A SITE CATCHMENT ANALYSIS: WALKUNDER ARCH CAVE, NEAR CHILLAGOE, NORTH QUEENSLAND

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INTRODUCTION

Walkunder Arch Cave, is a rich archaeological site with evidence of repeated human occupation during the Late Pleistocene and Holocene. It is located at the central base of Cape York Peninsula, North Queensland (144° 31'E and 17° 13'S) some 10km south of the township of Chillagoe (Figure 1). The site lies at the southern end of a belt of fossiliferous limestone towers which extends about 100km northwards into the Palmerville district. Numerous art sites have been discovered in the Chillagoe-Palmerville area but the Walkunder Arch region is particularly rich in archaeological campsites.

This study was undertaken to augment work by John Campbell, Mireille Mardaga-Campbell and David Horton, who made initial soundings at Walkunder Arch Cave in December 1980 and followed with major archaeological excavations in 1981 and subsequent field seasons. Campbell (1982,1984) has reported a well-dated sequence of human occupation in the Late Pleistocene and Middle to Late Holocene. The discovery of rich layers of plant and animal remains which occur as components of "living floors" in the Holocene layers, was particularly interesting. It was considered that this site would be extremely well served by a site catchment analysis (SCA), especially while archaeological excavations were still being carried out. Thus, an excellent opportunity existed for independent comparison of SCA findings with excavation results. By examining the site's "exploitation territory" it was thought that the likely choice of food and other useful raw materials could be determined. Eventually, when excavations and laboratory analysis were completed, a comparison with the SCA results could be made.

SCA THEORY

Since it was first introduced by Vita-Finzi and Higgs (1970), many archaeologists have come to regard SCA as a useful field tool (see Bintliff 1981, Davidson 1981). The phrase "site catchment analysis" was coined by Vita-Finzi and Higgs to provide an independent name "for the study of relationships between technology and those natural resources lying within economic range of individual sites" (1970:5). It has its origins in fluvial geomorphology, where a catchment refers to a stream's drainage network, or that area which provides water and sediment to a fluvial system.

