as well as wildlife in general - and this may draw in tourists (Ferguson 1979). The Indians would be given further opportunities of employment. Lewis (1985a: 29) suggested that governments, if they recognize this information concerning hunter-gatherer groups, could conceivably instigate the preservation of tracts of these managed lands, and this would be an asset to all concerned.

On Melville Island, Forestry might benefit from active participation of the Tiwi; certainly the Tiwi are capable of managing tracts of the territory away from the plantations and fire-protecting the plantations themselves. Haynes (1978c) stressed the need for forestry projects to be designed so as to complement the local community

requirements, or as the Maningrida example illustrates, divisive problems will occur. This is not to say the Forestry Unit on Melville neglects community needs, but a more active involvement of the Tiwi could conceivably benefit both parties concerned. If the Aborigines carried out more of the burning on their own territory, the expenses of the Forestry Unit would be lessened, and their efforts could be directed to other objectives, explained previously.

In this manner, anthropologists can contribute to fire management programs. They can provide data on the indigenous fire regime patterns, and the overall nomadic foraging patterns, of which the fire technology is a part. And the study of the ecotone phenomenon, as exemplified here, could conceivably benefit ecological research in the process.

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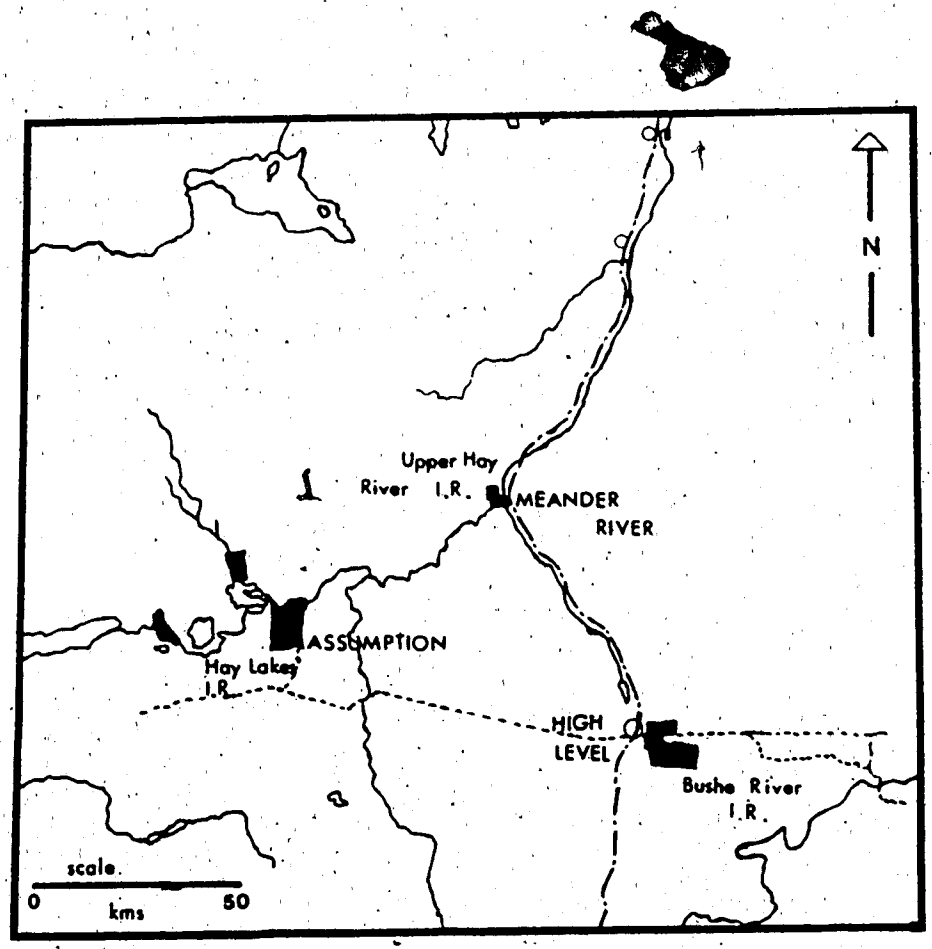
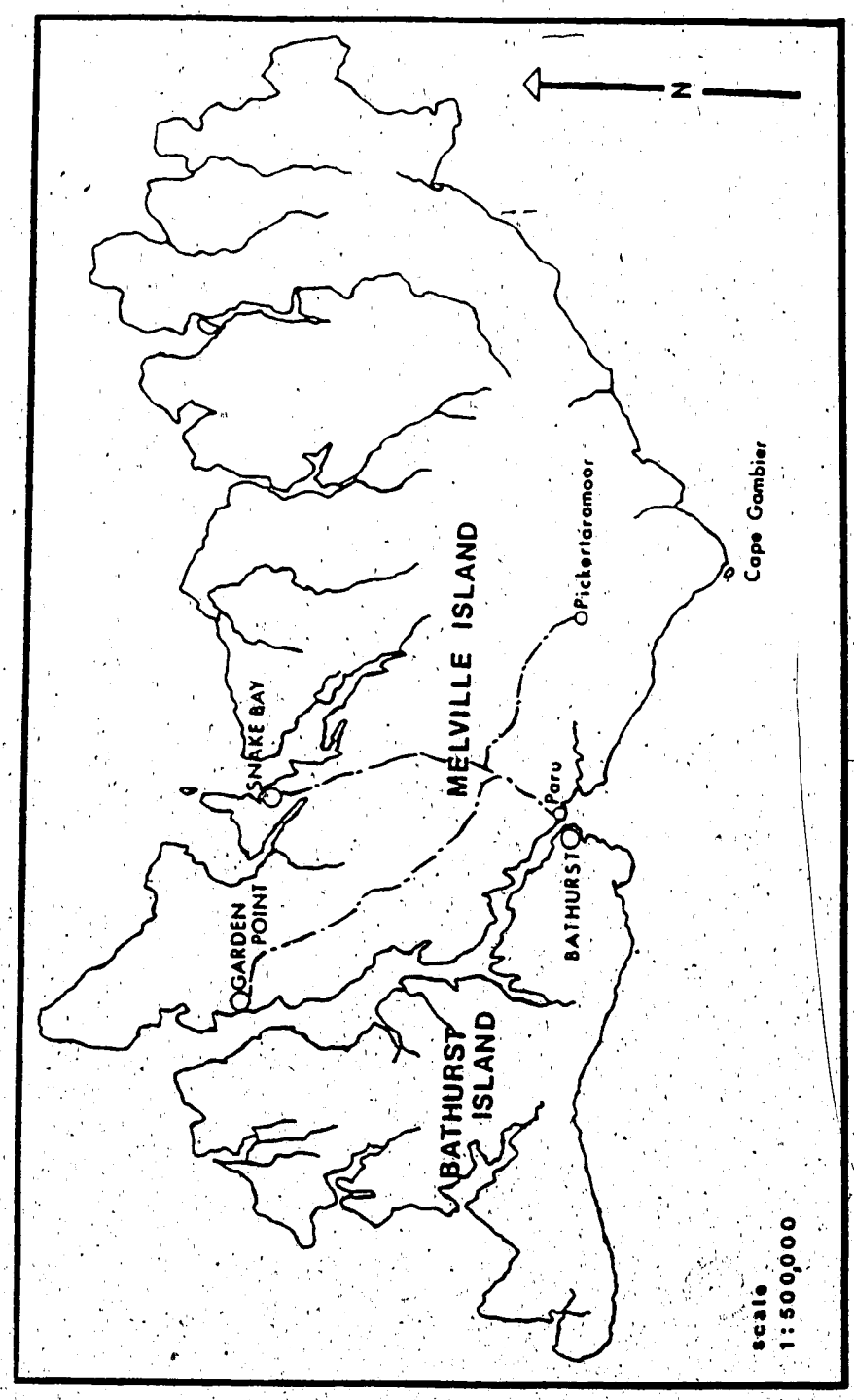
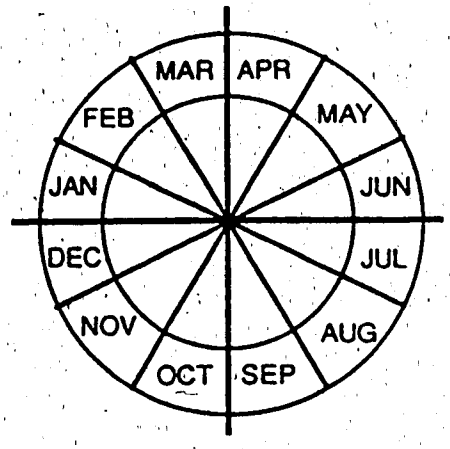
APPENDIX 1: Study Area of Northwestern Alberta - Adapted from Ferguson 1979



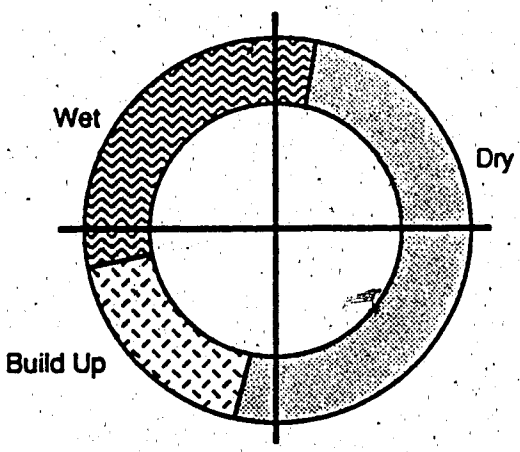
APPENDIX 2: Study Area of Melville Island - Adapted from NTCC 1983



