RESULTS OF A SPOTLIGHT AND HELICOPTER SURVEY OF THE MITCHELL RIVER IN MAY 1994.

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RESULTS OF BOAT SPOTLIGHT AND HELICOPTER SURVEYS IN THE MITCHELL RIVER SYSTEM IN MAY 1994

R.P.Gueho June 1994

INTRODUCTION

This report summarises the results of spotlight and helicopter surveys of the estuarine crocodile, *Crocodylus porosus*, in the Mitchell River system in the North West Kimberley Region of Western Australia during May 1994.

In August of 1993 a number of reports were received at the Kununurra office of the Department of Conservation and Land Management which alleged that the activities of professional barramundi fishermen were having detrimental effects on the estuarine crocodile population in the Mitchell River.

An attempt was made to undertake a boat survey of the Mitchell system in October of 1993, however inclement weather made this survey impossible.

An opportunity to survey the system presented itself with an offer from G.Finlay of the Fisheries Department at Broome to travel on a Fisheries charter vessel, the Kingfisher III, from Wyndham to Broome.

The Mitchell River was last surveyed for crocodiles in July of 1977 by Messel and Burbidge . At this time they believed that the system was badly depleted of crocodiles and that long term recovery was the best scenario.
The Mitchell river is classified as a TYPE 1 system(Messel *et al* 1987)." Normally these are tidal river systems meandering through coastal floodplains and having a major freshwater input during the wet season however in the Kimberley the rivers often run through rugged gorges and fault lines...Systems running through coastal floodplains have good to excellent nesting habitat and could be expected to have good recruitment potential...nesting habitat in the TYPE 1 systems in the Kimberley is usually more limited and thus the recruitment potential of these systems is decreased accordingly".(1)

Other examples of TYPE 1 systems in the North West Kimberley include the Roe, and the Prince Regent Rivers.

The main aims of this survey were to provide data on the status of the crocodile population in a river not subject to commercial crocodile operations(i.e harvesting) and to determine if the incidental take by professional barramundi fishermen in the Mitchell River has had an impact on crocodile numbers in this area.

To the best of my knowledge this is the first time that the Mitchell River has been helicopter surveyed and the the results for this activity are interesting given the level of tourism based scenic flights which apparently take place in the area as well as the annual influx of fresh water into the upper reaches of the system following the 1994 " wet "season.
It is the second boat based survey that has been undertaken in this system.

The helicopter count index is presented for *C.porosus* (Table 1)in the Mitchell system as it may be possible to repeat this survey technique in the future and it could form the basis of an ongoing monitoring program, as is the case in the Northern Territory.

METHODS

Survey Methods:(Spotlight)

The survey technique has been described in detail by Messel et al.(1981). It involves travelling the river in an open boat, scanning the exposed banks and the water surface with a 100 watt spotlight; crocodiles are detected by a red eyeshine (reflection from the tapeteum).

When spotted the crocodile is approached to within 6 metres and and an experienced observer identifies the animal(*Crocodylus porosus or Crocodylus johnstoni*) and estimates the total length of the animal in feet.

If an animal cannot be identified due to its position on the bank(i.e behind heavy mangrove growth) or it submerges before identification is possible it is recorded as "eyes only ".

A navigator / recorder records the estimated size of all the crocodiles that are able to be approached, their position in the water or their location on the bank using simple descriptive terms such as "shallow water on edge", "mid - stream", " on bank".

The navigator also records the location of any animals that are sighted(using maps in Messel *et al.*1987).

The technique adopted in this survey of the Mitchell River involved the use of a hand held Garmin* GPS with which it was possible to accurately log the positions of all animals sighted as well as significantly improve the accuracy of the Messel map for this system. (this technique will be discussed in detail later).

The surveys in the Mitchell River and the side creeks from 0 - 36 kilometres were carried out using a 4.3 metre punt with a 40hp outboard motor. The survey team operated from a "mother ship", the 16.8 metre Broome charter vessel Kingfisher III which was based at km15 on the Mitchell River for the duration of the survey.

Personnel:

One spotter ;Russell.Gueho, (CALM) was used for the Mitchell River survey. Additional personnel involved in the survey were Peter Trembath;(CALM) navigator / recorder and Greg Gayfer and Greg Finlay (Fisheries Department) who shared the boat driving during the survey.

Areas Surveyed:

During the two nights spent at the Mitchell River the aim was to match as closely as possible the surveys undertaken in July 1977.(Appendix 1)

During that survey a total of 47.7 kilometres were surveyed. This was also achieved during the 1994 survey and a further 15.8 kilometres in the side creeks were also surveyed as the conditions were suitable(this increased survey area is shown in Table 3 with total counts for the respective survey areas shown in Tables 4,5 and 6).

The survey commenced at 1815hrs on the 23/05/1994 on a rising tide at km15, downstream to 0.0km following the eastern bank and included the side creek at 14.6km, after completing this section the survey continued on the western bank and included the side creeks at 3.0km and 11.0km.The survey ceased at 2025hrs at Ref.n 51L6786 - 83955 due to too much water being present as a result of the rising tide. The survey

recommenced at 2225hrs at the above ref.point and continued upstream along the western bank to 25km including the side creeks at 12.2km, 15.5km and 17.5km. Crossing to the eastern bank at 25km the survey continued downstream including the creeks at 23.8km and 18.2km.(see maps at App 2) The survey ceased at 0110 on 24/05/1994.
On the 24/05/1994 the survey recommenced at 1900hrs at Ref.n.5110785440 - 8379815, both banks were able to be accurately surveyed from this point upstream to km36 and included the side creeks at km 27.6, 32.0 and 34.0. The Mitchell River survey was completed this night at 2010hrs. The survey party returned to the KingfisherIII and departed to Cassini Island.

Helicopter Survey:

Survey Methods and Results:

This technique has been descibed in detail in numerous reports and by Webb *et al.* 1990. It involves flying at a speed of approximately 60 - 70 kmh, at about 30 metres above ground level and about 20 metres towards midstream.
For the Mitchell River a Kawasaki helicopter was used. *Crocodylus porosus* sighted are recorded as small(2' - 4'), medium(4' - 7'), large(7' - 11') and extra large(>11'). Once again the navigator / recorder recorded the size of the animals and their location using the hand held Garmin*GPS .
A total of 11 *C.porosus* were sighted during the helicopter survey of the Mitchell River within the areas designated as the monitoring zones(see below Areas Surveyed)(Table 1). Comparitive data is not available for this survey technique in this area, however initial impressions are that the data is low and several suggestions as to why this may be are found below Table 1.
The observer, Russell Gueho,has carried out several *C.porosus* and *C.johnstoni* helicopter surveys in the East Kimberley and has been involved in 4 *C.porosus* nesting surveys using helicopters to locate nests as well as having involvement with crocodile helicopter surveys over the past 5 years in the Cambridge Gulf river systems.

Table 1:

Numbers of C.porosus Sighted During a Helicopter Survey of The Mitchell River System During May 1994.