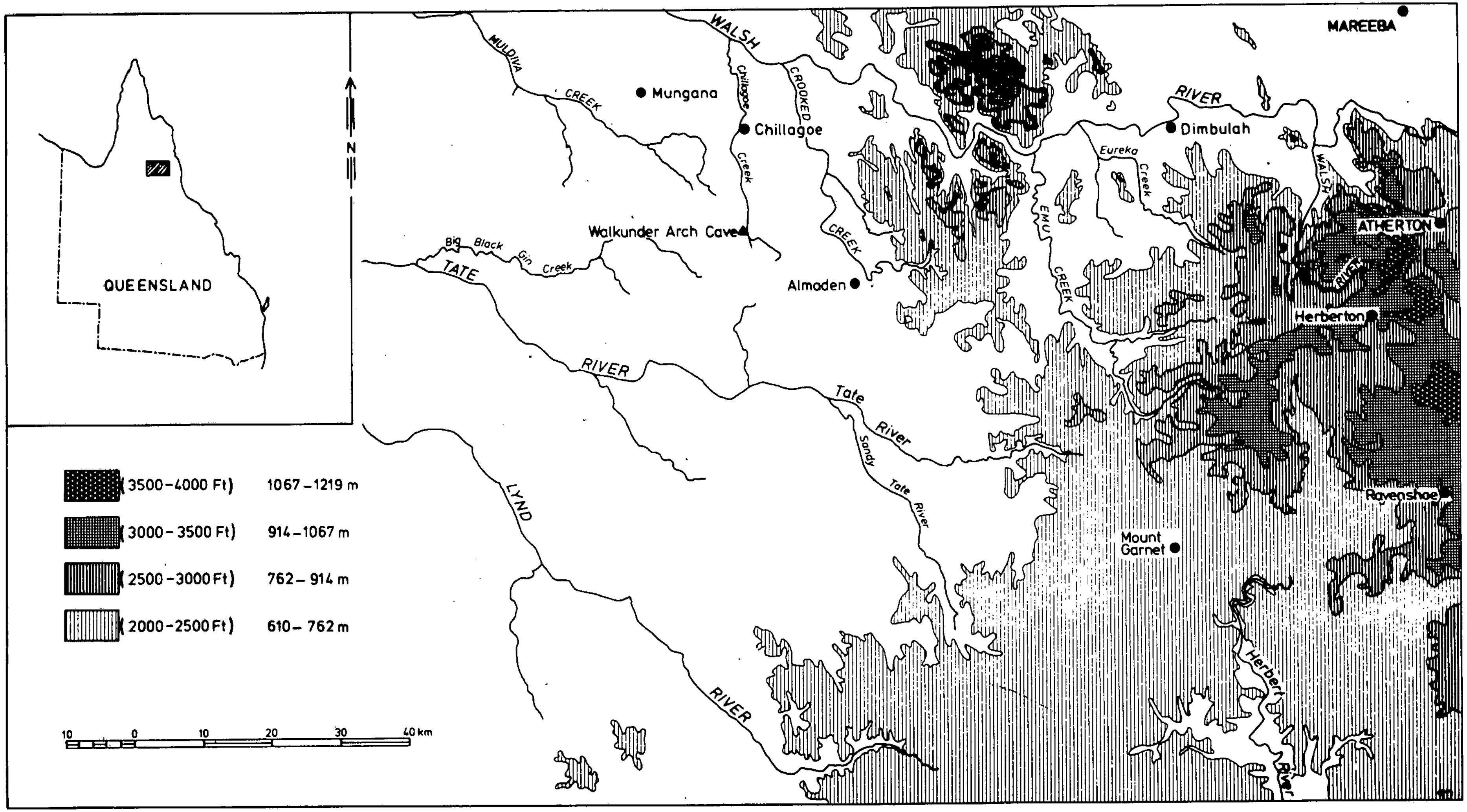

Figure 1. Relief and drainage of the Mount Garnet-Atherton-Chillagoe area, North Queensland (based on 1:250,000 topographical map).

Just as in geomorphology it is necessary to investigate a stream's drainage network, or catchment, in order to make definitive observations regarding that stream, in archaeology we are able to study patterns of human economy partly through studies of the environment in which people lived. This is done by defining the likely area within which people carried out most of their economic activities. It should be stressed that SCA is fundamentally concerned with evaluating the economic potential of a site's catchment over space and time. Further, it has the underlying concern of eventually being able to compare adjacent territories and, ultimately, to set the stage for initiating a palaeoeconomic/palaeoecological data base for a particular region(s) or entire countries.

SCA is not always carried out unidirectionally. That is, one does not necessarily commence with a "home base" and then calculate its "exploitation territory" or "the territory surrounding the site which is exploited habitually by the inhabitants of the site" (Vita-Finzi and Higgs 1970:7). It can operate in reverse. Large tracts of land can be formally investigated, either in the laboratory or in the field (or preferably both), followed by the postulation of potential site locations.

From the sorts of information derived by SCA techniques, home bases can subsequently be proposed with reasonable certainty. In fact, this particular study carried out a hybrid approach which entailed starting from a proposed home base, and after defining an exploitation territory, using established SCA theory to suggest where subsequent sites should be found, and also hypothesising their relative importance with respect to the initial site. It is thus particularly important to delimit, as accurately as possible, that territory which, in the defined sense, "belongs" to a particular site.

Vita-Finzi and Higgs (1970) based the theoretical range of this territory on the principle that there is a close relationship between one's capacity to exploit resources profitably and the outlay of energy to do so. In other words, there comes a time when one would not be able to exploit a distant resource because it would take more energy to do so than that which one was attempting to procure (the "law of diminishing returns"). It can thus be assumed, that people can only exploit those resources that occur within a theoretically definable distance from their particular occupation site. The actual distance that will be travelled is governed by relationships between technology, demography, resource potential and the particular economic strategy used by the group, all of which are dependent upon the local topography and seasonal climatic variations. It is usually assumed that an occupation site is anchored to an adequate water source. Although water may be a prerequisite, it is not suggested that these "home base" sites are always permanent, despite the fact that in many cases they have been either used for lengthy periods of time or were returned to regularly on a seasonal or other cyclical basis. However, the broader aim of SCA is to try to identify the annual territory of a particular group, a particularly difficult thing to determine accurately, especially after thousands of years have elapsed (see Roper 1979:124).