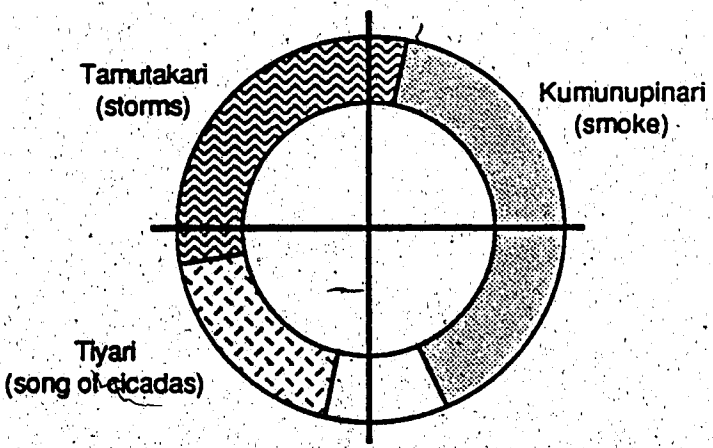
APPENDIX 3: The Tiwi Seasons - Adapted from Stevenson 1979



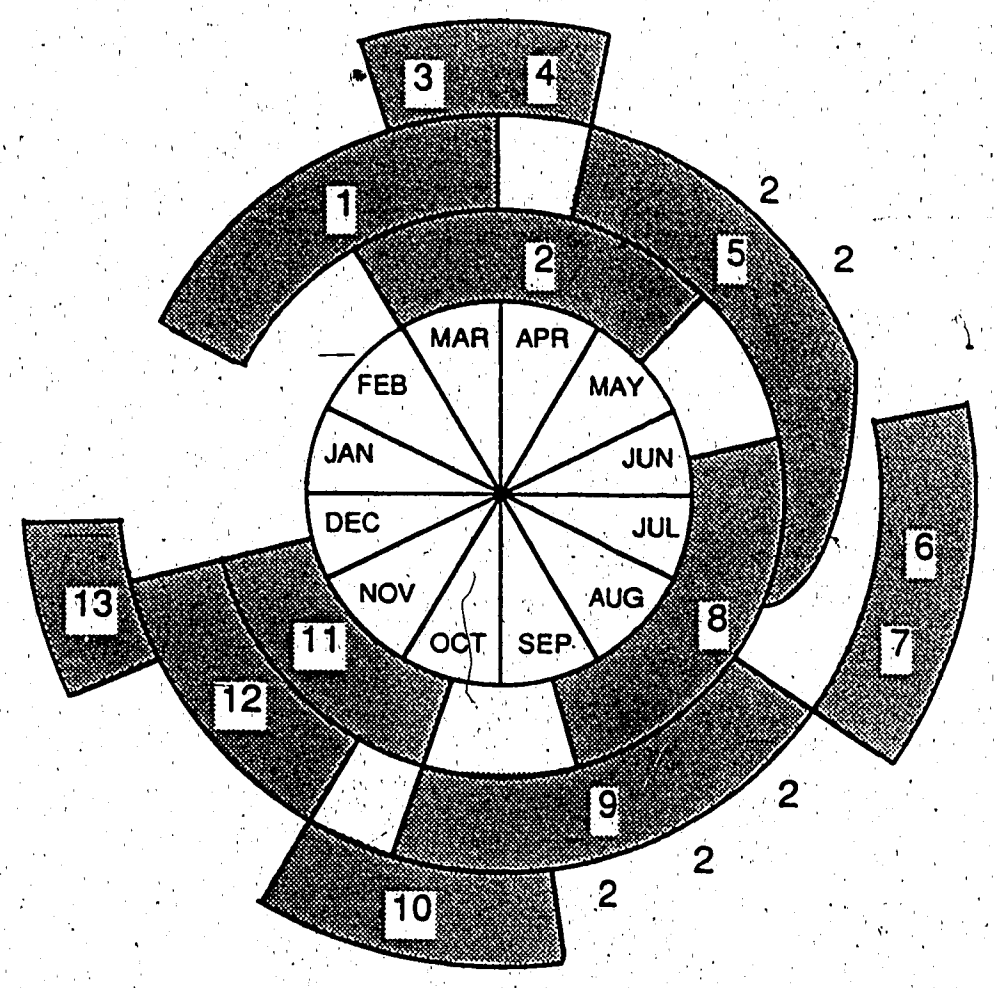
1. The Cyclic Year



2. Monsoonal Seasons Used by Europeans



3. Monsoonal Seasons Used by Tiwi



1. tawutawungari (clap sticks)
2. wurrijingari (flowers)
2. flowering times of special plants
3. marrakatari (tall grass)
4. wurringawunari (knock-em-downs)
5. kimirrakinari (fire)
6. yirriwinari, munu¡utari (cold)
7. kumwari (fog)
8. pwmitingari (wind that flakes skin)
9. yartupwari (dry creek bed)
10. milikitorinari (hot feet)
11. pumwanyingari (thunder)
12. kurukurari (breeding mangrove worm)
13. mumpikari (muddy possum tracks)