Area	Small (2-4')	Medium (4-7')	Large (7-11')	Extra Large (>11')
0km - 8km	-	-	-	-
8km - 13km	-	-	-	-
13km- 14.6km	-	-	-	-
14.6km -18.2km	-	-	1	-
18.2km - 23.8km	-	-	-	-
23.8km - 30.4km	-	-	1	-
30.4km - 36.0km	-	5	4	-
Total	-	5	6	-

As can be seen the majority of animals were sighted in the last two upstream monitoring zones. The most likely explanation for this is the prescence of freshwater runoff from the Mitchell Plateau. Given these figures one could assume that the population in this system is small, however when taken with the results from the spotlight counts the most obvious questions are;where are the extra large animals that could be expected to be found in this system?; and why was only one animal sighted in the first 5 survey areas?.

Animals in the downstream sections could have been obscured by vegetation, however approximately 43 animals were sighted on the east bank during the spotlight survey. I suspect that there are two main influences on sightability(1) disturbance by scenic helicopter flights(the flights operate for approx.5 months with a 7 month break, this is the second year of operation) and(2)the operation of fishing boats and their tender vessels may have contributed to the wary nature of at least some of these animals.
No islands in the Mitchell River were surveyed due to their changing nature and they should be excluded in any future survey.

Areas Surveyed:
As this survey was the first time a helicopter had been used on the Mitchell River to gain an indice for comparison with the spotlight data, 7 discrete monitoring zones were identified following the eastern bank of the river and including creeks at 14.6km, 18.2km and 23.8km.(These monitoring zones are indentified in the map at Appendix 3 and at table 1).
The eastern bank only was flown with the creeks being surveyed up to their maximum navigable point (i.e creek at 14.6km was surveyed up to 16km, creek at 18.2km was surveyed up to 21km(both arms) and creek at 23.8 was surveyed up to 26km).
One bank only was surveyed to ensure that no double counting of animals occurred should they change situation as the helicopter passed over.
All the areas surveyed were subject to tidal influences.
Details of tidal information for the period of the survey can be found at Table 2.

Table2:
Tidal Information for Walmesly Bay, Mitchell River System 23-24 May,1994
Australia, North-West Coast - Cape Voltaire(Krait Bay)

Date: 23/05/94	Time	M	Date24/05/94	Time	M
	0241	2.1		0331	1.7
	0845	6.0		0933	6.5
	1526	1.4		1612	0.9
	2121	5.4		2208	5.7

For Walmesly Bay a time difference of +0011 minutes for Mean High Water and +0022 for Mean Low Water provides a reasonably accurate estimate for tide expection in the Mitchell River.

Allocation Of " Eyes Only" Sightings
No *Crocodylus johnstoni* were sighted either during the helicopter survey or the spotlight survey, consequently all of the "eyes only" count was allocated to the totals for *Crocodylus porosus*

RESULTS

Spotlight surveys:
A total of 63.5 kilometres of the Mitchell River (including side creeks) was surveyed over 2 nights.
A total of 108 *C.porosus* were sighted (89 non hatchlings)during spotlight surveys of the Mitchell River.

The surveys undertaken during July 1977 covered a total of 47.7 kilometres. The difference in survey distances is attributable to an extra 15.8 kilometres being surveyed in the side creeks during the May 1994 visit.
*(*In this extra 15.8 kilometres a total of 16 C.porosus(12 non hatchlings) were sighted. The 4 hatchlings were distributed between the creek at 17.5km(1) and the creek at 18.2km(3)*).
A direct comparison can be made with the *C.porosus* recorded during the 1977 survey and the 1994 data.(Tables 4 to 6 and Appendix 1)

Discounting the data in * above a total of 92 *C.porosus*(108 -16) were sighted during spotlight surveys in May 1994 compared with 50 *C.porosus* sighted during the 1977 surveys. This represents an increase of 42 animals in 17 years.
Non hatchling figures are 1977(42) and 1994(72)

The **non hatchling** density in 1977 equated to 0.9 / km for the Mitchell System; in 1994 the **non hatchling** density equates to 72 *C.porosus* for the equivalent 47.7 kilometres = 1.5 / km; an increase of 0.6 / km for this system

There was a higher proportion of " eyes only " in the non hatchling segment of the population surveyed in 1994 with 32 EO(29.6%) being recorded compared with only 3 EO(6%) during the 1977 survey.

The 1994 survey was conducted with a full moon on both nights, as well as this effect there are other influences on crocodiles in this system which also need to be considered such as the potential effect of the activities of professional barramundi fishermen setting nets and travelling the system in small boats as well as the influences on the population from the recreational sector with a minimum of 3 scenic helicopter flights along the Mitchell River per day since the beginning of May 1994(Greg Corser (pilot) pers.comm.) The above factors may have made a proportion of the crocodile population more "flighty" and contributed to the relativly high proportion of EO recorded.

Table 3.
Distances surveyed in 1977 and in 1994.

	1977 KM	1994 KM
Mainstream	36.0	36.0
Creek at km3.0	1.0	3.8
Creek at km 11.0	2.0	5.0
Creek at km 12.2	0.2	1.0
Creek at km 14.6	1.0	2.0
Creek at km 15.5	1.0	2.5
Creek at km 17.5	2.0	5.5
Creek at km 18.2	1.0	4.0
Creek at km 23.8	1.5	2.2
Creek at km 27.6	0.5	0.5
Creek at km 32.0	1.0	0.5
Creek at km 34.0	0.5	0.5
Total	47.7	63.5

Table 4

Distribution of C.porosus in Side Creeks(total) 1994

Size	No.Crocs	OB	SWOE	MS
Hatchling	6	1	4	1
2-3	7	1	6	
3-4	2	1	1	
4 -5	4	1	2	1
5-6	5		2	3
6-7	4		1	3
> 7	2		1	1
EO	6	2	4	
Total	**36**	**6**	**21**	**9**

Abbreviations: OB - On Bank(edge of mangroves, out of the water)SWOE - Shallow Water On Edge, MS -midstream.

Number of C.porosus sighted in each size class in the creeks identified in Fig.1 for total km surveyed in 1994(27.5km)

Table5

Distribution of C.porosus in Mitchell River Mainstream 1994

Size	No.Crocs	OB	SWOE	MS
Hatchling	13	5	8	
2-3	7	5	2	
3-4	7	5	2	
4-5	4		4	
5-6	6	2	3	1
6-7	2		1	1
> 7	7		2	5
EO	26	7	8	11
Total	**72**	**24**	**30**	**18**

Abbreviations: OB - On Bank(edge of mangroves, out of the water) SWOE - Shallow Water on Edge, MS - midstream.

Number of C.porosus sighted in each size class and their situation on the Mitchell River mainstream. total km surveyed 36.0.