SCA adherents have inevitably arrived at arbitrarily defined boundaries to exploitation territories. These were based on the work of Chisholm (1968) for agriculturists and Lee (1969) for hunter/gatherers. The methods used to measure these boundaries fall under two distinct headings. The first is "fixed-distance radii", which defines the boundary of exploitation as lying at a 5km radius (which equals one hour's walk in flat country) from the site for agriculturists, and 10km (or two hours in flat country) for hunter/gatherers. The second, a system of "time contours", is based on the time taken to walk one hour and two hours distances respectively, in relation to the real topography of the site's potential territory (see Birkett 1983 for details).

There are certainly some criticisms of SCA (e.g. Roper 1979), but they are general and can be levelled at many other field techniques in archaeology. It is felt that the benefits attained by this method far outweigh the negative aspects as long as the investigator is aware of potential 'traps' and problems associated with each study. A shortcoming that has particular relevance to this study, one which will only be overcome in time, is the lack of published Australian examples of ethnographic SCA work. Only when adequate numbers of SCA's have been carried out, will useful comparisons be possible and the real power of SCA as a research tool be realised in Australian archaeology and ethnography.

METHOD

An hypothetical 'territorial boundary' must first be identified before a SCA can be developed. The accuracy with which one measures this arbitrarily defined boundary of exploitation is vitally important to the results because error made in the initial stage may be amplified later. With this in mind, one must select the most appropriate method based on such known or assumed factors as the type of resource exploitation being carried out (e.g. hunting/gathering, fishing, farming etc.) and the nature of the physical environment around the site.

Of the two approaches noted, 'fixed-distance radii' and 'time contours', the latter was chosen for two important reasons. Firstly, pre-field laboratory work showed that the environment of the Walkunder Arch district was far from being flat and homogeneous (e.g. like that of the !San people of Botswana upon which the usual SCA model is based for hunter/gatherers - see Lee 1969, Vita-Finzi and Higgs 1970). In fact, it was obvious that the belt of karst towers alone would present a strong influence on patterns of exploitation due to both the time it would take to walk over or to circumvent them and the fact that they would probably contain a far richer collection of fire-protected resources than the neighbouring open eucalypt woodland. Secondly, the lack of published information of a reliable or definitive nature meant that fieldwork was essential. It is also argued that wherever one can walk both the one-hour and two-hour radii (this is normally possible in Australia), this should be done (see especially Bintliff 1981, who criticizes fixed-distance radii as an armchair approach).

The early stages of research included detailed study of topographic maps, aerial photographs and the relevant literature on soils, vegetation, geology and geomorphology. This preliminary work identified certain features which were thought to be important or otherwise interesting as far as resources were concerned, thus these were subsequently recorded on a baseline map to be used as a 'SCA skeleton plan' in the field.

The SCA fieldwork was carried out along similar lines to those recommended by Higgs (1975:223-224). Four radii in the cardinal directions were walked. Not only is this the standard procedure for SCA, but it had an added benefit in this study in that the north-south transects followed the belt of karst towers and the main stream channel of the immediate district, Chillagoe Creek. The east and the west transects were quite suitable also as they covered a reasonable cross-section of the remainder of the surrounding countryside.

Each radius was of two hours' duration, in accordance with the standard SCA model for hunter/gatherers (Higgs 1975). The procedure adopted was to walk a two-hour radius in two one-hour legs, with a break between each and at the end to write field notes and to verify the location of boundaries on the base map. Further, a trail-bike was used to obtain a fairly detailed picture of the Walkunder district and to measure distances between localities accurately.