4. Minor Seasons of the Tiwi Calendar

5. Seasons and Seasonal Markers of the Tiwi.

The cyclical nature of the seasons is depicted in No. 1 The Cyclic Year. The three seasons recognized by the Tiwi in North Australia compare closely to those distinguished by Europeans for the monsoonal climate of Northern Australia (see No. 2 & 3 above). In Tiwi terminology the noun of the seasonal marker has the suffix *"ari"* added to indicate the season during which the marker occurs, eg. *tamutakari* is the season of *tamutaka* (storms).

Temperatures are usually in thirties (degrees Celsius) all year, and the most important factor affecting vegetation is rainfall. After seven months of virtually no rain *tamutakari* (season of storms), with up to 2500mm (100") of rain in five months, produces lush growth. When this ends, the vegetation drys and is fired by the Aborigines (and Forestry), thus *kumunupinari* (season of smoke). And, before the next season of storms there is a hot, humid month or two when the cicadas emerge and their characteristic shrill song is heard, *tiyari* (season of the song of the cicada). Minor seasons (some as short as a week), are based on environmental events that are characteristic of that particular period of the year. Many of these overlap, so that they need to be portrayed on several levels as indicated in Stevenson's diagram in No.4.

At the beginning of the year the first minor season is *tawutawungari* (seasons of the clap sticks), during which the

kurlama cermonies are held and the oral tradition of the tribe is remembered and extended. These center upon the *kurlama*, a yam, that is prepared, baked and eaten at this time.

As the end of the wet season approaches many of the trees and shrubs flower resulting in an obvious and extended *wurrijingari* (season of flowers). Many plants flower at this time so that the seeds can be prepared during the long dry season to sprout with the first rains of the wet season.

There are several short periods during the year when individual trees are in flower, which do not coincide with the season of the flowers. These trees are all of importance as food or medicine and each specific flowering season is named after the plant or its fruit (eg. *jimijingari* (season of the diarrhea medicine plant, Personia flacata), *jarrikarlinari* (season of the big wattle tree, Acacia auriculoformis).

Two short seasons indicate the end of the wet season *marrakatari* (season when the tall grass flowers) and *wurringawwunari* (season of the knock-em-downs). Every year at this time one of the tall wet season grasses (Sorghum plumosum) breaks into a large brown seed head which also signals the arrival of other seasonal markers, migrating birds (eg. Black-faced Cuckoo-shrike and the Rainbow bird. Sometimes before and sometimes after the arrival of these birds strong storms knock the grasses down into a compact mass. This is why everyone in the north calls these storms

the "knock-em-downs".

When the last rain falls in mid-April the compacted grasses cure and are traditionally fired by the people, resulting in *kimirrakinari* (season of fire). As the middle of the year approaches the temperatures at night do fall to 15 to 20 degrees Celsius. This period is called *yirriwinari* or *munuputari* (season of cold) and everyone sleeps close to a fire at night. Sometimes when the temperatures are low, fog develops along the valleys and creeklines in the morning, hence *kumwari* (season of fogs).

Strong winds are characteristic of the dry season and a time is designated as *pumitingari* (the season when our skin flakes like ashes). The background noise of the wind in the trees allows good hunters to get very close to their quarry and this is usually a plentiful time of the year. Often at these times, there is a drying up of watering points, this is the during *yarupwari* (season of the dry creek bed).

In September and October both the maximum and minimum temperatures rise and the hard-packed earth, often burnt black, heats quickly during the day. This is *milikatorinari* (season of hot feet) and food gathering is often centered in the mangroves and jungle patches, rather than the dry plains or woodland.

The *pumwanyingari* (season of thunder) starts the "build up" to the next season. As humidity increases, cumulus clouds develop in the afternoon, and there is thunder and lightning at night, but little rain.

This is also the breeding season for the the mangrove worm, a food source for the Tiwi. This worm is a wood borer up to 2cm thick and 1m long that eats long holes out of the center of mangrove trees. *Kurukunari* (season of the breeding mangrove worm) is also a time when other animals can be obtained easily, or taste their best.