Table 6

Distribution of C.porosus Mitchell River System (Mainstream and Creeks)1994

Size	No.Crocs	OB	SWOE	MS
Hatchling	19	6	12	1
2-3	14	6	8	
3-4	9	6	3	
4-5	8	1	6	1
5-6	11	2	5	4
6-7	6		2	4
> 7	9		3	6
EO	32	9	12	11
Total	**108**	**30**	**51**	**27**

Abbreviations: OB - On Bank(edge of mangroves, out of the water) SWOE - Shallow Water On Edge, MS - Midstream

Number of C.porosus sighted in each size class and their situation on the overall Mitchell River System in 1994. Total distance surveyed was 63.5km.

The above tables have been based on the data tables on pages 146 and 147 of Monograph 20;" Surveys of Tidal Waterways in the Kimberley region Of Western Australia and their Crocodile Populations 1987."(Appendix 1)
The situation that crocodiles have been recorded in i.e"On Bank" etc has been adapted to the more standard format used by CALM and G.Webb Pty Ltd.
The "On Bank" situations shown above includes the situation categories descibed in Monograph 20 as IV-in vegetation, IVIW- in vegetation in water and OM- on mud.

The following tables show comparative data recorded during the 1994 survey for the mainstream of the Mitchell River, the side creeks and a combined total of animals sighted and their situation for **47.7 km** (as originally surveyed by Messel *et al.* 1977).
The tables can be compared with those in Appendix 1.
The abbreviations are standard and are described in the tables above.

Table 7.

Mitchell River, Overall Creeks, May 23-24,1994

Size	No.Crocs	OB	SWOE	MS
Hatchling	2		1	1
2-3	5	1	4	
3-4	2	1	1	
4-5	2	1	1	
5-6	2		1	1
6-7	3		1	2
.> 7	1			1
EO	3	1	2	
Total	**20**	**4**	**11**	**5**

Table 5 is repeated in Table 8 for comparitive purposes

Table 8:

Mitchell River Mainstream, May 23-24,1994 ,0-36km

Size	No.Crocs	OB	SWOE	MS
Hatchling	13	5	8	
2-3	7	5	2	
3-4	7	5	2	
4-5	4		4	
5-6	6	2	3	1
6-7	2		1	1
> 7	7		2	5
EO	26	7	8	11
Total	**72**	**24**	**30**	**18**

A total of 50 estuarine crocodiles were recorded during the surveys of July 1977 giving a total estimated density of 1.05 animals per kilometre.
As can be seen from the above tables a total of 92 estuarine crocodiles were recorded during the May 1994 surveys in the same 47.7 km survey area, giving a total estimated density of 1.9 animals per km.
In July 1977 the density of **non-hatchling** crocodiles sighted was 0.9 animals per km.
The May 1994 survey showed a **non-hatchling** density for the same area of 1.5 animals per km.

Since 1988, the Department of Conservation and Land Management has been advised on crocodile management by G.Webb Pty Ltd.
This company uses a more suitable method of recording population and location data and the present data ispresented in their format for ease of interpretation and use in future years.

Table 9:
Numbers of crocodiles in Each Size Class(in feet) sighted in spotlight surveys of the Mitchell River in 1977 and 1994. Numbers in Brackets are Crocodiles greater than 7' Long(Messel *et al.*1987).

Year	<2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	EO	TOTAL
1977	8	1	9	12	8	3	(6)						3	50
1994	19	14	9	8	11	6	7		1	1			32	108

A total of 108 C.porosus were sighted during spotlight surveys in the Mitchell River, 19 (17.6%) were hatchlings(Table 10). 12 of these hatchlings were located between 24 - 36 km on the mainstream with this section having the highest density of animals over the system. The next highest concentration was found between km 12-24. The side creek at km18.2 held 10 animals (3 hatchlings) and was the most populous of the creeks.

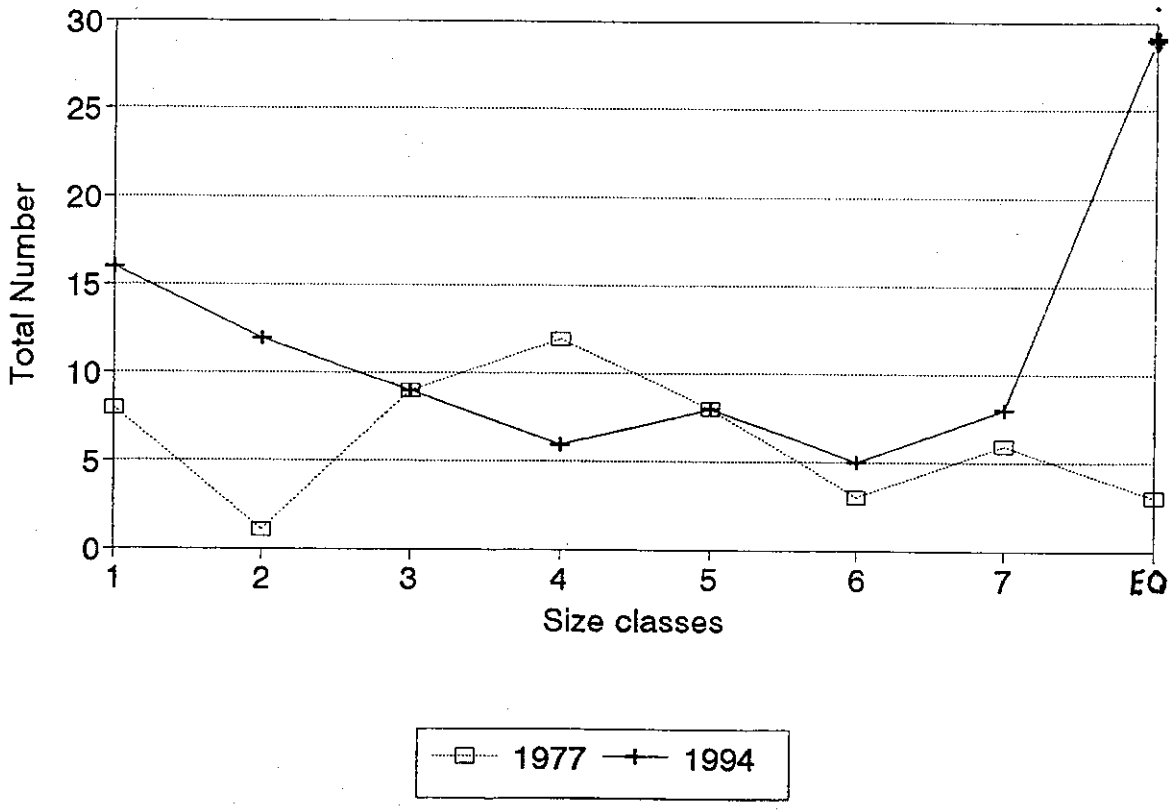
Table 10
Numbers of C.porosus , in each size class(in feet), sighted in spotlight surveys of the Mitchell River in 1994. MS= mainstream; side creeks are identified at KM.