After field data had been obtained laboratory analysis commenced. An attempt was made to adapt the formal theoretical approach to SCA, to suit conditions at Chillagoe, which were clearly different from areas previously studied, such as the Near East and Italy (cf. Higgs 1975, Jarman, Bailey and Jarman 1982, Vita-Finzi and Higgs 1970). The apparent complexity of the pattern of resources at Chillagoe, plus the fact that it was being attempted in novel country, necessitated a more informative and intensive SCA than has normally been attempted.

Laboratory work was divided into two sections. The first dealt with plants alone and the second was concerned with mapping the territorial boundary and determining the resources within that boundary. The two parts were then brought together to explain why people might have favoured Walkunder Arch Cave and what benefits were made available by their choice of location.

Briefly, the initial laboratory work involved checking the preliminary identification of plant specimens gathered in the field. Identifications were partially checked in the field by Mick Godwin of the Queensland National Parks and Wildlife Service (Cairns). Final laboratory identification was accomplished with the kind assistance of Betsy Jackes of the Department of Botany, James Cook University of North Queensland. Thus, a plant list was compiled and an attempt was made to identify the documented uses of these species in other parts of Aboriginal Australia (Table 1).

I have discussed in detail elsewhere how the site catchment maps were drawn up (Birkett 1983). Suffice it herein to mention that a special technique was conceived in the laboratory to estimate the territorial boundaries more accurately than possible using the normal SCA method. A new base map was made by joining colour aerial photographs and the four radii and their one and two-hour points were marked on the photographs. Under stereographic viewing and with the use of field notes, it was possible to ensure that the mapped radii followed the path that had been walked quite accurately. The actual radii walked were then traced onto a clear acetate film that had been laid over the base map. These 'real radii' could then be measured with an opisometer.

After some experimentation it was concluded that opisometer readings could be made to coincide quite well with 'time radii', as long as the process of following radii was carried out while viewing the photographs with a stereoscope. This was because the radius in question could be drawn along the route most likely walked, allowing for circumnavigations of steep hills and karst towers. This was possible, of course, because one could view these features three-dimensionally. The final result was also made more accurate by conducting small detours on the acetate film with the opisometer each time a small stream was crossed in order to approximate the time that would normally have been lost in going up and down the banks.

By this process it was possible to fill in several additional radii between the four cardinal ones which had been walked in the field. These data were eventually combined, and the one-hour and two-hour exploitation territories were determined as precisely as possible. With topographic map sheets as a base, information derived from field notes and aerial photographs was added and by the time the site catchment maps had reached rough draft stage, it was possible to identify and measure the important ecological zones (Figure 2).

RESULTS

Resources associated with those specific ecological zones found to exist in the territory most likely to have been exploited by the inhabitants of Walkunder Arch Cave at any one time, can be discussed under the three headings of water, food and shelter, the material essentials of human existence. In doing this it is hoped that one of the basic tenets of SCA will be fulfilled, viz. "... that it is possible by describing the environment of the site to assess the potential resources made available by the choice of that site" (Davidson 1981:26).

Despite fluctuations (often diurnal) in the ranking of resources, water will always be the primary underlying requirement in most semi-arid environments like Chillagoe. For this reason people have to locate their home-base within a short distance of water. If a source of water is minor the options for location will be restricted. Conversely, where the source is widespread like a river or lake, more choices are available. In this situation, sites can be chosen where one or both of the other resources are favourable. The optimum conditions obviously obtain when all three conditions overlap.

The three sources of water available in the general study area include creeks, karst towers and some water-producing plants. The most important source would probably have been the creeks. Within the two-hour exploitation territory (Figure 2), Chillagoe Creek, Muldiva Creek and Quaker Creek would seem to supply the greatest amount of water. Of these, Chillagoe Creek would probably be the most important as it is perennial in all but the driest years, though the quality of its water is quite variable (Ford 1978:81). The presence of these creeks, providing some water at least all year round, would give people the opportunity of locating within a tract of country that roughly follows the belt of limestone towers.

Varying amounts of water can also be found in and around the limestone towers. Not only is there standing water and springs (de Keyser and Wolff 1964, Ford 1979) but the towers hold water in a manner not very different from that of a sponge, gradually drying out at the top and remaining moist below. This retained water drips into caves and out of crevices in the limestone for many months after moderate rain, and may be gathered by placing a suitable vessel (e.g. a coolamon) underneath one of the drip points.