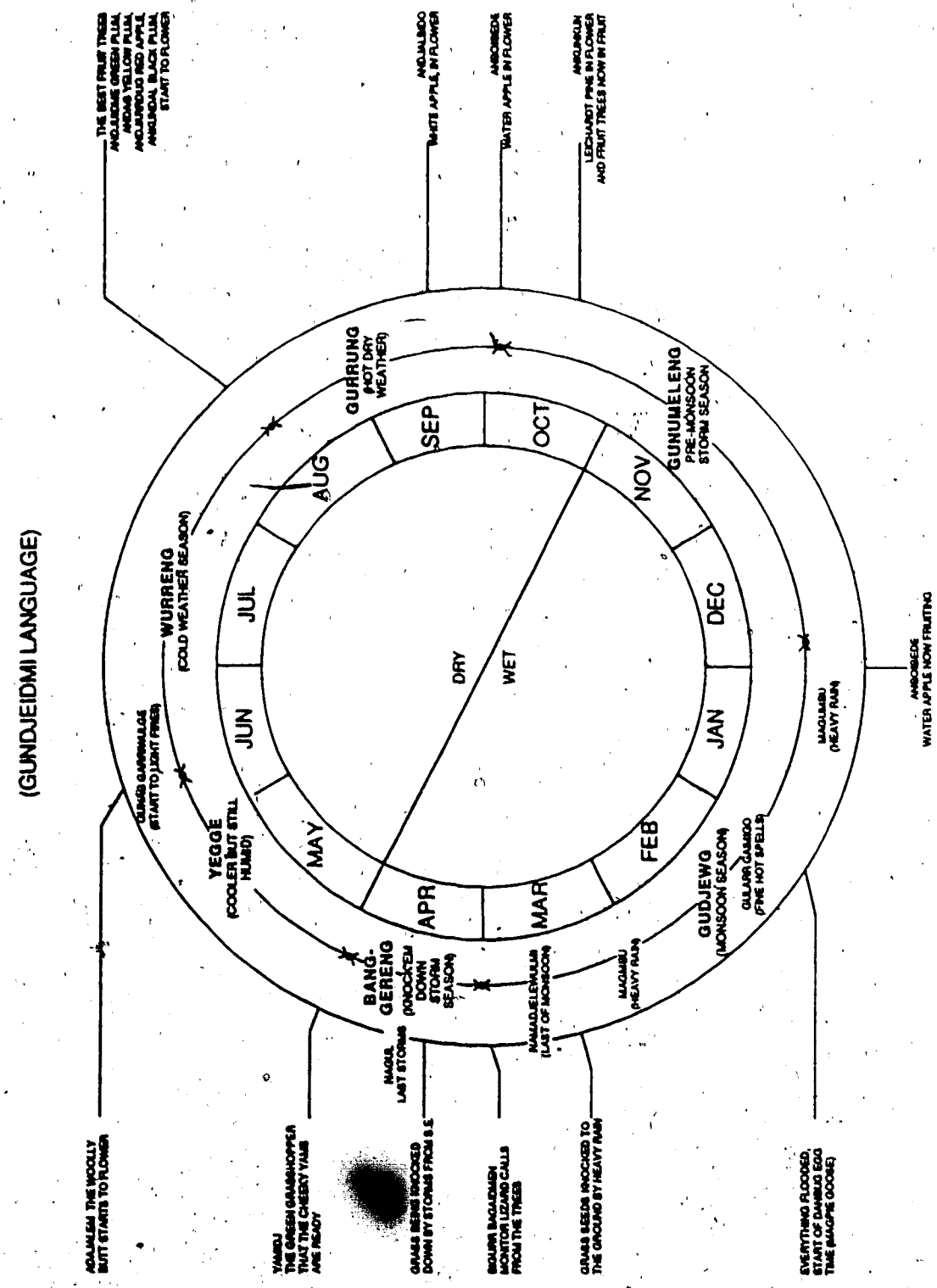
Mumpikari (season of muddy possum tracks) completes the cycle of minor seasons. When the first rains fall, and the possums (another favourite Tiwi food) return to their trees from foraging on the ground at night, they leave tell-tale muddy footprints on the trunk of the tree. This facilitates possum hunting, and is recognizably a useful seasonal marker.

Then the wet season starts with its heavy storms, creating lush vegetative growth, and with a month or two the first *kurlama* ceremonies begin *tawutawungari* (season of the clapsticks). To tribal Aboriginal people, climate and weather follow a well known sequence, each year with its variations of rainfall and strong winds. Aboriginal people change their lifestyle according to key environmental factors, their food sources, and ceremonial activities.

APPENDIX 4: Seasonal Calendar for the Kakadu Region -

Adapted from Australian National Parks and Wildlife Service

1980



2. Fire and the Seasonal Calendar For Kakadu - Adapted from Lewis and Haynes (1984)

The region is covered by eucalypt dominated open forests (about 30%) and woodlands (about 40%). Trees of the open forest are taller (15-19m), with an understory of shrubs, palms and grasses. Woodlands, found on poorer soils, contain smaller trees (10-12m) that are widely dispersed, with a greater uniformity of understory grasses. Open spaces in both areas are dominated by annual sorghum grasses (1-2m), and these are highly flammable in the dry season. Remaining areas are made up of freshwater plains, paperbark swamps, and stands of rainforest. Climate here is characterized by the wet-dry monsoon. The annual rainfall of 1200-1500mm usually falls between December and March. The dry period occurs between May and September.