Area (km)	< 2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	EO	Total
MS(0-12)							2				5	7
MS(12-24)	1	2		1	3		3		1		11	22
MS(24-36)	12	5	7	3	3	2	1				10	43
Ck at 3.0				1			1					2
Ck at 11.0			1								1	2
Ck at 12.2											1	1
Ck at 14.6										1	1	2
Ck at 15.5				1		1						2
Ck at 17.5	1	1	1	1	2							6
Ck at 18.2	3	2			1	3					1	10
Ck at 23.8		2		1	1							4
Ck at 27.6	1											1
Ck at 32.0		1									2	3
Ck at 34.0	1	1			1							3
TOTAL	19	14	9	8	11	6	7		1	1	32	108
%	17.6	13	8	7	10	6	6.5		0.9	0.9	29.6	

The size structure of all *C.porosus* sighted less than 7' long shows some trends with the data from the 1977 survey in that animals between 2' and 7' made up the majority of sightings(44%) in 1994 as they did in 1977(66%).
The "eye only" component show variation from the 3 EO (6%)recorded in 1977 to the 32 EO (29.6%) recorded in 1994. The majority of these animals did not allow an approach within 50 metres before submerging and this is possibly indicative of (1)animals being boat / spotlight shy or (2) animals less affected by the spotlight due to the full moon.

I have some concerns (and this can be seen graphically at Fig1.) that there is some influence on animals in the 3-4' to 6-7' size classes which appears to be holding the numbers of these animals steady at their 1977 figures.Also of concern is the lack of mature animals(>7') sighted although obviously these could be a component of the "eyes only" category.
Animals in the size classes identified above would be susceptible to the effects of netting by professional fishermen.
The logical reccommendation to make is that there needs to be some form of benchmark data available to compare the above figures. The data from the Cambridge Gulf systems is probably not relevant as these systems have been consistently harvested for a number of years.
I suggest that to enable an accurate interpretation of the data and to provide a control for future surveys at least one complete river system should be closed to the activities of professional fishermen using set nets.As data has been collected on two occassions from the Mitchell System it is probably most appropriate that this is the system used as a control for future surveys.

Fig 1:
Distributional patterns of C.porosus on the Mitchell River system by size class comparison between 1977 and 1994.



Discussion and Recommendation

This report discusses survey information from two surveys of estuarine crocodile populations in the Mitchell River system using boat and helicopter techniques to gather population data.
These techniques have been developed and improved upon since the original survey of 1977.
In the Mitchell River in May 1994 a toatl of 63.5 km (including side creeks) was surveyed over 2 nights.
A total of 108 *C.porosus* were sighted, composed of 89 non-hatchlings and 19 hatchlings.
To compare this with the original 1977 survey all animals that were sighted in the system were recorded on the survey maps to enable accurate reference to their location (*particularly when calculating the number of crocodiles sighted in the extra 15.8 km for subtraction*) when comparing the 1977 47.7 km and the 1994 47.7 km.survey areas.

The non hatchling density in 1977 was 0.9 animals / km.
In 1994 the non hatchling density was 1.5 animals / km.

Although the figures indicate that there has been some recovery since the 1977 survey the size structure of the population recorded in the system in 1994 indicates that there are some form of external influences on the population. 44% of all the animals recorded in 1994 were within 2' and 7'. After hatchlings, animals in this size range are the most vulnerable yet there was only one animal over 10' recorded during the entire survey.

It must be said that it is most likely that some component of the "eyes only" class are undoubtably these larger animals however their obvious wariness is interesting considering the initial aim of the survey.
As mentioned before there does need to be some form of benchmark to compare the data with.
On the same day as the survey commenced a professional fishing boat " *Streeter*" was operating in the mouth of the Lawley River. This vessel was one of those alleged to have taken as a by- catch, large numbers of estuarine crocodiles in the Mitchell System in 1993.

Another TYPE 1 system should be surveyed and as I have recommended I believe a complete system should be closed to netting activities to provide a control for future surveys.
The provision of the data sheets from professional fishermen may also provide an insight into the population dynamics.

REFERENCES

(1)Messell.H, Burbidge.AA. Vorlicek.GC. Wells.AG. Green.WJ. Onley.IC. and Fuller.PJ (1987); Surveys of Tidal Waterways in the Kimberley Region, Western Australia, and their crocodile populations. Monograph 20. Pergammon Press. Sydney.

G.Webb Pty Ltd. Results of spotlight and Helicopter Surveys of Crocodiles In Cambridge Gulf, Lake Argyle and Lake Kununurra, 1993

TABLE 20.4.1
MITCHELL RIVER MAINSTREAM, JULY 20-21, 1977

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	3					3		
2-3 (0.6-0.9)	1					1		
3-4 (0.9-1.2)	6		1	1		3	1	
4-5 (1.2-1.5)	11	1				10		
5-6 (1.5-1.8)	5		2			2	1	1
6-7 (1.8-2.1)	1		1					
>7 (>2.1)	5					5		1
EO<6 (<1.8)								
EO>6 (>1.8)	2						2	
EO								
TOTAL	34	1	4	1	—	24	4	2

ABBREVIATIONS:
IV — IN VEGETATION IVIW — IN VEGETATION IN WATER OM — ON MUD IM — IN MUD
SWOE — SHALLOW WATER ON EDGE MS — MIDSTREAM EO — EYES ONLY

Table 20.4.1
Number of *C. porosus* spotted in each size class and situation on the Mitchell River mainstream. Total distance surveyed was 36.0 km.

TABLE 20.4.2
MITCHELL RIVER, OVERALL CREEKS, JULY 20-21, 1977

SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	5		1			4		
2-3 (0.6-0.9)								
3-4 (0.9-1.2)	3					3		
4-5 (1.2-1.5)	1					1		
5-6 (1.5-1.8)	3					3		
6-7 (1.8-2.1)	2					2		
>7 (>2.1)	1			1				
EO<6 (<1.8)	1					1		
EO>6 (>1.8)								
EO								
TOTAL	16	—	1	1	—	14	—	—

ABBREVIATIONS:
IV — IN VEGETATION IVIW — IN VEGETATION IN WATER OM — ON MUD IM — IN MUD
SWOE — SHALLOW WATER ON EDGE MS — MIDSTREAM EO — EYES ONLY