Finally, certain trees in the exploitation territory are considered to be a potential source of water, although perhaps only used in times of severe shortage. Species belonging to the genus Brachychiton some Acacia and the species Erythrina espertilio have documented usage in other parts of Aboriginal Australia (Table 1). Although the Chillagoe area lies in a semi-arid zone, along the belt of limestone towers at least, water is reasonably abundant, and as long as people remained within about two hours of the towers they would have had an adequate supply of water in all but the driest years.

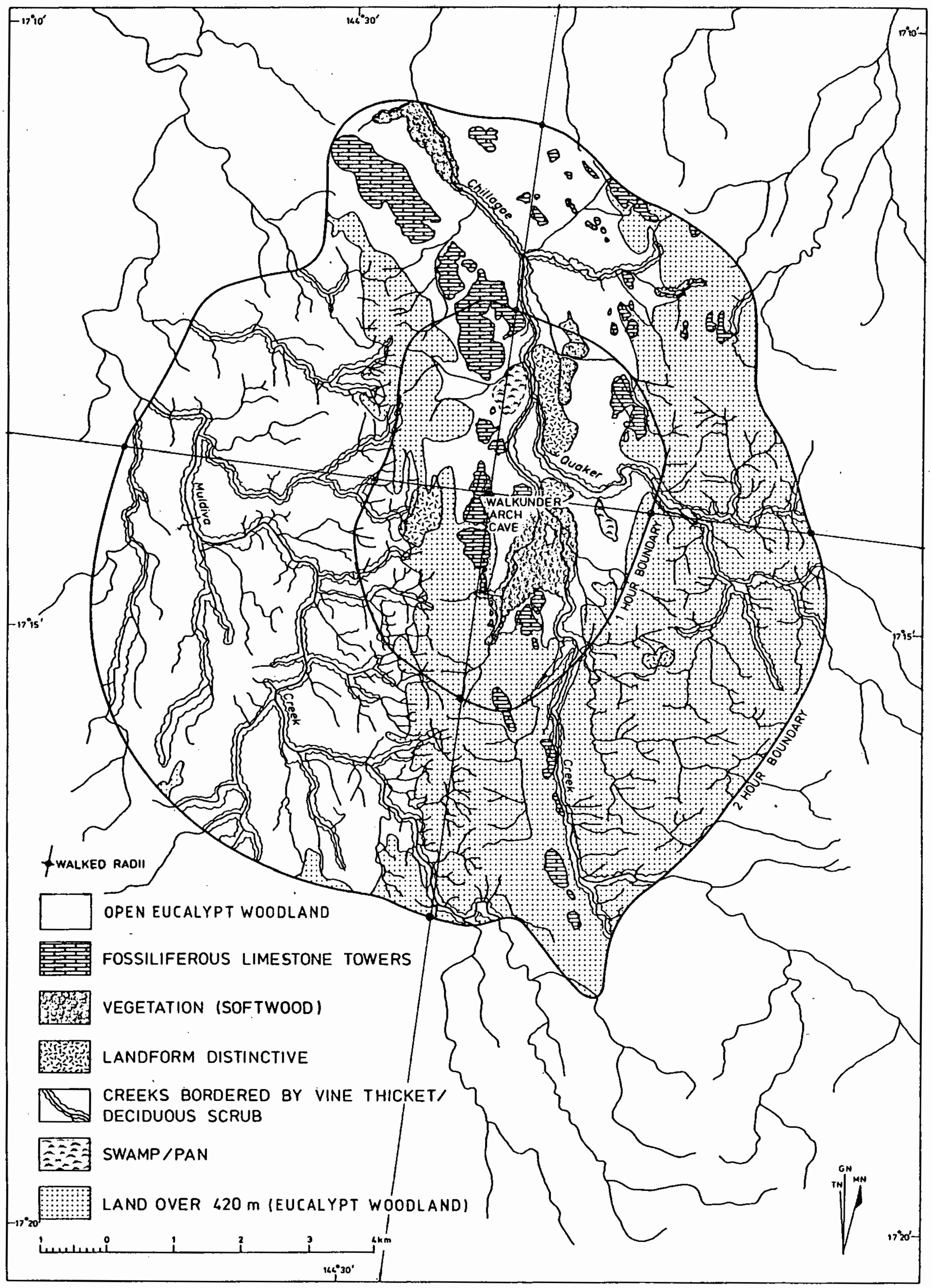

Figure 2. **Site catchment map for Walkunder Arch Cave showing ecological zones within 1-hour and 2-hour time contours, walked radii and major karst features.**

After water the next most immediate survival requirement in this tropical environment would be food. For the purposes of this study, food is divided into plant and animal sources. Further, I concentrate on plant-foods as these are dependable even if less often studied. Five reasonably distinct ecological zones, occurring within the one and two-hour territories, were identified:

1. the karst towers (softwood vegetation)
2. the creeks (mixed softwood and hardwood)
3. swamps and pans
4. eucalypt woodland
5. other areas of softwood vegetation.

The 'karst towers' and the 'creeks' and to a somewhat lesser degree the 'other softwood vegetation' were observed to be the most productive areas for food, while the 'eucalypt woodland' was considered to be the least. The distribution of plant food, as one would expect, is very similar to the distribution of water.

Within the two-hour, but more importantly within the one-hour territory, people would have been able to follow water along the belt of limestone towers and would find that this strategy would also provide them with the highest quantity of plant food. Table 1 gives a list of plants that were gathered in the Chillagoe district and supplies information regarding documented Aboriginal uses in other parts of Australia.

Macropods and birds were the most common animals seen during my fieldwork at Chillagoe. Generally, I concluded that the distribution of animals assumed to have been eaten by the inhabitants of Walkunder Arch Cave (principally macropods) closely parallels the requirements of food and shelter for these animals. A high proportion of all macropods observed were inhabiting either the karst towers and other rocky outcrops or were certainly within retreating distance of the shelter provided by these places. Like the distribution of plant food and drinking water, the favoured location of animals was in close proximity to the larger towers or other rocky outcrops and hills.