This calendar from the South Alligator River area, in the Gundjeidmi language, contains six major seasons based on climatic and biological events. Combinations of the events dictate the setting of fires in specific habitat locations.

Although most fires are set in the dry months, a few may be set during *gularr gaimigo* (fine hot spells) in the monsoon season, *gudjewg*. These fires clear camps, settlement areas for poisonous snakes move to high ground at this time, and this is a concern of the Aboriginals.

Once the monsoon rains end, and before the last storms *banggereng* (knock'em down storms), the first dry season fires may be set. The margins of floodplains are burnt where

grasses and sedges have been exposed, as a result of the dropping water levels. Paperbark and rainforest stands may be fire protected at this time. As floodplains dry, larger fires will be set, sometimes weeks apart. Aborigines utilize the magpie geese, and burning in the floodplain is important for their nesting and feeding requirements.

By the beginning of May, with the flowering of the woolly butt trees, fires extend well beyond the camps and settlement areas. *Wurrgeng* (cold weather season) is marked by the arrival of the cool south-easterly winds, and low nighttime temperatures. Forest and woodland areas are burnt, in different ways; to reduce scorch height; and to protect the flowers of fruiting trees. Mixed habitat is left as a result of burnt/ unburnt locations. As much as 40 to 50 per cent of a given area of woodland and tall forest may remain unburned. These early season fires burn out in late afternoon or early evening, this is in contrast to the beginning of the season where fires last little more than an hour, and the end of the season, about mid-August, when fires may burn into the night until early morning dew extinguishes them.

Gurrung (hot weather time) is when the humidity reaches its lowest point. Burning in the open forest is usually completed by this time. Fires may still be used in hunting kangaroos or wallabies. Woodland fires may be set much later, some in mid-November *gunemeleng* (pre-monsoon storm season).

APPENDIX 5: Aerial Controlled Burning - Adapted From South Australia/N. Territory Permit 1983

Annex of Requirements For The Carriage and Dropping of Incendiaries From Aircraft For the Ignition and Controlled Burning of Forest Undergrowth - Department of Aviation For The South Australia/ Northern Territory Region

Operations Manual

Section: Incendiary Dropping - Bush Fire Control Operations.

The following requirements and conditions are to be observed during the carriage of and dropping of incendiary devices.

1. Carriage of Incendiary Devices

A. Incendiary Devices other than those authorised may not be carried in the aircraft. The following incendiary device is authorised:

(i) Incendiary Capsule - standard pharmaceutical vials made of clear polystyrene, filled with 5.5 grams of potassium permangate, sealed with a tightly fitting polythene cap specially manufactured for the purpose with a thin diaphram for injection with a vaccinating syringe.

(ii) Vaccinating Syringe - standard commercially available syringe with a reservoir capable of injecting a

measured dose (1.3ml) of ethylene glycol through the polythene cap of the incendiary capsule.

B. Incendiary capsules are to be carried in rigid metal containers with a closeable lid, of the size and weight to provide for ease of jettisoning the contents in the event of an emergency arising such as mechanical or structural failure of the aeroplane necessitating a forced landing or the inadvertent flaring of an incendiary capsule prior to the despatch from the aircraft.

C. Ethylene Glycol - is to be carried in non fragile containers in a position in the aircraft to avoid accidental contact with incendiary capsules.

D. No person other than those essential to the conduct of the operation shall be carried in the aircraft while incendiaries are carried.

2. Dropping Site

A. Incendiary dropping operations within the Northern Territory shall be authorised by the Conservation Commission or the Bush Fire Council of the Northern Territory.

B. The incendiary dropping site shall be specified and clearly defined by the state forestry or Bush Fire Council authorities using terrain features, ground signals and markers etc; and

C. The pilot in command shall make at least one preliminary flight over the sight and he/ she shall obtain confirmation from a forestry or Bush Fire Council officer on

the ground or in the aircraft that he/ she is over the site and is aware of the boundaries of the area to be ignited.

D. The pilot in command is to ensure that the designated incendiary dropping area is clear of all unauthorised persons prior to commencement of burning operations.