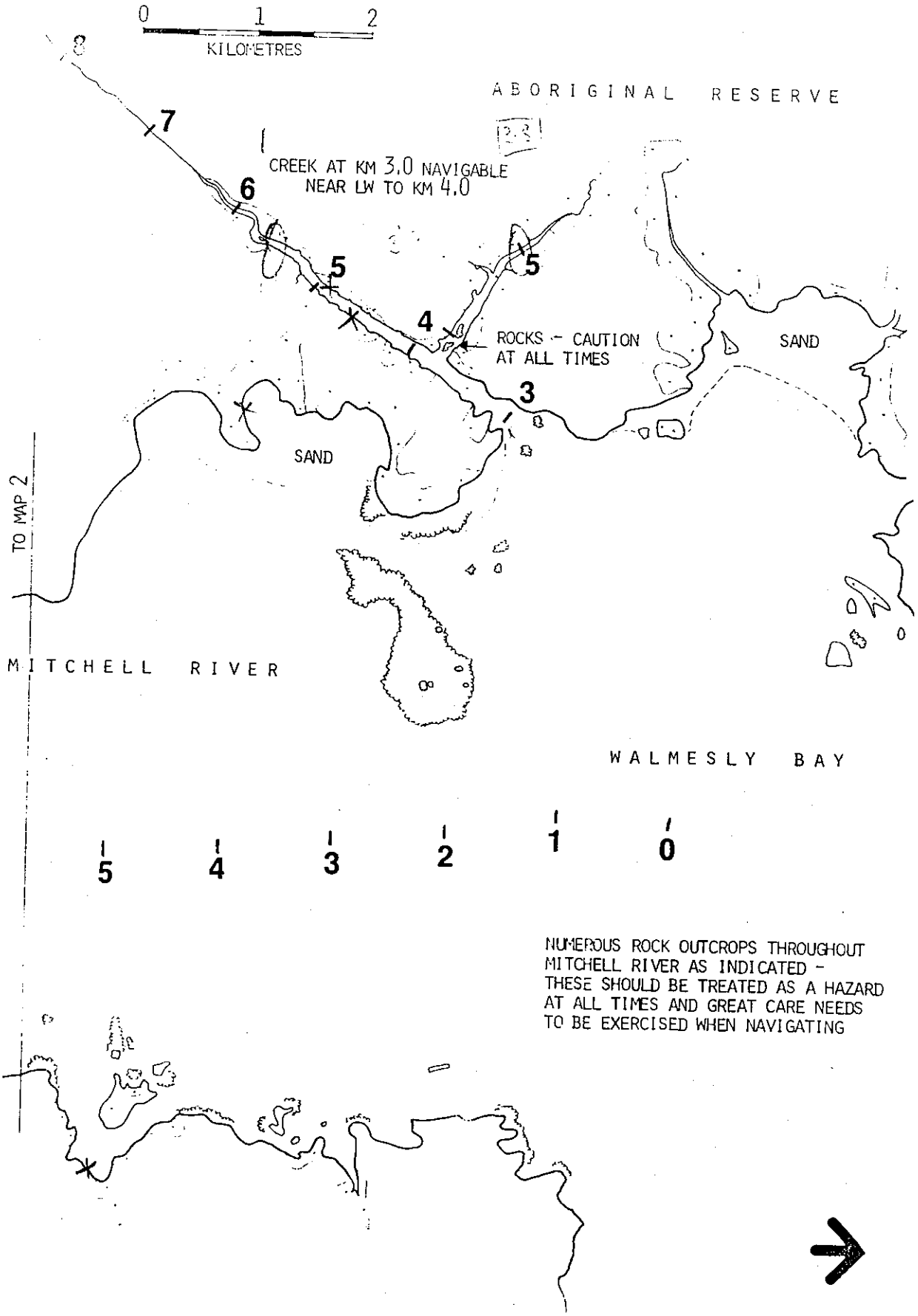
Table 20.4.2
Number of *C. porosus* spotted in each size class and situation on the Mitchell River, overall creeks. Total distance surveyed was 11.7 km.

TABLE 20.4.3
OVERALL MITCHELL RIVER SYSTEM, JULY 20-21, 1977

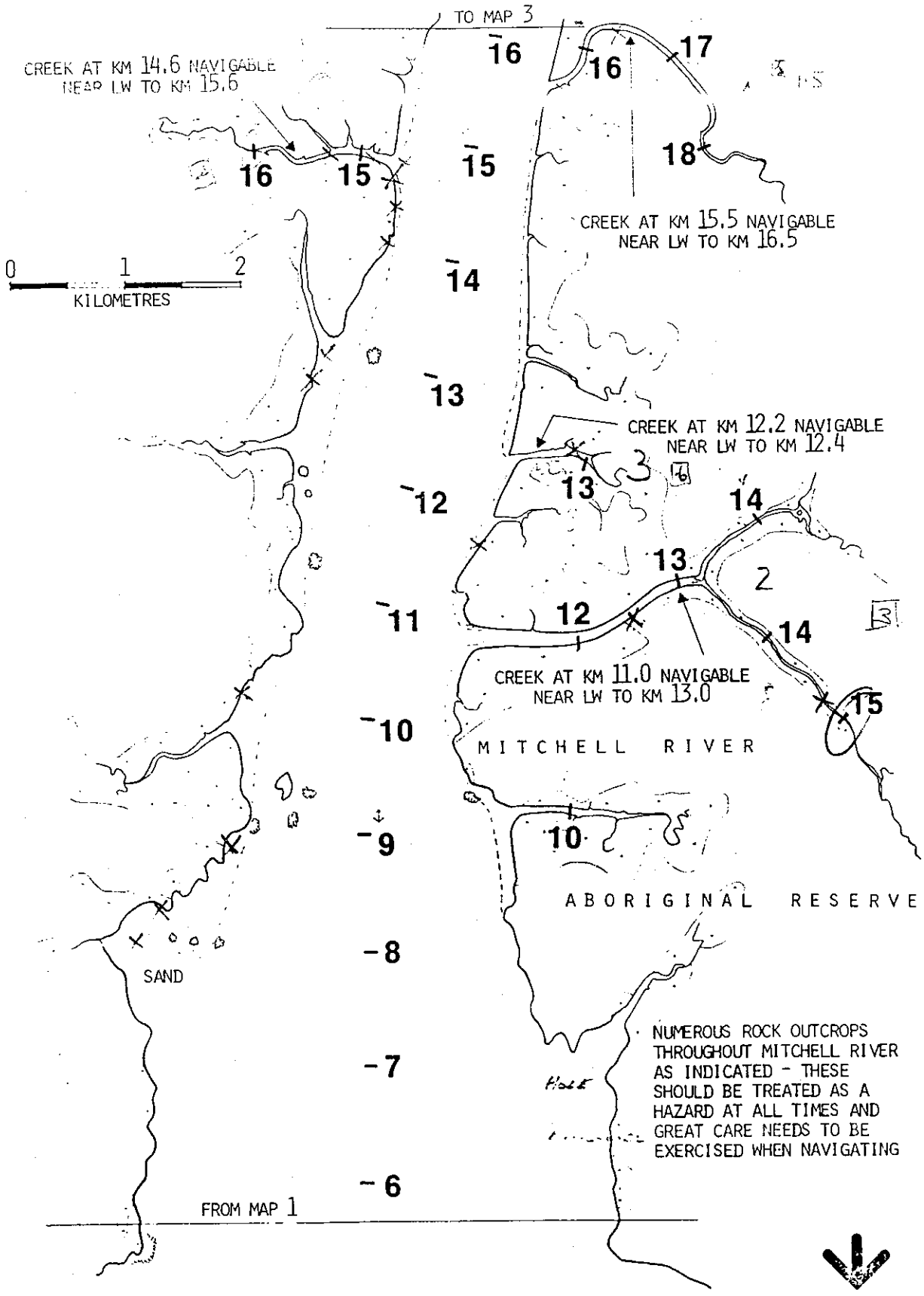
SIZE IN FEET (metres)	NUMBER OF CROCS	SITUATION						OBSERVED FEEDING
		IV	IVIW	OM	IM	SWOE	MS	
HATCHLING	8		1			7		
2-3 *(0.6-0.9)*	1					1		
3-4 *(0.9-1.2)*	9		1	1		6	1	
4-5 *(1.2-1.5)*	12	1				11		
5-6 *(1.5-1.8)*	8		2			5	1	1
6-7 *(1.8-2.1)*	3		1			2		
>7 *(>2.1)*	6			1		5		1
EO<6 *(<1.8)*	1					1		
EO>6 *(>1.8)*	2						2	
EO								
TOTAL	50	1	5	2	—	38	4	2