Finally, the fact that Walkunder Arch Cave provided the best natural shelter so far found in the district is another important reason why people should have chosen it as a home-base. It is unknown at this stage if the cave was used all year round, but certainly people have used the many shelters within the Walkunder Towers from time to time. Walkunder Arch Cave itself, the only established major living site in the Chillagoe district, provides a unique overlap of the material essentials of human existence, namely water, food and shelter.

There is little doubt, given the richness of the archaeological deposits, that it formed at least one major home-base for the people living in the general Chillagoe region. Judging from the numbers of lesser sites and shelters within the exploitation territory, it is likely Walkunder Arch Cave was the home-base from which people exploited the surrounding territory, using the lesser sites and shelters for ranging beyond the two-hour boundary. It is also likely, depending on the number of people and the seasonal availability of water (or more importantly the lack of water in particularly dry years), that people would have migrated up and down the belt of limestone towers in a roughly north-south direction, at least as far away as the Tate and Walsh Rivers.

Based on information presented elsewhere (Birkett 1983), one could reasonably attempt to predict the location of other base-camps adjacent to, but not normally closer than four-hours' walking time from Walkunder Arch Cave. It is suggested that one should look in the first instance for sites either to the north or south of the study area. If people were to remain generally within two hours of the belt of limestone towers which essentially follows Muldiva and Chillagoe Creeks, they would have been able to exploit a wider variety of both plant and animal foods. Water would not have been a problem in this karst/creek corridor in most years, and the towers themselves certainly have provided shelter, and specifically in the case of Walkunder Arch Cave, a quite sizeable, dry and well protected location in which to live for extended periods. Beyond the corridor, in either an easterly or westerly direction, this would not be the case. Here water is not as available, the eucalypt woodland does not supply the rich resources that the tower areas do and there are fewer natural shelters (Figure 2).