3. Incendiary Dropping Operations

A. Except where the aircraft is equipped with an approved, self-contained, fully automatic incendiary dropping device under the direct control of the pilot, the incendiaries shall be dropped by a despatcher who has no other functions as flight crew member during actual dropping operations;

B. If a forestry or Bush Fire Council officer is near or at the dropping site, the pilot in command shall maintain two-way radio communications with him/ her at all times when the aircraft is in the dropping area. If the forestry or Bush Fire Council officer is in the aircraft, he/ she shall have access to the pilot on the aircraft's intercommunication system;

C. The pilot in command shall be personally briefed by a responsible forestry or Bush Fire Council officer on the location of the dropping site and on any other matters associated with the ignition operation prior to the start of operations; and

D. The pilot in command shall ensure that the movement of persons or articles during the conduct of the operation will not result in any unsafe movement of the aircraft's centre of gravity;

E. The minimum height permitted during dropping operations is 500 feet above the highest obstruction with a horizontal radius of 600 metres from the aircraft. Normal operating heights are to be maintained at other times;

4. Crew Qualifications

A. The pilot in command shall be the holder of a commercial pilot license with an agricultural rating or have at least 250 hours in command on aeroplanes.

B. The despatcher shall be trained to the satisfaction of the pilot in command in all aspects pertaining to the dropping of incendaries including equipment malfunctions and emergency procedures.

5. Equipment Requirements

A. The dropping equipment and the associated incendiary device shall be subject to airworthiness approvals, obtainable by application to the Regional Headquarters of the Department of Aviation.

B. Except where the aircraft is equipped with an approved self-contained, fully automatic incendiary dropping device under the direct control of the pilot, an asbestos flexible or similar purpose sheet, and a CO2 fire

extinguisher shall be readily available to the despatcher; and

C. The aircraft shall be fitted with a gyroscopic horizon indicator (in addition to the instruments required by Air Navigation Orders Section 20.18 for VFR operations).

6. Aircraft Configuration

A. For incendiary dropping operations, the aircraft should be of a minumum size, so as to accomodate one despatcher and necessary equipment in a rear cabin area;

B. The rear cabin area is to be free of obstructions and other equipment not required for the conduct of incendiary dropping operations;

7. Chief Pilot Responsiblities

A. The Chief Pilot shall ensure that pilots in command of aircraft conducting incendiary dropping operations are qualified in accordance with paragraph 4 above;

B. The Chief Pilot shall ensure that the pilot in command is thoroughly conversant with the relevant company operations manual instructions and is capable of conducting the flight with due regard to the safety of the flight.

APPENDIX 6: List of General Subject Topics Discussed in Informant Interviews

FIRE TECHNOLOGY/ ECOTONE AND EDGE

Informal multiple extended interviews were conducted in Northwestern Alberta, and Melville Island in North Australia. Essentially this was directed conversation. Information collected from the various interviews was compared, and conclusions were drawn. Most often this evidence corroborated previous studies made by other researchers (eg. Lewis 1982, 1980a, 1980b, 1982b, 1986; Ferguson 1979).

1. customs of traditional habitat fires
2. current prescribed burning programs (eg. Forestry, Melville Island)
3. multiple effects of fires/ patterns of burning
4. vegetation manipulation/ changes
5. meadows/ grazing areas
6. bird nesting locations
7. campsites
8. insects
9. stream/ slough regions
10. deadfall regions
11. trails
12. induced/ inherent environmental regions of disturbance & discontinuity
13. Forestry/ Native burning methods
14. backfires
15. animals (domestic/ wild)
16. food resources (plant/ fauna)
17. berry production
18. territorial rights
19. fire drives
20. native land systems
21. vegatation boundaries
22. forest/ open edge regions (resources/ effects of fires)
23. fires (frequency, intensity, seasonality, site selection)
24. fire & early vegetative growth
25. firebreaks (natural/ man-made)
26. timing of fires

VITA

BIOGRAPHICAL DATA

Name: Donald Erik Reid

Present University Address:

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The University of Sydney,
Sydney, N.S.W.
Australia 2006

Born: January 11,1958
Killaloe, Ontario, Canada

Citizenship: Canadian

EDUCATIONAL DATA

Primary and Secondary Education

Killaloe Central School, Killaloe, Ontario
Madawaska Valley District High School, Barry's Bay, Ontario

University

Trent University,Peterborough, Ontario, Canada
Faculty of Arts 1976 - 1977, 1978 - 1981
Degree: Honours Bachelor of Arts (1981)
Major: Anthropology

University of Alberta, Edmonton, Alberta, Canada
Faculty of Graduate Studies 1981 - 1986
Degree: Master of Arts (1986)
Major: Anthropology

University of Sydney, Sydney, N.S.W., Australia
Faculty of Arts, Department of Anthropology
Degree: Ph.D. (in progress)

RESEARCH AND TEACHING INTERESTS

Introductory Anthropology
Ecological Anthropology
Oceanic Anthropology and Archaeology
Australian Aboriginal Studies
Fire Technologies of Indigenous Peoples
The Lapita Cultural Complex of the Southwest Pacific
Prehistoric Pacific Navigational Systems