ABBREVIATIONS:
IV — IN VEGETATION IVIW — IN VEGETATION IN WATER OM — ON MUD IM — IN MUD
SWOE — SHALLOW WATER ON EDGE MS — MIDSTREAM EO — EYES ONLY

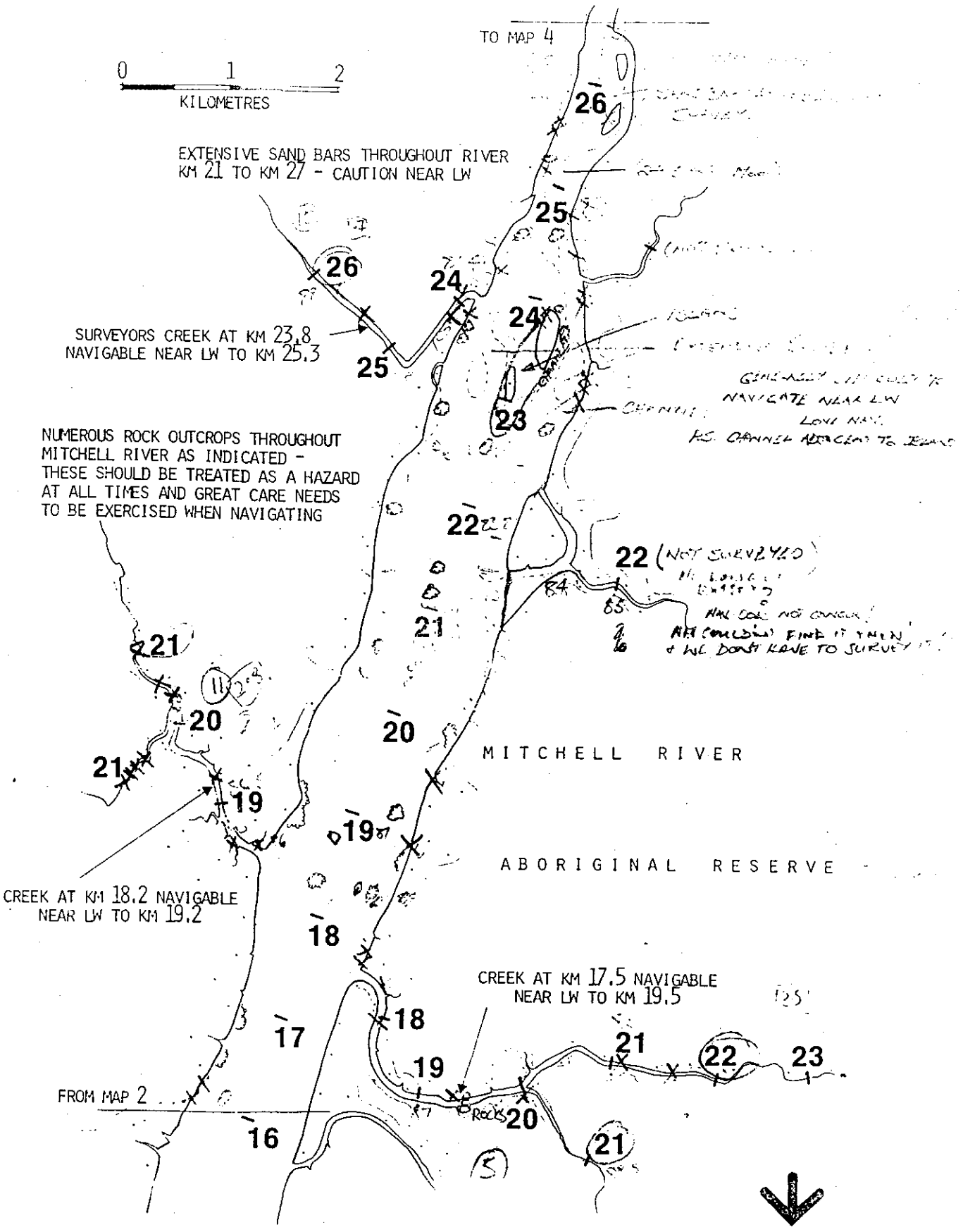
Table 20.4.3
Number of *C. porosus* spotted in each size class and situation on the overall Mitchell River System. Total distance surveyed was 47.7 km, on moon age days 4 and 5.