FUTURE RESEARCH

Future SCA research in the Chillagoe-Palmerville area could be carried out in one of several broad areas. Firstly it would be possible to improve the resolution of the picture of resources that make up the particular ecological zones found in this study. This would require visits to the area during different seasons, preferably over several years. In this way one could develop a more accurate approximation of seasonal fluctuations in resources. Another area of research already mentioned involves surveying the annual territory for other base-camps in an attempt to determine what interactions may have occurred between sites within this territory and beyond into the annual territories of neighbouring groups (if such exist).

It would also be possible to test the SCA model by checking for other sites within the one-hour and two-hour territories; contemporary base-camps should not be located in either of these areas unless they were seasonal and complementary to Walkunder Arch Cave. To attempt a more diachronic appraisal at the Walkunders, one could test further some of the models for the initial human colonisation of Australia. According to both Bowdler's (1977) "coastal colonisation" model and Horton's (1981) "well watered woodland colonisation" model, Walkunder Arch Cave ought not to have been occupied at the height of the last glacial, 18,000 - 14,000 years ago, when it fact it was. My own observations on the diversity and apparent richness of the Walkunder district today, which might well appear a 'barren' environment at first glance to many Europeans, would suggest that even with a somewhat more limited water supply Walkunder could still have quite easily supported a reasonable number of people during the last glacial maximum. The existence of such 'oasis' type niches, if found in enough numbers, may make other theories of colonisation possible.

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Table 1. Useful Plants of the Chillagoe Region compiled by the author.

BOTANICAL NAME	COMMENTS	LOCALITY	CALENDAR
Acacia bidwillii	Young shoots eaten	Eucalypt woodland	
Acacia holoserica	Fish poison	Near water courses	All year
Alstonia actinophylla	Medicinal		
Ampelocissus gardenerii	? Native grape, prob food.	In shelter	
Antidesma parvifolium	Prob. food, 5-6 species eaten		
Brachychiton australe	Probable food	Well drained hillside	
	Seeds and roots	and sunny site	
Brachychiton bidwillii	Probable food	Well drained hillside	
	seeds and roots	and sunny site	
Brachichiton paradoxum	Seeds edible, roots edible	Rocky limestone	Mar/Apr/May
	making string, roots eaten	" "	
	seeds eaten, very popular	" "	Dry season
Brachichiton populneus	Seeds, tubers edible, water supply		
Canarium australianum	Seeds eaten raw, medicinal,	Rocky outcrops, in	Oct. to May
	fruit eaten if ripe	thickets	
	styptic tree		
Capparis lasiantha	Fruit buried before being eaten		
Carissa lanceolata	Fruit edible	Widely available	May/Jun/Jul
	fruit edible	" "	Aug
Carissa ovata	Fruit edible	" "	
Cassia mimosoides	Possible food, other sp. eaten	Open forest	
Cassia occidentalis	Possible food, other sp. eaten	" "	
Cissus adnata	Possible food, other sp. eaten	Moist rocky areas	
Cissus opaca	Tuber roasted	" " "	
Cissus repens	Leaves and shoots eaten raw	" " "	
Cayratia grandifolia	Possible food, other sp. eaten	" " "	
Cayratia trifolia	Tubers roasted and eaten	" " "	
	fruit and tubers eaten	closed woodland	Feb/Mar/Apr
	roots eaten, berries not eaten	very sandy soils	
Celtis paniculata	Possible food, *C. philippensis* eaten		
Clerodendrum tomentosum	Possible food, other sp. eaten		
Cochlospermum gillivraeii	Probable food		
Crotalaria laburnifolia	Possible food, other sp. eaten	Widely available	
Crotalaria trifoliastrum	Possible food, other sp. eaten	" "	
Cymbidium caniculatum	Pseudo-bulbs eaten	Eucalypt woodland	
Eremophila mitchelli	Possible food		
	possibly medicinal	Eucalypt woodland	All year
Erythrina vespertilio	Seeding shoots eaten		
	water producers	" "	All year
	roots eaten raw	" "	" "
Eucalyptus papuana	Medicinal	" "	" "
Eucalyptus terminalis	Medicinal nectar from flowers	" "	" "
	Tree attracts the 'lerp scale'		
Eucalyptus tetradonta	Useful tree, especially bark	" "	" "
Exocarpos latifolius	Fruit edible		
Ficus copiosa			
Ficus infectoria	All figs are edible	Rocky outcrops	
Ficus obliqua var obliqua	and are usually good indicators	especially in the	
Ficus obliqua var petiolaris	of water	limestone	
Ficus opposita			
Ficus platypoda	Fruit and seeds edible	"	Oct/Nov/Dec.
Ficus racemosa	All figs edible		
Ficus virens	often good indicators		
F. virens var sublanceolata	of water		
Gardenia ochreata	Possibly fruit edible, other species eaten	Widely available	
Grevillea glauca	Flowers and nectar edible	Open woodland	
Grevillea mimosoides	Nectar possibly eaten	" "	
Grevillea parallela	Nectar possibly eaten	" "	
Grevillea polystachya	Nectar possibly eaten	" "	
Grewia retusifolia	Edible, medicinal	Open forest	
	berries edible, medicinal	" "	
Hakea arborescens	Flowers edible	Open forest	Ap/May/Jun/Jul/Aug/Sep
Heterodendron oleifolium	Seeds eaten		
Heterodendron sp.	Possible food, other sp. eaten		
Heteropogon contortus	'Calendar plant'	Eucalypt forest	Flowers in April
Heteropogon triticeus	'Calendar plant', some is sometimes eaten		Flowers Apr/May
Hibiscus meraukensis	Fruit dried and then eaten	Hilly country	
	seeds eaten raw	Open forest	Flowers Mar/Apr
Hibiscus sp.	Probable food, other sp. eaten	" "	
Lysiphyllum hookeri	Nectar eaten	Near or on limestone pediments	