Native Habitat Modification and Resource Management

MEMBERSHIPS IN PROFESSIONAL SOCIETIES

American Anthropological Association
Society for American Archaeology
The Polynesian Society of New Zealand
Canadian Ethnology Society
American Ethnological Society
Society for Conservation Biology
American Institute of Biological Sciences
Association for Tropical Biology
Ecological Society of America
Bishop Museum Association

AWARDS AND DISTINCTIONS

Young Canadian Researchers Award 1986-7
(International Development Research Centre)
Sigma XI Research Award 1985
University of Alberta Research Grant 1982
University of Alberta Scholarship/Bursary 1981-4
University of Alberta Intersessional Bursaries 1982-3
Madawaska Valley District High School Bursaries 1976

SPECIAL NON-CREDIT COURSES

January to April 1985 - Aboriginal Economy
February 1983 - Remote Sensing and Satellite Imagery
September to December 1981 - Paleoecology

THESES AND PAPERS

1986 Fire and Habitat Modification: An Anthropological Inquiry Into the Use of Fire by Indigenous Peoples. Master's Thesis. Department of Anthropology, University of Alberta, Edmonton, Alberta, Canada.

In Progress. Fire, Habitat and Man in Highland Papua New Guinea: Land Use and Resource Management. Ph.D. Thesis. Department of Anthropology, University of Sydney, Sydney, Australia.

In Prep. Tiwi and Forestry Burning Patterns: Melville Island, Northern Australia. To be submitted to the journal Mankind.

In Prep. Fire and Habitat Modification. To be submitted to the journal Culture.

CURRENT RESEARCH PROJECT

My doctoral study entails anthropological fieldwork in the Highlands of Papua New Guinea. The significance of fire to the environment and peoples of the region, in terms of habitat change and manipulation, is being investigated. A primary objective of this research is the development of prescription management strategies for land use and resource management.

RELATED EXPERIENCE AND FIELDWORK

Fieldwork

June 1985 to August 1985

This time was spent on Somerset Island, in the Northern Arctic of Canada. I was a member of an archaeological research team investigating prehistoric Dorset cultural remains.

May 1983 to August 1983

During this period I was engaged in an anthropological study in the Northern Territory of Australia. I investigated the Tiwi use of fire and Forestry's use of fire in resource management on Melville Island. Dr. Henry T. Lewis supervised this research.

June 1982 to August 1982

At this time I conducted fieldwork in Northwestern Alberta at Assumption and Meander River. I was concerned with the native use of fire in habitat modification, and their perception of ecotonal areas. Dr. Henry T. Lewis supervised this investigation.

Research Experience

February 1986

At this time I worked as an assistant on an archaelogical contract, analyzing data from southern Alberta aggregate sites.

January 1984 to April 1984

During these months I held a research assistantship position in the Anthropology Department at the University of Alberta. The position entailed library research, manuscript preparation (computer textforming) and editing. I was also responsible for the construction of a large (6'x4') aerial photographic mosaic of an irrigation network in the

Philippine Islands. My work was supervised by Dr. Henry T. Lewis.

September 1983 to December 1983

This assistantship position, in the Anthropology Department at the University of Alberta, consisted of photographic work in the darkroom. Black and white print enlarging and developing were the main tasks. The project itself was the preparation of a teaching guide for palynology. This work was supervised by Dr. Charles Schweger.

May 1983 to July 1983

I was hired by Dr. Henry T. Lewis as a Graduate Research Assistant through a Social Sciences and Humanities Research Grant. Library and archival studies were carried out in addition to my field investigations. The project was concerned with the Aboriginal and Cattlemens' patterns of habitat burning in the Northern Territory of Australia.

September 1982 to December 1982

This assistantship position in the Department of Anthropology at the University of Alberta entailed the preparation of primatological data for SPSS computer analysis.

June 1976 to August 1976

I was employed as a historical researcher by the Renfrew County Board of Education in Ontario. I was involved in a local history study of the Madawaska Valley region. Interviews and the collection of archival materials played an important part of the project. A learning kit for elementary schools in the area was developed in order that the students might have a chance to learn their own local history.

Teaching Experience

July 1984 (summer session)

During this time I taught a three week anthropology course entitled "Technology and Culture" at the Dept. of Anthropology, University of Alberta. I was responsible for all facets of this course.

January 1983 to April 1983

During this period I was a teaching assistant to Dr. Owen Beattie for the Introductory Physical Anthropology course, in the Department of Anthropology at the University

of Alberta. I helped in lectures, handling of lab and audio-visual equipment. There were one-hundred and thirty students in the course. Exam preparation and grading were also my responsibility.

September 1981 to May 1982

This teaching assistantship position was for a course on human evolution. Duties included lectures, seminars and the handling of fossil casts and other lab materials. The first half of the year was devoted to human osteology while the second half stressed issues in human evolution.

January 1, 1987