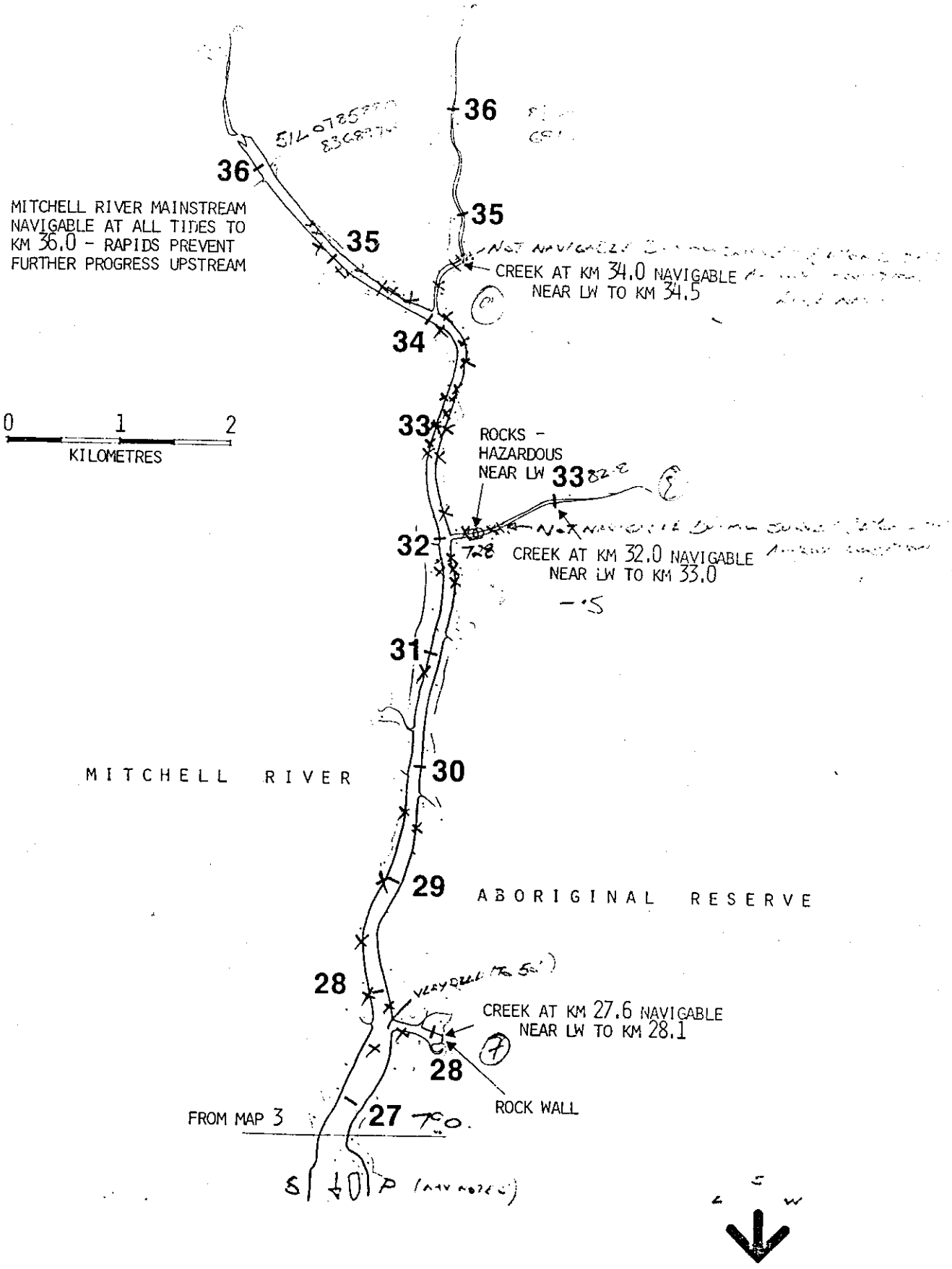
MITCHELL RIVER 1



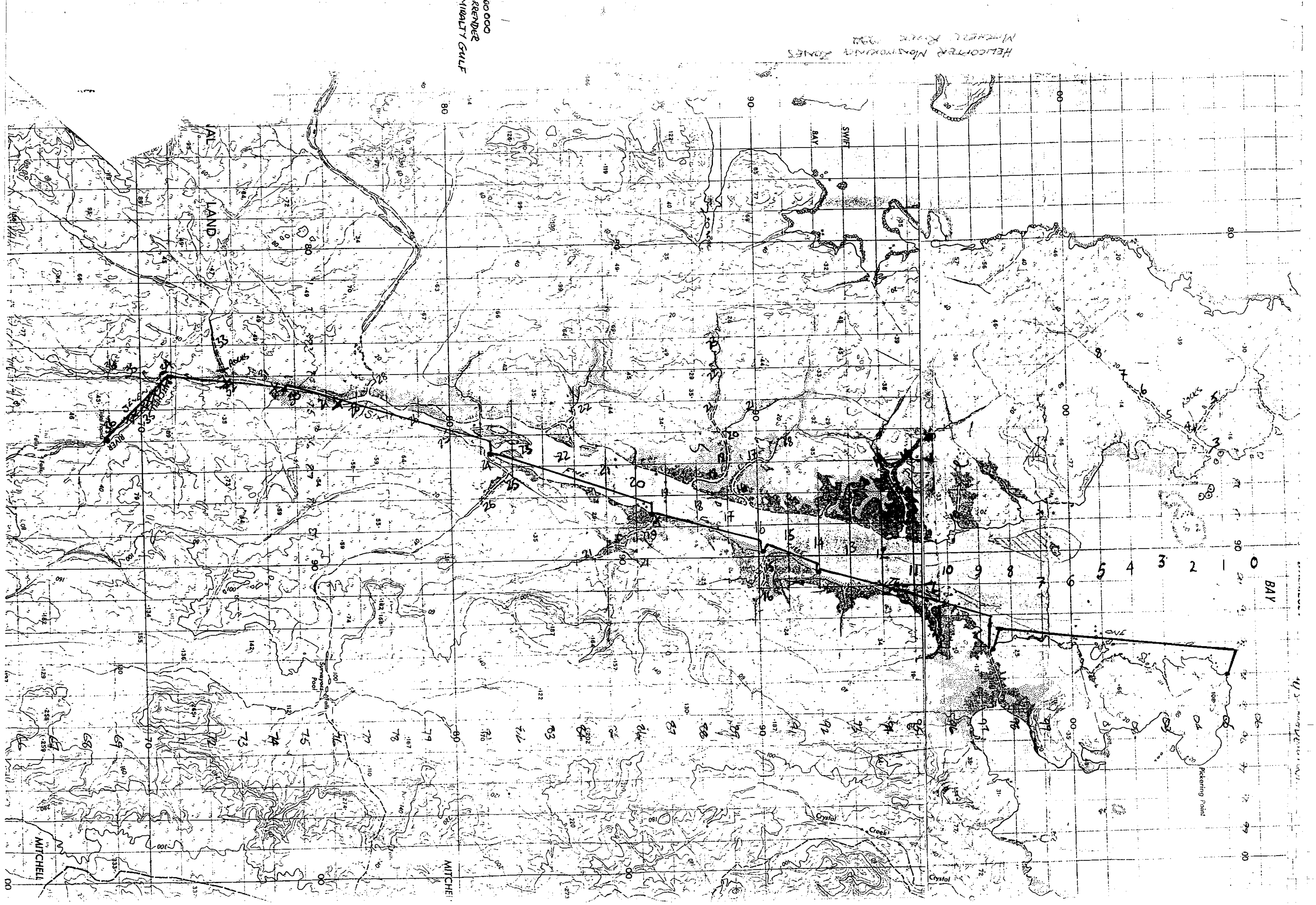
MITCHELL RIVER 2



MITCHELL RIVER 3



MITCHELL RIVER 4


HELICOPTER MONITORING ZONES
1:100 000
WARRENDER
ADMIRALTY GULF
SWIFT
BAY
LAND
RIVER
MITCHELL
Crystal Creek
Pickering Point

4.

WALMESLY BAY, MITCHELL RIVER SYSTEM

A. General

Phillip Parker King had the following to say about Walmesly Bay: "Walmesly Bay appeared to be a good port also, but it is open to the eastward. We did not enter it." Thus King and his men, on leaving Port Warrender, failed to discover the Mitchell River System.

We did enter and survey it in July 1977 and prepared our standard river work maps shown in Fig. 20.4.1 and on pages 333-336 of Monograph 15. The Mitchell River flows into Admiralty Gulf via Walmesly Bay. Extremely rugged King Leopold sandstones occur on either bank. Walmesly Bay is 8km wide at Pickering Point.