Table 1 continued.

Marsdenia sp.	Possible food, other sp. eaten		
Melaleuca acaciodes	Many uses, incl a water supply	Around streams swamps and pans	
Melaleuca argentea	Many uses, incl a water supply	"	
Melaleuca leucadendron	Nectar and water supply	"	
	Useful tree	"	Flowers in April
Melaleuca quinquenervia	Useful tree	"	
Melaleuca viridiflora	Useful tree	Streams and pans that	Flowers Dec/Mar
	Useful and medicinal	dry out	" " "
Morinda oliefera	Possible food, other sp. eaten		
Pandanus sp.	Flesh eaten, seeds eaten	Near streams	
	medicinal, edible, useful	" "	Fruit ripens Aug/Jan.
Passiflora foetida	Fruit eaten	In shady areas	
Petalostigma pubescens	Medicinal, a contraceptive	Rocky, undulating hills	
Planchonella myrsinoides	Possibly eaten, other sp. edible		
Planchonella pohlmaniana	Fruit eaten after pounding	Eucalypt forest	Flowers Nov. to Jan.
	Fruit eaten		
Planchonia careya	Fruit eaten raw or cooked, medic.	Widely available	
	fish poison	" "	All year
	edible, medicinal, useful	" "	
Santalum lanceolatum	Fruit eaten	Near watercourses	
	Medicinal, fruit eaten	" and on sandy areas	Flowers Aug/Sept.
Sesbania aculeata	Possible food, other sp. eaten		
Siphonodon pendulus	Fruit and pulp eaten		
Solanum ellipticum	Fruit eaten	Sheltered areas around rocky outcrops	
	fruit eaten	Moist sheltered regions	May to September
Syzygium eucalyptoides	Fruit poss. eaten, as other sp.		
Terminalia chillagoensis	All species probably eaten	Widely available	
Terminalia platyphylla	" " " "	" "	
Terminalia platyptera	" " " "	" "	
Terminalia sp. aff. carpentariae	" " " "	" "	
Tribulus sp.	Rootstock possibly edible	Open woodland	
Vigna canescens	Rootstock eaten		
Xanthorrhoea sp.	Growing point and nectar edible	Hilly ground	
Xylomelum pyriforme	Seeds edible		