From Pickering Point to about 8km upstream there are a number of wide, shallow bays. Creeks running into some of these bays were inadequately surveyed because of the difficulty in entering them at low tide. However, our experience with similar creeks elsewhere is that very few crocodiles are missed because only a few larger crocodiles are usually found in such areas, and at low tide they often move downstream and are thus usually near the creek mouth where their eye-shine can be seen.

From km20 to km26.5 upstream the river contains a series of sandbars, some strewn with rocks, and is impassable at low tide. From km26.5 to the tidal rapids at km36 the river runs through a gorge. From km15 to about km34 upstream the river contains extensive gradually sloping mud banks below the mangrove fringe. Since the river is strewn with rocks, rock bars and rock islands of various sizes, at various distances from shore and at various depths (see the work maps in Fig. 20.4.1) one can only survey the downstream sections of the Mitchell System at low speed at night. The preferable survey time is a ¼ flood tide, though some of the creeks may be surveyed on a ½ flood tide.

The University of Sydney's research vessel found suitable anchorage at km9.0 and remained there during our period on the Mitchell System. Distances surveyed on the System during the July 1977 survey were:

		km
Mainstream		36.0
Creek at km3.0	1.0	
Creek at km11.0	2.0	
Creek at km12.2	0.2	
Creek at km14.6	1.0	
Creek at km15.5	1.0	
Creek at km17.5	2.0	
Creek at km18.2	1.0	
Creek at km23.8	1.5	
Creek at km27.6	0.5	
Creek at km32.0	1.0	
Creek at km34.0	0.5	11.7
Total		47.7

B. Salinities, temperatures and tidal data

Air and water temperatures were recorded at the vessel's anchorage at km9.0 and the resultant profile is shown in Fig. 20.4.3. No tidal data were recorded as the tide times at the mouth of the Mitchell River follow closely those for the Standard Port at Malcolm Island in Port Warrender. The tidal range is some 7m.

Salinity measurements were made near both low and high water on the Mitchell mainstream and the resultant profile is shown in Fig. 20.4.2. The profile shows that the Mitchell System is TYPE 1 and receives a substantial inflow of freshwater. However it should be noted that the surface salinity was down only to 20.8‰ at the rapids at km36.0. A number of the small upstream creeks on the mainstream were also shown to have a substantial inflow of freshwater.

C. Vegetation

The Mitchell River follows a fault line entering Admiralty Gulf through Walmesly Bay (Fig. 20.4.1). Deeply dissected Precambrian sandstones occur along both banks. The catchment area occupies 3193km². Mangal occupies 45km² along the river and short sidecreeks (Fig. 20.4.1). From Pickering Point about 8km upstream, there are a number of wide shallow embayments encompassing a further 14km² of swamp — the dominant species here is *Rhizophora stylosa.*

Mangals are widespread along the sidecreeks but a relatively narrow mangrove fringe lines the main channel up to 36km. The landward extension of the mangal is limited by rocky terrain along both banks. Extensive, gently sloping mudbanks are found throughout the entire river system, particularly along the first 20km. The pioneer community on these mudbanks is an association of *Sonneratia alba* and *Avicennia marina* (canopy height ≤8 m). Low closed forest of *Rhizophora stylosa* (canopy height ≤8 m) occurs immediately behind this riverine fringe. The more landward forests include associations of *Camptostemon schultzii*, *Avicennia marina*, *Rhizophora stylosa* and *Xylocarpus australasicus.*

Thickets of *Ceriops tagal* var. *australis* occur on heavy clay soils — at sites having slightly higher physiographic relief.

Distribution and assessments of cover abundance of mangrove species occurring as fringing riverside vegetation are shown in Fig. 20.4.4. The most abundant species are *Avicennia marina*, *Rhizophora stylosa* and *Aegiceras corniculatum.* Fringing forests of *Avicennia marina* and *Sonneratia alba* occur up to 26km upstream. From this point, fringing riverside vegetation species merge into a tree association of *Avicennia marina*, *Rhizophora stylosa* and *Camptostemon schultzii* often with a shrub understorey of *Aegiceras corniculatum.* On rocky sites from 22.5km upstream, an association of *Excoecaria agallocha* and *Xylocarpus australasicus* occurs. The species *Bruguiera exaristata*, *Lumnitzera racemosa* and *Osbornia octodonta* occur within the river system but were not observed at any of the specified quadrats.

Some suitable *C. porosus* nesting sites exist, particularly up the numerous sidecreeks that enter the mainstream.

D. Distribution, number, situation and size classes of the observed crocodiles.

The Mitchell River System was surveyed on the nights of July 20-21, 1977, moon age days 4 and 5. The number of *C. porosus* sighted in each size class and situation on the mainstream is shown in Table 20.4.1. Table 20.4.2 shows the animals sighted on the overall sidecreeks and Table 20.4.3 shows the overall results for the Mitchell System. The distribution of the observed crocodiles is shown in Fig. 20.4.5. Note the skewed distributional pattern of the animals sighted. Undoubtedly this is largely due to the inhospitable nature of the downstream sections of the waterway.

The total distance surveyed on the Mitchell was 47.7km of which 11.7km was on the eleven small creeks. However these small creeks running into the mainstream are important for we sighted 16 crocodiles on them out of the total of 50 for the overall Mitchell System. On the creeks downstream of km27.6, 8 crocodiles were sighted, of which the smallest was in the (3-4′) size class, indicating that these creeks were being inhabited by

crocodiles excluded from the upstream breeding sections. The 5 hatchlings sighted in the creeks were distributed among the 3 final upstream creeks at km27.6, 32.0 and 34.0. The 3 hatchlings sighted on the mainstream were on the terminal km30-36 section. It is likely that all 8 hatchlings are the result of one nest, either on one of the 3 creeks involved or on the mainstream. Only one (2-3') crocodile was sighted. Thus it is evident that recruitment had been low over the past 2 wet seasons, although Table 20.8.2 shows that 11 large crocodiles were sighted.

The density of the non-hatchlings sighted was only 0.9/km for this TYPE 1 system, indicating that the Mitchell is badly depleted. Subjectively, the Mitchell appears to provide excellent saltwater crocodile habitat and there is little doubt that it once held large numbers of crocodiles. The *Australia Pilot*, Volume 5, 1972, reports that during the 1918 survey of the Mitchell: "The River swarmed with alligators, over 100 having been seen in one day". Certainly this is not the case today.

Bustard in his "Report on the current status of crocodiles in Western Australia" made in 1970 to the Department of Fisheries and Fauna, quotes Father Sanz of Kalumburu Mission as describing the shooting of 35 crocodiles in four days *in daytime* in Admiralty Gulf, six or seven of which exceeded 14 feet in length. Father Sanz said that shooting in this area started about 1963 and that in two years over 3,000 were shot between Bigge Island and Cape Londonderry, most coming from Admiralty Gulf. The present situation is in stark contrast — only 50 crocodiles being present, over seven years after the species was legally protected, and possibly twelve years since the period of maximum shooting pressure. There seems little doubt that a very high proportion of those crocodiles present in the Mitchell were shot. Recovery can be expected to be a long term process only.